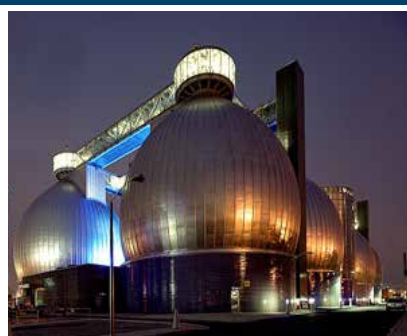
WATER DEMAND MANAGEMENT PLAN

NYC Environmental Protection

Bill de Blasio
Mayor
Emily Lloyd
Commissioner



Emily Lloyd
Commissioner

Dear Friends:

Our mission at the New York City Department of Environmental Protection is to protect public health and the environment by supplying clean drinking water, collecting and treating wastewater, and reducing air, noise, and hazardous materials pollution.

To ensure a reliable water supply for decades to come, DEP launched the Water for the Future program. Under this $1.5 billion program, DEP will shut down the Delaware Aqueduct to repair sections that are leaking up to 35 million gallons of water per day. The Delaware Aqueduct provides approximately half of the city's daily water supply, and one of our strategies to ensure that the city has enough water during the shutdown is to manage demand through targeted conservation.

Effective water demand management strategies are critical to the sustainable management of our water supply during major infrastructure upgrades and for future generations. The City is leading by example to reduce the demand on our drinking water supply by directing funding toward retrofit programs that will conserve water at parks, schools, and other public buildings across the city.

This report provides a detailed description of DEP's approach to water demand management planning. With a large-scale repair project in the pipeline, and a vast network of aging infrastructure to maintain in a state of good repair, DEP remains focused on cost-effective approaches to sustainable water demand management while providing clean, safe, and reliable drinking water to all New Yorkers.

Sincerely,

Emily Lloyd
Commissioner

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Cover photographs
Top photograph: The Unisphere, Queens, New York
Bottom left photograph: Demonstration of a fire hydrant spray cap, Queens, New York
Bottom left middle photograph: Water meter register head
Bottom right middle photograph: Demonstration of sonar leak detection equipment
Bottom right photograph: Newtown Creek Wastewater Treatment Plant, Brooklyn, New York

Angela Licata
Deputy Commissioner

Dear Friends:

The New York City Department of Environmental Protection is the largest municipal water utility in the nation, delivering more than 1 billion gallons of drinking water to over nine million customers and treating 1.3 billion gallons of wastewater each day. In 2011 DEP launched the Water for the Future program, a comprehensive long-term planning effort to repair leaks in sections of the Delaware Aqueduct by 2021. This program is truly a sustainability program, which covers many aspects of DEP's operations and requires extensive long-term planning in order to complete this repair safely and expeditiously.

To support this program, a newly created Demand Management Unit within DEP was tasked with development of a citywide strategy that will outline DEP's plan for implementation of water demand management projects between now and 2021. The *Water Demand Management Plan* identifies five key strategies for managing water demand in New York City in light of the Water for the Future program, and details 21 specific initiatives to be implemented over the next eight years in order to achieve targeted water demand reductions.

Over the course of nearly two years, the Demand Management Unit conducted planning and outreach efforts to create the foundation for the *Water Demand Management Plan* from the ground up. Building upon the efforts of the existing Water Conservation program at DEP, staff worked tirelessly to establish support for the strategies proposed in this Plan, to structure necessary programmatic, policy and funding mechanisms to implement the initiatives, and to ultimately illustrate the importance of a sustainable water demand management plan for our city, not only as preparation for large-scale infrastructure repairs, but for achieving water savings in perpetuity for future generations and protecting one of our most precious natural resources – water.

Sincerely,

Angela Licata
Deputy Commissioner, Sustainability

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EXECUTIVE SUMMARY

New Croton Reservoir.

Abundant, clean drinking water is one of New York City's most valuable resources. Indeed, the successful development of new water supplies in a nearly unbroken search from the early 1800s through the mid-1900s has been a critical factor in the city's transformation from a trading post to a global metropolis. The New York City Department of Environmental Protection (DEP) continues to improve the water supply system through watershed protection, monitoring, customer incentive and its capital improvement program, which includes over $10 billion invested since 2002 to build the largest ultraviolet treatment plant in the world, the filtration plant for the Croton watershed, the Third Water Tunnel, new water mains, and the repair of dams and other critical infrastructure. Thanks to these efforts, through periods of water abundance and shortage, over nine million New Yorkers and millions of commuters and visitors have access to safe and abundant water.

The Delaware Aqueduct will have to be shut down for six to eight months to allow DEP to connect a new bypass tunnel around the main area of concern. During this time DEP will need to augment its available supply and minimize demand.

Under the Water for the Future Program, DEP has initiated a large-scale Water Demand Management Program targeting a 5% overall reduction in water consumption citywide by the year 2020.

DEP has evaluated various options and has rejected costly augmentation projects to bring in water on a temporary basis from New Jersey or Nassau County. Instead, DEP has developed a cost-effective program with a focus on water demand management through conservation to ensure an adequate supply of water.

