One Water NYC: 2018 Water Demand Management Plan

NYC Environmental Protection

Bill de Blasio
Mayor
Vincent Sapienza, P.E.
Commissioner

Please print this plan using the double-sided printer setting.

Cover photograph: City Hall Park's fountain where, in 1842, water first flowed from the newly constructed Croton Aqueduct.

(Photo courtesy of dog97209)

Dear Friends,

At the New York City Department of Environmental Protection, our mission is to deliver clean, safe drinking water to more than nine million New Yorkers every day and ensure the near and long term resiliency of our water supply system for generations to come. As water utilities across the nation – and around the world – grapple with the consequences of climate change, we must continue to identify opportunities to ensure the resiliency and reliability of our water supply system.

I am pleased to share One Water NYC: 2018 Water Demand Management Plan, which builds upon DEP's dramatic success in reducing New York's per capita water demand from its peak of 213 gallons a day per person in 1979 to 115 gallons a day per person in 2017, a 46 percent reduction. Reducing water demand provides benefits for both the water supply system and New York City at large – it provides flexibility as we operate our water supply system, reduces our energy footprint by treating less drinking water and wastewater, reduces greenhouse gas emissions, and helps keep water bills affordable.

Over the past five years, DEP has achieved savings of nearly 10 million gallons of water each day through our demand management initiatives, such as installing efficient toilets and spray showers in city properties and by offering discounts to residential customers on new, efficient toilets. We also launched voluntary Water Challenges with hotels, restaurants, and hospitals, as well as our own wastewater treatment plants.

This report highlights the success of these and other demand management programs from the past five years and presents a plan that will drive down demand by an additional 10 million gallons of water per day by 2022.

To achieve these additional savings, DEP will expand upon our partnerships with other City agencies as well as our wholesale customers in communities north of the city and incentivize water-efficient and emerging technologies, such as low-flow plumbing fixtures and non-potable water reuse, wherever feasible. I encourage you to learn more about our exciting initiatives in this report.

DEP would like to acknowledge that this program would not be possible without the support of our partners at the Department of Education, Department of Parks and Recreation, New York City Fire Department, City University of New York, New York City Housing Authority, our wholesale customers, Water Challenge participants, and other city agencies and non-profit organizations.

Sincerely,

Vincent Sapienza, P.E.
Commissioner

Dear Friends of the Environment,

Water is central to New York City, and without our extensive reservoir, sewer and wastewater treatment systems, the city could not have grown to the size it is today. Continuing to provide safe drinking water and protect the environment and public health of New Yorkers is central to our mission. At the Department of Environmental Protection (DEP), we strive to optimize and protect precious water resources and keep water affordable for all New Yorkers. Balancing multiple objectives requires a holistic, One Water, approach that supports the vision promoted by our city's OneNYC plan—to become the most resilient, equitable, and sustainable city in the world.

Even as our city continues to grow, the environmental impact of each New Yorker has declined as per capita water demand has decreased from 213 gallons per day in 1979 to 115 gallons in 2017. New York's increase in water efficiency also helps keep water bills low, and reduces the impact we all have on our upstate water supply and environment. To support this movement toward greater efficiency, DEP has invested over $50 million in water demand management projects over the past five years. These projects currently reduce citywide demand by nearly 10 million gallons of water per day.

In addition to reducing our water footprint, our demand management initiatives save energy and reduce our carbon footprint. An example of this nexus is at our Newtown Creek Wastewater Treatment Plant, one of DEP's 14 wastewater treatment plants, where water demand management initiatives in nearby communities have reduced wastewater flow by over 200 million gallons per year in the last five years. The energy saved by reducing wastewater flows to this treatment plant results in greenhouse gas reductions equivalent to over 25 metric tons of carbon dioxide each year.

Finally, while demand management helps reduce our impact on the environment, it also helps us prepare for the impacts of climate change on our water systems. During times of drought or water shortage, demand management optimizes our existing water supply. During heavy rain events, demand management reduces flow to sewers and treatment plants, and lessens the volume of sewage contributing to combined sewer overflow events.

I hope that this report will help illuminate the ways that New York City, New Yorkers, and DEP are becoming more efficient and contributing to our shared One Water vision. This effort would not be possible without our partners at city agencies, wholesale customers, voluntary challenge participants, and most importantly, our customers .

Sincerely,

Angela Licata
Deputy Commissioner of Sustainability

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Executive Summary

New York City's drinking water demand is the lowest it has been in more than 50 years, while the city's population in 2017 reached a record high of over 8.6 million people. Reducing drinking water demand is not only helping the City to prepare for a major infrastructure improvement project, but it also readies the City in times of drought, offsets energy and greenhouse gas emissions associated with pumping and treatment, and reduces flow to the sanitary and combined sewer systems. DEP is the lead agency not only for delivering drinking water, but for ensuring its sustainable use by optimizing existing resources and maximizing co-benefits with a holistic, One Water approach.

Since the release of the 2013 Water Demand Management Plan, DEP has invested over $50 million to achieve savings of approximately 10 million gallons of water per day (MGD). As DEP enters the sixth year of implementation, the 2018 Water Demand Management Plan presents DEP's goal to achieve an additional 10 MGD of savings by 2022.

Beyond the Water Demand Management Plan, DEP continues to optimize New York City's water supply system through watershed protection, monitoring, and a $19.1 billion capital program. In recent years, DEP's capital program has supported the construction of the largest ultraviolet treatment plant in the world for the Catskill/Delaware water supply, a filtration plant for the Croton water supply, the extension of City Water Tunnel No. 3, new water mains, and the repair of dams and other critical infrastructure. Thanks to these efforts, the US Environmental Protection Agency (USEPA) again awarded New York City a Filtration Avoidance Determination in 2017, permitting the City to continue to avoid filtering its Catskill/Delaware water supply, which allows DEP to avoid building a $10 billion water filtration plant.

Within this capital program, the Water for the Future program helps ensure the success of this water supply system, and progress continues on the repair of the Delaware Aqueduct, which is crucial to future supply. The Delaware Aqueduct, which supplies 50 percent of

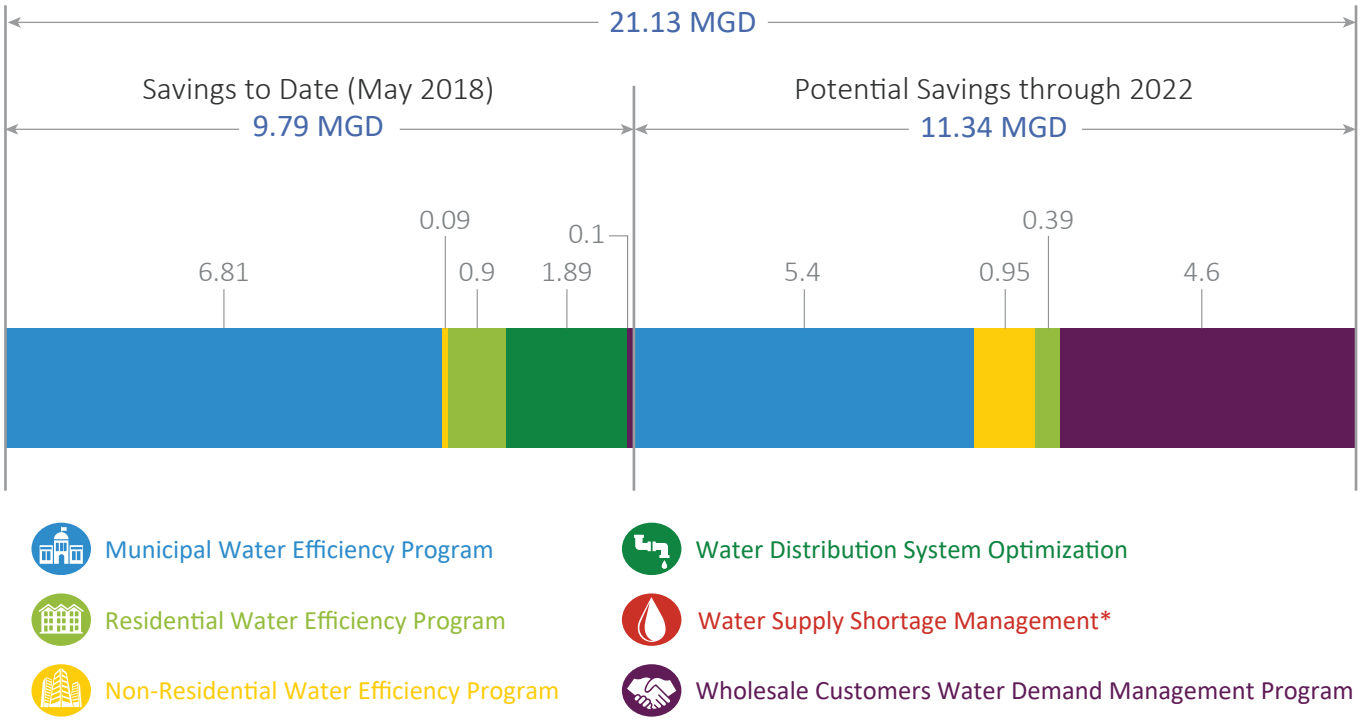


Figure 1. Demand Management Strategies: Savings to Date and Potential Savings through 2022

the city's water supply, will require a shutdown for six to eight months as DEP connects and tests a bypass tunnel that is currently being constructed parallel to the aqueduct. DEP has already constructed new shafts, assembled a tunnel boring machine, and begun drilling for the bypass tunnel.

To optimize water supply during the shutdown, DEP released the 2013 Water Demand Management Plan, and in accordance with the 2013 Plan, the City has invested and managed $50 million in demand management initiatives for the last five years, including retrofitting older building stock, hosting water challenges with private sector partners, and increasing and optimizing the repair and maintenance of 7,000 miles of water distribution pipes. DEP has funded infrastructure to reduce water consumption by retrofitting spray showers in parks, funding water recycling systems to offset potable water use, and increasing awareness of issues including home water leaks and curbing excessive consumption.

The 2013 Water Demand Management Plan was chosen as an alternative to connecting to an adjacent water system that would provide backup water during the shutdown. This program has continued to provide benefits to the city, with emphasis on reducing non-revenue water, optimizing metering infrastructure, and reducing losses in the distribution system with continuous improvement and monitoring efforts. DEP's Bureau of Customer Services continues to distribute home water savings kits and information on how customers can cut down on residential water use, while DEP's Office of Information Technology provides accessibility to meter information and automatic leak information online, allowing customers to monitor and fix leaks and high water use. With this 2018 Water Demand Management Plan, DEP will continue to reduce water use by expanding already successful programs and adding new efforts to enhance reductions.

Due in part to DEP's demand management initiatives, citywide consumption has continued to decline. In the last five years, average daily water consumption has averaged approximately 1 billion gallons of water per day. Twice, the city's annual average consumption has dropped below 1 billion gallons per day, a massive decrease since the average of 1.4 billion gallons per day when DEP began its modern demand management programming in the early 1990s. This reduction occurred even as in-city population has grown, leading to a decrease in per capita consumption.

2018 Water Demand Management Plan: Goals and Strategies

Overall demand has continued to drop due to DEP's Water Demand Management Program and improvements in building water efficiency. Several years of program implementation have provided insight on cost-effective demand management strategies, and thus, DEP has revised the reduction goal stated in the 2013 Water Demand Management Plan to 20 million gallons per day through ongoing and new initiatives under the six established strategies described herein:

DEP has provided annual updates since the 2013 Water Demand Management Plan was released and will continue to track implementation through annual updates, including the new initiatives stated in this 2018 Water Demand Management Plan.

1. Municipal Water Efficiency Program
2. Residential Water Efficiency Program
3. Non-Residential Water Efficiency Program
4. Water Distribution System Optimization
5. Water Supply Shortage Management
6. Wholesale Customers Water Demand Management Program

Strategy 1: Municipal Water Efficiency Program

The Municipal Water Efficiency Program provides funding for water demand reduction projects in City-owned facilities. Under this program, DEP has completed retrofits and upgrades in over 450 City facilities with interagency partners including the Department of Education, the Department of Parks and Recreation, the New York City Fire Department, and the City University of New York. DEP has also evaluated its own wastewater treatment plants for water conservation opportunities and launched an annual water conservation challenge for treatment plant operators to implement best practices and monitor potable water use reductions, which has been completed at all 14 facilities. DEP is working to expand successful partnerships with the Department of Parks and Recreation and Department of Education, and to include new partners including the Health and Hospitals Corporation, Department of Citywide Administrative Services, and members of the Cultural Institutions Group. Local Law 86 of 2005 mandates that newly-constructed buildings or substantial reconstruction of buildings that use City funding achieve certain efficiency standards and requirements, including a LEED rating and a reduction in potable water use. These regulations ensure that new public facilities are efficient, but this Plan also works to enhance water efficiency in the City's existing building stock.

Strategy 2:
Residential Water Efficiency Program

New York City continues to develop housing on a finite footprint, and this dense residential environment means domestic water use continues to drive overall demand and consumption. Residential dwellings account for 81 percent of New York City's metered water usage. In 2014, DEP launched a Toilet Replacement Program, modeled after the earlier Toilet Rebate Program in the 1990s. As of May 2018, over 12,600 inefficient toilets have been replaced across all five boroughs through this popular program, achieving savings of 500,000 gallons of water per day. As eligible customers continue to enroll in the program, and as some customers replace their inefficient toilets without participating in the program, the population of eligible customers continues to decline. Thus, to further increase participation, DEP expanded the Toilet Replacement Program to over 80 eligible New York City Housing Authority facilities in 2017, and to over 4,300 Homeowner Water Assistance Program customers in 2018. In addition to the Toilet Replacement Program, DEP, with contractor assistance, conducted nearly 100,000 complementary apartment-level household water surveys in single- and multi-family buildings between 2013 and 2017 to promote water conservation and identify leaks. DEP and its contractor also distributed home water savings kits to these customers.

Strategy 3:
Non-Residential Water Efficiency Program

The Non-Residential Water Efficiency Program promotes conservation in commercial and non-residential buildings through voluntary partnerships. Since 2013, DEP has launched and completed three separate water challenges with hotels, restaurants, and hospitals. Participants were asked to calculate baseline water consumption, track water usage in their facilities for 12 to 24 months, develop Water Conservation Plans, and attend meetings with DEP and the Mayor's Office to discuss progress. Successful challenge participants received formal recognition from DEP, in addition to acknowledgment through press releases about their efforts. DEP used these challenges to create water efficiency guides for these respective sectors, and the guides have been successful in continuing to educate customers on water efficiency best practices. DEP will be launching a fourth water challenge to city universities in 2018.

In 2016, DEP launched the On-site Water Reuse Grant Pilot Program, a cost sharing program that provides incentives to commercial, mixed-use, and multi-family residential property owners to build, operate, and maintain reuse systems. The program covers a portion of efficiency technology capital costs for rainwater, gray water, and black water systems at both the building- and district-scale.

Strategy 4: Water Distribution System Optimization

DEP has a large service area with 7,000 miles of pipes that distribute water to end users. As water travels through these underground pipes, undetected leaks can occur, and therefore constant maintenance, leak detection, and metering optimization is key to efficient management of water supply. DEP has a system of pressure management zones that are crucial for properly operating the system. Pressure management can help reduce leaks by reducing the amount and severity of water main breaks.

Old and under-registering meters present the next challenge, as under-registration can result in inaccurate measurement of water use. Every year, DEP replaces thousands of older meters, particularly larger meters, to limit this problem. Automatic Meter Reading (AMR) infrastructure now covers over 97 percent of DEP's customer base, which decreases accounting errors by producing actual readings rather than estimates, and provides a more accurate depiction of water use across the city. DEP also provides data access to customers at a more granular level than in the past through the My DEP portal, which allows customers to actively monitor their own use. This improved access to information provides customers with the opportunity to address leaks and proactively increase water efficiency in their homes.

