

WORKING TOGETHER FOR OUR RIVER

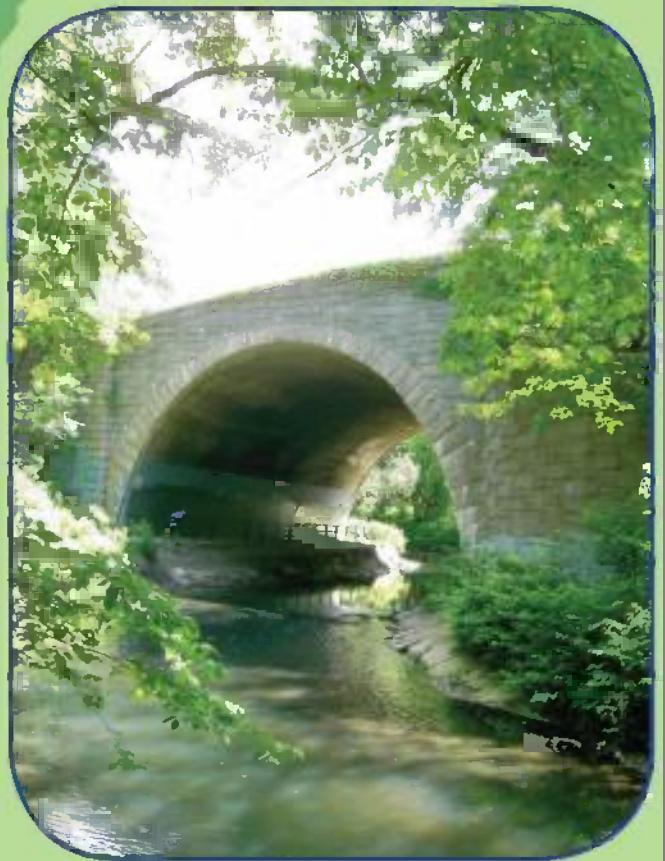
Bronx River Intermunicipal Watershed Management Plan

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December, 2010

This report was prepared by the Center for Watershed Protection, Inc. in partnership with the Bronx River Alliance, New York City Department of Parks & Recreation and Westchester County Planning Department for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund. Numerous community, not-for-profit, and government partners participated in reviewing and supplying the content for this report, including:

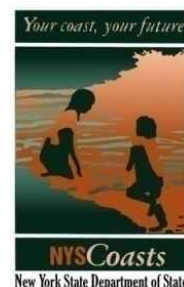
*NYC Department of Environmental Protection
NYC Mayor's Office of Long Term Planning and Sustainability
NY State Department of Conservation
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NY-NJ Harbor Estuary Program
Members of the Bronx River Ecology Team of the Bronx River Alliance
NYC Soil and Water Conservation District
The Wildlife Conservation Society
The New York Botanical Garden
The Gaia Institute
GrowNYC
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National Fish and Wildlife Service
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The status of projects listed in this report will be updated periodically to reflect change in status. Updates will be available at: www.bronxriver.org.

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EXECUTIVE SUMMARY

The Bronx River—a tributary to the Long Island Sound and Hudson River estuary systems—flows southward for 23 miles from Valhalla, New York near the Kensico Reservoir and empties into the East River between the Soundview and Hunts Point neighborhoods in the South Bronx (Figure 1). Encompassing an area of more than 56 square miles, the River's highly urbanized and multi-jurisdictional watershed spans two states, three counties, and fifteen municipalities, flowing through a landscape of reservoirs, suburban and urban development, and commercial and transportation corridors.

The Bronx River Intermunicipal Watershed Management Plan (IWMP) is the result of collaboration between the Bronx River Alliance, the City of New York Department of Parks & Recreation Natural Resources Group, New York State Department of State and the Westchester County Department of Planning, along with more than 100 stakeholders engaged in planning efforts and resource management throughout the watershed. These partners formed the Bronx River Watershed Coalition (the Coalition) in 2006 to work together towards the broad goals of improving water quality, protecting and improving aquatic and riparian habitat and riparian and ecosystem services, biodiversity and ecological values, and reducing overall environmental stress to the river system.

The intention of this Plan is to:

- 1.) Affirm a shared vision for watershed management integrating the objectives and priorities identified across the Bronx and Westchester Counties, and;
- 2.) Encourage a unified approach to watershed management for all municipalities, organizations, businesses and residents within the Bronx River watershed.

The vision guiding the Bronx River IWMP is that of an ecologically healthy river system that is protected by water-sensitive practices and policies in the watershed, supports diverse native aquatic and riparian communities, and helps support economic strength, public health, recreation, and a high quality of life for the communities in the Bronx River and Long Island Sound watersheds. The opportunities for and constraints to pursuing this vision, and the roles and responsibilities of community and government stakeholders in this effort, are outlined in the Plan.

Building on Westchester County's *2007 Bronx River Watershed Assessment and Management Report*¹ and the Bronx River Alliance's *2006 Ecological Restoration and Management Plan*², the Bronx River IWMP presents ten strategies, based on objectives and approaches identified in these earlier planning initiatives, to develop an integrated framework aimed at meeting the broad watershed goals defined above:

- 1. Facilitate coordination between federal, state, and local agencies, community groups, and others involved in Bronx River watershed activities to maximize effective implementation.** An integrated approach that establishes mechanisms for

¹ Center for Watershed Protection (CWP) and Biohabitats, 2007a.

² Bronx River Alliance (Alliance), 2006a.

ongoing communication and tracking progress is essential for effective implementation of this comprehensive multi-jurisdictional watershed plan.

- 2. Work with local, state and federal agencies to update and enforce environmental regulations and policies.** Regulatory mechanisms (including targeted local land use and zoning regulations) are important tools for reducing non-point source pollution and facilitating the implementation of best management practices.
- 3. Reduce discharges of raw sewage from an aging sanitary sewer system, illicit connections, and combined sewer overflows.** A multi-jurisdictional approach that includes cost-sharing, expanded monitoring, reporting and enforcement, are recommended to address these significant threats to water quality in the Bronx River.
- 4. Invest in controlling stormwater at its source to reduce runoff volume and provide water quality treatment prior to discharge into the River or sewer system.** These actions target sediment, nutrient and pathogen load and volume reduction through stormwater interception, detention, retention (infiltration, and evapotranspiration) and reuse. Stormwater source control also reduces the erosive force of runoff.
- 5. Implement large- and small-scale stream, riparian, and wetland restoration projects.** Desired outcomes include more diverse, complex and robust habitats; better protected and connected native plant communities; increased floodplain storage; upstream access for migratory fish; and reduced stream bank erosion.
- 6. Restore riparian buffers and upland pervious areas through land acquisition, invasive plant management, soil protection and enhancement, and planting of native trees.** These actions help maintain native habitat, protect native species diversity, stabilize soil, protect riparian functions, and promote infiltration.
- 7. Promote pollution prevention at stormwater hotspots for municipal operations and in targeted residential areas and businesses that have a high potential for contaminating stormwater runoff.** Improved “housekeeping” practices at municipal, commercial, industrial and residential sites result in a reduction of polluted runoff.
- 8. Facilitate community education and involvement in all matters affecting the health of the watershed.** Community involvement and education are critical to the adoption of pollution prevention practices and support and expansion of riparian restoration, storm water source control, and best management practices.
- 9. Coordinate monitoring and project tracking to better assess the delivery, implementation, and effectiveness of management practices.** Tracking and monitoring can improve the delivery of future projects, while demonstrating whether performance standards are being met and conditions in the River improving.
- 10. Communicate regularly with partners and the broader community on implementation progress, plan updates, and watershed conditions.** A coalition of partners should be sustained, through an annual public meeting to review progress, exchange ideas and information, celebrate accomplishments and outline next steps.

Moving Forward

The Westchester and Bronx County watershed plans collectively identify many individual opportunities for stormwater retrofits, stream restoration, tree planting, and other potential enhancement projects, offering a variety of benefits to the watershed. Implementation of these recommendations is the most significant aspect of the watershed restoration process, with costs up to millions of dollars depending on the extent of restoration activities, number of jurisdictions involved, land costs, and other factors. Salaries, land acquisition and construction of restoration projects often account for a majority of these costs. While full scale implementation can take decades, this plan provides a strategy for moving forward with short-term priorities and planning for eventual implementation of long-term projects, and advocates for evaluating the progress of these collective efforts in meeting watershed goals.

Demonstrating early success is essential for generating momentum for the longer-term implementation process and, more importantly, for building confidence among community partners, funders, and agencies. Effective watershed protection requires a multi-faceted approach: combining land use planning with low-impact development; implementation of best management practices in new development, redevelopment and restoration projects; and, regulation and enforcement and education and outreach. Westchester County, the Bronx River Alliance, and New York City have already identified priority projects and management activities as part of their watershed planning and other resource management activities that address these broad strategies. Working together, along with community groups and local citizens, our combined efforts will help us achieve a shared vision for the Bronx River.

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Introduction

The Bronx River Intermunicipal Watershed Management Plan (IWMP) is the result of a long history of activism and community-led restoration efforts along this urban river. It is designed for use by municipal officials as well as stakeholder groups in the community to help improve water quality by identifying opportunities and recommending actions across the watershed. The Bronx River IWMP should serve as a resource for individuals, organizations, agencies, institutions, and companies with a vested interest in the Bronx River.

In 2003, the City of New York applied for a grant under the Environmental Protection Fund Local Waterfront Revitalization Program, to develop a single watershed management plan that would ensure a consistent and comprehensive approach to water quality improvement in the Bronx River Watershed. The Bronx River Watershed Coalition (the Coalition) was then formed in 2006 as a partnership among municipalities, state agencies, county governments and not-for-profit organizations to improve water quality in the Bronx River by focusing on watershed management. The Coalition determined that a comprehensive watershed management plan was needed, to provide a strategy for reducing the amount of stormwater pollution entering the river and its tributaries.

As part of this strategy, the Coalition identified three specific goals for the group to work towards. These shared goals help define targets for restoration projects, policy changes, education, and outreach efforts carried out by the members of this Coalition:

- 1. Protect and improve water quality.**
- 2. Protect native aquatic and riparian plant and animal diversity, and improve habitat.**
- 3. Reduce environmental stresses on the river ecosystem.**

This plan summarizes current watershed conditions as of Dec 2010, water resource protection practices, recommended actions, and the implementation priorities for the Bronx River watershed. Background information for this plan was largely provided by the Westchester County *2007 Bronx River Watershed Assessment and Management Report* and the Bronx River Alliance *2006 Ecological Restoration and Management Plan*. Together, these two documents present a detailed characterization of existing watershed conditions and potential restoration opportunities, and provide specific management recommendations within each of the jurisdictions. The Bronx River IWMP builds on both of these reports, as well as other relevant documents, to provide specific proposed actions or recommendations for each of the four major drainage units in the watershed: the river mainstem, the sewersheds, the tributaries, and the reservoirs. The Plan provides estimates of the general cost range associated with implementing these actions

and, finally, identifies specific short-term and long-term actions that should be pursued under each of the above strategies.

Improving the quality of the Bronx River, which consistently appears on the New York State Department of Environmental Conservation (NYS DEC) list of impaired waterbodies, presents significant challenges. The river receives high nutrient and sediment loads from untreated stormwater runoff, flashy flood flows, and leaks from an aging infrastructure, which is typical for a highly developed urban system. The river supports flora and fauna that are pollution and disturbance tolerant; frequently, these pollution tolerant plants and wildlife are in fact invasive species that can cause harm to native species populations. Dissolved oxygen levels do not meet NYS DEC standards in Westchester County and bacteria levels exceed NYS DEC standards in tidal estuaries in the Bronx. Despite these challenges, the current value and potential future value of the Bronx River as a recreational, educational and ecological resource has inspired the communities around it to advocate for its improvement. Their collective restoration activities have already begun to make a difference.

1.1 Bronx River Watershed Context

The challenges of maintaining a healthy river system in the Bronx River's highly urbanized and multi-jurisdictional watershed can seem daunting. Watersheds do not recognize political, social, or economic boundaries; therefore improving the health of the river requires a long-term commitment from all communities in the contributing drainage area.

The Bronx River flows southward for 23 miles from Valhalla, N.Y. near the Kensico Reservoir and empties into the East River—a tributary to the Long Island Sound and Hudson River estuary systems—between the Soundview and Hunts Point neighborhoods in the South Bronx (Figure 1). With a drainage area of more than 56 square miles, jurisdiction of the Bronx River watershed includes two slivers of Fairfield County in Connecticut and fifteen municipalities in New York. The 20.7 miles of the freshwater river flows across a relatively gradual gradient, from about 350 feet elevation to sea level. It traverses through a landscape of reservoirs, commercial corridors, and areas of suburban and urban development. As the river flows southward, the landscape is increasingly dominated by impervious surfaces such as roads, rooftops and parking lots. From the Cross-Bronx Expressway interchange south of Drew Gardens, the river's final 2.5 miles is a tidally influenced estuary. In this farthest downstream section of the watershed, the landscape is characterized by dense urban development consisting of residential, commercial and industrial land uses, and the river's shorelines are mostly hardened as it flows southward into the East River. The Bronx River valley functions as a transportation and recreational corridor, with the Bronx River Parkway and the Metro-North Harlem railroad line bordering and crisscrossing the river for most of its length. In addition, parks, gardens, canoe launches and an ever-evolving greenway system hug the river's banks.

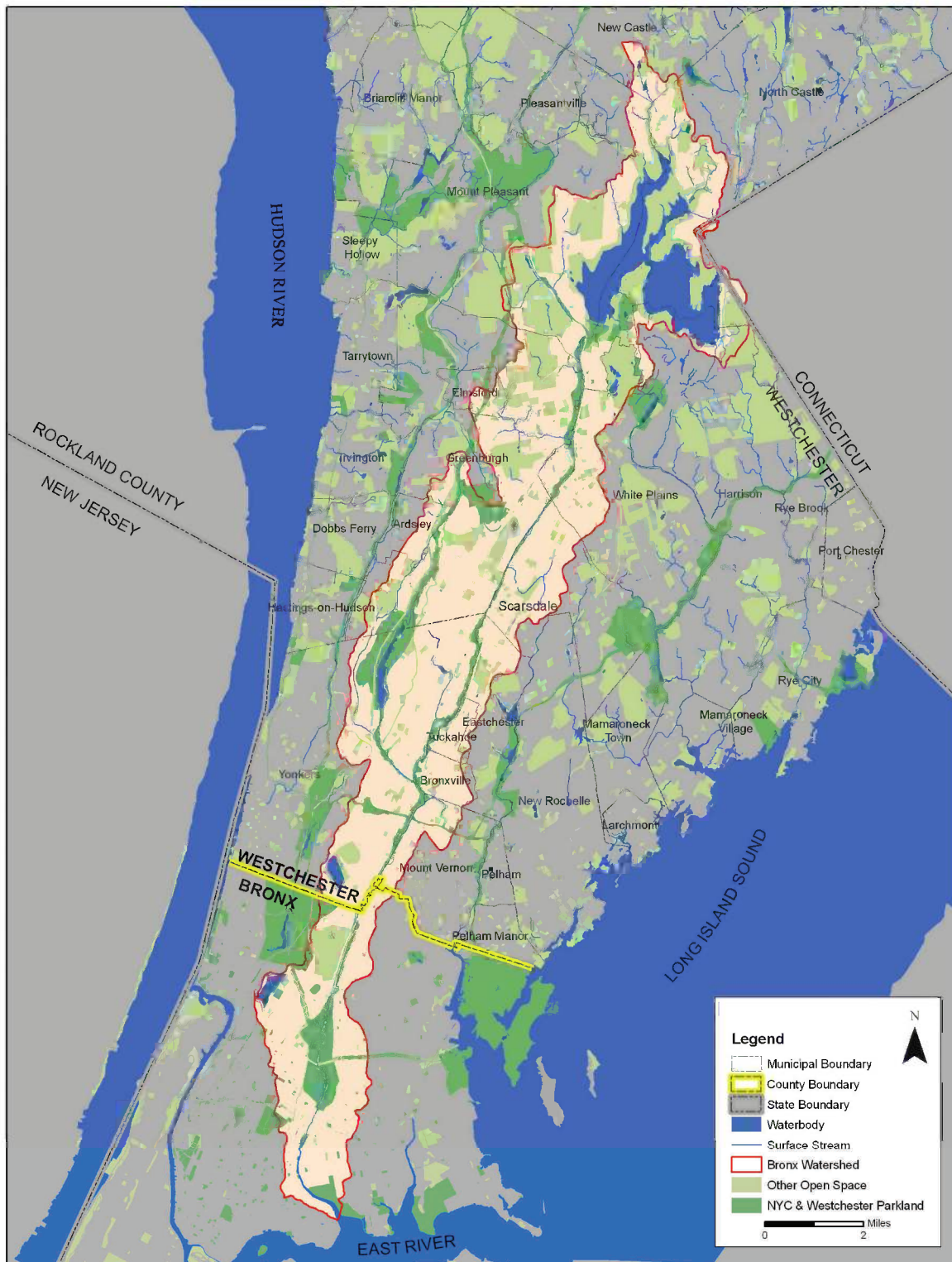


Figure 1. Bronx River Watershed (Data Source: Westchester County Department of Planning and Bronx River Alliance).

1.2 Degradation of the Bronx River Watershed

Over the last two centuries, human activity has significantly altered the Bronx River and its watershed resulting in the degradation of its ecological health and biological diversity, and a reduction in its capacity to provide recreational opportunities and other social benefits to the community. Historically, a sinuous, forest-lined waterway fed a vast tidal marsh system; today urban land uses dominate the river corridor. Much of the river network has been straightened and piped; floodplains have been filled, and water quality has been degraded by polluted discharges. Despite these changes, some remaining wooded areas still exist within the river corridor. These natural remnants are considerably fragmented and often overrun with invasive species.

Portions of the river system have been dammed, historically, for industry and the creation of reservoirs and lakes. In many places, natural shorelines have been replaced with rock and concrete to make way for dense development and transportation infrastructure. Through the systematic incorporation of the river in the sewage system in past centuries, and more recently, through inadvertent dumping and littering, untold waste has entered the river. Today the urbanized watershed has a high portion of impervious area and infrastructure that pipes untreated storm water directly to the river, resulting in a larger volume and higher frequency of polluted runoff than under forested conditions. Such disturbed hydrology increases erosion and sedimentation, as well as frequency of in-channel habitat disturbance. Aging infrastructure, illicit sanitary-to-storm sewer connections, and inappropriate land uses also contribute to sanitary leaks and combined sewer overflows throughout the watershed.

Physical alterations to the watershed, as described in Table 1 below, have directly impacted the river and its ability to support many recreational and wildlife uses. These features are the focus of our collaborative restoration efforts.

Despite suffering the effects of pollution and urban development, the Bronx River continues to support aquatic insects, water birds, small bait fish and commercial sport fish, small mammals, and diverse vegetation. It is also an important tributary feeding regional water bodies downstream including the East River and Long Island Sound and serves as an important migratory bird and fish corridor.

Table 1. Summary of Bronx River Degradation	
Disturbed Hydrology	In the highly urbanized Bronx River watershed, the volume and frequency of runoff is much greater today than under a forested system. This disturbed hydrology results in diminished infiltration to groundwater, increased erosion, sedimentation, and habitat disturbance.
Poor Water Quality	Sewage and untreated stormwater carrying large particulate matter, floatable debris, engine oil, animal waste, and other contaminants into the river have led to poor water quality that violates health standards and makes the water unsuitable for primary contact recreation (e.g. swimming). Sewage inputs also contribute to low dissolved oxygen (DO) levels that limit the growth and survival of aquatic organisms.
Aging Infrastructure	Aging infrastructure , disparate jurisdictional authority, and limited resources result in chronic sanitary sewer leaks and combined sewer overflows (CSOs), uncoordinated approaches to detect and eliminate illicit discharges, and an inability to proactively address water quality concerns.
Invasive Vegetation	Invasive vegetation limits the diversity of the ecological community, reduces ecological functions, and contributes to bank instability. Invasive plants also exclude trees from the river bank, thus limiting the supply of large woody debris necessary to create certain habitats. The reduced shade from the absence of tree canopy contributes to raising the water temperature, causing stress to aquatic species.
Degraded Habitat	Degraded habitat is a cumulative result of poor riparian management, channel alterations, hydrologic disturbance and degraded water quality, and diminishes the diversity of native flora and fauna. Fewer and primarily pollution tolerant species flourish under these conditions.
Dams	Dams limit connectivity between river sections and impede passage of diadromous fish (species that use both marine and freshwater habitats during their life cycle) and other aquatic species. These barriers also disturb natural sediment flow, creating impoundments that fill and later become sources of sediment.

1.3 An Impaired Waterbody under Repair

The Bronx River is an impaired water body. The NYS DEC rates the Bronx River watershed as a Category I watershed, which means it does not meet clean water and other natural resource goals.³ All sections of the Bronx River are listed on NYS DEC's Final 2008 Section 303 (d) list of priority waterbodies for dissolved oxygen and/or pathogens.⁴ Regulations require the development of acceptable total maximum daily loads (TMDL) for pollution to achieve sufficient reduction of pollutant load from point and nonpoint sources in order to support designated uses, such as swimming, boating, and fishing.⁵ A TMDL has not yet been completed for the Bronx River.