Conservation or demand management is also one of the most sustainable alternatives with multiple cross-program benefits. Although designed to meet the more immediate needs of the Water for the Future program, the strategies presented in this plan will provide long term benefits by reducing the overall throughput of water and therefore

the energy used in the new ultraviolet and Croton filtration water treatment plants and also for pumping and pollution reduction in our in-city wastewater treatment plants. In addition, conservation allows us to accommodate population growth and adapt to periodic droughts.

Water demand management through conservation is not a new concept. DEP's existing metering, leak detection, residential water audits, and retrofit kit programs have continued to drive water demand down. In addition, DEP also maintains system-wide efficiency by reducing losses in the distribution system with continuous improvement and monitoring efforts to inspect and repair water mains and hydrants as well as to adjust pressure gradients. All of these measures support system efficiency as well as DEP's commitment to delivering the best drinking water to New Yorkers, while minimizing waste and maximizing quality.

These programs and the natural replacement of old fixtures with more water efficient models in real estate development and redevelopment have yielded over 30% in water savings in the last thirty years. In fact, the city's demand is at its lowest in the last 50 years despite population increases throughout that period. This puts DEP in a favorable position to create cost effective options for demand reduction rather than developing additional supply.

GOAL

DEP's near term goal is to reduce demand by 50 million gallons per day through five strategies:

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**

DEP will track the implementation of this Water Demand Management Program and progress toward the goal by reporting on the progress of the strategies and initiatives in an annual update to this Plan.

Strategy 1: Municipal Water Efficiency Program

The Municipal Water Efficiency Program provides funding for water conservation and water efficiency projects in city-owned facilities. Under this program, DEP has identified opportunities for water savings in more than 2,000 city properties, with estimated water savings of over 9 million gallons of water per day by the end of the program. DEP has established inter-agency partnerships with the School Construction Authority, the Department of Education, the Department of Parks and Recreation, the Fire Department of New York, the City University of New York, and the New York City Housing Authority, to plan and implement water efficiency projects in schools, parks, playgrounds and recreation centers, public universities, firehouses, and public housing developments. The agency has evaluated our own wastewater treatment plant facilities for water conservation opportunities and launched an annual water conservation challenge for plant operators to implement best practices and monitor reductions in potable water usage.

Investing in public buildings to improve water efficiency supports the efforts of the Water for the Future program, as well as the goals outlined in Mayor Bloomberg's sustainability plan for the city, *PlaNYC 2030*. As new buildings become more efficient, it is crucial that we also develop retrofit programs for our older building stock. Through these partnerships, the city will demonstrate how these types of projects can be implemented successfully, with benefits to the public and our natural environment.

Strategy 2: Residential Water Efficiency Program

With relatively little private outdoor green space within the City, water demand in the residential sector is largely driven by various types of domestic end uses inside of buildings. As residential dwellings account for 80% of New York City's water usage (Figure 1), DEP has identified apartment buildings and homes with considerable opportunities for water conservation. Home water survey studies have indicated that the largest percentage of water consumption in single family homes and multi-family dwellings is used for flushing toilets, followed closely by laundry, showering, and running faucets or taps (Figure 2).

The Toilet Rebate Program of the 1990s was particularly successful in creating significant and measurable reductions in water demand. Based on the popularity and achievements of that program, DEP will be launching a Toilet Replacement Program in 2014. Phase I will provide discounts for owners of residential and multi-family buildings who replace outdated toilets with high-efficiency models. Many older toilets can use 3.5 to 5.0 gallons of water per flush, whereas high-efficiency models have been engineered to consume as little as 1.28 gallons per flush. Phase II of the Toilet Replacement Program will provide incentives to homeowners who replace older toilets in all remaining housing that did not participate in the original 1994 Toilet Rebate Program.

As part of our commitment to environmental stewardship, DEP is launching a Toilet Recycling Program to run in tandem with the Toilet Replacement Program to capture the waste volumes generated by large-scale toilet replacements. Rather than discarding toilets in landfills, DEP has developed a mechanism for the material to be beneficially reused in sidewalk repair and green infrastructure projects throughout the city. By closing the loop on this waste stream and launching two programs with numerous environmental benefits, DEP continues to fulfill its core mission of protecting the environment.

In addition to the Toilet Replacement Program, DEP will be partnering with the New York City Department of Housing Preservation and Development and the Mayor's Office of Housing Recovery to implement water conservation measures in storm damaged homes under the NYC Build It Back program. Homeowners, landlords and tenants in the five boroughs whose homes were affected by Hurricane Sandy will receive City's assistance with repairs and facilitate delivery of permanent, sustainable housing through various options, including rebuilding and reimbursing for eligible out-of-pocket repair expenses. DEP will provide funding for high-efficiency water fixtures which will be installed in homes that registered for the program. This partnership gives DEP the opportunity to assist an ongoing program through promoting water savings in homes affected by Hurricane Sandy and building back a greener, greater New York.

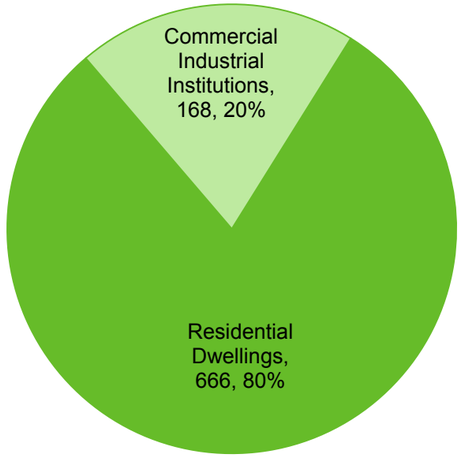


Figure 1: Total water usage in New York City by residential and commercial Industrial Institutions (This does not include unaccounted for water, which is approximately 21%).