Strategy 5: Water Supply Shortage Management

Beyond infrastructure upgrades and programs that promote near-term savings, DEP is also working on its rules and regulations to properly manage its water supply in the event of water shortage during infrastructure repairs, or droughts. Since the release of the 2013 Demand Management Plan, DEP has worked to enhance these rules.

DEP has revised its drought management rules, now known as the Water Shortage Rules. The revised name better reflects the need of these rules, and potential restrictions that could be implemented during planned and unplanned infrastructure work, including the upcoming Delaware Aqueduct shutdown.

Strategy 6: Wholesale Customers Water Demand Management Program

The Wholesale Customers Water Demand Management Program is a partnership effort aimed at reducing demand in 10 of DEP's largest utility partners' service areas. Since 2014, DEP has collaborated with these utility partners to develop tailored demand management strategies that will reduce demand by 5 percent of each utility partner's 2013 baseline demand. DEP identified strategies after an extensive analysis of each utility partner's water system, and DEP worked with utility partners to develop plans using DEP's own water demand management strategies as models.

Utility partners will implement a variety of strategies, including water loss control (leak detection, line repair, and pressure management), residential indoor upgrade voucher programs (modeled after DEP's Toilet Replacement Program), municipal fixture upgrades, automated metering infrastructure, and transition to monthly billing. This collaboration will reduce demand on the city's water supply ahead of the Delaware Aqueduct shutdown, and provide a foundation for these utility partners to independently continue water demand management into the future.

Introduction

New York City's water supply system is one of the most extraordinary and efficient water delivery systems in the world. The New York City Department of Environmental Protection (DEP) manages an extensive network of aqueducts and tunnels, some dating back more than 150 years, that flow largely by gravity from sources that extend as far north as 125 miles from New York City and across a 2,000-square-mile watershed. About one billion gallons of potable water are delivered to over 8.6 million New Yorkers each day—a number that DEP continues to reduce by enhancing efficiency through its Water Demand Management Program.

Resiliency of New York City's water supply system is critical to meeting the demands of population growth and effects of climate change. DEP's systems are able to function under extraordinary conditions. In the wake of storms and droughts that can cause disruptions to watersheds or reservoirs, DEP's system operators are able to draw from other parts of the system, thereby maintaining an uninterrupted flow of potable water. Although precipitation in New York City is expected to increase in the coming years, the City needs to plan for drought patterns and changes in temperature that may lead to decreased winter snowpack and longer growing seasons that reduce the availability of water to refill reservoirs to meet summer demand. In addition to meeting the city's drinking water needs, DEP also needs to support fishery habitat and recreation, generate electricity, and help mitigate flooding in areas downstream of reservoirs.

Every drop counts, and as such, DEP is taking measures large and small to optimize the city's water supply system. Since the 1990s, DEP has been monitoring leaks in a portion of the Delaware Aqueduct that are estimated to release between 15 and 35 million gallons of water per day. To repair the leaks, DEP developed the Water for the Future Program, which will temporarily shut down the leaking portion of the aqueduct to carry out repairs. During this temporary shutdown, water from the Delaware system west of the Hudson River will be unavailable. To ensure a continued supply of drinking water during this time, DEP has developed projects to optimize water supply.

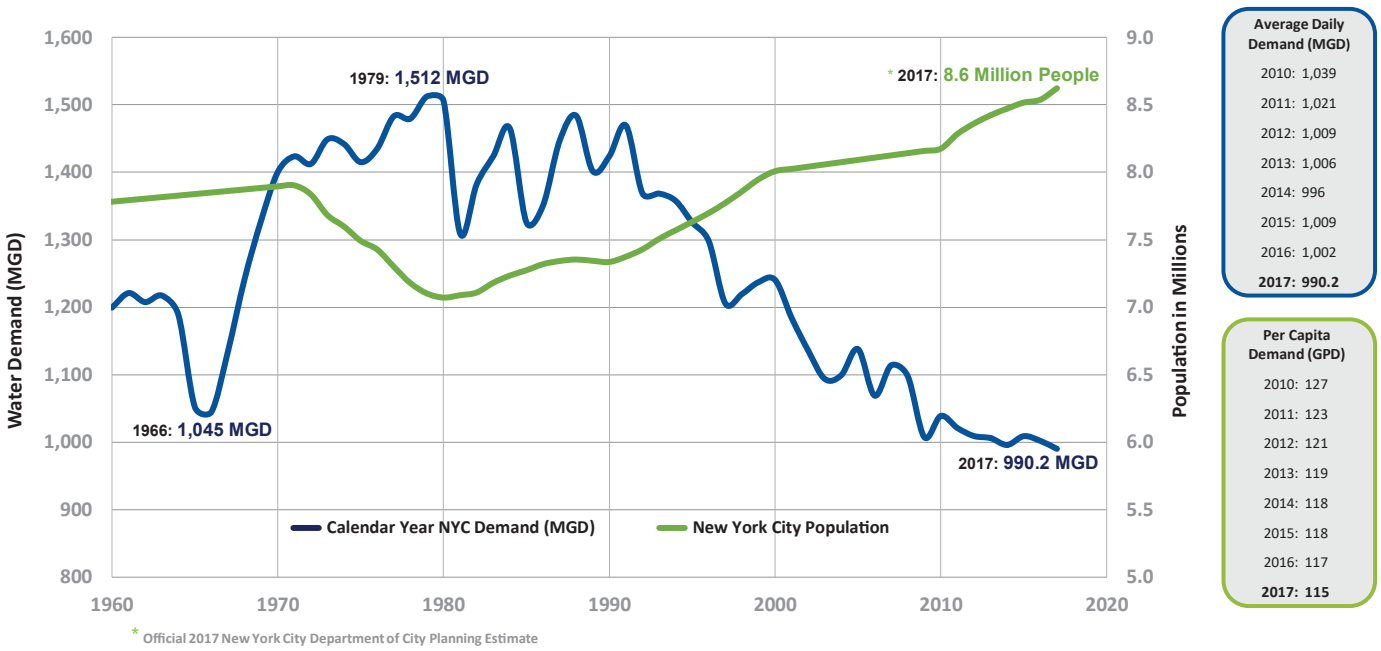


Figure 2. New York City Water Demand and Population Growth

One of the most straightforward approaches to drinking water resiliency is demand reduction—a measure which helps prepare the city for aqueduct repairs in the near-term, and for interruptions that may occur in the future, including drought. Since 2009, water usage has been NYC's previous record low usage in 1966, which was when the last major drought occurred. Reduced demand is due in large part to universal metering, which DEP began in earnest in 1985; a Toilet Rebate Program that ran from 1994-1997, during which approximately 1.3 million inefficient toilets were replaced; and improved overall water efficiency of new building stock. In 2013, DEP issued a Water Demand Management Plan that reinstated a Toilet Replacement Program for customers not covered under the original program, advanced system optimization in the distribution system and metering program, and created partnerships with City agencies to upgrade plumbing and replace inefficient fixtures in municipal facilities.

DEP's 2018 Water Demand Management Plan marks five years of progress since the 2013 Water Demand Management Plan was released. In this time, DEP's Water Demand Management Program has saved the city almost 10 million gallons of water per day. Many lessons have been learned in the process of implementing the program; the 2018 Plan reflects on those lessons, advances already successful programs, and initiates new partnerships, building upon successes and new opportunities. One lesson learned is the challenge of reaching some of the initial 2013 targets, and as such, this report reflects revised goals. By 2022, DEP estimates that total water savings from the Water Demand Management Program will double, to 20 million gallons of water per day.

This report highlights accomplishments from the past five years of the Water Demand Management Program and sets the direction to build upon this success for the next five years. DEP will continue to issue annual updates, noting progress toward water savings that will prepare the city for critical infrastructure repairs and enhance the resiliency of New York City's water supply for future generations.

Pepacton Reservoir

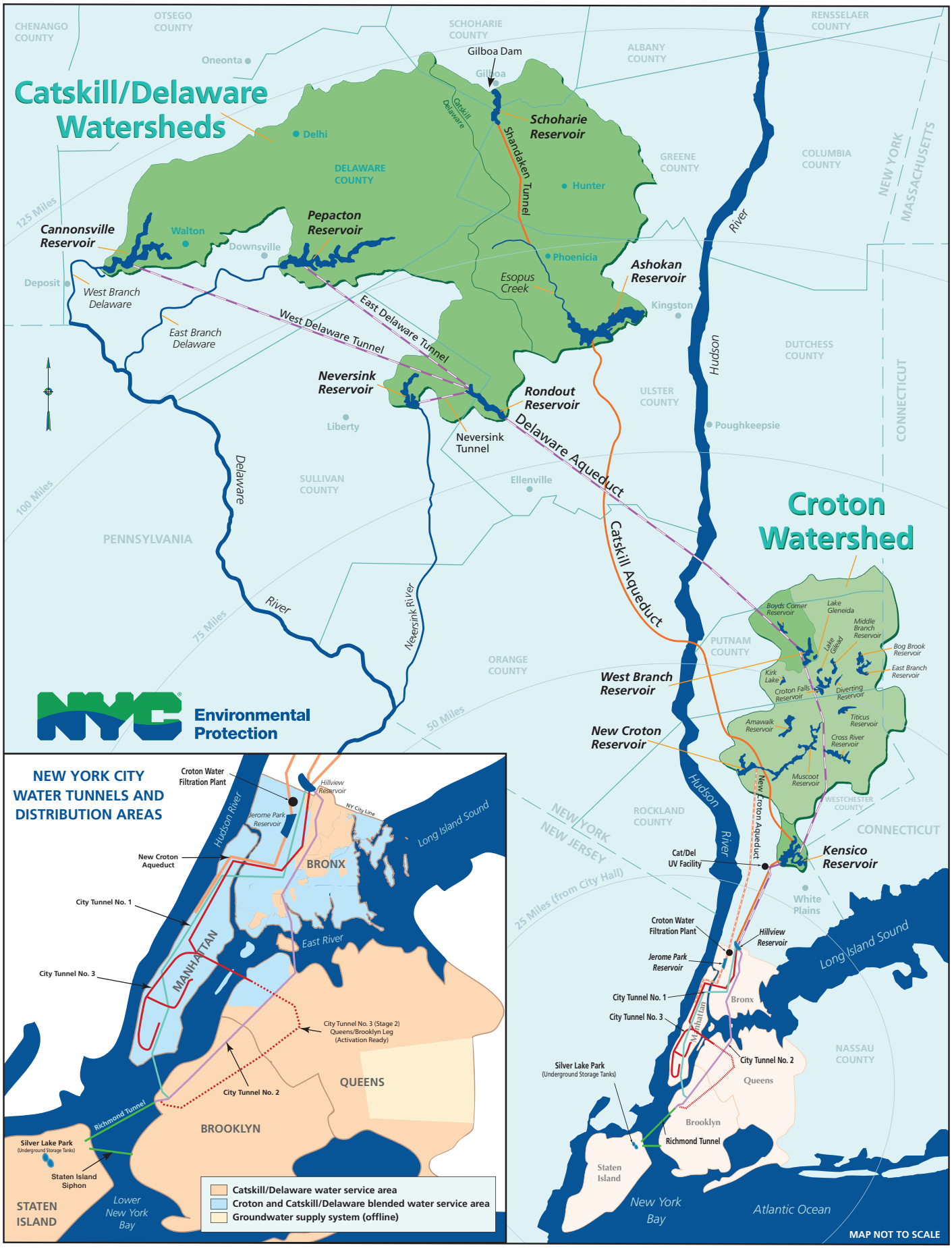


Figure 3. New York City Water Supply System

Municipal Water Efficiency Program

Water is required for a range of activities that are necessary in municipal properties to keep the City operating efficiently and to keep people safe. From firefighters testing their equipment on Randall's Island, to groundskeepers keeping Central Park's lawns green and lakes full, water is needed in nearly every corner of the city. By developing partnerships with other municipal agencies, DEP has improved both citywide water efficiency and operations for partner agencies.

The Municipal Water Efficiency Program (MWEP) has achieved the most savings of all the programs initiated under the Water Demand Management Plan. Through May 2018, DEP has achieved 6.81 MGD in total savings through MWEP. Following several years of successful partnerships, DEP completed an in-depth study in 2017 to identify additional municipal conservation projects, partnership opportunities, and demand savings to guide the next five years of MWEP. The 2017 MWEP study reviewed previous partnerships not included in the original MWEP strategy, and explored other possible projects to upgrade City facilities and achieve additional water savings.

DEP plans to continue to invest in this strategy, and based on the results of the study, will expand MWEP to the New York City Health and Hospitals Corporation (HHC) and may pursue new partnerships with the New York City Cultural Institutions Group (CIG) and the Department of Citywide Administrative Services (DCAS). In addition, DEP may expand existing partnerships with the New York City Department of Education (DOE) and the New York City Department of Parks and Recreation (DPR). Through MWEP, DEP will continue to advance a wide-ranging effort that incorporates water efficiency retrofits, education, curriculum development, metering, and water benchmarking.

Completed Initiatives

New York City Department of Parks and Recreation

Savings Achieved (May 2018): 1.1 MGD

The New York City Department of Parks and Recreation (DPR) is one of the largest landowners in New York City. DPR is dependent on City water to irrigate much of its land and provide activities and recreational opportunities for New Yorkers, especially in the heat of the summer.

When the 2013 Water Demand Management Plan was released, DEP had an ambitious goal of retrofitting 400 spray showers in playgrounds. These spray showers normally run all day, typically from Memorial Day through Labor Day, even when park visitors are not present. DEP and DPR partnered to install push-button activated timers that limit water use to five to ten minutes each time the button is pushed. In addition to reducing water use at these sites, DEP provided funding to upgrade older, inefficient fixtures at nine DPR recreation centers throughout the city.

In June 2017, DEP and DPR completed the targeted 400 spray shower retrofits and renovation of nine recreation centers. DEP is also funding the retrofit of 67 playgrounds with green infrastructure for stormwater management, and these sites will also be retrofitted with new bathroom fixtures and push button spray showers where suitable.

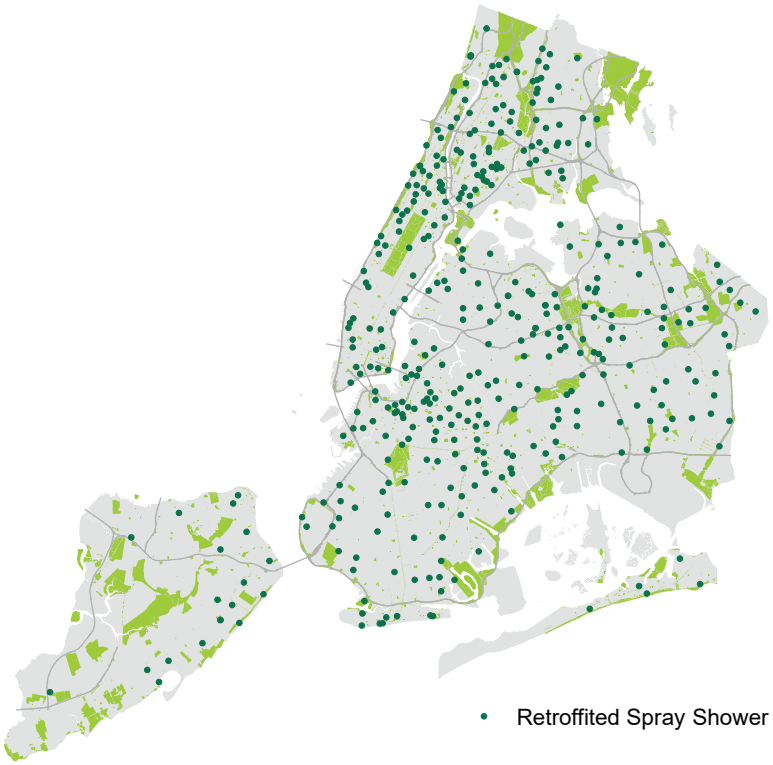


Figure 4. Retrofitted Spray Showers
By June 2017, DEP and DPR completed 400 spray shower retrofits

A push button spray shower at Thomas Boyland Park in Brooklyn

City University of New York

Savings Achieved (May 2018): 0.04 MGD

The City University of New York (CUNY) is part of New York State's public university system, and is the largest urban public university in the United States. CUNY's City College campus in Manhattan is the flagship of the CUNY system, serving over 16,000 undergraduate students with a full-time staff of 500. In 2014, DEP formed a partnership with CUNY to fund the upgrade of inefficient plumbing fixtures in the older buildings on City College's campus. In 2017, CUNY staff completed the targeted retrofit of 500 toilets and 280 urinals in 10 buildings.