The DEC classifies the uppermost reach within Westchester County (NY-1702-0107) as Class C, which indicates that it is safe for its intended use of primary and secondary contact; the middle freshwater Bronx River (NY-1702-0106) as Class B; and the lower tidal portion (Section 1702-0006) as Class I, which indicates that it is safe only for fishing and secondary contact.⁶

To better understand conditions and restoration potential across the watershed, previous reports have divided the watershed into small drainage units (e.g. 15 subwatersheds and 4 river sections). For this Plan, however, we have simplified these groupings into four larger units based on physical drainage patterns: direct drainage to mainstem, drainage through small surface tributaries, piped drainage in combined sewersheds, and drainage to reservoirs (Figure 2). These larger drainage units within the Bronx River watershed are referred to here as the Mainstem, Surface tributaries, Reservoirs, and Sewersheds units.

Those living and working within the watershed have recognized the problems associated with the river's ecology and have taken steps to protect and restore the waterway. The restoration work that has already been completed is largely the result of successful collaboration between the many organizations that make up the Bronx River Watershed Coalition. Some examples of these restoration projects that are helping to repair the river are described below.

³ New York State Department of Environmental Conservation (NYS DEC), *Unified Watershed Assessment and Watershed Protection and Restoration Priorities for New York State*, 2005.

⁴ NYS DEC, *The Final New York State 2008 Section 303 (d) List of Impaired Waters Requiring a TMD/Other Strategy*, May 26, 2008.

⁵ Ibid.

⁶ <http://www.dec.ny.gov/regs/4525.html>

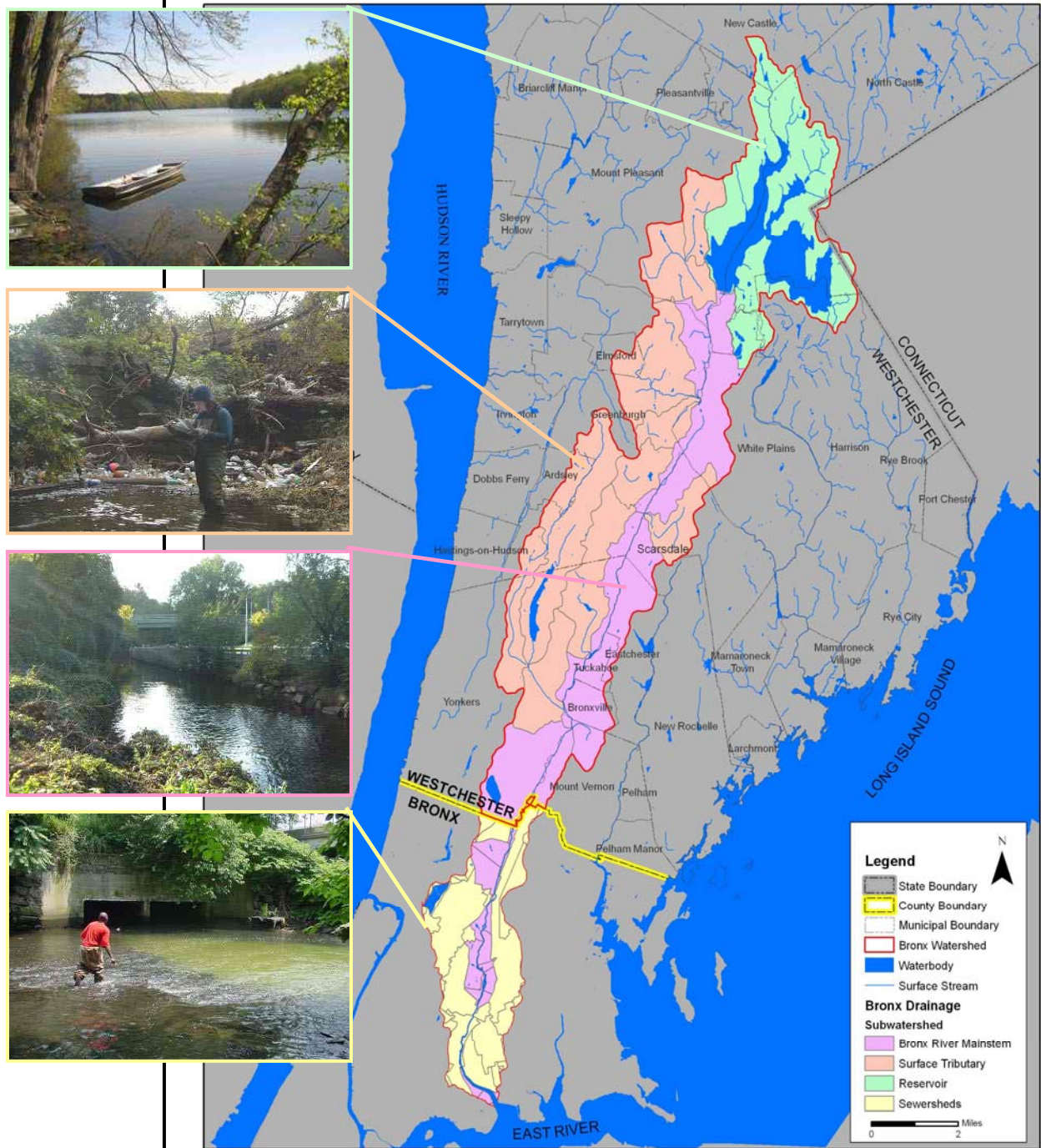


Figure 2. Bronx River Subwatershed Units (Data Source: Center for Watershed Protection)

In the Bronx portion of the watershed, the Bronx River Alliance's (BxRA) Conservation Crew and NYC Parks' Natural Resources Group (NRG), and other community organizations have conducted riparian restoration and management programs since 2001 with funding from the New York State Department of State (DOS), NYS Department of Environmental Conservation (DEC), the National Atmospheric and Oceanic Administration (NOAA) and matching in-kind resources totaling over \$10 million. These organizations have planted more than 83,607 native trees, shrubs and herbaceous plants along the banks and over six acres of floodplain of the Bronx River. They also removed more than 567 tons of floating garbage from the river channel throughout its seven mile length in the Bronx. Through several construction projects, NYC Parks has installed boulder-habitat structures in the channel, reclaimed ball fields for the floodplain restoration, established high flow floodplain habitat, improved the existing pedestrian paths, and controlled invasive plant species across over ten acres of floodplain forest. Parks has also installed a greenstreet and raingardens within the watershed as part of a program of pilot projects that capture stormwater runoff to increase the detention of rainfall and help reduce combined sewer overflows. Parks, along with other agency and academic partners, is assessing the performance and effectiveness of stormwater capture at various source control locations.

To educate the public about the ecology and restoration work along the river, the BxRA instituted a public education campaign with a Bronx River focused curriculum guide⁷, began a rainwater harvest pilot and education program, and coordinated installation of storm drain markers within the drainage area. In addition, the Alliance coordinates water quality monitoring, volunteer cleanup efforts, and canoe trips for the public, to raise awareness and draw people to the river.

In 2006 and 2007, NRG, BxRA, the Wildlife Conservation Society (WCS), Lehman College, and the Connecticut Department of Environmental Protection (CTDEP) stocked mature alewives in the impoundment upstream of the 182nd Street Dam to re-establish a native population. In the spring of 2009, NRG, along with the BxRA and community partners monitoring the Bronx River, found several mature alewives at the base of the 182nd Street Dam, evidencing the need for fish passage over the dams to allow anadromous fish to access upstream spawning habitat. Construction of the first fish passage at the 182nd Street Dam is targeted for the summer of 2011, and is funded by the NY State



Photo 1. An example of an upstream fish ladder on a dam. (Data Source: Bronx River Alliance).

⁷ The document, titled "Bronx River Classroom: The Inside Track for Educators," is available as a free download on the Bronx River Alliance website: www.bronxriver.org.

Department of State, the WCS/NOAA Lower Bronx River Partnership, the Bronx Borough President's Office, and other partners. The observation of alewives at the base of the dam, as well as the return of two beavers to the lower part of the river in the Bronx Zoo, is testimony to the water quality and habitat restoration improvements that have been achieved along the Bronx River over the past several decades. The reforestation and restoration of the riverbanks and the watershed, and the work and commitment of local conservation partners, are all integral parts of this ongoing aquatic ecosystem restoration.

Westchester County has implemented numerous projects to help repair the river in its upper reaches. The Westchester Department of Planning completed a stormwater retrofit at the County Center parking lot located adjacent to the river, in an area that was recognized as a significant source of pollution. This project involved the renovation and rehabilitation of 9.8 acres of the Bronx River Parkway Reservation to accommodate parking near the Metro-North Railroad Line and provide new open space and pathways along the Bronx River. Stormwater management and water quality issues were addressed with a comprehensive system of stormwater ponds, including native wetland and upland plantings, a dry planted swale and grass swale medians. Parking places in the new parking lot were installed using pervious pavement as well as surface storm drains. Westchester County Department of Planning has also built a pilot stormwater infiltration swale in the median strip of the Parkway.



Photo 2. The renovated Westchester County Center parking lot. September 2009. (Data Source: Bronx River Alliance).

Another stormwater management project was implemented at the Crestwood Maintenance Facility in Tuckahoe. The project included the installation of two pocket wetlands, a wet swale, and a modified bioretention basin (rain garden). Each of these elements captures polluted stormwater runoff, from the maintenance facility via three pipes that discharge into the wetlands or from sheet runoff from the parking lot and paved Bronx River Bike Path. The landscaping incorporated native wetland, facultative and upland plants, while removing invasive, exotic vegetation such as Japanese knotweed, Japanese barberry, mugwort, and garlic mustard from the project site. Once stormwater has been cleansed in the wetlands, swale and rain garden through chemical and biological processes in the soil and vegetation, it is discharged into the Bronx River as surface and/or ground water. Three interpretive signs describing the stormwater management practices were installed along the pathway.

Westchester County has also led several stream restoration efforts. At Bronxville Lake, in Yonkers, the banks were stabilized with brush layering (layered shrub and tree branches covered with soil to promote rooting). Native grasses and wildflowers were added to improve native plant diversity, filter water and further control erosion, and inhibit geese traffic. Crestwood Lake is located in the Bronx River Parkway Reservation, spanning Yonkers and Tuckahoe. Analysis of Crestwood Lake was completed in April 2008 and consisted of strategies to address the impacts of excessive sedimentation in the Lake, as part of a comprehensive lake “restoration” and maintenance project. The consultant collected data from previous studies, performed preliminary field investigations, developed a list of potential alternatives, identified data gaps associated with each potential alternative, and developed a recommended sediment management strategy for Crestwood Lake. Westchester County Parks Department has developed a volunteer-powered vine-cutting program to reduce the impact of harmful invasive vines within the riparian areas in the Bronx River watershed.

These are only a few of the ongoing efforts to improve the ecological health of the watershed. A variety of restoration strategies must be pursued at a multiple scales, with different Bronx River Coalition Partners taking the lead. The Bronx River IWMP seeks to build on the work of the many organizations, agencies and municipalities working on behalf of the Bronx River, organizing site-specific challenges and priorities into a watershed-scale framework.

2.1 County, Municipal, and Local Entities

The multi-jurisdictional management of the Bronx River watershed consists of oversight at local, state and federal levels. These jurisdictions may have related goals for managing water resources, but often approach them from different perspectives based on individual agency missions and/or regulatory mandates. Multiple agencies are engaged in activities that have an impact on the protection and sustainability of the Bronx River. This section provides a list of key government agencies and their general types of authority or interest regarding the Bronx River.

Bronx River Alliance (BxRA)

The Bronx River Alliance was formed in 2001 to serve as a coordinated voice for the river and work in partnership to protect, improve and restore the Bronx River corridor and greenway, and thus establish healthy ecological, recreational, educational and economic resources for the surrounding communities. The BxRA initiated this plan and will assist in guiding its implementation within New York City. With the City of New York Department of Parks & Recreation (NYC DPR), the Alliance manages the New York City segment of the Bronx River corridor and greenway, implements small-scale restoration projects through the work of its Conservation Crew, coordinates larger scale restoration projects, and supports community-led or -sponsored restoration and development projects. In 2006, BxRA released the *Bronx River Ecological Restoration and Management Plan*, which provides much of the basis for the Bronx River IWMP. The

more than 100 organizations that make up the Bronx River Alliance partnership play a significant role in support of, participation in, and education about the river's long term improvement.

New York City Department of Environmental Protection (NYC DEP)

The NYC DEP maintains and operates the City's wastewater treatment system. Though significant, wastewater treatment is only one part of a very broad program to protect and improve the City's water environment that includes: pollution prevention and remediation; maintenance and upgrading of the City's sewer and wastewater treatment infrastructure; technically innovative wastewater collection and treatment; ecosystem protection; and ongoing scientific and technical research. The ultimate goal is to reduce and control pollution before it reaches wastewater treatment plants. NYCDEP is the New York City agency tasked with meeting the requirements of the 2004 consent order with New York State Department of Environmental Conservation (NYS DEC) by drafting Watershed/Waterbody Facility Plans for each waterbody in New York City. The most recent Bronx River Watershed/Waterbody Facility Plan was approved by the NYS DEC on July 27, 2010, and will guide the City's work toward compliance with the consent order. The Bronx River is one of two pilot project areas in the NYC DEP Urban Watershed Project. In September 2010, DEP released the NYC Green Infrastructure Plan which sets specific targets for reducing stormwater runoff using an alternative approach to improving water quality that integrates "green infrastructure", such as swales and green roofs, with investments to optimize the existing system to build targeted, cost-effective "grey" or traditional infrastructure.

New York City Department of Parks & Recreation (NYC DPR)

New York City Department of Parks & Recreation (NYC DPR) With the BxRA, NYC DPR manages the New York City segment of the Bronx River corridor and greenway. NYC DPR's Natural Resources Group (NRG) works closely with the BxRA to manage the ecological health of the river by planning and implementing restoration and monitoring activities, and coordinating with DPR Capital Design division to incorporate natural resource protection objectives into DPR projects. NRG developed the Bronx River Ecological Restoration and Management Plan with the BxRA, and provided expertise for the plan. Parks' Central Forestry and Horticulture division designs and installs planting areas within the public right-of-way, known as Greenstreets. These Greenstreets increase the permeability of the concrete and asphalt-dominated landscape, while capturing stormwater and providing bioretention and infiltration within the Bronx River drainage area in New York City. Parks' NRG and Central Forestry have begun to look systematically for opportunities to implement this type of green infrastructure within the Bronx River sewershed/watershed. The recommendations of the Bronx River IWMP will help to guide this process and future site identification, site selection, project tracking and coordination of Parks and other projects. Another example of Parks' efforts to expand and improve stormwater capture is a street tree pilot program is being undertaken with Parks' Central Forestry Division, The Gaia Institute, Drexel University, NYSDEC and a local community group, Youth Ministries for Peace and Justice. The

purpose of the pilot is to try out several innovative methods to incorporate stormwater retention infrastructure with street tree plantings. Drought stress is one of the leading causes of mortality among young street trees, and a creative stormwater retention method that makes the water available to trees would be dually beneficial.

High Performance Landscape Guidelines: 21st Century Parks for NYC is the first document of its kind in the nation: a comprehensive, municipal primer for sustainable parks and open space. The product of a unique partnership between the New York-based nonprofit Design Trust for Public Space and the NYC Department of Parks & Recreation, the Guidelines cover every aspect of creating sustainable parks, from design to construction to maintenance, and feature hundreds of best practices for managing soil, water, and vegetation resources.

New York City Mayor's Office of Long-Term Planning and Sustainability (OLTPS)

The Mayor's Office of Long-Term Planning and Sustainability is responsible for implementing PlaNYC, a comprehensive sustainability plan for the City's future. PlaNYC puts forth a strategy to reduce the City's greenhouse gas footprint by 30% by 2030, while also accommodating a population growth of nearly one million, and improving our infrastructure and environment. The OLTPS seeks to implement the 127 PlaNYC initiatives in collaboration with City agencies and a Sustainability Advisory Board comprised of community, business, and environmental leaders. In December, 2008, the OLTPS released the Sustainable Stormwater Management Plan for New York City⁸, which lays out a strategy for significantly reducing stormwater runoff impacts significant impact on drainage areas that discharge to the Bronx River and other waterbodies.

New York City Soil and Water Conservation District (SWCD)

The SWCD is developing the New York City Soil Survey, a pioneering study of urban soils, including a citywide reconnaissance soil map, a series of intensive soil surveys and special research projects. The survey is a cooperative effort of the U.S. Department of Agriculture - Natural Resources Conservation Service and the SWCD. The SWCD is also playing a key role in the monitoring of green infrastructure (such as Greenstreets) throughout NYC.

Westchester County Department of Planning (WCDP)

The WCDP spearheaded the development of a management plan for the Westchester portion of the watershed – The Bronx River Watershed Assessment and Management Report (2007) – and has been instrumental in advancing the implementation of projects and programs that protect and restore water quality in the Westchester County portion of the Bronx River watershed. Its website contains full reports developed as part of the watershed planning efforts, thanks in part to funding provided by the NY State Department of State. The Management Report, by the Center for Watershed Protection,

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<http://www.nyc.gov/html/planyc2030/html/stormwater/stormwater.shtml>

included a baseline watershed assessment and the identification of opportunities for stream restoration, pollution prevention and storm water retrofits. The report outlined key actions recommended as a management and restoration framework for the watershed to be implemented by Westchester County, municipalities within the watershed area and/or the Bronx River Coalition. There were over 150 recommended management and restoration opportunities identified that could help reduce the impacts of storm water runoff and restoration of degraded resources. These recommendations included upland storm water retrofits; riparian corridor restoration; management and restoration of pervious areas; pollution prevention and source control education; and municipal practices and programs.

Westchester Municipal Governments

Each of the municipalities through which the river flows has a significant role to play in protecting and improving the ecological health of the watershed. Decisions made at the local level regarding erosion control, road salt, use of pesticides and fertilizers, local stormwater drainage and illegal dumping affect the potential for restoration and water quality improvement on the river. The following jurisdictions all border the river channel and contain land in the drainage area: City of New York, City of Mount Vernon, City of White Plains, City of Yonkers, Town of Eastchester, Town of Greenburgh, Town/Village of Harrison, Town of Mount Pleasant, Town of New Castle, Town of North Castle, Village of Ardsley, Village of Bronxville, Village of Elmsford, Village of Scarsdale and Village of Tuckahoe. The involvement and coordination of each of these municipalities is crucial to the implementation of this plan and the protection of the watershed.

2.2 New York State Agencies

New York State Department of Environmental Conservation (NYS DEC)

The NYS DEC is the primary state agency responsible for the protection of the state's natural resources and environment. Regulatory programs administered by NYS DEC control water, land and air pollution in order to enhance the health, safety, and welfare of the people of the state and their overall economic and social well-being. In the Bronx River watershed, the NYS DEC is involved with the permitting and monitoring of the Hunts Point Water Pollution Control Plant and associated five combined sewer outfalls that discharge to the Bronx River, as well as the regulation of tidal and freshwater wetlands. In addition, the NYS DEC regulates the compliance of municipalities with the Clean Water Act. For most municipalities that discharge stormwater to the Bronx River, this means meeting the National Pollution Discharge Elimination System (NPDES) Stormwater Program Phase II requirements of the Clean Water Act. In New York City, a Consent Order with the NYS DEC regarding the abatement of combined sewer overflows throughout NYC requires DEP to develop waterbody/watershed facility plans for each individual waterbody, including the Bronx River. The Bronx River Waterbody/Watershed Facility Plan (BxR WB/WS FP) was first submitted to the NYS DEC in June 2007. The current BxR WB/WS FP was submitted in July 2009 and is currently being revised by the City in response to NYS DEC and public comments. After

it is approved, the City will prepare a CSO Long Term Control Plan for the Bronx River in accordance with the USEPA Long Term Control Plan policy.

New York State Department of State (NYS DOS)

The Department of State is responsible for the administration of New York's Coastal Management Program (CMP). The CMP establishes direction for the appropriate use and protection of the State's coasts and waterways, which is articulated in the State's coastal policies. The Department of State serves to ensure that federal and state agency activities are consistent with the enforceable policies of the New York State Coastal Management Program.

In addition to its role in federal and state consistency, the DOS serves as an advocate for programs and projects to protect and restore natural resources and communities. In addition to providing guidance and technical assistance, through Title 11 of the Environmental Protection Fund, Local Waterfront Revitalization, the Department of State provides matching grants to eligible communities for planning and implementation advancing revitalization. Preparing or implementing a local or regional watershed management plan is an eligible grant category. The Departments of State and Environmental Conservation jointly prepared New York State's Coastal Nonpoint Pollution Control Program (CNPCP) to implement management measures to control sources of pollution to coastal waters. New York's CNPCP emphasizes the importance of preparing watershed plans to protect high water quality and improve degraded water quality within the coastal watershed, including the Bronx River Watershed.

Office of the Attorney General (OAG)

Through its Environmental Protection Bureau, the OAG enforces laws that prevent environmental damage, sometimes through prosecutorial action. The OAG has investigated three cases of pollution to the Bronx River that resulted in settlements with the Wildlife Conservation Society/Bronx Zoo (WCS), New York Botanical Garden (NYBG), and the City of Yonkers. In 2001, the WCS agreed to implement a pollution abatement program and environmental benefit projects in response to claims that it was illegally discharging animal wastes and other pollutants into the Bronx River. A 2002 OAG settlement with the NYBG stopped the flow of pollutants, including pesticides, from NYBG's greenhouses into the river. Another OAG investigation found that pipes in the City of Yonkers had been illegally discharging thousands of gallons of untreated sewage each day into the Bronx River since 1999. In response to this case, a State Supreme Court judge ordered the City of Yonkers to stop the discharge of raw sewage by repairing improper pipe connections. These OAG actions have provided over \$7 million in settlement funds that are being used for the restoration of the watershed, demonstrating that enforcement provides an important and necessary complement to the physical restoration and environmental policy changes recommended in the Bronx

River IWMP. A list of projects funded in 2008, 2009 and 2010 can be found on the National Fish and Wildlife Foundation website⁹.