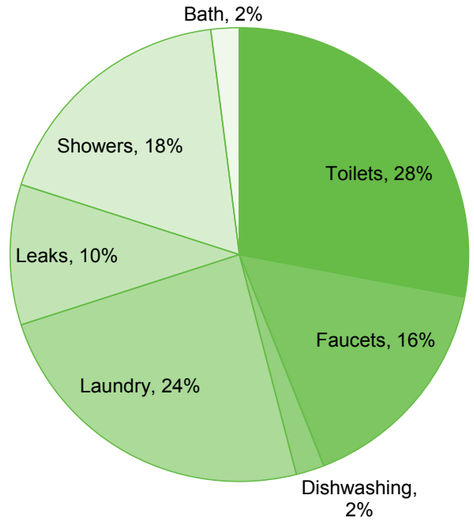


Figure 2: Indoor water use in a typical single family home.

Strategy 3: Non-Residential Water Efficiency Program

The Non-Residential Water Efficiency Program will promote conservation in commercial and non-residential buildings through partnerships with the private sector. During the spring of 2013, DEP and the Mayor's Office launched a water efficiency program called the Mayor's Water Challenge, a year-long, voluntary challenge to private sector groups to match the drop in consumption in municipal use. Some of the city's largest and most well-known hotels will be among the first private sector entities to participate in the Challenge. Participants will be asked to calculate baseline water consumption, track water usage in their facilities for 12 months, develop a Water Conservation Plan, and attend meetings with DEP and the Mayor's Office to discuss progress. Challenge participants will receive formal recognition from the Mayor's Office and DEP in addition to recognition through press releases and news conferences about their efforts.

DEP is currently evaluating criteria for initiating a broader cost sharing program by 2015, targeted to specific water efficiency opportunities in the non-residential sector. The scope of this program could encompass water-cooled refrigeration in food related businesses, hotels or health care facilities; water reuse in laundry and car wash facilities; steam condensate use for toilet or urinal flushing, cooling tower makeup water or other non-potable uses; increased cycles of concentration in cooling towers; changes to water-related industrial processes; climate based smart irrigation controls; and water reuse for non-potable applications, such as toilet flushing and irrigation.

Strategy 4: Water Distribution System Optimization

On a system-wide basis, it is critical to reduce leaks and other lost or unaccounted for water in the nearly 7,000 miles of sub-surface water main infrastructure that DEP maintains to provide service to homes in the five boroughs. To ensure that our distribution infrastructure is efficient and in excellent operating condition at all times, DEP has adjusted pressure gradients, expanded its leak detection program, launched a service line protection program, pursued full build-out of water meter and Automated Meter Reading technology, replaced large water meters on industry recommended cycles, and monitored system pressure zones.

For example, improvements in our pressure management program have reduced drastic fluctuations in pressure zones that can cause water mains to leak or break. Over the past six years, water main breaks have been reduced by 40%. DEP has also expanded the work of its Leak Detection Unit, which has been investigating leaks throughout the city's water distribution system in order to prevent property damage, water loss, and infrastructure failure for the past 40 years. Over the past three years, DEP leak detection crews have surveyed more than 6,500 miles of water mains. Repairing the leaks discovered during these surveys can save millions of gallons of water per day. Given the value of these water savings to the agency and to the Water for the Future program, DEP is evaluating whether to expand its leak detection program from water mains in streets to interconnections in large parcels with multiple buildings.

For customers with Automated Meter Reading devices, DEP has also developed a Leak Notification Program to proactively send emails alerting customers of potential water leaks on their property. Since its inception in 2011, the Leak Notification Program has saved customers more than $33.5 million in wasted water and avoided repair costs.

Finally, DEP will continue to optimize the metering networks that serve 836,000 customer accounts. Through system improvements, DEP plans to monitor an added 30% of overall daily water consumption that are currently associated with flat-rate billing accounts. While tracking additional consumption through Automated Meter Reading technology, DEP will continue to replace old and faulty meters with new, more efficient and durable meter models.

Strategy 5: Water Supply Shortage Management

DEP will also make comprehensive contingency plans for water supply shortages, including weather related droughts and any shortages encountered during the bypass cutover in the Water for the Future program. Over the past 75 years, New York City has experienced nine drought periods of record, the most severe of which occurred prior to the 1980s.

Historically, New Yorkers have had a strong track record in supporting citywide water conservation initiatives during droughts. Current mandatory and voluntary water use rules are triggered only when shortages are created by the lack of rainfall and reservoir storage. DEP is expanding these rules to address situations when shortages result from both planned and unplanned outages of water supply infrastructure.

DEP will continue this effort by formalizing the responsibilities of city agencies during a water shortage in the Water Supply Shortage Management Rules and Plan. When a water supply shortage condition occurs, DEP will coordinate with the Office of Emergency Management to convene the Water Supply Shortage Condition Task Force, made up of representatives from each city agency, and implement appropriate agency protocols.