Waterless urinals at City College's North Academic Center

New York City Fire Department

Savings Achieved (May 2018): 0.03 MGD

The New York City Fire Department (FDNY) provides fire protection, technical rescue, primary response to biological, chemical, and radioactive hazards, and emergency medical services to the five boroughs of New York City. FDNY is the largest municipal fire department in the country with 11,000 firefighters and 4,400 emergency medical technicians. Water is critical to FDNY's services, and beyond its crucial use when fighting fires, it is also needed to test equipment, train new firefighters, and wash and clean equipment.

In addition to funding bathroom retrofits in 12 of FDNY's largest firehouses, FDNY and DEP partnered to identify and fund a project at FDNY's Randall's Island Training Facility. The new water recovery facility recycles water needed to test and calibrate the meters and equipment of the fleet's pumper truck rig. These vehicles need to be tested prior to being accepted into the fleet to make sure they are in working order. Once a rig is in service, it requires testing and calibration once a year. These tests require water pumped from a hydrant, for which FDNY would typically use City water that would then drain directly to the East River or to catch basins connected to a sewer. To improve this process, the new water recovery facility creates a closed loop system, so that used water can be recovered and reused, instead of relying solely on potable water. This project saves an estimated 30,000 gallons of water per day and significantly reduces the potable water needed at the FDNY training facility.

FDNY's water recovery facility on Randall's Island (Photo courtesy of FDNY)

Existing Partnership and Project	Savings to Date (MGD) (May 2018)	Potential Savings by 2022 (MGD)
New York City Department of Education (DOE) – Bathroom Fixture Retrofits	3.29	4.71
DEP – Wastewater Treatment Plant (WWTP) Water Challenges	1.68	1.98
New York City Department of Parks and Recreation (DPR) – Spray Shower Retrofits in City Parks and Recreation Center Bathroom Fixture Retrofits	1.10	1.10
New York City Housing Authority (NYCHA) – Leak Repair	0.67	0.57
City University of New York (CUNY) – Bathroom Fixture Retrofits at City College of New York	0.04	0.04
New York City Fire Department (FDNY) – Fixture Retrofits in Firehouses and 30,000 Gallon Water Reuse Facility at Randall's Island Training Facility	0.03	0.03
Total	**6.81**	**8.43**

Table 1. Savings Achieved and Potential Savings from Existing Municipal Partnerships

Ongoing Initiatives

New York City Department of Education

Savings Achieved (May 2018): 3.29 MGD
Potential Savings by 2022: 4.71 MGD

The New York City Department of Education (DOE) is the largest school system in the country, with over 1,400 facilities and 1 million students served on an average school day. Since 2013, DEP has been upgrading bathroom fixtures in DOE facilities. Since the program began, 400 facilities have been retrofitted with over 34,000 new and efficient fixtures. Specifically, older toilets that utilize 3.5 gallons per flush (GPF) or more were replaced with 1.6 and 1.28 GPF models, and 1.0 GPF urinals were replaced with 0.125 GPF models. DEP will continue this initiative and expects to complete an additional 100 facility retrofits by Summer 2019.

The 2017 MWEP study identified over 200 additional schools that could be retrofitted for an additional savings of 0.78 MGD. DEP plans to work with DOE to continue this program to promote sustainability and water conservation in school facilities. These additional schools would be incorporated into the existing program, thus expanding the timeline of the program by three years.

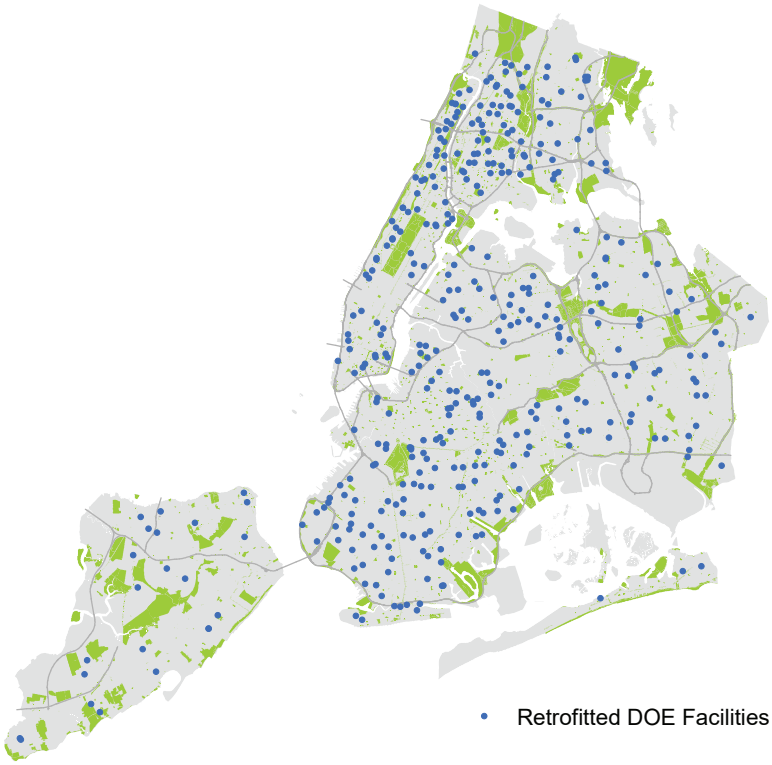


Figure 5. Retrofitted DOE Facilities
400 DOE facilities have been retrofitted with over 34,000 new and efficient fixtures

P.S. 115, The Daniel Mucatel School in Brooklyn, one of the participating schools

Newtown Creek Wastewater Treatment Plant

Water Challenge to Wastewater Treatment Plants

Savings Achieved (May 2018): 1.68 MGD
Potential Savings by 2022: 1.98 MGD

In addition to providing 1 billion gallons of clean drinking water each day, DEP also treats an average of 1.3 million gallons of sewage at 14 wastewater treatment plants (WWTPs) located throughout the city. Since the release of the 2013 Water Demand Management Plan, DEP's Bureau of Wastewater Treatment has worked to achieve water savings at WWTPs by hosting Water Challenges. To date, DEP has hosted four Water Challenges. Each Challenge encourages three or four different facilities to compete with each other to reduce consumption by 10 percent from an established baseline. To lead by example, DEP's reduction target is even greater than the goal for other Water Challenges with the private sector for the Non-Residential Water Efficiency Program (Strategy 3).

Since each facility has unique equipment and design capacity, DEP relies on its experienced staff to identify and implement capital upgrades or update standard operating procedures to achieve water savings. At Jamaica WWTP, for example, staff upgraded the valves of the pump seal tanks to reduce the amount of make-up water needed for the seal system. At Tallman Island WWTP, staff recognized that the blower cooling system was discharging water, and worked to improve flow balancing between seal skids and the cooling water tank. That facility now recycles 100 percent of its cooling water discharge, thus achieving a reduction of 11,000 gallons per day, or an estimated 4 million gallons per year.

Certain conservation strategies have been effective at all WWTPs. For example, under previous conditions, water hoses used for facility operations did not have nozzles and used large quantities of water from hydrants. DEP has since purchased efficient nozzles that reduce water use by half, from 110 to 55 gallons per minute. WWTP staff have also worked to coordinate with DEP's Bureau of Water and Sewer Operations staff to inspect hydrants and service lines for leaks, tackling water losses that could otherwise go undetected.

DEP plans to host a fifth Water Challenge to Wastewater Treatment Plants that will include all 14 facilities, seeking an additional 10 percent reduction in water use at each WWTP. An additional 10 percent reduction would yield savings of approximately 600,000 gallons of water per day. Through the Water Challenge, water audits at WWTPs (see Case Study: *New York City's Water-Energy Nexus*), and additional coordination with plant staff, DEP will continue to lead by example by saving water at its own facilities.

Rain garden in construction

Completed rain garden

Case Study: Beneficial Reuse of Crushed Porcelain

DEP proactively recognized that the initiative to update plumbing in 500 Department of Education facilities would create significant construction waste, presenting an opportunity for beneficial reuse of the porcelain. Working with the New York State Department of Environmental Conservation (DEC), DEP tested the material and acquired two Beneficial Use Determinations (BUDs) from DEC, allowing DEP to reuse the porcelain for ecological restoration and green infrastructure projects.

DEP began recycling porcelain from DOE facilities in May 2015. Rather than disposing of the old fixtures in a dumpster, they were instead returned to a facility and processed. The crushed material was then stored at two separate New York City Department of Sanitation (DSNY) sites for weatherizing, to ensure cleaner material. The first project utilized 6,500 crushed fixtures to help construct an artificial oyster reef in Jamaica Bay. The porcelain, mixed with oyster and clam shells, acts as a receiver reef for breeding oysters placed in the Bay.

After the completion of the reef, DEP continued to recycle retrofitted toilets from DOE facilities. Fixtures were crushed and stored, and a second BUD was received from DEC. Working with DEP's Office of Green Infrastructure, the crushed porcelain was used as clean fill for rain gardens. A total of six rain gardens used crushed porcelain as fill instead of crushed stone. These rain gardens are being monitored to ensure that they continue to function as effectively as traditionally-built rain gardens.

Following the success of crushed porcelain use in smaller green infrastructure assets, DEP collected and utilized porcelain from 3,500 crushed fixtures as fill in an on-site green infrastructure project at Public School (PS) 120Q in Flushing, Queens. Similar to the rain gardens, crushed porcelain was used instead of crushed stone as porous fill underneath a new turf field. The turf field now acts as a large sponge that can retain up to 500,000 gallons of stormwater per year.

Turf field in construction

Completed turf field

New Initiatives

Since the release of the 2013 Water Demand Management Plan, DEP has continually refined its forecast of potential water savings to account for programmatic changes, unforeseen circumstances, and other factors not initially identified in 2013. Through this work, DEP has measured which programs have reached their goals and which ones may need more resources in order to achieve their targets. The 2017 MWEP study identified new municipal partnerships and opportunities to expand current ones to provide additional water savings.

At the onset of the study, DEP identified and evaluated 40 municipal agencies that own or operate New York City property. The study ranked agencies that were not included in the 2013 Water Demand Management Plan, or could not partner with DEP through a legal financial agreement. After initially ranking the agencies, six were chosen for further study, and all existing MWEP partnerships were evaluated for expansion. In-depth interviews were held with the agencies' facility managers to evaluate projects, discuss contracting, and gather data in order to provide initial estimates of costs and water savings.

Several initiatives that would help DEP reach its target of 20 MGD for water conservation projects were selected from a list of demand management strategies based on benefit score, spending efficiency, and water savings data from the cost benefit analysis. The results of this study helped identify a number of projects that DEP has worked to include under the scope of the Water Demand Management Program. New projects are presented in this report as new initiatives.

New York City Health and Hospitals Corporation

Potential Savings by 2022: 1.22 MGD

The New York City Health and Hospitals Corporation (HHC) operates public hospitals and clinics in New York City. HHC is the largest municipal healthcare system in the United States, serving 1.4 million patients including more than 475,000 uninsured city residents, and provides services in more than 190 languages. HHC was created in 1969 by the New York State Legislature as a public benefit corporation and currently operates 11 acute care hospitals, five nursing homes, six diagnostic and treatment centers, and more than 70 community-based primary care sites, serving primarily low-income patients. Each year, HHC's facilities provide about 225,000 inpatient admissions, 1 million emergency room visits, and 5 million clinic visits to New Yorkers. HHC facilities treat nearly one-fifth of all general hospital discharges and more than one third of emergency room and hospital-based clinic visits in New York City.

Harlem Hospital, an HHC facility and one of 11 acute care hospitals, participated in DEP's Water Challenge to Hospitals from 2016-2017 and was the sole winner (see Strategy 3). As part of their participation in the Challenge, the hospital conducted a water audit, which found plumbing fixtures and operational appliances that could be upgraded with efficient models to significantly reduce overall water consumption. DEP is working with HHC to retrofit the Harlem Hospital campus through Fall 2018. Specifically, though this partnership, 546 toilets, 37 urinals, 48 showerheads, 985 faucet aerators, 12 water-cooled ice machines, and an industrial dishwasher will be replaced. The retrofits at Harlem Hospital are expected to result in savings of 0.06 MGD.

NYC Health + Hospitals/Woodhull in Brooklyn

DEP included 10 HHC hospitals in its 2017 MWEP study and is partnering with HHC to survey these facilities for future retrofits. DEP will work to complete these retrofits between 2019 and 2021. These retrofits would yield savings of 1.16 MGD. Including Harlem Hospital, the total potential savings from DEP's partnership with HHC is 1.22 MGD.

New York City Department of Citywide Administrative Services

Potential Savings by 2022: 0.24 MGD

The Surrogate's Courthouse in Manhattan

The New York City Department of Citywide Administrative Services (DCAS) manages, leases, and purchases property for the City; operates, manages, and repairs courthouses and other City-owned public buildings; administers an energy conservation program; purchases supplies, materials and equipment for use by City agencies; is responsible for citywide fleet management including operation and maintenance of a motor vehicle pool; and supports government recruitment.

DCAS was identified as a potential partner in the 2017 MWEP study. DCAS's direct portfolio includes approximately 50 public buildings throughout the city, including courts and City office buildings that have both full time employees and a large number of daily visitors. The entire DCAS portfolio was added to the study to evaluate savings.

DEP may pursue a partnership with DCAS and work to retrofit the plumbing fixtures in their portfolio, and explore other options for water conservation (including water reuse). DEP estimates that these upgrades could save 240,000 gallons per day.

Cultural Institutions Group – American Museum of Natural History

Potential Savings by 2022: 0.07 MGD

An additional opportunity identified in the 2017 MWEP study is a partnership between DEP and the American Museum of Natural History (AMNH) through the Cultural Institutions Group. Through this potential partnership, approximately 200 toilets and 100 sinks would be upgraded with high-efficiency models in AMNH's existing campus to reduce water consumption. DEP estimates that these retrofits would result in water savings of approximately 67,000 gallons per day. In addition, funding from DEP could facilitate the construction of a 3,000 gallon per day water reuse facility within the new Gilder Center. If pursued, this partnership could result in savings of 0.07 MGD.

The American Museum of Natural History

Prospect Park Lake in Brooklyn

New York City Department of Parks and Recreation

Potential Savings by 2022: 1.05 to 1.25 MGD

In Prospect Park, DEP has identified a running service line that is used for makeup water for the park's lake system. Currently, Prospect Park Lake is augmented with an estimated 1 MGD or more of potable water in summer months. The service line has an existing valve that cannot be turned off due to its age and condition. In order to lower the water in the lake system during rain events, Prospect Park staff discharge water into the combined sewer system, which flows to Owls Head wastewater treatment plant (WWTP). DEP estimates that approximately 2 MGD is discharged to the combined sewer system, between 24 and 70 days each year. DEP may pursue a partnership with DPR to excavate and replace the existing valve. This project would achieve a potential savings of at least 0.75 MGD, and would also prevent tens of millions of gallons of water each year from entering the combined sewer system.

In Central Park, DEP has observed a dry weather flow in the park's northern waterbody system that does not appear to be stormwater runoff. Coordinating with the Central Park Conservancy, DEP discovered archived plans to recirculate the water system. The plans indicate that approximately 300,000 gallons per day of potable water flows into the northern waterbody system and is discharged to the combined sewer system, which flows to Wards Island WWTP. DEP's Bureau of Water and Sewer Operations (BWSO) tested this flow and results indicate that the water is most likely potable City water from system leaks. BWSO is currently utilizing listening devices to further test for the source of this leak.

