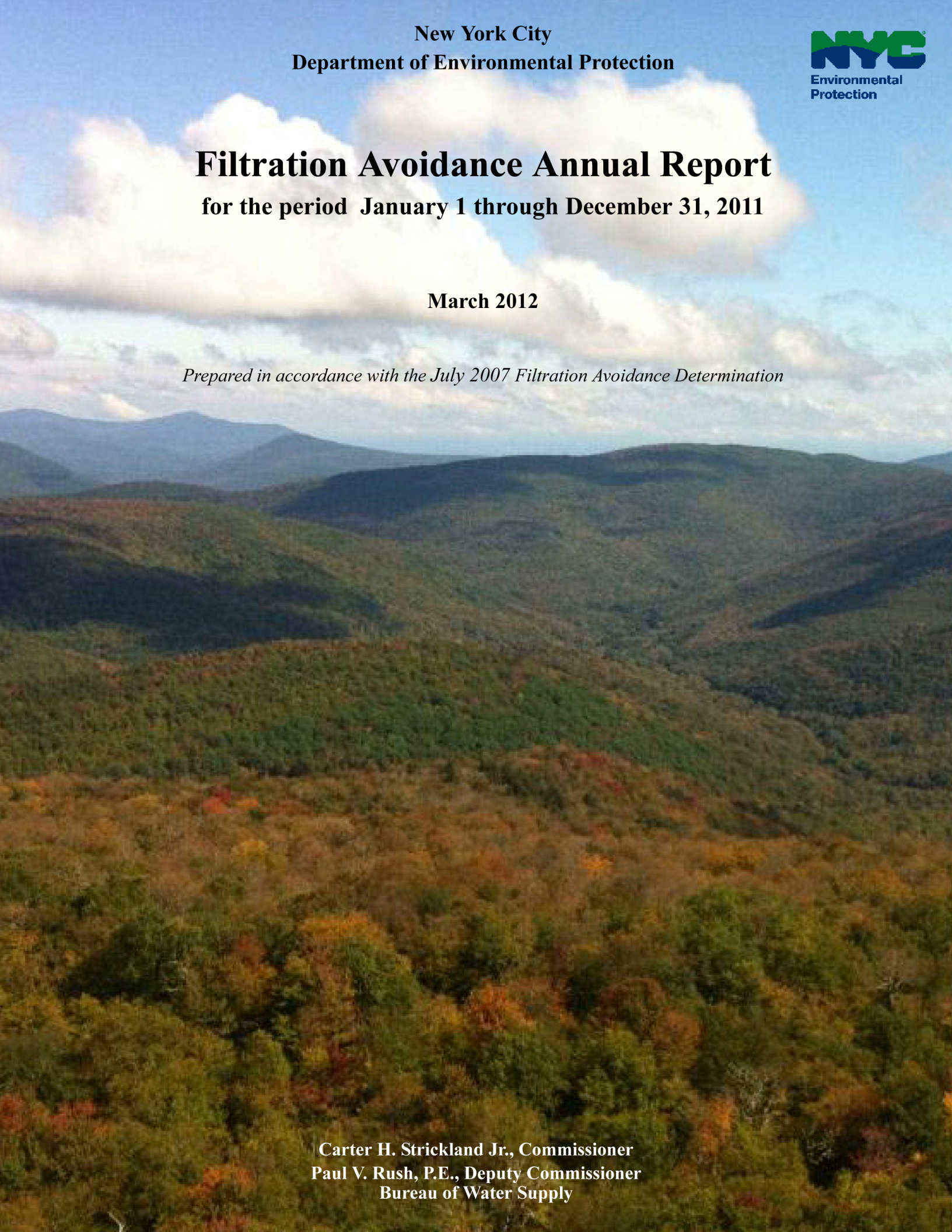

New York City
Department of Environmental Protection

Filtration Avoidance Annual Report

for the period January 1 through December 31, 2011

March 2012

Prepared in accordance with the July 2007 Filtration Avoidance Determination

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Cover photo by John Schwartz - NYC DEP

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1. Introduction

In 2011, New York City continued to implement a broad array of initiatives as part of the City's source water protection program. It also marked the fifteenth year of program implementation since the signing of the landmark Watershed Memorandum of Agreement (MOA) in 1997.

The City first applied for a waiver from the filtration requirements of the Surface Water Treatment Rule (EPA 1989) for the Catskill/Delaware System in 1991. Since then, the Department of Environmental Protection (DEP) has committed more than $1.5 billion in capital funds, plus significant annual expenses and countless staff hours, to sustain the pristine quality of the source waters of the Catskill and Delaware watersheds.

DEP's comprehensive source water 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 on the information collected through its monitoring and research efforts, DEP has crafted a watershed protection strategy that focuses on implementing initiatives that are both protective (antidegradation) and remedial (specific actions designed to reduce pollution generated from identified sources).

In the late 1980s and early 1990s, DEP's assessment of potential sources of pollutants pointed to several key areas: 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 Plan report (DEP 2006). 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 (FAD), issued by EPA in July 2007. In 2011, DEP continued to comply with the substantive requirements of the 2007 FAD.

Several notable events took place in 2011. First, in August and September, Tropical Storms Irene and Lee brought heavy rains and flooding to the watershed region and beyond. The rains caused significant damage to certain communities across the watershed. In the days and weeks following the storms, DEP deployed staff and other resources to assist in community recovery and clean up. Acute water quality impacts included debris washed into the reservoirs,

and elevated turbidity levels and high bacteria counts in multiple reservoirs, including Kensico. DEP took advantage of the size and flexibility of the water supply system, making numerous operational changes and employing treatment at several locations. Through the skill and professionalism of DEP staff, the water quality delivered to the City was never compromised and DEP complied with all water quality standards in the distribution system.

Also of note in 2011 was the completion in March of the Watershed Protection Program Summary and Assessment (the Assessment) (DEP 2011a), and submission on December 15 of DEP's revised Long-Term Watershed Protection Plan (the Plan) (DEP 2011b). The Assessment summarized the past five years of implementation of the watershed program, and provided an in-depth analysis of water quality status and trends. All signs point to the continued effectiveness of the City's overall program—source water quality remains high. The Plan laid out DEP's proposed source water protection activities for 2012 through 2017, the second five years of the current FAD. The Plan builds on the existing programs and includes significant commitments to continue implementation in the coming five years.

Finally, continued tough economic times kept pressure on resources at DEP. The agency strives to balance the need for strong source water protection and construction and maintenance of critical infrastructure with efforts to keep water rates affordable. During 2011, DEP sought ways to improve efficiency while continuing steady implementation of critical watershed protection projects. 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, 2011, through December 31, 2011, 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. These partnerships are vital to the continued success of the source water protection program and recognize the need to strike a balance between protecting water quality and the fact that the watershed is home to tens of thousands of people. The contributions of many of these groups are acknowledged throughout this report. The other private, governmental, community, academic, and non-profit entities that share a role in 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 2011, 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 2011, DEP collected a total of 51,729 samples and conducted a total of 596,574 analyses. Of these, 32,633 samples were collected and 350,821 analyses were completed within the City. Once again, the results were impressive. The City complied with the objective criteria of the Surface Water Treatment Rule (SWTR) (EPA 1989). Of the 9,944 in-City compliance samples analyzed pursuant to the Total Coliform Rule (TCR), only 0.5% were total coliform positive. All samples were negative for *E. coli*. Since 1995, DEP has collected more than 180,356 TCR 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 TCR, and other federal regulations that have been in effect since 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 Surface Water Treatment Rule 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 2011, 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 93.4% and 91.3%, respectively.

As shown in Figures 2.1 and 2.2, in 2011 the six-month running percentages of positive raw water fecal coliform samples at both the Catskill and Delaware Aqueduct effluents from Kensico Reservoir were samples with fecal coliform levels > 20 CFU 100 mL^{-1} below the maximum percentage of positive samples allowed under the SWTR. The increase in positive samples in the latter part of the year were due to the impacts of Tropical Storm Irene and Tropical Storm Lee, described in Section 5.1.2.

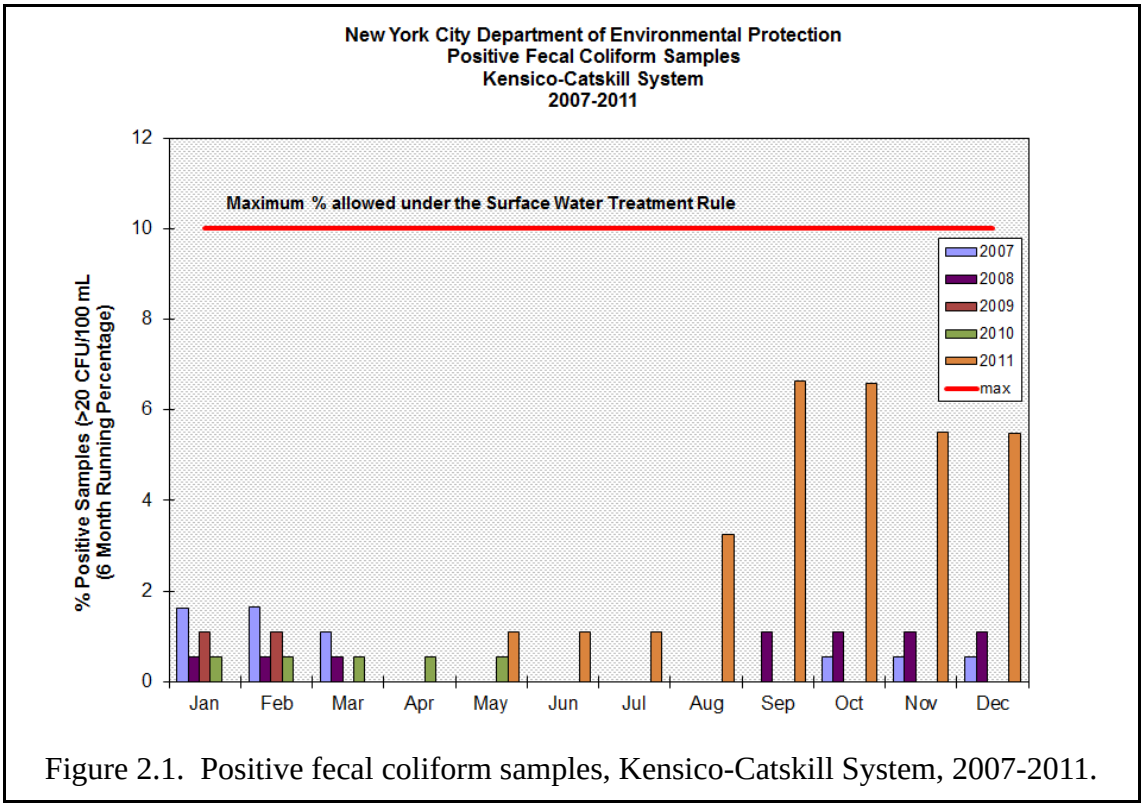


Figure 2.1. Positive fecal coliform samples, Kensico-Catskill System, 2007-2011.

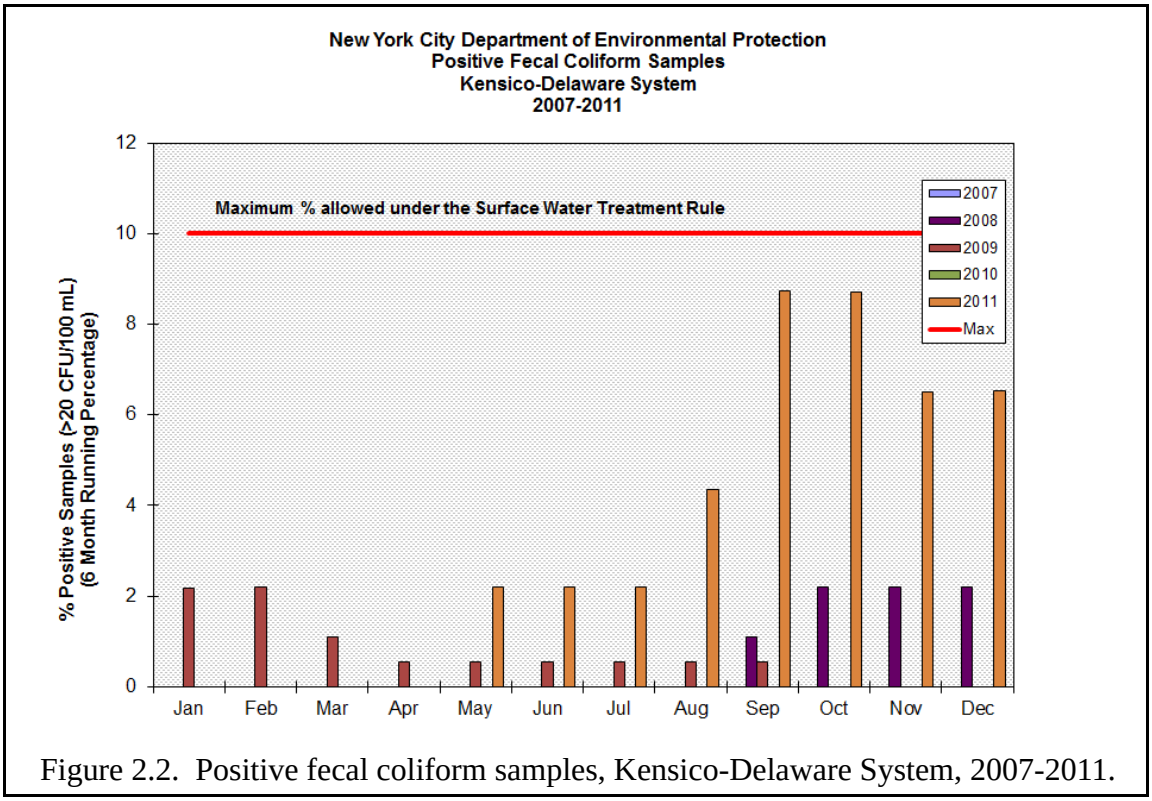


Figure 2.2. Positive fecal coliform samples, Kensico-Delaware System, 2007-2011.

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

The Catskill and Delaware Aqueduct effluents from Kensico Reservoir exhibited turbidity levels greater than 5 NTU in water prior to disinfection on only a single occasion in 2011, a measurement of 5.1 observed in January (Figure 2.3). No exceedance of the regulatory limit occurred on that occasion, however, because, for turbidity values between 1 and 10 NTU, the analytical method requires reporting to one decimal place, which effectively places the regulatory limit at 5.4 NTU.

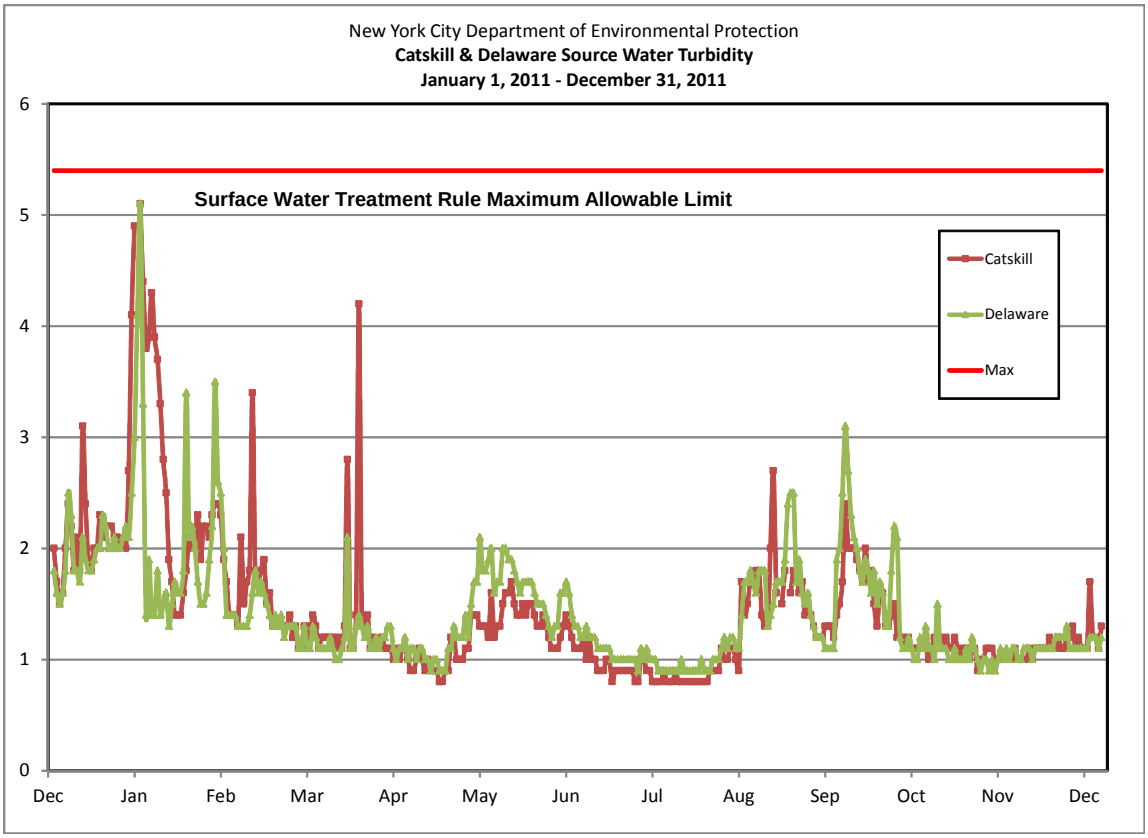


Figure 2.3. Catskill and Delaware source water turbidity, January 1, 2011–December 31, 2011.

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

CT values recorded each day during the year for the Catskill and Delaware Systems produced net inactivation ratios greater than or equal to 1.0. The actual lowest net inactivation ratio was 1.3 for the Catskill System and 1.0 for the Delaware System.

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

Chlorine residuals were maintained at concentrations at or above 0.20 mg L^{-1} at all distribution entry points during the year. The lowest chlorine residual measured at an entry point was 0.31 mg L^{-1}.

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

All chlorine residuals for the 15,020 samples measured within the distribution system during the year were detectable.

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) value of 94 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) value of 76 µg L^{-1} in the Catskill/Delaware Distribution Area.

The highest TTHM quarterly running average during the year, recorded during the fourth quarter, was 52 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 fourth quarter, was 49 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 TCR (Figure 2.4). Of the 9,944 compliance samples analyzed for total coliform, 45 were total coliform positive. All resamples were coliform negative, with the exception of 13 resamples—two in June, two in July, and nine in September. Resampling of the 13 sites was coliform negative for all locations except two, one in June and one in September, requiring a third round of resampling at those sites. The third set of resamples was coliform negative for both of these locations. All samples were *E. coli* negative for the year. The annual percentage of compliance samples that were total coliform positive was 0.5% and the highest monthly average was 2.4%.

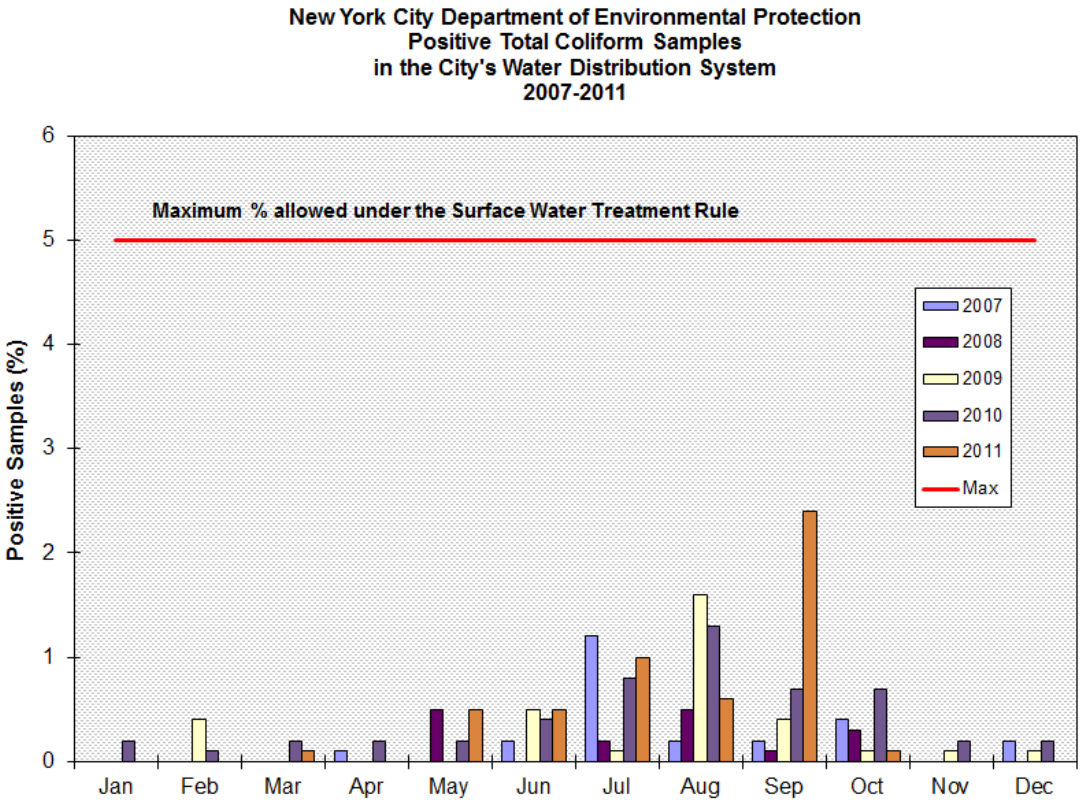


Figure 2.4. Positive total coliform samples, NYC distribution system, 2007-2011.

2.2.2 Chlorine Residual Maintenance in the Distribution System

During the year, DEP continued a number of programs to ensure adequate levels of chlorine throughout the distribution system. These included: (1) maintaining chlorination levels at the distribution system's entry points, (2) conducting spot flushing when necessary, and (3) providing local chlorination booster stations at remote locations. Four permanent chlorination booster stations have been continuously operating to improve the chlorine residual levels for the Fort Tilden, Roxbury, and Breezy Point areas (Rockaway Peninsula) in Queens; City Island in the Bronx; Floyd Bennett Field in Brooklyn, and Staten Island. As a result of these steps, detectable chlorine residuals were maintained throughout the distribution system in 2011.

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 (WOH) watershed.

The Septic System Rehabilitation and Replacement Program is managed by the Catskill Watershed Corporation (CWC), a local not-for-profit organization created to manage watershed partnership and protection programs. It includes the following sub-programs: the Priority Area Program, the Hardship Program, and the Reimbursement Program.

The Priority Area Program is an inspection and repair program implemented geographically based on the proximity of septic systems to reservoirs and watercourses. The program was implemented by the CWC in July 1999 in the 60-Day Travel Time Area and has since expanded sequentially to include septic systems located within 250 feet of a watercourse. In 2011, the CWC funded the repair or replacement of 216 failing or likely-to-fail septic system through this program. A total of 1,817 failing septic systems had been repaired or replaced under the program through the end of December 2011.

The Hardship Program funds septic repairs located in areas not covered by the Priority Area Program for applicants who meet certain income eligibility criteria. In 2011, the CWC funded the repair or replacement of two failing septic systems under the Hardship Program. Eighty-four failing septic systems had been replaced under the program through the end of December 2011.

The Reimbursement Program reimburses home owners who repair or replace failing septic systems in areas not covered by the Priority Area Program, depending on funding availability. Presently, home owners who fixed failing septic systems outside the priority areas between July 21, 2008, and December 31, 2011, are eligible for reimbursement.

Under the various sub-programs discussed above, the CWC funded the repair or replacement of 227 septic systems in the WOH watershed in 2011. Since the program's inception, 3,789 failing or likely-to-fail septic systems have been repaired, replaced, or managed.

3.1.2 Septic Maintenance Program

The Septic Maintenance Program is a voluntary program intended to reduce the occurrence of septic system failures through regular pump-outs and maintenance. Under the program, the CWC pays 50 percent of eligible costs for pump-outs and maintenance. In 2011, the

CWC subsidized 112 septic tank pump-outs, bringing to 687 the number of septic tank pump-outs subsidized since the program's inception.

3.1.3 Alternate Design Septic Systems Program

The Alternate Design Septic Systems Program (ADSSP) is a $3 million program to pay for the importation of fill material and/or pumping apparatus used in the construction of septic systems that have been required by DEP or its delegate solely to achieve compliance with the New York City Watershed Rules and Regulations (WR&R) (1997). No ADSSP activity occurred during 2011. Since 2001, the CWC Board has authorized the transfer of $1,999,000 in ADSSP funding to other, more active, watershed protection and partnership programs.

3.1.4 Other Septic Programs

The Small Business Septic System Rehabilitation and Replacement 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. Eligible business owners are reimbursed 75 percent of the cost of septic repairs, up to a maximum of $40,000. To be eligible, failing commercial septic systems must be 250 feet or less from a watercourse or 500 feet or less from a reservoir or within the 60-day Travel Time Area.

In 2011, one small business received reimbursement for the repair or replacement of a failing septic system under the program. Four failing septic systems had been replaced under the program through the end of December 2011.

Program rules for the Cluster Septic System Program were adopted in April 2011. There was no project activity in this program during 2011.

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. Project closeout occurred August 31, 2005.

The Roxbury pump station and force main project from the Hamlet of Roxbury to the Grand Gorge wastewater treatment plant (WWTP) is complete. The Hubbell Corners Supplemental Service Area project was completed during 2011.

The Hunter WWTP project is complete. Project closeout occurred November 22, 2011.

The Windham WWTP and collection system are functionally complete. Work continued in 2011 on collection system additions and WWTP and pump station improvements.

The Fleischmanns WWTP project is complete. Project closeout occurred January 15, 2010.

The Town of Shandaken completed the design review study for the Phoenicia project in 2011. The Engineer's Review Report was presented to the Shandaken Town Board in October 2011 and approved by DEP in November 2011. The Town must pass a resolution in early 2012 to move the project into the pre-construction (design) phase.

The Prattsville WWTP and collection system are functionally complete.

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 sewerage collection systems, and/or the creation of septic maintenance districts, including septic system replacement, rehabilitation and upgrades, and operation and maintenance of the district.

Figure 3.1. Ashland Wastewater Treatment Plant.

To date, CWMP projects have been completed in Bovina, DeLancey, Bloomville, Hamden, Boiceville and Ashland. CWMP projects are under design in the hamlets of Trout Creek, Lexington, and South Kortright.

In Ashland, functional completion acceptance was issued in August 2011 for the re-circulating sand filter WWTP with small diameter gravity sewers (Figure 3.1). Sanitary lateral installations were delayed due to flooding associated with Tropical Storms Irene and Lee. Lateral installations commenced October 26, 2011. Thirty-seven out of 90 lateral connections were made by the end of 2011.

The Town of Lexington passed a resolution in May 2011 to begin the 18-month preconstruction phase (design and bidding) for the sand filter community septic system and small diameter gravity sewer system for the hamlet of Lexington. The project engineer was working on completing the 65% design plans as of December 2011.

The Town of Tompkins passed a resolution in November 2010 to begin the 18-month pre-construction phase (design and bidding) for the community septic system and small diameter gravity sewer system for the hamlet of Trout Creek. DEP issued comments on the 65% design plans in August 2011and received responses in November 2011. The project was approved by the

Delaware River Basin Commission and incorporated into its Comprehensive Plan for the Delaware River Basin in December 2011. At year's end, work was continuing on final design of the collection system and treatment sites.

The Town of Stamford passed a resolution in October 2011 to begin the 18-month pre-construction phase (design and bidding) for a conventional sewer collection system for the hamlet of Trout Creek. The sewage is to be pumped to the Village of Hobart WWTP for treatment.

3.4 Sewer Extension Program

DEP continued to implement the Sewer Extension Program during 2011. Highlights of program activities in communities with projects still underway in 2011 are described below.

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

The planning and design of this sewer extension, located just south of the former Village of Pine Hill along NYS Route 28, was completed in 2011 after receiving final approval from DEC.

Prior to DEP's preparation of a construction contract, the Town of Shandaken must adopt a new Sewer Use Law (SUL) and procure all of the remaining easements for this project. Toward this end, DEP staff worked cooperatively with local Town officials preparing a new SUL that will provide standards for the usage of the Pine Hill Sewer System, including the new planned sewer extension. It is anticipated that the Town of Shandaken Town Board will adopt the new SUL early in 2012. Once that happens, the Town will focus on obtaining the remaining easements.

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

The planning and design of the sewer extension along County Route 23C and Showers Road continued to move forward during the past year. DEP completed compliance with the State Environmental Quality Review Act (SEQRA) and conducted soil borings along the proposed sewer main alignments. Based on the results of the soil borings, the design of the extension was modified to account for shallower than anticipated depth to bedrock.

DEP also provided assistance to the Town of Hunter in securing the easements required to finalize the design of the project. The Town obtained nearly all of the remaining easements needed to ensure that all residents who are eligible for connection to the new sewer main can be included in the project.

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

During the past year, considerable progress was made addressing planning and design issues, assessing the project's potential environmental impacts, determining an acceptable method of construction for several planned sewer main and lateral stream crossings, and revising the

alignments for each of the three planned extensions based on environmental and technical factors. These elements resulted in revisions to the 30 percent design plans.

A few of the more notable issues that were addressed included designing lateral connections to several homes across a stream from the sewer main along Bull Run Road, designing one of the planned extensions through an area where there are Great Blue Heron nests, and designing sewer main and lateral stream crossings to minimize future impacts.

Pursuant to the New York City Watershed Memorandum of Agreement (MOA), the Town and Village must adopt a new SUL and procure all of the remaining easements DEP requires for the project. Toward that end, DEP provided Town and Village officials with proposed amendments to their existing SULs. The Town and Village continue efforts to contact residents from whom DEP needs lateral access/construction easements.

3.5 Wastewater Treatment Plant Upgrade Program

As part of the MOA, the City agreed to fund the upgrades of all existing non-City-owned WWTPs in the New York City Water Supply 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 provide highly advanced treatment of WWTP effluent. The task of coordinating these complex projects with the WWTP owners in the Catskill/Delaware Watershed is enormous. Many of the owners are restaurateurs, hoteliers, camp operators, school administrators, and managers of recreational facilities, not professional WWTP operators and construction specialists. DEP has proceeded diligently with this vast undertaking and provided step-by-step guidance on a host of engineering, operating, contracting, and regulatory issues.

The upgrade of non-City-owned WWTPs is divided into two distinct programs: Regulatory Upgrades and State Pollutant Discharge Elimination System (SPDES) Upgrades (WOH only). Although these are two separate programs, the Upgrade Agreement between the Environmental Facilities Corporation (which acts as the contracting agency under agreement with DEP) and the WWTP owner encompasses both of them.

The Regulatory Upgrade Program is designed to help WWTPs meet 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 help certain WWTPs meet 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 2011 efforts focused on completing regulatory upgrades for the remaining non-upgraded WWTPs. By the end of 2011, 37 WWTPs, representing 100 percent (3.9 MGD) of the total WOH flow, had achieved functional completion and begun operation.

In addition to the efforts to complete functional completion at all WOH WWTPs, 2011 efforts also focused on negotiating Operation and Maintenance (O&M) agreements and budgets, as well as processing start up and performance payments and O&M payments. O&M agreements and budgets were successfully negotiated with all eligible WWTPs.

Notable progress was also made in completing the upgrades of nine East of Hudson (EOH) FAD-related WWTPs located in the Croton Falls/Cross River watershed. By the end of 2011, the regulatory upgrades of all nine, representing 100 percent (1.3 MGD) of the Croton Falls/Cross River watershed flow, had been completed and begun operation.

3.6 Stormwater Programs

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 (SPPPs) and individual residential stormwater plans for new construction commencing 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 is administered by the CWC, and reimburses municipalities and large businesses 100 percent and small businesses 50 percent for eligible costs. A separate program known as Future Stormwater Controls, paid for by the City, reimburses low-income housing projects and single-family home owners 100 percent and small businesses 50 percent for eligible costs.

The City has fully funded the $31.7 million West of Hudson Future Stormwater Controls Program. From this allotment, the CWC has funded $4,198,825 in eligible activity and transferred $16,676,724.18 to other eligible watershed protection programs. The fund balance was $16,794,105 at the end of 2011, including interest. See Table 3.1 below.

Table 3.1. 2011 West of Hudson Future Stormwater Controls Program projects.

Applicant	Project	Approval date	CWC funding	Percent funding CWC/DEP
Delhi Fire District	Stormwater controls associated with parking lot expansion	2/8/11	$197,454	100% CWC
Stamford Society Foundation	Stormwater controls associated with new 60-bed adult care facility (Robinson Terrace)	3/1/11	$148,919	100% CWC
New York Land & Lakes Development, LLC	McMurdy Brook subdivision—SPPP design costs	3/1/11	$11,256	50%/50%
Town of Bovina	Town of Bovina Highway Garage O&M	3/1/11	$20,000	100% CWC
West Mountain Properties, LLC	Hobart Quickway (gas station and convenience store) O&M	4/5/11	$20,000	50%/50%
Cannie D's Corner Corporation	Cannie D's (gas station and convenience store) O&M	5/3/11	$20,000	50%/50%
Paul Cheney	SPPP costs (DEP meetings, pollutant loading analysis) associated with residential property	6/7/11	$2,446	100% CWC
Joseph Mugnai	Additional funding for costs associated with SPPP for residential property	7/5/11	$1,973	100% CWC
L E T LLC (Dollar General)	SPPP stormwater controls at Margaretville store	8/2/11	$39,970	50%/50%
Kenneth Hoffman	SPPP design costs for residence	9/13/11	$6,780	100% CWC
Geraldo Mato	SPPP Stormwater controls	10/4/11	$63,500	100% CWC
Winter Partners (Enclave)	Stormwater controls related to townhouse and condominium development	10/4/11	$41,358	50%/50%
DeFrancesco	Additional costs for stormwater controls for residence	12/6/11	$1,338	100% CWC
Delaware Park LTD	Repair of stormwater control structures damaged by Tropical Storm Irene	12/6/11	$7,000	100% CWC

3.6.2 Stormwater Retrofit Program

The Stormwater Retrofit Program is administered jointly by the CWC and DEP and has three components: a construction grants (or capital projects) component, a maintenance component, and a planning and assessment component. The program provides funding for the design, permitting, construction, and maintenance of stormwater best management practices to address existing stormwater retrofit runoff in concentrated areas of impervious surfaces, for the purpose of correcting or reducing existing erosion and/or pollutant loading.

The program currently maintains an open application timetable for construction grant project applications, evaluating each application as it is submitted. Funding preference is given to construction grant project applications where a planning and assessment project has already been successfully completed or where a NIP project or CWMP project is in progress. The required "local share" contribution is 15 percent 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.

From 1999-2011, 66 stormwater retrofit projects were completed under the program. Of these, 53 were constructions projects, including 7 in 2011, and 13 were planning and assessment projects, including 1 in 2011. Nine construction projects and three planning and assessment projects remain open. Projects of both types—construction (Tables 3.2 and 3.3) and planning and assessment (Tables 3.4 and 3.5)—that were completed or open in 2011 are presented below.

Table 3.2. 2011 Stormwater Retrofit Program construction projects.

Applicant	Project description	Project cost	Closing date
Greene County Soil & Water Conservation District (GCSWCD)	Windham Mountain (collection, conveyance, sedimentation)	$279,630.00	12/20/11
Town of Hurley	Bristol Hills Subdivision (collection, conveyance, sedimentation)	$110,885.90	3/2/11
GCSWCD and Sugar Maples	Sugar Maples (collection, conveyance, sedimentation)	$153,503.00	3/2/11
Town of Walton	Bob Gould Road (collection, conveyance, sedimentation)	$59,720.00	3/8/11
Town of Walton	Oxbow Hollow (collection, conveyance, sedimentation)	$137,990.00	3/8/11
Town of Windham	Masonic Temple Access Road (collection, conveyance, sedimentation)	$22,474.90	4/20/11

Table 3.2. (Continued) 2011 Stormwater Retrofit Program construction projects.

Applicant	Project description	Project cost	Closing date
Village of Fleischmanns	Little Redkill/Schneider Avenue (collection, conveyance, sedimentation)	$187,825.74	4/20/11

Table 3.3. Current open Stormwater Retrofit Program construction projects.

Applicant	Project area	Project description	Status
Village of Andes	Delaware County Route 2 and Coulter Road	Installation of collection, conveyance and sedimentation devices for stormwater drainage from medium density residential, commercial and county highway surfaces	Construction
Village of Tannersville	Hunter Foundation	Design and installation of stormwater collection, conveyance, and treatment structures	90% complete
Village of Delhi	Delhi Stormwater Mitigation Measures	Implementation of stormwater mitigation practices to reduce inflow and infiltration into Delhi sanitary sewer collection system	Open
Town of Roxbury	Lake Street	Design of stormwater collection, conveyance, and treatment structures	Design
Town of Andes	High Street	Design and installation of stormwater collection, conveyance, and treatment structures	Design
Town of Ashland	Ashland	Design and installation of stormwater collection, conveyance, and treatment structures	90% complete
Town of Shandaken	Highway Garage	Design of stormwater collection, conveyance, and treatment structures	Design
Mountain Top Library	Haines Falls Free Library	Design and installation of stormwater collection, conveyance, and treatment structures	95% Complete
Town of Shandaken	Pine Hill Design	Design of stormwater collection, conveyance, and treatment structures	Design

Table 3.4. 2011 Stormwate Retrofit Program planning and assessment projects.