DEP also realizes the importance of public participation in achieving desired water consumption reductions during periods of water shortage. Therefore, DEP is developing a formal public outreach and communications program to educate and inform customers of water shortage conditions. Customer participation and compliance with mandatory water use restrictions during a water shortage are crucial to the city's demand management strategy, not only during times of water shortage but also as part of long-term conservation efforts. DEP has added an optional conservation rate structure to the Water Supply Shortage Management Plan that would go into effect only during a water shortage emergency. Combined with an effective public outreach and communications program, an emergency rate plan ensures that we are prepared to further reduce demand in the most severe water shortage conditions.

Additionally, DEP will use the My DEP Account web portal to provide customers with access to their current water use and information on targeted water use reduction goals based on the severity of the supply shortfall. By allowing customers to track their water use in near real-time and providing direct access to information on water supply shortfalls through My DEP Account, customers will be encouraged to monitor their consumption more closely and avoid emergency water rates.

Maintaining transparency and keeping customers informed of changes in water supply shortage conditions is an important part of DEP's demand management strategy, both in preparation for the repair of the Delaware aqueduct, and for ensuring the most effective response to any unforeseen future water shortage conditions.

Next Steps

DEP is currently developing an Upstate Water Conservation Program that will help lower water demand for the one million consumers in 55 communities north of the city. These communities and the utilities that serve them purchase water from the City on a wholesale basis. Since the communities supplied with city water exhibit a wide range of land use types, conservation plans will be tailored to their particular needs, whether they are dense urban centers or smaller suburban areas.

INTRODUCTION

Kensico Reservoir (30 billion gallons).

Through a complex arrangement of dams, reservoirs, tunnels, and aqueducts, the New York City system serves 8.3 million New York City residents, millions of commuters from the tri-state area, and more than one million residents in 55 upstate communities per day. From the 1840s to the 1960s the City's approach to water was to increase supply to meet demand. Since then, DEP's strategy has been to optimize the existing system while promoting water conservation and managing demand to fall within current supplies. The city played an important role in driving significant decreases in water demand during the 1980s and 90s through implementation of several policies and programs that incentivized water efficiency (Figure 3). Overall demand has decreased by approximately 30% since the 1980s and year to year demand can decrease by 18%, as was the case when drought restrictions were in place in 1989, 1991, and 1995, despite consistent increases in population during that period.

That dramatic reduction is because New Yorkers use water more efficiently. To accelerate that trend, DEP has supported federal, state, and city wide conservation policies regarding low-flow shower heads and plumbing fixtures. In 1989, the New York City Council prohibited the sale of high-flow shower heads and faucets through enactment of Local Law 29. The Energy Policy Act of 1992 stated that by 1994, new toilets sold in the US must use no more than 1.6 gallons per flush, and new shower heads were capped at flow rates of 2.5 gallons per minute. The Council remained focused on encouraging the sale and installation of low-flow plumbing fixtures and in 1992 enacted a local law prohibiting the sale of high-flow toilets and instituting a 1.6 gallon maximum flow rate requirement. Federal laws were also enacted that strengthened existing state and city low-flow fixture laws. DEP advanced these objectives by running the city's widely adopted Toilet Rebate Program from 1994 to 1997, in which 1.3 million high flow toilets were replaced by low flow toilets.

Price signals are a direct way to inform customers of the costs of wasting water and the benefits of conservation. DEP adopted universal metering in 1987 and between 1990 and 2013, the number of metered accounts increased to 96% of all accounts. Customers that have signed up for a leak notification program are incentivized to fix leaks and DEP helps them do so by sending them alerts when water usage is unusually high.

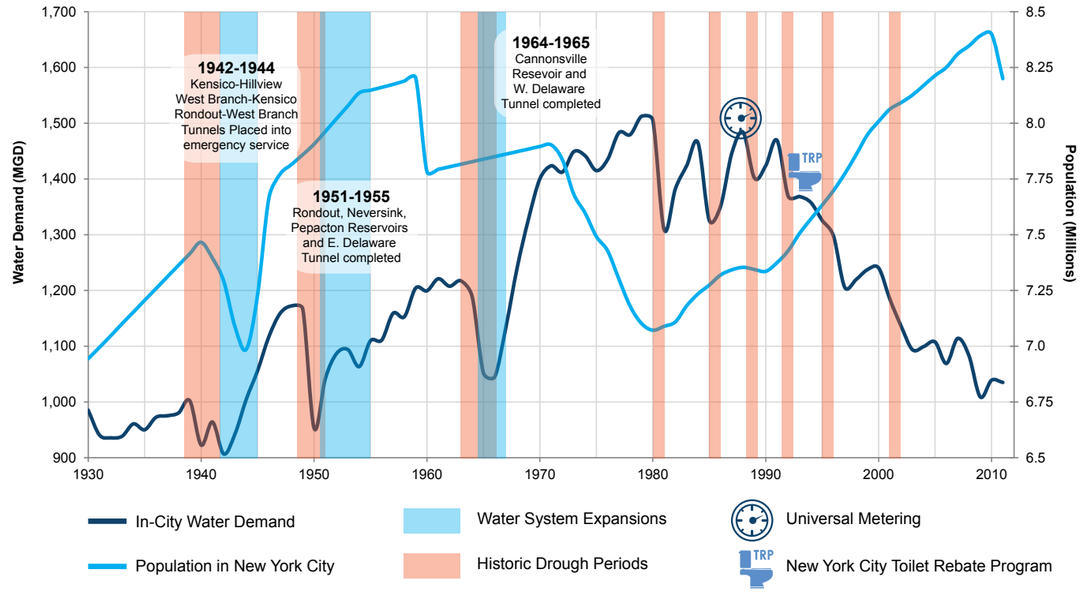


Figure 3: Timeline showing New York City water demand compared with population growth, and other factors affecting overall demand.