The Central Park Conservancy is interested in recirculating the water flow in the northern waterbodies, and is currently conducting a feasibility study . DEP may pursue a partnership with the Central Park Conservancy to cost share a portion of this project, which would achieve a potential demand savings of 0.3 to 0.5 MGD by upgrading infrastructure and addressing leaks. The water captured and recirculated would offset the need for potable water use for irrigation, aesthetics, and make-up water used at the Jackie Onassis Reservoir.

Case Study: New York City's Water Energy Nexus – Linking Water Sustainability to Greenhouse Gas Reductions

As New York City is a global leader in sustainability, DEP continues to proactively track and reduce greenhouse gas (GHG) emissions in an effort to meet citywide climate change objectives. While DEP's water supply, stormwater, and wastewater management facilities currently account for 17 percent of total GHG emissions from New York City government buildings, many DEP sustainability programs, including water demand management, help offset GHG emissions and provide indirect energy co-benefits.

DEP's commitment to achieving the Mayor's OneNYC goal of reducing GHG emissions 80 percent by 2050 (relative to the 2005 baseline) is driving changes in the way DEP operates at an agency-wide level. While GHG inventories have recently been developed for many traditional facilities, including water and wastewater treatment plants (WWTPs), DEP did not have a way to quantify the impacts of initiatives like demand management on the agency's overall GHG portfolio. Therefore, in 2016, DEP initiated a Water-Energy Nexus Study to quantify these initiatives' role in reducing GHG emissions. In order to perform this study, DEP applied for funding through the Department of Citywide Administrative Services ExCEL Program, a competitive funding program for energy efficiency projects. Receiving energy efficiency funding for a water conservation project was an important step towards demonstrating the link between water and energy, as well as promoting integrated water management.

As part of the study, an analytical tool was developed that helps quantify treatment reductions at drinking water and wastewater facilities from implementation of DEP's demand management initiatives, while accounting for any added emissions associated with operations and maintenance activities. Analysis was performed for each sewershed, based on the 14 DEP-owned and operated WWTPs. The tool can be used to produce GHG reduction estimates for water demand management programs at the sewershed level, based on the benefits of reduced treatment volume at both the water treatment plant and WWTP, based on specific geography.

Water Efficiency Programs

68
Metric Tons CO2e per year

- 400 Schools Retrofitted
- 400 Spray Showers Retrofitted
- 12,637 Toilets Replaced (Residential)

Greenhouse Gas Reductions from DEP's Water Demand Management Program

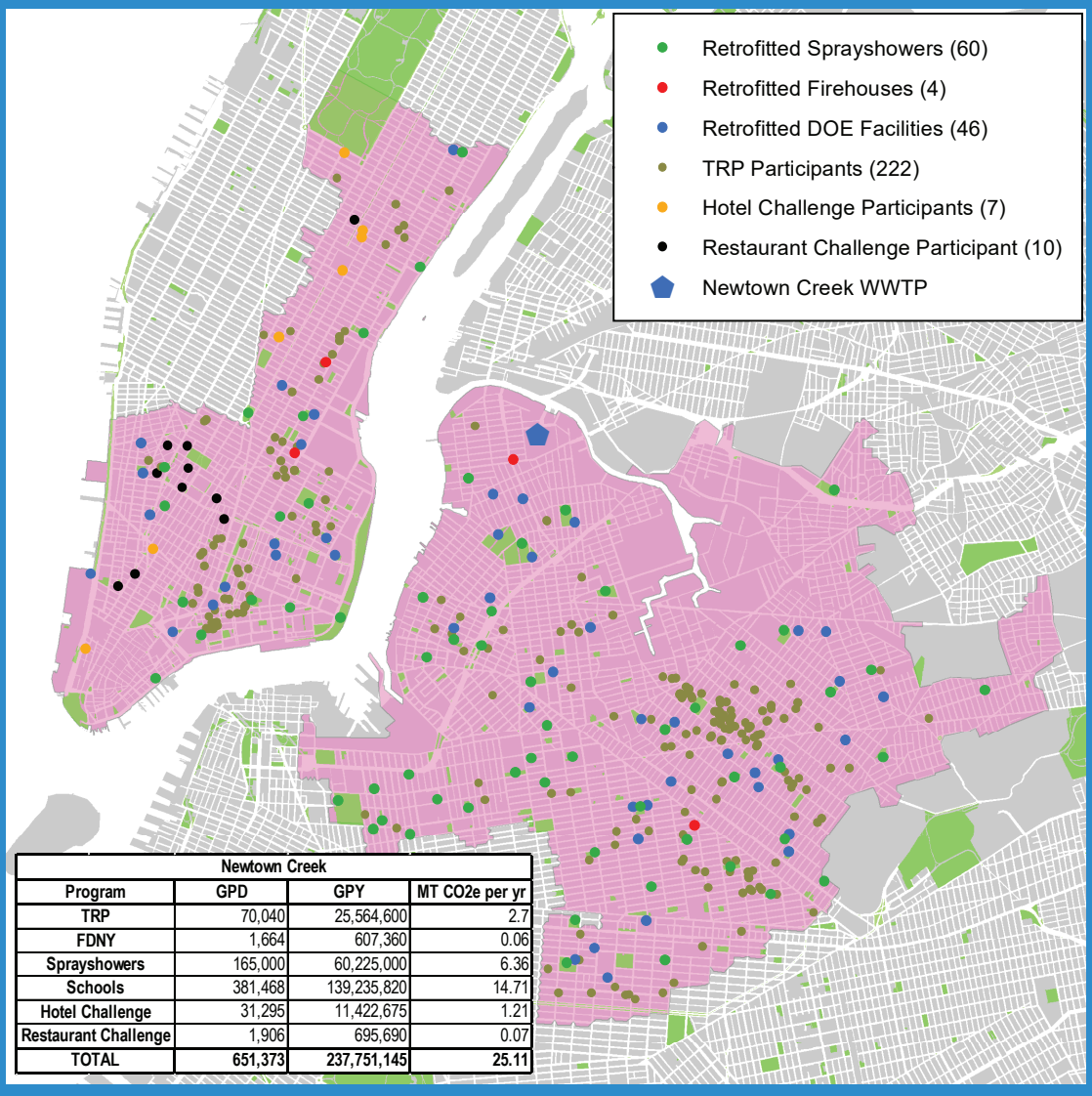
Utilizing the Water Energy Nexus Tool, DEP is now able to directly calculate the impact that water efficiency programs have on DEP's GHG inventory. DEP's water efficiency programs have accounted for a reduction of 68 metric tons (MT) CO2 equivalent (CO2e) per year, resulting from retrofits of fixtures in 400 schools, replacing 400 spray showers in City parks, and replacing 12,637 toilets in multi-family residential buildings. Overall, DEP's sustainability programs have reduced carbon emissions by over 480 MT CO2e per year, which is equivalent to 131 standard passenger cars (10,000 miles per year) or 6,406 60-Watt lightbulbs (used for 8 hours per day, every day).

Building off of the success of this study, DEP applied for and was awarded additional funding through DCAS's ExCEL Program to carry out a WWTP Water-Energy Nexus Study. This study aims to expand on the previous work by evaluating the carbon footprint and energy tradeoff impacts associated with potable water conservation measures at DEP's WWTPs. These facilities collectively treat an average of 1.3 billion gallons per day (BGD) of wastewater and utilize large

volumes of City water for various treatment applications such as ring flushing, foam control, grit suspension, chemical dilution, pump seal waters, tank wash-down, and general cleaning purposes. However, not all treatment applications require high quality City water. Utilizing plant effluent instead of City water, where possible, as well as using City water more efficiently where required, would decrease potable water demand at WWTPs, offering opportunities for potential energy savings.

This study will result in detailed water audits of three WWTPs, provide specific recommendations for demand management measures, and quantify water and GHG savings that can be achieved through these measures. Once completed, the Water-Energy Nexus Tool will be updated to capture the GHG benefits of water conservation improvements at each WWTP, and will allow users to model the potential GHG benefits of future demand management measures. The tool will also assist DEP with long-term planning efforts for future demand management initiatives, and will be a resource for other municipalities that would like to explore how water sustainability projects can impact their carbon footprint.

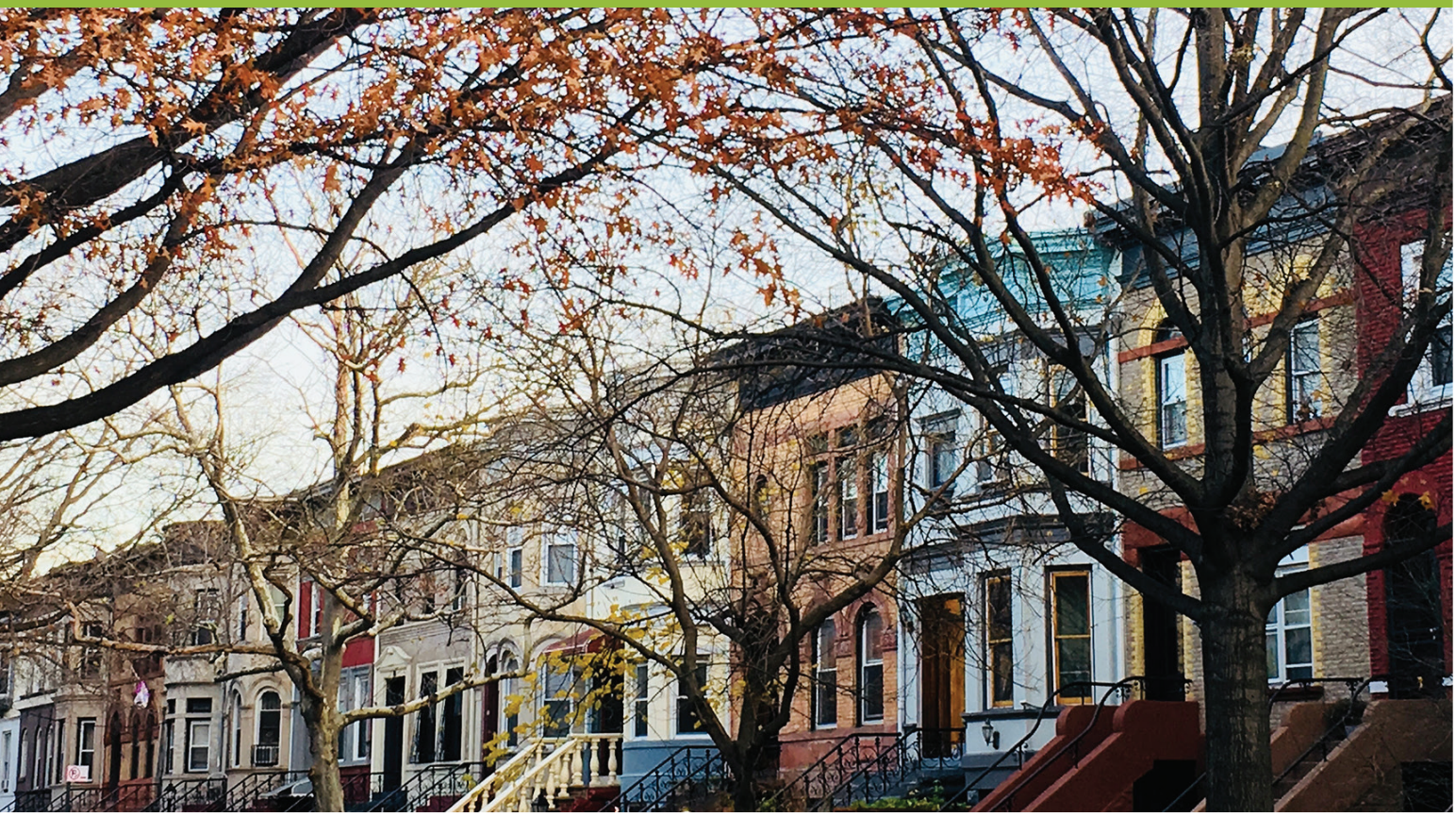
Newton Creek WWTP - Demand Management Projects



Newtown Creek			
Program	GPD	GPY	MT CO2e per yr
TRP	70,040	25,564,600	2.7
FDNY	1,664	607,360	0.06
Sprayshowers	165,000	60,225,000	6.36
Schools	381,468	139,235,820	14.71
Hotel Challenge	31,295	11,422,675	1.21
Restaurant Challenge	1,906	695,690	0.07
TOTAL	**651,373**	**237,751,145**	**25.11**

Figure 6. Water-Energy Nexus Tool Results
Demand management projects are estimated to reduce flow to the Newtown Creek WWTP by over 200 million gallons per year, and achieve GHG savings of over 25 MT CO2e

Residential Water Efficiency Program



Residential water fixture efficiency has improved since the 1990s, leading to a decrease in residential water demand nationally, despite a growing population. According to the Water Research Foundation's (WRF) 2016 Residential End Uses of Water, Version 2 study, there was a 22 percent decrease per household in residential indoor water use in single-family homes between 1999 and 2016, among the 23 utilities studied. Efficiency improvements in toilets, clothes washers, and dishwashers, in addition to a decrease in leaks, are chiefly responsible for these demand reductions, according to WRF study.

Although New York City mirrors these national trends and demand continues to decrease citywide, residential properties accounted for 81 percent of the city's total metered water demand in 2017, making it the highest water user by land use type. According to WRF study, toilet flushing is the largest indoor use of water in single-family homes at 24 percent; research indicates that this could be even higher in multi-family buildings. To target this high demand, DEP has promoted toilet efficiency citywide since the 1990s through two incentive programs: the 1994-1997 Toilet Rebate Program, through which 1.3 million toilets were replaced citywide, and the current Toilet Replacement Program, which began in 2014.

To date, through the Toilet Replacement Program and the distribution of Home Water Savings Kits, DEP has achieved 0.9 MGD of savings through the Residential Water Efficiency Program.