Applicant	Amount expended	Closing date
Town of Halcott	$25,000.00	1/6/11

Table 3.5. Current open Stormwater Retrofit Program planning and assessment projects.

Applicant	Grant amount	Funding round
Village of Margaretville	$49,900.00	2006
Town of Andes	$35,275.00	2009
Town of Ashland	$42,491.50	2009

4. Protection and Remediation Programs

4.1 Waterfowl Management Program

The Waterfowl Management Program will submit a separate annual report on the date specified in the 2007 Filtration Avoidance Determination (FAD), which currently is July 31, 2012 but which could change as a result of the 2011 Long-Term Watershed Protection Plan (DEP 2011b).

4.2 Land Acquisition

Between the 1860s, when the City began to acquire land for construction of what would later be known as the Catskill/Delaware System, and 1957, when acquisitions of land ended, the City acquired roughly 35,600 acres of land surrounding the reservoirs that were eventually built. As of December 31, 2011, following 15 years of Land Acquisition Program (LAP) activity, the City had protected an additional 121,090 acres in the Catskill/ Delaware System (including land and conservation easements (CEs) secured by the City as well as CEs acquired by the Watershed Agricultural Council (WAC). This represents an addition of more than three times the amount of land that had been acquired previously, in a fraction of the time and based on voluntary transactions. In many basins, City land holdings have increased dramatically compared with pre-1997 ownership patterns (see Figure 4.1). In Rondout, a high priority 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 almost tripled in size. Overall, City-controlled land in the Catskill/Delaware System (including easements secured by both DEP and the WAC) has increased from 35,588 acres in 1996 to 156,844 acres (including deals yet to close). In 1996, roughly 3.5% of the watershed was owned by the City and another 21% was protected by New York State and others; today, roughly 15.2% is City-controlled, a major component of the 36.4%non-reservoir portion of the watershed that is under some form of permanent protection. Below are summaries of the main components of the LAP's activities during 2011.

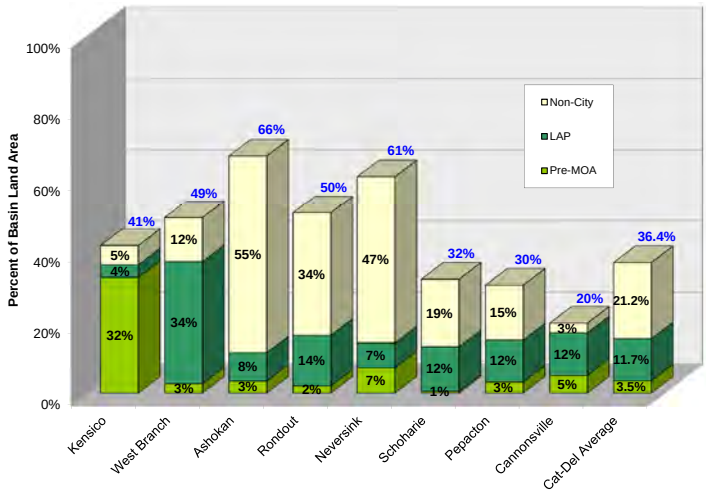


Figure 4.1 Protected lands by basin, through 2011, as a percentage of basin land area, Catskill/ Delaware System.

4.2.1 Solicitation/Resolicitation

The 2007 FAD required a solicitation plan for 2011-2012, which was submitted in 2010. Under this plan, DEP's solicitation goal for 2011 was 60,000 acres, while a further 5,000 acres of farmland were to be solicited by the WAC. DEP solicited 69,830 acres of land and the WAC also exceeded its goal. Total acreage solicited by DEP since 1997 is now over 480,000 (excluding previously-solicited properties that the City is no longer interested in, and farms solicited by the WAC). Experience continues to show that repeated solicitation of the same properties over time yields worthwhile results.

4.2.2 Purchase Contracts in the Catskill/Delaware System

Overall results for purchase contracts signed and closed in 2011, on both fee simple and conservation easements (CEs), are described below, followed by data related to more specific aspects of the program. See Appendix Table A for a detailed list of specific properties acquired during 2011.

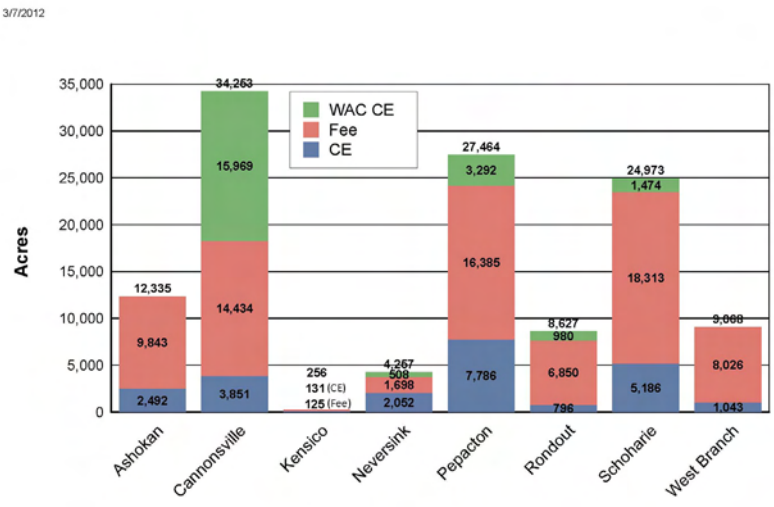


Figure 4.2 Acres signed, by basin and real estate type, through 2011, Catskill/Delaware System. The Neversink, Pepacton, Rondout, and West Branch totals do not exactly reflect their constituent acreages because of rounding errors.

By the end of calendar year 2011, DEP had secured 1,276 purchase contracts (excluding WAC CEs) throughout the Catskill/Delaware System, comprising 99,014 acres at a cost of $353.6 million (with additional "soft costs" for related site services of about $29 million) (Figure 4.2, Table 4.1). Of these, 1,165 contracts totaling 88,471 acres have been acquired (closed) (Table 4.2), with the remaining acres under purchase contract. During 2011, DEP signed 73 purchase contracts accounting for 6,076 acres; another 969 acres were signed to contract by the WAC in CEs (Tables 4.1 and 4.3, Figure 4.9). In the same year, DEP closed 86 contracts comprising 9,049 acres and the WAC closed 12 more comprising 2,212 acres (Table 4.2, Figures 4.3-4.8). The 11,260 total acres closed in 2011 is the most acres closed in any year since the program began, even when WAC CEs are included.

Table 4.1. Contracts signed in the Catskill/Delaware System, by reporting period and real estate type.

Real estate type	Number of contracts	Acres	Average size of project	Purchase price
Reporting Period: 1995 to 2010				
Fee	1,058	70,940	67	$277,743,540
CE	145	21,999	152	$ 53,731,467
WAC CE	115	21,273	185	$ 29,269,290
Total	1,318	114,212	87	$360,744,297
Reporting Period: 2011				
Fee	64	4,734	74	$18,260,580
CE	9	1,342	149	$ 3,842,500
WAC CE	6	969	162	$ 1,456,422
Total	79	7,045	89	$23,559,502
Program-to-date subtotals				
Fee	1,122	75,674	67	$296,004,120
CE	154	23,340	152	$ 57,573,697
WAC CE	121	22,242	184	$ 30,725,712
Grand Total	1,397	121,256	87	$384,303,799

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

Real estate type	Number of contracts	Acres	Average size of project	Purchase price
Reporting Period: 1995 to 2010				
Fee	963	62,603	65	$238,756,936
CE	116	16,820	145	$ 34,477,317
WAC CE	98	18,379	188	$ 23,540,093
Total	1,177	97,802	83	$296,774,346
Reporting Period: 2011				
Fee	68	5,870	86	$29,227,367
CE	18	3,179	177	$12,337,544
WAC CE	12	2,212	184	$ 4,629,189

Table 4.2. (Continued) Contracts closed in the Catskill/Delaware System, by reporting period and real estate type.

Real estate type	Number of contracts	Acres	Average size of project	Purchase price
Total	98	11,261	115	$46,194,100
Program-to-date subtotals				
Fee	1,031	68,473	66	$267,984,303
CE	134	19,999	149	$ 46,814,861
WAC CE	110	20,591	187	$ 28,169,282
Grand Total	1,275	109,062	86	$342,968,446

Table 4.3. Status of Catskill/Delaware System contracts* signed in 2011, by reservoir basin.

Reservoir basin	Number of contracts	Acres	Cost
Ashokan	4	393	$ 997,552
Cannonsville	12	1,292	$ 2,578,047
Pepacton	20	2,053	$ 6,322,091
Rondout	10	918	$ 3,090,331
Schoharie	31	2,381	$ 9,296,480
West Branch	2	8	$ 1,275,000
Program Totals	79	7,045	$ 23,559,501

* Includes NYC Fee, NYC CE and WAC CE transactions.

Figure 4.3 A private road passing through a 310-acre property (PIN 496) in the Town of Woodstock, acquired by DEP in 2011.

Figure 4.4 The vacant land in the foreground is part of a 71-acre property (PIN 7033) in the Town of Roxbury, acquired by DEP in 2011.

Figure 4.5 A frozen stream on a 456-acre property (PIN 296) in the Town of Olive, acquired by DEP in 2011.

Figure 4.6 The eastern half of Lake Heloise was purchased by DEP in 2011 as part of a 325-acre acquisition (PIN 587) in the Town of Windham.

Figure 4.7 A stream on a 58-acre easement in the town of Olive, acquired by DEP in 2011.

Figure 4.8 A meadow on a 190-acre conservation easement (PIN 2910) in the Town of Neversink, acquired by DEP in 2011.

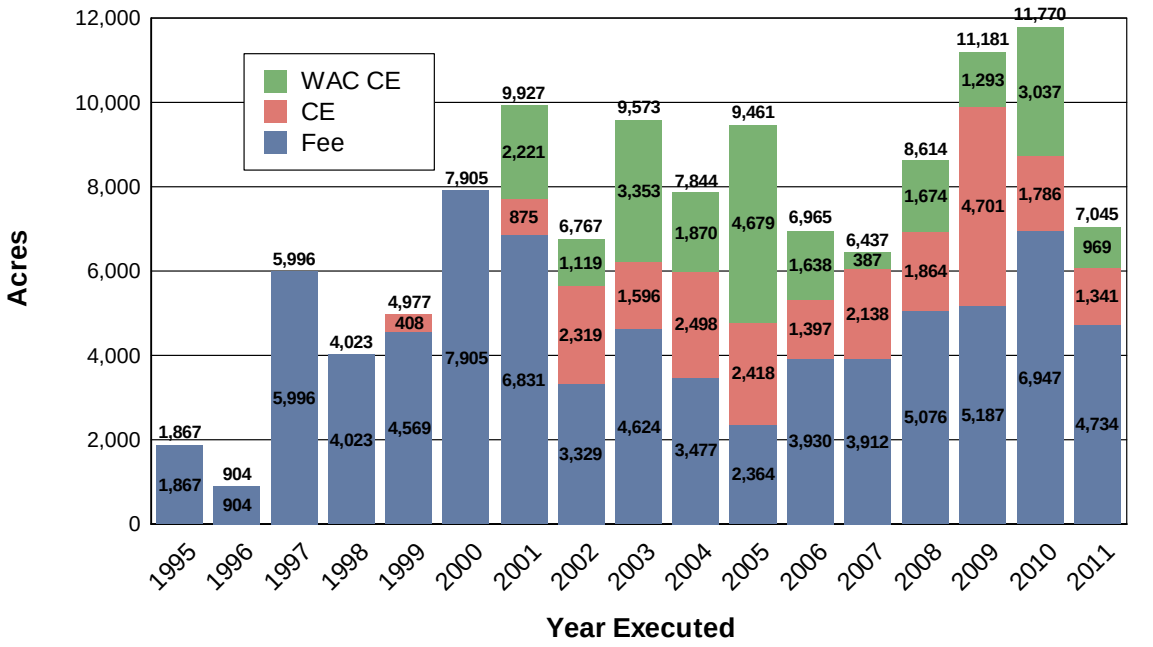


Figure 4.9 Acres signed, by year and real estate type, Catskill/Delaware System, 1995-2011. The 2004 totals do not exactly reflect their constituent acreages because of rounding errors.

Conservation Easements

DEP

During 2011, 9 CEs totaling 1,342 acres were signed to purchase contract by DEP and 18 CEs totaling 3,179 acres were closed by DEP (Table 4.2). Overall, 154 easements in the Catskill/ Delaware System totaling 23,340 acres are now closed or under contract, equal to 24% of the acres protected by DEP (excluding WAC CEs).

WAC

During 2011, the WAC executed six purchase contracts for 969 acres in CEs. By the end of the year, the WAC held easements on 110 farms totaling 20,591 acres.

The Farm Easement Program—including the costs of all easement acquisitions and program overhead, and the majority of stewardship costs—has been supported by the following allocations from DEP:

- $20 million dedicated in 1999, from the original $250 million Land Acquisition Program fund. This includes $10 million for "agricultural easements" and $10 million for easements on "non-agricultural lands under common ownership with farms [of] property owners who have Whole Farm Plans approved by WAC" (New York City Watershed Memorandum of Agreement (MOA) 1997).
- $7 million dedicated in 2006 from the $50 million Supplementary Fund outlined in MOA Section 74
- $20 million dedicated in 2007 from the Supplementary Fund
- $23 million budgeted in 2008 as directed by DOH in a letter dated April 30, 2008. These funds will be dedicated to acquisition of farm easements under a new program contract in 2012.

DEP has budgeted for an additional $6 million toward the nascent Forest Easement Program to be managed by the WAC. Upon allocation of the new funds, the total committed to easement programs managed by the WAC will be $76 million. Pursuant to the FAD, status of efforts to implement the Forest Easement Program was reported under separate cover on June 30, 2011.

Riparian buffers

See Section 4.7 for information on riparian buffers protected through the Land Acquisition Program.

Wetlands

See Section 4.8 for information on wetlands protected through the Land Acquisition Program.

4.2.3 Land Acquisition in the Croton System

The $38.5 million allocated to this program has been spent; DEP's acquisition program in the Croton System as envisioned by the MOA is complete. Acquisition statistics are summarized below:

Table 4.4. Real property interests acquired in the Croton System, 1999-2009.

Real property interest	Projects	Acres
DEP fee simple	15	840
DEP CEs	7	388
DEP Fee or CE acquired in Croton incidental to acquisitions in the Catskill/ Delaware System	11	151
WAC CEs	1	189
Fee simple acquired by New York State and conveyed to DEP	3	422
Fee simple acquired by Putnam County using non-LAP DEP funds*	3	574
Total	40	2,564

* Using the Water Quality Infrastructure Fund. To avoid double-counting, this does not include 189 acres acquired by Putnam County and later placed under WAC CE.

With the exception of one additional property (269 acres) already acquired by New York State that may eventually be transferred to New York City, no further acquisitions are foreseen in the Croton System.

4.2.4 Transfer of Conservation Easements on Fee Acquisitions to NYS

Thirteen conservation easements covering 230 LAP-acquired properties representing over 15,600 acres have been prepared using a new model document drafted pursuant to Special Condition 16d of the 2010 Water Supply Permit. These easements will be submitted to DEC in the first half of 2012. DEP's program-to-date easement conveyances to DEC remain at a total of 53 CEs on 656 DEP properties comprising 42,394 acres.

4.2.5 Technical Program Improvements

During 2011, DEP continued to seek ways to improve and revise program documents and policies, subject to requirements of the MOA, FAD, Water Supply Permit, and City Charter, to maximize program effectiveness.

- Purchase Contract. Since 2008, many land owners have continued to take advantage of the City's contribution of up to $5,000 offered in the revised model purchase contract for subdivision costs. The incentive appears to have increased the rate of accepted offers from land owners whose properties require subdivision before conveyance of the vacant portion.
- Conservation Easement Policy. DEP revised and updated its criteria for consideration and design of CEs. An automated ranking tool now assists with staff analysis. The LAP worked

with DEP's Natural Resources Management team to inform the design policy with information about the stewardship challenges of managing CEs.

- Technology. The Watershed Land Information System (WaLIS) was enhanced to support new program components related to the issuance of the new Water Supply Permit in December, 2010. The system can now provide real-time information on natural features criteria, the new designated hamlet areas, and the level of protection in each sub-basin. These and other upgrades demonstrate how WaLIS offers tremendous productivity enhancement and efficiencies which impact every step of the acquisition process.
- Land Trusts. DEP spent considerable time during 2011 seeking ways to augment involvement of land trusts in protecting watershed lands:

  - o *Enhanced Land Trust Program (ELTP)***.** The overall framework for the ELTP was completed by the Working Group. (See Special Condition 33 of the 2010 Water Supply Permit for details of the program and the composition and role of the Working Group.) Land trusts, the Coalition for Watershed Towns, and various municipalities held several meetings to review the program with local community leaders in West of Hudson towns. In the end, five towns "opted in" (Hunter, Gilboa, Halcott, Woodstock, and Olive). Together, these towns include six eligible properties totaling almost 4,000 acres. Immediate plans in 2012 are to meet with land trusts to select which organizations will contact these six land owners.
  - o *Educational Forums***.** DEP sponsored an educational forum administered by the Land Trust Alliance on Conservation Easement "permanence," which was attended by DEP and many WAC staff members along with professionals from other local land trusts. DEP was also one of the sponsors of a seminar on the "Financial Benefits of Land Conservation" hosted by the Delaware Highlands Conservancy.
  - o *Transactions***.** DEP executed one contract (288 acres) to purchase vacant land directly from a land trust, and closed on two contracts (282 acres) to acquire land from land trusts.

4.2.6 Pilot Forest Easement Program

The 2007 FAD mandated that DEP fund a $6 million pilot program through which WAC would acquire easements on "forested portions of non-agricultural" land. Negotiations between DEP and WAC began in earnest in late 2007 and, following a hiatus in 2010 for reasons described in last year's annual report, continued successfully through 2011. The terms of the new Forest Easement Program managed by WAC are close to completion and will be incorporated into the updated program contract for the Farm Easement Program, expected for final implementation in late 2012.

4.2.7 Funding Status

The 2007 FAD required the City to allocate an additional $90 million to LAP no later than December 31, 2011.

During 2010, the City deposited $90 million for purposes of land acquisition into a segregated account to satisfy the 2007 FAD requirement that such a deposit be made by

December 31, 2011. In addition, during September 2011 the City deposited $19.8 million into an account dedicated to "soft costs" in support of acquisitions (appraisals, surveys, title work, etc). Of the overall $541 million dedicated to land acquisition, a total of $62.34 million (11%) to date has been allocated to (but not all spent on) soft costs.

4.3 Land Management

The City has made a significant investment in purchasing water supply lands and CEs. To manage these lands for water quality protection, DEP has developed a comprehensive, long-term plan for land management. Land management activities fall into three major categories, primarily focused on City lands:

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

4.3.1 Management of Water Supply Lands and Conservation Easements

Property Management of City Lands

All City lands owned in fee simple are inspected as per the DEP Fee-land Monitoring Policy (DEP 2010), which outlines procedures for property inspections and boundary maintenance on City lands. Property inspections are divided into three types: 5-year boundary inspections, focused inspections, and aerial inspections. The type of inspection a property receives depends on its priority, which is assigned based on its location and the various uses conducted on the property (e.g., recreation, land use permit). "High priority properties" include parcels on which recreational use is high, where there is a history of encroachments, where there are active land use permits or other projects, or where there are many adjacent landowners. These properties receive a focused inspection annually. "Standard priority properties" are those on which have no trespass or encroachments have been observed, or which have little road frontage or little public use. These properties receive a focused or aerial inspection at least once every five years. In addition to focused and aerial inspections, all properties must receive a boundary line inspection every five years. Five-year boundary inspections are the most comprehensive and include a traverse of all property boundary lines as well as the interior of the property; this ensures proper monumentation and maintenance of property boundary lines over the long term. Table 4.5 displays the number and acres of inspections completed in 2011. DEP can change a property's priority at any time depending on circumstances (such as the discovery of encroachments) or perform additional site visits as needed. All inspections and site visits, along with journal notes, photos, encroachments, and observations, are recorded in WaLIS. Inspections are also scheduled using WaLIS. All City lands are posted as appropriate; signage includes "posted," "no

trespassing," "public access area," or "entry by permit." Other types of signs may be used depending on the situation.

Table 4.5. Number and acreage of inspections completed in 2011 by DEP field offices.

DEP field office	Property inspections (number/acres)	Five-year boundary inspections (number/miles of boundary line)	Site visits
Shokan	197/16,707	73/113	5
Downsville	66/7,291	43/110	101
Grahamsville	122/24,856	26/126	58
Schoharie	172/3,710	54/67	173
EOH	204/34,761	124/1,233	1
Total	761/87,325	320/1,649	338

Conservation Easement Stewardship

At the end of 2011, DEP had 141 easement properties totaling 20,386 acres in the Catskill, Delaware, and Croton Systems. DEP conducts two annual inspections of all its easements. DEP continues to expand the use of aerial inspections for CEs because they provide an efficient alternative for inspecting properties, especially the larger ones. Potential violations which could have serious water quality impacts, such as land clearing, construction, and road building, are evident using aerial inspections. Combined with an annual on-the-ground inspection, aerial inspections provide a high level of protection for the City's investment.

The number of easement term violations committed by landowners remains extremely low. Requests to conduct activities that require DEP notice and approval remained low as well. Forestry is the most requested activity on DEP easements: 15 forest activity plans were reviewed and approved in 2011.

Watershed Agricultural Council Conservation Easements and Stewardship

At the end of 2011, the WAC had 111 easement properties totaling 20,780 acres in the Catskill, Delaware, and Croton Systems. DEP continues to provide an oversight and advisory role with respect to the WAC's farm easement stewardship responsibilities, which continue to increase as the Council's portfolio grows. The WAC, with assistance from DEP, began developing several stewardship policies in 2011 for the activation of reserved rights, including water resources and stream work, wind turbines, towers and communication devices, locating septic systems, and future acceptable development areas.

Recreation

DEP's water supply lands provide outstanding public recreational opportunities at 19 reservoirs and two controlled lakes, and on water supply lands throughout the Catskill, Delaware, and EOH watersheds. These activities represent a way of life that many of the watershed communities want to see continued. 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 lands by DEP and by its attempt to allow "expanded recreational opportunities in the City's watershed," a specific goal of the agency's strategic plan 2011-2014 (DEP 2011c). DEP's management priority is to allow those recreational activities that are compatible with water quality. DEP's strategic plan 2011-2014 includes as a specific goal "expand recreational opportunities in the City's watershed."

In 2011, DEP opened an additional 6,903 acres of land to recreation, bringing the total lands and reservoirs available for public use to almost 109,000 acres. DEP continued to open WOH watershed lands as Public Access Areas (PAAs). PAAs allow users to hunt, hike, fish, or trap without a DEP Access Permit. Many of the new PAA-designated lands were those that had previously been designated as "no trespassing" or "entry by permit." Figure 4.10 provides a breakdown of the acres of land, by category, opened for recreation since 2003.

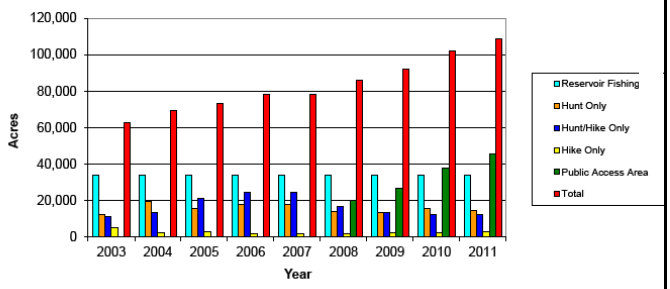


Figure 4.10 New York City-owned water supply land open for recreation, 2003-2011. Reservoir fishing acreage includes shorelines.

Cannonsville Reservoir Recreational Boating Pilot Program

The Cannonsville Reservoir Recreational Boating Pilot Program ended in 2011. Over the course of the three-year program, 871 recreational boating permits were issued to 350 individuals, demonstrating that a large percentage of participants were repeat users. The number of actual participants was probably much higher than 350, since DEP tracked only the person acquiring the boat tag, not others in the same boat. Kayaks were by far the most popular vessel used (584 permits) (Figure 4.11), with canoes second (226 permits). The majority of tags issued were for one to seven days' use (804 permits); only a small number of seasonal tags were issued (67 permits). No major incidents were reported. DEP staff regularly inspected boat launch areas, removed garbage, and performed routine maintenance as needed (Figure 4.12). Portable latrines and two canoe/kayak racks were installed at several locations (Figure 4.13) and regularly maintained. Several surveys of participants were conducted over the course of the program and most of the feedback was positive. There was little interference with the existing boaters, who keep their rowboats on the reservoir. DEP, along with other partners, is finalizing a report showing that the pilot program was a success and recommending it be expanded to other reservoirs.

Figure 4.11 Kayakers enjoying Cannonsville Reservoir

Figure 4.12 Recreational boating signs installed at launch sites on Cannonsville Reservoir

Figure 4.13 Recreational boating canoe/kayak racks installed at Cannonsville Reservoir

Agricultural Use

DEP allows its land to be used for agricultural activities but sets certain conditions on landowners who choose to farm, such as a minimum 25-foot buffer along all streams and wetlands, a prohibition on spreading raw manure during frozen or snow-covered conditions, and, if fertilizers are to be used, an approved nutrient management plan. Most of the farmers using City lands are enrolled in the WAC's Whole Farm Plan Program. These plans are generally developed for private land but can be adapted for use on City lands. The most common agricultural use on City land is the harvesting of hay. In 2011, DEP approved 18 new projects covering 339 acres for a total of 62 projects in 23 different towns covering 1,759 acres.

4.3.2 Forest Management

DEP has an active Forest Management Program staffed with four geographically-based foresters and one supervisor/coordinator. The program is responsible for conducting forest management projects on City land. Recently, the program, in conjunction with the USDA Forest Service (USFS), developed its first ever Forest Management Plan (FMP) (DEP 2011d) to guide forest management activities on City-owned watershed forest land. The FMP includes the DEP Conservation Practices (CPs), which define the process for forest management project planning and implementation and set the standards for the protection of natural and human resources. The FMP recommends silvicultural treatments on approximately 40,000 acres over the next 10 years to help move the forest from the current condition to the desired condition as outlined in the FMP. The desired condition is one in which forest cover on City land is maximized for long-term water quality protection while the risk of loss of forest cover is minimized.

To further the goals of the FMP, DEP began development of the FMP Implementation Strategy, based on the recommendations outlined in the FMP, staff and financial resources, agency and program priorities, and on-the-ground realities (e.g., access, local ordinances, deer impacts). The primary goal of the strategy is to focus management activities, prioritize the treatment of stands across the watershed, and provide additional detail on the types of projects that will be undertaken. Another goal is to provide guidance to management, the Forest Management Program, and Forest Interdisciplinary Technical Team (FITT) members on the criteria for determining how, why, and where projects will be chosen. The strategy provides a planning window for 2012 and 2013 and will be updated every two years to address changing conditions and/or priorities. As stated in the FMP, it is expected that as time goes by there will be an increase in Forest Management Program projects compared to current levels. The table below lists the number of forestry projects that are currently in each phase of the development process as outlined in the CPs, as well as the number of acres in each process phase.

Table 4.6. Status of forestry projects.

CP process phase	Number of projects	Acres
Initiation	6	608
Planning	9	431
Implementation	4	151
Completion	1	50
Total	20	1240

4.3.3 Invasive Species Control

Invasive Species Working Group

The Invasive Species Working Group (ISWG) was formed in 2008 to develop and implement a science-based, comprehensive plan to identify, prioritize, and address invasive species threats to the water supply. The ISWG met three times in 2011 and developed and began

implementation of an Early Detection and Rapid Response Plan (ED/RR) for invasive species that addresses risk assessment, development of a priority species list, early reporting of new occurrences (early detection), and rapid response.

Elements of the ED/RR plan implemented in 2011 include:

- Finalization of a priority species list of 43 species that are of concern to DEP. Risk assessments of 120 non-native invasive species were completed using a qualitative risk assessment form developed by the ISWG in 2009-2010 to assess a species' potential to impact water quality, water supply infrastructure, ecosystem functioning and/or health and safety. The species on the list will be prioritized by DEP for prevention, early detection/rapid response, and management. The list will be periodically updated and new species assessed.

- A centralized reporting and tracking system utilizing WaLIS was developed to allow DEP employees and the public to report suspected new occurrences of priority invasive species while their populations and extent are still small and manageable. A protocol was also developed for investigating those reports and deciding on the appropriate response.

- Work began on redesigning the DEP website to allow for online reporting of DEP's priority invasive species and to provide information on those species and on ways the public can help prevent their introduction and spread in the watershed. The redesigned website is expected to become live in early 2012.

- Work began on developing two of the plan's major early detection elements: passive and active monitoring programs and an E&O strategy. The monitoring programs will help detect new occurrences of priority species, while the E&O strategy will allow DEP to effectively educate the public and DEP employees on (1) DEP's invasive species concerns and (2) how to report invasive species and how to prevent their introduction and spread. Both of these strategies are due to be implemented by the middle of 2012.

New York State Invasive Species Advisory Committee

DEP has a seat on the New York State Invasive Species Advisory Committee (ISAC), which was created through state invasive species legislation in 2007 to provide information, advice, and guidance to the New York State Invasive Species Council (ISC) on issues related to invasive species impacts, prevention, regulation, detection, and management in the state. In 2011, the committee continued to provide a forum for the exchange of information among the ISAC's member groups and the ISC. DEP attended two ISAC meetings and one ISC meeting in 2011.

Invasive Species Management

DEP continued treatment of priority invasive species on City land. A summary of these efforts follows:

- *Swallow-wort (Pepacton Reservoir)*: Efforts to eradicate pale and black swallow-wort at one site on the eastern end of Pepacton Reservoir continued in 2011 and an assessment of previous

eradication efforts was made. This site has been managed since 2007, and while there is still swallow-wort on-site, its density has been greatly reduced by a combination of herbicide treatments and manual control, including seedling pulling and seed pod collection. Eradication was performed by a certified pesticide applicator, using glyphosate, under DEP supervision; applications were completed in June and September. The concentration of glyphosate was doubled from 2% to 4% in 2011 to treat plants that appeared to be surviving the lower concentration.

- *Giant hogweed (Croton Falls Reservoir)*: DEP continued work on eradicating giant hogweed in the Croton Falls Reservoir watershed along the West Branch of the Croton River using Rodeo (5% glyphosate solution). This project has been ongoing since 2008 and has significantly reduced the number of plants. In 2011, several seedlings were discovered in a scoured area and were treated. Post-treatment surveys revealed very few plants remaining, all of which were unhealthy and not expected to go to seed.
- *Mile-a-minute vine (Kensico Reservoir)*: A new 12-acre infestation of mile-a-minute vine was discovered in 2011 at a forest restoration site along the Kensico Reservoir shoreline. DEP responded by hand-pulling the vines throughout the site. A clump of vines had been damaged by the mile-a-minute weevil, and was left in place to allow the weevil to survive. Follow-up survey and management will take place in 2012.
- *Emerald Ash Borer (Ashokan Reservoir):* In July 2010, emerald ash borer (EAB), an invasive insect from China, was discovered by DEC in a campground in Saugerties, NY. While the discovery was not within the City's watershed, it was in close proximity to the Schoharie and Ashokan watersheds. As a result of the discovery of EAB in the Hudson Valley, DEC and the USFS Forest Health unit initiated a response which culminated in a sampling plot scheme to assess the distribution of EAB in the eastern portion of Ulster County. A portion of the sampling area included City lands surrounding the eastern end of Ashokan Reservoir. DEP staff, working in cooperation with DEC and the USFS, conducted field sampling on 37 plots. Destructive sampling was used, in which three trees per plot were felled and three 1-meter bolts were peeled in and immediately below the tree crown. Two plots on City land tested positive for EAB, one on the north side of Ashokan Reservoir along the Route 28 corridor and one at the southeast corner of the reservoir in the Town of Hurley

  In support of the sampling plot scheme, DEP initiated a study to assess the impact of EAB on City lands, particularly the impact on ash trees, which are the host species for EAB and die within several years of infestation. Ash (white, green, and black) comprises approximately seven percent of the trees found on City lands in the Ashokan watershed and is the sixth most dominant tree, so the impact of EAB in this watershed could be significant. Using forest inventory data from the FMP, the impact assessment described the distribution of ash and identified areas of high ash density in the Ashokan watershed, information which can be used to target future sampling plots and forestry projects.

  Since EAB cannot be eradicated, DEC and the USFS are employing the "SLow Ash Mortality" (SLAM) protocol, which prescribes methods to slow the spread of EAB. Based on the SLAM protocol, DEP established three sets of trap trees in the spring of 2011within a quarter-mile radius of the Route 28 infestation site. Trap trees are ash trees that have been girdled, producing stress the trees that is intended to lure the EAB to the trees, thus slowing their spread. These trap trees will be destroyed in March 2012 to kill the insects, prior

to the May emergence of the adults. Additional trap trees will be established as recommended by the USFS for the 2012 EAB flight season. Also as per the SLAM protocol, DEP established sentinel ash trees in 1-mile intervals along the north side of Ashokan Reservoir. Sentinel trees are individual, girdled trees utilized to monitor the spread of EAB. These sentinel trees will be felled in March 2012 and assessed for EAB presence.

DEP is currently working with USFS forest health scientists to develop enhanced forest management practices and protocols for forest management within the Ashokan watershed to manage the impacts of EAB on the watershed lands. These practices will support the SLAM protocol and be employed in upcoming forest management projects.

In 2011 DEP revised its field equipment decontamination protocol for *Didymosphenia* (Didymo) to add procedures that allows for felt soled waders and boots, thus allowing this equipment to be used in the field. The previous policy's ban on felt soled waders caused safety concerns due to the increased likelihood of slips and falls in streams. The new procedures were put in place to alleviate these concerns while still preventing the spread of the alga by contaminated footwear.

Catskill Regional Invasive Species Partnership

DEP continued to work regionally with partners on aquatic and terrestrial invasive species survey, education, and outreach in the Catskill Region**.**

Education and Outreach

DEP presented aspects of the ED/RR plan and its invasive species program at the Watershed Science and Technical Conference at West Point and at a workshop of Pacific Northwest water utilities in Seattle, Washington. The workshop, "Management of Disruptive Aquatic Species in Pacific Northwest Drinking Water," was sponsored by Tacoma Water, Seattle Public Utilities, and the City of Everett as part of a Water Research Foundation Tailored Collaboration. DEP is on the project advisory committee for the collaboration project.

4.4 Watershed Agricultural Program

The Watershed Agricultural Program (WAP) is a longstanding partnership that supports the development and implementation of Whole Farm Plans (WFPs) as well as other initiatives that assist watershed farmers. The WAP is administered by the WAC using core funding provided by DEP along with technical and financial assistance from the U.S. Department of Agriculture (USDA) and other agencies. Local entities such as the Delaware County Soil and Water Conservation District and Cornell Cooperative Extension (CCE) provide planning and engineering services, educational programs, and other forms of WAP support.

The 2007 FAD requires DEP to report annually on a number of WAP goals and metrics, and these accomplishments are summarized in Table 4.7. The subsequent narrative describes additional progress in achieving other WAP goals during 2011. For a summary of activities

relating to the WAC Agricultural Easement Program, see the Land Acquisition Program chapter of this report (Section 4.2). Finally, it is worth noting that pursuant to the 2010 WAP Evaluation, and with concurrence from the FAD regulators, DEP and the WAC no longer utilize the "sub-farm" designation when reporting farm numbers.

Table 4.7. Summary of the WAP's accomplishments during 2011.

Accomplishments	Large farms	Small farms	EOH farms
WFPs completed	2	10	6
WFP revisions	21	7	3
Nutrient management plans completed	77	25	11
Annual status reviews completed	248	85	56
Active farm status reviews	183	79	52
Inactive farm status reviews	65	6	4
New best management practices (BMPs) implemented	89	71	40
Total cost	$1,801,500	$581,449	$570,093
Existing BMPs repaired or replaced	13	11	0
Total cost	$47,914	$40,456	$0
New Conservation Reserve Enhancement Program (CREP) contracts developed	4	2	0
New acres enrolled in the above contracts	32.2	7.4	0
CREP re-enrollment contracts completed	1	0	0
Acres re-enrolled in the above contracts	1	0	0

4.4.1 Whole Farm Planning

In 2011, the WAP continued to work with active large and small farms in the West of Hudson (WOH) watershed as well as active farms in the East of Hudson (EOH) watershed to develop new WFPs, revise existing WFPs, and conduct annual status reviews (ASRs). Currently, there are 270 known large commercial farms in the WOH watershed, of which 205 are still active (76%) and 65 are considered "inactive" (24%); all of the inactive farms had/have a WFP. Of the 205 active large farms, 193 (94%) are enrolled in the WAP and 185 (90%) have WFPs, including two new plans that were completed in 2011. The 2007 FAD requires the WAP to continue developing WFPs on WOH large farms while pursuing recruitment of non-participating farms. In 2011, three new large farms signed up for the WAP, which leaves about 12 large farms that are not currently participating.