These efforts were strengthened when DEP launched the Automatic Meter Reading program in 2009. Through the AMR program, DEP customers can see reports of their water usage every six hours on average and receive electronic leak notifications, cultivating an awareness that has led to a 1.5% decrease in water use each year since 2005. DEP will continue to improve water bill accuracy and as of 2012 has installed these advanced meters for more than 800,000 customers.

DEP is also committed to scaling back its total energy use and reducing its carbon footprint. For many years, DEP has relied on a source water protection program, rather than filtration, for the Catskill and Delaware watersheds, as memorialized in a Filtration Avoidance Determination from the United States Environmental Protection Agency and a 1997 Memorandum of Agreement with New York State and other stakeholders. By protecting our water supply sources through land conservation, DEP minimized the need to construct costly filtration plants operating energy intensive processes in order to supply our high quality drinking water.

However, DEP must begin to filter the water from the Croton system and will soon bring a new filtration plant online for the Croton system. In addition to the new Croton filtration plant, DEP also constructed the largest ultraviolet treatment plant

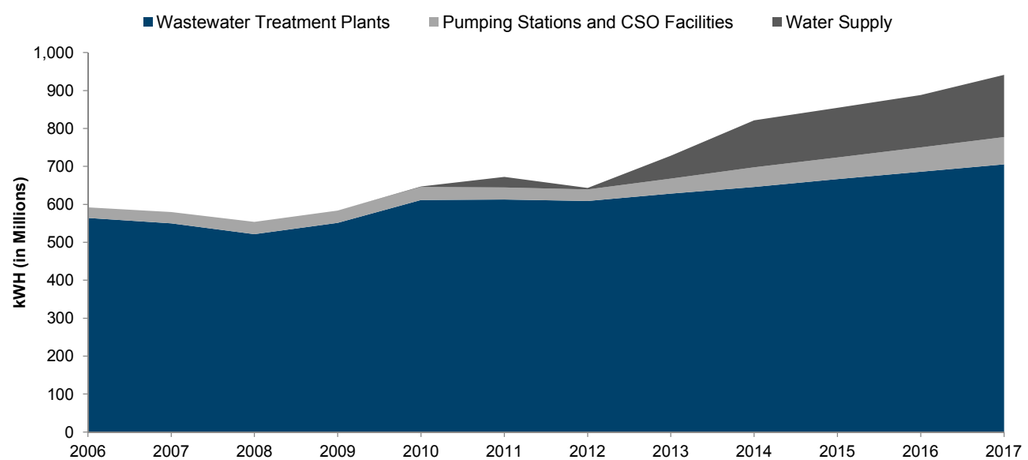
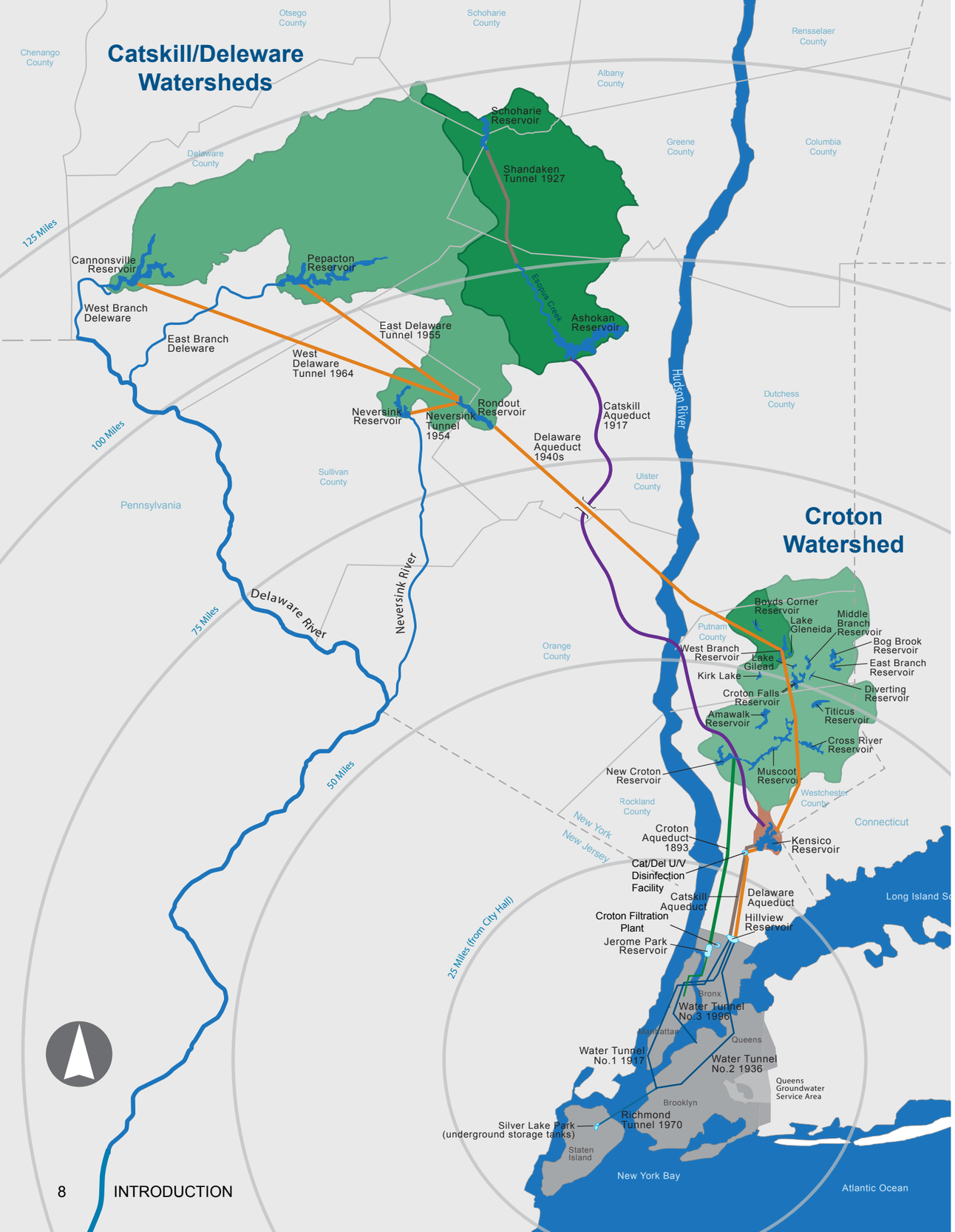
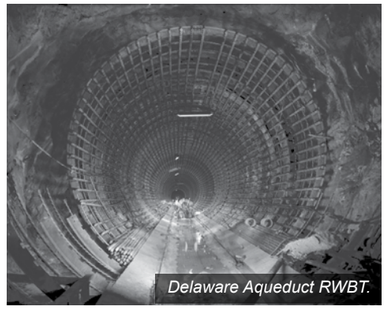