Existing Project	Savings to Date (MGD) (May 2018)	Potential Savings by 2022 (MGD)
Toilet Replacement Program	0.50	0.89
Home Water Savings Kits	0.40	0.40
Total	**0.90**	**1.29**

Table 2: Savings Achieved and Potential Savings from Residential Water Efficiency Program

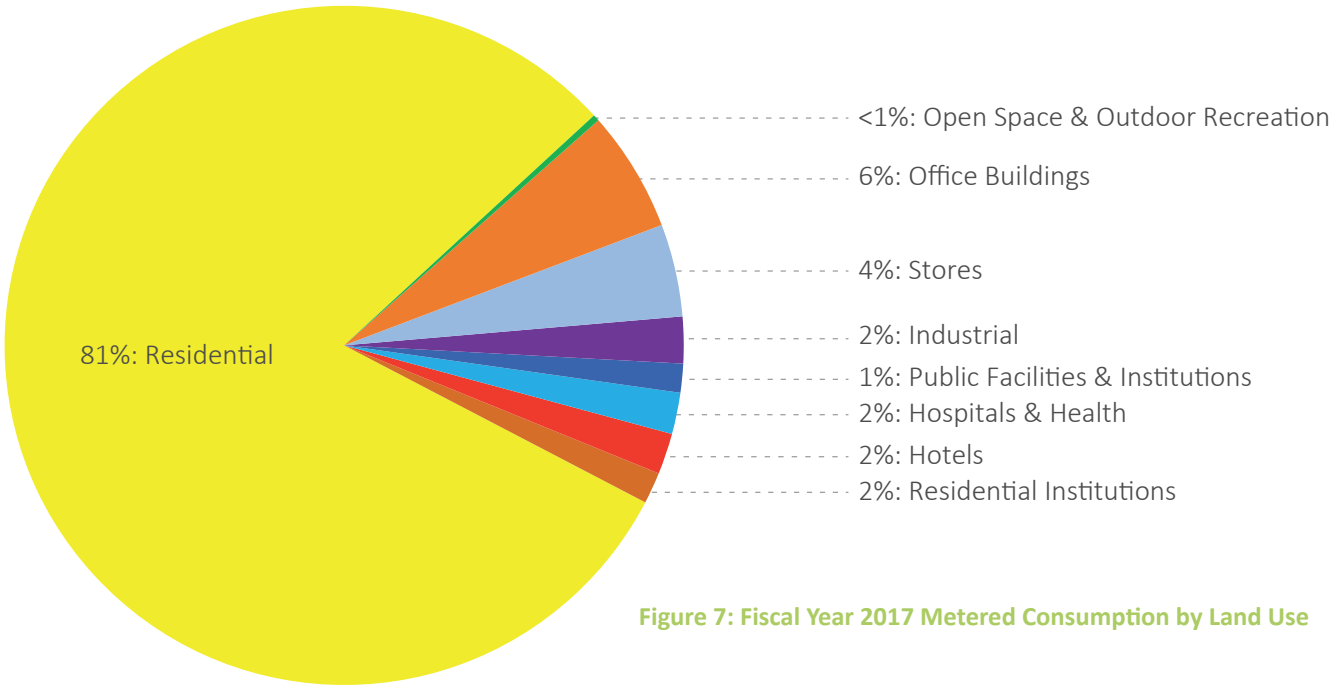


Figure 7: Fiscal Year 2017 Metered Consumption by Land Use

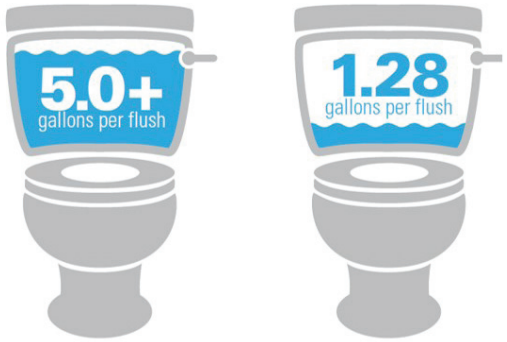
Ongoing Initiatives

Toilet Replacement Program

Savings Achieved (May 2018): 0.5 MGD
Potential Savings by 2022: 0.89 MGD

DEP's Toilet Replacement Program (TRP) is one of the most robust voucher-based toilet replacement programs in the United States. To date, 978 vouchers have been redeemed for the replacement of 12,637 toilets since 2014, accounting for 0.50 MGD of savings. Currently in its fourth year, TRP continues to offer $125 vouchers to customers working to meet the conservation requirements established by the Multifamily Conservation Program (MCP) to purchase and replace old toilets with high-efficiency, 1.28 gallon per flush (GPF) models. MCP is a per-unit flat-rate billing program designed for buildings with four or more residential units that complete a set of water efficiency measures. Coinciding with national trends in residential efficiency, over 13 percent of MCP customers eligible for TRP have indicated that they have already upgraded their toilets, without the assistance of TRP. Thus, the TRP-eligible population continues to decline, while residential water efficiency continues to increase citywide.

The success of DEP's TRP is due in large part to a robust and targeted outreach campaign. The various outreach efforts undertaken since the launch of the program include: presentations to homeowner association boards, meetings with co-op boards and building management companies, meetings with elected officials, informational mailings and postcards in multiple languages, in-person sign-up events at each of the TRP-authorized plumbing fixture vendor locations, robocalls, and tabling and presentations at outreach events, including DEP Rain Barrel Giveaway events. DEP receives considerable positive customer feedback during these events and many customers appreciate the opportunity to retrofit their properties and help DEP meet the agency's demand targets.



A pre-1980s toilet used over five gallons of water per flush. The high-efficiency toilets provided through DEP's Toilet Replacement Program use 1.28 gallons per flush.

Borough	Number of Deactivated/ Redeemed Vouchers	Number of Retrofitted Toilets
Manhattan	194	3,066
Bronx	194	4,032
Brooklyn	467	3,488
Queens	120	2,030
Staten Island	3	21
Total	**978**	**12,637**

Table 3. TRP Participation by Borough, 2014 to May 2018

In addition, DEP identified a strategic partnership in 2016 to increase outreach and began collaborating with New York City Retrofit Accelerator, a City organization that provides personalized advisory services to building owners and managers to streamline the process of making efficiency improvements in buildings. On behalf of DEP, Retrofit Accelerator Efficiency Advisors reach out to New York City Department of Housing Preservation and Development (HPD) building owners and managers enrolled in MCP through phone calls and emails, informing them of TRP and encouraging them to participate in the program to comply with MCP fixture efficiency requirements. As of May 2018, Retrofit Accelerator's efforts lead to the deactivation of 51 vouchers and installation of 404 toilets.

NYC Retrofit Accelerator staff at an outreach event

To further increase TRP participation, DEP identified two additional populations for program expansion. In July 2017, DEP expanded TRP to 86 eligible New York City Housing Authority (NYCHA) properties, and as of May 2018, 8 vouchers have been deactivated for the replacement of 545 fixtures in 8 NYCHA properties. DEP continues to work directly with NYCHA property managers and staff to complete the application and installation process.

Installation of a new, high efficiency toilet in an apartment at NYCHA Latimer Gardens in Queens, one of the buildings participating in TRP.

In February 2018, DEP expanded TRP to the second identified population, approximately 4,300 three- and four-unit Home Water Assistance Program (HWAP) customers. HWAP provides a $115.89 bill credit annually to low-income, senior, and disabled households. As of May 2018, 96 HWAP customers are participating in TRP and 15 toilets have been retrofitted through the HWAP expansion. DEP continues to provide special outreach to HWAP customers, including office hours for navigating program sign-up and assisting with setting up email accounts, at DEP's borough offices in all five boroughs.

In January 2018, the New York City Water Board announced that the deadline for complying with MCP requirements, including the fixture efficiency standards, will be December 31, 2018. If a property does not comply with the requirements, annual surcharges will be assessed by DEP. This is the first time since TRP began in 2014 that a MCP compliance deadline is being set. Because of the deadline and potential surcharges, DEP expects that TRP participation will increase leading up to the December 2018 compliance deadline and prior to TRP ending in May 2019.

Home Water Savings Kits

Savings Achieved (May 2018): 0.4 MGD

In addition to TRP, since 1994, DEP provided building owners with complimentary household water surveys and kits to promote water conservation in their buildings. The surveys assist building owners with identifying water savings opportunities and detecting leaks. Although DEP has achieved the projected savings of 0.4 MGD through reported leaks and other corrective measures, DEP anticipates continuing this program to achieve additional savings through 2022 and increase customer awareness regarding leak detection and repair.

A DEP home water savings kit, provided to customers upon request

Year	Number of Individual Surveys Completed (Apartment or Unit-level)	Total Number of Building Surveys Completed
2013	20,047	3,519
2014	19,726	2,585
2015	15,297	2,667
2016	18,477	3,247
2017	25,408	4,190
Total	**98,955**	**16,208**

Table 4. Completed Household Water Surveys in Single- and Multi-family Buildings, 2013-2017
Over a five-year period, DEP completed nearly 99,000 individual household water surveys in over 16,200 single- and multi-family buildings throughout the city.

NYCHA's Johnson Houses in Manhattan (Photo courtesy of NYCHA)

Non-Residential Water Efficiency Program

In addition to improving water efficiency in New York City's residential buildings, DEP also partners with and provides incentives to non-residential and mixed-used property owners to increase efficiency in their buildings. Large commercial buildings in the city use approximately 38 million gallons of water per day, which is approximately 35 percent of all non-residential water consumption. Thus, commercial buildings present a significant opportunity for water savings that can result in financial benefits to property owners.

To target non-residential water consumption, DEP conducted several "Water Challenges," inviting participants from a variety of commercial industries including hotels, restaurants, and hospitals to participate in sector-specific challenges to reduce their water consumption by 5 percent from baseline conditions through voluntary water efficiency measures. There are four key components of these Water Challenges: workshops, creation of monthly water data reports for benchmarking data, development of water conservation plans, and recognition of achievements with a press release and award for winners.

Through these Challenges, DEP learned what water conservation opportunities exist across these sectors. For example, all participants can benefit from upgrading water use fixtures, identifying heating and cooling upgrades, and increasing behavioral awareness among staff. To promote these lessons learned and the results and best practices identified from the Challenges, DEP created a Manager's Guide to Water Efficiency for each sector. These booklets are available on DEP's website, and are distributed at conferences and meetings to support green building practices.

Completed Initiatives

Water Challenge to Hotels

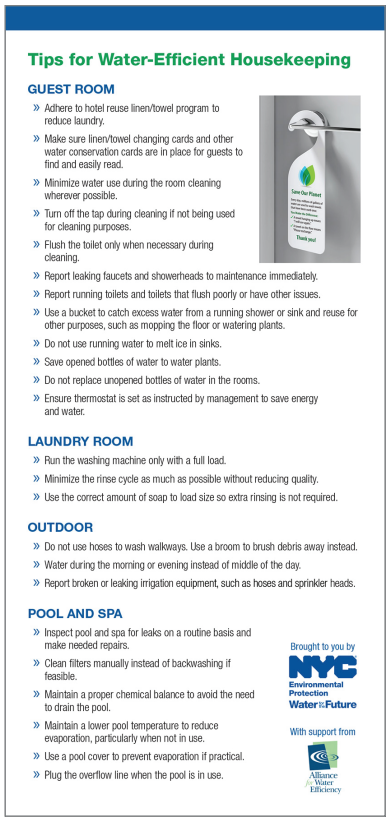
Savings Achieved (May 2018): 0.031 MGD

DEP partnered with the Hotel Association of New York City (HANYC) and the Mayor's Office in April 2013 to launch the Mayor's Water Challenge to Hotels. For this Challenge, DEP led a series of educational workshops featuring guest speakers from public and private groups that presented water conservation strategies available to the hotel industry. In addition to coordinating workshops, DEP assisted participating hotels in conducting audits and creating water demand management plans.

Working closely with hotel partners to co-create effective conservation strategies and measure the associated water savings, DEP learned that strategies can vary greatly between hotels. Some hotels had the ability to achieve savings by upgrading showerheads, faucets, and bathrooms in guest rooms, and upgrading cooling systems or repairing ice machines. Newer hotels that already had efficient fixtures found they were able to achieve savings through customer outreach programs, such as providing guests the option to decline laundry services to save water. Many of these strategies were discussed during the four workshops that DEP hosted with participants.

At the conclusion of the Challenge in May 2014, four of the 12 participating hotels had achieved or surpassed the 5 percent demand reduction goal. Collectively, winning participants had conserved nearly 11.3 million gallons of water over the course of the one-year challenge, or an average of 31,000 gallons per day. Each

Figure 8. Water Challenge Participants



Tips for Water-Efficient Housekeeping

GUEST ROOM

- Adhere to hotel reuse linen/towel program to reduce laundry.
- Make sure linen/towel changing cards and other water conservation cards are in place for guests to find and easily read.
- Minimize water use during the room cleaning wherever possible.
- Turn off the tap during cleaning if not being used for cleaning purposes.
- Flush the toilet only when necessary during cleaning.
- Report leaking faucets and showerheads to maintenance immediately.
- Report running toilets and toilets that flush poorly or have other issues.
- Use a bucket to catch excess water from a running shower or sink and reuse for other purposes, such as mopping the floor or watering plants.
- Do not use running water to melt ice in sinks.
- Save opened bottles of water to water plants.
- Do not replace unopened bottles of water in the rooms.
- Ensure thermostat is set as instructed by management to save energy and water.

LAUNDRY ROOM

- Run the washing machine only with a full load.
- Minimize the rinse cycle as much as possible without reducing quality.
- Use the correct amount of soap to load size so extra rinsing is not required.

OUTDOOR

- Do not use hoses to wash walkways. Use a broom to brush debris away instead.
- Water during the morning or evening instead of middle of the day.
- Report broken or leaking irrigation equipment, such as hoses and sprinkler heads.

POOL AND SPA

- Inspect pool and spa for leaks on a routine basis and make needed repairs.
- Clean filters manually instead of backwashing if feasible.
- Maintain a proper chemical balance to avoid the need to drain the pool.
- Maintain a lower pool temperature to reduce evaporation, particularly when not in use.
- Use a pool cover to prevent evaporation if practical.
- Plug the overflow line when the pool is in use.

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With support from Alliance for Water Efficiency

of the winners utilized a variety of strategies to reduce water use in their facility. The Sheraton Tribeca led the winners by reducing their annual consumption by more than 20 percent. Three other hotels, the InterContinental New York Barclay, The Ritz-Carlton, and the Carlton Hotel all surpassed the goal, with each reducing their consumption by more than 10 percent. The hotels were honored at an awards ceremony where DEP also released a Hotel Manager's Guide to Water Efficiency. The guide provides conservation tips for guest rooms, common areas, food service, laundry, and pool operations, as well as leak detection strategies.

Water Challenge to Restaurants

Savings Achieved (May 2018): 0.026 MGD

For the next Challenge, DEP collaborated with the United States Environmental Protection Agency (USEPA), Con Edison, the New York City Chapter of the New York State Restaurant Association (NYSRA), and the Alliance for Water Efficiency to develop the Water Challenge to Restaurants. This partnership challenged 30 New York City restaurants to reduce their annual water consumption by 5 percent. Restaurants offer a significant opportunity for water conservation, as there are many end water uses in food preparation and overall operation of a restaurant.

Similar to the Water Challenge to Hotels, DEP held workshops with industry experts to highlight several partner programs available to restaurants, including capital assistance and rebates through Con Edison and NYSRA. Other workshops focused on staff behavior and operating procedures, and how conservation education can lead to both water and economic savings. Simple behavior changes, like turning off running water while staff mop floors, for example, could significantly reduce total water consumption and waste. Most participating restaurants conducted audits of their kitchen spaces to identify low-cost kitchen upgrades that would reduce water.

The Water Challenge to Restaurants concluded in September 2015, with 10 of the 30 participating restaurants reducing consumption by at least 5 percent. Together, all of the winning restaurants saved 2.6 million gallons of water over the course of the Challenge, and individual restaurants saw measurable results and savings in their water bills. Strategies that were particularly effective included: eliminating the use of water to defrost food, running dishwashers only when full, and creating a communication plan when leaks are detected. DEP compiled these and other strategies and operational changes into a checklist and guide to help restaurant managers continue to build a water conservation ethic.

Havana Central in Times Square, a Water Challenge participant

Water Challenge to Hospitals

Savings Achieved (May 2018): 0.035 MGD

DEP launched the Water Challenge to Hospitals in January 2016. Participating hospitals included: New York-Presbyterian Queens, Memorial Sloan Kettering Cancer Center, and NYC Health + Hospitals/Harlem. The participants represented a mix of public and private hospitals providing inpatient care, teaching, and research services, including publicly-funded Harlem Hospital which focuses on patient care, and privately-run Memorial Sloan Kettering, which is globally recognized for its research centers. Like the previous Water Challenges, participants were asked to reduce their water consumption by 5 percent from an established average baseline.

Due to the large size and complexity of hospital campuses, the Water Challenge to Hospitals continued for two years. With this extended timeline, facility managers had additional time to work on facility audits and incorporate findings and upgrades into the hospitals' capital budgets. Workshops were held with industry experts, including the Alliance for Water Efficiency and the USEPA, to help identify strategies for the hospitals' water demand management plans. Two of the three hospitals conducted water audits with third-party professionals and shared their results in participant workshops.

Mirroring the other Challenges, DEP worked with the participants to solicit feedback on lessons learned. Feedback included: using the appropriate amount of water based on specifications for lab equipment; upgrading heat exchangers on boilers; and installing sub-meters in kitchens and restaurant spaces so that water use can be more accurately tracked. Challenge participants also considered how to brand sustainability, including creating "Green Teams" that could help incorporate efficiency practices at the staff level. The Challenge concluded in January 2018, with Harlem Hospital successfully achieving the Challenge goal and reducing their baseline water consumption by over 7 percent, saving approximately 35,000 gallons per day in the final Challenge year.