The WAP has compiled 284 Tier I surveys representing the current known universe of small farms in the WOH watershed. For these 284 farms, the WAP has completed 213 Tier II assessments (75%) and completed 95 WFPs (33%), including 10 plans that were completed in 2011 as per the FAD goal. It is worth noting that of the 189 small farms that completed Tier I

surveys but do not yet have WFPs, at least 37 (20%) do not meet the $1,000 income threshold to participate in the WAP. In addition, 6 of the 95 small farms that have WFPs are no longer active, which leaves 89 active small farms with a WFP.

In the EOH watershed, the WAC approved six new WFPs during 2011, which meets the annual FAD requirement of 6-10 new plans per year. To date, 62 WFPs have been completed on EOH farms, of which 48 have commenced implementation. Four farms have since become inactive, leaving 58 active EOH farms with a WFP.

During 2011, the WAP conducted ASRs on 389 large, small, and EOH farms. As part of this process, the WAP confirmed that 65 large farms, 6 small farms, and 4 EOH farms were inactive. It is worth noting that pursuant to the 2010 WAP Evaluation, the FAD regulators agreed to support a proposed new metric that requires that ASRs be completed on at least 90% of all active WFPs each year, with a goal of 100%. For 2011, ASRs were completed on 100% of all active WFPs.

4.4.2 BMP Implementation

The 2007 FAD requires DEP to annually report on the number and types of BMPs that are implemented each year. As summarized in Table 4.8, during 2011 the WAP implemented 224 BMPs on large, small, and EOH farms at a cost of $3,042,222. To date, 6,054 BMPs have been implemented on all watershed farms at a cost of $43.6 million. These figures include 4,722 BMPs on large farms ($36.3 million), 878 BMPs on small farms ($3.8 million), and 454 BMPs on EOH farms ($3.6 million).

Table 4.8. Implementation of BMPs on large, small and EOH farms in 2011.

NRCS code	BMP name	Large farms	Small farms	EOH farms
309	Agricultural Handling Facility	0	0	1
312	Waste Management System	1	0	0
313	Waste Storage Structure	1	0	0
317	Manure Composting Facility	2	0	0
328	Conservation Crop Rotation	8	0	8
340	Cover and Green Manure Crop	0	0	2
362	Diversion	2	5	2
382	Fencing	10	16	4
386	Field Border	3	0	0
393	Filter Strip	1	0	0
500	Obstruction Removal	1	0	0
511	Forage Harvest Management	1	0	0
512	Pasture and Hayland Planting	0	1	0

Table 4.8. (Continued) Implementation of BMPs on large, small and EOH farms in 2011.

NRCS code	BMP name	Large farms	Small farms	EOH farms
516	Pipeline	1	12	2
528	Prescribed Grazing	4	1	0
558	Roof Runoff Management	1	6	2
560	Access Road	3	2	0
561	Heavy Use Area Protection	8	12	5
574	Spring Development	5	5	0
575	Animal Trails and Walkway	5	5	0
578	Stream Crossing	0	2	0
580	Streambank Protection	0	2	1
585	Contour Strip Cropping	1	0	0
587	Structure for Water Control	1	1	1
595	Pest Management	5	0	0
606	Subsurface Drain	1	0	3
612	Tree and Shrub Planting	4	2	0
612.3	Tree and Shrub Planting-Natural Regeneration	1	3	0
614/642	Watering Facility/Well	0	2	4
620	Underground Outlet	2	0	1
633	Waste Utilization	19	3	4
634	Waste Transfer System	4	0	0
3010	Roofed Barnyard	5	2	0
3130	Barn Ventilation	1	0	0
3410	Manure Spreading Equipment	1	0	0
	Total number of BMPs implemented	102	82	40
	Total cost of BMPs	$1,849,414	$621,905	$570,903

In 2011, pursuant to the 2010 WAP Evaluation and with concurrence of the FAD regulators, the WAP began using a new BMP Prioritization Methodology to develop its annual BMP implementation workload on all WOH watershed farms (including both large and small farms). Table 4.9 provides a breakdown by pollutant category of the new BMPs and repaired BMPs that were implemented in 2011. For the 24 BMPs that were repaired in 2011, participating farmers signed 23 renewed operation and maintenance agreements.

Table 4.9. WOH structural BMP implementation summary for 2011.

Pollutant category	New BMPs	Cost	Repaired BMPs	Cost
Animal waste storage BMPs	16	$569,388	1	$1,800
Animal and manure management BMPs	18	$253,267	6	$20,711
Nutrient management BMPs	38	$305,173	8	$23,487
CREP BMPs	36	$227,063	0	$0
Concentrated nutrients BMPs	39	$984,443	6	$30,200
Diffuse sediment BMPs	8	$17,794	1	$300
Concentrated sediment BMPs	3	$25,819	2	$11,872
Total	158	$2,382,947	24	$88,370

Finally during 2011, the WAP organized an effective response to the catastrophic flooding that occurred due to Tropical Storms Irene and Lee. Over 40 watershed farms in the impacted areas were contacted by phone to assess damages, followed by WAP field staff visiting farms to estimate restoration costs to damaged streambanks and BMPs. The WAP worked closely with local Soil and Water Conservation Districts to apply for funding through the New York State Agricultural and Community Recovery Fund (ACRF). This coordinated effort resulted in 18 watershed farms receiving $389,000 worth of assistance from ACRF, in addition to one farm receiving $23,900 worth funding from the Federal Emergency Management Agency. The WAC directly paid $9,472 for restoration work on two farms.

4.4.3 Nutrient Management Planning

As summarized in Table 4.7, 113 nutrient management plans (NMPs) were completed on active watershed farms in 2011, including new and updated plans on large, small and EOH farms. One hundred seventy-four active large farms in the WOH watershed are following NMPs, of which 165 (95%) are current (developed within the last three years).

Also during 2011, the WAP Nutrient Management Credit Program worked with 81 participating farmers who submitted manure spreading records in order to receive $327,812 worth of credits that can be applied towards their nutrient management expenses. An additional 10 farms received federal nutrient management incentive payments by enrolling in the USDA Agricultural Water Enhancement Program (AWEP), through which the WAP received a multi-year grant to expand the Nutrient Management Credit Program. Eleven more farms have enrolled in the AWEP in order to receive federal nutrient management incentives in 2012.

4.4.4 Conservation Reserve Enhancement Program (CREP)

To date, 2,049.7 acres of riparian forest buffers have been enrolled in a CREP contract, which includes 39.6 new acres that were enrolled in 2011 and one acre that was re-enrolled in 2011. An additional 120 acres of riparian buffers are currently approved and waiting in the CREP contract development pipeline for implementation in 2012.

4.4.5 Farmer Education Program

The WAP conducted nearly two dozen farmer education programs that were attended by more than 470 participants, of which at least 185 (39%) were watershed farmers and 161 (34%) were "other" farmers. Examples of key educational programs include the annual Catskill Regional Dairy, Livestock and Grazing Conference; four sheep and goat producer meetings; one dairy producer group meeting (calf housing tour); one no-till production workshop; one winter crop school; one nutrient management workshop; one grain discussion group meeting; two emergency flood meetings; four meat production meetings for beginners; one farm business discussion seminar; one EOH composting tour; and four farmer outreach meetings that promoted the new BMP Prioritization Methodology.

4.4.6 Farm-to-Market Program

The WAC continued to implement its Farm-to-Market Program, which includes the popular "Pure Catskills" Buy Local Campaign that reaches more than 30,000 people through its annual print guide, quarterly newsletters, periodic e-bursts, and website (www.purecatskills.com). Other program highlights include the annual Farm-to-Market Conference (150 participants); a series of five farm tours (120 participants in total) sponsored through a new initiative called the Catskills Collaborative Regional Alliance for Farmer Training (CRAFT); the awarding of 12 agricultural development and marketing grants totaling $50,000 to local farms and agricultural businesses; and a presence at the Sullivan County Agricultural Summit, Catskill Mountainkeeper Barnfest, NOFA-NY Conference, and several New York City venues such as Winter Jam, New Green City, Brooklyn's Green Expo, and a TED "Changing the Way We Eat" conference.

4.4.7 WAP Implementation Plan for 2012

The 2007 FAD requires DEP to report on the WAP implementation plan for the subsequent year, including the number and types of BMPs, estimated cost of these BMPs, NMPs to be created or revised, and WFPs to be completed or revised. The WAP plan for 2012 includes:

- Implemention of 101 BMPs on large farms at a total estimated cost of $2,684,401
- Implemention of 128 BMPs on small farms at a total estimated cost of $974,176;
- Implemention of 30 BMPs on EOH farms at a total estimated cost of $550,000;
- Completion of new or updated NMPs on 67 large farms and 31 small farms;
- Revision of 26-28 large farm WFPs and development of new WFPs as needed
- Development of 6-10 WFPs on small farms in the West of Hudson watershed and 6-10 WFPs on EOH farms

In addition, the WAP has utilized its new BMP Prioritization Methodology to develop its projected BMP implementation workload for 2012, and this is summarized in Table 4.10.

Table 4.10. WOH projected BMP implementation summary for 2012.

Pollutant category	New BMPs	Cost	Repaired BMPs	Cost
Animal waste storage BMPs	19	$1,208,470	1	$20,855
Pesticide mixing/loading BMPs	1	$1,000	0	$0
Animal and manure management BMPs	57	$936,070	3	$23,000
Nutrient management BMPs	40	$286,455	7	$100,185
CREP BMPs	60	$375,424	5	$20,250
Concentrated nutrients BMPs	19	$184,574	6	$118,200
Diffuse sediment BMPs	3	$17,794	0	$0
Concentrated sediment BMPs	13	$25,819	2	$28,320
Total	212	$3,035,606	24	$310,810

4.4.8 Related Research Activities

During 2011, the WAC completed the agricultural portion of its comprehensive database management system, which is now called FAME (Forestry, Agriculture, Marketing, and Easements). The WAP portion of FAME went live in September and allows the annual farm ranking process for WFP development and BMP implementation to be completed almost immediately based on the newest ASR data. This affords greater accuracy and saves a large amount of staff time. After years of development, the WAP workload process is now fully managed within FAME.

Finally, the following WAP-related research papers were published during 2010-2011:

Armstrong, A., E. James, R. Stedman, and P. Kleinman. 2011. Influence of resentment in the New York City Conservation Reserve Enhancement Program. J. Soil Water Conserv. 66: 337-344.

Harpold, A.A., S.W. Lyon, P.A. Troch, and T.S. Steenhuis. 2010. The hydrological effects of lateral preferential flow paths in a glaciated watershed in the northeast USA. Vadose Zone J. 9:397-414.

Ketterings, Q.M., K.J. Czymmek, and S. Swink, 2011. Evaluation methods for a combined research and extension program used to address starter phosphorus fertilizer use for corn in New York. Canadian Journal of Soil Science. 91:467-477.

Kleinman, P.J.A., A.N. Sharpley, R.W. McDowell, D. Flaten, A.R. Buda, L. Tao, L. Bergstrom, and Q. Zhu. 2011. Managing agricultural phosphorus for water quality protection: principles for progress. Plant and Soil 345: Online First.

Kleinman, P.J.A., A.N. Sharpley, A.R. Buda, R.W. McDowell, and A.L. Allen. 2011. Soil controls of phosphorus runoff: management barriers and opportunities. Canad. J. Soil Sci. 91: 329-338.

Veith, T.L. and L.T. Ghebremichael. 2011. Economic and phosphorus-related effects of precision feeding and forage management at a farm scale. NEPC Fact Sheets. p. 1.
White, E.D., Z.M. Easton, D.R. Fuka, A.S. Collick, and T.S. Steenhuis. 2011. Development and application of a physically based landscape water balance in the SWAT model. Hydrol. Proc. 25:15-925.

4.5 Watershed Forestry Program

The Watershed Forestry Program is a partnership between DEP, the WAC, and the USDA Forest Service (USFS) that promotes and supports the economic viability of well-managed working forests as a beneficial land use for watershed protection. The WAC utilizes core DEP contract funds and matching grants from the USFS to support the following initiatives: (1) forest management planning and stewardship, (2) BMP implementation, (3) logger and forester training, (4) model forest program, (5) urban/rural education, and (6) wood products marketing and utilization. This chapter describes the Watershed Forestry Program's progress in accomplishing these six initiatives in 2011; Table 4.11 provides a qualitative summary of key programmatic metrics for 2011 and totals to date.

Table 4.11. Watershed Forestry Program accomplishments as of December 31, 2011.

Accomplishments	2011	To Date
Forest management plans completed	82	996
New plans/original enrollment	51	908
Plan updates/re-enrollment	31	88
Riparian plans completed	52	395
Riparian acreage	2,495	13,235
Total acreage enrolled in forest management plans	19,200	182,713
Forested acreage only	14,350	142,470
Forest road BMP projects completed	34	311
New timber harvest roads	31	243
Remediated forest roads	3	68
Portable bridge projects completed	4	100
Short-span cost-shares	0	19
Short-span loans	2	38
Long-span rentals	0	1
Long-span loans	2	28
Arch culverts	0	14
Forestry stream crossing BMP projects completed	8	27

Table 4.11. (Continued) Watershed Forestry Program accomplishments as of December 31, 2011.

Accomplishments	2011	To Date
Management Assistance Program projects completed	39	272
Timber stand improvements	20	152
Wildlife enhancements	12	56
Invasive species control	5	30
Riparian improvements	1	29
Tree planting	1	5
Logger training workshops conducted	10	215
Number of participants	124	2,000

4.5.1 Forest Management Planning and Stewardship

The Watershed Forestry Program continued to fund the development of forest management plans by private watershed landowners; this effort includes the first-time enrollment of properties in the WAC program, the updating of older plans to meet newer WAC specifications, and the development of riparian management plans as a subset of the broader forest management plan document.

The program also continued to fund the implementation of WAC forest management plans through the Management Assistance Program (MAP). Initiated in 2005, the MAP provides funding to landowners to implement the following specific practices as recommended in their WAC plans: timber stand improvements (TSI), tree planting (including deer fencing), riparian improvements, wildlife improvements, and invasive species control. Two MAP funding rounds were held in 2011.

4.5.2 Best Management Practice Implementation

The Watershed Forestry Program continued to fund the completion of road BMP projects, including the installation of new timber harvest roads and the remediation of existing forest roads. As part of its forestry BMP programs, the WAC also provides funding and technical assistance to properly utilize or install forestry stream crossing BMPs during active timber harvest operations.

In addition to road and stream crossing projects, the WAC also encourages the use of portable bridges while distributing free samples of numerous BMP technologies. During 2011, The WAC distributed 21 free BMP samples including geotextile road fabric, non-petroleum chainsaw oil, traditional pipe culverts, hay bales and grass seed (for site stabilization purposes), and straw wattles. To date, the WAC has distributed more than 200 free BMP samples, including the ones already mentioned as well as silt fencing, rubber belt water deflectors, and erosion control blankets.

The WAC also conducted an evaluation of its pilot “Trees for Tribs” Program in the Croton watershed, which was launched in 2010 through collaboration with the DEC Hudson

River Estuary Program. The pilot program was comprised of the fall 2010 and spring 2011 planting seasons, during which 10 projects were completed on both public and private properties in the towns of Bedford, North Salem, Mount Kisco, Patterson, Pawling, Somers, and Yorktown. These 10 pilot projects established 4.5 acres of riparian buffers through the planting of 992 native trees and shrubs by 119 volunteers. In July, the Watershed Forestry Program reviewed three different options for continuing the effort over a five-year period at various degrees of project size, scale, funding levels, and WAC staff commitments. After weighing budgetary and staffing considerations against other programmatic needs and priorities, it was agreed that the program should continue at its current pace while formally becoming the Croton Chapter of Trees for Tribs. During the fall of 2011, five more planting projects were completed (160 plants) by 190 volunteers in the towns of Bedford, Carmel, North Salem, and Yorktown.

4.5.3 Logger and Forester Training

The Watershed Forestry Program continued to collaborate with CCE of Greene County and New York Logger Training, Inc. (NYLT) to sponsor and conduct voluntary training workshops in support of the statewide Trained Logger Certification (TLC) Program. Ten workshops were held in 2011 and attended by 124 participants; these workshops included two each of the core required TLC courses (Forest Ecology and Silviculture, Game of Logging, First Aid & CPR) along with three continuing education courses that addressed forest pests, hardwood bucking, and forestry BMPs. A total of 108 individuals working in the Catskill/Lower Hudson region were fully certified through NYLT as of December 31, 2011.

No forester training workshops were conducted during 2011. Forty-three foresters are currently trained and approved to develop WAC forest management plans.

In support of its 2011 training efforts, the WAC also produced an annual logger training calendar, distributed promotional TLC roadside signs, and participated in the annual Deposit Lumberjack Festival, Catskill Forest Festival, and NYS Woodsmen's Field Days.

4.5.4 Model Forest Program

The Watershed Forestry Program continued working with the SUNY College of Environmental Science and Forestry, CCE of Delaware and Greene Counties, and Frost Valley YMCA to coordinate and support three watershed model forests: Lennox (Delaware County), Frost Valley (Ulster County), and Siuslaw (Greene County). All three model forests are maintained and utilized by the host organizations for various education, outreach, demonstration, and research programs, while work continues at each site to conduct and monitor silvicultural treatments and to repair/install BMPs and other forestry demonstrations.

The program also fulfilled a 2007 FAD deliverable by establishing an EOH model forest at Clearpool Environmental Camp in Putnam County. A ribbon-cutting ceremony was held in October to formally announce the Clearpool Model Forest, and the Clearpool Model Forest Committee meets monthly to discuss and develop projects.

4.5.5 Urban/Rural Education

The Watershed Forestry Program continued working with the Catskill Center for Conservation and Development and Common Ground Educational Consulting to implement an urban/rural school-based education program comprised of the Watershed Forestry Institute for Teachers, the Green Connections School Partnership Program, the Watershed Forestry Bus Tour Grants Program, and the Catskill Stream and Watershed Education Program (CSWEP).

During the spring, the Catskill Center conducted both the 2011 Green Connections Program (4 partner schools, 15 classrooms, 329 participants) and the 2010-2011 CSWEP (11 schools, 30 classrooms, 465 participants). In July, the Catskill Center conducted the thirteenth annual Watershed Forestry Institute for Teachers at the Taconic Outdoor Education Center in Cold Spring (seven participants) in addition to sponsoring two separate teacher reunions at the Newtown Creek Visitor Center and the Taconic Outdoor Education Center (nine participants per event). Nearly 240 teachers have participated in the Institute since 1999. In the fall, the Catskill Center launched the 2011-2012 CSWEP, which will be ongoing through June 2012.

The Watershed Forestry Bus Tour Grants Program held one funding round in 2011, with eight grants awarded out of 14 applications. Thirteen bus tours were completed in 2011 for approximately 855 participants, primarily New York City school groups. In total, the Watershed Forestry Program has sponsored 155 bus tours that have involved nearly 7,000 participants.

4.5.6 Forest Products Marketing and Utilization

The Watershed Forestry Program continued to support the "Catskill WoodNet" marketing website (catskillwoodnet.org), which currently represents 87 businesses that utilize or sell locally harvested wood from the Catskill region. In support of this campaign, the WAC disseminates a bimonthly Catskill Woodnet e-newsletter that routinely reaches more than 500 people. The WAC is also exploring the establishment of an online Pure Catskills store that would integrate agricultural products from the Pure Catskills campaign with forestry products from the Catskill Woodnet campaign to create a single marketing identity for all these products.

The Watershed Forestry Program also completed a third round of woody biomass pre-feasibility studies for seven facilities and municipalities located in Delaware, Ulster, and Westchester Counties. Six of these entities appear to be good candidates for pursuing the installation of wood biomass boiler systems. Subsequently, the WAC assisted the Frost Valley YMCA (one of the seven entities) with developing and submitting a grant proposal to the New York State Energy Research and Development Authority (NYSERDA) that would fund up to

75% of the costs of installing a wood pellet heating system for portions of their campus. At the WAC's request, DEP submitted a letter of support for this potential project.

4.6 Stream Management Program

The DEP Stream Management Program (SMP) made considerable progress in 2011 toward protecting and restoring stream system stability and ecological integrity by facilitating the long-term stewardship of streams and floodplains. The SMP partnership with county Soil and Water Conservation Districts (SWCDs) was initiated 15 years ago after the 1996 flood demonstrated the need for an approach that addresses the requirements of all watershed stakeholders: improved water quality for the City, minimized rates of erosion and stream instability for protection of infrastructure and property, and enhanced habitat to support an increasingly recreation-based regional economy. In 2011, DEP and its partners, having completed stream management plans for all Catskill and Delaware System mainstem rivers, are working together to implement the plans' recommendations. In its fifteenth year, the program was tested by the most significant regional flood on record, Tropical Storm Irene. The program's comprehensive response demonstrated the experience and leadership of its partners and the effectiveness of the overall program.

Prior to Tropical Storm Irene, the emphasis of SMP work had been implementing the recommendations of its stream management plans: awarding new Stream Management Implementation Program (SMIP) grant proposals and implementing previous grant contracts; launching field surveys for updating of floodplain maps and coordinating new map steering committees; extending education, outreach and training opportunities; expanding Catskill Streams Buffer Initiative (CSBI) activities and completing FAD restoration projects. Tropical Storm Irene temporarily delayed or slowed some core program activities while DEP and its partners responded to urgent community needs for assistance. Nonetheless, the field season was productive: CSBI completed a full planting schedule, and several non-flood-related construction projects and FAD restoration projects were completed.

Significant accomplishments of 2011 include:

- Completed the Neversink Stream Management Plan
- Awarded 57 SMIP grants totaling $3,438,551
- Extended the Post-Flood Emergency Stream Intervention Protocol throughout the watershed, preventing channelization of watershed streams while aiding communities in recovery
- Completed two FAD stream restoration projects: the Walton Floodplain Restoration Project and the East Kill at Vista Ridge Project, fulfilling the FAD requirement to complete five stream restoration projects by May 2012
- Completed 37 CSBI projects that planted 23 acres addressing 3.5 linear miles of buffer
- Initiated floodplain mapping activities across the WOH watersheds

4.6.1 Stream Management Plans and their Implementation

Publication of the Neversink Stream Management Plan in 2011 completed the set of mainstem stream management plans for the WOH watershed. Stream management plans can be viewed at www.CatskillStreams.org/Stream_Management_Plans.html. Adoption of these plans is necessary for watershed communities to be eligible for SMIP funding through their local, watershed-scale SMP teams. Every year, each team updates its Action Plan, which covers a two-year period and outlines its priority projects for the period, including SMIP funded projects.

Eligible communities in the Delaware, Ashokan, and Schoharie watersheds were actively engaged in 2011 in serving on their advisory committees to review and award a range of projects that are consistent with or recommended by their respective stream management plans. Table 4.12 summarizes the 2011 funding allocation. A total of 57 projects were funded, totaling $3,467,551. With the additional work brought on by the recovery from Tropical Storm Irene, the partnering agencies will likely be delayed in completing both contracting and implementation of SMIP projects on the schedule previously planned.

Since late August, most program activities in each watershed have been redirected because of Tropical Storm Irene. These efforts are described in detail in Section 4.6.2.

Delaware Watershed Stream Management Program

The Delaware Watershed Stream Management Program, consisting of the Delaware County Soil and Water Conservation District (DCSWCD) in partnership with the Delaware County Planning Department (DCPD), continued to implement the recommendations of the East and West Branch Delaware River stream management plans through the program's Project Advisory Committee (PAC) and its subcommittees. The PAC worked closely with the program on floodplain management, highway infrastructure, recreation, and education and outreach. The program strengthened its links with the local floodplain administrators, emergency management officials, highway superintendents, agricultural extension, planning boards, chambers of commerce, and community leaders by sponsoring regular meetings and trainings for these officials to extend support for improved stream management. Examples of this extension include support for the work of the Walton Flood Commission to address flood issues in the Village and Town of Walton, regular attendance at monthly meetings of the Association of Highway Superintendents, planning to improve recreation opportunities on the East and West Branch Delaware, participation in the County All Hazard Mitigation Plan update, training for WAC and WAP staff, and presentations to the Catskill Chamber of Commerce and at regional watershed management symposia. These efforts have made the Delaware Watershed Stream Management Program a key resource for the county and a driving force for science-based stream and floodplain management in the community.

The Delaware Watershed SMIP expanded in 2011 by approving 25 projects, both construction-related and programmatic (see Table 4.12 and www.CatskillStreams.org/grants).

Major accomplishments included the construction of the first three SMIP projects and the contracting for two program initiatives, one for the creation of a plan to enhance recreation access on the East Branch Delaware, the other to purchase a hydroseeder for intermunicipal use to control stormwater on stream-related construction sites. To address the impact of recent floods, including those resulting from Tropical Storm Irene, the grant program approved separate grants to the Village of Walton, the Village of Fleischmanns, and the Village of Delhi to study flooding in these communities and consider hazard mitigation options. Finally, DCSWCD worked in close cooperation with the Delaware County Department of Public Works on projects to eliminate hydraulic constrictions in the Mallory Brook and Roses Brook watersheds.

Table 4.12. Number of SMIP projects awarded in 2011 by grant type, and their funding allocation, in the West of Hudson watershed.

Type of Grant	Schoharie	Delaware	Ashokan	Total	Total Value
Restoration	4	1	7	12	$1,614,951
Stormwater	1	0	0	1	$ 12,000
Recreation	0	6	1	7	$ 115,550
Education	2	1	3	6	$ 47,000
Planning	0	3	4	7	$ 442,590
Infrastructure	2	13	3	17	$1,095,555
Research and Monitoring	0	1	6	7	$ 139,905
Total Projects and Funding	9	25	24	57	$3,467,551

On Mallory Brook, the SMIP funding enabled a substantial hydraulic constriction to be addressed by upgrading an undersized culvert with a state-of-the-art bottomless three-sided concrete box culvert, designed to handle the flows of water and sediment associated with the 1% chance storm event (Figures 4.14 and 4.15). The natural streambed bottom will enable fish passage continuity. To prevent headcutting of the streambed upstream and scour downstream of the culvert, constructed rock riffles were built to provide grade control. These constructed riffles are a viable alternative to rock cross vanes and provide advantages in terms of ease of construction, improved functionality and a potential reduction in maintenance.

Figure 4.14 Mallory Brook before culvert replacement.

Figure 4.15 Mallory Brook after culvert replacement.

Ashokan Watershed Stream Management Program

In 2011, the Ashokan Watershed Stream Management Program (AWSMP) team focused its efforts on flood response, recovery, and helping communities improve their resilience to flooding. A first priority was strengthening the role of the Ashokan Watershed Advisory Council by undertaking a visioning process to evaluate the role of the council, and to redefine its roles and responsibilities and formalize its membership and decision-making structure. Repeated flooding in the Village of Phoenicia (three times in 10 months) catalyzed new and strengthened existing partnerships in 2011 by increasing community awareness of the resources available from the AWSMP. These included hands-on technical flood response and recovery assistance, providing answers to the countless technical and funding-related questions from landowners and watershed towns, providing leadership in the Shandaken Emergency Operation Command center, and funding for plans and projects to mitigate future flood impacts. The community is very aware and appreciative of what the AWSMP has to offer, exemplified by a letter to the Kingston Freeman following Tropical Storm Irene affirming the success of this partnership.

In April, the AWSMP sponsored the second annual Ashokan Watershed Conference in Shandaken, with 91 landowners, municipal employees, and agency staff focused on increasing community resilience to flood hazards. In December, CCE hosted a bus tour for Ulster County and agency officials to view flood damage and AWSMP post-flood activities. Throughout the year the ASWSMP participated in more than 20 stakeholder meetings and events. Newsletters and a 2011 Annual Report for the Ashokan watershed can be viewed at www.AshokanStreams.org. Finally, four AWSMP staff members and one staff member from the Ulster County Highway Department completed the Rosgen short course series covering stream process, assessment, monitoring, and natural channel design practices.

In 2011, the AWSMP approved 24 grant applications totaling $1,337,479 and is on target to meet its May 2012 deadline of allocating $2 million in SMIP funding. The number of projects awarded in 2011 is displayed, by category, in Table 4.12 and a description and status of funded projects can be found at www.CatskillStreams.org/grants.

One important activity funded and technically supported by AWSMP's SMIP is the Shandaken Area Flood Assessment and Remediation Initiative (SAFARI). This group, formed by the Town of Shandaken with the assistance and support of AWSMP staff following the 2010 floods, is composed of local elected officials, Ashokan watershed stream stakeholders, and professional agency staff. Shandaken, on behalf of SAFARI, secured a SMIP grant to develop an enhanced flood hazard mitigation plan for the town. Tetra Tech, Inc. and RCAP Solutions are the consultants leading this effort. The expected outcome of this process is a plan that looks at multiple time scales for pursuing strategies to reduce the hazard of floods to communities, infrastructure, residents, and water quality.

The immediate need to help reduce flood hazards in Phoenicia led to additional SMIP funding to the Town of Shandaken to develop, with DEP, an engineered approach to sediment removal from Stony Clove Creek, where a hydraulic constriction contributes to flooding. This DEP and AWSMP grant funded project is described in detail in Section 4.6.4.

Schoharie Watershed Stream Management Program

Throughout 2011, the Greene County Soil and Water Conservation District (GCSWCD), the Schoharie County Soil and Water Conservation District, and the Schoharie Watershed Advisory Committee (SWAC) continued implementation of stream management plans within the Schoharie Reservoir watershed. Partnerships in 2011 were strengthened through the process of emergency response and recovery following Tropical Storm Irene.

In 2011, GCSWCD successfully continued the Schoharie watershed education and outreach (E&O) program that is designed around three key events developed by the watershed's E&O subcommittee: the fifth annual watershed summit (educational presentations), the second annual watershed month (action oriented), and the fifth annual Batavia Kill stream celebration (celebration of water resources). The watershed summit was attended by 105 stakeholders and focused on forest management planning, stormwater and green infrastructure, and interpretation of floodplain laws. May was Schoharie Watershed Month, which provided opportunities for over 400 Mountaintop residents and visitors to participate in a variety of public events focused on stream stewardship and watershed appreciation. Finally, the Batavia Kill Stream Celebration welcomed 750 people to a day of festivities honoring Catskill rivers.

The two SMIP grant funding rounds offered in 2011 were the fourth and fifth since the program began in 2009. Nine projects were funded this year, with a combined value of $938,963. The number of projects in each category is displayed in Table 4.12, and brief descriptions of the

funded projects can be found at www.CatskillStreams.org/grants. The remaining SMIP funds ($323,677) will be available to be used towards the local match for approved Federal Emergency Management Agency (FEMA) Hazard Mitigation and/or Emergency Watershed Protection program projects. Through the five grant rounds, a total of 34 proposals have been funded totaling $1,676,323. Fourteen grant projects have been completed and the remaining 20 are in process.

SMIP funded projects completed in 2011 include the Partridge Ridge Road culvert replacement and the East Kill at Vista Ridge Restoration Project (with additional funding from the GCSWCD restoration budget). At Partridge Ridge Road, GCSWCD worked with the Town of Ashland and FEMA to eliminate a hydraulic constriction in a tributary to the Batavia Kill. The new culvert provides geomorphic and hydraulic consistency with the bankfull channel geometry of both the up- and downstream reaches. Following construction, a combination of riparian seed mixtures and live trees and shrubs were installed to initiate the development of a functioning riparian community.

The second project, East Kill at Vista Ridge, is described in Section 4.6.4. It was completed as a FAD deliverable in addition to receiving partial funding from SMIP.

Rondout-Neversink Stream Management Program

By the end of 2011, stream management plans were completed by the Sullivan County Soil and Water Conservation District (SCSWCD) and DEP for Rondout Creek, Chestnut Creek, and the Neversink River, including the mainstems of the East and West Branches of the Neversink. The Rondout Creek plan was adopted in 2010. The Neversink plan (completed in February 2011) and the Chestnut plan (revised in August 2011) were scheduled for review and adoption during September; the significant changes wrought by Tropical Storm Irene at the end of August, however, necessitated a rapid re-inventory of stream conditions to verify recommendations prior to public review. This inventory was completed in December, and the Neversink stream management plan is currently under revision and scheduled for review and adoption in the summer of 2012. Strategic planning discussions began with the Rondout Neversink Watershed Advisory Group (WAG) towards developing a SMIP, and subcommittees were formed for both E&O and Infrastructure to define priorities and protocols for grants in these categories.

The strong E&O subcommittee led an ambitious program of activities in 2011, including landowner workshops on streamside plantings and riparian management, an artist-in-residence program focusing on stream history and an associated gallery opening, a trail walk with a local herbalist, a tour of a local native plant arboretum, and a streamside volunteer planting with the local boy scout chapter. The highlight of the year was the development of a collaborative program with Tri-Valley School District instructor Robert Hayes, creating a Plant Materials Center to propagate and grow out plant stock to be used in CSBI riparian planting projects in the Rondout

and Neversink watersheds, and involving the students in these plantings as part of their conservation class curriculum. For more details, see Section 4.7.2.

Although a SMIP has yet to be established in the Rondout and Neversink watersheds, the SCSWCD and DEP were able to provide material and technical assistance in the aftermath of the flood event and commitments were made to provide the local cost share for several approved FEMA and USDA Natural Resources Conservation Service (NRCS) projects.

4.6.2 Flood Response and Recovery

The magnitude of the flood event precipitated by Tropical Storm Irene was unprecedented in the WOH watershed; for many of the communities the event was between the 100- and 500-year flood event, and as such it was the flood of record, far surpassing the inundation levels and damages of past record floods. The nature of the damages ranged from inundation of whole communities (Prattsville) with the physical loss of homes and businesses, to the loss of nearly all bridge and culvert stream crossings in the Esopus headwaters (Route 47, Shandaken). In the West Kill (Lexington), several miles of NYS Route 42 were simply washed away. Significant engineering and technical assistance was needed in the wake of the storm, and owing to its 15-year partnership with the SWCDs and CCE Ulster, DEP was able to meet this need. Between August 29 and October 31, 2012, 35 full-time SMP and partner staff contributed over 12,000 hours of service to the watershed communities. As recovery is ongoing, much of the SMP and partner effort is still devoted to flood recovery and planning for future flood mitigation.

Emergency Flood Response

During flood response, the primary focus of DEP and stream partner actions, after helping to secure the safety of individuals, was to provide the assistance needed to prevent over excavation of sediment and wood clogged channels and to ensure that work was directed to the most seriously impacted reaches (an assessment based on proper stream and floodplain dimensions) and was permitted and supervised to the extent possible.

SWCD lead staff in Delaware, Ulster, and Greene Counties deployed to their respective emergency operation centers to coordinate and direct stream clearance activities. Priorities were addressing extensive debris jams at bridge and culvert crossings, and addressing total road washouts. This event was the first in which the Post-Flood Emergency Stream Intervention Protocol developed by DCSWCD after the 2006 flood was extended for use on a watershed-wide scale. This protocol applies regional hydraulic geometry data collected from stable stream reaches by DEP to the re-dimensioning of channels. The SWCDs were aided by DEP staff and engineers from DEP's engineering contractor, Milone & MacBroom, Inc. (MMI), which supervised channel work throughout the watershed for several weeks following the flood. In total, dimensions were provided to guide 52 projects and work was supervised at 103 stream reaches. Figure 4.16 depicts locations and level of assistance provided throughout the watershed.