Figure 4: Water supply and wastewater historical and projected electrical use.




New Croton Dam.


Delaware Aqueduct RWBT.


Exterior of Delaware Aqueduct.

in the world for the Catskill and Delaware systems (Figure 4). As these large infrastructure projects are completed and require more energy to operate, it will become even more important for New Yorkers to be mindful of water conservation. Conserving water is not only important to ensure future supplies, but it also reduces the amount of energy required to treat our drinking water and our wastewater. The New York City water supply system is already highly efficient as it largely relies on gravity to deliver water, which minimizes pumping needs.

Water use also contributes to increasing costs in treating wastewater. Higher water use means higher base flows in our sewer system and wastewater treatment plants, which use energy and chemicals in increasing amounts as plant capacity continues to expand. Base flows also take up treatment capacity at wastewater treatment plants that otherwise accept stormwater, leading to combined sewer overflows. The ancillary benefits of lower flows from water conservation efforts include a longer useful life for existing pumping, storage, and treatment systems.

Finally, Conservation will also make us more resilient in the face of droughts and other outages. One planned outage will occur as a result of the Water for the Future Program. During leak repair and the construction of the new-three-mile tunnel under the Hudson River, the Delaware Aqueduct will be temporarily shut down, suspending delivery of about 50% of the city's water supply. DEP will be managing the subsequent shortfall through potential augmentation of water supply by optimizing the Catskill Aqueduct and reactivating the groundwater supply system, and additional conservation programs will reduce demand to a manageable level.

DEP created the *Water Demand Management Plan* to determine water conservation and demand management opportunities in publicly and privately owned properties. After identifying savings in targeted fixture retrofits and necessary infrastructure, DEP will use five comprehensive strategies with the goal of reducing water demand by 50 million gallons per day.

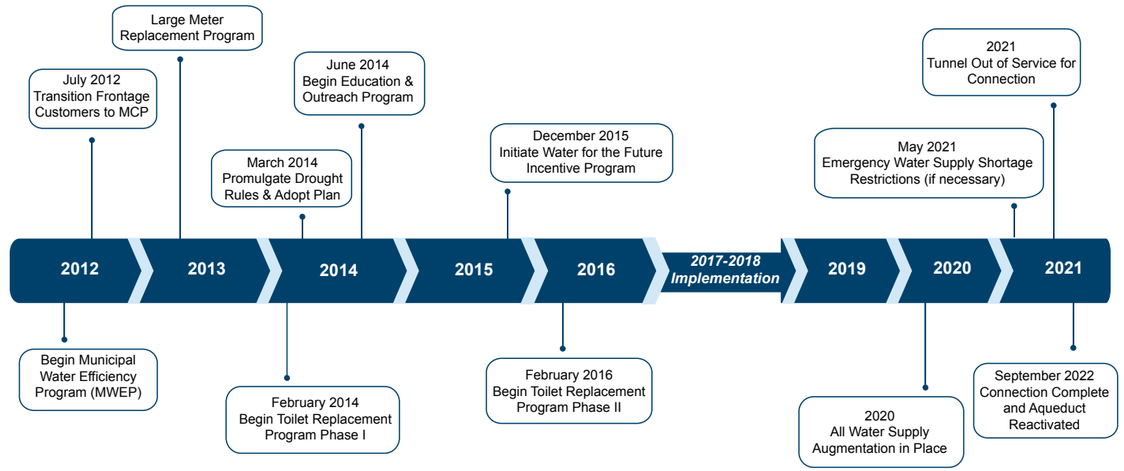


Figure 5: Demand management schedule targeting Water for the Future savings.