2.3 Federal Agencies

United States Army Corps of Engineers (USACE)

USACE is responsible for investigating, protecting and restoring the nation's water and related environmental resources. In recent years, the Corps has begun to implement a more holistic approach to managing our nation's aquatic resources by focusing on watersheds. This approach recognizes that rivers, lakes, wetlands and coasts are complex systems that interact with one another in numerous ways. Through the watershed approach the Corps is working to better understand these interactions and to take actions that benefit the whole system rather than just one part of it. USACE, New York District, in partnership with Westchester County and NYC DEP, is engaged in a study that will recommend a watershed-based plan that will provide ecosystem restoration measures for the Bronx River Basin. The study will evaluate several measures to provide ecosystem restoration including stream bank stabilization; stream channel realignment and/or redirection; aquatic ecosystem restoration; sediment management; restoration and/or creation of riparian wetlands; and fish passage creation. During the Feasibility Study, the USACE plans to complete a more detailed analysis for at least one restoration site in The Bronx and at least one site in Westchester County. These sites will become the first phase of implementation once the entire study is authorized for construction by Congress. The USACE is also a primary author of the Comprehensive Restoration Plan for the Hudson-Raritan Estuary, which identifies target ecosystem characteristics for restoration of tributaries such as the Bronx River.

The County of Westchester continues to work with the USACE and NYC DEP on the co-sponsored Bronx River Ecosystem Restoration Feasibility Study. Westchester is also working with USACE on identifying streambank stabilization projects along the Bronx River under Section 14 of the 1946 Flood Control Act. Known as Section 14 of the Continuing Authorities Program, the Act grants the USACE authority to construct emergency shoreline and streambank protection works to protect public facilities, such as bridges, roads, public buildings, sewage treatment plants, water wells; and non-profit public facilities, such as churches, hospitals, and schools. The maximum Federal expenditure at any one site is \$1,500,000, and each project must be economically justified and environmentally sound. In Westchester County, two projects have been identified on the Bronx River. At the Westchester County Center, USACE is working with Westchester County to protect the Bronx River Parkway from erosion caused by the River. At Yonkers Avenue in the Village of Tuckahoe, USACE is working with the Village to protect Yonkers Avenue, which is a major thoroughfare that leads into the City of Yonkers.

⁹

www.nfwf.org/brwi

U.S. Environmental Protection Agency (EPA)

The US EPA is responsible for, among other obligations, the development and implementation of regulatory programs to protect the environment. Air emissions, water and wastewater treatment, and water quality programs affecting the Bronx River are ultimately under its jurisdiction. In addition, the EPA has a mandate to improve water quality under the Clean Water Act. The agency works with state and local authorities and has been a participant in water quality and wetlands restoration studies in the Bronx River.

The EPA, New York, and Connecticut formed the Long Island Sound Study (LISS) in 1985 as a bi-state partnership consisting of federal and state agencies, user groups, concerned organizations, and individuals dedicated to restoring and protecting the Sound. The LISS supports restoration in the Bronx River as one of its important tributaries, as does the Harbor Estuary Program (HEP), a National Estuary Program authorized in 1987 by the EPA. HEP is a multi-year effort to develop and implement a plan, currently in the draft Comprehensive Restoration Plan, to protect, conserve, and restore the New York-New Jersey Harbor Estuary, which EPA designated an "Estuary of National Significance". Participants in the program include representatives from local, state, and federal environmental agencies; scientists; citizens; businesses environmentalists; and others. The Estuary includes the waters of New York Harbor and the tidally influenced portions of all rivers and streams that empty into the Harbor, including the Bronx River.

Natural Resource Conservation Service (NRCS)

The NRCS provides leadership in the conservation, maintenance, and improvement of the nation's natural resources and environment. One of the most visible efforts of NRCS has been, in cooperation with the New York City Soil and Water Conservation District and Cornell University, the preparation of soil survey reports for New York City. A draft of an intensive survey has been released for the Bronx River watershed characterizing soils to a level of detail that will enhance the quality of future restoration efforts, especially those that aim to improve stormwater infiltration and reduce contaminants.¹⁰ NRCS also works cooperatively with the Westchester County Soil and Water Conservation District to interpret data from the Westchester County Soil Survey. Soil surveys are often used in evaluating soil properties and their suitability for proposed development projects.

The Westchester County Soil and Water Conservation District (SWCD) is a special purpose District created to develop and carry out a program of soil, water, and related natural resources conservation. Environmental professional staff of the Westchester County Department of Planning serves the seven-member citizen Board of Directors.

¹⁰ http://www.nycswcd.net/soil_survey.cfm. Draft Bronx River Watershed Soil Survey and Map.

The Westchester County SWCD has developed a program with a district urban/suburban conservation orientation, and considers a wide range of soil and water resources conservation concerns, including:

- Restoring streams, freshwater and tidal wetlands, and other natural resources to improve water quality and fish and wildlife habitat, and retrofitting stormwater management facilities to improve water quality.
- Protecting and managing streams, wetlands, ponds, lakes, reservoirs, and floodplains.
- Controlling erosion and sedimentation as well as polluted stormwater (i.e., nonpoint source pollution) by advocating the use of best management practices through public education and outreach.
- Encouraging and facilitating the development and implementation of soil and water resources conservation practices and strategies based on watershed-wide perspectives and analyses.
- Promoting sound soil and water resources conservation techniques and natural resources stewardship through public outreach and education.

National Oceanic and Atmospheric Administration (NOAA)

The NOAA, a component of the United States Department of Commerce, is responsible, at the federal level, for Coastal Zone Management with the objective to provide comprehensive management of the nation's coastal resources and to ensure their protection for the future. Created in 1991, the NOAA Restoration Center is solely devoted to restoring the nation's coastal, marine, and migratory fish habitats. The Restoration Center works with a wide array of partners to restore mangrove, salt marsh, seagrass, oyster, coral reef, kelp forest, and river habitats.

In the lower Bronx River, the Wildlife Conservation Society–National Oceanic and Atmospheric Administration (WCS-NOAA) Jose E. Serrano Lower Bronx River Partnership was established through Congressman Serrano's support to specifically benefit the lower Bronx River ecosystem. This partnership continues to be a significant source of funding for Bronx River restoration efforts.¹¹

2.4 Foundations

National Fish and Wildlife Foundation (NFWF)

The NFWF is a 501(c)(3) non-profit that preserves and restores our nation's native wildlife species and habitats. NFWF is currently managing the Bronx River Watershed Initiative Grant (BRWI) for stormwater retrofit projects along the Bronx River. This grant program consists of several million dollars obtained from several settlements in cases arising from the discharge of sanitary sewage into the Bronx River.

¹¹ For more information about the WCS-NOAA Jose E. Serrano Lower Bronx River Partnership, visit <http://www.bronxzoo.com/about-wcs/community/restoring-bronx-rivers.aspx#>.

3

BROAD STRATEGIES

To meet the shared vision for the Bronx River watershed, the following overarching strategies were derived from the many recommendations and objectives of the Bronx River planning initiatives and management organizations discussed in the previous section. These inter-related recommendations are intended to provide an integrated framework to meet the goals and the vision for the watershed as articulated by the Bronx River Watershed Coalition.

A broad range of planning, policy, outreach and education, and on-the-ground construction, retrofit, and maintenance activities are necessary to modify practices and conditions in the Bronx River watershed and protect and restore water quality and ecosystem health. The ways that actions associated with the strategies below are prioritized, and which are most feasible, effective, and relevant, varies across the watershed in response to hydrologic, physio-geographic, historical, and political factors. Specific recommendations and actions to implement these strategies in each of the four subwatershed units (the tributaries, mainstem, sewersheds, and reservoirs) are found in the next section of the Plan.

1. Facilitate coordination between federal, state, and local agencies, community groups, and others involved in Bronx River watershed activities to maximize effective planning and implementation.

There are multiple on-going planning, management and aquatic restoration efforts in the Bronx River watershed that overlap and would benefit from coordination and sharing resources. Section 4 of this report, **Roles and Responsibilities**, provides an overview of the partners and their past and ongoing efforts in this watershed. Current and up-coming plans, studies and associated modeling efforts that should be coordinated include:

- The Draft Hudson-Raritan Estuary Comprehensive Restoration Plan
- The USACE Bronx River Ecosystem Restoration Study
- The NYC DEP Long Term Control Plan for CSOs and the NYC DEP Watershed Planning Model
- NYC Green Infrastructure Plan
- NYC Comprehensive Waterfront Plan
- The Westchester County Water Quantity and Quality Modeling Study for Bronx River sub-basins
- Vision 2020 NYC Comprehensive Waterfront Plan
- High Performance Landscape Guidelines: 21st Century Parks for NYC

Improved coordination and sharing of results, through activities such as regular meetings, compiling an annual list of projects, and creating a database or listserv for sharing information, will help build upon the collective experience of the various organizations and facilitate more efficient use of resources in setting and meeting shared goals for the Bronx River.

The Bronx River Ecology Team facilitates coordination of work aimed at protecting and restoring the Bronx River in NYC. Managed by the Bronx River Alliance, the team is made up of scientists, community activists, and public agency representatives, working together to identify the most pressing ecological restoration projects. The Ecology Team promotes community stewardship and involvement, and advocates for the use of science and research to guide planning, design, performance evaluation and environmental policy development throughout the watershed.

2. Work with local, state and federal agencies to update and enforce environmental regulations and policies.

The Clean Water Act (CWA), enacted in 1972, established the regulatory framework to control surface water pollution, and granted the US EPA the authority to implement pollution control programs. Among the key elements of the CWA was the establishment of the National Pollution Discharge Elimination System (NPDES) permit program, which regulates point sources that discharge pollutants into U.S. waters, in addition to combined sewer overflows and municipal separate storm sewer systems (MS4). In New York State, this permit is administered through NYS DEC, and is thus a State Pollution Discharge Elimination System (SPDES) permit program. As of 2007, there were nine SPDES permits along the Bronx River issued to the 14 municipalities in Westchester as well as non-municipal entities, but the state has very limited resources available to enforce these regulations. Consequently, the Coalition should advocate for the education of citizens, business owners and local officials to give them the tools to recognize potential problems and identify appropriate preventative measures that may reduce the cost of meeting, or failing to meet, these regulations in the long run.

At the local level, one of the most effective tools for use in controlling polluted stormwater is properly planned and executed land use regulations. In Westchester County, the Department of Planning staff assessed the land use regulations that may impact water quality and contribute to the control of polluted stormwater for the 14 municipalities in the watershed. As a result of this assessment, several opportunities for creating or updating local regulatory mechanisms to more effectively address polluted stormwater were identified. These recommendations are summarized in Table 2 as well as in the Westchester County Department of Planning report, the Bronx River Watershed Management Plan, and Recommendations for Municipal Ordinances.¹²

¹² This report is available online at: [http://www.westchestergov.com/planning/environmental/Bronx River/ManagementPlan.htm](http://www.westchestergov.com/planning/environmental/Bronx%20River/ManagementPlan.htm) 2007.

In New York City, initiatives that address land use regulations include the Bronx Overall Economic Development Corporation's zoning easements for waterfronts and, most broadly, PlaNYC 2030, developed by the Mayor's Office of Long Term Planning and Sustainability. In 2007, New York City analyzed their land use regulations and zoning rules while developing a plan to improve the Jamaica Bay Watershed, which laid the groundwork for initiatives and recommendations in PlaNYC 2030.¹³

The SWIM Coalition (Stormwater Infrastructure Matters) is dedicated to ensuring swimmable waters around New York City through natural, sustainable stormwater management practices in our neighborhoods. This diverse coalition includes representatives from community and environmental groups, environmental justice organizations, architects, water engineers, community development corporations, and other interests from around New York City. Major goals of SWIM include: encouraging New York City to create a meaningful public participation process; providing incentives for private stormwater management; strengthening legislation to facilitate progressive stormwater management practices; and mandating multi-agency cooperation to increase community-friendly stormwater management practices, such as:

- Urban Forestry (green streets, natural areas, parkland, street trees)
- Wetland management policy
- Green roofs
- Permeable pavement
- Rainwater harvesting
- Rain gardens
- Community gardens
- Using the Bronx River Watershed as a demonstration area for stormwater capture through greening

¹³ [http:// www.bronxriver.org/plans](http://www.bronxriver.org/plans)

Table 2. Summary of Recommended Municipal Regulatory Updates

Municipality	Adopt Model Ordinance for Wetland Protection	Steep Slope Management Criteria	Adopt Site Design Recommendations	Conservation and Management of Trees and Other Vegetation on Private Lands	Adopt Model Erosion and Sediment Control Ordinance	Adopt Stormwater Management and Erosion and Sediment Control Law Ordinance	Adopt Illicit Discharge and Connection Law Ordinance	Model Drinking Water Protection Ordinance	Amend Environmental Protection Overlay District	Adopt Vegetation and Tree Conservation and Management Ordinance
Village of Ardsley	Y	Y	Y							
Village of Bronxville	Y		Y	Y						
Town of Eastchester	Y	Y	Y	Y	Y	Y	Y			
Village of Elmsford	Y		Y	Y						
Town of Greenburgh	Y	Y	Y		Y	Y	Y			
Village of Harrison	Y	Y	Y		Y	Y	Y	Y		
Town of Mount Pleasant	Y		Y		Y			Y		
City of Mount Vernon	Y		Y	Y	Y	Y	Y			Y
Town of New Castle	Y	Y			Y	Y			Y	
Town of North Castle	Y	Y	Y			Y		Y		
Village of Scarsdale	Y	Y	Y	Y	Y	Y				Y
Village of Tuckahoe	Y		Y	Y	Y					Y
City of White Plains	Y			Y	Y	Y	Y			Y
City of Yonkers	Y		Y	Y	Y	Y	Y			Y
Reference: Westchester County Department of Planning, 2007										

In 2008, The New York City Council adopted bill no. 630 to enact Local Law 5, requiring the development and adoption of a stormwater management plan for New York City as a part of PlaNYC. The Sustainable Stormwater Management Plan (SSMP) of 2008 presents the City's overall plan on how to improve water quality by implementing a variety of feasible and proven technologies for stormwater source control, identifying needed areas of study for new technologies, and reviewing the city codes and regulations.¹⁴ Appendix D of the SSMP, titled *Methodology for Land Use, Scenarios, and Cost-Benefit Analysis*, provides detailed information on the analysis and assumptions about stormwater reduction and costs and benefits associated with these approaches.¹⁵ The SSMP also identifies potential approaches to addressing future funding needs. The high population density of the New York metropolitan area has resulted in a dense man-made environment with limited opportunities for infiltration, resulting in a large volume of stormwater runoff. The plan outlines ways to pilot, assess and implement green infrastructure projects, and develop best management practices to complement other infrastructure improvements, based on a 3-part strategy encompassing 10 goals:

Implement the most cost-effective and feasible controls:

1. Capture the benefits of ongoing PLANYC green initiatives.
2. Continue implementation of ongoing source control efforts.
3. Establish new design guidelines for public projects.
4. Change the sewer regulations and codes to adopt performance standards for new development.
5. Improve public notification of combined sewer overflows.

Resolve the feasibility of promising technologies:

6. Complete ongoing demonstration projects and other analysis.
7. Continue planning for the implementation of promising source control strategies.
8. Plan for the maintenance of source controls.

Explore funding options for source controls

9. Broaden funding options for cost-effective source controls.
10. Complete water and wastewater rate study and reassess pricing for stormwater services.

¹⁴ The plan is available online at:

http://www.nyc.gov/html/planyc2030/downloads/pdf/sustainable_storm_water_plan.pdf.

¹⁵ The appendix is available at:

http://www.nyc.gov/html/planyc2030/downloads/pdf/sustainable_storm_water_plan_appendix.pdf.

Actions being taken to implement this Plan include tracking, monitoring and reporting on source control efforts, encouraging the development of existing and new local markets, job training and green employment opportunities, and improving the collection of water quality data in New York Harbor to assess the effectiveness of stormwater control efforts. In accordance with the SSMP, NYC DEP is analyzing the water rate structure to improve conservation efforts and provide incentives for onsite stormwater retention activities to reduce stormwater flows into the combined sewer system. The City will conduct periodic reviews of the Plan and its goals, based on a series of discrete milestones for implementing initiatives and solutions to achieving a successful, comprehensive program. Most significantly, DEP has issued the New York City Green Infrastructure Plan, which sets forth an ambitious goal of managing runoff from 10 percent of impervious surfaces in combined sewer watersheds through detention and infiltration source controls over the next 20 years. This Plan takes a significant step in advancing stormwater source control by setting a specific target.

Other efforts to update environmental policies and to meet existing and new water quality and stormwater management regulations include the development of sustainable site and park design guidelines. The NYC Department of Design and Construction released its Sustainable Urban Site Design Manual in 2009, and in late 2010 NYC DPR will publish its High Performance Landscape Guidelines: 21st Century Parks for NYC, which will provide a detailed set of best management practices and design approaches aimed at sustaining high quality natural and water resources. NYC DPR and other NYC agencies are also working locally to revise building codes through the U.S. Green Building Council¹⁶; a dozen recommendations related to site design and stormwater have been identified and are being vetted through various city agencies (see short description below).

Proposed Recommendations:

- Current building codes discourage the implementation of stormwater Best Management Practices (BMPs) on private property (NYC Admin. Code §27-901(k)). Code revisions are needed to allow more flexibility in on-site retention, detention, and infiltration of stormwater, instead of mandatory sewer hook-ups.
- Revise the NYC Zoning text to incorporate tree pit design specifications that enable increased stormwater capture and to include revisions to the Yards text to reduce impact of runoff from impervious surfaces in front-yards, using techniques such as grading to direct drainage to planted or detention areas.
- Roadway design at the city and state level should incorporate vegetated swales to store, absorb and filter stormwater wherever possible. Responsibility for designing, paving, guttering, and construction of roadways rests with transportation departments.

¹⁶ http://www.nyc.gov/html/dob/html/guides/green_buildings.shtml

- The New York City zoning code has the potential to limit the imperviousness of driveways and parking lots, to incorporate requirements such as the use of porous pavements, increased tree planting, and perimeter landscaping, and can otherwise promote on-site retention and infiltration of stormwater by regulating the amount of pervious surface that must be retained on the sites of private development. Unfortunately, the New York City zoning codes does not currently address nonpoint source pollution in a comprehensive manner. Authority to amend the zoning code rests with the City Planning Commission and the City Council and responsibility to enforce the zoning code rests with the Department of Buildings (NYC Charter § 200,643).
- Adoption of stormwater fee programs within the watershed would provide incentives for landowners to reduce stormwater runoff from their properties. In NYC, potable water use is metered and wastewater fees are assessed as 159% of water charges. The money collected from these fees is used to pay for drinking water and wastewater infrastructure maintenance, operation and upgrades. The current rate structure provides no incentive to reduce stormwater flows. By adopting a system that more directly incorporates stormwater runoff into water bills, NYC could provide incentives for property owners to reduce their site runoff. A study is underway to analyze the current water rate structure and consider options for assessing stormwater impacts.
- Identify a dedicated funding mechanism for enforcement agencies, such as the Office of the Attorney General (OAG), to support the enforcement of water quality protection laws. At present, the OAG lacks the resources and staffing to effectively enforce regulations throughout the watershed, due to funding shortfalls in this and other key program areas.
- Enact water conservation incentive programs. NYC DEP has been planning for several years to re-institute a Toilet Rebate Program. Water saving toilets, shower heads, and other fixtures, and system-wide upgrades could result in widespread water conservation benefits. These include a reduced burden on the wastewater conveyance and treatment system, which ultimately would reduce combined sewer overflows.
- Complete the data collection required to identify all significant pollution sources along the Bronx River and determine what loadings should be allocated to those sources to meet water quality standards for the river. NYC DEP must complete this data collection for DEC to establish a TMDL. This TMDL should be used to develop priorities, evaluate proposals and coordinate efforts for meeting shared water quality goals. It is essential that the entirety of the Bronx River remain on the New York State 303(d) List of Impaired Waterbodies until it has achieved the criteria for fishable and swimmable waters.

3. Reduce discharges of raw sewage from an aging sanitary sewer system, illicit connections, and combined sewer overflows.

Aging infrastructure, illicit connections, and limited municipal resources are some of the conditions that contribute to pervasive and chronic sewer overflows throughout the watershed. Each municipality is responsible for maintaining its own storm and sanitary sewer lines and responding to overflows within their jurisdiction, as well as identifying locations for discharge investigations and existing infrastructure assessments.

Proposed Recommendations:

- Explore the potential for establishing an intermunicipal cooperation program where municipalities can cost share equipment, overflow response staff, educational materials, discharge investigations, and possibly repairs.
- Establish a centralized watershed hotline for reporting suspicious discharges and overflows, similar to the Nassau County hotline.
- Develop a Geographic Information System (GIS) tracking database and associated GIS mapping of infrastructure, to track maintenance activities and costs, and estimate discharge impacts. This monitoring data is critical for evaluating the effectiveness of green infrastructure techniques and sharing results. NYC DEP is working on developing a database of current activities, in an effort to collect and share results based on local conditions.
- Establish inspection requirements for onsite wastewater treatment systems. Discharge investigations should be conducted by municipalities where there are indications of poor water quality or pollutants that may be associated with unregulated pipes.