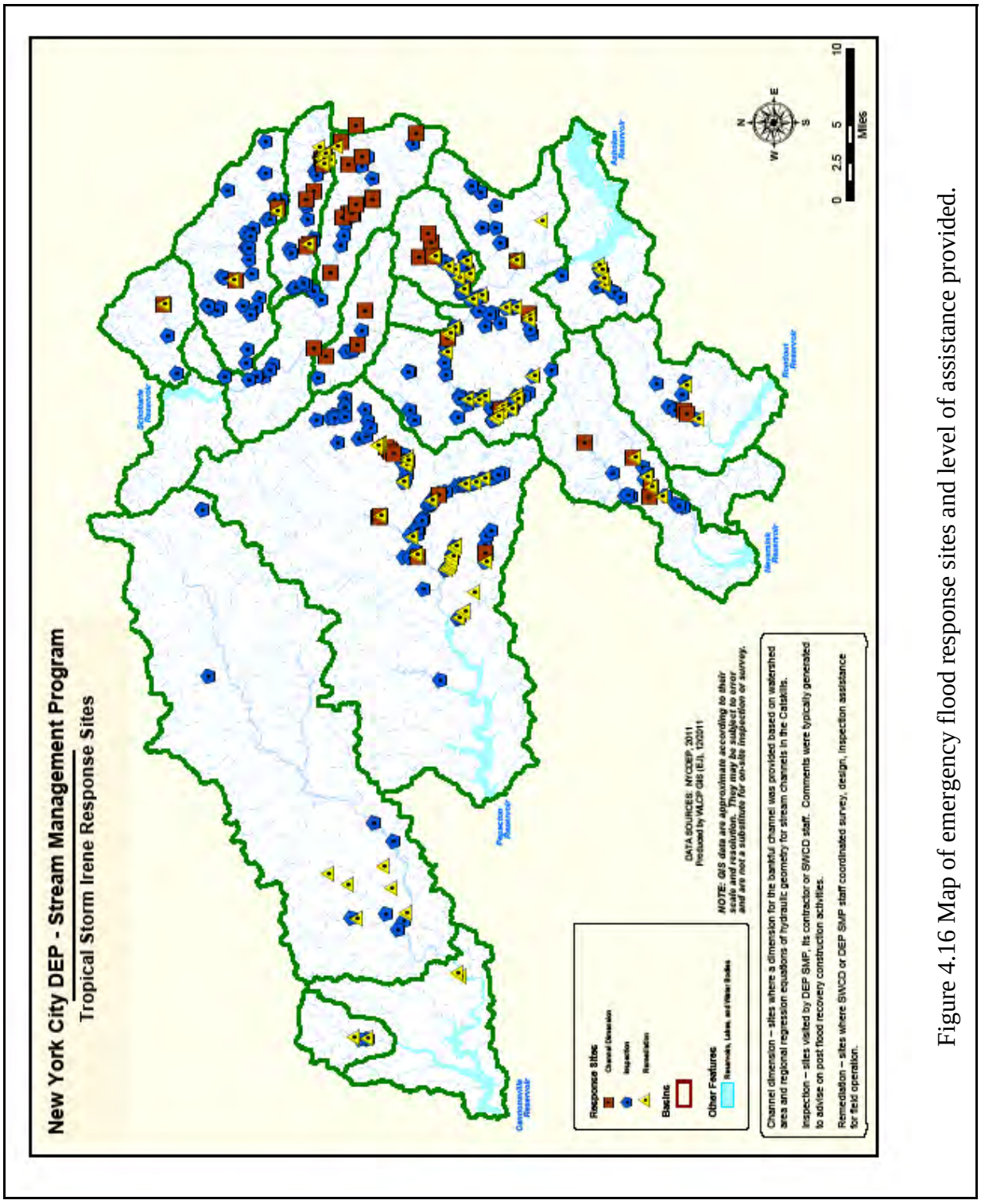


Figure 4.16 Map of emergency flood response sites and level of assistance provided.

The engineering support of MMI greatly extended flood response capacity: MMI also inspected 46 bridges immediately following the flood, evaluated the safety of flood control structures, and attended meetings to advise town, county, and state actions.

Soon after the flood, DEC approached the City and requested assistance in meeting the anticipated permitting demand for Article 15 stream disturbance permits under the Emergency Authorization issued by the Governor. Despite logistical and coordination challenges, DEP was able to visit more than 100 sites with DEC Region 3 and 4 permitting staff.

In the Ashokan, Rondout-Neversink, and Schoharie watersheds, outreach to private landowners has imposed a tremendous workload on the staff and will continue to do so. For example, in the Ashokan watershed, the AWSMP met with and advised over 100 landowners and attended three meetings of "Save our Shandaken," a group of landowners demanding that the Esopus and its tributaries be "cleaned" and advocating routine cleaning of stream channels to prevent flooding. In these three watersheds, more than 200 landowners received technical assistance from their SWCDs and from DEP and MMI.

Outreach to municipalities was also critically important. DEP and each SWCD participated in dozens of meetings (e.g., town boards, Mountaintop Mayors and Supervisors Association, Coalition of Watershed Towns) following the flood to address the public outcry for dredging and to guide recovery. To address this in an objective and scientifically-based manner, GCSWCD presented an analysis of the effects of dredging Schoharie Creek in Lexington. The results showed that a 3-foot dredge would not mitigate the 1% chance flood event, would slightly increase elevations in part of the study area, and would destabilize adjacent stream banks. This case study was presented at the November 2011 SWAC meeting and at the 2012 Schoharie Watershed Summit in January 2012, and is part of the upcoming contractor training in post-flood emergency stream intervention planned for Schoharie and Ashokan contractors in spring 2012.

The flood demonstrated the ability to construct approved and designed SMIP projects while heavy equipment resources were deployed for post-flood stream redimensioning in the East Branch Delaware River, Arkville Pavilion, and Arkville municipal well area.

In the headwaters of the East Kill (Jewett), where the Vista Ridge FAD restoration project was set to commence construction, the GCSWCD and the contractor were able to provide extensive emergency infrastructure repair assistance. The team re-established valley egress for dozens of residents and a summer camp for disabled children by opening the destroyed bridge at the end of Colgate Road. Additionally, the GCSWCD repaired two washed-out culverts and removed approximately 5,000 tons of woody debris that posed an imminent threat to infrastructure from the stream channel. Upon clearing and re-dimensioning these channels, the gravel was used to help repair numerous county and town roads and bridges.

Flood Recovery

As flood response has transitioned to flood recovery, the SMP and its partners are continuing to provide a broad range of technical assistance, professional engineering services, and funding, both to assist the recovery effort and to mitigate future flooding. State and federal

recovery funding programs were announced in December 2011, enabling the SMP and the SWCDs to begin the process of sorting priority projects among the various programs and their matching requirements. The principal programs that will be able to leverage City SMP funds (using DEP's primary contracts with SWCDs) are the NRCS Emergency Watershed Program (EWP) and the New York State Flood Hazard Mitigation Grant Program. By the close of the year, an interagency debris removal task force had completed its review of debris sites eligible for FEMA and NRCS funding in Greene County. At this writing, the task force has completed making determinations in the WOH watershed. In December, the CWC launched another debris removal effort, a $2.5 million debris removal program targeting hazardous material (fuel tanks), bulk materials (cement culverts, trucks, trailers, homes), and large woody debris that threatened the safety of property, persons, or water quality. The program is a partnership with DEP, requiring joint approval of DEP and the CWC for each debris removal project.

The Town of Prattsville requested DEP assistance to help understand the flood's probability of recurring, what measures might mitigate future flooding, and how to approach rebuilding with respect to flooding. DEP has provided the services of MMI for this project, and MMI is using the 2008 Schoharie watershed flood study to make informed recommendations.

4.6.3 Floodplain Mapping and Streams Geodatabase

On May 25, 2011, FEMA issued the order to commence work under its contract with Risk Assessment, Mapping and Planning Partners (RAMPP) for the mapping of floodplains in the WOH watershed. FEMA will remap floodplains along nearly 486 miles of stream, with over 200 miles mapped as detailed studies. Following the order, FEMA issued a grant to DEC to enable its Floodplain Management Section to coordinate E&O efforts associated with the mapping project. In June, the project team of FEMA, DEC, and DEP held its first Map Steering Committee meeting with local communities to launch the mapping effort in the Catskill System watersheds. A second Map Steering Committee for the Delaware System watersheds was established in October and both committees meet quarterly to receive progress updates, provide information to the project team, and receive training in aspects of floodplain management, mapping processes, and the National Flood Insurance Program.

Establishment of survey control commenced in May, and field surveys of stream cross-sections and structures followed in July after notification to local landowners and municipal officials. Despite delays due to high water conditions and access issues associated with the flood, RAMPP's survey contractor completed all initial field surveys in the Esopus, Neversink, Rondout, and Schoharie watersheds by the end of 2011. In September, survey teams were directed by FEMA Region II to document high water marks related to Tropical Storm Irene at several locations across the WOH watershed for use in calibrating flood models and as a future reference for communities. In addition to any marks surveyed by the United States Geological Survey, 62 high water marks were surveyed and documented by RAMPP for FEMA Region II.

Despite the delays caused by the flood, the contractors are on schedule to complete preliminary mapping in mid-2013. There is typically an 18-month period following preliminary map release that is needed for community review, protests and appeals, and final adoption.

The DEP Streams Geodatabase team created a new streams map viewer as a tool to facilitate rapid perusal of stream feature data, imagery, and photographs. This beta version was developed for possible later distribution of the information on a more open GIS platform like Google Earth or a website. The SMP also georeferenced historical aerial photos from Esopus Creek for use by the AWSMP, mapped vegetation in the Chestnut Creek watershed, and assisted stream feature inventory efforts on Warner Creek in the Esopus watershed.

4.6.4 Stream Projects

In 2011, the SMP fulfilled the FAD requirement to "complete a set of 5 stream restoration projects on a basin priority basis" by May 2012. These projects that DEP has completed in fulfillment of this requirement since 2007 are (1) the Long Road Project on the West Kill in Lexington, (2) the Post-Flood Stream Emergency Intervention Program of protocol development combined with training and demonstration at three sites in the Delaware Basin, (3) the County Route 22 Streambank Restoration Project in Walton, (4) the Walton Floodplain Restoration Project, and (5) the Vista Ridge Stream Restoration Project in Jewett. The projects discussed in this section are those that are especially worthy of note and were completed in 2011.

Stream projects are funded by different sources, including funds from SMP partner contracts (SMIP and Restoration categories), FEMA flood hazard mitigation funds, DEC, and Army Corps of Engineers Water Resources Development Act funds. The projects active or completed in 2011 are listed in Table 4.13, and mapped in Figure 4.17. For additional photographs and details of many stream projects, visit www.CatskillStreams.org/projects.

Table 4.13. DEP Stream Management Program projects completed or substantially advanced in 2011.

Basin	Project ID*	Type of project	Name of project
Schoharie Watershed			
	S-32	Full channel restoration; FAD	East Kill, Vista Ridge
	S-34	Stormwater and infrastructure	Batavia Kill, Partridge road culvert
	S-44	Debris removal	Batavia Kill, Hensonville debris removal project
		Full channel restoration; FAD	Batavia Kill, HoldenpProject
Delaware Watershed			
	D-32	Stormwater and infrastructure	Mallory Brook culvert replacement
	D-35	Stormwater and infrastructure	Pines Brook culvert outfall

Table 4.13. (Continued) DEP Stream Management Program projects completed or substantially advanced in 2011.

Basin	Project ID*	Type of project	Name of project
	D-36	Stormwater and infrastructure	Lake Odell Road ditch stabilization
	D-45	Floodplain restoration; FAD	Village of Walton floodplain restoration
Ashokan Watershed			
	A-9	Stormwater and infrastructure	Traver Hollow culvert replacement
	A-10	Full channel restoration	Stony Clove, Phoenicia
		Full channel restoration	Stony Clove, Chichester, Site 1
		Streambank stabilization	Stony Clove, Chichester, Site 4
Rondout Watershed			
	R-04	Streambank stabilization; FAD	Sundown Creek, Ulster County Highway Garage

* Projects without an ID have not been completed and are therefore not displayed in Figure 4.17.

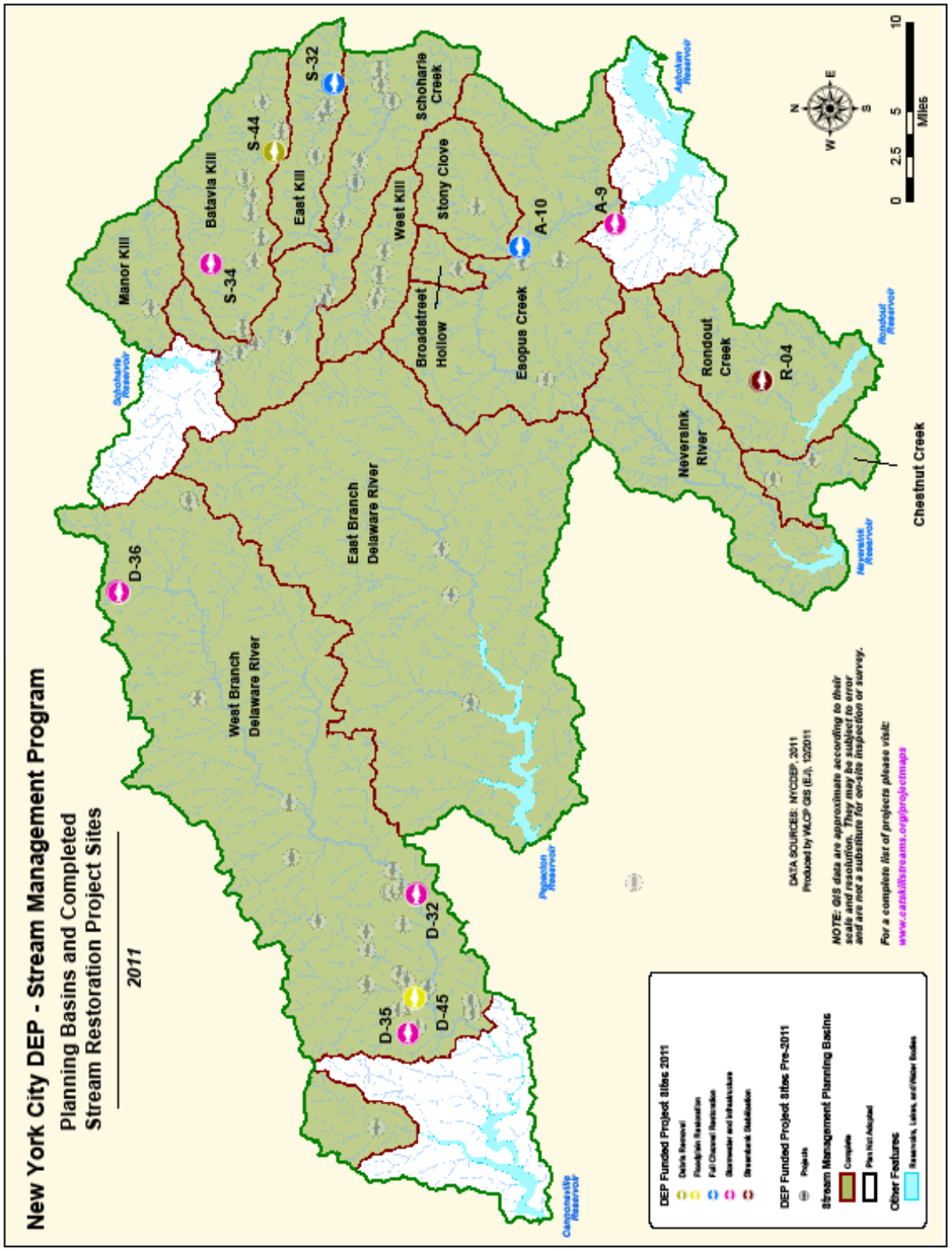


Figure 4.17 Planning basins and completed stream restoration project sites, 2011.

Delaware Watershed Stream Management Program

The DCSWCD completed construction of the Floodplain Restoration Project on West Brook in the Village of Walton (Figure 4.18). The project, funded entirely by the DCSWCD and DEP, involved the removal of fill from a 3-acre site in the Village upstream of the NYS Route 10 bridge, to provide additional flood storage and a reduction in flooding during storms smaller than the 0.25% recurrence (25-year) interval. The project was also made possible by the contributions of the Open Space Institute, which purchased the land from a private landowner who was seeking to develop the floodplain location for senior resident housing. The fill was removed from the site, regraded, and the riparian buffer was enhanced with plantings of native trees and shrubs. This project, supported by the Walton Flood Commission, serves as a pilot project for other potential floodplain restoration projects in the community.

Figure 4.18 Fill removal at Village of Walton floodplain restoration.

Ashokan Watershed Stream Management Program

The AWSMP's most significant project effort in 2011 was the engineered sediment removal project in the Village of Phoenicia, an experimental approach to reducing flood hazards. The two floods on Stony Clove Creek in 2010 provided the impetus for the project. Flooding on the creek is in part due to a loss of flood conveyance capacity in the channel arising from aggradation in the confined channel as it enters Esopus Creek. DEP provided the services of MMI to design an optimized engineered approach and the AWSMP provided SMIP funding to the Town of Shandaken for implementation. The project was initially planned for winter 2011, but did not receive a permit at that time. Reconceived to more comprehensively address the issues contributing to flooding (reshaping a stream bank encroaching on the bridge and including a boulder weir upstream of the bridge), the design was permitted in spring 2011 (Figures 4.19 and 4.20).

Figure 4.19 View of Stony Clove Creek at Phoenicia and Main Street bridge on September 3, 2011 following Tropical Storm Irene.

Figure 4.20 View of Stony Clove Creek at Phoenicia and Main Street bridge following post-flood response channel restoration work. Note cross vane extending upstream of bridge.

Design and permits in hand, DEP, MMI, and the Town of Shandaken began the sediment removal as soon as the flood waters receded. This first phase of the project was completed in two weeks and the second phase (weir installation and bank re-shaping and re-armoring) was completed in early November. The project includes pre- and post-construction surveying to monitor how the channel morphology changes following flood flows, so that the duration of benefit can be measured and a benefit cost analysis can be performed.

Schoharie Watershed Stream Management Program

The East Kill Restoration at Vista Ridge included restoration of 1,500 feet of the East Kill along County Route 78 (Figures 4.21 and 4.22). This FAD restoration project was undertaken in order to improve floodwater and sediment conveyance through this historically unstable stream reach. The project will reduce water quality impacts and reduce maintenance and flood mitigation costs for landowners, the Town of Jewett, and Greene County, as well as provide benefits to aquatic and terrestrial ecosystems. The project is a collaboration of the GCSWCD, SWAC, ACOE, and DEP.

Figure 4.21 East Kill at Vista Ridge prior to restoration. The East Kill had shifted to flow primarily through a side channel that ran alongside Colgate Lake and Vista Ridge Roads, leaving the primary channel, historically aligned with the bridge, nearly dry.

Figure 4.22 East Kill at Vista Ridge following restoration, with the stream back in its historical channel aligned with the bridge, the remainder of the site restored as wetland and floodplain, and the profile of Vista Ridge Road lowered to allow for flood flows.

The major stream restoration project underway in 2011, which fulfills requirements of both the FAD and the Shandaken Tunnel SPDES permit, was the Holden Project in Ashland, NY. This project was bid and awarded to Evergreen Mountain Inc. for $855,986. Construction commenced once the Batavia Kill reached an appropriate flow in August. Despite unusually high flows even before Tropical Storm Irene, the contractor nearly completed the upper half of the project. Although damage to the completed portion from the devastating flooding caused by Irene was minimal, flow levels and other emergency response priorities would not allow for work to continue in 2011. Moreover, the reach on which work was to be performed in Phase II of the project changed dramatically as a result of the storm, requiring a new topographic survey. This survey was performed in October; construction will resume within the permitted stream work window in 2012.

In 2011, the Schoharie Watershed SMP team planted riparian buffer or restored stream system stability to over 1.1 miles of Schoharie watershed streams, bringing the total length of streams treated to date to 6.9 miles.

Rondout Neversink Stream Management Program

In 2011, the Rondout Neversink SMP team completed its FAD restoration project at the failing streambank adjacent to the Ulster County Department of Public Works Highway Garage at Sundown in Ulster County (Figures 4.23 and 4.24). Poor yard management practices here over time had resulted in the complete loss of vegetation on the streambank. Additionally, road salts and petroleum products associated with equipment maintenance at the garage were able to freely run into the East Branch of Rondout Creek. The project, completed despite the arrival of Tropical Storm Irene during construction, demonstrated the technique of "live cribbing," in which willow plant material is alternated with log timbers to provide a crib wall that grows into a wall of willow, providing riparian buffering, in-stream habitat enhancement, and flow velocity mitigation on the face of the bank. A planting of trees and shrubs at the top of the crib wall, combined with a physical barrier to equipment activity and a stormwater swale running the length of the project, provide further buffering from yard activities. The project was completed in November 2011; the final project report can be found at http://www.CatskillStreams.org/majorstreams_rc.html.

Figure 4.23 Failing stream bank at Ulster County Highway Garage prior to restoration.

Figure 4.24 Completed Ulster County Highway Garage project.

The FAD also mandates a restoration demonstration project on the Neversink River. The site chosen was on the West Branch of the Neversink River at Frost Valley Road, but the project was postponed until 2012 following changes wrought by Tropical Storm Irene, which necessitated a re-survey and design revisions.

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. This section will provide an update on each of the milestones set forth in the 2007 FAD relating to riparian buffer protection, including the progress of existing DEP programs, the Catskill Streams Buffer Initiative, and E&O activities.

4.7.1 Activities on City-owned or Controlled Land

Land Acquisition Program

The LAP, which is described in detail in the 1997 MOA, 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, and that the watershed continues in the long term to be a source of high-quality drinking water to the City and other upstate consumers. Section 4.2 of this report conveys the comprehensive progress of the LAP in 2011.

Riparian buffers are defined as land within 100 feet of stream banks, but excluding the length of "shoreline" around reservoirs, ponds, lakes, or wetlands. The best way to protect buffers is to secure fee simple ownership, with a secondary entity holding enforcement rights or reversionary interests. The next best mechanism is to secure conservation easements (CEs) on privately-held land. Through the end of 2011, 37.9% of the entire 1,049,483-acre Catskill/ Delaware System was protected by outright ownership or easement held by DEP, WAC, or DEC, or by other public or private open space entities, such as municipal parks or land trusts. This area includes roughly 33.5% (25,582.8 acres) of all stream buffers in the watershed. Since 2004, DEP has increased the percentage of protected stream buffers from 7.5% to 14.9%. Table 4.14 presents a breakdown of the total land area in the Catskill/Delaware System by ownership.

DEP funds WAC's acquisition of CEs on farms. Such easements allow farming to continue under Whole Farm Plans, while prohibiting agricultural use within 25 feet of streams.

Table 4.14. Catskill/Delaware System[1] riparian buffer[2] summary as of 12/31/2011.

Land protection category	Total in Catskill/ Delaware System including reservoirs (acres)	% Total Catskill/ Delaware System Area	% Total Catskill/Delaware System Stream Miles	% Total Catskill/Delaware System riparian buffers
Publicly-owned or Controlled lands				
NYC-owned non-LAP property (pre-1997 or facility-related)	61,479.6	5.9%	2.8%	2.6%
NYC-owned LAP property (post-1997, fee simple)[3]	74,389.5	7.1%	7.3%	7.4%
Land protected by LAP NYC CE[3]	23,202.2	2.2%	2.5%	2.4%
Land protected by LAP WAC CE[3]	22,212.1	2.1%	2.6%	2.5%
Total NYC lands and easements	181,283.4	17.3%	15.2%	14.9%
New York State-owned land	208,057.4	19.8%	17.1%	17.6%
Other in protected status[4]	8,829.7	0.8%	1.1%	1.1%
Total Catskill/Delaware public land	398,170.5	37.9%	33.5%	33.5%
Private Watershed Lands	651,312.9	62.1%	66.5%	66.5%
Total lands in Catskill/Delaware System	1,049,483.4	100.0%	100.0%	100.0%

[1]The Catskill/Delaware System includes all WOH basins plus West Branch, Boyd Corners, and Kensico.

[2]100-foot area on both sides of watercourses, which includes streams and rivers and excludes reservoirs, ponds, and lakes.

[3]Under contract or closed.

[4]"Protected status" means the land is believed to be under some form of permanent ownership by a land trust or municipal government.

Natural Resource Management Program

DEP's Natural Resource Management Program protects the riparian buffers on City-owned lands in a variety of ways. These include regular inspections of lands (based on a priority ranking) and a thorough evaluation of all applications for permitted activities, including applications for agricultural, silvicultural, or stream work. In evaluating these proposed activities, emphasis is placed on the protection of riparian buffers. For example, DEP allows agricultural use of DEP land, but requires a minimum of a 25-foot buffer between farming activities and the stream. Proposals that plan on maintaining a buffer greater than 25 feet are given extra points in their rating. DEP also reviews all land use permits and proposed projects for potential impacts to riparian buffers, including stream crossings for silvicultural projects (for which DEP secures stream crossing permits as required by DEC). Extra measures are taken by foresters to select BMPs for stream crossings (e.g., temporary bridges, temporary arch culverts) that create the least amount of adverse impact to the stream and floodplain.

4.7.2 Activities on Privately-owned Lands

Privately-owned lands contain approximately 66.5% of the total riparian buffer acreage (50,717.3) in the Catskill/Delaware System. Privately-held riparian lands are most commonly found in the Cannonsville watershed (82.4%) and are least common in the West Branch Delaware watershed (41.7%). 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 developed and implemented largely in the Cannonsville and Pepacton watersheds, where private ownership is greatest. This section describes the ongoing activities of DEP programs that protect and enhance riparian buffers on privately-owned land.

Catskill Streams Buffer Initiative

The Catskill Streams Buffer Initiative (CSBI) is an important component of the City's efforts to protect and enhance riparian buffers and is an integral component of the Stream Management Program (see Section 4.6 for the comprehensive effort of the SMP in 2011). The SMP and its regional partners address riparian buffers through the mapping of riparian vegetation, corridor planning, designing and constructing stream restoration projects, removing invasive plants, and conducting extensive education and outreach. The CSBI works to enhance the extent of riparian buffers where gaps are evident in the landscape and is designed to provide a program for sites not eligible for other programs.

<u>Native Plant Materials</u>

Plantings are an essential ingredient of natural stream bank stability and an important component of DEP's overall stream management mission to restore ecosystem integrity. Providing Catskill native plant material is thus one of the critical aspects of CSBI. In order to do this, plant selection, propagation, and grow-out have and will continue to be carefully considered. As a result of these efforts, local genotype planting stock have become available not only to CSBI, but also other stream restoration projects initiated by DEP and its partners. CSBI

coordinators have established plant material holding areas to allow access to stock on an as needed basis. Once they reach these holding areas, the plants are carefully maintained to ensure the appropriate vigor, root strength, and overall health necessary to succeed in streamside restoration activities.

Plant Supply

After conducting a comprehensive solicitation of the plant-related services of over 200 nurseries throughout the Northeast, DEP identified New York City Parks and Recreation's Greenbelt Native Plant Nursery as the best entity to work with to collect, clean, and store Catskill native plant seed, and to propagate this seed for the CSBI.

In 2011, DEP received 22,000 herbaceous plugs and 5,000 gallon-sized trees and shrubs from Greenbelt. To date, Greenbelt has provided DEP with 72,000 herbaceous plugs, 15,000 gallon-sized trees and shrubs, and 17,500 tree and shrub tubelings. Under the current agreement with Greenbelt, the nursery will provide an additional 30,000 gallon-sized trees and shrubs through 2012 and 2013. All of this material originates from the Catskill Mountains, providing locally-native stock that is adapted to regional conditions, giving it a competitive edge for survival and providing a range of ecological values beyond stream bank stability. To keep up with the volume of plant material needed in 2011, DEP also received an additional 13,500 gallon-sized trees and shrubs from RPM Ecosystems, Inc. These plant materials represent the balance of what RPM Ecosystems was previously contracted to produce for use in stream management restoration activities.

Implementation

The five CSBI coordinators at partnering SWCDs, along with one DEP coordinator, play a central role in program implementation. A landowner reaches out to his or her local coordinator, a plan is developed for the property, and if the landowner concurs, he or she is invited to apply for funds and/or technical assistance to implement the project. Applications have been invited once each year since the program began.

Riparian Corridor Management Plans

Riparian Corridor Management Plans (RCMPs) provide landowners with a detailed analysis of their property in relation to the broader watershed and their streamside neighbors. The plans reference stream management plans where they have been completed and document landowner priorities and goals. After analyzing historical information and documents and landowner concerns, CSBI coordinators propose a suite of recommendations that range from BMPs landowners can implement themselves to more substantial practices that require SWCD assistance. In 2011, CSBI coordinators completed 29 RCMPs, bringing the number completed since 2009 to 73. These plans are valuable tools for educating landowners about the importance of riparian buffers and for documenting landowner concerns and property management goals. The

process of developing the plans and reviewing them with landowners helps bring landowner and CSBI goals closer together, prompting applications more likely to receive CSBI project approval.

Projects

The January 2011 deadline to apply for CSBI project grants yielded 25 applications from interested landowners. Pre-application site visits by CSBI coordinators had helped reduce the number of applications that would have been unqualified (primarily because of bank erosion on the site or because the applications proposed restoration practices that went beyond the scope of CSBI). As a result of this pre-application screening, only one CSBI application was rejected. Three additional projects which were held over from the 2010 grant round were also planned for 2011, bringing the expected number of projects for 2011 to 27. Ultimately, that number grew as a result of Tropical Storms Irene and Lee.

The damaging effects of Irene and Lee had a major impact on the CSBI program. Of the 24 projects that were approved before the floods occurred, only 19 were installed as originally planned; the other 5 were postponed due to flood-related sensitivities. In addition, the three 2010 grant round projects were cancelled because the properties were damaged beyond the point at which vegetative restoration alone would have been an effective practice. However, 18 additional projects were installed after CSBI, responding to restoration needs arising from the floods, modified its application process, switching from a once-per-year acceptance schedule to the acceptance of applications on a rolling basis through fall 2011, the goal being to restore as many streamside properties as possible.

Thus, for 2011, CSBI successfully installed 37 riparian buffer restoration projects, depicted in Figure 4.25. These 37 projects enhanced riparian vegetation on over 23 acres of streamside property and over 3.5 miles of stream bank length. This was accomplished by installing 14,611 trees and shrubs, 9,925 herbaceous plugs, and over 2,000 linear feet of bioengineering treatments consisting of native willow materials harvested from within the watershed. Riparian planting activities also took place on an additional four non-CSBI projects in 2011, as a result of which riparian vegetation was enhanced by 2,500 trees and shrubs, and over 600 linear feet of bioengineering treatments were installed. One particularly noteworthy bioengineering project was the Ulster County Highway Garage stream bank stabilization project, reported in Section 4.6.4. These additional projects represent the riparian portion of natural channel design restoration or flood mitigation projects.

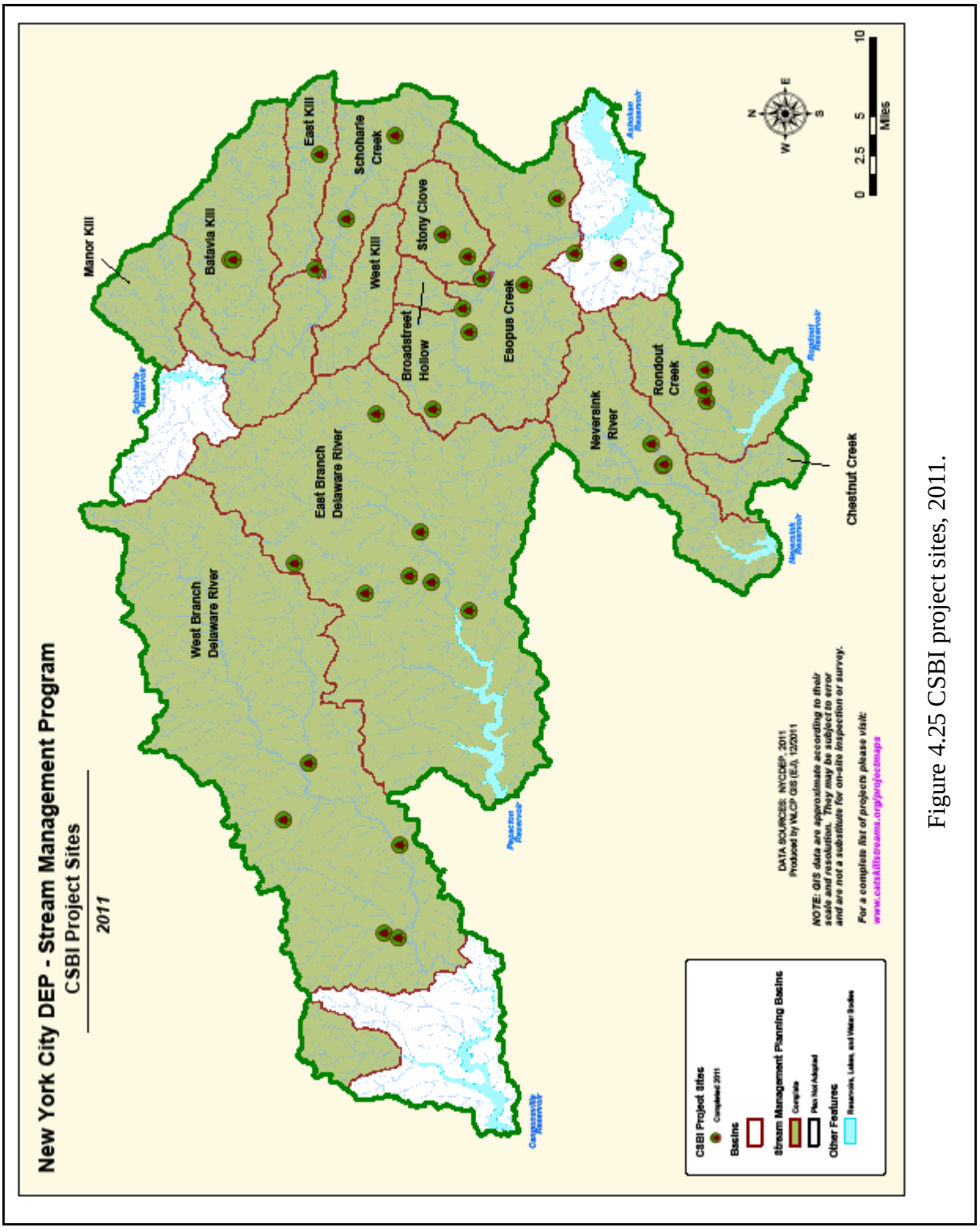


Figure 4.25 CSBI project sites, 2011.

Through partnerships with Ulster County Community College and the State University of New York Research Foundation on behalf of SUNY Delhi, three crews of summer interns

provided much of the labor needed to install the various plantings across the WOH watershed. In addition to the aforementioned projects, these intern crews helped remove stands of Japanese knotweed, an invasive plant that threatens the viability of riparian plantings. The crews also assisted CSBI coordinators with loading and unloading of material, site preparation, transplanting, plant material center maintenance, and vegetation monitoring. DEP and its partners plan to continue to work with these young adults to provide them with firsthand stream restoration experience.

Evaluation

A new protocol for monitoring the success of CSBI projects was developed and piloted at 17 sites in 2011. The protocol's goal is to collect data to determine the survival and growth rates of individual plant species, the effectiveness of installation techniques, and the factors that have the greatest influence over project success. CSBI projects will be monitored at regular intervals for a period of years before any conclusions are drawn regarding project success.

Riparian Buffer Education and Outreach

CSBI engaged the public in a variety of forums in 2011 to support the program's goals as well as the overarching agency mission to ensure the integrity of watershed streams. Approximately 34 targeted activities reached well over 500 individuals, ranging from volunteer plantings, tree identification, and local fair demonstrations to riparian workshops for students, families, and streamside landowners. Countless numbers of watershed residents and visitors were also reached through non-targeted efforts like newsletter and newspaper articles, various native plant and invasive species brochures, and www.CatskillStreams.org.

One unique E&O highlight in 2011 was a partnership formed between the Rondout Neversink Stream Program and the Tri-Valley Central District. This partnership, led by school teacher Robert Hayes, incorporated hands-on stream restoration activities that not only teach practical occupational skills, but also meet New York State Department of Education curriculum goals. The activities that these middle and high school students engaged in include: the building and maintenance of a Plant Materials Center to hold potted plants intended for use in restoration projects; the creation of a large willow-soaking pit where 9,000 live cuttings were prepped for use in the Rondout stream restoration demonstration project at the Ulster County Highway Garage in Sundown; and assistance with planting, seeding, and mulching at several CSBI projects. Because of his extensive work in developing and implementing this successful curriculum, Robert Hayes was been nominated for the 2012 USEPA Environmental Quality Award.

Watershed Agricultural Program and Watershed Forestry Program

Section 4.4 and Section 4.5 provide information about the riparian buffer protection efforts of the Watershed Agricultural Program and the Watershed Forestry Program, respectively, including an update on the Conservation Reserve Enhancement Program (CREP), which is described in Section 4.4.4.

4.8 Wetlands Protection Program

DEP's Wetlands Protection Strategy, initiated in 1996 and most recently updated in 2007, is designed to preserve the water quality functions of wetlands in the watershed. The strategy includes wetlands mapping and monitoring to inform protection through regulatory and partnership programs. In 2011, DEP continued to review federal, state, and municipal wetland permit applications in the watershed. DEP also continued to protect wetlands through land acquisition and to collect data from automated monitoring wells throughout the Catskill and Delaware System to add to its long-term reference wetland database. DEP also provided comments to proposed changes in federal programs regulating wetlands.

4.8.1 Permit Review

DEP continued to review and comment on federal, state, and municipal wetland permit applications in the watershed. Federal permit applications include those filed under Section 404 of the Clean Water Act (CWA) (P.L. 92-500, as amended by P.L. 95-217), which regulates discharges of dredged or fill material to waters of the United States. State review is under the New York State Freshwater Wetlands Act (N.Y.S. Environmental Conservation Law, Article 24), which regulates state-mapped wetlands as well as adjacent areas to a distance of 100 feet from such wetlands. Coverage by municipal regulations varies, but often also extends to adjacent areas. Applicants in Connecticut are required to notify DEP of any wetland permit applications within the City's watershed.