Water-cooled ice machines at NYC Health + Hospitals/Harlem will be replaced with more efficient models

NYC Health + Hospitals/Harlem in Manhattan

Ongoing Initiatives

On-site Water Reuse Grant Pilot Program

Potential Savings by 2022: 1.0 MGD

On-site water reuse is a process in which water used in a building or a group of buildings is treated and recycled. Today, New York City's installed on-site water reuse systems are estimated to save up to 100 million gallons of potable water per year for non-potable uses, such as toilet flushing, laundry, or cooling. To further promote on-site water reuse throughout the city, DEP launched the On-site Water Reuse Grant Pilot Program in 2016 to provide commercial, mixed-use, and multi-family residential property owners with incentives to install water reuse systems. This grant program builds upon the 2010 Comprehensive Water Reuse Program, which provides building owners with a 25 percent water bill discount for reducing their water consumption 25 percent or more through on-site reuse.

New York City is one of only a few cities in the country to support up-front capital costs and longer term operational costs of on-site reuse systems. On-site water reuse is ideal for district-scale residential or mixed-use developments, which provide economy of scale for energy and cost savings. However, reuse systems can still be cost-effective for single buildings, typically 100,000 square feet or greater. Since the launch of the grant, DEP continues to promote this cost-sharing opportunity by engaging the development and green building communities. To further incentivize water savings on private property, DEP is also considering expanding the grant program to additional water efficiency technologies.

Case Study: The New School

Completed in 2015, the New School's University Center exemplifies the on-site water reuse systems DEP is incentivizing through its On-site Water Reuse Grant Pilot Program. Designed using a "water fit for purpose" strategy, the University Center's reuse system conserves 74 percent of potable water use and reduces discharge into the combined sewer by 89 percent. The water reuse system aided the New School in achieving LEED® certification for the University Center. Highlights of the University Center include:

- All wastewater is collected and treated on-site. This includes water from toilets, sinks, showers, and laundry. Rainwater is also a source of reclaimed water after being detained by the vegetated green roofs.
- The University Center has one of the largest on-site water reuse systems in New York City at 40,000 gallons per day (GPD).
- The University Center is one of the first buildings approved to reuse treated water for laundry. Other uses for the treated water include toilet flushing, irrigation of the green roof, cooling tower make-up, and sidewalk maintenance.

The New School's University Center in Manhattan

40,000 GPD savings
from on-site reuse means:

74% Water Use Reduction

89% Combined Sewer Discharge Reduction

Information Source: Natural Systems Utilities

New Initiatives

Water Challenge to Universities

Following the success of previous Challenges, DEP will be launching a Water Challenge to Universities in 2018. New York City is home to more university students than any other city in the country. In line with national trends of enhancing university campus sustainability, some of New York City's largest universities have already identified a range of actions to conserve water. For example, Columbia University has invested in high efficiency washing machines, and both Columbia and New York University have invested in low flow bathroom fixtures. Similarly, in addition to replacing water fixtures, meters, and controls, The New School constructed an on-site water reuse system for greywater end uses in the school's University Center. Examples of additional water conservation measures that are unique to universities and could be implemented in New York City include dining hall kitchen efficiency improvements, and fixture and infrastructure upgrades in residence halls and dorm rooms.

The Water Challenge to Universities will build upon these past successes and promote further savings at universities across the city. This Challenge will be unique because it will engage university staff in implementing permanent water conservation measures, and will also be an opportunity to foster a water conservation ethic among university students and administrators alike. Additionally, many of the city's large universities have full-time staff dedicated to sustainability, who could help sustain and coordinate these efforts.

Like previous Water Challenges, the goal of this Challenge will be for participants to achieve a 5 percent reduction in water consumption. Through both voluntary reductions and permanent upgrades, New York City universities can realize significant water savings. For example, the 14 highest consuming universities citywide use an estimated total of 2.2 MGD. If these schools participate and each achieves a 5 percent reduction in water consumption by the end of the Challenge, the total water savings would be 100,000 gallons per day. DEP will estimate the potential savings goal from this Challenge upon kickoff in Fall 2018.

New York City is home to approximately 600,000 college students

Water Distribution System Optimization

Delivering a billion gallons of water to over 8.6 million people per day requires a complex system of pipes, pressure regulating valves, and pumping stations to make sure that water flows when any tap is turned on. Every day, DEP's distribution system receives nearly a billion gallons of water from reservoirs, distributes it to the five boroughs through thousands of miles of pipes, and then connects to customers through 830,000 service connections. Progressive maintenance, monitoring, upgrading, and replacement of this infrastructure is necessary for DEP to adequately serve customer demand. DEP strives to employ the best technology for both maintaining and replacing its distribution system, and a considerable amount of specialized equipment is employed to repair this hard-to-reach infrastructure. Additionally, DEP's Universal Metering Program allows both DEP and its customers to monitor water usage, detect leaks through Automated Meter Reading (AMR), and track water demand citywide. A well-run system helps ensure New Yorkers will continue to receive excellent water as sustainably as possible.

Ongoing Initiatives

Leak Detection Program

Savings Achieved (May 2018): 1.89 MGD

For nearly 40 years, DEP has actively pursued leaks in New York City's system. Leak detection employs acoustic technology to identify leaks without having to excavate roads. This monitoring helps prevent water loss, property damage, and further degradation of infrastructure. DEP's Field Operations personnel are equipped with Digital Correlators--sounding devices that are placed on either side of a suspected leak--to check water mains for leaks by listening to the flow of water through pipes.

Year	Miles Surveyed	Average Estimated 5-Year Savings (MGD)
2013	3,866	1.89
2014	3,416	
2015	3,567	
2016	3,182	
2017	4,720	

Table 5. Leak Detection Statistics, 2013-2017
Since the 2013 Water Demand Management Plan was released, each year, DEP has surveyed an average of 3,750 miles of distribution pipes, leading to an average estimated savings of 1.89 MGD.

DEP's Field Operations personnel perform two important functions regarding leak detection: responding to complaints, and implementing preventative programmatic work. When a suspected leak is called into the City's complaint line (311), DEP deploys crews to investigate the source of the leak. Crews may also perform programmatic leak surveys, in a proactive approach to discover unreported water leaks. Since the release of the 2013 Water Demand Management Plan, DEP has tracked the statistics shown in the above table. By proactively seeking out unreported leakage, crews are able to locate and repair leaks while they are small, before major repairs are necessary, pavements collapse, or basements and subways are flooded.

Hydrant Maintenance and Controlling Illegal Use

DEP's HEAT Program in action

DEP also maintains a system of 109,500 hydrants located throughout the five boroughs, used primarily for fire suppression by the New York City Fire Department (FDNY) and operational needs. DEP ensures that the hydrants operate properly and that appropriate pressure is maintained. An undetected leaking hydrant can cause significant water loss. For example, when hydrants are opened illegally during the summer months, up to 1,000 gallons of water are pumped out per minute. DEP began sponsoring the Hydrant Education Action Team (HEAT) Program in 2007 to educate communities about the dangers of opening fire hydrants illegally during the summer months. In addition, for the last 25 years, DEP employs locks (Custodian Locks) on hydrants in neighborhoods that are prone to having hydrants illegally opened.

Year	Number of Hydrants Repaired	Number of Hydrants Replaced	Other Hydrant Maintenance
2013	10,764	1,549	5,267
2014	11,075	1,588	9,072
2015	9,374	1,588	8,725
2016	11,690	1,595	11,429
2017	7,377	1,452	8,886
Total		**7,772**	**43,379**

Table 6. Hydrant Repair and Maintenance Statistics, 2013-2017
Since the 2013 Water Demand Management Plan was released, DEP has replaced over 7,700 hydrants and performed over 43,000 hydrant maintenance activities, to ensure optimal operation of New York City's hydrants.

Optimize Pressure Management

DEP crews working on a water distribution line

New York City's water is distributed from Hillview Reservoir, approximately 300 feet above sea level, which relies on gravity to provide pressure to push water throughout the distribution system. A system of pressure regulating valves (PRVs) control that pressure as the water travels throughout the distribution system. Optimizing the pressure of this system is imperative, and can further reduce water loss that occurs if there is high pressure, which could result in water main breaks.

Year	Preventative Maintenance Inspections	Pressure Regulators Overhauled
2013	6,386	88
2014	6,303	82
2015	5,822	74
2016	5,399	49
2017	5,385	48

Table 7. Pressure Management Statistics, 2013-2017
Since the 2013 Water Demand Management Plan was released, DEP has performed thousands of preventative maintenance inspections, and overhauled numerous pressure regulators, in an effort to optimize pressure management.

Sensors at key nodes within the distribution system send signals to DEP headquarters, which allows engineers to identify potential problems and take steps before damage is caused within the water distribution system. In 2011, DEP expanded the network of remote sensors to monitor every pressure zone in the city.

DEP's Trunk Main Maintenance Unit proactively inspects equipment and performs necessary maintenance, which has helped minimize unintended spikes in water pressure and has factored into reduced water main breaks. In 2017, DEP performed 5,385 preventative maintenance inspections on the City's 514 water PRVs, and overhauled 48 of them. The above table presents a breakdown of pressure management statistics for the past five years.

Automatic Meter Reading Infrastructure

Twenty years ago, the only time that customers would see their water meter data was every three months, when they would pay their water bills. With Automatic Reading (AMR) infrastructure, data are registered constantly and stored in a database, allowing both the utility and customers to access and view metered usage. In 2009, DEP launched its AMR program and largely completed that effort in 2012. To date, over 97 percent of DEP's customers have AMR connectivity. DEP is working to further optimize metering and AMR by installing this technology for DEP's few remaining unmetered accounts.

The majority of New York City Housing Authority (NYCHA) multi-family buildings were metered by 2005. In 2015, DEP initiated a multi-million dollar effort to install water meters in remaining unmetered NYCHA buildings to gain a more accurate representation of water consumption trends in NYCHA properties. This project also involves removing asbestos on water service lines and other basement utility areas, assessing the quality of those service lines, and installing AMR. These buildings are located in Brooklyn, Queens and the Bronx, and contain approximately 50,000 housing units. As of May 2018, 394 meters have been installed out of a planned 526. This project is expected to be completed in Fall 2018.

Another effort by DEP to expand AMR throughout the city is targeted at Multi-family Conservation Program (MCP) customers whom did not previously have AMR. Under MCP, owners of metered multiple family housing of four or more dwelling units that were previously billed on the older "frontage" fixed charge have the opportunity to be billed on a fixed charge per dwelling unit, in lieu of being converted to metered billing. This is possible only if the owner agrees to implement meters with AMR and achieve conservation requirements. The automatic conversion from the previous "frontage" fixed charge to MCP occurred on July 1, 2012, and now any qualifying property owner may apply at any time to take advantage of the benefits of the program. To ensure that these property owners are meeting MCP requirements, DEP inspects a sample of properties to ensure they meet the fixture, showerhead, and faucet requirements. During this inspection, DEP also performs leak detection in toilets and other domestic fixtures.

Through the Municipal Water Efficiency Program (MWEP), outlined in Strategy 1, many municipal buildings which are billed on an estimated charge have been identified as not having AMR or working meters. Through MWEP, over 250 schools, 100 parks, the FDNY training facility on Randall's Island, and 8 HHC hospitals have had their meters upgraded and AMR installed.

Optimize Metering and Replace Large Water Meters

Maintaining accurate water meters is important to both account for consumption and to bill customers fairly and appropriately. Water meter parts can wear down over time and, as a result, may under register the amount of water use. To accurately track consumption citywide, DEP has been replacing older water meters since the 1990s, and DEP also allows property owners to replace their meters using their own Licensed Master Plumbing Company under the Reimbursable Metering Program.

Investing in the modernization of metering infrastructure and replacing older meters with newer meters, which utilize more efficient and durable technology, helps maximize meter accuracy. For example, single-jet, electronic and advanced vertical turbine meters are replacing compound meters and two-inch positive displacement meters. Single-jet and electronic meters have fewer moving parts and require less maintenance. Some specific meter models can feed meter data directly into building energy management systems for monitoring, benchmarking, and leak detection.

Year	Number of Meters Replaced
2013	9,063
2014	11,824
2015	9,906
2016	804
2017	2,832
Total	**31,597**

Table 8. Large Meter Replacement Statistics, 2013-2017
Since the 2013 Water Demand Management Plan was released, DEP has replaced over 31,000 large meters citywide, in an effort to optimize metering and accurately account for consumption.

This initiative began before the 2013 Water Demand Management Plan and is considered an ongoing project, as DEP continues to work with property owners to upgrade remaining meters.

Approximately 70,000 of DEP's largest customers, including high-rise commercial and multi-family buildings, have meters that are 1.5 inches or more. This population represents a large proportion of the overall volume of water that DEP delivers, and as such, DEP has focused on replacing these meters to ensure accurate billing. In 2017, 2,832 large meters were replaced. The preceding table presents the number of large meter replacements made by DEP in the last five years. Through this program, which began in 2004, approximately 52,000 large meters have been replaced. This metering effort is mostly completed, but will remain an ongoing effort due to the importance of replacing the remaining meters.

Provide Customers with Easy and Timely Access to Water Usage Data

Providing customers with information related to their water consumption is an important, agency-wide goal, because it enables customers to identify leaks and other inefficiencies. Identifying these inefficiencies is significant for customers because it can prompt them to fix leaks to save water and money. For DEP, leak detection and repair is an important conservation strategy. As of May 2018, 399,000 customers have signed up for My DEP Account to view their bills, water usage, and payment history online. A My DEP Account also allows customers to view their water use, and provides a leak alert option. For those customers who enroll in leak alerts, those alerts are sent if consumption triples for five consecutive days. To date, over 290,000 customers have signed up for leak alerts. DEP will continue to promote My DEP Account enrollment and leak detection alert sign-up as an ongoing initiative.

Case Study: Advancing Meter Resolution and the Display of Customer Consumption Data

As DEP moved to AMR, meter readings changed from four times a year to at least four times a day and often, hourly. The water utility industry has long operated based on quarterly or bi-monthly meter reading and water meters did not need to produce granular data for that read frequency. The ¾-inch and 1-inch meters used for most one- to- three-family homes and small commercial properties generated data in 1 cubic foot (CF) or 5 CF increments, where 1 CF = 7.48 gallons. Larger meters usually produced reads in 10, 50, or even 100 CF increments for the largest meters. As part of a gradual turnover of water meters, DEP has been replacing most 5 CF and 10 CF meters with newer meters providing 1 CF resolution. One type of meter in use in some buildings incorporates data logging, allowing the download of the last 30 days consumption data based on five-minute increments. In the next few years, DEP will be testing electronic meters that register in increments under 1 CF. Data that is more granular means potentially better leak detection and better consumption comparisons, particularly in buildings and homes that do not use large volumes of water. DEP has already replaced tens of thousands of the older meters with higher resolution meters and will continue to do so over the next several years.

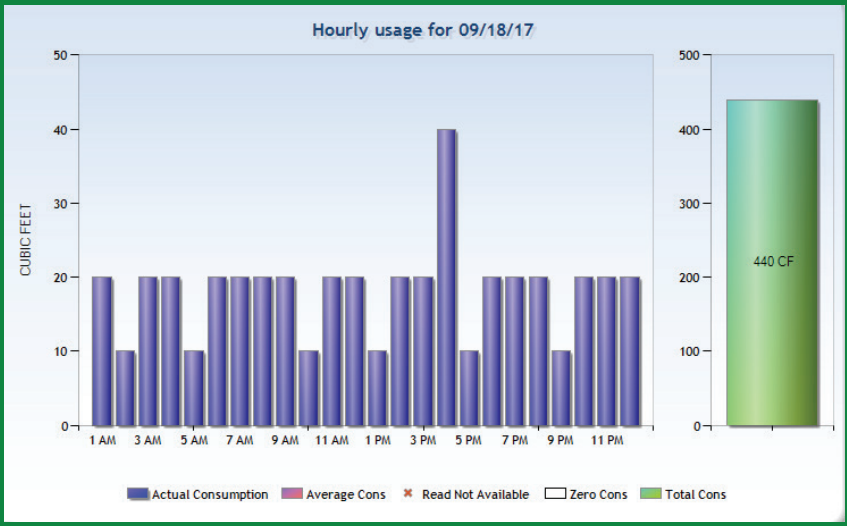

Figure 9. My DEP Meter Consumption with Old Meter
A display on My DEP showing hourly consumption in a 12-unit multiple dwelling with an older meter delivering in 50 CF units.