4. Invest in controlling stormwater at its source to reduce runoff volume, promote detention, retention and reuse, and provide for water quality treatment prior to discharge into the River or sewer system.

With rainfalls as little as 1/10 of an inch, in some locations, New York City's combined sewer system diverts raw, untreated sewage directly into local waters. Stormwater source control can help reduce the volume of runoff generated by capturing water through various retention, detention, and infiltration methods. Techniques include rain garden/bioretention, greenstreets, green roofs, rainwater harvest systems, disconnected downspouts where allowed, vegetated swales and buffers, detention ponds/wetlands, and storm water infiltration basins. Many of these techniques are being deployed across the watershed.

Since the total storm capture from each individual retrofit is relatively small, they must be widely implemented in order to be effective. In dense urban areas, such as the Bronx, the use of stormwater as a resource to support distributed, vegetative systems can provide additional environmental benefits such as increased green space for wildlife habitat or community use, and decreases the urban heat island effect. These additional benefits of distributed stormwater management techniques should be included in any cost-benefit analysis of their implementation. Proper design and implementation of these techniques, described briefly below, requires an in-depth, site-specific analysis of hydrology, soils, and infrastructure.

- **Rain garden/Bioretention:** a basin or shallow depression in the landscape planted with flood tolerant species for collecting stormwater. Plants filter water and trap sediment. Plants and soil biological processes remove nutrients and other pollutants. Water is evapotranspired by plants, and infiltrates the soil where it is stored and can recharge groundwater supplies.
- **Greenstreet:** vegetation planted in street median or traffic/parking lot island; ideally, these plantings are recessed below the grade of surrounding impervious surfaces with strategically placed curb cuts that allow flow of stormwater to the area; Greenstreets can calm traffic and provide shade to reduce fuel volatilization. NYC DPR oversees the design and maintenance of most Greenstreets throughout the city and is now incorporating stormwater capture into new designs.
- **Green roof:** a vegetated rooftop containing a porous medium such as soil that can support vegetation and has an increased water holding capacity over traditional rooftops, resulting in less water flowing into the combined sewer system; green roofs can last twice as long as conventional roofs, saving money and materials. Where possible, green roof installations should adhere to best practices, such as the German FLL Standard, which promotes maximum growing media depth for maximum stormwater uptake.
- **Blue roof:** a roof that is designed to store rain water resulting in less stormwater flowing into the combined sewer system; stored water can be used for irrigation, cooling buildings, or recreational opportunities.
- **Disconnected downspout:** redirection of a rooftop's downspout from an underground pipe to nearby gardens and green spaces where allowed, either directly or using storage techniques like rain barrels.
- **Swale:** a long narrow depression that can vary in depth and vegetation type; swales retain water following a rainfall event; they are generally used along roadways and in combination with other storm water systems.

- **Detention ponds/wetlands:** ponds and wetlands that store and treat stormwater; sediment and particulates settle out and plants absorb nutrients and pollutants.
- **Storm water infiltration basins:** basins built with loose porous material to maximize retention and infiltration.
- **Subsurface storage chambers:** storage structures installed underground for storage, detention, and stormwater reuse for irrigation or other appropriate uses.
- **Stream day-lighting:** re-construction of a stream that was historically buried or piped to slow stormwater conveyance, to reintroduce riparian habitat and support local biodiversity.

In the separately-sewered portion of the watershed, stormwater retrofits targeting nutrient and pathogen removal can directly reduce pollution loading. Retrofits designed to detain and retain stormwater help protect stream channels from erosive flows and control the volume of stormwater entering the combined sewer systems.

Proposed Recommendations:

- Install demonstration projects or innovative practice designs during construction or renovation of publicly-owned facilities.
- Encourage Best Management Practices (BMPs) for private infill and redevelopment projects.
- Develop performance standards, track progress, provide signage and disseminate findings actively for educational purposes.
- Develop maintenance and management strategies and sources of funding to sustain BMPs.

5. Implement large- and small-scale stream, riparian, and wetland restoration projects.

Several proposed stream and wetland restoration projects were identified throughout the watershed, as outlined in the next section on Site Specific Management Recommendations. These types of projects have multiple benefits that extend beyond those of stormwater management and control. Objectives for the projects include increasing in-stream habitat diversity and cover, controlling invasive species, increasing floodplain ecosystem function, managing stormwater flow, reducing stream bank erosion, constructing fish passages, and restoring salt marshes and shellfish reefs in the river's estuary. Due to the prevalence of invasive species, long-term invasive plant

management must be undertaken in conjunction with most stream and buffer restoration activities. These projects can improve habitat, provide flood attenuation, process nutrients, and reduce downstream impacts. In addition, these projects provide an opportunity for community involvement (e.g. planting) and education, which are mandated under the National Pollution Discharge Elimination System (NPDES) requirements for 'public education and outreach' and 'public participation and involvement.'

6. Restore riparian buffers and upland pervious areas through land acquisition, invasive plant management, soil protection and enhancement, and planting of native trees.

A number of riparian buffer reforestation projects were identified throughout the watershed that would help stabilize eroding stream channels and reduce untreated stormwater flow and trash loading into the stream. Locations of these projects are described in Section 5 below, in Tables 4, 5, and 10. Buffer planting and invasive species management projects require modest planning prior to implementation, though they require on-going maintenance for long-term sustainability. This type of work, together with stormwater source control retrofits, should be incorporated into the more extensive design work required for stream restoration projects. Effective protection of critical riparian buffers, headwater ephemeral channels, slopes and forested areas, will require outreach and education, careful review of land development proposals, and on-the-ground invasive plant control and reforestation projects throughout the watershed.

Over 30 acres of vacant land or large turf areas were identified for pervious area restoration (tree planting, soil amendments, etc.), to improve infiltration and groundwater recharge and increase urban canopy cover. Some of these areas are included in Table 4 in the categories of stormwater source control, restoring riparian areas, and managing invasive species.

7. Promote pollution prevention at stormwater hotspots for municipal operations, and in targeted residential areas and businesses that have a high potential for contaminating stormwater runoff.

Conventional practices by residents, businesses and municipal operations can negatively influence water quality. Some of these practices include over-fertilizing lawns; inappropriate disposal of paints, household cleaners, or automotive fluids; and dumping into storm drains. More than 40 business and municipal locations were assessed including auto-related sites (e.g. gas stations, servicing, car wash), municipal sites (e.g. maintenance facilities, schools, fire stations, parks, train stations), commercial sites, industrial sites, plant nurseries/landscaping, and a golf course. Over 25 neighborhoods were assessed to identify suitable watershed protection practices. The location of the sites and neighborhoods assessed are listed in the Westchester Management Report (2006) and in the Bronx River 2006 Ecological Restoration and Management Plan, both

available online at the Bronx River data website¹⁷. Recommended practices included: downspout disconnection where allowed, improving watershed awareness with measures such as storm drain stenciling, reducing lawn fertilizer use, improving landscaping practices to reduce erosion and sedimentation, reducing impervious areas, reducing stream buffer encroachment, and reducing yard waste dumping along the stream banks. Sites where this work is being conducted or proposed are described in Section 5 of this report. Though the individual impact of these practices is difficult to quantify, the wide-spread opportunities for improved “housekeeping” suggest these practices could have a significant positive cumulative effect.

Even though existing State Pollution Discharge Elimination System (SPDES) permits require municipal “good housekeeping,” all publicly-owned maintenance facilities visited were confirmed hotspots and multiple opportunities for improvement were observed. Municipal facilities and other public sites should serve as demonstration sites for comparable private operations. Training should be provided for municipal staff on appropriate pollution prevention techniques, and a model pollution prevention plan (PPP) should be developed that could be adapted for each maintenance facility.

8. Facilitate community education and involvement in all matters affecting the health of the watershed.

For maximum effectiveness, watershed education efforts need to focus on a broad base of constituents including local residents and businesses. The NPDES requirement of ‘public education and outreach’ includes topics such as the reduction of fertilizers, pesticide and salt application, use of native landscaping materials, and proper disposal of pet waste and trash. Community involvement should focus on providing better public access and increased opportunities to connect residents to the stream, incorporating environmental education into school programming, and encouraging participation in water quality monitoring. A mass media campaign, targeted brochures, and websites can help achieve this goal, but hands-on connections to the river remain a priority—public canoe trips, volunteer water quality monitoring programs, tours, etc.

9. Coordinated monitoring and project tracking to better assess the delivery, implementation, and effectiveness of management practices.

Coalition partners should promote a three-pronged approach to monitoring implementation activities: project monitoring, station monitoring, and project tracking. Project monitoring should be geared towards quantitative measures of success for both structural and non-structural management and restoration practices (e.g., stormwater retrofits, stream repair projects, public education, etc.). This body of monitoring data and performance measures should be collected in a standardized format, shared, and reviewed by scientists and professionals to expand the collective knowledge about the

¹⁷ http://bronxriver.org/puma/images/usersubmitted/greenway_plan/

effectiveness of various best management practices. Continued monitoring at existing stations throughout the watershed is recommended in Tables 5, 8, and 12, including baseflow and storm flow sampling to investigate water quality conditions, responses to management actions, and long term trends. Monitoring of hydrological and biological indicators is important to determine if stream conditions are improving, watershed goals are being met, and progress towards meeting regulatory requirements is being achieved. Additional stations are recommended for surface tributaries where no information is available (i.e., confluence with Davis and Clove Brook). Project monitoring and tracking data can be used to document implementation progress for reporting to funders and stakeholders. It can also be used to evaluate the effect of climate change and whether there will be a need to modify plans, designs or priorities adapt to climate change conditions in the future. The tracking system should account for all restoration practices undertaken in the watershed regardless of their type or size. Coalition partners should determine how and when this monitoring and project tracking information is best compiled and shared.

10. Communicate regularly with partners and the broader community on implementation progress, plan updates, and watershed conditions.

The Coalition should host periodic public meetings to discuss and share accomplishments, recognize participants, review lessons learned, identify ongoing constraints and priorities, and solicit feedback on plan updates and next steps.

Proposed Recommendations:

Designate a mechanism for hiring a watershed coordinator, to be responsible for integrating the various restoration activities within the watershed, and communicating with partners via a formal Coalition, based on the already existing Watershed Coalition structure.

Review and update the Watershed Management Plan, or key tables in the Plan, annually, as needed. The Plan recommendations should also be revised as needed at least every five years with updated recommendations for reducing pollutant loadings from point and nonpoint sources and for implementing other priority projects.

4

SITE SPECIFIC MANAGEMENT RECOMMENDATIONS

This section summarizes conditions within the four main subwatershed units (the mainstem, the sewersheds, tributary subwatersheds, and reservoirs) and presents recommendations for management, site investigations, and on-the-ground projects to help achieve the watershed protection and restoration goals.

Each sub-section contains a description of the subwatershed, a summary of primary recommended or on-going management actions and a table of specific recommendations. The recommendations consist of high priority and/or primary recommended management actions from the Bronx River Watershed Assessment and Management Report¹⁸ and the Ecological Restoration and Management Plan.¹⁹ High priority projects were determined using best professional judgment to rank each opportunity based on six factors: cost, synergy, visibility, water quality improvement, feasibility, and community involvement.²⁰ Primary management actions were categorized as follows: highly feasible, able to address identified ecological concerns, likely to be funded, requiring moderate (not significant) funding to initiate, or implementable within three to five years assuming available funding and resources as well as community or agency commitment. A planning level cost range is provided for each of these recommended projects.

4.1 Mainstem

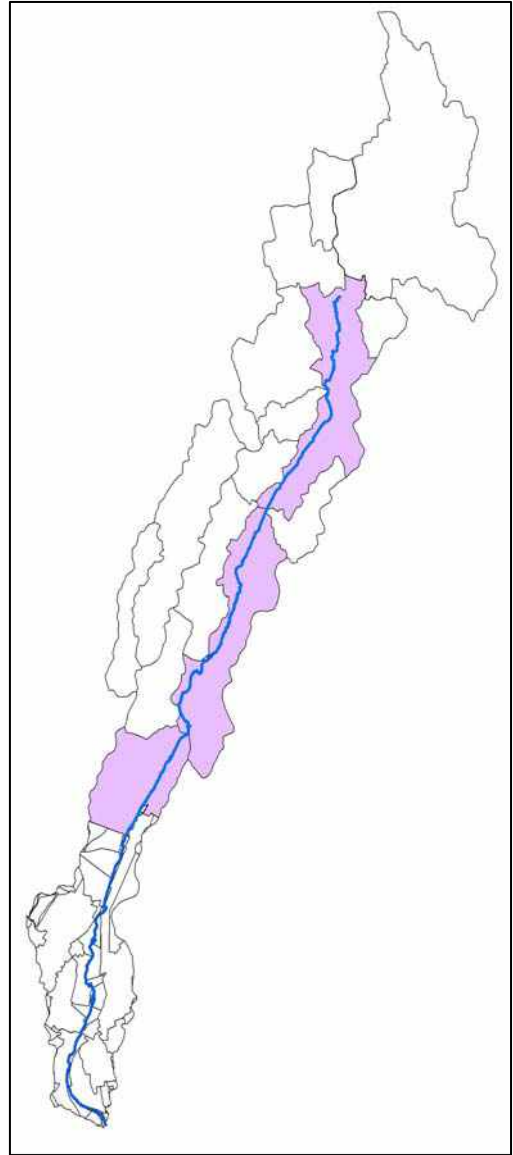
The mainstem of the river includes the narrow 23 mile corridor from the base of the Kensico Dam to the Long Island Sound, and the adjacent direct drainage area. Table 3 provides an overview of characteristics of this subwatershed area. Over two-thirds of the mainstem length is in Westchester County. Drainage within this portion of the watershed flows directly to the Bronx River through more than 100 discharge pipes or as sheet flow from nine jurisdictions. This stormwater carries pollutants from impervious surfaces, as well as undocumented illegal connections from residential sanitary systems, gas stations, and other small industries. In the Bronx, drainage infrastructure directs most of the stormwater to the lower 2.5 miles of the river, which are tidal (see Sewersheds on page 34).

¹⁸ CWP and Biohabitats, 2007.

¹⁹ BxRA, 2006.

²⁰ CWP and Biohabitats, 2007.

For most of its length in Westchester, the mainstem is bordered by the Bronx River Reservation and Parkway, parkland through which the bike/pedestrian path of the Bronx River Greenway runs. Much of this greenspace was preserved through the creation of the Bronx River Parkway, which serves as a major transportation and recreation corridor. Bronx Park, the New York Botanic Garden, and the Bronx Zoo, border the river in the Bronx for about half its length. An effort to extend bike/pedestrian paths into the lower portion of the river is underway as part of the eight-mile-long Bronx River Greenway.²¹



²¹ The Bronx River Greenway Plan is available at:
[http:// www.bronxriver.org/plans](http://www.bronxriver.org/plans)

Table 3. Basic Profile of the Mainstem Subwatershed		
Drainage Area	8,582.9 acres (13.4 mi ²)	
Impervious Cover	33%	
Stream Length	15 miles in Westchester, 8 miles in the Bronx, including 2 miles in the estuary	
Subwatersheds Included	<ul style="list-style-type: none"> • Bronx River Upper Direct Drainage • Bronx River Middle Direct Drainage 	<ul style="list-style-type: none"> • Bronx River Lower Direct Drainage
Jurisdictions	<ul style="list-style-type: none"> • New York City, the Bronx (Bronx County) • Bronxville • Eastchester • Greenburgh • Mt. Vernon 	<ul style="list-style-type: none"> • Scarsdale • Tuckahoe • Westchester County • White Plains • Yonkers
Significant Features	<ul style="list-style-type: none"> • Transportation and recreational corridor (i.e. Bronx River Parkway, Bronx River Parkway Reservation, Bronx River Greenway; Bronx Park, Bronx Zoo, New York Botanical Gardens) • Straightened and altered channel; poor water quality; degraded in-stream and riparian habitat; sedimentation in ponds 	<ul style="list-style-type: none"> • Garth Butler Woods and Bronx River Forest remaining natural areas • Three dams in the Bronx and seven dams in Westchester • Restoration priorities: stormwater source control and management, fish passage, streambank and floodplain restoration, floatable debris control, pollution prevention

As the mainstem flows south, forest cover decreases and development density increases across the watershed. In general, the river is characterized by a uniform, trapezoidal channel, little in-stream cover, and over-widening in some locations. Evidence of sand and fine sediment deposition suggests legacy sediment may be a significant part of the overall sediment budget. Streambanks appear relatively stable, although they are frequently armored, and predominately steep and high, indicating the disconnection from the floodplain. Much of the riparian buffer has been encroached upon and invasive species are prevalent. At several of the seven dams in Westchester, ecological connectivity is disrupted, and the impoundments behind the dam have filled with sediment. Garth Butler Woods Preserve, in the middle of the mainstem, is one of the last remaining relatively untouched oak and tulip complexes in the watershed.

Continuing downstream into the Bronx, several parks border the river including Muskrat Cove, Shoelace Park and the Bronx River Forest—the largest floodplain forest in the Bronx. The river then flows through the New York Botanical Garden and the Bronx Zoo, which contains reaches or segments that are relatively undisturbed as well as significantly modified reaches by three different dams. A quarter mile downstream of the lowermost dam, the river becomes tidal, with thin bands of salt marsh vegetation in some areas towards confluence with the East River. Water quality in this estuary section of the river is influenced by tidal waters from the Hudson River estuary, New York

Harbor and Long Island Sound. Low dissolved oxygen (DO) levels are of special concern in the Bronx River, where five combined sewer overflows (CSOs) are located (Figure 3, page 42). Monitoring conducted by the BxRA indicates periods of low DO levels in impoundments and areas near CSOs.²²

Primary recommended management actions for the mainstem (corresponding to Strategies #3-8):

- **Illicit Discharge Investigations** – These ongoing investigations will help identify and eliminate some of the most noxious point sources of pollutants.
- **Stormwater Retrofitting** – Though difficult to implement on a broad scale, the restoration of the Bronx River depends upon the restoration of the hydrology and the ability to reduce the frequency and volume of untreated stormwater to the river. Consequently, relatively large, visible, or practical opportunities for stormwater capture, recharge of clean water to groundwater, or flood storage should be pursued wherever they can be identified.
- **Riparian Edge and Floodplain Restoration** – Due to on-going disturbance, local stream restoration projects can have limited impact on the mainstem. But cumulative efforts to plant native species, manage invasive plants, increase flood storage or detention, and reduce erosion will result in greater protection and stewardship of the river. These projects should be pursued with careful consideration of the site objectives and sustainability of the selected approach.
- **Invasive Species Management** – Exotic invasive species can dominate riparian and floodplain vegetation and reduce biotic and habitat diversity. Invasive plant management needs to be targeted and persistent, and is critical for maintaining a native plant community in a disturbed urban environment. The level of intensity and the techniques used for invasive plant control must be adapted to meet site specific objectives.
- **Trash Removal** – This management action is important for ecological and social reasons. Trash can contain household and industrial waste products that pollute the water and breakdown into sizes that can be harmful to wildlife. Trash is a highly visible source of pollution. Removing these gross pollutants is relatively easy compared to other pollutant controls and has a large aesthetic and recreational benefit.
- **Community Education** – In a dense urban environment, there are relatively few large, regulatory, or construction actions that will result in significant environmental benefits. Education and outreach are critical both to impact human behavior in the

²² BxRA, 2006.

public right-of-way and on private property (e.g., lawn care, downspout disconnects where allowed), but also to support regulatory changes and neighborhood projects, such as those associated with stormwater retrofit projects.

- **Project Tracking** – On-going initiatives and programs should be used, where possible, as a means of tracking watershed restoration work. For example, in the Bronx, NYC DPR plans to incorporate all ecological restoration projects into an excel database being piloted for the HY/NJ Harbor Estuary Program, and in a restoration and invasive plant control pilot tracking project with Bronx River Alliance. Going forward, the Coalition should consider the development of a Bronx River watershed-wide tracking approach for all types of best management practices and projects.

In 2009, NYC DEP began a study to develop and test stormwater source control pilots, or best management practices (BMPs), across the City. Through this study, and through the NYC Green Infrastructure Plan, DEP will implement stormwater BMPs in various types of applications, such as on roof tops and residential properties, and in the street right-of-way. Due to the highly-urbanized landscape of the City and related constraints on the types and sizes of BMPs that are feasible, widespread penetration of source controls across a drainage area is critical toward achieving the stormwater benefits associated with BMPs. The building and monitoring of these pilots over the next several years will provide the information required to implement source controls Citywide and integrate them into New York City's stormwater management policies.

The specific locations identified for these recommended actions are provided in Tables 4 and 5 below. Project Partners for the recommendation listed in Westchester are the municipality named or Westchester County Planning Department.

Note: Recommendations may need verification as actions may have been or may be in the process of being implemented.