Through its review of all types of permit applications, DEP seeks to identify and recommend measures to avoid wetland impacts. In cases where impacts are unavoidable, DEP comments recommend that impacts be minimized and mitigated to the extent practicable. Elements of projects are often changed in response to DEP comments, resulting in less wetland and/or adjacent area impact than originally proposed.

In 2011, DEP reviewed 24 wetland permit applications including 1 U.S. Army Corps of Engineers (USACOE) Section 404 permit application, 16 DEC Freshwater Wetland Permit Applications, and 7 municipal applications (Figures 4.26 and 4.27, Table 4.15).

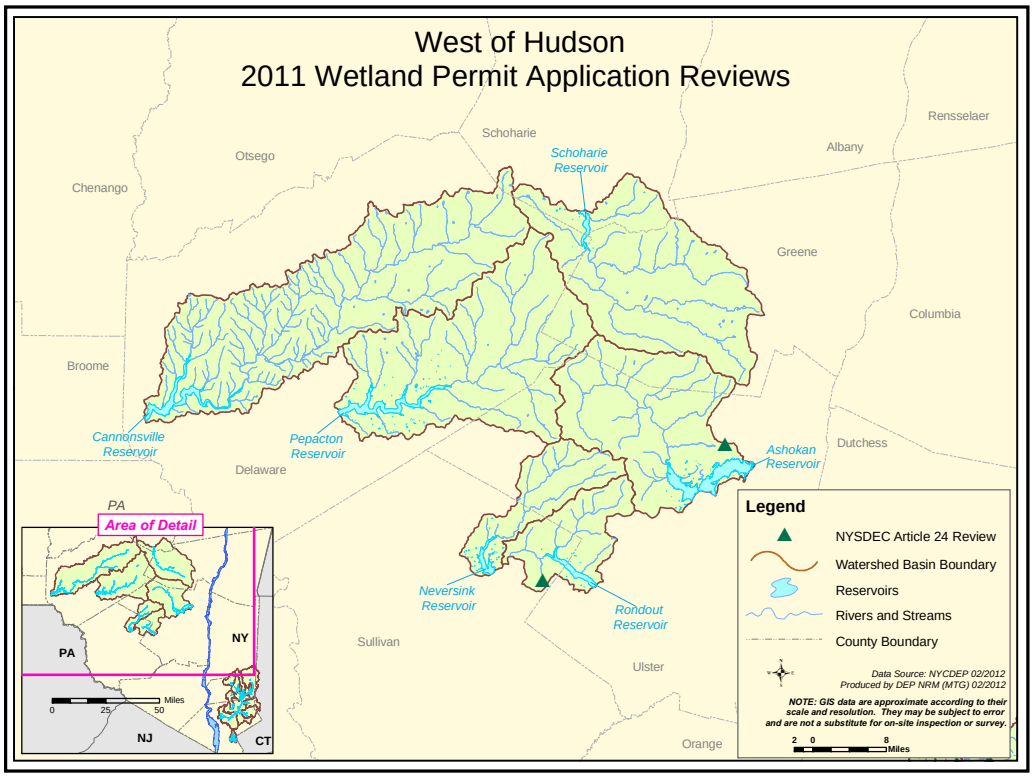


Figure 4.26 2011 West of Hudson wetland permit application reviews.

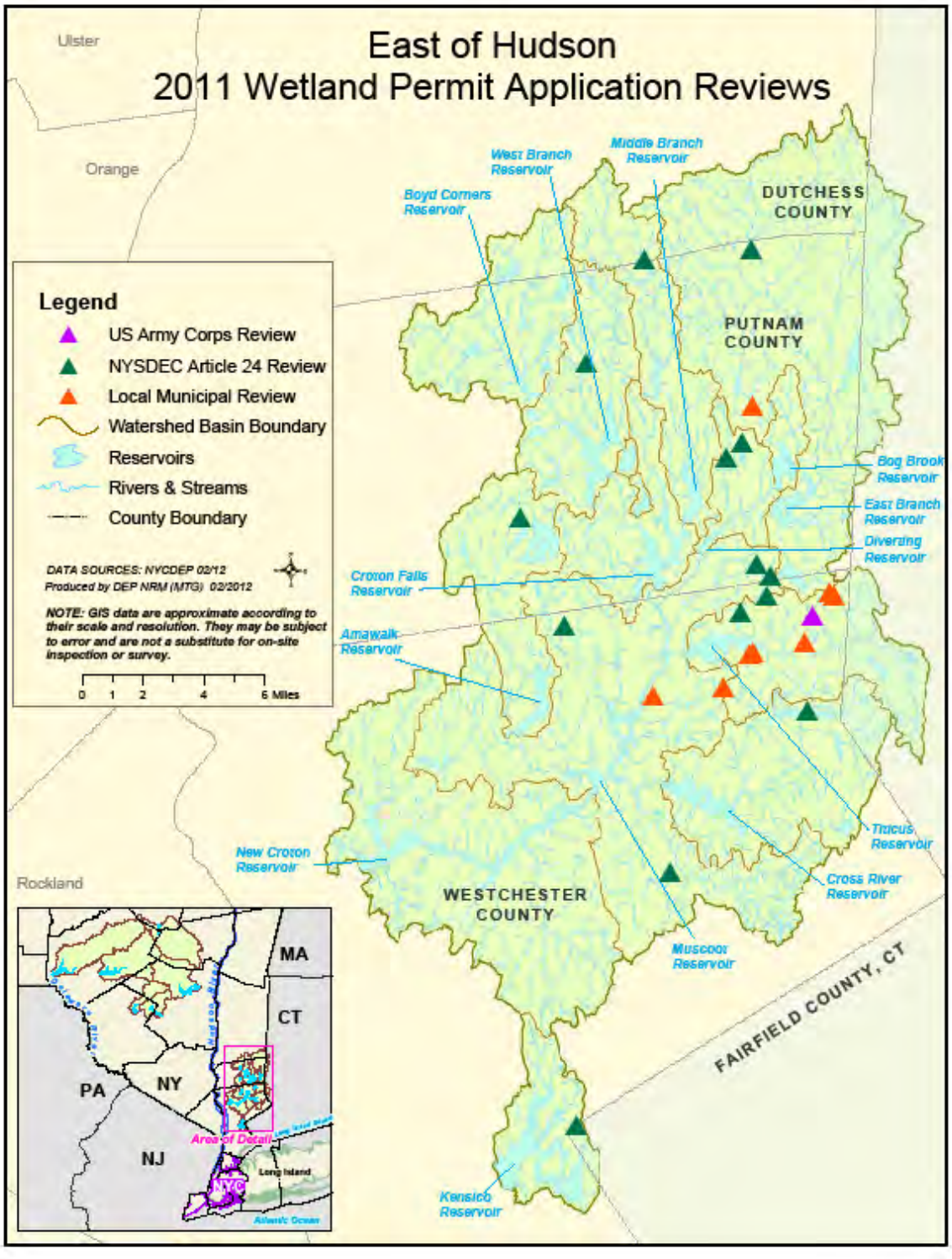


Figure 4.27 2011 East of Hudson wetland permit application reviews.

Table 4.15. Wetland permit reviews completed in 2011.

Project name	Permit type	Reservoir basin	Regulated activity
Kirk Lake Watershed Association, Inc.	DEC	Amawalk	ANS* management
Wittenberg Sportsmen's Club, Inc.	DEC	Ashokan	ANS management
Petruccelli Property	DEC	Cross River	Adjacent area disturbance
Lake Tonetta Stormwater Quality Basin	DEC	Diverting	Wetland disturbance
RCA Asphalt, LLC	DEC	East Branch	Adjacent area disturbance
Joseph Reilly aka Spruce Ridge Craftsmen	Local	East Branch	Adjacent area and wetland disturbance
IBM Corporate Headquarters	DEC	Kensico	Adjacent area disturbance
Lake Dutchess	DEC	Middle Branch	ANS management
Lake Lincolndale	DEC	Muscoot	ANS management
Feola Property	DEC	Muscoot	Adjacent area disturbance
North Salem Middle High School	DEC	Muscoot	Adjacent area disturbance
Zinman Dredge	DEC	Muscoot	Pond dredging,aAdjacent area disturbance
Ryder Farm	DEC	Muscoot	Wetland stream crossing
Kevin J. Howard	Local	Muscoot	Adjacent area disturbance
Beaverdam Pond	DEC	Rondout	ANS management
Monomoy Farms, LLC	ACOE	Titicus	Wetland disturbance
Little Creek Farm	DEC	Titicus	Adjacent area disturbance
Lake Hawthorne Home Owners Association	DEC	Titicus	Pond dredging, adjacent area disturbance
Giannini	Local	Titicus	Adjacent area disturbance
Gilbert Samberg	Local	Titicus	Adjacent area disturbance
Fink Property 55 Finch Road	Local	Titicus	Pond dredging
Harris and Roach Property	Local	Titicus	Adjacent area disturbance
Greenberg Residence	Local	Titicus	Pond dredging, adjacent area disturbance
Gipsy Trail Club or Pine Pond	DEC	West Branch	ANS management

*ANS refers to aquatic nuisance species management and includes herbicide, algicide, or triploid carp introduction.

In 2011, DEP sought to maintain and improve federal wetland protection levels in the watershed by commenting on proposed changes to the Nationwide Wetland Permits Program and the "Draft Guidance on Identifying Waters Protected by the Clean Water Act," issued by the EPA and USACOE. The proposed changes support clarification and restoration of CWA jurisdiction to waters and wetlands whose jurisdictional status was left uncertain after recent Supreme Court decisions. In commenting on the changes, DEP used findings from its wetland mapping and monitoring program to estimate the degree to which the current guidance fails to extend federal protection to watershed wetlands.

4.8.2 Land Acquisition

DEP calculates that there are 15,200 acres of wetlands within the Catskill/Delawarel System, as mapped by DEC or the National Wetlands Inventory (NWI). Since 1997, DEP has protected 2,512 acres, or 16.5%, of these wetlands through its Land Acquisition Program (Table 4.16).

Table 4.16. Wetlands acquired or protected by DEP's Land Acquisition Program in the Catskill/ Delaware and Croton Systems as of December 31, 2011*.

Description	Acres	% of Total Water-shed Acreage	% of Total Land Acquired	% of Total Wetland Type in System
Catskill/Delaware (Ashokan, Schoharie, Rondout, Neversink, Pepacton, Cannonsville, West Branch, Boyd Corners, Kensico watersheds)				
Entire Watershed	1,049,483			
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats**)	15,200	1.45		
Inundated Aquatic Habitats	28,339	2.70		
Total Wetlands and Inundated Aquatic Habitats	43,539	4.15		
*Lands Under Contract or Closed by DEP as of 12/31/11†**	120,048	11.44		
Wetlands (both NWI and DEC-regulated, excluding Inundated Aquatic Habitats**)	2,512		2.09	16.53
Inundated Aquatic Habitats**	169		0.14	0.60
Total Wetlands and Inundated Aquatic Habitats**	2,681		2.23	6.16
Croton				
Entire Watershed	212,577			
Wetlands (both NWI and DEC-regulated) (excluding Inundated Aquatic Habitats**)	20,038	9.43		

Table 4.16. (Continued) Wetlands acquired or protected by DEP's Land Acquisition Program in the Catskill/Delaware and Croton Systems as of December 31, 2011*.

Description	Acres	% of Total Water-shed Acreage	% of Total Land Acquired	% of Total Wetland Type in System
Inundated Aquatic Habitats	10,809	5.08		
Total Wetlands and Inundated Aquatic Habitats	30,847	14.51		
*Total lands under contract or closed by DEP as of 12/31/11†**	2,000	0.94		
Wetlands*** (both NWI and DEC-regulated, excluding Inundated Aquatic Habitats**)	98		4.88	0.49
Inundated Aquatic Habitats**	2		0.08	0.02
Total Wetlands and Inundated Aquatic Habitats**	100		4.96	0.32

* Acres are calculated directly from areas of GIS polygons and therefore may not match exactly other acreage totals submitted by DEP.

** Categories considered "Inundated Aquatic Habitats" include reservoirs or large lakes (L1), unconsolidated bottom (L2UB), riverbeds (RUB and RRB), or streambeds (RSB), but exclude uplands (U) and unconsolidated shore (L2US). Categories considered "Wetlands" exclude the Inundated Aquatic Habitats classes as well as all upland (U) and unconsolidated shore (L2US).

† Includes fee, conservation easements, and farm easements. Excludes non-LAP and pre-MOA land.

*** Twenty-nine acres of wetlands in the Croton System, that were formerly on LAP parcels under contract are now NYS-owned as per Paragraph 76 of the 1997 Watershed MOA, thus reducing this total by 29 from the December 2011 statistics.

4.8.3 Mapping and Monitoring

In 2011, DEP continued to rely on the NWI in its review of federal, state, and municipal wetland permit applications, as well as applications received under the New York City Watershed Rules and Regulations (WR&R) (1997) and the SEQRA, and in its design and review of capital construction and land management programs. The NWI maps are periodically updated to reflect land use changes and improvements in remote sensing methodology.

DEP's reference wetlands monitoring program provides standards to guide DEP's assessment of wetland impacts and mitigation in its review of wetland permit applications and other land management proposals. In 2011, DEP continued to maintain automated monitoring wells installed in 22 reference wetlands throughout the Catskill/Delaware System and to download data from those wells. The wells measure water table level at 6-hour intervals and provide a long-term hydrologic record for various wetland types. DEP also installed a monitoring well in a woodland pool wetland associated with the Mink Hollow reference wetland in the

Ashokan watershed. This additional well expands the reference wetlands monitoring program to include woodland pool habitat, whose distribution and characteristics are poorly understood in the Catskill/Delaware System. Reference wetland monitoring also provides data to support wetland delineation and the development or validation of wetland assessment methodologies.

4.8.4 Education and Outreach

DEP continued to distribute the educational pamphlet entitled "Wetlands in the Watersheds of the New York City Water Supply System" at public forums and upon request. DEP also presented findings from its wetlands mapping and monitoring programs at the annual conference of the New York State Wetlands Forum and at the Watershed Science and Technical Conference. DEP also attended a meeting of the New York State Interagency Wetlands Group. The wetlands interagency group was established in the 1980s to provide a way for federal, state, City, and local agency personnel to discuss wetland issues on a quarterly basis.

4.9 East of Hudson Non-Point Source Pollution Control Program

The East of Hudson Nonpoint Source Pollution Control Program seeks to address nonpoint pollutant sources in the four EOH Catskill/Delaware watersheds (West Branch, Croton Falls, Cross River, and Boyd Corners). The program supplements DEP's existing regulatory efforts and nonpoint source management initiatives.

4.9.1 Wastewater-Related Nonpoint Source Pollution Management Programs

Nonpoint sources of wastewater can 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 the existing sewer districts, wastewater is treated by subsurface sewage treatment systems (SSTSs).

Wastewater Infrastructure Mapping and Inspection Program

As part of its efforts to reduce potential pollutant loading from wastewater sources, DEP developed a program to video inspect and digitally map the sanitary infrastructure in the EOH Catskill/Delaware watersheds. The inspection program includes identifying defects and assessing those that may result in exfiltration of effluent to surface water.

In 2011, DEP received and accepted the Comprehensive Summary Report, which compiles the information obtained as part of the video inspection and digital mapping of the sanitary lines. The report narrative includes the use of a standardized coding system to establish the salient criteria for the hydraulic performance of the sanitary system and includes repair, rehabilitation, and maintenance options for the sections that present the greatest potential for exfiltration. The digital data were provided in a specified format that depicts the sanitary sewer infrastructure and defect locations. DEP incorporated these items into the DEP central GIS

library and provided digital versions, including access to the closed circuit television inspections, to the appropriate municipalities.

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. In 2011, DEP continued to help the Westchester County Health Department refine its comprehensive Septic System Management Program (SSMP) database and web-based SSMP database access tool. The database includes information on new septic applications, septic repairs/remediation, and pump out data, as well as contractor licensing information.

In 2011, Putnam County evaluated its Septic Repair Program (SRP) to determine the extent to which modifications might be needed based on MS4 requirements outlined in the DEC General Permit (GP-0-10-002) that became effective in May 2011. The MS4 permit requires that all municipalities "Develop, implement and enforce a program that ensures that onsite sanitary systems…are inspected at a minimum frequency of once every five years and, where necessary, maintained or rehabilitated." While the repairs of failing septic systems will continue in Putnam County as required by the provisions of the MS4 permit, the county is evaluating whether its goals would be better achieved through development of a low-cost loan program than through reimbursement of the cost of repairs. County representatives indicated that they held several discussions in 2011 with the New York State Environmental Facilities Corporation (EFC) in an effort to develop a loan program. During the interim review, the county has not been reimbursing home owners for the costs associated with repairs to their septic systems. The county reports that SRP staff continue to follow up on home owner maintenance agreements previously signed by program participants.

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 Catskill/Delaware watersheds. These projects include large retrofit projects as well as remediation of smaller erosion sites (See Figure 4.28).

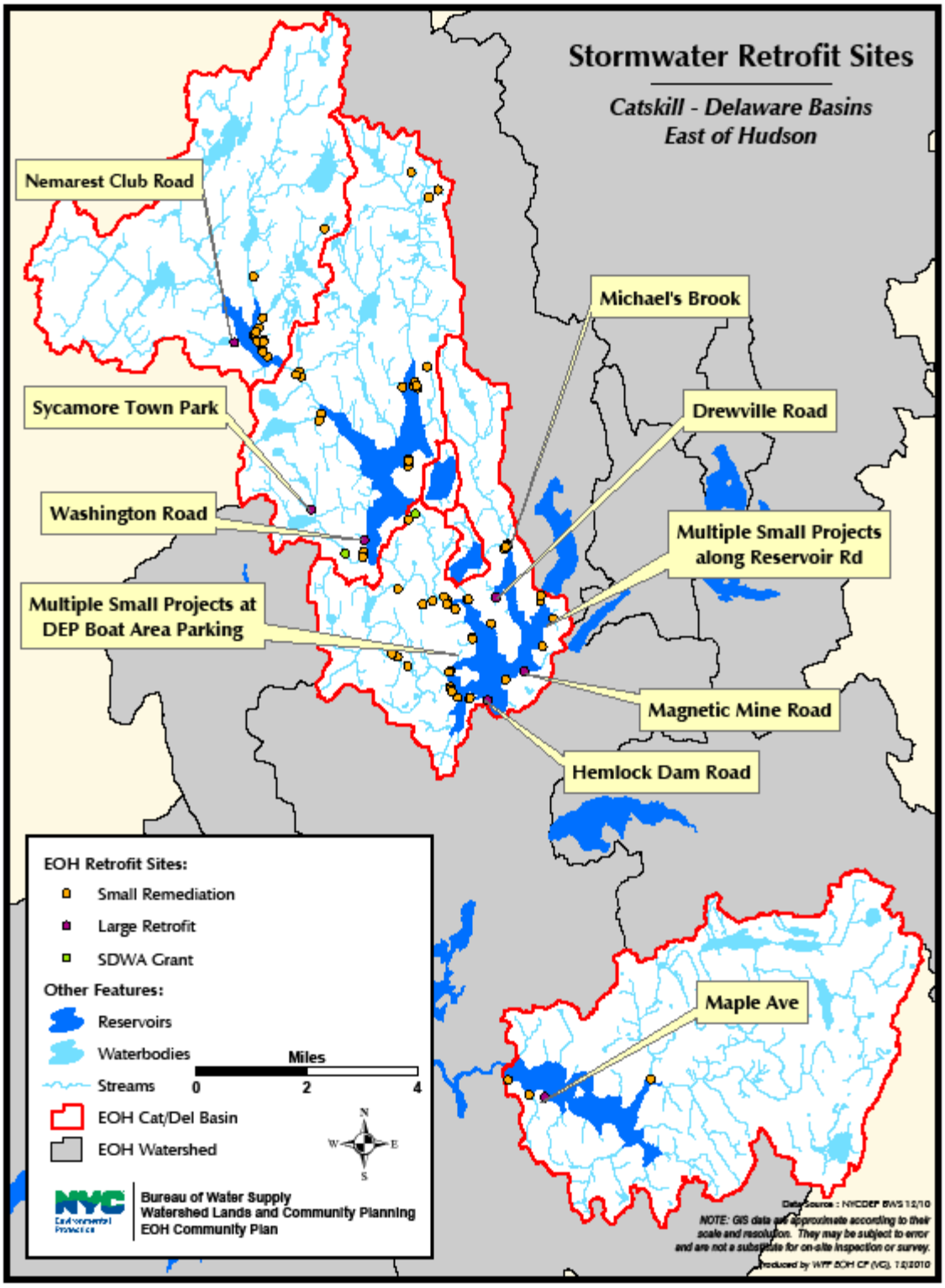


Figure 4.28 Stormwater retrofit sites, East of Hudson Catskill/Delaware basins.

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 completed all project work for the reconstruction of both Hemlock Dam Road and Magnetic Mine Road in 2010.

Stormwater Remediation Projects on City-Owned Property

Maple Ave., Town of Bedford, Westchester County: The designs are 100% complete. Due to changes in design, at the request of the Town, the stormwater pollution prevention plant (SWPPP) was not approved as anticipated in 2011. DEP anticipates receipt of the SWPPP approval in the first half of 2012.

Michael Brook, Town of Carmel, Putnam County: The designs are 100% complete. The Bid Opening took place on October 4, 2011, and was successful. The lowest bidder was selected and a pre-award meeting was held on November 30, 2011.

Drewville Road, Town of Carmel, Putnam County: Due to changes in design, at the request of the Town, the SWPPP was not approved as anticipated in 2011. DEP anticipates receipt of the SWPPP approval in the first half of 2012.

Remediation Projects on Privately-Owned Property

Sycamore Park, Long Pond Road/Crane Road, Town of Carmel, Putnam County: DEP resolved the remaining issues with species and habitat. The designs are 100% complete. The Bid Opening took place on October 4, 2011, and was successful. The lowest bidder was selected and a pre-award meeting was held on November 30, 2011.

Nemarest Club, Town of Kent, Putnam County: DEP secured the signed access agreement from the Nemarest Club owner. The designs are 100% complete. The Bid Opening took place on October 4, 2011, and was successful. The lowest bidder was selected and a pre-award meeting was held on November 30, 2011.

Stormwater Remediation Small Projects

The Small Stormwater Remediation Projects Program involved the identification and remediation of smaller erosion sites in the four EOH Catskill/Delaware watersheds. The program was completed in 2009. The sites are now maintained under the Facility Inspection and Maintenance Program.

Stormwater Facility Inspection and Maintenance

The facility inspection and maintenance program was developed to ensure that previously constructed stormwater remediation facilities continue to function as designed. New facilities continue to be brought on line and are added to the routine inspection program. Maintenance during the first year of a facility's life is completed under the warranty in the facility's

construction contract and under DEP's maintenance contract thereafter. Inspection and maintenance follow procedures identified in the Operation and Maintenance Guidelines contained in the maintenance contract; facility types not described in this document were incorporated into the facility maintenance contract with explicit maintenance instructions. DEP entered into a new three-year maintenance contract in August 2011.

Stormwater Infrastructure Mapping and Inspection Program

DEP completed the mapping and video inspection program in 2009.

Stormwater Infrastructure Capacity Evaluation

DEP completed the Stormwater Infrastructure Capacity Evaluation in 2010.

Stormwater Prioritization Assessment—DEP Properties

DEP completed the prioritization report in March 2009.

Funding Program—Croton Falls/Cross River

During 2011, DEP held numerous discussions with DEC and the EOH watershed communities to develop a funding agreement to allow the transfer of both the $4.5 million provided under the Croton Falls/Cross River Stormwater Retrofit Program as well as the additional funding required by the December 2010 Water Supply Permit (WSP). In June 2011, DEP and the watershed communities reached general agreement on a framework that is consistent with the 2007 FAD and 2010 WSP. A detailed funding agreement was developed in anticipation of the formation of a not-for-profit local development corporation consisting of the EOH communities in Putnam, Westchester, and Dutchess Counties.

In November, the majority of communities in Putnam, Westchester, and Dutchess Counties established the EOH Watershed Corporation (EOHWC). The mission of the EOHWC is to implement a regional retrofit program in the EOH watershed. The EOHWC subsequently elected officers and adopted by-laws. The EOHWC Executive Committee is currently conducting interviews to fill the position of administrator for the retrofit effort. It is anticipated that the Board of the EOHWC will authorize the signing of the funding agreement in the first half of 2012.

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 watershed. A comprehensive review of Kensico Reservoir water quality can be found in the 2011 Kensico Water Quality Annual Report (DEP 2012).

4.10.1 Stormwater Management and Erosion Abatement Facilities

BMP Construction, Operation, and Maintenance

DEP has 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 4.29, were routinely inspected and maintained as needed throughout 2011, in accordance with the Operation and Maintenance Guidelines. Maintenance consisted of such items as grass mowing, vegetation removal, tree removal, and sediment and debris removal. All BMPs are performing as designed. DEP entered into a new three-year maintenance contract in August 2011.

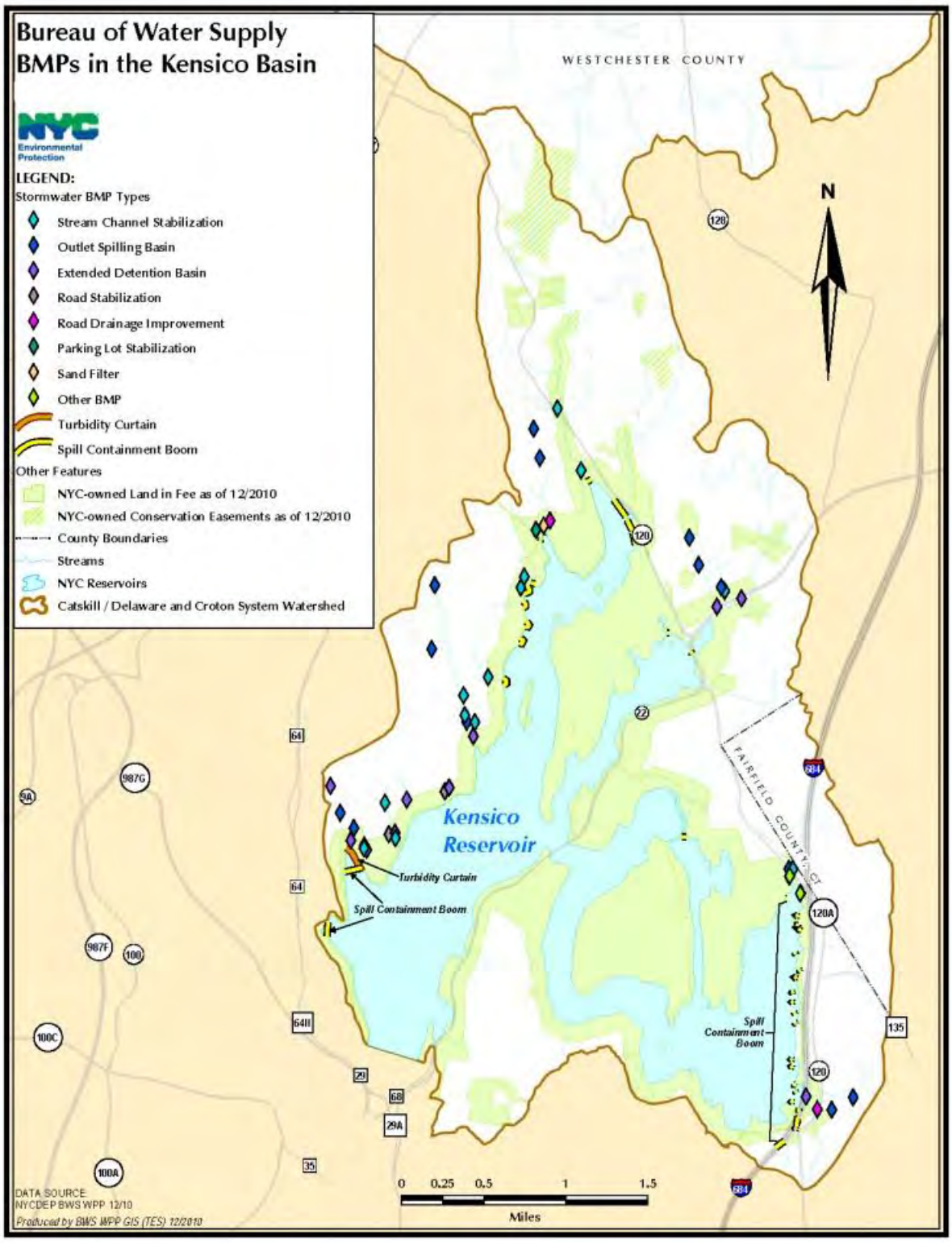


Figure 4.29 BMPs in the Kensico basin.

Spill Containment Facilities

DEP installed, and now maintains, spill containment facilities in and around Kensico Reservoir (see Figure 4.29). The facilities improve spill response and recovery, thereby minimizing water quality impacts in the event of a spill. In 2011, routine maintenance was completed at the spill boom sites. Twenty-eight 50-foot booms were replaced and two 100-foot booms were replaced. Seven sites had lanyards replaced.

In June 2011 home heating oil was discharged into a stream within the Kensico watershed off Nannyhagen Road near the Catskill Influent Chamber cove. DEP HazMat proceeded to the site, and confirmed the presence of a minor spill that had been contained within a small area by winds that had forced the sheen back into the cove. DEP HazMat deployed booms within the area and other strategic locations to prevent transport of the sheen and followed up to ensure proper clean-up. It was determined that no oil left the reservoir via water supply intakes.

Turbidity Curtain

DEP continues to monitor the extended primary curtain and the back-up turbidity curtain, designed to direct flows from Malcolm and Young Brooks further out to the body of the reservoir and to provide enhanced protection for water entering the Catskill Upper Effluent Chamber. DEP's diving contractor performed inspections of the both turbidity curtains in May and September 2011. Based on these inspections, the following repair work was completed: bolt, washer, and fabric repairs; anchor cable replacement; anchor block repositioning; and anchor cable reconnection. In addition, stainless steel ties were placed on select grommet locations of the primary turbidity curtain and the back-up turbidity curtain. The turbidity curtains appear to be functioning as intended.

4.10.2 Kensico Action Plan

During 2011, DEP continued progress on the implementation of the four stormwater treatment facilities plans proposed in the Kensico Action Plan. The construction contract was awarded in April, with the Notice to Commence Work issued in June. Since June, DEP and the contractor have worked to secure various internal approvals required to begin construction, including the contractor's health and safety, waste management, and minority/women-owned business utilization plans. DEP and the contractor continue to work to secure the remaining approvals for subcontractors, vendors, and materials. Below is a summary of project progress since the notice to commence work was issued.

N1 - West Lake Drive Drainage Improvements

The contractor's site sediment and stormwater control plan (SSCP) was reviewed and approved. An existing road conditions report and maintenance and protection of traffic plan were submitted to the Town of Mount Pleasant as required by the contract. Pre-construction photographs were taken and the contractor has marked trees for removal within the limits of disturbance.

N7 - Sub-Basin Pipeline System

The contractor's site SSCP was reviewed and approved. A topographic survey of existing ground conditions was reviewed with design staff. Changes to the cut and fill scope were required as a result of this review. In November, Consolidated Edison (Con Ed) indicated that it will require an approved work plan showing compliance with a 25-foot clearance limit from power lines. The contractor is currently preparing a plan in accordance with the Con Ed requirement. Any new areas of disturbance that are necessary to maintain the Con Ed power line clearance limit will be added to the SSCP and assessed for potential permit modifications. Pre-construction photographs were taken and trees slated for removal were marked and cut.

N12 – Extended Detention Basin

The contractor worked with design staff to prepare the site SSCP. A maintenance and protection of traffic plan was submitted to the Town of Mount Pleasant. A required DEC permit extension was obtained. The contractor identified and marked trees to be removed as part of the project.

Whippoorwill Stream Rehabilitation

The contractor identified and transplanted red trillium and cut Indiana bat roosting trees in accordance with applicable permit requirements. DEP applied for and received an extension to the Town of North Castle Wetland permit. The contractor is currently developing the site SSCP. Design staff is preparing a modified SPPP that conforms to permit conditions.

4.10.3 West Lake Sewer Trunk Line

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

Sanitary Sewer Remote Monitoring System

DEP proposed a sanitary sewer remote monitoring system for the West Lake Sewer Trunk Line, the purpose of which will be to provide real-time detection of problem events such as leaks, system breaks, overflows, and blockages. During the reporting period, DEP and the WCDEF completed the project scope of work and intermunicipal agreement (IMA). The IMA contains language that requires WCDEF to provide the contracting services for installation, monitoring, and maintenance of the system. DEP issued the Notice of Award to WCDEF in November 2011, with a proposed start date in the first quarter of 2012. The IMA proposes to use Smart Cover technology to monitor up to 25 manholes in the West Lake System.

Sewer Line Visual Inspection

DEP conducts an annual visual inspection of the trunk line to assess the condition of exposed infrastructure, including manholes, for irregularities. The annual full inspection was performed in September 2011. Partial inspections were conducted throughout the year in association with ongoing routine maintenance of Kensico stormwater BMPs in the vicinity of the line. No defects or abnormalities were noted.

4.10.4 Video Inspection of Sanitary Sewers

DEP has established a recurring inspection program for the portions of the sanitary sewer system located within the Kensico watershed which were identified as possible areas of concern during the prior video inspection of sanitary infrastructure in the watershed. Inspections of these areas were completed under the same contract as was entered into for the inspection and cleaning of the sanitary infrastructure contained within the EOH Catskill/Delaware watersheds.

In 2011, DEP received and accepted the Comprehensive Summary Report which, based on the video inspection and digital mapping of the sanitary lines, includes repair and rehabilitation options for the sections of the sanitary sewer system that present the greatest potential for exfiltration. (For details of the report, see Section 4.9.1.) None of the pipe sections that were inspected within the Kensico Reservoir watershed were cited as having severe structural defects that required immediate restoration or replacement.

4.10.5 Septic Repair Program

DEP initiated the Kensico Septic System Rehabilitation Reimbursement Program to reduce potential water quality impacts that can occur through failing septic systems. In April 2011, EFC mailed an annual reminder letter to eligible residents notifying them of the availability of funding. Based on responses to that mailing, EFC continued to update the database and sign interested participants into the program. Figure 4.30 shows the sewage service status of each parcel based on resident responses and other available records. During 2011, four residents who were cited by the Westchester County Health Department participated in the program.

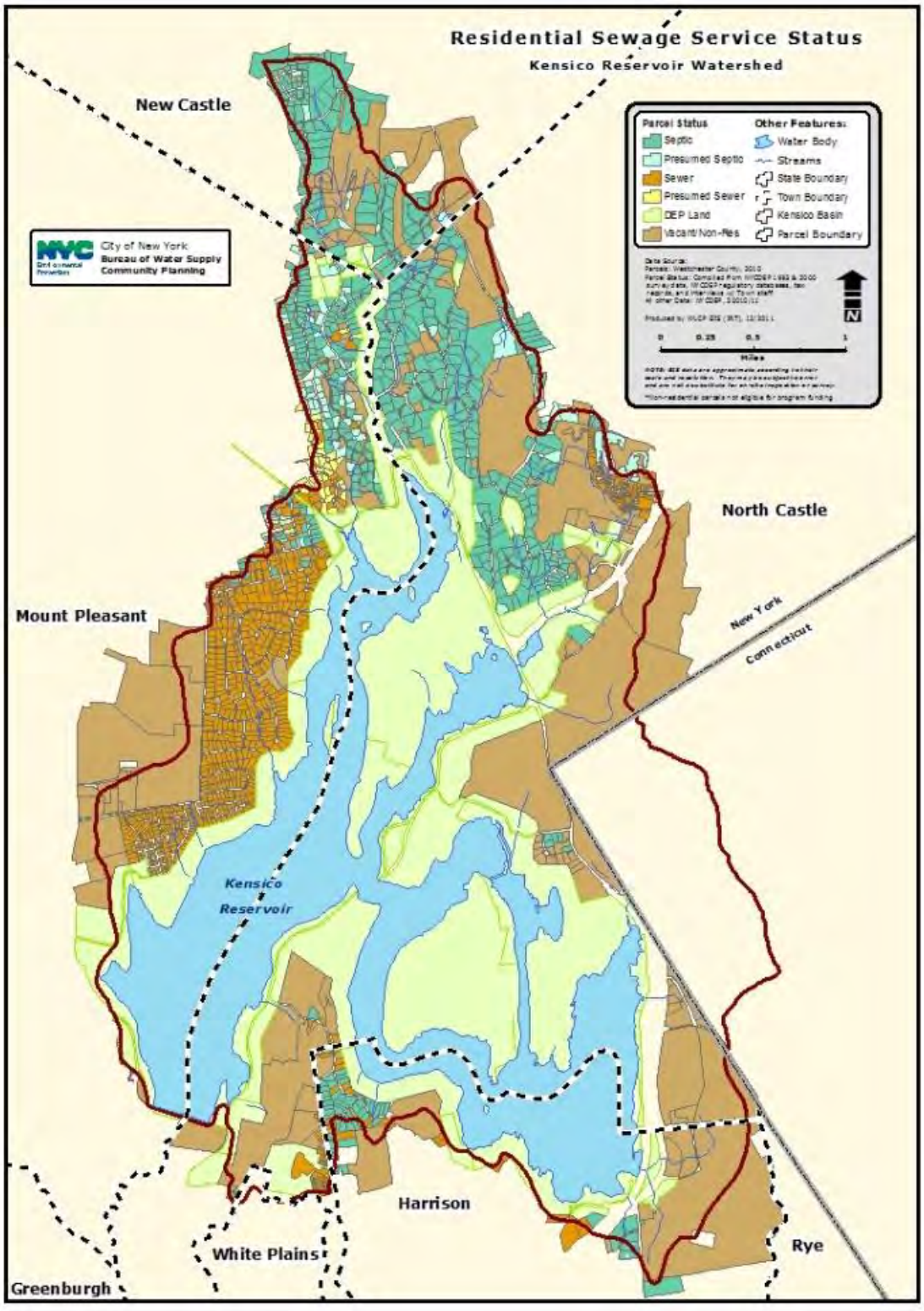


Figure 4.30 Residential sewage service status, Kensico Reservoir watershed.