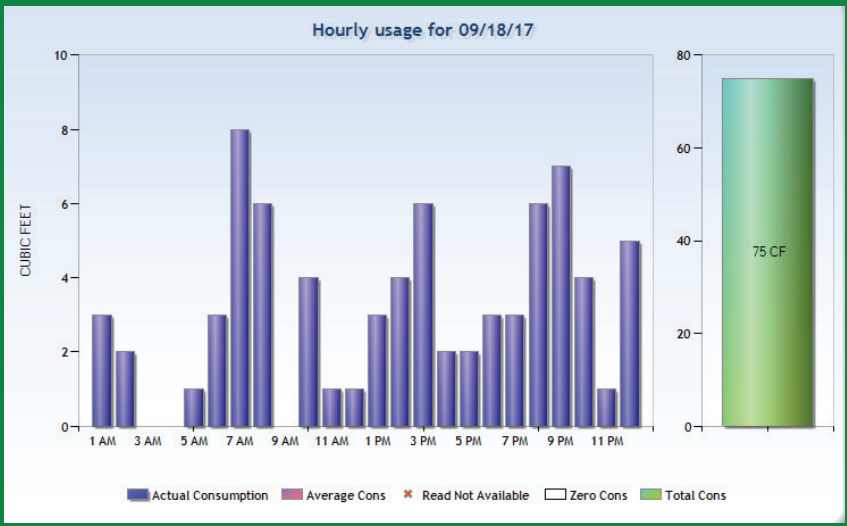

Figure 10. My DEP Meter Consumption with New Meter
Hourly consumption in a three-family dwelling with the same size meter providing 1 CF reads from an upgraded and more advanced meter.

Water Supply Shortage Management

DEP has been re-evaluating existing water use restriction mechanisms to adapt to future conditions including the planned Delaware Aqueduct shutdown, changing hydrologic conditions, and aging infrastructure. As part of this strategy, DEP is proposing to amend Chapter 21 of Title 15 of the Rules of the City of New York, titled "Drought Emergency Rules." Under the proposed rule amendments, "Drought Emergency Rules" would be renamed as "Water Shortage Emergency Rules." The proposed rule amendments would allow DEP to impose water use restrictions during a water shortage emergency, whether the shortage is caused by hydrological conditions or other circumstances, such as planned or unplanned infrastructure outages and repairs.

DEP's core Water Demand Management Plan strategies promote voluntary water conservation and demand management programming to generate near-term water savings without invoking rules and regulations. While these strategies are crucial to the demand reduction goals of the Water for the Future Program and for enhancing future resiliency of the City's water system, the initiatives described in this strategy would provide additional contingency water savings, if necessary, during the planned shutdown or future unplanned water supply shortages.

Completed Initiatives

Establish City Agency Responsibilities

In 2014, DEP briefed several City agencies on upcoming changes to the "Drought Emergency Rules" and the outcomes of the studies that informed the Water Demand Management Plan. Through these briefings, DEP confirmed that standard operating procedures for demand management under water supply shortage conditions were reviewed, updated, and in place for each agency that would be responsible for demand reductions in the event of a water supply shortage emergency. Additionally, DEP coordinated with the NYC Emergency Management (NYCEM) in 2014 to develop content regarding water supply shortages in the Hazard Mitigation Plan. The plan includes a detailed water shortage risk profile and is available to the public on NYCEM's website.

Ongoing Initiatives

Develop a Communications Strategy

In the event a water supply shortage emergency is triggered during the planned shutdown of the Delaware Aqueduct, DEP will develop a three-step communication strategy as part of a public information and education campaign. The three steps are as follows:

Step 1: Determine who the audience is and which vehicle or combination of vehicles is most appropriate and likely to reach the intended audience.

Step 2: Deliver the message and coordinate with the other agencies and groups that can help amplify the message.

Step 3: Determine if the audience has been reached.

The public information and education campaign would utilize media announcements, social and digital media posts, direct mailing and distribution of hard copy materials, 311 services, phone calls, and other methods for communicating to customers during a water supply shortage emergency regarding the situation and their role in helping to conserve water and reduce overall demand.

Construction of Release Works at Schoharie Reservoir

Updated Rules and Plan to Allow for Planned Infrastructure Repairs

DEP is in the process of amending the "Drought Emergency Rules" (15 Rules of the City of New York [RCNY] Chapter 21). The rulemaking process in New York City, called City Administrative Procedure Act (CAPA), began in July 2013 for this effort and in December 2016, the Mayor's Office of Operations and the City Law Department certified DEP's revisions to the "Drought Emergency Rules." The proposed revised title is "Water Shortage Emergency Rules," replacing the narrower focus of the previous title. In summary, the proposed revisions address water shortage emergencies due to circumstances not limited to natural drought conditions, such as planned and unplanned infrastructure outages and repairs. The proposed revisions also add, remove, and change certain water use prohibitions during the different stages of a water shortage emergency, to better reflect DEP's current understanding of city water use.

More specifically, the proposed rule amendments would apply to the following water uses only:

- Lawn, turf, and non-turf plant watering, both residential and commercial;
- Plant watering at nurseries for the purpose of distribution or sale;
- Golf course, playground, and athletic field watering; and
- Bottling plants, paper recycling facilities, and hotels using at least 100,000 gallons per day of water on an annual basis.

In addition, the proposed action would clarify the intention of the existing rule, including the following:

- Amendments to Defined Terms. The proposed action would amend the term "drought emergencies" to "water shortage emergencies," to accurately capture water shortages caused by non-drought circumstances such as planned or unplanned infrastructure outages and repairs. The proposed action would also clarify existing terms and add terms related to golf courses.

Ashokan Reservoir

- Clarifications to Exemptions from Water Use Restrictions. The proposed action would clarify when an individual or entity can apply for an exemption from the rules restricting water use, in addition to the process for applying for the exemption.
- Amendments to Signage Requirements. The proposed action would clarify and broaden the categories of residential units that would be required to display signs during water shortage emergencies.

The proposed rule amendments would also restrict or prohibit non-essential water uses in order to protect the natural and built environment. Although the proposed action would not apply to routine residential water use such as drinking, bathing, or dishwashing, DEP expects that public awareness of the restrictions would lead to decreased residential water use during a water shortage. DEP expects to promulgate this rule before the Delaware Aqueduct shutdown.

Wholesale Customers Water Demand Management Program

New York City has reduced water demand over the past five years by implementing the variety of water saving strategies discussed in this report. In 2014, DEP realized an opportunity to extend demand reduction strategies by partnering with its wholesale customers (utility partners), with a goal to reduce demand in each of these utility partners' communities by 5 percent from their 2013 baseline demand. These utility partners account for about 10 percent of total water demand from the New York City system, but the population of these utility partners is equal to about 8 percent of New York City's population. This overall difference in per capita water demand was a major factor in DEP's decision to implement this program.

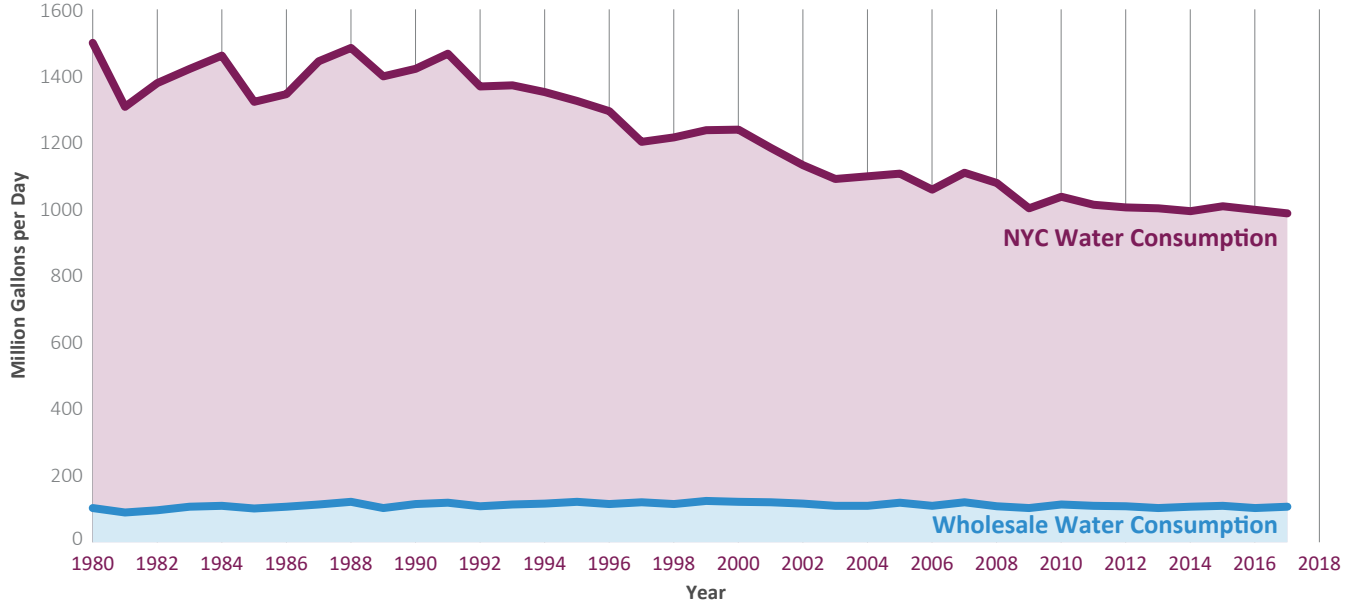

Figure 11. NYC and Wholesale Total Water Demand, 1980-2017

Utility Partner	2013 Demand (Million Gallons per Year)	Demand Reduction Goal (Million Gallons per Year)	Demand Reduction Goal (Million Gallons per Day)
The Town of Greenburgh	2,311*	115.4	0.32
The City of Mount Vernon	2,806	140	0.38
The Town of New Windsor	1,103	55	0.15
The Village of Ossining	1,013	46	0.13
The Village of Scarsdale	1,187	59.4	0.16
SUEZ	6,714	335.7	0.92
The Village of Tarrytown	628	31.4	0.09
Westchester Joint Water Works	4,672*	164	0.45
The City of White Plains	**	233.6**	0.64**
The City of Yonkers	9,534	476.7	1.31
Total			**4.6**

** Total demand, including exports to other utilities, which were excluded from their 5 percent goal calculation*
*** These values are the latest estimates, to be verified by the utility upon completion of a Demand Management Plan*

Table 9. Utility Partner 2013 Demand and Demand Reduction Goals
2013 water demand, and water demand savings goal for each Utility Partner

DEP partnered with 10 of its largest utility partners, based on 2013 demand levels. These utility partners include the Village of Ossining (Ossining), the Town of New Windsor (New Windsor), the City of Yonkers (Yonkers), the City of Mount Vernon (Mount Vernon), the Village of Scarsdale (Scarsdale), SUEZ, the Town of Greenburgh (Greenburgh), the Village of Tarrytown (Tarrytown), Westchester Joint Water Works (WJWW), and the City of White Plains (White Plains). The table above shows each utility partner's 2013 water demand and savings goals. This partnership between DEP and its utility partners has the potential to reduce demand by approximately 4.6 MGD by 2022.

After agreeing to collaborate with DEP, each utility partner provided extensive metering and water demand data dating back to 2011, which included information about their customer types (e.g., residential, commercial, and municipal) and billing structure. These data were analyzed by an expert consultant, who developed a non-revenue water profile for each utility partner. The expert consultant utilized American Water Works Association (AWWA) M36 water audit software, an industry standard for assessing and analyzing water losses, and concluded that every utility partner had extensive real water losses that could be improved through this program. Real water losses refers to water lost through leaks and system overflows, and is common in water systems with aging infrastructure. Additionally, proactive leak detection programs (an industry best practice) are often considered too costly to implement, but the results of the AWWA M36 audits performed for these utility partners revealed that the cost of their real water losses often exceeded the cost of a robust leak detection program. Thus, Water Loss Control was chosen as a strategy for each utility partner.

The additional analyses of customer types and billing structure for each utility partner revealed a variety of other potential strategies. For example, a utility partner with a large commercial industry may benefit from a water audit program to better understand commercial water demand practices. Likewise, a utility partner with a heavy concentration of multi-family residential buildings could benefit from an indoor fixture replacement voucher program. Finally, monthly billing is considered an industry best practice, so utility partners that do not currently bill their customers monthly are asked to consider this strategy. Many of these strategies were modeled after New York City's own demand management programming to reduce the city's demand, but are tailored to these utility partners' specific needs.

After the consultant and DEP proposed a variety of potential strategies for each utility partner, the utility partner chose which strategies they found most feasible to implement, given an agreed upon level of partnership funding from DEP. The utility partner and consultant discussed best practices for strategy implementation, giving extensive consideration to each utility partner's budget and resources. For each proposed implementation plan, DEP offered guidance and insight from its own experiences and lessons learned. Utility partners were encouraged to address concerns as they arose, and DEP and the expert consultant were made available to assist with and help guide every aspect of implementation planning. This multi-faceted collaboration and ongoing communication between DEP, an expert consultant, and each utility partner, lead to the creation of a tailored implementation plan for each strategy, with timelines, budget allocations, and project goals clearly delineated.

As each utility partner's implementation plan was developed, the key program elements were compiled into a corresponding list of related deliverables and milestones in an Intergovernmental Agreement (IGA). Each utility partner's IGA contains a schedule for funding, as well as reporting guidelines (e.g., annual reports) to document each partner's ongoing work. DEP plans to continue monitoring utility partner demand over the course of these four-year contracts to ensure efficacy of the implemented strategies.

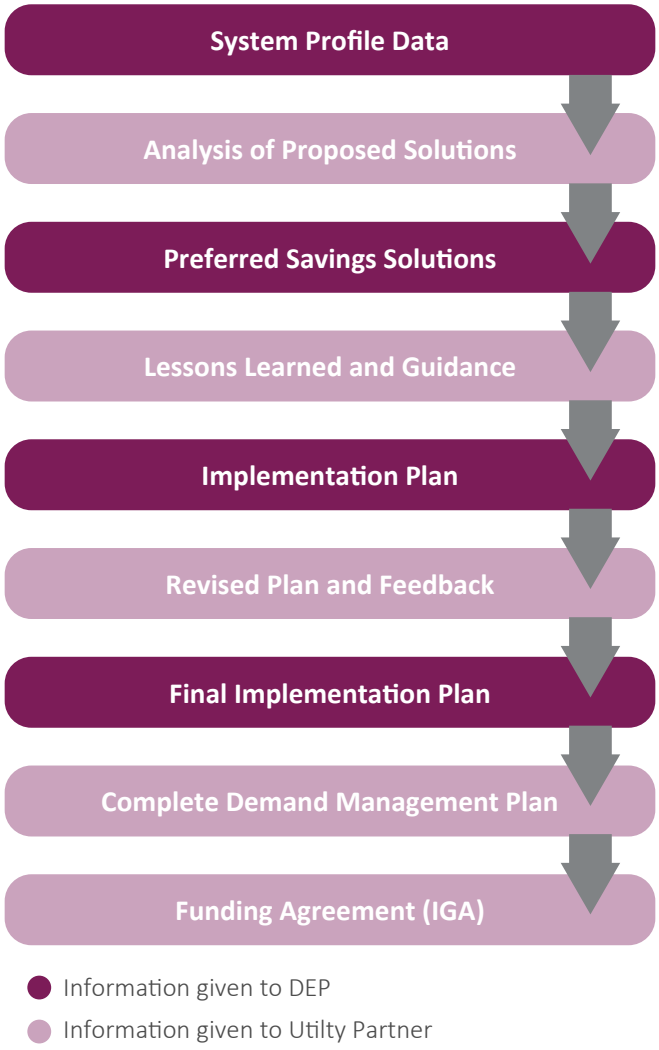

Figure 12. Processes of Utility Partnerships
Process of creating and adopting a water conservation plan

	Water Loss Control	Automated Metering Infrastructure + Monthly Billing	Municipal Upgrades	Residential Indoor Fixture Replacement Vouchers	Water Filtration Plant Upgrades
Greenburgh	✔	✔		✔	
Mount Vernon	✔		✔	✔	
New Windsor	✔				✔
Ossining	✔			✔	
Scarsdale	✔	✔			
SUEZ	✔				
Tarrytown	✔				
WJWW	✔	✔			
White Plains*	✔				
Yonkers	✔				

**Pending Demand Management Plan Development*

Table 10. Water Savings Strategies for Wholesale Customers
Water conservation strategies to be implemented by each utility partner

Ongoing Work

The Village of Ossining

Ossining successfully executed an IGA with DEP in Fall 2017, and began implementing a leak detection and line repair program, as well as a residential indoor upgrade voucher program.