Table 4. Specific Recommendations for Mainstem in Westchester **

Description	Location*	Cost Range
Investigate and reduce illicit discharges	<ul style="list-style-type: none"> • Eastchester (Eastchester Municipal Maintenance Yard); Eastchester/Yonkers (OT-1 in reach BRM-1) • Greenburgh/North Castle (OT-1 in reach BRU-1; Greenburgh/White Plains (OT-1 in reach BRU-3) • Mt. Vernon (OT-2 in reach BRM-3b); Mt. Vernon/Yonkers (OT-1 in reach BRM-1b) • N. Castle (Metro N. Welfare Facility on Fisher Ln.) • Scarsdale (Bronx River Reservation Maintenance Facility) • Tuckahoe/Yonkers (OT-1 in reach BRM-4) • Locations where new illicit discharges are identified 	\$-\$
Provide Stormwater source control	<ul style="list-style-type: none"> • Eastchester (Eastchester Municipal Maintenance Yard) • Greenburgh/Scarsdale (reach BRU-8) • Greenburgh/White Plains (Between Old Kensico Rd. and the Bronx River Pkwy under the I-287 crossing) • Mt. Vernon (Pennington Grimes Elem. School) • Scarsdale (Bronx River Reservation Maintenance Facility) • Tuckahoe (Tuckahoe Maintenance Yard on Marbledale Rd); (Westchester County Crestwood Maintenance Facility) • White Plains (reach BRU-5) • Yonkers (public park along Paxton Ave.) • Yonkers/Eastchester (near Garth Woods, along the Bronx River north of Strathmore Road/Harney Road) 	\$-\$-\$-\$
Restore stream, riparian corridor and floodplain	<ul style="list-style-type: none"> • Eastchester (Eastchester Park) • Eastchester (Leewood Golf Course) • Greenburgh/White Plains (Between Old Kensico Rd. and the Bronx River Pkwy under the I-287 crossing) • Mount Vernon/Yonkers (Along the Bronx River south of Midland Avenue, north of Scout/Parkway Field) • Yonkers/Eastchester (Near Garth Woods, along the Bronx River north of Strathmore Road/Harney Road) • At priority Target Ecosystem Characteristic sites as identified in cooperation with the USACE • Multiple sites where fish passage obstacles exist 	\$-\$-\$
Manage invasive species	<ul style="list-style-type: none"> • Eastchester (Eastchester Park) • Eastchester (Leewood Golf Course) • Greenburgh/White Plains (Between Old Kensico Rd. and the Bronx River Pkwy under the I-287 crossing) • Mt. Vernon/Yonkers (along the Bronx River south of Midland Avenue, north of Scout/Parkway Field) • Scarsdale (Bronx River Reservation Maintenance Facility) • Yonkers/Eastchester (near Garth Woods, along the Bronx River north of Strathmore Road/Harney Road) 	\$-\$-\$
Prevent pollution and remove trash	<ul style="list-style-type: none"> • Eastchester (Eastchester Park) • Mt. Vernon (Lincoln BBQ Restaurant) • Mt. Vernon (Pennington Grimes Elem. School) 	\$-\$-\$-\$
Provide community education	<ul style="list-style-type: none"> • Eastchester (Eastchester Municipal Maintenance Yard) • Mt. Vernon (Lincoln BBQ Restaurant) • Mt. Vernon (Pennington Grimes Elem. School) • Volunteer programs for community engagement • Storm drain stenciling • Public service announcements promoting actions to protect water quality 	\$-\$-\$-\$
\$: Estimated Planning Level Cost ≤ \$50,000 \$\$: \$50,000 < Estimated Planning Level Cost ≤ \$100,000 \$\$\$: \$100,000 < Estimated Planning Level Cost ≤ \$500,000 Cost ≤ \$500,000 Cost > \$500,000		

*Alpha numeric codes refer to the reach locations identified in the *Summary of Findings from Bronx River Watershed Stream Corridor and Upland Assessment (CWP, 2006)*

** Recommendations may need verification as actions may have been or may be in the process of being implemented.

Table 5. Specific Recommendations for Mainstem in Bronx

Description	Location	Partners	Cost Range
STORMWATER SOURCE CONTROL (capture, detention, retention, reuse)			
Construct stormwater source control projects to treat and detain stormwater before it enters the river.	All new capital projects in various locations including the Stone Mill restoration project in the NYBG, the overflow parking lot in the Bronx Zoo, and along the Bronx Parkway and Metro North, at Muskrat Cove, in Shoelace Park, in the West Farms and along the estuary section of the river.	NYBG, WCS, MTA, NYC and NYS DOT, NYC DPR, NYC DEP	\$\$-\$\$\$\$
STREAM, WETLAND AND RIPARIAN RESTORATION			
Install in-stream cover - such as anchored large woody debris (LWD) or placed boulders - and revegetate eroded banks, where needed. Increase in-stream hydraulic and habitat complexity.	<ul style="list-style-type: none"> Muskrat Cove Shoelace Park Bronx Forest West Farms (from River Park to Drew Gardens) 	NYC DPR, BxRA	\$\$-\$
Plant native woody and understory plants, and maintain plantings by controlling invasive species.	<ul style="list-style-type: none"> Muskrat Cove Bronx Forest Bronx Zoo Concrete Plant Park Shoelace Park NYBG West Farms Garrison Park 	NYC DPR, BxRA, NYBG, WCS, Green Apple Corps (GAC)	\$\$\$
Design and construct fish passage, or remove passage obstacles, at dams blocking anadromous fish access to freshwater reaches.	<ul style="list-style-type: none"> 182nd St. Dam Bronx Zoo double dam NYBG Snuff Mill Dam 	WCS, NYBG, NOAA, NYC DPR, BxRA, NYS DOS	\$\$\$\$
Construct or maintain salt marsh to increase aquatic habitat and tidal wetland function.	<ul style="list-style-type: none"> Soundview Park lagoon Concrete Plant Park 	NYC DPR, ACOE, BxRA	\$\$-\$\$\$\$
Restore/create shellfish habitat to increase the populations of mollusks and aquatic habitat complexity.	<ul style="list-style-type: none"> Soundview Park estuary Other sites in estuarine reach 	NYC DPR, Rocking the Boat (RTB), Baykeepers, Hudson River Foundation (HRF)	\$\$
INVASIVE PLANT MANAGEMENT AND POLLUTION PREVENTION			
Maintain NYC DEP trash boom.	River channel adjacent to Concrete Plant Park	NYC DEP	\$\$
Manage river corridor- trash removal, woody debris management, invasive plant control, and remove floatable garbage and excess small woody debris from LWD jams.	NYC parkland bordering Bronx River NYBG WCS	BxRA, NYC DPR, GAC	\$\$
Develop live plant material harvest sites as sources of native vegetation for applications such as erosion control and streambank stabilization.	Bronx Forest	NYC DPR NRG, BxRA, GAC	\$\$

Table 5. Specific Recommendations for Mainstem in Bronx

Description	Location	Partners	Cost Range
Prioritize invasive plant management in and adjacent to existing planting sites using an adaptive management approach. Expand invasive species control strategically to new sites based on available resources. Develop a plan and guidelines to codify these practices.	<p>Current sites:</p> <ul style="list-style-type: none"> • Shoelace Park east side • Bronx Forest • NYBG • West Farms Greenway <p>New / Future sites:</p> <ul style="list-style-type: none"> • Muskrat Cove • Woodlawn • Shoelace Park west side • Bronx Forest Island • Bronx Zoo • Starlight Park • Concrete Plant • Garrison Park 	NYC DPR, BxRA, GAC, NYBG, WCS	\$\$
COMMUNITY EDUCATION			
Provide technical and training support to volunteer water quality monitors who act as watchdogs for the river.	Monitoring stations along the entire river	BxRA, Bronx River Stewards, Westchester County Parks and Planning	\$\$
Develop and maintain website with links to public data on water quality, fisheries, soils, monitoring programs and restoration projects including data dictionary.	Sewersheds and Bronx River watershed in Bronx including Estuary section: BxRA and/or NYC DPR website	BxRA, NYC DPR	\$\$
Provide technical training and support to maximize use of stormwater retrofits, green roofs and point and non-point source pollution controls.	Sewersheds and Bronx River watershed in Bronx	NYC DPR, BxRA, NYC DEP, NYS DEC, NYC Council on the Environment	\$\$
Provide technical training and support to organized volunteer forest restoration activities such as invasive plant removal and native species plantings.	<ul style="list-style-type: none"> • Shoelace Park • Bronx Forest • NYBG • Drew Gardens 	NYC DPR, BxRA, NYBG, Phipps Community Center	\$

4.2 Sewersheds

Most of the drainage infrastructure in the lower eight miles of river consists of pipes used to transport both stormwater and sanitary sewage. These combined systems, called combined sewer overflows or outfalls (CSOs), are designed to convey stormwater and sewage to the Hunts Point wastewater treatment plant, which is located outside of the watershed. Under flow conditions greater than two times the dry weather flow volume, the capacity of the combined conveyance system can be exceeded. This can occur after as little as one-tenth of an inch of rain depending on the location and antecedent conditions. To relieve the overloaded wastewater treatment system, excess flows are diverted to CSO locations along the river, resulting in discharges of stormwater carrying untreated pollutants as well as raw human waste. The collective area that drains to an individual CSO is called a sewershed (Table 6, Figure 3), and there are a total of five CSOs within the sewershed unit of the Bronx River. Discharges from CSOs are one of the primary causes of water quality impairment in the Bronx, contributing to low DO and high fecal coliform levels.

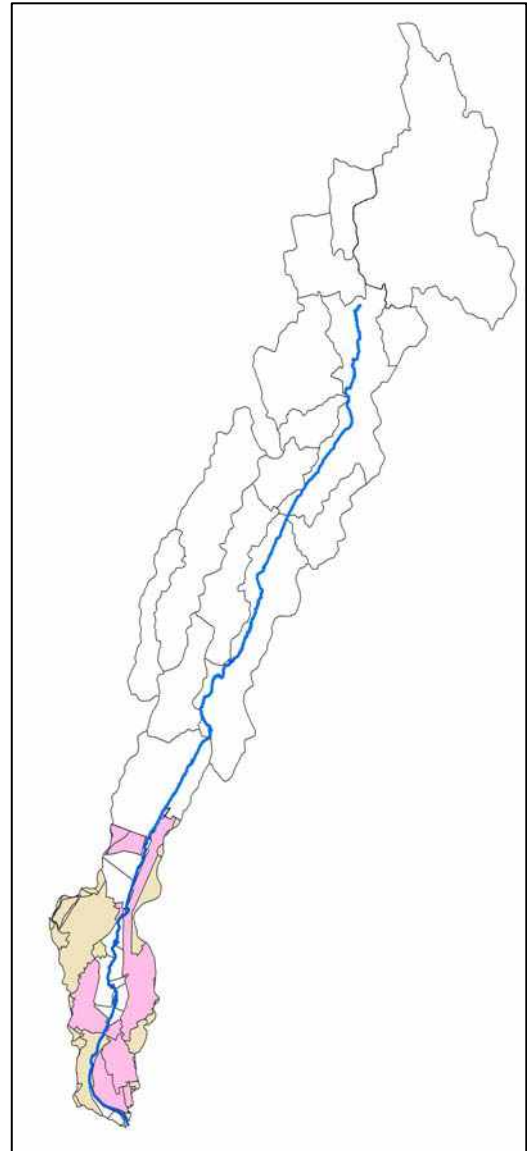


Table 6. Basic Profile of the Sewershed / Subwatershed		
Drainage Area	6,374 acres (9.9 mi ²)	
Impervious Cover ¹	HP 004 - 82.7% HP 007 - 75.1%	HP 008 - 76.6% HP 009 - 70.9% HP 010 - 36.1%
Stream Length	6 miles along the mainstem, 2 miles in the estuary	
Subwatersheds	• NYC sewersheds draining to Bronx River	
Jurisdictions	• Bronx County	• New York City
Significant Features	<ul style="list-style-type: none"> • Highly urban/piped drainages feeding five CSO outfalls • ~900 MG/yr combined discharge from HP-007, -004, and -009 	<ul style="list-style-type: none"> • Restoration priorities: increased system storage capacity; stormwater source control through dispersed retrofits, impervious area reduction and disconnection, rooftop and roadway disconnection; tree planting

¹ NYC Parks & Recreation Natural Resources Group, 2004.

NYC DEP prepared a watershed-specific Waterbody/Watershed Facility Plan report for controlling combined CSOs to the Bronx River in fulfillment of the 2004 CSO Consent Order requirements.²³ Based on this model, three sewersheds (HP-004, HP-007, and HP-009) were identified as contributing chronic discharges that collectively contribute an estimated 947 million gallons/yr in sewage and stormwater overflow (Table 7). These sewersheds each have over 60% impervious cover, and are primarily composed of high density residential and commercial development with little room for improved stormwater management.

Table 7. Bronx River Discharge Summary			
Combined Sewer Outfall	Discharge Volume (MG)	Percentage of CSO Volume (%)	Number of Discharges
HP-004	20	2	14
HP-007	81	9	19
HP-008	4	0.4	17
HP-009	842	89	50
HP-010	0.6	0	1
Total CSO	947	100	N/A
Data Source: NYC DEP, 2007b.			

²³

NYC DEP, 2007.

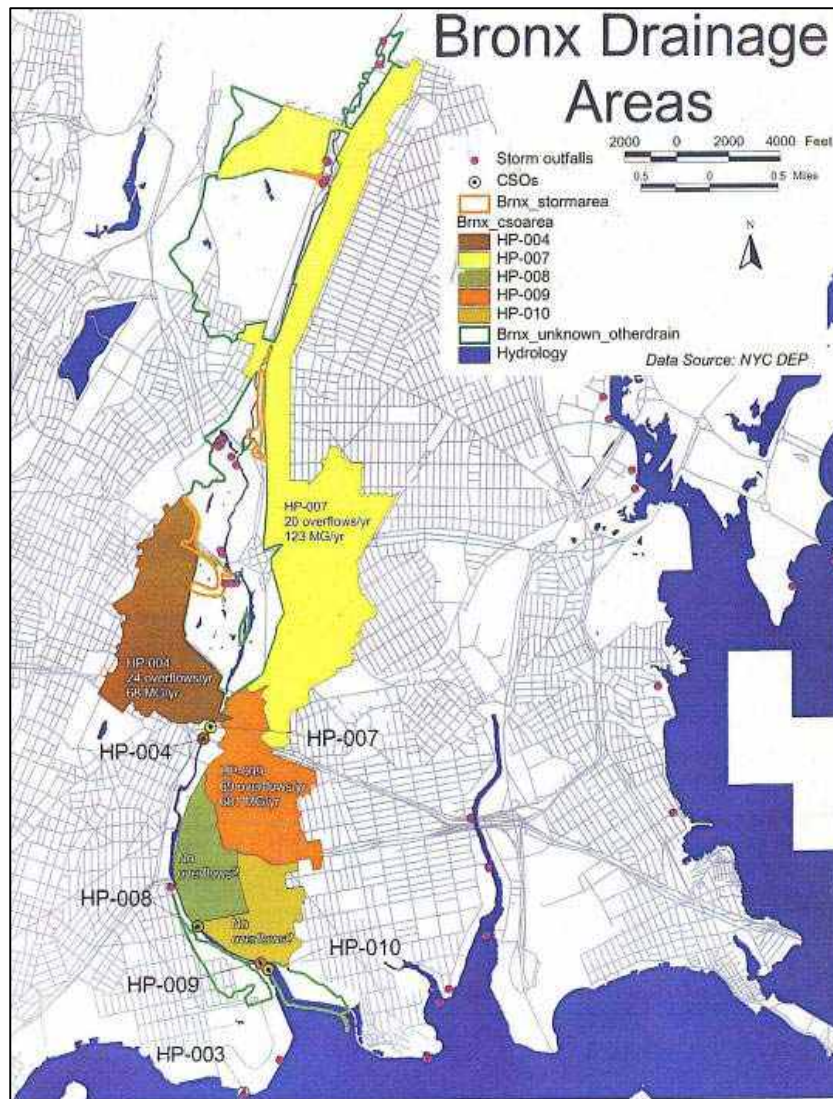


Figure 3. Bronx River Sewersheds (DEP, 2007)

Primary recommended management actions for the sewershed (corresponding to Strategies #3, 4, 7, 9):

- **Reduce CSOs** - The overarching restoration goal in the sewershed portion of the river is to reduce the occurrences and impact of CSOs through a combination of approaches, including the separation of the sanitary and storm sewer systems in new or reconstructed developments, increasing capacity of existing systems, and reducing the volume introduced to the system. NYC DEP has been analyzing strategies for decreasing CSOs in the Bronx through improved maintenance as well as by employing additional conventional infrastructure, such as increased storage

capacity in underground storage tanks, and by piloting green infrastructure to control stormwater at its source.

- **Stormwater Source Control** – Community organizations, DPR and DEP have been working to identify and implement projects to reduce the volume of stormwater entering the combined sewage system during rain events. Some of this water could infiltrate or be evapo-transpired by street trees or vegetation in bioretention systems in parks, in street right-of-ways, or along parking lots. Stored stormwater in subsurface chambers could be re-used to irrigate gardens or supply non-potable uses such as toilet flushing or car washing. Re-directing stormwater to vegetated areas can result in more green space, and help lower temperatures, lower energy and irrigation costs, and improve water quality. Integrating stormwater recharge and infiltration goals into the development of the Bronx River Greenway, residential rooftop disconnection where allowed, and municipal urban tree planting programs are priority goals for the sewershed portion of the river.
- **Community Education** – Stormwater source control in the landscape provides both an opportunity for outreach and education and a need to garner support and stakeholder buy-in for the long term sustainability of these dispersed BMPs. Projects that pilot the implementation of source controls in urban neighborhoods, such as those underway in the South Bronx, need to continue in these impacted areas.
- **Coordinate Monitoring and Project Tracking** – Assessment of project performance in the CSO-shed is particularly important for pilot stormwater source control projects. The on-going effort by the Mayor's Office of Long Term Planning and Sustainability to develop a tracking system in conjunction with the PlaNYC Stormwater Taskforce offers a potential repository for BMP project information in the sewershed, as a means of assembling information for assessing BMPs.
- **Project Tracking** – On-going initiatives and programs should be used, where possible, as a means of tracking watershed restoration work. For example, in the Bronx, NYC DPR plans to incorporate all ecological restoration projects in an excel database being piloted for the NY/NJ Harbor Estuary Program, and in a restoration and invasive plant control pilot tracking project with Bronx River Alliance. Going forward, the Coalition should consider the development of a Bronx River watershed-wide tracking approach to include all types of best management practices and projects.

Specific recommendations are provided in Table 8 (corresponding to Strategies #4, 7, 8).