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. DEP is assessing the feasibility and need for a shoreline stabilization project based on the future use and location of CATUEC. The project, if constructed, would be located south of CATUEC and would mitigate the erosion and possible resuspension of near-shore materials near CATUEC during wind events. During the reporting period, DEP worked to secure the permits required to mitigate the potential impact to wetlands of a shoreline project. DEP secured the DEC Water Quality Certification Permit in November 2011; still pending is the USACOE Individual Permit, which USACOE currently has under review.

4.10.7 Route 120

In February 2011, the New York State Department of Transportation began a project to resurface I-684 and construct 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. During the reporting period, all of the main project elements listed above were completed, with the exception of some electrical components that will be completed in the spring of 2012. DEP will continue to monitor the project until all work is complete.

4.10.8 Westchester County Airport

The Westchester County Airport is located east of Kensico Reservoir in close proximity to Rye Lake. Because of the closeness to the reservoir, DEP continues to review any activities that are being proposed at the airport. There was no activity to report in 2011.

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 stream banks, 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 undertook the Catskill Turbidity Control Study to provide a comprehensive analysis of potential engineering and structural alternatives to reduce turbidity levels in the Catskill System. DEP 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 was conducted in three phases. The Phase I study, completed in December 2004, provided a preliminary screening-level assessment of turbidity control alternatives at Schoharie

and Ashokan Reservoirs, and identified potentially feasible, effective, and cost-effective measures for subsequent detailed evaluation. Phase I results also showed that turbidity sources during high flows within the Ashokan watershed are the driver for elevated turbidity levels leaving the reservoir.

The Phase II study, completed in September 2006, consisted of detailed conceptual design, cost estimation, and performance evaluation of three alternatives for improving turbidity and temperature in diversions from Schoharie Reservoir: Multi-Level Intake, In-Reservoir Baffle, and Modification of Reservoir Operations. The performance evaluation relied on development and application of an integrated modeling framework that linked the OASIS water supply model of the entire NYC reservoir system and Delaware watershed with the W2 water quality model of Schoharie Reservoir. DEP selected Modification of Reservoir Operations (MRO) as the most feasible, effective, and cost-effective alternative for improving turbidity and temperature control at Schoharie Reservoir, and proposed in the December 2006 Phase II Implementation Plan to develop a system-wide Operations Support Tool (OST) to support implementation of this alternative. The MRO/OST plan was conditionally approved by regulatory agencies in August 2008, pending completion of additional analyses. DEP is currently proceeding with development of the OST.

The Phase III study, completed in December 2007, focused on alternatives at Ashokan Reservoir that could reduce turbidity levels entering Kensico Reservoir, including a West Basin Outlet Structure, Dividing Weir Crest Gates, East Basin Diversion Wall, Upper Gate Chamber Modifications, a new East Basin Intake, and Catskill Aqueduct Improvements and Modified Operations. The performance evaluation relied on an updated version of the OASIS-W2 model, which included water quality models of the West and East Basins of Ashokan Reservoir and Kensico Reservoir. The Phase III evaluation indicated that, when turbidity levels rise, taking the Catskill System offline (or operating the Catskill Aqueduct at the minimum flow rate needed to satisfy demand) is the most effective way to reduce the turbidity load transferred from Ashokan to Kensico and reduce the frequency of alum treatment. Releasing water from the West Basin prior to and during a storm event was also found to provide significant reductions in turbidity loading to the East Basin, and hence to Kensico.

DEP selected Catskill Aqueduct Improvements and Modified Operations as the most feasible, effective, and cost-effective alternative for reducing turbidity levels entering Kensico Reservoir, and proposed implementation of this alternative in the July 2008 Phase III Implementation Plan. The Phase III Implementation Plan also presented the results of extensive model sensitivity and uncertainty testing undertaken by DEP. These analyses demonstrated that while inherent uncertainty in some model parameters (e.g., Esopus Creek flow-turbidity

relationship) influences the absolute performance of alternatives, it does not generally affect their relative performance.

4.11.1 Implementation of Catskill Turbidity Control Alternatives

Catskill Aqueduct Improvements

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

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

One construction contract is being developed to provide the new stop shutters and to make the improvements to the six stop shutter locations along the Catskill Aqueduct. This project is currently in design. Significant comments were received during preliminary design (at 30% design complete) regarding operational concerns and lifting devices, as well as expected flows in the aqueduct and stop shutter opening widths and heights. In April 2011, a scoping report was developed to lay out the design approach addressing all of the concerns, and a revised preliminary design was issued in June 2011. After some additional comments were addressed, work was commenced on the 60% design in September 2011.

Five of the six sites have been inspected. The remaining site, the Harlem Railroad Siphon Chamber, requires a diving company since the site receives backwater from Kensico Reservoir. Since the diving inspection requires a brief shutdown of the Catskill Aqueduct, a safe work plan, including lock-out/tag-out procedures and responsibilities, was developed in July/August 2011 in preparation for the expected dive in September. The dive could not be completed at that time, however, because of water demand issues with the local communities (who tap off of the aqueduct to provide water to their service areas) and because of turbidity levels resulting from Tropical Storm Irene. The diving inspection is now expected to be completed in early 2012.

4.11.2 Shaft 4 Project

The City has hired a design consultant to proceed with full scale design of a Shaft 4 interconnection. The interconnection will allow Delaware Aqueduct water to be discharged into the Catskill Aqueduct at the Shaft 4 site in Gardiner, NY, where the systems intersect. The Shaft 4 design process was refocused in 2011 in an effort to significantly reduce costs, while providing the same level of benefit from the interconnection. The interconnection design is currently at the 90% stage. The design includes an addition to the existing Shaft 4 facility which will house piping, valves, instrumentation, flow control equipment, and monitoring stations. The facility will remain largely underground, except for a few vent pipes and an access door. Design will be proceeding toward the 100% stage in early 2012.

4.12 Sand and Salt Storage

The Institutional Sand and Salt Storage Facilities Program is administered and managed by the CWC in consultation with DEP. During the reporting period, CWC funded the design of a sand and salt storage structure at the Delaware Valley Hospital in Walton.

Other institutions that have expressed interest in applying for the program include the Frost Valley YMCA campus in Claryville and SUNY Delhi in the Village of Delhi.

5. Watershed Monitoring, Modeling, and GIS

5.1 Watershed Monitoring Program

5.1.1 Routine Water Quality Monitoring

To ensure high quality drinking water, DEP conducts extensive water quality monitoring that encompasses all areas of the watershed, including sites at aqueducts (keypoints), streams, and reservoirs. DEP's monitoring objectives for 2011 are documented in the 2009 Watershed Water Quality Monitoring Plan (WWQMP) (DEP 2009), which is designed to meet the broad range of DEP's many regulatory and informational requirements. The plan prescribes monitoring to achieve compliance with all federal, state, and local regulations; meet the terms of the 2007 FAD; enhance the capability to make current and future predictions of watershed conditions and reservoir water quality; and ensure delivery of the best water quality to consumers through ongoing surveillance.

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 the plan have been defined by the requirements of those who ultimately require the information, including DEP program administrators, regulators, and other external agencies. As such, the monitoring regime prescribed in the plan is driven by legally binding mandates, stakeholder agreements, operations, and watershed management information needs. The plan covers four major areas that require ongoing attention: compliance, FAD program evaluation, modeling support, and surveillance monitoring, with many specific objectives within these major areas.

Compliance. The compliance objectives of the sampling plan are focused on meeting the regulatory compliance monitoring requirements for the New York City watershed. This includes the requirements of the Surface Water Treatment Rule (SWTR) (EPA 1989) and its subsequent extensions, as well as the New York City Watershed Rules and Regulations (WR&R) (1997), the Croton Consent Decree (CCD), administrative orders, and State Pollution Discharge Elimination System (SPDES) permits. The sampling sites, analytes, and frequencies are defined in each objective according to each specific permit, rule, or regulation.

FAD program evaluation. EPA has specified many requirements in the 2007 FAD that must be met to protect public health. These requirements form the basis for the City's ongoing assessment of watershed conditions, changes in water quality, and ultimately any modifications to the strategies, management, and policies of the Long-Term Watershed Protection Program. The City also conducts a periodic assessment of the effectiveness of the program, using DEP's water quality monitoring data. Program effects on water quality are reported in the Watershed Protection Summary and Assessment reports (e.g., DEP 2011a), which are produced approximately once every five years.

Modeling support. Modeling data are used to meet the long-term goals for water supply policy and protection and provide guidance for short-term operational strategies when unusual water quality events occur. These objectives are achieved through implementation of watershed and reservoir model improvements based on ongoing data analyses and research results; ongoing testing of DEP's watershed and reservoir models; updating of data necessary for the development of models; and development of data analysis tools to support modeling projects.

Stream, reservoir and aqueduct, and meteorological data are all needed to develop, calibrate, and validate models. Data acquired through stream monitoring includes both flow and water quality data. Reservoir monitoring provides flow and reservoir operations data to support reservoir water balance calculations. The water balance and reservoir water quality data are required to test, apply, and further develop DEP's one- and two- dimensional modeling tools. The meteorological data collection effort provides critical input necessary to meet both watershed and reservoir modeling goals.

Surveillance monitoring. The surveillance monitoring plan contains several objectives that provide information to guide the operation of the water supply system, other objectives to help track the status and trends of constituents and biota in the system, and specific objectives that include aqueduct monitoring for management and operational decisions. Another surveillance objective relates to developing a baseline understanding of potential contaminants such as trace metals, volatile organic compounds, and pesticides, while another summarizes how DEP monitors for the presence of zebra mussels in the system. Zebra mussel monitoring is meant to trigger actions to protect the infrastructure from becoming clogged by these organisms. The remaining objectives pertain to recent water quality status and long-term trends for reservoirs, streams, and benthic macroinvertebrates in the Croton System. It is important to track the water quality of the reservoirs to be aware of developing problems and to pursue appropriate actions.

5.1.2 Additional Water Quality Monitoring

Several weather-related events impacted water quality in 2011, leading to enhanced monitoring beyond that prescribed in the WWQMP, followed by treatment. Two large runoff events in October and December 2010 resulted in high turbidity levels in the Catskill System. Turbidity in Ashokan Reservoir, particularly in the west basin, remained elevated throughout December 2010 and January and February 2011. DEP used modeling results and implemented operational controls to limit the effects of this turbid water on the water supply; however, alum treatments were ultimately necessary. Two periods (January 31-February 11, 2011 and March 2-May 20, 2011) of alum treatment of the Catskill System were conducted along with enhanced monitoring during these periods. See the DEP after-action reports for details (DEP 2011e, DEP 2011f).

Later, on August 28, the entire water supply system was impacted by catastrophic flooding from Tropical Storm Irene. The flooding from this storm again resulted in highly turbid water in Ashokan Reservoir. To prevent this turbid water from reaching Kensico Reservoir, alum treatment

of the Catskill Supply began on August 29 and continued into 2012. On September 7, 10 days after the flooding from Tropical Storm Irene, the water supply watershed was impacted by a second flooding event caused by Tropical Storm Lee. In addition to turbidity issues, Kensico Reservoir experienced unusually high fecal coliform counts following these two storm events. To protect public health, maintain compliance with SWTR requirements for filtration avoidance, and reduce the load of bacteria entering Kensico Reservoir, DEP began chlorine treatment of the Delaware Aqueduct on September 9. This treatment consisted of adding chlorine, in the form of sodium hypochlorite, into the Delaware Aqueduct at Shaft 10 (located at West Branch Reservoir) and dechlorination using sodium bisulfite at Shaft 17 (located just prior to discharge into Kensico Reservoir). The chlorine treatment lasted 39 days and ended on October 18, and is documented in an after-action report (DEP 2011g).

In addition to the weather-related monitoring in Ashokan and Kensico Reservoirs, non-routine water quality monitoring, referred to as Special Investigations (SIs), were also conducted. SIs are performed to document man-made or natural events occurring in the watershed that have the potential to negatively affect water quality (like sewage overflows). Two such events occurred in 2011 and are documented in SI reports.

Finally, extra sampling occurred on Cannonsville Reservoir in an effort to monitor potential water quality impacts from the Cannonsville Recreational Boating Pilot Program (DEP 2011h). See Section 4.3 for details.

5.1.3 Water Quality Reports

Pursuant to the City's Long-Term Watershed Protection Plan (DEP 2011b) and as a FAD requirement (Section 5.1 Watershed Monitoring Program), DEP produces a Watershed Water Quality Annual Report, which is submitted to EPA in July of each year (e.g., DEP 2011i). This document contains chapters covering water quantity (e.g., the effects of droughts or excessive precipitation during the reporting period), water quality of streams and reservoirs, watershed management, and water quality models (terrestrial and reservoir). For the 2011 report (due 2012), the limnology and hydrology components of the document will draw largely from information obtained from approximately 230 routinely-sampled reservoir and stream sites, resulting in almost 6,700 samples and nearly 65,000 analyses. For the pathogen component, 612 routine samples were analyzed for *Giardia*, *Cryptosporidium*, turbidity, pH, and temperature (2,206 analyses) at 54 sampling sites (including keypoints), while 289 samples were collected for human enteric virus (HEV) examination.

It is very important that DEP monitor pathogen concentrations in the water supply on an ongoing basis to be able to confirm that pathogens do not threaten the safety of the water supply. To maintain a constant flow of information to DEP managers and regulators, pathogen data are reported frequently and in several different reports. The following reports were issued in 2011:

- Weekly results of *Cryptosporidium* and *Giardia* sampling at the three source waters, which are routinely posted on DEP's website and sent directly to regulators by email
- Monthly filtration avoidance reports
- Monthly Croton Consent Decree reports
- Annual mid-term report on DEP pathogen studies of *Giardia* spp., *Cryptosporidium* spp., and HEVs
- Annual Kensico Reservoir report
- Watershed Water Quality Annual Report
- Drinking Water Supply and Quality Annual Report
- Bureau of Water Supply Annual Report (or, every fifth year, the Watershed Protection Program Summary and Assessment)

Additional reports are submitted to describe the activities of the Kensico Water Quality Control Program. DEP submits a Kensico Programs Annual Report to EPA in January, and a companion report in March, which analyzes monitoring data from the Kensico watershed and provides an update on the status and application of the Kensico Reservoir model. Additionally, the document reports observations from the assessment of Kensico BMPs, sampling for toxic substances, and applications of the Kensico water quality model to guide operations. A Kensico Programs Semi-Annual Report is submitted in July that provides a brief report discussing material events in Kensico program implementation.

5.1.4 Wastewater Treatment Plant Pathogen Monitoring

The purpose of the wastewater treatment plant (WWTP) pathogen monitoring is to demonstrate that microfiltration, and technologies deemed equivalent, continue to perform well with respect to pathogen removal from the effluents of the plants. The new WWQMP outlines FAD monitoring at five plants not sampled under the previous monitoring plan (Andes, Fleischmanns, Hunter, Prattsville and Windham), and at three which had been previously sampled (Grahamsville, Hunter Highlands and Stamford) (Figure 5.1). All eight plants were monitored quarterly for *Giardia* and *Cryptosporidium* in 2011. Previously, plants had been sampled quarterly for HEV as well, but that ended in November 2010, when DOH approved DEP's request to discontinue HEV sampling at WWTPs.

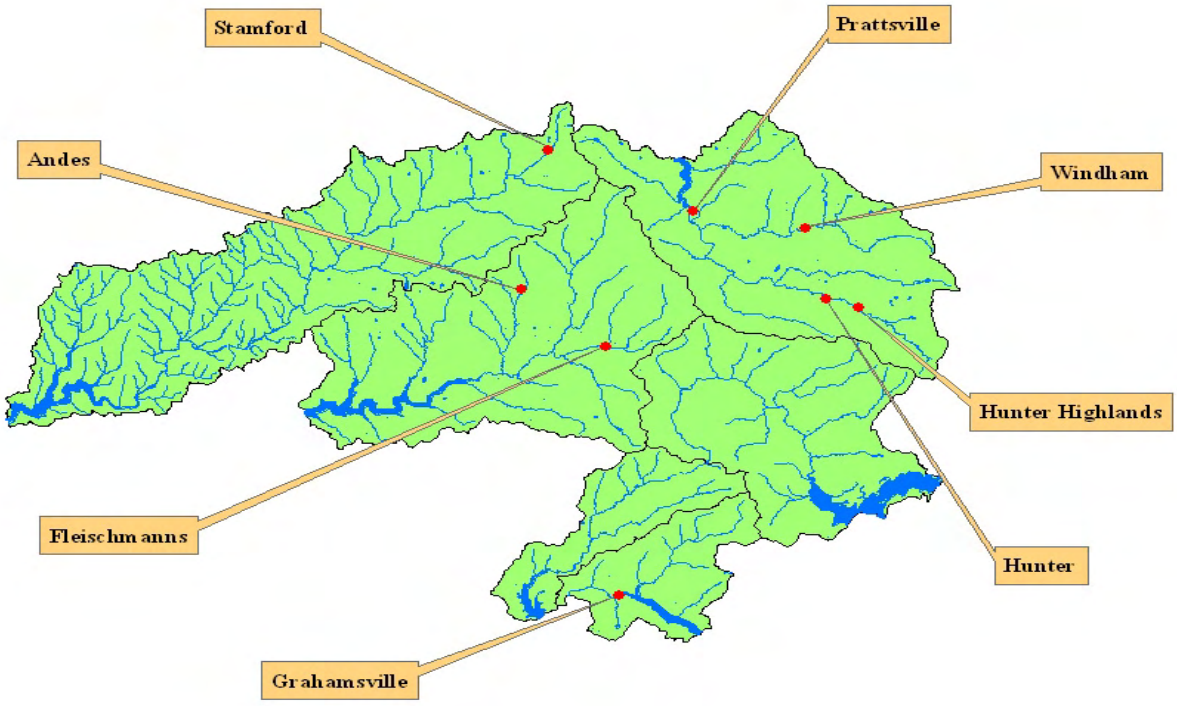


Figure 5.1. WOH WWTPs monitored for *Giardia* and *Cryptosporidium* in 2011.

Monitoring for *Cryptosporidium* and *Giardia* involved the field filtration of 50 L of water; samples were then analyzed by DEP according to EPA Method 1623 (EPA 2005). HEV samples involved the field filtration of 200-300 L of water, with samples analyzed by Environmental Associates Laboratory (EAL) Ltd. according to the ICR method (EPA 1996).

Giardia

Five of the eight WWTPs sampled in 2011 were negative for *Giardia* cysts in all four quarters (Table 5.1). The other three plants (Windham, Andes, and Hunter Highlands) each had one positive sample. The highest concentration was 3 cysts $50L^{-1}$ at Windham in February 2011. While operators reported no violations at Windham during this period, it should be noted that the sample was taken on the Tuesday after a three-day holiday weekend, when there was an increase in flow due to increased skiing and lodging in the area. Inspectors' reports also indicate 0.6 inches of precipitation that weekend.

Table 5.1. Pathogen results for WOH WWTPs sampled in 2011.

Site	Sample date	*Cryptosporidium* (oocysts $50L^{-1}$)	*Giardia* (cysts $50L^{-1}$)	Analyzed volume (L)
Hunter Highlands BD	2/22/11	0.00	0.00	49.9
Hunter Highlands BD	5/19/11	0.00	0.00	50.0
Hunter Highlands BD	8/17/11	0.00	0.00	50.0
Hunter Highlands BD	12/21/11	0.00	1.00	50.0
Hunter	1/11/11	0.00	0.00	50.0
Hunter	4/6/11	0.00	0.00	50.0
Hunter	7/20/11	0.00	0.00	50.0
Hunter	10/26/11	0.00	0.00	50.0
Andes	3/28/11	0.00	0.00	50.0
Andes	6/20/11	0.00	0.00	50.0
Andes	9/15/11	0.00	2.00	50.0
Andes	12/14/11	0.00	0.00	50.0
Fleischmanns	3/28/11	0.00	0.00	50.0
Fleischmanns	6/20/11	0.00	0.00	50.0
Fleischmanns	9/20/11	0.00	0.00	50.0
Fleischmanns	12/21/11	0.00	0.00	50.0
Prattsville	1/20/11	0.00	0.00	50.0
Prattsville	4/19/11	0.00	0.00	50.0
Prattsville	7/20/11	0.00	0.00	50.0
Prattsville	10/25/11	0.00	0.00	50.0
Grahamsville MF	2/9/11	0.00	0.00	50.1
Grahamsville MF	5/16/11	0.00	0.00	50.0
Grahamsville MF	8/15/11	0.00	0.00	50.0
Grahamsville MF	11/16/11	0.00	0.00	50.0
Stamford	3/16/11	0.00	0.00	50.1
Stamford	6/15/11	0.00	0.00	50.0
Stamford	9/20/11	0.00	0.00	50.0
Stamford	12/14/11	0.00	0.00	50.0
Windham	2/22/11	0.00	3.00	50.0
Windham	5/10/11	0.00	0.00	50.0
Windham	8/17/11	0.00	0.00	50.0
Windham	11/28/11	0.00	0.00	50.0

In the middle of September, *Giardia* cysts were detected at Andes approximately a week after Tropical Storm Lee, a potential explanation for the detection. To prevent an overflow at the plant after the storm on September 7, some treatment steps (sequencing batch reactors, sand, microfiltration) were bypassed. Plant operators resumed treatment steps on September 8, with sand and microfiltration coming back online September 9. Later that day, the post-aeration tank, ultraviolet lights and trough, and the effluent meter pit were cleaned. All of this activity, in addition to continued drainage from the storms, may have provided a source for the two *Giardia* cysts found in the sample collected on September 15.

The third *Giardia* detection was at the Hunter Highlands WWTP. The sample for the last quarter at this location had to be rescheduled three times due to low flow. Eventually, a sample was collected on December 21, which was positive for *Giardia* (1 cyst 50 L^{-1}). Later, however, it was discovered that the plant was in the process of a recirculation procedure during sample collection, and that the sample was not representative of the final effluent. DEP will be coordinating with operators to avoid sampling under these conditions in the future.

Cryptosporidium

All eight WWTPs sampled in 2011 were negative for *Cryptosporidium* oocysts (Table 5.1).

5.2 Multi-Tiered Water Quality Modeling Program

DEP's Multi-Tiered Water Quality Modeling Program applies watershed and reservoir models and analyzes data to support reservoir operations, watershed management, and long-term water supply planning. A detailed account of the activities of the Modeling Program during 2011 is given in the October 2011 FAD Modeling Program Status Report (DEP 2011j). The following is a summary of those activities.

Applied modeling included two series of extended modeling analyses that were conducted to evaluate turbidity inputs to Catskill System reservoirs and to support reservoir operations to mitigate turbidity impacts. The first series spanned the period October 2010 through February 2011. This period included several large rain events and the spring snowmelt. Model runs provided guidance for aqueduct flows and use of stop-shutters, enabling alum treatment to be delayed until the end of January, when it became unavoidable. The second series of model applications was conducted to minimize alum use from late August 2011 through December 2011, following the effects of Tropical Storms Irene and Lee.

The effects of nonpoint source watershed management, point source upgrades, and land use change on eutrophication in the Delaware System were evaluated using DEP's Eutrophication Modeling System, as part of the 2011 FAD evaluation process. Comparison of modeling scenarios for a baseline period (1990s prior to implementation of FAD watershed management programs) and two post-implementation periods (early 2000s, late 2000s) showed significant declines in

phosphorus loadings and chlorophyll levels in Delaware System reservoirs. The decline was particularly noticeable in Cannonsville Reservoir from the 1990s through the two post-implementation periods, and could be attributed to a combination of point source reductions from WWTP upgrades, nonpoint source reductions through application of BMPs (particularly agricultural BMPs), and naturally-occurring reductions in agricultural land use.

A number of modeling analyses to evaluate the effects of future climate change on the quantity and quality of water in the NYC water supply were conducted as part of the Climate Change Integrated Modeling Project (CCIMP). Climate change scenarios based on Global Climate Model (GCM) output were refined by calculating statistically-distributed meteorological change factors (instead of average monthly change factors), to represent variability in future climate change across a range of meteorology. Climate change impact analyses included: sediment source areas and future climate impact on erosion and sediment yield in the Cannonsville watershed, regime shift detection in streamflow and selected water supply indicators, streamflow response and ecological implications of climate change, impact of climate change on the thermal structure of Delaware System reservoirs, and assessment of potential impacts and identification of adaptation options using vulnerability assessment and risk management tools for climate change.

Model development, testing, and improvement continued with the following activities: analysis of turbidity transport dynamics in the Esopus Creek watershed and new developments in turbidity prediction, sediment fingerprinting in the Esopus Creek watershed and results from a pilot study, streamflow calibration in the Cannonsville watershed using the SWAT-WB watershed model, an analysis of the influences of channel processes on phosphorus export in the Cannonsville watershed, development of a hybrid approach to simulating future East of Hudson (EOH) reservoir inflows, and calibration of a one-dimensional reservoir model for Cannonsville Reservoir.

Model data acquisition and organization included GIS and time series data. GIS data development included: updating of water quality monitoring sites and DEP meteorological station data, use of SSURGO soils data to derive soil property layers for WOH watersheds, hydrologic buffer analysis for the Cannonsville watershed, development of Generalized Watershed Loading Function (GWLF) watershed model parameters for selected catchments, and development of a spatial model of stream power in Esopus Creek tributaries. Time-series data development included updating of meteorology, WWTP nutrient loads, streamflow, stream water quality, temperature, limnology, keypoint, and reservoir operations data used for driving and testing watershed and reservoir models.

Modeling Program collaboration and participation in external research projects in 2011 included: Water Resource Foundation (WRF) Project 4262, Vulnerability assessment and risk management tools for climate change: assessing potential impacts and identifying adaptation options; WRF Project 4306, Analysis of reservoir operations under climate change; and the Water

Utility Climate Alliance (WUCA) Pilot for Utility Modeling Applications (PUMA). The Modeling Program continued managing three contracts which provide data for model calibration and testing: Integrated program of measurement, process studies and modeling for turbidity control at Schoharie Creek and Esopus Creek (Upstate Freshwater Institute (UFI)); Robotic monitoring of selected New York City reservoirs and major tributaries (UFI); and Turbidity and suspended sediment monitoring in the upper Esopus Creek watershed (United States Geological Survey (USGS)). The Scientific Modeling Support contract with the Research Foundation of the City University of New York continues to provide postdoctoral staff for the program.

The Modeling Program also helped prepare three funding proposals with potential external collaborators, which if funded would improve the program's modeling capability and data access. These proposals included: The influence of changing climate extremes on natural organic matter and turbidity in drinking water systems (Principal Investigator (PI): Upmanu Lall, Columbia University; Funding Agency: EPA); Use of satellite data to improve model simulations of snow, streamflow, and water supply for the NYC water supply system (PI: Dorothy Hall, National Aeronautics and Space Administration (NASA)/Goddard Space Flight Center; Funding Agency: NASA); and Application of evapotranspiration and soil moisture remote sensing products to enhance hydrological modeling for decision support in the NYC water supply (PI: Nir Krakauer, City College of New York Center for Remote Sensing of the Earth Science and Technology; Funding Agency: NASA).

The Modeling Program authored nine scientific papers that were accepted for publication in peer reviewed journals and made 15 conference presentations in 2011.

5.3 Geographic Information System

Geographic Information System (GIS) activities support numerous FAD and New York City Watershed Memorandum of Agreement (MOA) (1997) watershed management applications. This report describes progress in providing GIS technical support for protection programs, monitoring programs, and modeling applications; the completion or acquisition of new GIS data layers and aerial products in the GIS spatial data libraries; GIS infrastructure improvement; and GIS data dissemination summaries.

GIS is used to manage the City's interests in the lands and facilities of the water supply system, and to display and evaluate the potential efficacy of watershed protection programs through maps, queries, and spatial analyses. GIS is also used to support watershed and reservoir modeling of water quantity and quality, as well as modeling of water supply system operations. GIS resources are utilized by DEP staff at offices throughout the watershed, directly and via the Watershed Lands Information System (WaLIS).

5.3.1 GIS Technical Support

During 2011, the GIS program provided technical support and data development, including extensive GPS fieldwork, for a variety of protection programs and modeling applications in the following areas:

Watershed Protection Programs and Facilities:

- Potential impact of hydrofracking on the WOH watershed and infrastructure;
- Impacts on water quality from Tropical Storms Irene and Lee
- Emergency response efforts resulting from Tropical Storms Irene and Lee
- Various analyses of Land Acquisition Program (LAP) activities in connection with the Water Supply Permit application
- Lower Esopus Creek turbidity and Ashokan Release Channel
- Delaware Aqueduct project in Wawarsing
- Indian Point emergency planning requirements for DEP facilities
- Hydroelectric project evaluation and Federal Energy Regulatory Commission application
- MS4 inventory of DEP EOH facilities
- Ongoing efforts:
  - stormwater infrastructure mapping and inspection
  - land acquisition prioritization
  - water supply infrastructure mapping
  - municipal sewer infrastructure mapping
  - septic repair prioritization and mapping
  - stream assessment and riparian vegetation classification
  - wetland trend assessment
- Invasive species mapping and assessment

Water Quality Monitoring Programs:

- Compliance monitoring and continuous update of sample site data for the Water Quality Laboratory Information Management System (LIMS)

Water Quality Modeling Programs:

- Modeling evaluation of watershed management programs for the March 2011 FAD Assessment
- Ongoing efforts:
  - variable source area modeling in the watershed
  - pathogen source analysis
  - lower Delaware basin loading
  - climate change impact assessment
  - graphics for reports, presentations, and peer reviewed publications
  - animation of time-series data in ArcGIS

5.3.2 Completion or Acquisition of New GIS Data Layers and Aerial Products

During 2011, many new feature classes and tables were created and placed in the GIS library, and several existing feature classes were updated or overhauled. Mission-critical datasets for various DEP programs that were continuously developed or updated included annual digital tax parcel updates for all watershed counties, NYC-owned land or interests, New York State-owned land, DEP water supply facilities, stream reaches and restoration projects, septic repairs, engineering project locations, regulatory hydrological buffers, and USGS and DEP stream monitoring gages and sites. Regular update of DEP monitoring sites included the addition of EOH WWTP locations and newly-established stream sites on lower Esopus Creek. GIS staff updated point datasets of DEP snow survey sites and the locations of snow pillow instrumentation.

A new set of GIS layers, derived from various Internet sources, was created for the GIS library to assist with broader regional mapping requirements. They included: Bronx reservoirs, northeastern US state boundaries and detailed shorelines, the Canadian shoreline, US and Canadian political jurisdictions (including offshore and Great Lakes international boundaries), Lake Champlain and Great Lakes detailed shorelines, New Jersey towns and counties, detailed Delaware River polygon and line versions, and the lower Esopus watershed.

Significant progress was made, via contract, in deriving final hydrography data from the 2009 Light Detection and Ranging (LiDAR) collection. GIS staff spent a significant amount of time performing quality assurance on each draft dataset, and several corrections were made per watershed for missing streams and ponds. Most of the WOH watershed hydrography was completed and submitted to the National Hydrography Dataset (NHD). Final deliveries, including new reservoir drainage basin delineations, will be made in mid-2012. A contract to map impervious surfaces and land use/land cover at high resolution from 2009 orthoimagery was initiated and pilot data have been completed and accepted for impervious data. This work will be ongoing throughout 2012.

5.3.3 GIS Infrastructure Improvement

Hardware and Software

In 2011, new Windows-based GIS servers were procured to replace older ones from 2006 no longer under maintenance. To complete their installation, additional power and HVAC systems needed to be brought into the Kingston facility, which was done in late 2011. Once installation is complete, the new servers will provide much needed additional storage space to accommodate new large aerial datasets, as well as a growing body of WaLIS database attachments. GIS-capable workstations for 24 advanced GIS users, including data developers, were procured in early 2011 to keep up with changing software and operating system technology requirements.

System and Database Administration

During the past year, the GIS database administrator managed the GIS library by creating and updating geodatasets, maintaining file geodatabase copies of the library, supporting spatial data development for WaLIS, and migrating several ArcSDE raster datasets to Image Server.

DEP continues to develop, upgrade, and maintain WaLIS, which currently operates on the workstations of approximately 255 registered DEP users. Of those, 157 used WaLIS at least 10 or more times during 2011. A major focus in 2011 was integrating the Regulatory Compliance database and application into WaLIS. This began by identifying and cleaning numerous anomalies in the database, including facility locations and sample collection units. The property tax information system (TAXIS) used by the LAP was also fully integrated into WaLIS. Throughout WaLIS, field "Observations" were changed from a business table to a spatial feature layer, and all existing "Observations", including encroachments, were moved to Journal entries. All database attachment "Type" and "Sub-type" fields were standardized. A significant amount of assistance was provided to the Land Use Permits group with billing and receipts via WaLIS.

5.3.4 Data Dissemination to Stakeholders

Using data sharing policies developed in cooperation with DEP Legal, the GIS program reviewed all outside requests for GIS data, and either emailed or wrote 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, were sent data via email or CD as they became available. 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 construction and engineering projects. Various GIS datasets were also forwarded to several researchers collaborating with the Modeling Program.

6. Regulatory Programs

A primary component of DEP's overall watershed protection strategy is the enforcement of applicable environmental regulations, which include the New York City Watershed Rules and Regulations (WR&R) (1997), the federal Clean Water Act (33 U.S.C. §1251 et seq.), the National Pollutant Discharge Elimination System, and the State Environmental Quality Review Act (SEQRA), as well as local ordinances. Of these, the primary mechanism for protection of the water supply is the WR&R.

DEP's regulatory efforts are focused on three major areas: review and approval of projects within the watershed, environmental law enforcement, and regulatory compliance and inspection of wastewater treatment plants (WWTPs).

6.1 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 WWTPs, the installation of subsurface sewage treatment systems (SSTSs) and sewer collection systems, the preparation of stormwater pollution prevention plans (SWPPPs), and the construction of certain impervious surfaces. In addition, DEP reviews and issues permits for individual residential stormwater plans (IRSPs) and for impervious surfaces associated with stream diversions or pipings. DEP also ensures that during and after construction, projects that require SWPPPs or IRSPs have the necessary best management practices (BMPs) installed, and that erosion controls are properly sited and maintained. In addition, DEP 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 Memorandum of Understanding.

Table 6.1 lists the number of new projects received in 2011 in the East of Hudson FAD basins. The new, delegated, and remediated individual septic systems for these basins are listed in Table 6.2.

Table 6.1. East of Hudson FAD basin new projects for 2011. Project summaries and maps showing project locations can be found in the biannual Filtration Avoidance 6.1 Project Activities reports. OT = other; SP = stormwater and crossing, piping, diversion; VA = variance.

Basin	Town	Total	OT	SP	VA
Cross River	Lewisboro	3		1	2
Croton Falls	Carmel	4	1	3	
Croton Falls	Southeast	1		1	

Table 6.1. (Continued) East of Hudson FAD basin new projects for 2011. Project summaries and maps showing project locations can be found in the biannual Filtration Avoidance 6.1 Project Activities reports. OT = other; SP = stormwater and crossing, piping, diversion; VA = variance.

Basin	Town	Total	OT	SP	VA
Kensico	Greenwich, CT	1	1		
West Branch	Carmel	1		1	
Totals		10	2	6	2

Table 6.2. East of Hudson FAD basin individual SSTSs for 2011.

Reservoir	Delegated septics	New septics	Septic repairs	Approvals	Constructions
Boyd Corners	1	0	3	6	0
Cross River	12	0	1	15	10
Croton Falls	8	0	17	21	5
Kensico	2	0	0	1	1
West Branch	7	0	9	13	3
Totals	30	0	30	56	19

All new and repaired individual septic system applications in the Kensico, West Branch, Boyd Corners, Croton Falls, and Cross River basins located in Putnam and Westchester Counties are subject to delegated review by the county health departments. (For more on delegation agreements, see Section 6.1.2.) The new and repaired individual septic systems located in Dutchess County are reviewed and approved by DEP.