When DEP first began working with Ossining and discussed a water loss control program, they immediately detected a major leak in a 12-inch section of water main. The leak was successfully repaired, saving an estimated 0.1 MGD. Ossining will utilize DEP funding to perform bi-annual, system-wide leak surveys to make subsequent, similar leak repairs. Ossining has its own in-house team for leak repairs, but is utilizing another portion of their DEP partnership funding to procure materials needed for these additional repairs. Ossining is also using DEP partnership funding to expand system pressure monitoring, which will allow them to make further adjustments to operating pressures and reduce the chance of leaks. This entire Water Loss Control Strategy is estimated to save Ossining 0.07 MGD, or 60 percent of their goal.

Additionally, Ossining will begin implementing an Indoor Upgrade Voucher Program, which calls for distributing $200 vouchers to 500 eligible residents. These vouchers will be used to replace old, low-efficiency toilets (6-gallon per flush) with high-efficiency (1.28-gallon per flush) toilets in residential homes. Using insight from DEP's own Toilet Replacement Program, Ossining developed eligibility criteria for voucher recipients and reporting requirements to verify fixture installation. Ossining also has a dedicated staff member who formulated a reimbursement structure for residents to redeem eligible vouchers. This Indoor Upgrade Voucher Program is estimated to save Ossining 0.04 MGD, or 40 percent of their goal.

Downtown Ossining

Upcoming Work

The other nine utility partners working with DEP are in various stages of developing their Water Demand Management Plans. Partners that are currently finalizing their Water Demand Management Plans include Greenburgh, Mount Vernon, New Windsor, Scarsdale, SUEZ, Westchester Joint Water Works and Yonkers. Tarrytown is midway through developing their Water Demand Management Plan, and White Plains began the process of providing DEP and an expert consultant with their system profile data for initial analysis.

Each utility partner has a unique system profile, and thus, a unique plan for water demand management. Based on efforts to date, DEP expects the remaining nine utility partners to implement the following strategies, summarized below.

Greenburgh is pursuing a strong water loss control program to address their 14 percent non-revenue water loss, along with a residential toilet replacement program for apartment buildings in their community, and a system-wide transition to monthly billing. These efforts will result in an estimated 0.32 MGD of water savings.

Mount Vernon plans to replace the fixtures in their schools and municipal buildings with high efficiency models. By publicizing their commitment to increased water efficiency in municipal buildings, Mount Vernon hopes to inspire 1,500 residents to replace their fixtures through a residential toilet replacement voucher program. Additionally, Mount Vernon is planning a robust leak detection and line repair program. In all, Mount Vernon expects to save an estimated 0.38 MGD.

New Windsor identified a way to increase the efficiency of a water treatment plant, by reducing backwash losses via an expanded lagoon, saving up to 0.05 MGD. Furthermore, by installing pressure reduction valves in eight key locations within their water system, New Windsor can save an additional estimated 0.05 MGD. These measures, in conjunction with a water loss control strategy, will lead to an estimated demand reduction of 0.15 MGD.

Scarsdale began installing Automated Meter Reading (AMR) technology in 2015, and will use DEP partnership funding to outfit their entire system with devices for remote meter reading. Eventually, this will allow Scarsdale to transition to monthly billing. Billing their customers monthly, alongside a water loss control program, is projected to save an estimated 0.16 MGD.

SUEZ ramped up their water loss control program and switched to monthly billing after partnering with DEP. Utilizing DEP partnership funding, SUEZ plans to supplement and expand their already robust leak detection and line repair program, saving an estimated 0.92 MGD.

Tarrytown currently employs some industry best practices for water savings, but stands to benefit from a robust water loss program. Their longstanding water system and challenging topography have made leak detection and repairs difficult. However, with partnership funding from DEP, Tarrytown will be able to implement a strong leak repair program, which will save an estimated 0.09 MGD.

Westchester Joint Water Works began billing their largest customers monthly, but plans to expand monthly billing to their entire system by using DEP partnership funding to install system-wide Advanced Metering Infrastructure (AMI). Additionally, they are considering a water loss control program. Both efforts have an estimated savings goal of 0.45 MGD.

White Plains approved their Customer Agreement in March 2018, and began providing DEP with water system profile data to subsequently develop a Water Demand Management Plan. This plan will have recommended strategies with a savings total of 0.64 MGD.

After working with two expert consultants in collaboration with DEP, **Yonkers** received a detailed water loss analysis report from DEP that revealed extensive real water losses. As a result, Yonkers is working to develop a robust leak detection and line repair program to implement with DEP partnership funding. Additionally, Yonkers may move forward with replacing inefficient fixtures in their municipal buildings and enhancing their AMI customer alerts. These strategies are expected to save an estimated 1.31 MGD.

This collaborative program provides partnership funding to initiate these strategies and the foundation for these utility partners to sustain demand management measures on their own. Although this program is focused on achieving savings ahead of the 2022 Delaware Aqueduct shutdown and repair, DEP also views this program as a way to encourage and provide utility partners with tools to continue implementing effective demand management strategies beyond 2022. This program's success may pave the way for smaller utility partners to follow suit, and adopt similar demand management measures.

Lessons Learned

As with any successful collaboration, clear communication of expectations and goals is required. Since the program was new, there were initial hurdles in helping utility partners understand DEP's requirements for funding. To alleviate this challenge, summary tables were developed to simplify the requirements outlined in the IGA, and requirements were streamlined whenever possible. Additionally, DEP conducted extensive internal coordination to ensure all proper legal and procurement practices were communicated properly to the utility partners. Utility partners found it challenging to take on a new program, and had to overcome staffing and resource issues, which were resolved by each utility with guidance from DEP. DEP highly commends the efforts of every utility partner; acknowledges the challenges that come with undertaking a large commitment; and is grateful to have partnered with utilities dedicated to water demand management. Overall, this program is a model of true collaboration, and relied on a genuine desire by all parties to reduce demand on the New York City water supply.

Boniface Water Tower in Scarsdale

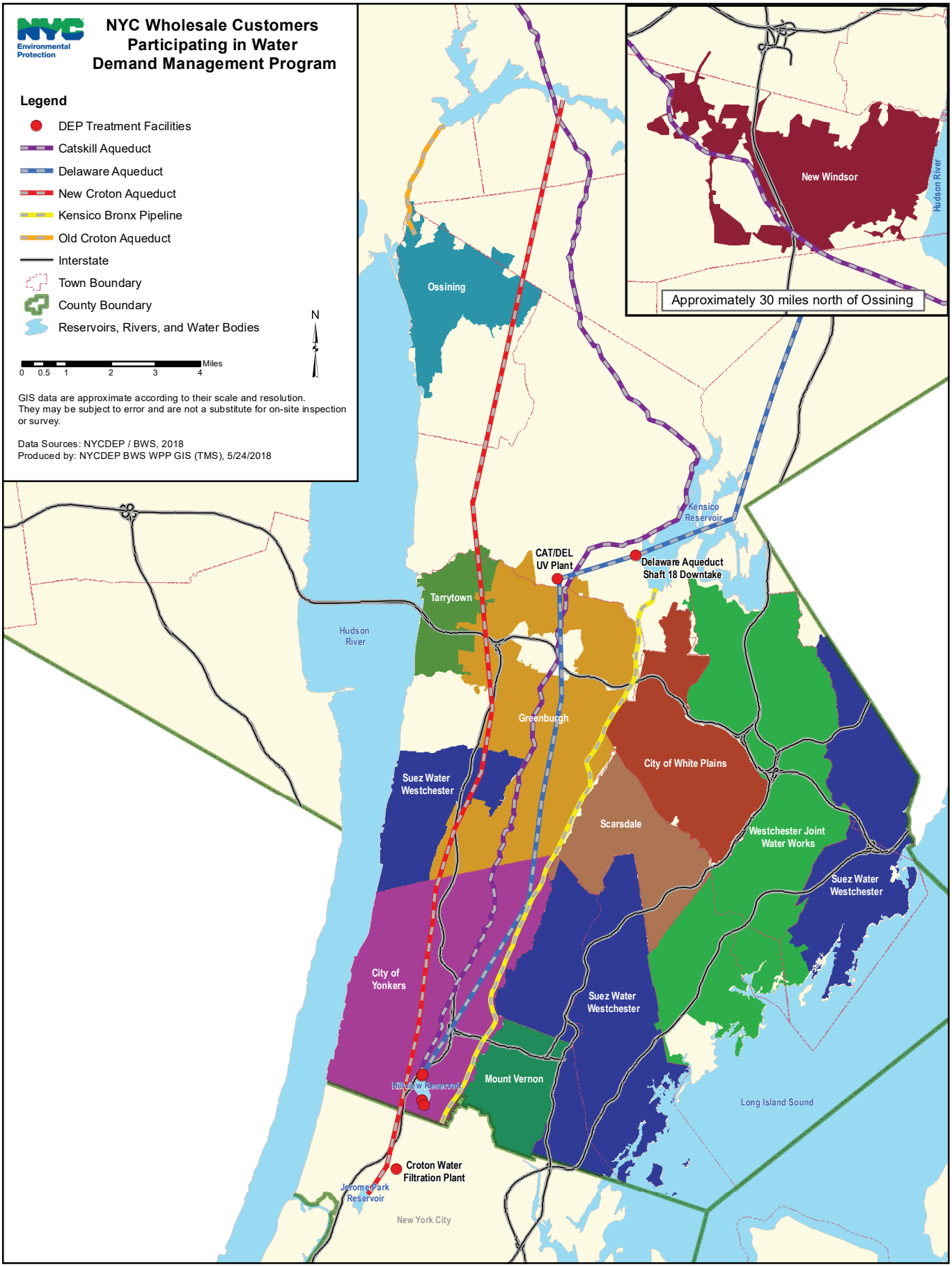

Figure 13. NYC Wholesale Customers Participating in Water Demand Management Program

Next Steps

Demand management has been a critical component of New York City's preparation for the repair of the Delaware Aqueduct. By the time the next Water Demand Management Plan is issued, those repairs may already have been completed, but the need for demand management will continue. Over the next few years, DEP will continue to assess the One Water benefits of demand management, seeking opportunities to expand upon the successes of the Water Demand Management Program to further enhance New York City's resiliency, equity, and sustainability.

Optimization of the city's water supply, including demand management, can be a first line of defense for population growth and climate change. As the City continues to assess climate projections, DEP will analyze strategies for enhancing its resiliency. DEP also remains committed to reducing its impact on the environment, and demand management has been demonstrated to reduce energy and greenhouse gas emissions from water treatment. Reducing drinking water demand also results in less water sent to wastewater treatment plants, which reduces pumping and treatment, and can reduce sewage contributing to combined sewer overflows. DEP will also continue to identify leaks in water supply infrastructure, and will explore opportunities to use recycled water for non-potable uses.

Integrated and sustainable water management seeks to advance the most cost-effective strategies, aiming to maximize benefits to people and the environment. DEP has demonstrated its commitment to this approach over the last five years of the Water Demand Management Program, and remains committed through the next five years of implementation. Measured savings, new partnerships, and environmental co-benefits advanced by this program will enhance the agency's commitment to these goals.

Tugboat hauling steel liners for the Delaware Aqueduct Bypass Tunnel

Appendix

New York City water consumption continues to decline despite increases in population. This is partially attributable to cooler and wetter summers in recent years, as well as increased operational efficiencies and initiatives from the 2013 Demand Management Plan. Due to expanded AMR and volumetric meter-based billing, DEP expects overall New York City and wholesale customer water demand to remain stable or decrease further. This trend could be affected in the future by factors including, but not limited to, annual temperature fluctuations and potential drought.

DEP conducts water demand analyses and projections for many purposes, including: water supply and wastewater infrastructure planning; revenue analysis; affordability studies; new growth and rezoning assessments; and analyzing and understanding the effects of water demand on agency operations. In 2013, DEP began using AWWA water audit software to assess system water balance. The table below includes the results of the audit for Fiscal Year 2017. Since using the AWWA audit software, DEP has seen a decrease in non-revenue water from 17 percent in 2013 to 14 percent in 2017.

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

WAS v5.0

Water Audit Report for:	NYC Department of Environmental Protection
Reporting Year:	2017 — 7/2016 - 6/2017

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 78 out of 100 ***

System Attributes:

	Apparent Losses:	14,123.412	MG/Yr
+	Real Losses:	30,148.975	MG/Yr
=	**Water Losses:**	**44,272.387**	MG/Yr
?	Unavoidable Annual Real Losses (UARL):	4,088.56	MG/Yr
	Annual cost of Apparent Losses:	$180,872,844	
	Annual cost of Real Losses:	$15,978,957	Valued at **Variable Production Cost**

Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	14.4%	
	Non-revenue water as percent by cost of operating system:	13.9%	Real Losses valued at Variable Production Cost
Operational Efficiency:	Apparent Losses per service connection per day:	46.39	gallons/connection/day
	Real Losses per service connection per day:	99.02	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	1.65	gallons/connection/day/psi
	From Above, Real Losses = Current Annual Real Losses (CARL):	30,148.98	million gallons/year
?	Infrastructure Leakage Index (ILI) [CARL/UARL]:	7.37	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

Table 11. AWWA Water Audit Results for Fiscal Year 2017

Acronyms

AMI advanced metering infrastructure

AMR automated meter reading

AWWA American Water Works Association

BWSO Bureau of Water and Sewer Operations

CAPA City Administrative Procedure Act

CF cubic foot

CUNY City University of New York

DCAS Department of Citywide Administrative Services

DEC New York State Department of Environmental Conservation

DEP New York City Department of Environmental Protection

DOE New York City Department of Education

DPR New York City Department of Parks and Recreation

DSNY New York City Department of Sanitation

FDNY New York City Fire Department

GPD gallons per day

GPF gallons per flush

HPD New York City Housing Preservation and Development

HANYC Hotel Association of New York City

HEAT Hydrant Education Action Team

HHC Health + Hospitals Corporation of New York

IGA Intergovernmental Agreement

LEED® Leadership in Energy and Environmental Design

MCP Multi-family Conservation Program

MGD million gallons per day

MGY million gallons per year

NYCEM New York City Emergency Management

NYCHA New York City Housing Authority

NYSRA New York State Restaurant Association

OIT Office of Information Technology

PRV pressure regulating valve

RCNY Rules of the City of New York

TRP Toilet Replacement Program

USEPA United States Environmental Protection Agency

WRF Water Research Foundation

WWTP wastewater treatment plant