Table 8. Specific Recommendations for Sewersheds

Description	Location	Partners	Cost Range
STORMWATER SOURCE CONTROL (capture, detention, retention, reuse)			
Conduct feasibility evaluation to determine most effective sites for CSO load reduction through stormwater source control.	HP007 and HP009 Sewersheds	NYC DEP, Drexel University	\$\$
Invest in stormwater treatment and source control projects, such as stormwater capture tree pits and other bioretention systems, at parkways, at streets adjacent to parklands and along historic streams.	<ul style="list-style-type: none"> Bronx River Parkway and adjacent streets Pelham Parkway Bruckner and Sheridan Expressways Shoelace Park along Bronx Boulevard Bronx Park East / Trojan Fields Tremont, Devoe and Morris Park Avenues 	NYC DPR, NYS DOT, NYC DOT, BxRA, NYC DEP	\$\$\$-\$\$\$\$
Implement stormwater source control demonstration projects at a City facility, (e.g. rain barrels, cistern, planter boxes, porous pavement, bioretention, subsurface storage, blue roof, green roof, or downspout disconnects where permitted).	NYC DPR, Bronx Borough Park Headquarters: Ranaqua (Green roof project is in design phase.)	NYC DPR, BxRA	\$\$\$
Maintain a database of potential greenstreet sites in Parks Greenstreets Program and conduct analyses to prioritize sites for stormwater capture at Greenstreets.	<ul style="list-style-type: none"> Southern Blvd from Fordham to Cross Bronx Expressway Harrod Place & Westchester, Story, Morrison & Lafayette Aves. Streets within HP009: Metcalf Ave. & Westchester Ave. & Watson Ave. & Soundview Ave. East Tremont Ave. & 177th St. Bronx Park East, Unionport Rd. and White Plains Rd Streets within HP007: Bronx Park East & Pelham Pkwy North & Bronx River Pkwy Northbound Ramp. Bruckner underpass 	NYC DPR, BxRA, NYC DOT, NYC Dept. of Design and Construction (DDC), NYC OLTPS, NYC DEP	\$\$\$
Incorporate stormwater source control into the renovation of neighborhood parks and playgrounds (porous pavement, stormwater harvest, spray-shower water capture, tree pit retrofit for stormwater, raingardens).	<ul style="list-style-type: none"> Starlight Park raingardens Prospect playground Farragut playground Mapes Pool & ballfield Noble Playground French Charley playground DEP BMP pilot at Shoelace Park Darryl Pop McKinney Park Mathews Muliner playground Zimmerman playground Ciccarone Park Belmont playground Quarry ballfields Vidalia Park Garden of Happiness 	NYC DPR, BxRA, NYC DEP, NYC OLTPS, NYS DOT	\$\$

Table 8. Specific Recommendations for Sewersheds

Description	Location	Partners	Cost Range
STORMWATER SOURCE CONTROL (capture, detention, retention, reuse) <i>CONTINUED</i>			
Develop implementation strategies for greening NYC schools, specifically with regard to stormwater source control and impervious cover disconnection and removal.	<p>All Schools including:</p> <ul style="list-style-type: none"> • PS 92, 129, 195, 234 • PS 211 and IS 318 • PS 6 West Farms • PS 67 Mohegan ,PS 188 <p>Schools of particular interest due to building footprint or location:</p> <ul style="list-style-type: none"> • PS/IS 214 • Fannie Lou Hamer Freedom High School • PS-103 Hector Fontanez 	OLTPS, Department of Education (DOE), DDC, BxRA, NYC DEP	\$\$\$-\$\$\$\$
Promote and expand downspout disconnection where allowed, through the rainbarrel project and other existing programs.	<p>Residential neighborhoods including:</p> <ul style="list-style-type: none"> • E 182 St. and Mapes Ave. • Southern Blvd. and E. Tremont Ave. • Katonah Ave./242 St./Vireo Ave. • E. 233 St./Van Cortland Park • Rhineland <p>Rosedale Ave. Magenta/Burke Ave. 3619 Willet Ave. 4736 Richardson Ave. 4825 White Plains Road</p>	BxRA, NYC Council on the Environment	\$\$
Identify opportunities for stormwater source control at public housing complexes (e.g. porous pavement, spray shower water capture, green roofs, impervious cover disconnection through diversion to planter boxes and grassy areas).	<p>Public housing complexes including:</p> <ul style="list-style-type: none"> • Bronx River Houses 1605 E. 174th St. • Bronxdale Houses • Murphy Homes • Parkside Houses <p>Fordham Bedford Housing Corp</p> <ul style="list-style-type: none"> • 2751 Grand Concourse • 2662 Decatur Ave. • 2668 Decatur Ave. • 2350 Webster Ave. 	BxRA, New York City Housing Authority (NYCHA)	\$\$-\$\$\$
Pursue private property stormwater source control opportunities (green roofs, parking lots retrofits on large properties, downspout disconnection where allowed using stormwater planters on small properties, rainbarrels).	<p>Various buildings, parking lots at businesses, industrial properties, grocery stores, churches and apartment buildings. Anticipated projects include:</p> <ul style="list-style-type: none"> • 1349 Stratford Ave. rainbarrel • Moshulu Preservation Corp. (MPC) rainbarrel 3400 Reservoir Oval • Neighborhood Initiatives Development Corp. (NIDC) rainbarrel at 2523 Olinville Ave. • DEP – Drexel University BMP Project on Manor Ave. & Stratford Ave. between E. 174th St. & E. 172nd St. • Rocking the Boat, rainbarrel at 812 Edgewater Rd. Bronx, NY 10474 • Hunts Point housing complexes managed by SEBCO • Bright Temple AME Church, Hunts Point Seventh Day Adventist Church • Hunts Point industrial properties 	BxRA, Drexel University, Youth Ministries for Peace and Justice (YMPJ), private landowners, Sustainable South Bronx (SSBX)	\$-\$\$\$

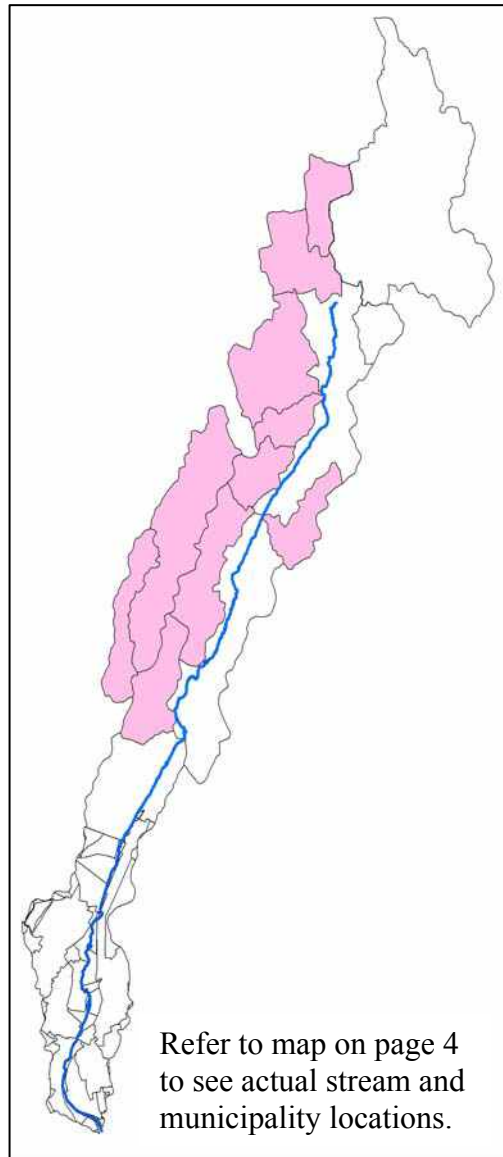
Table 8. Specific Recommendations for Sewersheds			
Description	Location	Partners	Cost Range
STORMWATER SOURCE CONTROL (capture, detention, retention, reuse) CONTINUED			
Support a long-term program for retrofitting internal downspouts on all buildings, for example, through blue roof stormwater detention. Advocate for new building codes, ordinances, and regulations to treat stormwater.	Buildings within the CSO areas; prioritizing schools and public buildings.	OLTPS, NYC DEP, NYC Dept. of Buildings (DOB), DDC, BxRA, NYC DEP, SWIM (Stormwater Infrastructure Matters)	\$\$
COMMUNITY EDUCATION & POLLUTION PREVENTION			
Develop and maintain website with links to public data on water quality, fisheries, soils, monitoring programs and restoration projects including data dictionary.	Sewersheds and Bronx River watershed in Bronx including Estuary section: BxRA and/or NYC DPR website	NYC DPR, BxRA	\$\$
Provide technical training and support to maximize use of stormwater retrofits, green roofs and point and non-point source pollution controls.	Sewersheds and Bronx River watershed in Bronx	NYC DPR, BxRA, NYC DEP, NYS DEC, NYC Council on the Environment	\$\$
Incorporate stormwater information into educational materials, visit green roofs and other stormwater retrofits with students and community partners, and coordinate with volunteers to stencil storm drains.	Sewersheds and Bronx River watershed in Bronx	BxRA, Sustainable South Bronx (SSB), RTB, community organizations	\$\$
PROJECT TRACKING			
Document BMP projects and share information on project performance and design.	Throughout sewersheds	NYC DPR, NYC DEP, BxRA, SSBx, RTB, HEP/NOAA, OLTPS, Drexel University	\$-\$
<i>Note: Recommendations may need verification as actions may have been or may be in the process of being implemented.</i>			
\$:	Estimated Planning Level Cost ≤ \$50,000	\$\$: \$100,000 < Estimated Planning Level Cost ≤ \$500,000	
\$\$:	\$50,000 < Estimated Planning Level Cost ≤ \$100,000	\$\$\$: Estimated Planning Level Cost > \$500,000	

4.3 Surface Tributary Subwatersheds

In the Westchester County portion of the watershed, a few tributary streams to the mainstem still flow above ground (rather than in pipes) and are categorized, here, as surface tributaries. Table 9 provides an overview of characteristics of these subwatersheds. They include Clove and Davis Brooks in the northwestern part of the watershed; Manhattan Park, Fulton, Hartsdale, and Fox Meadow Brooks that drain to the mid-section, and Troublesome Branch and Sprain Brook, which enter the mainstem closer to the county line.

There are primarily pollution tolerant macroinvertebrates and relatively few fish, in the Bronx River tributaries. Trout have been observed in Davis Brook, and have been reportedly present near the reservoir backwash area, but these trout may be present as a result of past stocking by NYS DEC²⁴. Habitat in many areas appears sufficient to support trout or other fish communities; therefore, water quality conditions and fish barriers are suspected to contribute to reduced in-stream biology. Buffer encroachment, trash and dumping, and extensive invasive plant species appear to be significant problems along most of the tributary streams. Many stream reaches are physically constrained into a narrow corridor by roads or buildings, and are extensively channelized, armored with concrete or riprap, piped underground or constricted through culverts. At several locations sanitary sewer overflows discharge untreated sewage to the river. In lower tributary reaches, there are large amounts of sand present within the channel. This sediment may be “legacy” sediment from erosion caused by past disturbances.

The U.S. EPA’s NPDES Stormwater Program regulates stormwater discharges from three potential sources: municipal separate storm sewer systems (MS4s), construction activities, and industrial activities. Phase II Stormwater regulations require that municipalities take actions to address aging sewage infrastructure and municipal operations (street sweeping, sewage overflows, good housekeeping at maintenance facilities, etc.). There are many opportunities for on-site stormwater retrofits,



Refer to map on page 4 to see actual stream and municipality locations.

²⁴ CWP, 2006.

particularly at parking lots and publicly owned facilities, since the area was developed prior to current stormwater regulations. Underground practices (e.g. sand filters, proprietary filter and storage systems, and catch basin inserts) may be appropriate for highly urbanized sections of the watershed where surface practices are less feasible.

Table 9. Basic Profile of the Surface Tributary Subwatersheds

Drainage Area	11,176.9 acres (17.4 mi ²)
Impervious Cover	21%
Stream Length	25.9 miles
Subwatersheds	<ul style="list-style-type: none"> • Clove Brook • Davis Brook • Fox Meadow Brook • Fulton Brook • Grassy Sprain Brook • Grassy Sprain Brook Direct Drainage • Hartsdale Brook • Manhattan Park Brook • Sprain Brook • Troublesome Brook
Jurisdictions	<ul style="list-style-type: none"> • Greenburgh • Mt. Pleasant • Scarsdale • Westchester County • White Plains • Yonkers
Significant Features	<ul style="list-style-type: none"> • Contiguous tracts of forest • Six subwatersheds with surface streams draining to mainstem ranging from suburban/rural to urban density
Restoration Priorities	<ul style="list-style-type: none"> • Incorporating BMPs into municipal operations, controlling stormwater discharges, eliminating illicit discharges; managing invasive plants and reforesting the buffer, preventing pollution prevention at stormwater hotspots, and reducing trash inputs.

Management priorities for surface tributaries should include protection strategies as well as restoration activities at specific sites. Private stewardship practices are critical since very little of the tributary stream corridor is public parkland. Across private and public land, recommended practices include buffer protection and reforestation, invasive species management, and trash cleanups within stream corridors.

A number of active and planned projects are described here, and the specific locations identified for these actions (corresponding to Strategies 3-8) are provided in Table 10.

Active Projects

Stormwater Management at Scout Field:

This project, partially funded by the National Fish and Wildlife Foundation (NFWF), consists of designing and constructing a stormwater retrofit at the terminus of an existing 52-inch stormwater pipe at Scout Field, Bronx River Parkway Reservation, in the Village of Bronxville. The concept design includes directing stormwater runoff from

the pipe into a newly constructed stormwater wetland and stabilizing the eroding river bank.

Bronx River Watershed Stormwater Management and Assessment Tool:

For this study, Hydroqual has been conducting watershed modeling for water quantity and quality objectives in the Bronx River and Long Island Sound Watersheds, as well as developing construction plans and specifications to improve the functional value of Crestwood Lake in the Bronx River Parkway Reservation in Yonkers. The model will evaluate the water quality impacts of land use decisions and the effect of implementing BMPs for stormwater control within sub-basins and townships in the watershed. The model, scheduled for phased completion in 2010 and 2011, will be configured to account for major changes in river geometry including impoundments, dams, and tributaries along the main stem; and encompass enough resolution to distinguish spatial gradients of observed water quality. The watershed portion of the model will include sufficient detail on topography and land uses to evaluate run-off volumes and non-point source nutrient and pathogen loads.

Bronx River Watershed Flood Mitigation Projects Assessment:

AKRF has been hired by Westchester County to conduct analyses for potential flood mitigation/water quality improvement project sites on County-owned properties in the Bronx River watershed. Five sites are located in the Bronx River watershed and six sites are located in the Tibbetts Brook watershed, a tributary to the Bronx River watershed.

Planned Projects

Bronx River Streambank Stabilization at the Westchester County Center:

This project involves the restoration and stabilization of streambank and a small island along the eastern bank of the Bronx River adjacent to the Westchester County Center Parking Lot, and will include removal of invasive plant species, installation of coir logs, and planting of native trees and shrubs appropriate to wetland and floodplain areas.

Fisher Lane Wetland Restoration:

This project consists of the design and construction of a wetland restoration project at Fisher Lane in the Bronx River Parkway Reservation, Town of Greenburgh. The project will include the restoration of a degraded freshwater wetland and improving its hydrological connection to the Bronx River. The freshwater wetland is dominated by *Phragmites australis*, an invasive plant that thrives in disturbed areas. The wetland will be restored by eradicating the invasive plants and replacing them with native herbaceous plants. The wetland's hydrological connection will be improved by modifying its existing microtopography. Additionally, the aquatic buffer on the west side of Fisher Lane pond will be enhanced. These restoration activities will improve the quality and reduce the quantity of stormwater runoff entering the Bronx River.

The County of Westchester continues to work with the USACE and NYC DEP on the ACE-led Bronx River Ecosystem Restoration Study. Westchester is also working with the ACE on identifying streambank stabilization projects along the Bronx River under Section 14 of the 1946 Flood Control Act. The Act grants the ACE authority to construct emergency shoreline and streambank protection works to protect public facilities, such as bridges, roads, public buildings, sewage treatment plants, water wells, and non-profit public facilities, such as churches, hospitals, and schools. The maximum Federal expenditure at any one site is \$1,500,000, and each project must be economically justified and environmentally sound.

Town of Greenburgh Constructed Wetlands and Permeable Pavement:

The Town of Greenburgh has been awarded funding to use constructed wetlands and permeable pavement to capture and treat approximately 250,000 gallons of stormwater annually from the parking areas of the Greenburgh Nature Center. This project will provide the added benefit of educating visitors to the center about the use of green infrastructure solutions.

Village of Tuckahoe Stormwater Treatment at Municipal Public Works Yard:

The Village of Tuckahoe will implement a system to collect and filter stormwater at the Public Works Yard that currently discharges untreated into the Bronx River.

Village of Bronxville Catchment System at Municipal Maintenance Yard:

A catchment system will be constructed at the Village of Bronxville's municipal maintenance yard. This system will collect and filter stormwater that currently discharges untreated into the Bronx River.

Note: Recommendations may need verification as actions may have been or may be in the process of being implemented.

Table 10. Recommendations for Surface Tributaries

Description	Location*	Partners	Cost Range
Investigate and reduce illicit discharges.	<ul style="list-style-type: none"> • Mount Pleasant (reach CB-7) • Mount Pleasant (OT-2 in reach DB-7) • Yonkers (OT-1 in reach SB-6) • Greenburgh (OT-2 in reach SB-12) • Greenburgh (reach MP-5, MP-10,11,12, MP-14, MP-17) • Wherever new illicit discharges are found 	Mount Pleasant, Yonkers, Greenburgh	\$
Stabilize and maintain outfalls.	<ul style="list-style-type: none"> • Mount Pleasant (reach DB-8) • Mount Pleasant (reach CB-6) • Yonkers (reach SB-2, SB-6) • Greenburgh (reach SB-12) 	Mount Pleasant, Yonkers, Greenburgh	\$-\$\$
Provide stormwater source control.	<ul style="list-style-type: none"> • Mount Pleasant (Westchester County DPW Grasslands facility) • Yonkers (City of Yonkers Water Works Building/Sign Shop) • Greenburgh (Large school complex) • Greenburgh (Best Buy Shopping Center on Central Avenue) • Greenburgh (Turco's Shopping center on Central Avenue) • Greenburgh/White Plains (Light industrial strip along Fulton St.) • Greenburgh (Veterans Park North) • Greenburgh (Single family residential area along Secor Rd) • Greenburgh (Greenburgh Maintenance Yard) • Greenburgh (Greenburgh Nature Center) • Greenburgh (Hartsdale Train Station) • Greenburgh (Single family neighborhood east of North Central Ave., N. of East Hartsdale Ave., and S. of Jane St) • Greenburgh (Single family neighborhood bounded by Thomas St., S. Healy Ave., Marion Ave., and N. Healy Ave.) • Greenburgh (Greenburgh Elem. School on Hillside Ave.) • Greenburgh (Crossroads Plaza on Tarrytown Rd) • Greenburgh (Greenburgh Town Hall) • Greenburgh (Greenburgh Library) • Greenburgh (Westchester Community College) • Greenburgh (Single family residential neighborhood bounded by Hillside Ave., North Rd., and Winneout Rd.) • Greenburgh (single family residential neighborhood bounded by Mclean Ave., Hillside Ave., I-287, and Manhattan Ave.) • Greenburgh (Greenburgh Housing Authority Apartments off of Old Tarrytown Rd.) • Greenburgh (Crossroads Plaza on Tarrytown Rd) • Ardsley (Ardsley Park) • Elmsford (Elmsford Maintenance Facility) • Bronxville (Scoutfield Bronx River Parkway Reservation) • White Plains (Michaelian Office Building) 	Mount Pleasant, Yonkers, Greenburgh, Ardsley, Elmsford, Bronxville, White Plains	\$\$\$

Table 10. Recommendations for Surface Tributaries

Description	Location*	Partners	Cost Range
Restore stream, wetlands, riparian corridors, and floodplains.	<ul style="list-style-type: none"> • Mount Pleasant (Westchester County DPW Grasslands facility) • Ardsley (Our Lady of Perpetual Help) • Yonkers (Sprain Brook Golf Course) • Greenburgh (Along Manhattan Park Brook at the Old Tarrytown Park, south of Old Tarrytown Rd.) • Greenburgh (Single family residential neighborhood bounded by Hillside Ave., North Rd., and Winneout Rd.) • Greenburgh (Fisher Lane wetland) • Bronxville (Scoutfield Bronx River Parkway Reservation) • White Plains (Westchester County Center) • At priority Target Ecosystem Characteristics sites as identified in cooperation with the USACE • Sites where fish passage obstacles exist 	Mount Pleasant, Ardsley, Yonkers, Greenburgh, Bronxville, White Plains	\$-\$\$\$
Manage invasive species and restore stream wetlands and floodplains.	<ul style="list-style-type: none"> • Mount Pleasant (Westchester County DPW Grasslands facility) • Yonkers (City of Yonkers Water Works Building/Sign Shop) • Yonkers (Old Macy's Distribution Center) • Yonkers (Sprain Brook Golf Course) • Ardsley (Veterans Park) • Ardsley (Our Lady of Perpetual Help) • Greenburgh (Large school complex) • Greenburgh (Single family neighborhood east of North Central Ave., N. of East Hartsdale Ave., and S. of Jane St) • Greenburgh (Crossroads Plaza on Tarrytown Rd) • Greenburgh (Along Manhattan Park Brook at the Old Tarrytown Park, south of Old Tarrytown Rd.) • Greenburgh (Greenburgh Housing Authority on Manhattan Ave.) • Greenburgh (Greenburgh Library) • Greenburgh (Single family residential neighborhood bounded by Hillside Ave., North Rd., and Winneout Rd.) • Greenburgh (Fisher Lane wetland) • Bronxville (Scoutfield Bronx River Parkway Reservation) • White Plains (Westchester County Center) 	Mount Pleasant, Yonkers, Ardsley, Greenburgh, Bronxville, White Plains	\$-\$\$\$\$
Prevent pollution and remove trash.	<ul style="list-style-type: none"> • Mount Pleasant (reach DB-4,DB-7,DB-8) • Mount Pleasant (reach CB-6) • Yonkers (City of Yonkers Water Works Building/Sign Shop) • Yonkers (reach SB-2, 4, 18,19, 20, 22, 24) • Greenburgh (reach SB-10,12,13,15,17) • Greenburgh/White Plains (Light industrial strip along Fulton St.) • Yonkers (Single family residential area along Mountindale Road) • Greenburgh (single family residential neighborhood bounded by Mclean Ave., Hillside Ave., I-287, and Manhattan Ave.) • Greenburgh (Greenburgh Housing Authority Apartments off of Old Tarrytown Rd.) • Greenburgh (Crossroads Plaza on Tarrytown Rd.) • Greenburgh (MP-4, MP-7, MP-14) • Elmsford (Reach MP-3, MP-4) 	Mount Pleasant, Yonkers, Greenburgh, Elmsford	\$

Table 10. Recommendations for Surface Tributaries

Description	Location*	Partners	Cost Range
Develop stormwater management and flood mitigation assessment tools, and track and share project results.	<ul style="list-style-type: none"> • Yonkers (Crestwood Lake stormwater management and assessment) • Bronx River and Tibbetts Brook watershed flood mitigation assessment • Watershed-wide project information sharing and tracking 	Hydroqual, AKRF. Yonkers, Westchester Planning, Coalition Members	\$\$-\$\$\$
\$: Estimated Planning Level Cost ≤ \$50,000 \$\$: \$50,000 < Estimated Planning Level Cost ≤ \$100,000		\$\$\$: \$100,000 < Estimated Planning Level Cost ≤ \$500,000 \$\$\$\$: Estimated Planning Level Cost > \$500,000	

*Alpha numeric codes refer to the reach locations identified in the *Summary of Findings from Bronx River Watershed Stream Corridor and Upland Assessment (CWP, 2006)*.