Table 6.3 lists new projects received in 2011 in the West of Hudson basins. These projects include new or repaired commercial, institutional, and multi-family septics, and individual advanced treatment units (ATUs). The “Other” projects consist of DOT projects, wetland and stream disturbances, mining applications from DEC, timber harvesting, and stormwater retrofit projects. New, delegated, and remediated individual septic systems are listed in Tables 6.4 (Catskill watersheds) and 6.5 (Delaware watersheds).

Table 6.3. West of Hudson new projects for 2011. Project summaries and maps showing project locations can be found in the biannual Filtration Avoidance 6.1 Project Activities reports. CR = intermediate repair; IS = intermediate SSTS; OT = other; SC = sewer collection; CN = sewer connection; SP = stormwater and crossing, piping, diversion; SD = stream disturbance; VA = variance.

Reservoir	Town	CR	IS	OT	SC	CN	SP	SD	VA	Total
Ashokan	Hunter							1		1
Ashokan	Shandaken	3					2		1	6
Cannonsville	Delhi							1		1
Cannonsville	Franklin							1		1
Cannonsville	Hamden							1		1
Cannonsville	Kortright							3		3
Cannonsville	Tompkins							1		1
Cannonsville	Walton			1				2		3
Cannonsville	(V) Delhi						1			1
Cannonsville	(V) Walton						1	1		2
Pepacton	Andes							2		2
Pepacton	Middletown	1	1	1				3		6
Pepacton	Roxbury						1			1
Pepacton	(V) Fleischmanns							1		1
Rondout	Denning							1		1
Rondout	Neversink	1								1
Schoharie	Ashland			2			2			4
Schoharie	Conesville							1		1
Schoharie	Gilboa						1			1
Schoharie	Hunter		2			1	1	1		5
Schoharie	Jewett			1			1	1	2	5
Schoharie	Lexington			3				1		4
Schoharie	Prattsville			1						1
Schoharie	Roxbury							1		1
Schoharie	Windham			4	1		2	1		8
Schoharie	(V) Tannersville			1						1
Totals		5	3	14	1	1	12	24	3	63

Table 6.4. Ashokan and Schoharie Reservoirs individual SSTSs for 2011.

Reservoir	Delegated septics	New septics	Septic repairs	Approvals	Constructions
Ashokan	5	3	54	62	44
Schoharie	N/A	27	47	74	59
Totals	5	30	101	136	103

Table 6.5. Cannonsville, Neversink, Pepacton, and Rondout Reservoirs individual SSTSs for 2011.

Reservoir	Delegated septics	New septics	Septic repairs	Approvals	Constructions
Cannonsville	N/A	17	66	84	70
Neversink	1	1	5	6	7
Pepacton	N/A	4	50	53	54
Rondout	2	3	13	17	13
Totals	3	25	134	160	144

6.1.1 SEQRA Coordination

DEP conducts reviews of all SEQRA projects 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, and interacts with local, state, and federal officials and other parties.

SEQRA Actions include Notices of Intent to Act as Lead Agency, Determinations of Action Types, Environmental Assessment Forms (EAFs), Scoping Documents, Draft Environmental Impact Statements (DEISs), Final Environmental Impact Statements (FEISs), Supplemental Environmental Impact Statements, and Findings to Approve or Deny. Table 6.6 presents a summary of SEQRA actions in 2011.

Table 6.6. SEQRA actions in 2011.

Received	Reviewed	Comment letters issued	Ongoing reviews	SEQRA process closed
100	100	63	88	47

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

Table 6.7 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. 2011 SEQRA activity and status for significant Type I Actions.

Project name	Town/County	Basin	Description	Status
T/Olive Comprehensive Plan	Olive/Ulster	Ashokan	Proposed Town-wide Comprehensive Plan	DEP issued comment letter on 9/12/11 on the draft Comprehensive Plan.
Zen Mountain Monastery	Shandaken/Ulster	Ashokan	Construction of a 5,400 sq. ft. new building. Site plan includes 50 parking spaces.	DEP issued comment letter on 2/17/11 and received Lead Agency Negative Declaration on 4/13/11.
Trout Creek CWMP	Bovina/Delaware	Cannonsville	Proposed new wastewater collection and treatment system to service 48 properties. Stormwater retrofit is also proposed to include new catch basins, collection, and stormwater treatment at the Town Highway Garage.	DEP issued comment letter on 3/15/11 and received Lead Agency Negative Declaration on 4/11/11.
Pawling Comprehensive Plan	Pawling/Dutchess	East and West Branch	Proposed Comprehensive Plan Update and Zoning Amendments	DEP reviewed and issued comments on the DGEIS on 10/25/11.
Kent Wireless Infrastructure Plan	Kent/Putnam	West Branch	Proposed locations for cell towers in formalized agreement	DEP reviewed and issued comment letter on DGEIS on 11/1/11. DEP issued comments on the FGEIS on 1/19/12.

Table 6.7. (Continued) 2011 SEQRA activity and status for significant Type I Actions.

Project name	Town/County	Basin	Description	Status
11 New King Street (Log #2008-KE-2045)	North Castle	Kensico	Construction of a multi-story, 1,450-space parking garage to provide additional parking space for the Westchester County Airport.	DEP attended public hearing and issued comment letter on the DEIS on 5/23/11. DEP is waiting for acceptance of FEIS from Town Planning Board.
Moresville Energy LLC for Wind Energy	Roxbury and Stamford/Delaware	Multiple	Proposal to construct a wind energy facility consisting of 33 wind turbines and approximately 8.27 miles of access roads	DEP issued DEIS comment letter to the Town of Roxbury Planning Board on 6/2/08.
North Salem Comprehensive Plan	North Salem/Westchester	Multiple	Proposed 2011 Comprehensive Plan	DEP issued comment letters on the Draft Scope on 3/22/11 and the DEIS on 6/27/11. DEP received the FEIS on 9/2/11 and received the Lead Agency Findings to Approve on 9/28/11.
Destination Windham	Windham/Greene	Schoharie	Proposed 41-unit condominium, ice rink, and conversion of parking lot to beginner ski trail	DEP issued comment letter on 9/1/11 and received Lead Agency Negative Declaration on 12/5/11.

Table 6.7. (Continued) 2011 SEQRA activity and status for significant Type I Actions.

Project name	Town/County	Basin	Description	Status
Windham Mountain Sporting Club	Windham/Greene	Schoharie	Construction of 345 multiphase residential units, two lodges, wellness center with swimming pool, roads, and two ski lifts on 465- acre parcel	DEP issued a comment letter on 2/17/10 on the draft scope. DEP attended several planning board meetings and had several discussions with the Lead Agency regarding the alternative open space layout plan. In 2011, DEP met with the project sponsor and conducted an on-site watercourse delineation.

6.1.2 Delegation Agreements

Westchester and Putnam Counties perform reviews of new and repaired septic systems in accordance with their Delegation Agreements. Ulster County performs reviews of new septic systems in accordance with its Delegation Agreement.

DEP received documentation concerning the review of 300 delegated systems during calendar year 2011. Sixty-nine of these reviews were for projects located in the West of Hudson watershed. The remaining 231 delegated septic systems are located in the East of Hudson watershed.

6.2 Enforcement Activities

DEP investigates and confirms septic failures, issues Notices of Violation (NOVs), pursues enforcement actions on failed SSTSs, and refers certain criminal activity to the DEP Police. These activities are coordinated with DEP Legal and Corporation Counsel, county health departments, local building inspectors, and the Catskill Watershed Corporation if the activity is in a New York City Watershed Memorandum of Agreement (MOA) (1997) program area.

The DEP Police patrol the watershed on a daily basis. The police receive over 300 hours of training in environmental law and services, as well as 170 hours of practical field training in environmental and infrastructure protection. They have the authority to issue summonses or Notices of Warning for violations of the New York State Environmental Conservation Law and the WR&R, as well as other state and local laws. The DEP Police coordinate with other DEP

divisions to ensure they are aware of ongoing construction sites in the watershed, and that areas of special concern are being monitored. Currently, members of the DEP Police attend the DEP monthly enforcement meetings for both the East of Hudson (EOH) and West of Hudson (WOH) watersheds.

In 2011, DEP Police:

- Completed 18,271.5 hours of training
- Conducted 6,293 preliminary investigations
- Conducted 430 long-term investigations related to crimes arising from acts of pollution or to terrorism
- Patrolled 2,138,961 miles
- Conducted 176,281 physical security inspections

Also in 2011, the DEP Police made 88 arrests, issued 799 summonses, and served 595 Notices of Warning for violations of the New York State Penal Law, the New York State Environmental Conservation Law, the New York State Vehicle & Traffic Law, the WR&R, and various other state and local statutes.

6.3 Wastewater Treatment Plant Compliance and Inspection Program

DEP's Wastewater Treatment Plant Compliance and Inspection (WWTPCI) Program conducts a quarterly compliance inspection at each surface-discharging WWTP that operates on a year-round basis. A minimum of two compliance inspections are conducted during the operating season per year at seasonal surface-discharging facilities. 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 sampling results from biweekly DEP sampling and analyses. When needed, DEP laboratories are asked to collect samples and conduct special analyses to identify violations and assist in resolving operational issues.

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

WWTPs in the City's watershed were impacted by the severe weather events over the past year. The snowmelt and record rainfall in March, Tropical Storm Irene in August, and the Halloween blizzard in October, all proved challenging to both the physical structures and the operators who manage these plants. Five WOH WWTPs experienced problems treating wastewater overflows or bypasses due to Tropical Storm Irene. Two days following the tropical storm, only two facilities—Boiceville and Prattsville WWTPs—were still bypassing a small portion of their operations. Exactly one week following the storm, all WOH facilities were in full compliance. All the EOH WWTPs experienced increases in flow due to infiltration and inflow (I&I), along with sustained periods operating on auxiliary power; nevertheless, the plants were still able to provide adequate treatment of their waste streams.

Facility Compliance in the Catskill/Delaware Watershed

Thirty-five WOH WWTPs, including the New Infrastructure Program (NIP) facilities and Community Wastewater Management Program (CWMP) facilities and their respective connections, were inspected by DEP on a regular schedule in 2011. (The most recently-constructed CWMP facility, the Ashland WWTP, came on line in November 2011.) Of these, 28 are permitted for year-round discharge and seven for seasonal discharge. Three of the 35 are wastewater treatment facilities permitted to discharge to groundwater. These are the Hamlet of Chichester, Mountainside Farms, and Hanah Country Club. Three other facilities are classified as industrial non-contact cooling water discharges. These are Ultra Dairy, Friesland Campina-DOMO, and Kraft Dairy. Altogether, DEP conducted 224 scheduled compliance, emergency response, and WWTP upgrade construction inspections in 2011.

Compliance with State Pollution Discharge Elimination System (SPDES) permits continued to improve among WWTPs in the Catskill/Delaware watersheds in 2011, due in large part to the Program.

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 by DEP to remediate the problem with the facility owner and/or operator have failed. DEP, in conjunction with DEC and local regulatory authorities, sends out an NOV letter prior to calling for a CC. Because many problematic and outdated facilities which exceeded their permits on a regular basis have been connected to another upgraded facility, upgraded as a standalone facility, converted to subsurface discharge, or totally abandoned, the number of these failed WWTPs has decreased greatly. As a result of implementation of the compliance program and completion of all regulatory upgrades during the monitoring period, DEP did not need to conduct any CCs in 2011.

DEP reviewed, approved, and monitored the implementation and construction of several WWTP connections to NIP facilities. The Bread Alone and Onteora Jr-Sr High School

connections, conveying wastewater to the Village of Boiceville WWTP, were completed in 2011, with final inspections and decommissioning of the onsite WWTP scheduled for the first quarter of 2012.

Facility Compliance in the East of Hudson Watershed

DEP ensures that adequate measures are taken to enforce compliance with the SPDES permits issued to the 65 WWTPs and the 38 groundwater remediation systems, landfills, oil/water separators, and wastewater collection systems that discharge into the EOH watershed, including Croton basins. In 2011, DEP conducted 635 scheduled compliance, emergency response, and WWTP upgrade construction inspections in 2011.

The West Branch, Boyd Corners, Croton Falls, Cross River, and Kensico Reservoir basins are of special interest because they contribute to waters of the Delaware System. The following is a summary of the WWTPs and collection systems inspected within the West Branch, Croton Falls, and Cross River 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.

There are nine active and one inactive WWTPs in the West Branch, Croton Falls, and Cross River basins. All of the active WWTPs were in substantial compliance with their SPDES permit discharge limitations in 2011. Carmel Sewer District #2 WWTP did experience a sewage overflow from its collection system on March 6, 2011 that was not entirely contained; water quality, however, was not impacted. The excess hydraulic load caused by heavy rain led to all available tankage being filled, as a result of which the plant had no capacity to accommodate the overload. For approximately six hours, the plant experienced peak flow rates exceeding 3,000 gallons per minute, causing the Parshall flume to overflow. The spill was chlorinated and contained within the plant grounds. The microfilters could not handle the peak flows, so a bypass was instituted to protect the treatment equipment.

DEP reviewed, approved, and monitored the construction of the standalone upgrades for all of the WWTPs contained within the West Branch, Croton Falls, and Cross River basins. The Lake Plaza/Ralph Morando service connection to the Carmel Sewer District #1 collection system, which conveys wastewater to the City-owned Mahopac WWTP, was completed in May 2011, following which, in the third quarter of 2011, the Lake Plaza WWTP was decommissioned. The Waccabuc Country Club WWTP upgrade project was certified functionally complete by the design engineer on June 15, 2011; DEP authorized start-up and performance testing on June 30, 2011.

DEP performed visual inspections of the West Lake Trunk Sewer monthly throughout 2011 in conjunction with regularly scheduled stormwater BMP inspections in the Kensico basin. These inspections revealed no abnormal conditions. Following Tropical Storm Irene and Tropical

Storm Lee in September 2011, DEP performed numerous inspections of the West Lake Trunk Sewer in conjunction with representatives from the Westchester County Department of Environmental Facilities, in response to elevated fecal and total coliform counts in DEP samples collected at Shaft 18 and the lower effluent chamber. Dye testing was also conducted to establish any exfiltration from the sewer line. No abnormalities were discovered and no evidence of overflow was observed.

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 2011 monitoring period. The inspections revealed no abnormal conditions. Several inspections were performed, in conjunction with the impacted watershed towns, in response to the aforementioned elevated coliform counts in the Kensico basin. A visual inspection of the collection system and its appurtenances in the Towns of New Castle, North Castle, and Harrison was conducted. The inspections revealed no abnormal conditions at any of the lift stations, nor was there was evidence of a sewage overflow.

6.3.1 Sampling of WWTP Effluents

Sampling of surface-discharging WWTP effluents is conducted by DEP's ELAP-approved laboratories. At non-City-owned WWTPs, grab samples are taken twice monthly. In addition, a composite sample is collected once a year from those plants that have composite sample monitoring requirements in their SPDES permits; these plants are listed in the Watershed Water Quality Monitoring Plan (DEP 2009). Special cases are the non-contact cooling water discharges at Kraft and Morningstar Foods/Dairyvest, which are routinely sampled quarterly by composite sample. City-owned WWTPs are sampled in accordance with SPDES permit monitoring requirements; these samples, including grab samples, are analyzed by DEP laboratories, with results reported in Discharge Monitoring Reports.

In the Catskill System in 2011, 18 WWTP effluents were sampled; composite samples were collected from 9 of them. In the Delaware System, 12 WWTP effluents and the 2 non-contact cooling water discharges (Kraft and Morningstar) were sampled. Composite samples were collected at 10 of the WWTPs and at both non-contact cooling water discharges. The EOH System (including Croton) had 63 WWTPs sampled and composite samples were collected at the Mahopac WWTP.

In 2011, 2,249 analyses were performed on 417 effluent samples from WWTPs in the Catskill System. For the Delaware System, there were 2,600 analyses performed on 329 effluent samples from WWTPs and non-contact cooling water discharges (e.g., Kraft). Lastly, 969 analyses were performed on 249 effluent samples from EOH WWTPs.

Sampling data are reviewed to track compliance with SPDES-permitted effluent limits. In addition, total phosphorus concentration data are used to develop point source phosphorus loads.

6.4 Winter Road Deicer Policy and Protection Development

In the past, DEP has reported on developments pertaining to local and regional initiatives to mitigate the impacts associated with the application of roadway deicing materials. There was no significant action at the local or state level in 2011. DEP will report on initiatives in the future if there is renewed activity related to roadway deicing.

7. Catskill/Delaware Filtration/UV Disinfection Facilities

DEP's Ultraviolet (UV) Disinfection Facility is being constructed on the City-owned Eastview Parcel (Towns of Mount Pleasant and Greenburgh, Westchester County). Provisions have been made for future connections from the Catskill Aqueduct once it is pressurized, as well as from the proposed Kensico-City Tunnel and to/from the Catskill/Delaware water filtration facility, if built. The current design also provides design elements to facilitate connections for local consumers and for the delivery of finished water to the Kensico-City Tunnel should it someday be constructed at this site.

To maintain its dual track approach for meeting the goals of the Surface Water Treatment Rule (EPA 1989), DEP continues to perform biennial updates of the preliminary design of 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 review was completed in September 2011.

7.1 Ultraviolet Disinfection Facilities

7.1.1 Facility Construction Contracts

Progress has been steady, allowing completion of Administrative Consent Order milestones ahead of schedule. Milestone 8, Enclosure of the UV Building with a Permanent Structure, was achieved in January 2011 and the next milestone, Completion of the Installation of the Electrical Substation, is ahead of schedule.

Work on the other buildings related to the facility continued. These buildings include the North Forebay, South Forebay, and the Energy Dissipating Valve Chamber. At the end of 2011, each of these buildings was enclosed and wiring of the equipment to control panels had commenced. The contractor is also installing other major site utilities and electrical duct banks to allow for communications and power between each major structure.

The manufacture, shipment, and installation of key pieces of equipment continued throughout 2011. As of December 2011 all of the 16 flow control valves had been installed. Work to establish an air gap between the raw water and treated water continued.

7.1.2 Project Schedule

The project schedule is prescribed in both the 2007 Filtration Avoidance Determination and an Administrative Order on Consent between DEP and EPA. Monthly reports are submitted in accordance with the Administrative Order on Consent and describe progress on the project and provide a mechanism for describing any known or anticipated non-compliant milestones. To date, the contractor's progress allowed DEP to achieve Milestones 3 to 8 in advance of the consent order dates.

7.1.3 Design of Ancillary Projects

Wetland Mitigation

The contract to perform wetland work was issued to Halmar International, LLC, in an order to commence in July 2009. The contract calls for the creation, restoration, stabilization, and maintenance of wetland areas in accordance with U.S. Army Corps of Engineers Protection of Waters permit requirements. The portion of the work to be performed in North Castle was completed in the summer of 2010. The contractor continues to monitor the site verifying plant viability.

As of December 2011, the contractor had cleared and graded the portion of the Eastview site in the Town of Greenburgh and begun mobilization at the portion of the site in the Town of Mount Pleasant. The planting on the on-site parcels will be completed in 2012 and monitored by the contractor through 2014.

Mount Pleasant Water Main

To meet certain requirements of the Mount Pleasant Site Plan Approval, DEP constructed a pipeline between the Delaware Aqueduct on the Kensico campus and the Town's Commerce Street Pumping Station. The contract was issued to Northeast Remsco in November 2009. This contract achieved substantial completion in September 2010.

Mount Pleasant UV

As part of the site plan permit approval agreement, DEP is required to provide the Town of Mount Pleasant with UV treated water. The project involves the installation of a new UV disinfection system within the Commerce Street pump station. In 2011, the contract was awarded to the FCM Group, Inc. The contract is currently underway. Site specific validation of the UV units is currently scheduled for spring 2012.

7.1.4 Permitting

New York State Department of Transportation

The installation of the Catskill treated water conduits under Route 100C was completed in 2009. Continuous meetings and correspondence between Town representatives and the New York State Department of Transportation facilitated temporary partial road closures allowing for timely performance of work.

Greenburgh Work Permits

The contractor proceeded with monitoring the work performed in the Town of Greenburgh relating to the building permit to construct a small superstructure that will provide access to the proposed treated water connection to the Catskill Aqueduct.

State Pollutant Discharge Elimination System (SPDES) Permits for Operations

The SPDES application for Operation was sent to DEC on August 27, 2010, and approved in 2011. It includes monitoring the discharge at three outfalls and an effective date of January 2012.

7.1.5 Pilot Studies

UV Lamp Fouling Study

The final report was submitted to DEP in 2009. Results presented in this report are being used to develop operation and maintenance procedures for the full-scale facility. The data presented also aided in preliminary staffing discussions.

Dyed Microshpere Study

A study to analyze the level of *Cryptosporidium* inactivation was performed at the Hydroqual facility in Johnstown, NY. Dyed microspheres were added to the water to simulate *Cryptosporidium.* The microspheres were analyzed before and after disinfection to measure the actual rate of inactivation. This study provided additional information that will aid in the determination of the appropriate UV dose during operation. The information was submitted for review in 2010 and may be used in the future to optimize the UV treatment.

7.2 Filtration Planning Design Update

7.2.1 Facility Design Update

In accordance with the terms for relief from completing final designs for a filtration facility, a preliminary design update was completed in September 2009 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 converting the previous design into a three-dimensional drawing platform. This change will facilitate additional coordination among the different design disciplines while resolving many conflicts before work begins on-site.

The 2011 biennial review of the Filtration Plant Design found that the previously submitted report still is valid as a complete preliminary design. As there were no significant site modifications since the 2009 update, modifications to the report were not performed.

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. The two major ongoing functions of WDRAP are:

- 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 ensure rapid detection of any outbreaks

Active laboratory surveillance, involving regular visits to or telephone contact with parasitology laboratories by DOHMH staff members, began in July 1993 for giardiasis and in November 1994 for cryptosporidiosis, and continued through 2010. In January 2011 active laboratory surveillance for giardiasis and cryptosporidiosis was discontinued, as it had been replaced by an electronic reporting system. By January 2011 almost all New York City clinical laboratories were fully enrolled in the Electronic Clinical Laboratory Reporting System (ECLRS), which was developed to ensure rapid and more complete reporting of conditions such as giardiasis and cryptosporidiosis. Electronically reported health data are more timely than active surveillance, and are more complete than typical paper-based systems. DOHMH does not anticipate that this change in surveillance will have a significant impact on the program or the completeness or quality of giardiasis and cryptosporidiosis surveillance data.

For all cryptosporidiosis cases, and as needed for giardiasis cases, public health epidemiologists contact patients to verify the data provided in the case report, to collect additional demographic and clinical information, and to identify possible sources of exposure. At the time of this writing, the 2011 *preliminary* count of cases reported to DOHMH among New York City residents was 918 cases of giardiasis and 86 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 (ED) logs; under another system DOHMH monitors and assists in the investigation of GI outbreaks in eight sentinel nursing homes; and a third system tracks the number of stool specimens submitted to a clinical laboratory for microbiological testing. In the ED system, there were data transmission problems starting August 10, 2011, resulting in the exclusion of data from some EDs. These problems were resolved by August 31, and the previously missing data were provided. Otherwise, the outbreak detection systems involving data from EDs, nursing homes, and clinical labs were all in operation through 2011.

The fourth type of outbreak detection system in operation in New York City involves monitoring of sales of over-the-counter or non-prescription antidiarrheal medications. The City's antidiarrheal medication monitoring activities have two components: the ADM system and the OTC system. The two systems monitor daily sales of non-prescription antidiarrheal medications at two separate major store chains. The ADM System is managed by DEP and the OTC system is managed by DOHMH.

Regarding the OTC system, beginning in mid-June there was a decrease in the number of stores reporting medication sales. The decrease resulted from a disruption in data transmission that occurred because the store chain that submits the data was undergoing a revision to its data systems, and stores within the chain were being gradually moved over to the new system. This change affected the ability of the OTC system to detect signals in antidiarrheal medication sales from mid-June to October 20. Starting October 21, and throughout the month of December, the OTC analysis was no longer run. It is currently anticipated that the OTC analysis will resume in March 2012, by which time data transmission issues should be resolved.

The ADM system was in operation throughout 2011. In the first half of 2011 (January to approximately July), the system experienced some data analysis and reporting delays. ADM data analysis and reporting timeliness were improved in the second half of 2011. Also, a metrics tracking system for the ADM system has been put in place, and an IT upgrade in 2011 improved system efficiency.

Educational outreach in 2011 included a presentation by a DOHMH WDRAP team member to graduate students at a school of public health in April 2011.

There was no evidence of a drinking water-related disease outbreak in New York City in 2011. Additional results and program information can be found in the WDRAP semiannual and annual reports.

8.2 Cross Connection Control Program

During 2011, DEP's Cross Connection Control Program continued to exceed milestones established by the 2007 Filtration Avoidance Determination (Table 8.1).There was, however, a decline in the number of exemption requests processed and the Notices of Violation (NOVs) for failure to test annually, the former due to a new fee schedule and rejections, the latter to an enforcement emphasis on installation.

Table 8.1. Cross connection FAD milestones.

Annual and Semi-Annual Periods	Responding to Incidents	Facility "Hazardous" Inspections	Enforcement Initiated for "Hazardous" Premises	Backflow Preventer Plans Approved	Backflow Preventer Plans Reviewed with Self-Certification (Approved)	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	0	3207	1124	2642	12	1160	586
Jan. - Dec. 2009	0	2812	1064	3021	0	792	568
Jan. - Dec. 2010	3	9262	2887	3280	1	472	474
Jan. - Dec. 2011	2	5187	4060	7625	19(6)	445	57
FAD Requirement	1-2/yr	300-450/yr	225/yr	400/yr	TBD[1]	400/yr	200/yr

[1] To be determined. No established minimum level of response.

Highlights of the Cross Connection Control Program's activities in 2011 include:

- DEP completed a contract to retain the services of a consulting engineering firm to perform cross connection control inspections, review plans for new installations, and prepare warning notices and correspondence directing installation as required for both the U.S. Environmental Protection Agency and New York State Department of Health (DOH) compliance. This contract began January 19, 2010. The contract work was completed on January 19, 2011. The contract sparked a large number of requests for re-inspection and assessments. At the time the contract ended, a large number of plans were coming in for review. This was handled by re-appropriating resources to the review section, which stabilized the growing backlog condition.
- In addition to conducting detailed internal site and plumbing inspections of potentially hazardous facilities, DEP performed inspections of some locations classified as aesthetically objectionable, all of which are recorded in the Cross Connection Control database.
- In 2011, the Cross Connection Control Program enforced recent changes to the New York City Building Code which specified the level of protection for certain types of water services, including a requirement that fire sprinkler systems have, at a minimum, a Double Check Detector Assembly (DCDA) installed. Fire sprinkler systems containing a chemical treatment for the prevention of freezing or corrosion control must have a greater level of protection. Inspections were performed in systems located in buildings designated as "high rise" (over 10 stories tall) by the Department of Buildings.
- DEP established an email address on its cross connection control website (backflow@dep.nyc.gov) to receive inquiries from small businesses and the public relating to compliance requirements. Also, a new address was created to accept requests for a waiver from the requirement that an approved backflow prevention device (BPD) must be used when utilizing a fire hydrant as a temporary source of potable water. Hydrantwaiver@dep.nyc.gov is now available for non-profit organizations and community garden associations who wish to obtain such a waiver when they want to use a fire hydrant as a watering station. These organi-

zations are required to demonstrate that the City's water supply will be protected from potential backflow when operating the fire hydrant for watering, and their applications are processed and evaluated on a case-by-case basis. Such waivers have been issued to, among others, the New York Road Runners Association and the New York City Department of Parks and Recreation, whose waiver allows "piggybacking" by registered garden associations.

- DEP responded to two separate incidents relating to possible backflow or cross connection conditions, neither of which, as it turned out, was the result of a cross connection.
- Several educational and outreach presentations were made, each focusing on a different audience. These presentations outlined changes to program rules and requirements regarding cross connection prevention and the need to use appropriate backflow prevention devices. One presentation was made to real estate groups and the public, one to the plumbing industry, and one to engineers and architects focusing on submission requirements regarding the installation of backflow prevention devices.

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 both upstate watershed residents and downstate water consumers. Toward this end, DEP works closely with the Catskill Watershed Corporation (CWC), Cornell Cooperative Extension (CCE), Soil and Water Conservation Districts (SWCDs), the Watershed Agricultural Council (WAC), and numerous local, City, state, and federal partners to inform constituents and raise public awareness about the water supply system, source water protection and conservation, and environmental stewardship.

The 2007 FAD requires DEP to report annually on the educational efforts of the Watershed Agricultural and Forestry Programs, the Stream Management Program, and the 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 land use planning, stream corridor protection, and stormwater management.

Throughout 2011, DEP estimates that up to 431,450 people were exposed to watershed information and educational materials through more than 380 unique events that were directly attended, coordinated, or supported by DEP and its watershed partners. The majority of these events (about 80%) were targeted programs, such as audience-specific workshops, professional development trainings, school visits, speaking engagements, presentations, and tours that reached approximately 28,150 people. At least 76 of these events (20%) were considered "general public outreach" events, such as county fairs and outdoor festivals, which attracted approximately 403,000 visitors.

This chapter summarizes 2011 watershed education and outreach accomplishments organized according to five primary audience categories; a complete listing of all documented activities with locations and attendance numbers is available upon request.

9.1 Water Consumers

During 2011, DEP's official website (nyc.gov/dep) continued to feature a wealth of information about the water supply system, watershed protection, water conservation, drinking water quality, watershed recreation, and environmental education. In order to make the City's FAD deliverables more accessible, DEP created a dedicated FAD report web page which eliminated the need to distribute multiple digital and hard copies. The DEP website now contains key publications such as the annual consumer confidence report, various watershed program brochures, DEP newsletters and press releases, watershed regulations and recreational rules, regulatory guidance

documents (including new ones posted in 2011), environmental education materials, and numerous updates about current events. In 2011, DEP also increased its online presence through social networking sites such as Twitter and Facebook (search: NYC Water).

It is worth noting that in 2011, DEP issued 109 press releases, of which nearly half were devoted to the water supply system or upstate watershed. Among the diverse topics covered by these press releases were water and sewer rates, forestry on City lands, upstate wastewater treatment plant upgrades, land acquisition, watershed recreation, minute amounts of pharmaceuticals in the water supply, hydrofracking, watershed flooding, water supply infrastructure repairs (including the Gilboa Dam and Delaware Aqueduct Bypass), Ashokan turbidity, and other topics.

Also in 2011, as part of its ongoing campaign to promote New York City tap water, DEP once again utilized "water-on-the-go" stations at various events throughout the City, with an estimated 200,000 people visiting these stations. In 2011, DEP attended approximately 120 meetings, attended by thousands of people, to discuss water-related topics, including water conservation and water quality. These meetings consisted of homeowner forums, town halls with elected officials, and local community boards. DEP also utilized the Visitor Center at Newtown Creek in Brooklyn to conduct more than 70 in-City educational programs for more than 3,300 people.

9.2 Watershed Land Owners and Home Owners

In 2011, the Watershed Agricultural Program directly sponsored or conducted 20 farmer education programs that reached more than 470 participants, 346 of whom were identified as farmers. In addition to these targeted programs, WAC also sponsored four farmer outreach meetings to explain the new BMP Prioritization Methodology, conducted a weekly watershed program on Roxbury's WIOX radio station, co-sponsored the annual Clean Sweep Chemical Disposal Day for Delaware County residents and farmers, exhibited at the Old Salem Horse Show in Westchester County, conducted an East of Hudson composting tour, and sponsored multiple watershed film screenings of farm or food-related documentaries. WAC also continued to update and maintain its primary website (nycwatershed.org) along with the Pure Catskills website (purecatskills.com), while helping to launch a third website (catskillsfarmlink.org) that is intended to help connect new/beginning farmers with potential agricultural land owners.

The Watershed Forestry Program continued to work with Greene County CCE to implement a targeted forest land owner education strategy that includes workshops, self-study courses, and a fledgling collaboration with the statewide Master Forest Owner Program. These combined efforts directly involved more than 70 forest land owners in the Catskill/Delaware watersheds. In the East of Hudson watersheds, the Watershed Forestry Program co-sponsored a Quality Deer Management Workshop at Clearpool Education Camp that was attended by 20 land owners and foresters.

The Stream Management Program continued to educate streamside land owners in the Catskill/Delaware watersheds primarily through basin-specific workshops, public presentations and speaking engagements, volunteer riparian planting efforts, local stream cleanup events, watershed advisory committees, project advisory meetings, newsletters and press releases, and the catskillstreams.org website. Key topics that were addressed during 2011 for home owners and land owners included streamside erosion, conservation landscaping, stream recreational access, pond management, rain barrel building, and watershed flooding/storm response.

The CWC sponsored two home owner workshops covering septic system maintenance that were attended by 14 people. The CWC also kept watershed residents informed about its programs and other issues through 31 press releases, *The Advocate* e-newsletter, the CWC website (cwconline.org), and appearances at dozens of special events in the region. The CWC also worked with the Catskill Institute for the Environment (CIE) to coordinate two public lectures in Delhi and Liberty that were attended by 100 participants and co-sponsored by DEP.

9.3 School Groups and Youth Audiences

During 2011, DEP continued to conduct educational programs for students, teachers, educators, and other youth audiences through classroom visits, professional development workshops, and through established programs that promote upstate/downstate collaboration. For example, DEP continued its collaboration with Trout Unlimited to support the hugely popular Trout in the Classroom program which attracts nearly 200 teachers to its annual fall conference each year and which involves 120 classrooms and more than 6,000 students in both New York City and watershed schools.

DEP's 25th annual Water Conservation Art & Poetry Contest attracted more than 400 fourth, fifth, and sixth grade students from New York City and watershed schools. DEP also reached out to teachers at the annual Science Council of New York City (SCONYC) conference and 2011 Environmental Education Expo event, while continuing to support and participate in other youth-oriented programs such as Operation Explore, Green Horizons, and Take Your Child-To Work Day. Thousands of visitors also viewed exhibitions about the New York City Water Supply System at the Queens Museum of Art and the Center for Architecture.

The Watershed Forestry Program continued to implement a comprehensive urban/rural school-based education program comprised of the Watershed Forestry Institute for Teachers, the Green Connections School Partnership Program, the Watershed Forestry Bus Tour Grants Program, and the Catskill Stream & Watershed Education Program. These four school-based education programs collectively attracted 1,678 participants during 2011.

The CWC Public Education Grants Program continued to fund watershed education projects for both New York City and West of Hudson watershed audiences. During its Round 14 grant cycle, which took place during 2011, the CWC funded 22 education grants totaling $129,588. To date, the CWC has awarded 365 education grants totaling over $1.8 million.

Within the watershed, DEP and its partners continued to participate in several county-based environmental awareness days, which annually attract hundreds of students per event. DEP also participated in the following school-based activities: Woodstock Elementary Go Green Day, Blue Mountain Middle School Career Day, Rondout Valley Middle School Career Day, Bennett Elementary Earth Day, and several other school visits and presentations/demonstrations.

Finally, one of the most significant events of 2011 was the Catskill Aqueduct Boy Scout Trek of West Shokan Troop 163, which was founded 100 years ago by engineers who helped construct Ashokan Reservoir. As part of this project, which was supported by DEP and its partners, 15 boy scouts plus several scoutmasters and parent chaperones spent nine days hiking from Ashokan Reservoir in Ulster County all the way into New York City while following the route of the Catskill and Old Croton Aqueducts. Along the way, the scouts were accompanied by the DEP Police and participated in numerous educational programs, including training on invasive species, a water quality sampling presentation at Kensico Dam, a visit to a water treatment facility, and overnight activities at Hilltop Hanover Farm in Westchester and the Museum of Natural History in Manhattan, among other locations. The watershed boy scout trek was so successful it prompted one local resident from the Town of Olive to write DEP with the following acknowledgment: "The Town of Olive and DEP coming together in cordial cooperation after a century of chilly relations is a historic development which will herald in a new era in our sometimes stormy relationship, in my view and the view of many others here in Olive. Thank you for hosting us." Pictures and video from this spectacular project can be viewed at the following website: www.olives-couts.org.

9.4 Local Officials and Watershed Professionals

During 2011, DEP supported and/or participated in numerous professional conferences that are regularly attended by scientists, regulators, local officials, legislators, business groups, resource managers, and watershed professionals. Highlights include: New York Watershed Science and Technical Conference, New York State ReLeaf Conference, New York State Wetlands Forum Conference, New York State Society of American Foresters Annual Meeting, Hudson River Watershed Alliance Conference, Land Trust Alliance Workshop, and Clearpool Sustainability Conference. Attendance at these conferences exceeded 1,500, with most participants from the watershed but with many from across the region/state.

The CWC organized the annual Catskills Local Government Day, but the event was ultimately cancelled due to flooding impacts from Tropical Storms Irene and Lee; the event is being rescheduled for early 2012. The CWC did, however, sponsor a stormwater training workshop that was attended by 90 people, primarily local officials and watershed professionals.