ESTIMATED PERFORMANCE, BENEFITS, AND PREDICTED COST

As part of the Water for the Future program, DEP developed a portfolio of solutions to temporarily augment our water supply for the duration of shutdown and has performed a cost-benefit analysis to evaluate and compare each option. DEP's analysis assesses the impact of two different infrastructure investment strategies for supplementing our water supply while the Delaware Aqueduct is temporarily offline – a Demand Reduction Strategy and a Water Supply Development Strategy. Existing water supply resources and infrastructure such as the Catskill and Croton conveyance systems and the Croton Falls and Cross River pump stations were quantified and incorporated into the cost-benefit analysis for both strategies. Proposed demand reduction and water supply augmentation projects were evaluated for cost-effectiveness and additional gallons of water delivered to supplement existing available supply. By identifying the most cost-effective augmentation opportunities in managing water demand or in developing new sources of supply, DEP has identified a group of selected Demand Reduction programs that will yield approximately 50 million gallons per day of water the city will need during the shutdown and repair of the Delaware Aqueduct.

Figure 6 is a graphic depiction of the projected water savings yielded from selected Demand Reduction Strategy and additional supplies delivered by Water Supply Development Strategy projects. Under the Demand Reduction Strategy, five cost-effective water demand management and conservation programs targeting municipal, residential, non-residential buildings citywide and optimization of distribution system infrastructure will be implemented over the next eight years will reduce the 2021 demand by approximately 50 million gallons per day.

Under the Water Supply Development Strategy, the four programs evaluated would generate approximately 60 million gallons per day of water supply. In addition to optimizing existing supplies under both strategies, DEP is committed to continue on-going water distribution system optimization activities under both strategies. The Water Supply Development Strategy programs target infrastructure efficiency improvements and expansions such as activating a connection to water supply in Nassau County, Long Island, or constructing a supply line underneath the Hudson River to connect to available supplies in New Jersey. These projects have significant capital, operation, and maintenance costs associated with them and would be considered permanent investments for a temporary solution. As shown in Figure 3, and with declining demands, projects like the New Jersey connection could provide more water than needed to deliver adequate water supplies to New Yorkers during the shutdown.

Figure 7 shows the costs of the programs and projects under each of the proposed strategies. Based on DEP's cost-benefit analysis, both strategies will allow DEP to meet the projected water demands during temporary shortages during the shutdown, however, the programs under the Demand Reduction Strategy are more cost-effective on a cumulative basis. The cost savings for using the Demand Reduction Strategy is $21.1 million compared to the investments in large-scale infrastructure expansion solutions to generate water supply beyond what is needed for the period of the shutdown. For this reason, DEP determined that the suite of Water Demand Management programs represented the more cost-effective and sustainable use of funds to continue to deliver clean, reliable and safe drinking water for the duration of the repair project.