** *Note: Recommendations may need verification as actions may have been or may be in the process of being implemented.*

4.4 Reservoir Subwatersheds

The areas draining directly to the large reservoirs and lakes are called *reservoir subwatersheds*. Table 11 provides an overview of characteristics of these subwatersheds. Located at the headwaters of the watershed, the Kensico Reservoir serves as a drinking water supply, and historically was a complex network of wetlands and streams feeding the Bronx River. Construction of the Kensico Dam in 1915 removed the overland hydrologic connection between the reservoir and the river by directing essentially all flow from the reservoir into the NYC drinking water system. Today, the Bronx River only receives a very small, intermittent flow from the reservoir when the grates at the reservoir are flushed for cleaning. The present day headwaters of the river consist of a series of wetlands along Davis Brook in Valhalla, NY. In addition to the Kensico Reservoir, there are two other reservoirs in the watershed, the White Plains Reservoir and the Grassy Sprain Reservoir. The Kensico and White Plains subwatersheds are the least developed and have the greatest proportion of forest cover. The exception, Grassy Sprain Reservoir, contains 50% low to medium density residential development.

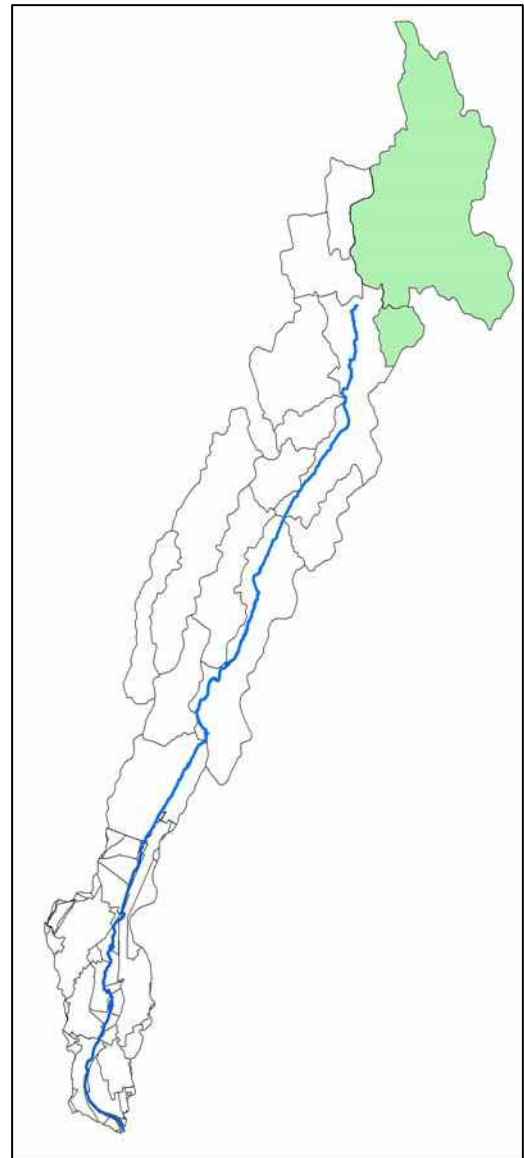


Table 11. Basic Profile of the Reservoir Subwatersheds

Drainage Area	8,524 acres (13.3 mi ²)
Impervious Cover	5.7%
Stream Length	12.3 miles
Subwatersheds	Kensico Reservoir, White Plains Reservoir
Jurisdictions	<ul style="list-style-type: none"> • Ardsley • Greenburgh • Harrison • Mt. Pleasant • New Castle • North Castle • Westchester County • White Plains • Yonkers
Significant Features	<ul style="list-style-type: none"> • Receiving waters are drinking water reservoirs or other lakes (e.g. Kensico Reservoir, White Plains Reservoir, Cranberry Lake Preserve) • Relatively high remaining forested area
Restoration Priorities	Capture and treat stormwater runoff; develop spill prevention plans, manage septic systems

In 1997, a Memorandum of Agreement (MOA) was signed by over 80 governmental agencies and environmental groups to protect New York City's drinking water supply including the Kensico Reservoir. The MOA identifies the elements of a groundbreaking watershed protection program which protects drinking water for almost 9 million residents of New York City without inhibiting the economic vitality of the watershed communities. The MOA consists of the following watershed protection programs: Land Acquisition; Watershed Regulations; Watershed Protection Programs; and a Watershed Protection and Partnership Council. In the White Plains Reservoir, water quality is tested daily in accordance with the United States Environmental Protection Agency, New York State Department of Health, and Westchester County Department of Health standards.

Management strategies for the reservoir subwatersheds focus on land conservation and practices to limit nutrients and sediment. For specific subwatershed recommendations, refer to the Westchester County plan.²⁵ Stormwater retrofits and pollution prevention from hotspot areas such as the White Plains Airport were designed to keep pollutants out of the Kensico Reservoir. Spill prevention planning for highways and other urban centers adjacent to the reservoirs, particularly at Grassy Sprain, are also critical.

²⁵ <http://www.westchestergov.com/Planning/environmental/BronxRiver/Management%20Plan.htm>

The Westchester and Bronx County watershed plans collectively identify hundreds of potential stormwater retrofit, stream restoration, tree planting, education, and other restoration and protection projects. The Bronx River Intermunicipal Watershed Management Plan identifies and prioritizes implementation of the most visible, effective, or feasible of these projects. The implementation of restoration and protection projects is by far the longest, most expensive, and most uncertain step in the watershed restoration process. Restoration costs can be millions of dollars depending on the extent of project activities, number of jurisdictions involved, land costs, and other factors. Salaries, land acquisition and construction of restoration projects often account for a majority of these costs. While full scale implementation will take decades, at best, this Plan suggests an approach for moving forward with short-term priorities, planning for eventual implementation of long-term objectives, and evaluating the progress of the efforts as they progress (Table 12).

All of the recommended activities outlined in this Section of the Plan are deemed important. However, some actions are easier to accomplish, can serve as catalysts for subsequent actions, or are considered time-sensitive. Short-term priorities are actions that should be implemented over the next one to two years, as technical, financial, and as staffing capacity becomes available. Short-term priorities often involve promoting the adoption of local environmental laws to protect remaining unimpaired areas; investigating suspicious discharges and critical infrastructure maintenance issues; implementing demonstration rehabilitation projects; and engaging the community through education and outreach related to implementation projects. *Although these short-term priorities generally describe projects that have a high likelihood of being implemented and have funding or agency support, they will require that the Bronx River Watershed Coalition continue to track and support progress, formally or informally, to insure that implementation is done in a timely manner and to increase the chances that they will be appropriately monitored.*

Long-term actions are those that are continuous or ongoing (e.g. watershed coalition meetings, public education, monitoring and tracking); require significant fundraising or feasibility studies (e.g. large capital improvement projects, land acquisition/reclamation); require outreach and planning to garner public and political support; or are less time sensitive (e.g. less critical projects or watershed plan revisions). *While these long term priorities generally describe projects that have a lower likelihood of being implemented soon and would require new funding or agency support, they still need to be tracked and supported by Bronx River Watershed Coalition members, to insure continued progress in implementation.*

Table 12 provides priority short and long term recommendations, identifies the lead agencies or organizations associated with these recommendations, and estimates ranges of costs for implementation. The wide range in nature and scale of recommended projects reflects the fact that watershed restoration and protection requires a multi-faceted approach, combining land use policy and regulations, along with education to influence public and private actions, and on-the-ground construction and management projects.

Showing early success is important for generating momentum for on-going implementation and, more importantly, for demonstrating effective performance and building confidence among community partners, funders, and agencies. Westchester County, as a precursor to the development of the Intermunicipal Watershed Plan, developed a management plan for the Westchester County portion of the Bronx River Watershed. This plan identified priority projects for the restoration and protection of water quality in the Bronx River. The Bronx River Alliance has also identified priority projects and management activities as part of their additional watershed planning activities. For more information on specific sites and how these recommendations were developed, see the Bronx River Ecological Restoration and Management Plan²⁶ and the Bronx River Watershed Assessment and Management Plan²⁷, which are available online at the links below. Table 13 in the Appendix provides a list of active organizations taking a lead on watershed restoration activities, including websites to visit for additional information on these organizations and their work.

Funding Opportunities

In order to meet the objectives and follow the recommendations outlined in the Bronx River Intermunicipal Watershed Management Plan, potential funding opportunities must be identified and pursued. The various parties invested in the health of the Bronx River watershed must continue working to secure funding for projects within their communities and beyond. Developing strong partnerships is an effective means of sharing responsibilities and maximizing outcomes by making the most of limited resources.

²⁶

http://bronxriverdata.org/puma/images/usersubmitted/repository/Ecological_Restoration_and_Management_Plan.pdf

²⁷

<http://www.westchestergov.com/Planning/environmental/BronxRiver/Management%20Plan.htm>

12. Priority Recommendations for Implementation **				
Objective Met	Recommended Action		Responsible Parties	Costs Range (Annual)
	Short Term (year 1-2)	Long Term (year 3+)		
1. Coordination	Organize regular Coalition meetings to track and coordinate activities, provide education and outreach, generate support and strategize about fund raising. Identify mechanism for funding a watershed coordinator and establish a formal charter for the Watershed Coalition, building on existing structure.	Continue with regular meeting to track and coordinate activities, analyze results from outreach and education efforts, and raise funds to hire a watershed coordinator and sustain the group.	Westchester County, BxRA, DPR	\$\$
2. Regulatory Reform	Promote update of Westchester County and municipal regulations per recommendations developed through code review. Advocate for comprehensive review of NYC codes to support watershed goals	Adopt all recommended code changes. Reform NYC codes to maximize uptake of BMP.	Westchester County, Municipalities (see Table 1), NYC DEP, NYS DEC, NYC DOT, OLTPS	\$\$
3. Discharge Prevention	Encourage the continued investigation and elimination of chronic sanitary sewer overflows in Westchester County and begin to outline a multi-jurisdictional Illicit Discharge Detection and Elimination (IDDE) program. Review and adopt a long term control plan (LTCP) for Bronx River that maximizes CSO reduction.	Examine TMDL through the LTCP process to develop priorities and guide watershed management goals. Develop a new strategy for CSO abatement, which includes stormwater source control and incorporate into NYC CSO plan.	NYC DEP, NYS DEC, Westchester County, Municipalities, OAG	\$\$\$-\$\$\$\$

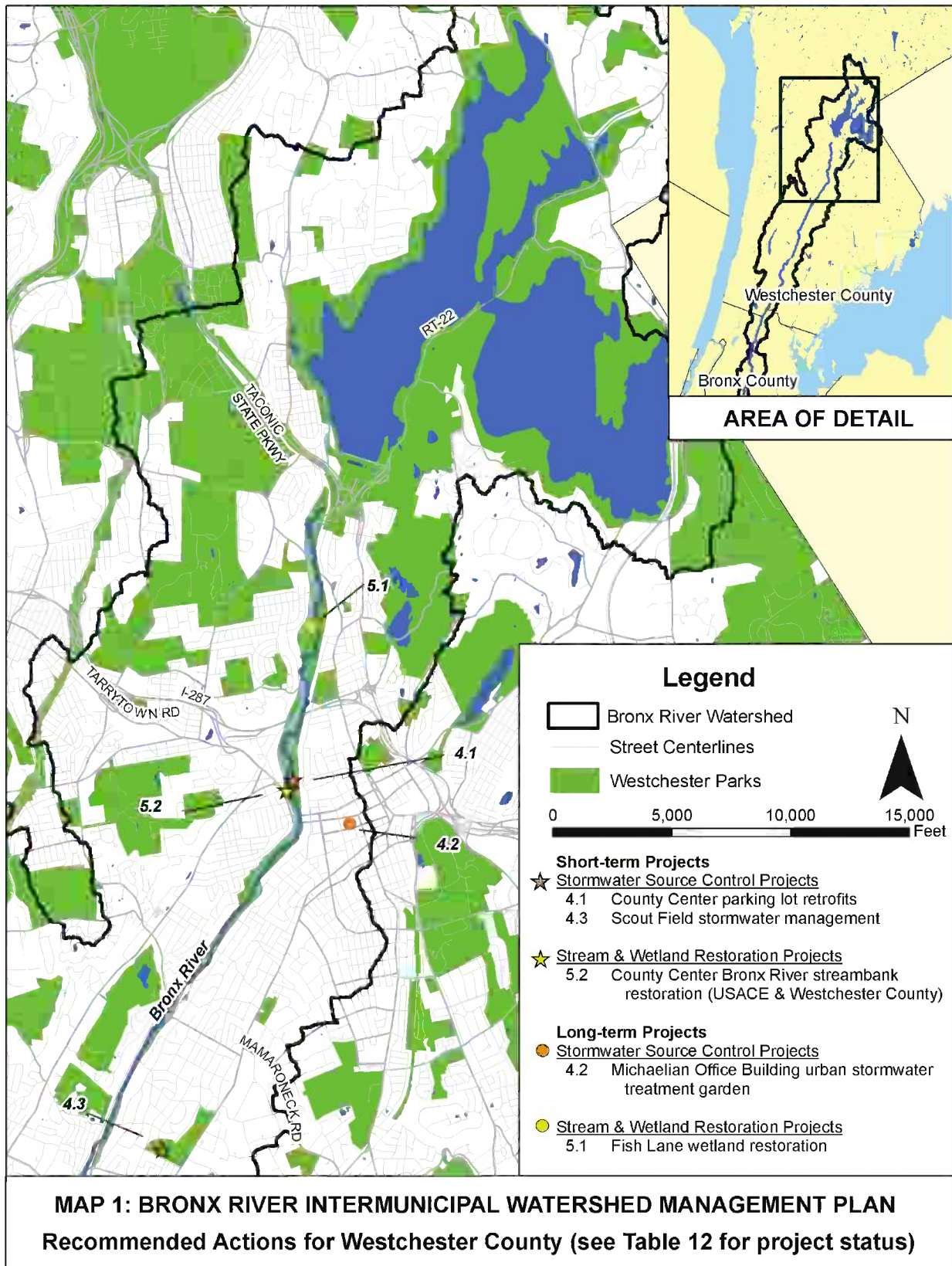
12. Priority Recommendations for Implementation **				
Objective Met	Recommended Action		Responsible Parties	Costs Range (Annual)
	Short Term (year 1-2)	Long Term (year 3+)		
4. Stormwater BMPs	<p>Construct stormwater retrofits along Bronx River and in sewersheds:</p> <p><u>Westchester (MAPS 1 & 2):</u></p> <ul style="list-style-type: none"> County Center parking lot retrofits Scout Field stormwater management project Crestwood Maintenance Facility stormwater management project Town of Greenburgh constructed wetlands and permeable pavement at Greenburgh Nature Center parking lot Village of Tuckahoe treatment of stormwater discharges at municipal public works yard Village of Bronxville catchment system at municipal maintenance yard <p><u>Bronx (MAP 3):</u></p> <p><u>DESIGN</u></p> <ul style="list-style-type: none"> NYC DEP BMP Modeling and Planning for the Bronx River Watershed Bronx Park East greenstreets at Bronx River Pkwy northbound ramp and Pelham Pkwy Metcalf Ave. & Westchester Ave. and Metcalf Ave., Watson Ave., & Soundview Ave. greenstreets Ranaqua (stormwater BMPs & greenroof) Stormwater retrofits at NYBG- including reduction and treatment of discharge at Horticultural Operations Center Bronx Overall Economic Development Corporation green roof project at 1055 Bronx River Avenue 	<p>Pursue other high ranking retrofits possibilities, including but not limited to:</p> <p><u>Westchester (MAPS 1 & 2):</u></p> <ul style="list-style-type: none"> Stormwater Management Assessment Tool – watershed modeling for water quantity and quality objective Michaelian Office Building urban stormwater treatment garden <p><u>Bronx (MAP 3):</u></p> <ul style="list-style-type: none"> Muskrat Cove stormdrain retrofit and upslope stormwater source control Shoelace Park BMPs at street ends Bronx Park East, Unionport Rd., Bronxdale Ave., & White Plains Road greenstreets and bioretention, including stream-daylighting where possible, in the park. Tremont and Morris Park Ave bioretention, including stream-daylighting where possible. Greenroof at CS 214 Bioswale at Soundview Park near Bronx River <p>Construction of all design-phase BMPs.</p>	Westchester County, BxRA, NYC DPR, Municipalities, NYC DEP	\$\$\$\$

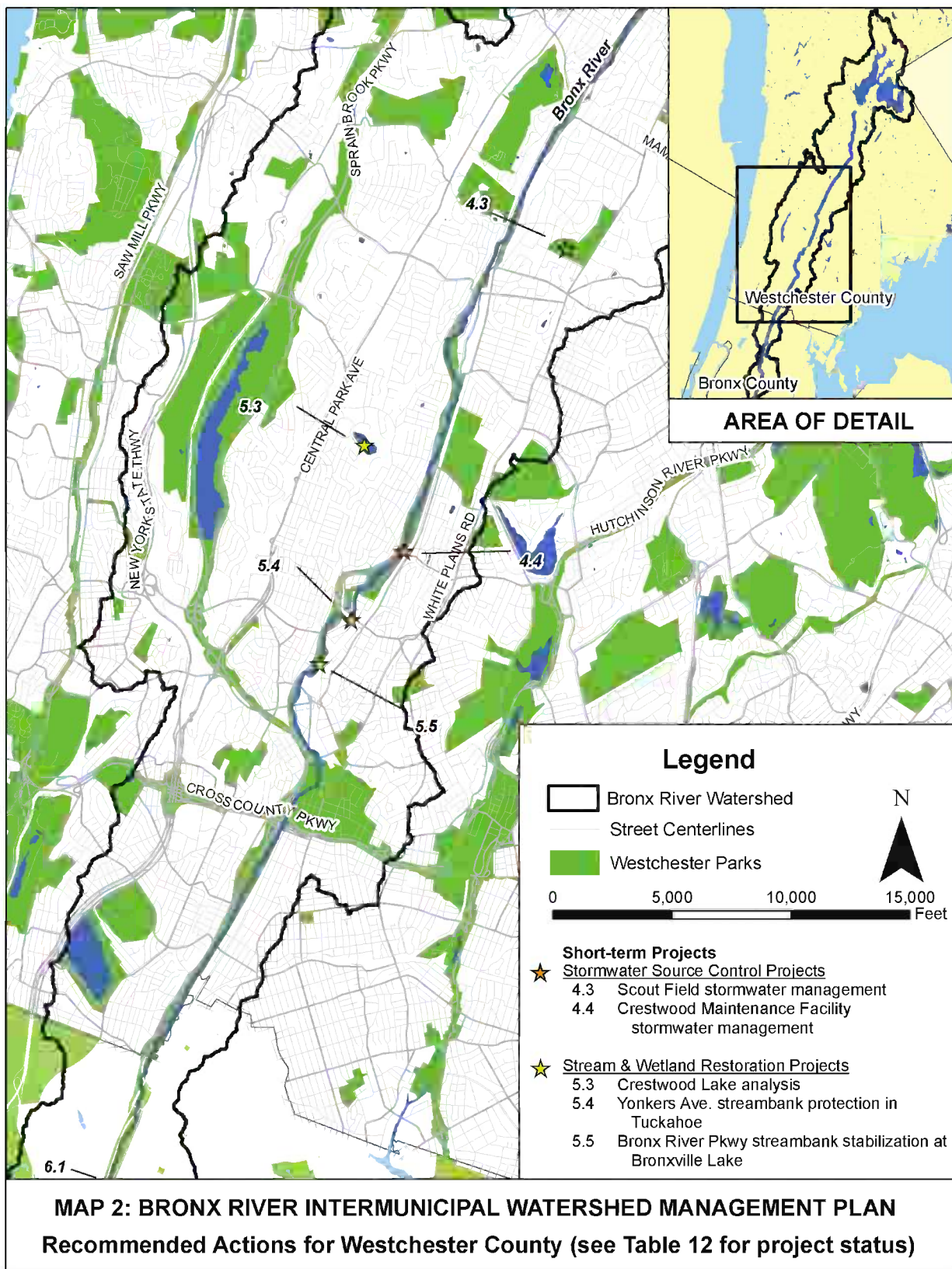
12. Priority Recommendations for Implementation **				
Objective Met	Recommended Action		Responsible Parties	Costs Range (Annual)
	Short Term (year 1-2)	Long Term (year 3+)		
Stormwater BMPs, <i>continued</i>	<ul style="list-style-type: none"> Trees NY stormwater capture and treatment from western sidewalk of Bronx River Avenue. GrowNYC implementation of rainwater collection systems at 5 Bronx community gardens. NYC DEP stormwater management in Shoelace Park 228th St. Stormwater retention at Devoe and 177th St. NYC DOT project Raingarden at Bronx River Pkwy and Shoelace Park North <p><u>CONSTRUCT</u></p> <ul style="list-style-type: none"> NYC DPR bioswale at Shoelace Park 211th St. Mosholu Preservation Corp. rainbarrel, 3400 Reservoir Oval NYSDOT Starlight Park raingardens Bronx River Houses rainbarrel, 1605 E. 174th St. <p><u>MAINTENANCE</u></p> <ul style="list-style-type: none"> French Charley Playground rainbarrel, E. 204th St. NIDC rainbarrel, 2523 Olinville Ave. Sagamore St. & Cruger Ave. NYC DPR greenstreet NYC DEP –Drexel University BMP Project on Manor Ave. & Stratford Ave. between E. 174th St. & E. 172nd St. 1349 Stratford Ave. rainbarrel 		Westchester County, BxRA, NYC DPR, Municipalities, NYC DEP	\$\$\$\$