Through the efforts of the Watershed Agricultural and Forestry Programs, DEP supported and/or participated in many professional events and programs during 2011, including the WAP Contractors Meeting; New York State Forestry Awareness Day; Annual WAC Farm-to-Market Conference; Catskill Regional Dairy, Livestock, and Grazing Conference; NOFA-NY Winter Conference; Bedford 2020 Conference on the Environment; New York Biomass Energy Alliance Annual Meeting; New York State Nutgrowers Association; American Farmland Trust "No Farms, No Food" Rally; TED "Changing the Way We Eat" Conference; Deposit Lumberjack Festival; Catskill Forest Festival; and the NYS Woodsmen's Field Days.

In addition, the Stream Management Program continued to work closely with local officials, technical professionals, and other municipal representatives to educate and train these audiences about stream corridor protection, roadside ditch maintenance, native vegetation, watershed flooding/storm response, and other topics. Highlights for 2011 include: Ashokan Watershed Conference; Schoharie Watershed Summit; Central Catskills Chamber of Commerce Meeting; Catskill Map Steering Committee Meeting; and various targeted workshops/presentations for highway departments, municipal planners, regulatory agencies, and other officials.

Finally, DEP continued to participate in the Catskill Regional Invasive Species Partnership (CRISP), while collaborating with WAC and the CWC to organize and host a series of watershed tours for international delegations from India, World Bank Latin America, Mongolia, and France; these professional groups visited the New York City Water Supply Watershed to learn more about the concept of Payment for Ecosystems Services (PES) as it relates to watershed protection.

9.5 Other "General Public" Audiences

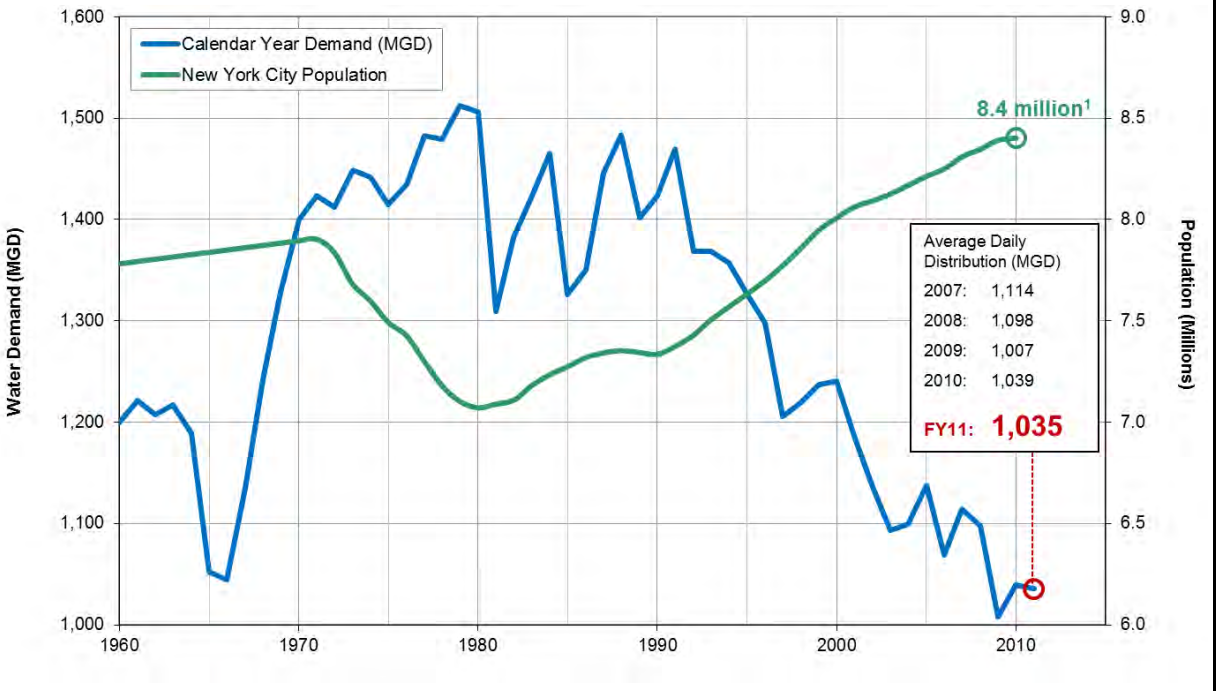
Each year, DEP and its partners attend numerous large community outreach events throughout New York City and the Catskill/Delaware/Croton watersheds in order to display and disseminate educational information about watershed protection, water conservation, and environmental stewardship. Highlights for 2011 include: Delaware County Fair, Grahamsville Little World's Fair, Ashokan Eco-Heritage Festival, Batavia Kill Streamside Celebration, Hudson River Snapshot Day, Kensico Earth Day, Meredith Dairy Festival, Ulster County Fair, New York City Green Expo, Winter Jam (NYC), New Green City Event (NYC), Roxbury Sidewalk Festival, Catskill Mountainkeeper Barnfest, Walton Winter Festival, Open House New York, and Windham Foundation Family Day. It is important to recognize that hundreds of thousands of visitors

attend these events on a collective basis, which doesn't take into account the multiplier effect that occurs when people attend an event and then pass along information to their friends, family members, and neighbors.

10. Miscellaneous Reporting Provisions

10.1 Water Conservation

DEP is committed to the philosophy of water conservation because it is often the most accessible and cost-effective method of ensuring an adequate water supply for the region with minimal impacts to the environment. Largely as a result of its conservation efforts, significant year-over-year reductions in demand have occurred over the past decade, despite population growth. This is reflected in the daily water distribution system data, which reveals a 30 percent decline since the early 1990s, dropping to 1,035 MGD in 2011 (Figure 10.1). New York City residents are also consuming less water than in prior years, with per capita residential water consumption dropping from 77 gallons per capita per day (GPCD) in 2010 to 75 GPCD in 2011 (Table 10.1).



[1]July 2010 population estimate, US Census Bureau/New York City Department of City Planning.

Figure 10.1. Historical water distribution and population.

Table 10.1. Consumption for residential development, GPCD.

Land use class	FY10		FY11	
	All billing types	Meter-billed accounts	All billing types	Meter-billed accounts
Tax Class 1, one-family dwellings	69	67	71	69
Tax Class 1, two- and three-family dwellings	66	64	68	67
Multi-family buildings	77	56	75	53
Mixed residential and commercial buildings	94	79	86	65
All residential development	77	65	75	63

DEP continues to maintain existing water conservation efforts to ensure a manageable level of water demand in New York City. These efforts include, but are not limited to, distribution of water efficiency kits, public education campaigns, full build-out of City-wide Automated Meter Reading (AMR) device installations, and most recently the Water Leak Notification Program, which detects unknown leaks by monitoring spikes in usage and sends notifications to customers that sign up for the program.

Water for the Future and the Demand Management Strategy

Under its Water for the Future Program, DEP is planning the repair of a leaking section of the Delaware Aqueduct, which is scheduled for completion in 2020. In order to perform the work, the leaking portion of the Delaware Aqueduct will be shut down and decommissioned while a bypass tunnel is constructed and reconnected to the system over a two-year period. These activities will suspend delivery of approximately 50 percent of the City's water supply for a period of six months to two years. In anticipation of this shortfall, DEP is considering a combination of solutions to augment the water supply, including creation of connections with New Jersey and Nassau County, optimization of the Catskill Aqueduct, and reactivation of the groundwater supply system.

To further address water shortage conditions during the shutdown and construction of the bypass tunnel, DEP is implementing a Demand Management Strategy to reduce water demand by 5 percent (approximately 50 MGD), which will be spread across both public and private water users. Installation of the AMR system allows DEP to monitor consumption data more closely, and target water use at the customer level and water demand in different neighborhoods throughout the City (Figure 10.2), thereby identifying where more water savings can be realized.

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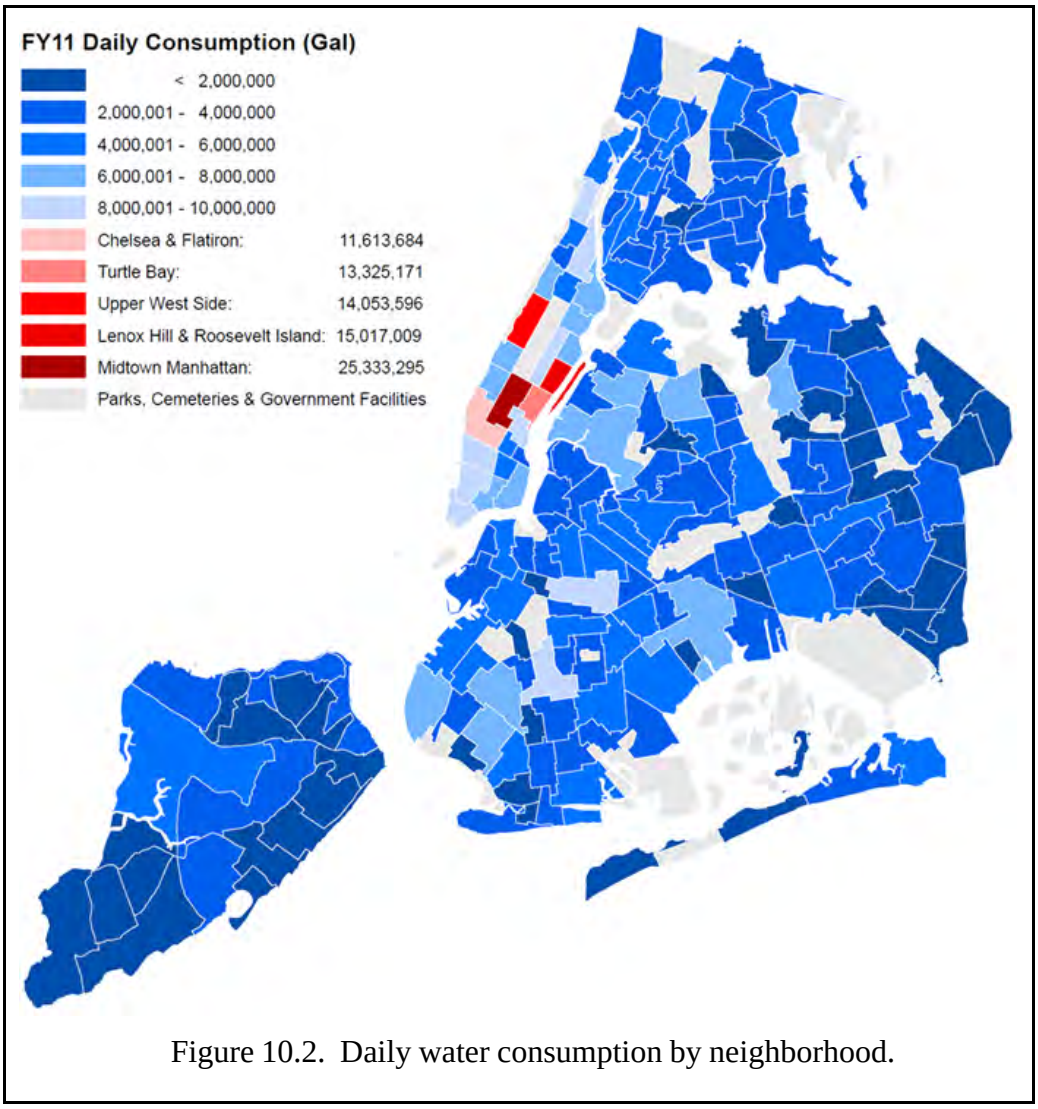

Figure 10.2. Daily water consumption by neighborhood.

The Demand Management Strategy consists of a tiered approach to water conservation, with the most cost-effective measures implemented in the near term (beginning in 2013), and more costly measures implemented in phases over the next six to eight years. A summary of these measures follows:

City-owned properties

DEP began initial outreach efforts for implementation of the Demand Management Plan in September 2011, meeting with City agencies that are on a fixed water charge to discuss water conservation and demand management opportunities on city-owned properties. A group of six cost-effective Initial Projects were identified to monitor and quantify the water savings generated from implementation of water efficiency measures such as fixture replacements and park spray shower retrofits. Water consumption data for each of the Initial Projects will be monitored, collected, and analyzed to determine total water use reduction as a result of replacing standard flow

fixtures and park spray showers with high-efficiency and automated units. Based on the information obtained and lessons learned from the Initial Projects, DEP will scale up the initiative to encompass as many City-owned properties as possible.

End of Frontage Billing and Transition to the Multi-Family Conservation Program

The New York City Water Board intends to end traditional flat rate water and sewer billing in June 2012. With frontage rates due to expire, DEP worked diligently over the last year to finalize a plan for transitioning approximately 33,000 frontage (fixed rate) accounts to the Multi-Family Conservation Program (MCP), including New York City Housing Authority properties. Customers have a choice of moving directly to metered billing or to the MCP, which carries specific water conservation requirements. The MCP offers owners of multi-family housing properties containing six or more dwelling units a water billing rate based on a fixed charge per dwelling unit if the owner invests in low-consumption plumbing hardware and fixtures, and cooperates with DEP in conservation efforts in its buildings. Unmetered properties will be permitted to enter the MCP provided that the owners install a meter and an AMR device on all service lines by January 2015. New enrollees are given three years to complete all conservation-related requirements of the program after they are converted to the MCP rate. During 2011, DEP and the New York City Water Board established the updated/new MCP rates and determined a timeline for expiration of the existing frontage rate. DEP is currently in the process of finalizing the conservation requirements for these properties.

Fixture Replacements and Toilet Disposal Program

As part of the Demand Management Strategy, DEP has initiated internal conversations to plan for a fixture replacement incentive program in residential buildings, including frontage properties transitioning to MCP. This program is voucher-based and will be offered to residential building owners via a portal on the DEP website. Initial planning work has begun to modify and update the web portal that customers will use to register for vouchers that can be redeemed toward purchase of low-flow toilet fixtures. In order to address potential large waste streams generated by the fixture replacement program, DEP has begun to develop a beneficial reuse strategy for discarded/replaced toilets. DEP has projected approximately 800,000 toilet replacements during the course of the six-year fixture replacement program. DEP has also explored procurement processes for permitted waste processing/waste transfer facilities that might have an interest in the material.

Other Initiatives

DEP is currently exploring the development of a water reuse/alternative use incentive program for large water users, organizing a pilot leak detection project to demonstrate the benefits of leak detection on campus-like properties, and drafting revisions to the City's Drought Rules and Drought Management Strategy.

10.2 Updates to Drought Management Plan

In 2011, 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 2011 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
- Planning for a Roseton Bypass

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 in 2011 to study the nature of the leak are described below.

- The Tunnel Monitoring Program continued. 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.
- Surface investigations continued in areas of Roseton and Wawarsing, where water is suspected to be leaking from the tunnel.

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. The 2009 inspection (the first since 2003) indicated there were no significant changes in crack patterns between 2003 and 2009. Another AUV run is planned for 2012.

Remote Operated Vehicle (ROV) Inspection of the RWBT

DEP is moving forward with the ROV program and expects to perform a detailed inspection of the Wawarsing and Roseton areas in 2013. Unlike the AUV, the ROV will allow capture of real-time tunnel data, and provide the ability to perform detailed, close-up investigations beyond the ability of the AUV. The ROV is, however, limited to suspect areas in the tunnel.

Tunnel and Shaft Rehabilitation Program

During 2011, work under the Tunnel and Shaft Rehabilitation Program construction contract was delayed as a result of water quality issues which prevented shutdowns. This work at Shaft 6 to prepare for eventual dewatering of the tunnel is now expected to be complete in 2013.

Planning for a Roseton Bypass

The Roseton bypass project is being implemented through two contracts to expedite the work. The first contract, which is to be bid in 2012, is for construction of a shaft in Newburgh and a shaft in Wappinger. The Newburgh shaft is scheduled to be complete at the end of 2015, with the Wappinger shaft lagging by six months. The bypass tunnel will start at the end of 2014. This contract will connect the shafts, and upon completion of this effort, the tie to the existing RWBT. During the execution of the tie-in, the leaks in the Wawarsing area of the tunnel will be grouted from within the dewatered tunnel. The project is expected to be completed in 2021.

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Appendix Table A. Parcels acquired by easement or fee simple: 1/1/11 to 12/31/11.

NYC property	County	Town	Tax map number	Location	R.E. type	Acquired acres	Closing date
2284	Delaware	Andes	281.-1-8.12	Route 1	Fee	112.05	7/12/11
2291	Delaware	Andes	280.-1-44.2	Bussey Hollow Rd.	Fee	129.31	10/26/11
3825	Delaware	Andes	279.-1-2.4	Fall Clove Road	Fee	105.63	11/2/11
3825	Delaware	Andes	279.-1-2.51	Fall Clove Road	Fee	60.13	11/2/11
7028	Delaware	Andes	381.-3-4	Beech Hill Road	Fee	4.24	2/25/11
7028	Delaware	Andes	381.-3-5.1	Beech Hill Road	Fee	8.07	2/25/11
7028	Delaware	Andes	381.-3-6	Beech Hill Road	Fee	12.41	2/25/11
7028	Delaware	Andes	381.-3-27.1	Beech Hill Road	Fee	9.20	2/25/11
7028	Delaware	Andes	381.-3-27.5	Beech Hill Road	Fee	5.80	2/25/11
7028	Delaware	Andes	381.-3-27.6	Beech Hill Road	Fee	9.92	2/25/11
7028	Delaware	Andes	381.-3-27.7	Beech Hill Road	Fee	1.74	2/25/11
7028	Delaware	Andes	381.-3-27.9	Beech Hill Road	Fee	24.35	2/25/11
7028	Delaware	Andes	381.-3-32	Beech Hill Road	Fee	7.35	2/25/11
7168	Delaware	Andes	260.-1-13.12	New York State Route 28	Fee	26.56	12/29/11
7229	Delaware	Andes	302.-1-1	off Bussey Hollow Road	Fee	116.72	8/2/11
7482	Delaware	Andes	281.-1-9.1	County Route 1	Fee	89.17	7/5/11
7482	Delaware	Andes	281.-1-9.2	County Route 1	Fee	0.34	7/5/11
7657	Delaware	Andes	258.-1-9	State Road	CE	14.16	5/18/11
7657	Delaware	Andes	258.-1-10	State Road	CE	16.21	5/18/11
7657	Delaware	Andes	258.-1-16.112	State Road	CE	42.35	5/18/11
7657	Delaware	Andes	258.-1-16.113	State Road	CE	28.34	5/18/11
7657	Delaware	Andes	258.-1-16.2	State Road	CE	16.24	5/18/11
7766	Delaware	Andes	237.-3-2.2	County Route 2	Fee	5.68	8/16/11
7766	Delaware	Andes	237.-3-2.3	County Route 2	Fee	6.01	8/16/11
7766	Delaware	Andes	237.-3-2.4	County Route 2	Fee	7.05	8/16/11
7766	Delaware	Andes	237.-3-2.5	County Route 2	Fee	5.10	8/16/11
3213	Delaware	Bovina	129.-2-3	Scutt Mountain Road	Fee	244.52	10/20/11
4236	Delaware	Bovina	153.-1-5	Jim Lane Road	CE	74.61	12/30/11

Appendix Table A. (Continued) Parcels acquired by easement or fee simple: 1/1/11 to 12/31/11.

NYC property	County	Town	Tax map number	Location	R.E. type	Acquired acres	Closing date
7692	Delaware	Bovina	152.-2-17	East Bramley Mountain Road	Fee	161.97	10/13/11
7999	Delaware	Bovina	151.-4-20	Martha Lane	Fee	8.34	2/25/11
6151	Delaware	Delhi	148.-1-8.1	Franklin Road	WAC CE	121.99	4/5/11
6156	Delaware	Delhi	169.-2-20.1	West Platner Brook Road	WAC CE	96.50	2/24/11
6156	Delaware	Delhi	169.-2-20.2	West Platner Brook Road	WAC CE	142.44	2/24/11
6156	Delaware	Delhi	191.-2-2	West Platner Brook Road	WAC CE	58.28	2/24/11
6160	Delaware	Delhi	127.-1-22.1	NYS Route 10	WAC CE	107.62	6/2/11
7690	Delaware	Delhi	193.-1-26.12	Scotch Mountain Road	Fee	97.09	11/15/11
7999	Delaware	Delhi	151.-8-13.3	Martha Lane	Fee	0.41	2/25/11
8030	Delaware	Delhi	127.-1-2.112	Hollister Hill Road	Fee	61.53	7/13/11
7317	Delaware	Franklin	167.-3-10.12	Freer Hollow Road	Fee	20.86	3/10/11
6137	Delaware	Hamden	190.-1-24.131	East Brook Road	WAC CE	55.25	3/30/11
7359	Delaware	Hamden	278.-1-1	Basin Clove	CE	150.85	7/21/11
3494	Delaware	Kortright	84.-1-33	Scotch Hill Road	CE	94.40	7/12/11
3596	Delaware	Kortright	86.-1-2	Shaw Road	Fee	198.52	6/8/11
6130	Delaware	Kortright	87.-2-23.11	NYS Route 10	WAC CE	335.05	8/2/11
6139	Delaware	Kortright	52.-2-3.2	Hobart Hill Road	WAC CE	48.66	2/24/11
6139	Delaware	Kortright	52.-2-12	Hobart Hill Road	WAC CE	119.87	2/24/11
7101	Delaware	Kortright	84.-1-11	County Route 33	Fee	97.81	5/18/11
7146	Delaware	Kortright	68.-3-5.13	McMurdy Brook Road	CE	78.63	2/23/11
6140	Delaware	Meredith	64.-1-18.4	Elk Creek Road	WAC CE	10.34	3/24/11
6140	Delaware	Meredith	64.-1-25.121	Elk Creek Road	WAC CE	31.13	3/24/11
6140	Delaware	Meredith	83.-1-6.1	Elk Creek Road	WAC CE	127.23	3/24/11
6151	Delaware	Meredith	125.-2-22	Franklin Road	WAC CE	26.08	4/5/11
3111	Delaware	Middletown	220.-1-11.2	Bragg Hollow Road	Fee	2.72	6/14/11
3111	Delaware	Middletown	220.-1-11.6	Bragg Hollow Road	Fee	7.50	6/14/11
5539	Delaware	Middletown	285.-2-38.1	279 Morse Hill Road	CE	117.11	4/28/11
6134	Delaware	Middletown	283.-2-5	County Route 6	WAC CE	151.94	2/24/11

Appendix Table A. (Continued) Parcels acquired by easement or fee simple: 1/1/11 to 12/31/11.

NYC property	County	Town	Tax map number	Location	R.E. type	Acquired acres	Closing date
7301	Delaware	Middletown	365.-2-6.1	Kittle Road	CE	95.20	7/19/11
7751	Delaware	Middletown	261.-3-9.22	County Route 6	Fee	10.14	2/4/11
7751	Delaware	Middletown	261.-3-10.2	County Route 6	Fee	19.39	2/4/11
1826	Delaware	Roxbury	222.-4-1	County Route 36	Fee	4.56	12/29/11
1826	Delaware	Roxbury	222.-4-3.41	County Route 36	Fee	5.12	12/29/11
1826	Delaware	Roxbury	222.-4-3.42	County Route 36	Fee	2.79	12/29/11
1826	Delaware	Roxbury	222.-4-3.43	County Route 36	Fee	5.13	12/29/11
1826	Delaware	Roxbury	222.-4-3.44	County Route 36	Fee	4.11	12/29/11
1826	Delaware	Roxbury	222.-4-3.45	County Route 36	Fee	3.43	12/29/11
1826	Delaware	Roxbury	222.-4-3.46	County Route 36	Fee	7.30	12/29/11
1826	Delaware	Roxbury	222.-4-3.47	County Route 36	Fee	45.30	12/29/11
1826	Delaware	Roxbury	222.-4-Road Area	County Route 36	Fee	2.00	12/29/11
2119	Delaware	Roxbury	133.-2-15	off Roses Brook Road	Fee	57.57	2/22/11
4857	Delaware	Roxbury	222.-3-39.1	Denver Mountain Road	CE	127.17	3/21/11
4857	Delaware	Roxbury	222.-3-39.2	Denver Mountain Road	CE	27.00	3/21/11
4857	Delaware	Roxbury	243.-3-5	Denver Mountain Road	CE	14.12	3/21/11
4857	Delaware	Roxbury	243.-3-6	Denver Mountain Road	CE	47.45	3/21/11
5391	Delaware	Roxbury	133.-2-3	Hardscrabble Road	Fee	23.00	12/29/11
5391	Delaware	Roxbury	134.-1-1.11	Hardscrabble Road	Fee	171.73	12/29/11
5777	Delaware	Roxbury	180.-1-17.21	G Lawrence Road	Fee	210.57	9/14/11
6161	Delaware	Roxbury	221.-1-11	Scudder Hill Road	WAC CE	104.08	6/30/11
6161	Delaware	Roxbury	221.-1-27	Scudder Hill Road	WAC CE	27.19	6/30/11
7033	Delaware	Roxbury	92.-1-8.12	Van Aken Road	Fee	71.12	6/9/11
7400	Delaware	Roxbury	180.-1-2	Sally's Alley	CE	121.22	11/17/11
7623	Delaware	Roxbury	177.-1-7.32	Thompson Hollow Road	Fee	66.92	11/22/11
7623	Delaware	Roxbury	177.-1-9	Thompson Hollow Road	Fee	4.83	11/22/11
2119	Delaware	Stamford	132.-4-10	off Roses Brook Road	Fee	81.11	2/22/11
3213	Delaware	Stamford	129.-1-11	Scutt Mountain Road	Fee	575.43	10/20/11
6136	Delaware	Stamford	70.-1-35	Turkey Hollow Road	WAC CE	103.50	11/8/11

Appendix Table A. (Continued) Parcels acquired by easement or fee simple: 1/1/11 to 12/31/11.

NYC property	County	Town	Tax map number	Location	R.E. type	Acquired acres	Closing date
6136	Delaware	Stamford	89.-1-5.11	Turkey Hollow Road	WAC CE	63.91	11/8/11
6136	Delaware	Stamford	89.-1-12	Turkey Hollow Road	WAC CE	142.62	11/8/11
7786	Delaware	Stamford	132.-1-10.63	Narrow Notch Road	CE	46.80	7/12/11
7786	Delaware	Stamford	132.-1-10.64	Narrow Notch Road	CE	41.70	7/12/11
4289	Delaware	Tompkins	293.-2-19.2	Finch Hollow Road and Dryden Road	Fee	32.41	10/18/11
4289	Delaware	Tompkins	293.-2-22.2	Finch Hollow Road and Dryden Road	Fee	1.35	10/18/11
7656	Delaware	Tompkins	228.-2-4.1	Windfall Road	Fee	135.67	8/23/11
1765	Delaware	Walton	335.-2-14	Off NYS Route 10	Fee	205.83	12/8/11
7317	Delaware	Walton	167.-2-1.2	Freer Hollow Road	Fee	59.99	3/10/11
5214	Greene	Ashland	60.00-1-34.112	Case Road	Fee	65.54	5/10/11
7279	Greene	Ashland	60.00-1-43	County Route 32C	Fee	7.69	2/17/11
7279	Greene	Ashland	60.00-1-44	County Route 32C	Fee	11.42	2/17/11
7694	Greene	Ashland	93.00-2-4.12	NYS Route 23	Fee	11.10	4/6/11
7963	Greene	Ashland	93.00-2-32	NYS Route 23	Fee	101.42	11/17/11
7358	Greene	Halcott	125.00-1-9	128 Steinfeld Road	CE	133.21	2/1/11
8054	Greene	Halcott	142.00-1-7	Off Mead Road	Fee	38.98	7/22/11
1694	Greene	Hunter	182.00-5-4.2	off NYS Route 23A	Fee	46.40	12/7/11
2749	Greene	Hunter	165.00-2-4.12	NYS Route 23C, Maude Adams, Cranberry, Kip Roads	CE	21.55	4/28/11
2749	Greene	Hunter	165.00-2-37	NYS Route 23C, Maude Adams, Cranberry, Kip Roads	CE	721.60	4/28/11
2749	Greene	Hunter	165.00-2-43	NYS Route 23C, Maude Adams, Cranberry, Kip Roads	CE	9.23	4/28/11
2749	Greene	Hunter	166.00-2-30	NYS Route 23C, Maude Adams, Cranberry, Kip Roads	CE	123.72	4/28/11
4125	Greene	Hunter	166.01-2-7		CE	156.69	4/28/11
7376	Greene	Hunter	196.00-5-38	Mink Hollow and Elka Park	Fee	6.83	12/27/11
7376	Greene	Hunter	196.00-5-39	Mink Hollow and Elka Park	Fee	5.14	12/27/11
7376	Greene	Hunter	196.00-5-40	Mink Hollow and Elka Park	Fee	5.95	12/27/11
7376	Greene	Hunter	196.00-5-41	Mink Hollow and Elka Park	Fee	6.11	12/27/11
7376	Greene	Hunter	196.00-5-42	Mink Hollow and Elka Park	Fee	6.05	12/27/11

Appendix Table A. (Continued) Parcels acquired by easement or fee simple: 1/1/11 to 12/31/11.

NYC property	County	Town	Tax map number	Location	R.E. type	Acquired acres	Closing date
7376	Greene	Hunter	196.00-5-43	Mink Hollow and Elka Park	Fee	6.04	12/27/11
544	Greene	Jewett	149.00-1-22.1		Fee	67.50	8/30/11
2749	Greene	Jewett	149.00-2-20	NYS Route 23C, Maude Adams, Cranberry, Kip Roads	CE	99.20	4/28/11
2749	Greene	Jewett	149.00-2-27	NYS Route 23C, Maude Adams, Cranberry, Kip Roads	CE	148.03	4/28/11
5437	Greene	Jewett	129.00-4-3.11	Koss Road	Fee	30.33	11/2/11
5866	Greene	Jewett	114.00-2-14	Barnum Road	Fee	31.57	9/14/11
7273	Greene	Jewett	132.00-8-8	NYS Route 23C	Fee	25.08	6/16/11
603	Greene	Lexington	126.00-1-37	Beech Ridge Road	CE	168.60	5/13/11
2077	Greene	Lexington	160.00-2-31.1	Spruceton Road	Fee	37.59	5/17/11
4718	Greene	Prattsville	42.00-1-5.12	Stanley Slater Road	Fee	35.63	11/2/11
7679	Greene	Prattsville	90.00-1-4	County Route 2 and Ski Run	Fee	45.78	2/17/11
7758	Greene	Prattsville	91.00-3-4	River Road	Fee	13.72	11/3/11
7758	Greene	Prattsville	91.00-3-5	River River	Fee	7.18	11/3/11
587	Greene	Windham	62.00-1-4.111	Nauvoo Road	Fee	325.38	11/22/11
3977	Greene	Windham	97.00-4-8	Pinekill Meadows Road	Fee	36.04	5/4/11
3977	Greene	Windham	114.00-1-17	Pinekill Meadows Road	Fee	53.74	5/4/11
4598	Greene	Windham	95.00-1-49	off Cuomo's Cove Road	Fee	5.58	10/5/11
4598	Greene	Windham	95.00-1-50	off Cuomo's Cove Road	Fee	5.47	10/5/11
4598	Greene	Windham	95.00-1-51	off Cuomo's Cove Road	Fee	2.79	10/5/11
4598	Greene	Windham	95.00-1-52	off Cuomo's Cove Road	Fee	2.79	10/5/11
4598	Greene	Windham	95.00-1-53.1	off Cuomo's Cove Road	Fee	3.14	10/5/11
4598	Greene	Windham	95.00-1-53.2	off Cuomo's Cove Road	Fee	3.32	10/5/11
4598	Greene	Windham	96.00-1-56	off Cuomo's Cove Road	Fee	3.22	10/5/11
4598	Greene	Windham	96.00-1-57	off Cuomo's Cove Road	Fee	5.58	10/5/11
4598	Greene	Windham	96.00-1-58	off Cuomo's Cove Road	Fee	5.86	10/5/11
4701	Greene	Windham	63.00-4-4	Old Road	Fee	6.28	11/15/11
4701	Greene	Windham	63.00-4-40	Old Road	Fee	5.12	11/15/11
4701	Greene	Windham	63.00-4-41	Old Road	Fee	3.03	11/15/11

Appendix Table A. (Continued) Parcels acquired by easement or fee simple: 1/1/11 to 12/31/11.

NYC property	County	Town	Tax map number	Location	R.E. type	Acquired acres	Closing date
4701	Greene	Windham	63.00-4-42	Old Road	Fee	5.11	11/15/11
4701	Greene	Windham	80.00-1-47	Old Road	Fee	2.92	11/15/11
4701	Greene	Windham	80.00-1-48	Old Road	Fee	3.00	11/15/11
5085	Greene	Windham	61.00-7-8.2	Siam Road	Fee	36.14	4/11/11
5447	Greene	Windham	61.00-3-25	Mill Street	Fee	57.70	7/28/11
6132	Greene	Windham	78.00-6-1	Hickory Hill Road	WAC CE	148.33	3/1/11
6162	Greene	Windham	46.00-1-77	County Route 10	WAC CE	85.36	3/31/11
6162	Greene	Windham	61.00-1-77	County Route 10	WAC CE	104.42	3/31/11
7747	Greene	Windham	79.00-3-61	Dusty Road off Cross Road	Fee	2.10	7/13/11
80	Putnam	Carmel	53.-2-51		Fee	35.86	4/13/11
111	Putnam	Kent	21.-1-5	Smalley Corners Road	Fee	2.34	12/29/11
111	Putnam	Kent	21.-1-6	Smalley Corners Road	Fee	2.34	12/29/11
4963	Putnam	Kent	43.-2-28	NYS Route 301	Fee	2.15	9/26/11
7099	Putnam	Kent	43.-2-63	Gipsy Trail Road	Fee	20.73	2/4/11
7151	Schoharie	Conesville	202.-1-35	Caulkins Road	Fee	9.51	8/2/11
1973	Sullivan	Neversink	30.-1-6.2	Seeman Road	Fee	15.70	6/27/11
2910	Sullivan	Neversink	30.-1-4	Seeman Road	CE	75.83	6/27/11
2910	Sullivan	Neversink	30.-1-39.1	Seeman Road	CE	67.21	6/27/11
2910	Sullivan	Neversink	30.-1-60.1	Seeman Road	CE	47.07	6/27/11
4488	Sullivan	Neversink	12.-1-24.1	Twinshaven Road (Town Road 24)	Fee	70.32	10/5/11
4696	Sullivan	Neversink	25.-1-33.1	NYS Route 55	Fee	17.17	7/7/11
1173	Ulster	Denning	51.-2-16.112	Brooks Hill Road a/k/a Dubois Road	Fee	23.65	12/6/11
8106	Ulster	Denning	50.-3-1	Old Dinch Road	Fee	121.77	10/27/11
623	Ulster	Hardenburgh	11.3-1-1	off Millbrook Road	CE	74.45	6/20/11
623	Ulster	Hardenburgh	11.3-1-3	off Millbrook Road	CE	1.14	6/20/11
623	Ulster	Hardenburgh	11.3-1-4	off Millbrook Road	CE	34.46	6/20/11
623	Ulster	Hardenburgh	11.3-1-5	off Millbrook Road	CE	36.93	6/20/11
623	Ulster	Hardenburgh	11.3-1-6	off Millbrook Road	CE	20.84	6/20/11

Appendix Table A. (Continued) Parcels acquired by easement or fee simple: 1/1/11 to 12/31/11.

NYC property	County	Town	Tax map number	Location	R.E. type	Acquired acres	Closing date
296	Ulster	Olive	37.1-5-3	Bostock & Peck Roads	Fee	71.04	10/26/11
296	Ulster	Olive	37.1-5-4	Bostock & Peck Roads	Fee	40.47	10/26/11
296	Ulster	Olive	37.1-6-17	Bostock & Peck Roads	Fee	103.09	10/26/11
296	Ulster	Olive	36.2-1-14.120	Bostock & Peck Roads	Fee	204.87	10/26/11
4843	Ulster	Olive	45.4-2-8.100	Turner Road	Fee	5.64	12/29/11
7084	Ulster	Olive	36.3-3-6.2	NYS Route 28A	Fee	8.19	5/17/11
7985	Ulster	Olive	36.2-1-14.111	Bostock Mt Road	CE	57.89	11/29/11
736	Ulster	Shandaken	5.14-1-7.120	Peck Hollow Road	Fee	24.68	2/23/11
1887	Ulster	Shandaken	14.1-2-6.121	Schweitzer Road	Fee	14.04	7/14/11
1887	Ulster	Shandaken	14.1-2-6.200	Schweitzer Road	Fee	62.16	7/14/11
7597	Ulster	Shandaken	13.7-1-4	NYS Route 28	Fee	15.00	10/26/11
296	Ulster	Woodstock	36.2-2-22	Bostock & Peck Roads	Fee	36.97	10/26/11
496	Ulster	Woodstock	26.-1-8	off Jonet Lane, f/k/a Whispell Road	Fee	110.06	8/9/11
496	Ulster	Woodstock	26.-1-11.111	off Jonet Lane, f/k/a Whispell Road	Fee	200.31	8/9/11
7609	Ulster	Woodstock	37.2-3-8	Montoma Lane	Fee	5.93	6/21/11
7956	Ulster	Woodstock	14.4-2-7	Grogkill	Fee	3.47	12/28/11
1508	Westchester	North Castle	107.02-1-5	93 Whippoorwill Road	CE	20.80	12/20/11