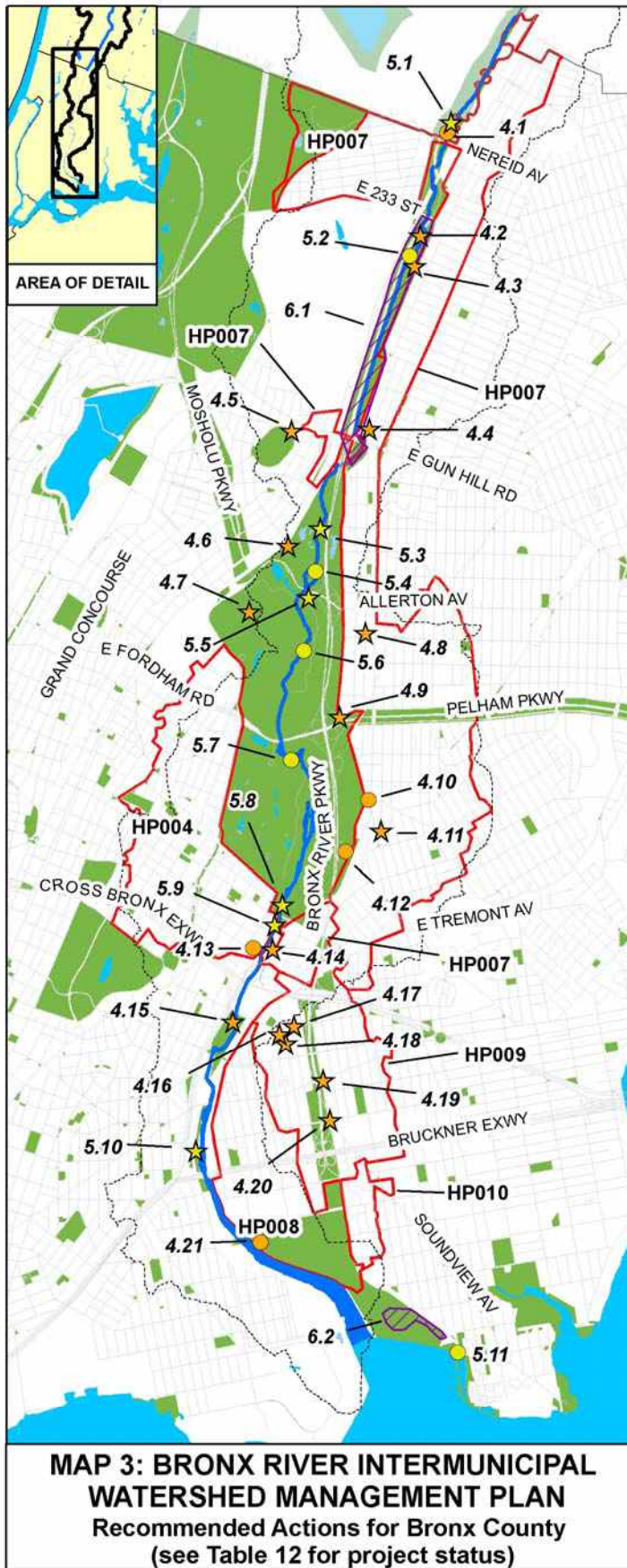
12. Priority Recommendations for Implementation **				
Objective Met	Recommended Action		Responsible Parties	Costs Range (Annual)
	Short Term (year 1-2)	Long Term (year 3+)		
5. Stream and Wetland Restoration	<p>Implement and maintain five stream and salt marsh restoration projects.</p> <p><u>Westchester (MAP 1):</u></p> <ul style="list-style-type: none"> • Westchester County Center Bronx River streambank stabilization • USACE County Center Bronx River streambank restoration, at Central Ave. and Bronx River Pkwy. • Crestwood Lake analysis • Yonkers Ave. streambank erosion protection in Tuckahoe • Bronx River Parkway streambank stabilization, Bronxville Lake <p><u>Bronx (MAP 3):</u></p> <p><u>DESIGN</u></p> <ul style="list-style-type: none"> • Muskrat Cove hill slope revegetation near Nereid Ave. Bridge • 182nd St. Dam fish passage • Phase 2 Shellfish reef restoration • Soundview Lagoons salt marsh restoration • Constructed wetlands on east river banks at 1055 Bronx River Avenue (RTB) • Creation of 1 acre of habitat for mussels (Gaia Institute). <p><u>CONSTRUCT</u></p> <ul style="list-style-type: none"> • Bronx Forest and NYBG floodplain invasive plant management • West Farms riparian plantings 	<p>Continue to manage river corridor through wetland restoration, trash removal, woody debris management, invasive species control, and bank stabilization.</p> <p><u>Westchester (MAP 1):</u></p> <p>Fisher Lane Wetland Restoration</p> <p><u>Bronx (MAP 3):</u></p> <ul style="list-style-type: none"> • Shoelace Park wetland floodplain expansion • Bronx Forest LWD and erosion control management • Snuff Mill Dam fish passage • Bronx Zoo Dam fish passage • Soundview Lagoons salt marsh 	BxRA, NYC DPR, USACE, Westchester County, Municipalities	\$\$

12. Priority Recommendations for Implementation **				
Objective Met	Recommended Action		Responsible Parties	Costs Range (Annual)
	Short Term (year 1-2)	Long Term (year 3+)		
6. Reforestation Projects	Develop an invasive plant management plan for the Bronx; implement riparian forest planting in Bronx based on recommendations of the plan; identify watershed wide invasive plant control research needs. <ul style="list-style-type: none"> Bronx Floodplain Forest Shoelace Park (selected sites) Soundview Park (selected sites) 	Conduct ongoing invasive plant removal, street tree planting, and reforestation efforts. Set watershed wide or subwatershed specific goals for reforestation and canopy cover.	BxRA, NYC DPR, Westchester County	\$\$
7. Pollution Prevention	Encourage municipalities to develop individual pollution prevention plans for municipal facilities. Review and improve spill prevention plans for reservoirs and for hazardous operations.	Implement structures and practices to reduce pollution potential; develop municipal report cards as part of SPDES program	Municipalities, Westchester County, NYS DEC	\$\$\$
8. Community Involvement	Install stormdrain markers on public properties and in previously identified target residential and business areas. Engage communities in stormwater source control site pilot projects through education and identifying stewardship opportunities.	Follow-up education and outreach efforts using Westchester County's behavior survey to evaluate success. Design and install watershed signage throughout the watershed. Continue installation of stormwater retrofits (e.g. rainbarrels, raingardens, disconnect downspouts where allowed).	Coalition, BxRA, NYC DPR, NYC DEP, Westchester County	\$
9. Monitoring and Tracking	Improve agency and public data sharing on the health of the river and status of ongoing projects and monitoring. Coordinate design and monitoring efforts to promote comparisons of project performance.	Develop priorities for monitoring and continue to track and report stream monitoring, restoration, BMP, and invasives management projects.	Coalition, BxRA, NYC DPR, NYC DEP, Westchester County, NOAA	\$
10. Communication	Hold periodic progress meetings with the Coalition to discuss project implementation and priorities. Begin applying for funding.	Present progress report, monitoring results, and implementation strategy at Coalition/public meeting.	Westchester County, BxRA, Municipalities, NYC DPR, NYC DEP, OLTPS	\$
Annual Costs				
\$: Estimated Planning Level Cost ≤ \$50,000		\$\$\$: \$100,000 < Estimated Planning Level Cost ≤ \$500,000		
\$\$: \$50,000 < Estimated Planning Level Cost ≤ \$100,000		\$\$\$\$: Estimated Planning Level Cost > \$500,000		

** Note: Recommendations may need verification as actions may have been or may be in the process of being implemented







Legend

- Bronx River
 - Street Centerlines
 - Bronx River Sewersheds
 - Bronx River Watershed
 - NYC Parks
- 0 2,000 4,000 8,000 Feet



Short-term Projects

★ Stormwater Source Control Projects

- 4.2 Raingardens @ Bronx Rvr Pkwy and Shoelace Pk North
- 4.3 NYCDEP BMP pilot at Shoelace Pk 228th St
- 4.4 NYCDPR raingardens @ 211th St
- 4.5 Mosholu Preservation Corp. rainbarrel
- 4.6 French Charley Playground rainbarrel
- 4.7 Stormwater retrofits at NYBG
- 4.8 NIDC rainbarrel
- 4.9 Bronx Pk E greenstreets at Bronx River Pkwy & Pelham Pkwy
- 4.11 Sagamore St & Cruger Av greenstreet
- 4.14 NYCDOT stormwater retention project @ E Tremont and Devoe Ave
- 4.15 Starlight Pk raingarden
- 4.16 NYCDEP-Drexel University BMP Project on Manor Av & Stratford Av
- 4.17 Bronx River Houses rainbarrel
- 4.18 1349 Stratford Av rainbarrel
- 4.19 Metcalf Av & Westchester Av greenstreet
- 4.20 Metcalf Av, Watson Av, & Soundview Av greenstreet

★ Stream & Salt Marsh Restoration Projects

- 5.1 Muskrat Cove streambank revegetation near Nereid Av
- 5.3 Bronx Forest Floodplain invasive plant management
- 5.5 NYBG floodplain invasive plant management
- 5.8 182nd St Dam fish passage
- 5.9 West Farms riparian plantings
- 5.10 Concrete Plant salt marsh plantings

▨ Reforestation Projects

- 6.1 Shoelace Park (selected sites ~2 acres)
- 6.2 Soundview Park (selected sites ~10 acres)

Long-term Projects

● Stormwater Source Control Projects

- 4.1 Muskrat Cove stormdrain retrofit and upslope stormwater source control
- 4.10 Bronx Pk E & Unionport Rd greenstreet
- 4.12 Ranaqua
- 4.13 Greenroof @ CS 214
- 4.21 Bioswale @ Soundview Pk

● Stream & Salt Marsh Restoration Projects

- 5.2 Shoelace Pk wetland floodplain expansion
- 5.4 Bronx Forest LWD and erosion control management
- 5.6 Snuff Mill Dam fish passage
- 5.7 Bronx Zoo Dam fish passage
- 5.11 Soundview Lagoons salt marsh restoration

Improving water quality, quantity, and the ecological health of the Bronx River and its tributaries will cumulatively contribute to improvements in the downstream waters of the East River, Long Island Sound and New York Harbor. Linking the management goals for the Bronx River watershed to the objectives and priorities established for Long Island Sound and for the Hudson-Raritan Estuary is an important part of a comprehensive ecosystem-based approach to natural resource management. In 1994, the states of Connecticut and New York and the US EPA approved the Comprehensive Conservation and Management Plan (CCMP) for Long Island Sound. Developed by the Long Island Sound Study, the CCMP identifies the specific commitments and recommendations for actions to improve water quality, protect habitat and living resources, educate and involve the public, improve the long-term understanding of how to manage the Sound, monitor progress, and redirect management efforts. Many of the goals of the Bronx River Intermunicipal Watershed Management Plan are consistent with those of the Long Island Sound CCMP, as indicated in Table 13. Over time, the Bronx River IWMP will serve as a guide that summarizes the goals and strategies for restoration of the Bronx River. Every 5 years, it is recommended that the Bronx River IWMP be updated to provide an opportunity to highlight progress made and incorporate new information and refine recommendations. Stakeholders named in the Bronx River IWMP can also refine and add detail to the priorities identified.

Table 13. Linking Bronx Watershed Goals with Long Island Sound Management

Bronx River Watershed Goals	Long Island Sound Study Issues of Concern						
	Low DO	Contamination		Floatable debris	Living resources & habitat mgmt	Land use & development	Public involvement & education
		Toxic	Pathogen				
1. Coordination	Y	Y	Y	Y	Y	Y	Y
2. Regulatory Updates					Y	Y	
3. Discharge Prevention	Y	Y	Y	Y			
4. Stormwater Retrofit Projects	Y	Y	Y	Y	Y	Y	Y
5. Stream Restoration Projects				Y	Y		
6. Reforestation Project					Y		Y
7. Pollution Prevention	Y	Y	Y	Y			Y
8. Community Involvement					Y		Y
9. Monitoring and Tracking					Y		Y
10. Communication	Y	Y	Y	Y	Y	Y	Y

Summary

Progress on water quality improvement and watershed restoration has been underway for decades along the Bronx River. The implementation of projects and other actions to protect water quality, protect, enhance and restore wetlands and riparian ecosystems, provide better stormwater management, and eliminate pollution sources have largely been conducted through the independent efforts of state and local government agencies, community groups, and individuals. Organizations may be motivated by different interests, from the need to meet regulatory requirements, such as NYC DEP's obligation to meet federal water quality standards and Westchester County's need to meet Phase II stormwater regulations, to the desire to pursue ecological restoration opportunities, such as NYC DPR's effort to construct fish passage for river herring in the lower Bronx River. While these independent efforts go a long way toward meeting individual organizational goals, increased coordination and cooperation by sharing resources, expertise and common goals will improve overall efficiency and provide greater results for the entire Bronx River Watershed.

Over the past several years, stakeholders in the Bronx River Watershed have begun to actively collaborate to conduct watershed assessments, develop management plans, and pursue projects that collectively benefit the entire watershed. Although projects will continue to be implemented opportunistically, when fiscal, regulatory, community and political support coincide, the adoption of a guiding vision for the river, and steps to reach that vision is essential to sustaining progress. The added level of collaboration and coordination under the Bronx River Watershed Coalition will maximize opportunities, facilitate complementary projects, and reduce redundant or conflicting efforts, ultimately resulting in a healthier Bronx River ecosystem.

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Glossary

disconnected

downspout: redirection of a rooftop's downspout from an underground pipe to irrigation system for nearby gardens and green spaces, either directly or using storage techniques like rain barrels.

dissolved oxygen (DO):

amount of oxygen that is present (dissolved) in water and therefore available to fish and other aquatic animals; low DO levels can stress or kill aquatic animals.

downstream: in the direction of a stream or river's current toward the sea.

estuary: the tidal portion of a river where the freshwater enters into a sound, bay or the sea and mixes with salty sea water.

floatables: floating debris including both street litter (paper, plastics, bottles, etc.) and toilet-generated waste such as hygiene products.

floodplain: the flat area adjacent to the channel constructed by the river and overflowed at a recurrence interval of about two years or less.

green roof: a rooftop containing a porous medium such as soil that can support vegetation and has an increased water holding capacity over traditional rooftops.

greenstreet: vegetation planted in street median or traffic/parking lot island; ideally, these plantings are recessed below the grade of surrounding impervious surfaces with strategically placed curb cuts that allow maximum flow of water to the area.

greenway: stretch of continuous linear parkland frequently containing a multi-use pathway.

herps: a term that refers to reptiles and amphibians .

hydrology: the science of the study of the occurrence, distribution, movement and properties of the water and its relationship with the environment within each phase of the hydrologic cycle.

impoundment: the portion of a river upstream of a dam that tends to be wider. than the free-flowing river, and have slower moving water like a pond or lake.

Indices of Biological

Integrity: a method for describing water quality using characteristics of aquatic communities, such as the types of fish and invertebrates found in the water body; it is expressed as a numerical value between 0 (lowest quality) to 100 (highest quality).

invasive species: a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

large woody debris (LWD): wood, generally at least ten centimeters in diameter and two meters long, that protrudes or lays within a stream channel that become lodged into a stream bed or banks creating stable structures that create grade controls, scour pools and cover and habitat for aquatic organisms.

low-impact development: landscape planning and design aimed at maximizing green space, natural soils, and on-site storm water retention utilizing best management practices, such as uniformly distributed decentralized micro-scale storm water controls, to manage stormwater in a way that reduces the impact of built

areas and promotes the natural movement of water within an ecosystem or watershed.

macroinvertebrate: animal without a backbone usually in a nymph or larval stage; the quantity and diversity of macro-invertebrates provide an indication of the health of a stream system.

mitigation: action taken to alleviate potential adverse effects.

native species: animals or plants that originated and naturally occur in the area in which they are found.

nutrients: essential chemicals needed by plants and animals for growth; excessive amounts of nutrients, such as nitrogen and phosphorus, can lead to degradation of water quality and growth of excessive amounts of algae; some nutrients can be toxic at high concentrations.

primary contact recreation: swimming and other activities that potentially involve total body immersion and/or incidental water exposure including, but are not limited to, rafting, canoeing, kayaking, scuba diving, snorkeling and ceremonial uses.

rain garden: a clustered planting of flood tolerant species placed strategically where storm water collects in a shallow depression in the landscape. Utilizes bio-retention to capture sediments and pollutants, which are treated by soil biological processes and through plant uptake. Allows water to infiltrate into the soil and recharge groundwater supplies.

reach: stretch of water visible between bends in a river; or a certain expanse of river.

riparian: relating to the bank of a river; a zone of transition from an aquatic to a terrestrial system, dependent upon surface or subsurface water, that reveals the complex influence of such surface or subsurface water through existing or potential plant communities.

salt marsh: a community of organisms in low-lying coastal habitats composed of plants tolerant of tidal inundation and salinity.

secondary contact recreation: activities that involve limited direct contact with water but is associated with a low probability of swallowing water including wading,

boating, canoeing, kayaking and fishing.

sedimentation: mud, sand, silt, clay, shell debris, and other particles that settle on the bottom of rivers, lakes, estuaries, and oceans; buildup of sediment can bury plants or animals, or create new open habitat favored by invasive plants.

sewershed: region of a city served by a particular sewer system or waste treatment plant.

shellfish: any aquatic animal with a shell, especially mollusks or crustaceans.

storm water: water that accumulates on land as a result of storms, and can include runoff from urban areas such as roads and roofs.

storm water infiltration basins: built with loose porous material to maximize retention and infiltration, thus using the soil as a filter to treat storm water.

swale: a long narrow depression that can vary in depth and vegetation type; swales retain water following a rainfall event; they are generally used

along roadways and in combination with other storm water systems.

tributary: a stream or river which flows into the mainstem river.

understory: the low-growing vegetation (shrubs, seedlings, saplings, small trees) growing under the tree canopy or overstory.

upstream: direction opposite a stream or river's current.

watershed: region of land where water from rain or snowmelt drains downhill into a body of water, such as a river; the drainage basin includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels; area drained by a river and its tributaries.

wetland: an area that is periodically or permanently saturated with water, and in which plants and animals are uniquely adapted to wet conditions; wetlands are extremely biologically productive and perform a wide variety of important ecological functions

Acronyms

BMPs	Best Management Practices
BRAC	Bronx River Art Center
BxRA	Bronx River Alliance
CSO	Combined Sewer Overflow
DO	dissolved oxygen
HRF	Hudson River Foundation
MOA	Memorandum of Agreement
MOB	Michaelian Office Building
NFWF	National Fish and Wildlife Foundation
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
NRG	New York City Department of Parks & Recreation
	Natural Resources Group
NPDES	National Pollution Discharge Elimination System
NYC DPR	New York City Department of Parks and Recreation
NYC DEP	New York City Department of Environmental Protection
NYC SWCD	New York City Soil and Water Conservation District
OLTPS	New York City Mayor's Office of Long-Term Planning and Sustainability
NYC DOH	New York City Department of Health
NYCHA	New York City Housing Authority
NYS DEC	New York State Department of Environmental Conservation
NYS DOS	New York State Department of State
NYS DOT	New York State Department of Transportation
NYBG	New York Botanical Garden
OAG	Office of the Attorney General (New York State)
RTB	Rocking the Boat
SPDES	State Pollution Discharge Elimination System
SSBx	Sustainable South Bronx
SSMP	Sustainable Stormwater Management Plan for NYC
USACE	United States Army Corps of Engineers
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WCDP	Westchester County Department of Planning
WCS	Wildlife Conservation Society
YMPJ	Youth Ministries for Peace and Justice

Table 14. Parties Actively Involved in the Restoration of the Bronx River

Parties and Contact Information	Activities						
	Tree Planting	Stormwater Treatment Projects	Stream Enhancement	Volunteer Stream Monitoring	River Education	Paddling, Biking, Walking Tours	Pollution Enforcement
MillionTrees NYC http://www.milliontreesnyc.org	X						
NYC Department of Parks & Recreation http://www.nycgovparks.org/sub_your_park/trees_greenstreets.html	X	X	X	X	X		
Bronx River Alliance 718-430-4665; http://www.bronxriver.org	X		X	X	X	X	
Youth Ministries for Peace and Justice 718-328-5622; www.ympj.org		X			X		
Westchester County Soil and Water Conservation District http://www.westchestergov.com/Planning/environmental/SoilH2O.html		X					
Westchester County Citizen Volunteer Monitoring Program 914-995-4400; https://secure01.westchestergov.com/CVMP				X			
Westchester County Parks Department 914-864-PARK; http://www.co.westchester.ny.us/parks					X	X	
NYS Office of Attorney General Spills or dumping reporting: 1-800-457-7362; http://www.oag.state.ny.us/complaints/html/comp_enviro.html							X
NYC Soil and Water Conservation District 212-431-9676; www.nycswcd.net		X					
NYS Department of Environmental Conservation (DEC) Spill Response Hotline: 1-800-457-7362 http://www.dec.ny.gov/							X
NYC Dept of Environmental Protection (DEP) Call DEP 24 hours a day 7 days a week at 311 http://www.nyc.gov/html/dep/html/home/home.shtml		X					
New York State Department of State 518-474-6000 http://nyswaterfronts.com	X	X	X	X	X		X
U.S. Army Corps of Engineers 917-790-8799; http://www.nan.usace.army.mil/			X				
Rocking the Boat (718) 466-5799; http://www.rockingtheboat.org/					X		
Wildlife Conservation Society (718) 220-5100; http://www.wcs.org/					X	X	