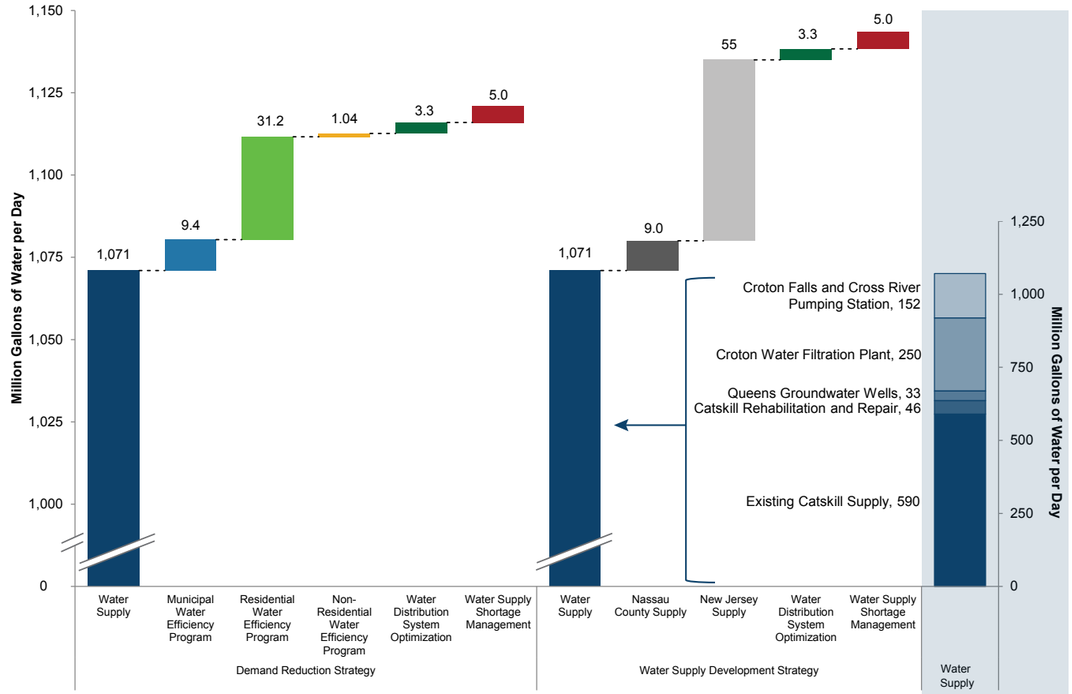


Figure 6: Total demand reduction strategy vs. water supply development strategy in million gallons per day.
Cross Falls and Cross River Pumping Station can provide addition supply if needed.

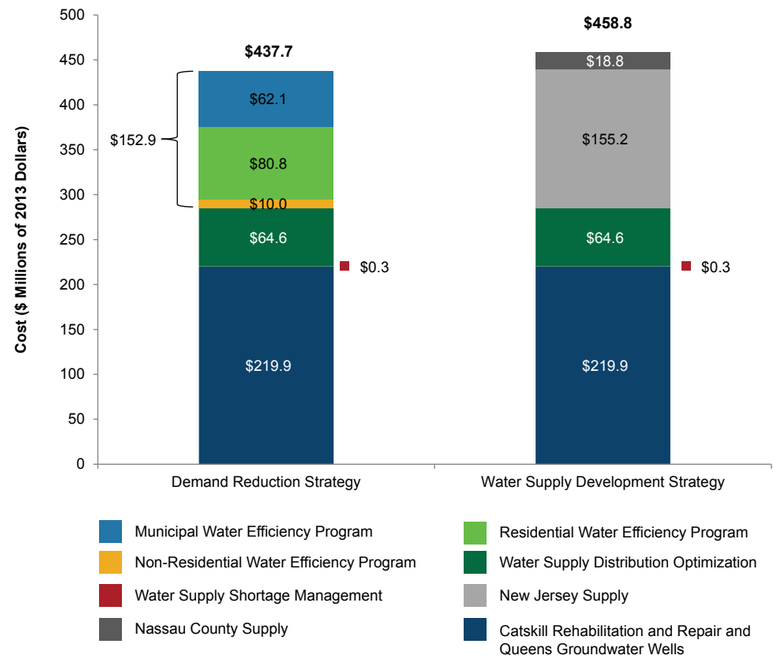


Figure 7: Projected total costs in demand reduction strategy vs. water supply development strategy.
Catskill Aqueduct Rehabilitation and Repair, Queens Groundwater Wells work are included in the baseline of both strategies because they are existing city owned assets that need to be brought into a state of good repair to provide additional benefits needed. Water Supply Distribution Optimization is included in the baseline as an ongoing DEP commitment to water efficiency. The costs above do not include the repair of the Delaware Aqueduct.

Case Study 1: Quantify Benefits of Reuse in Supply and Wastewater Variable Cost

Water and wastewater treatment are energy intensive processes, with variable costs that are highly dependent upon the amount of wastewater and water DEP treats and supplies. The agency's system-wide wastewater treatment variable cost in FY11 was $125.3 million, including costs from potable water, electricity and natural gas, contracts, chemicals, supplies, and fuel oil. This cost is itemized in Figure 8. As indicated in Table 1, the variable cost per 1,000 gallons of dry weather flow is $0.30. For each 5% reduction in water use and wastewater flows, $6.3 million in wastewater costs could be avoided.

The water treatment variable cost is currently $34.6 million per year or $0.08 per 1,000 gallons of water use. If DEP were to achieve a system-wide 5% water use reduction of about 50 million gallons per day, the estimated reduction in water treatment cost would be $1.5 million.

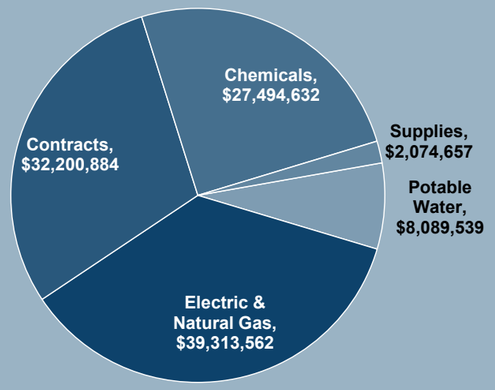
In addition, the water supply variable cost was $25.6 million in FY11, which accounts for supplies and materials, fuel oil, chemicals, and electricity (itemized in Figure 9). The cost of 1,000 gallons for water supply is estimated to be $0.06. By applying the system-wide 5% water use reductions, $1.1 million could be saved in water supply cost.

As shown in Table 1, the total variable cost for wastewater collection and treatment, water treatment, and water supply is $185.4 million annually or $0.44 per 1,000 gallons of water use. The avoided cost from a 5% reduction in water use is $9.2 million for FY11. Although relatively small water flow declines have been observed thus far, larger scale permanent decreases in water use and wastewater flow could further reduce the future cost of capital projects.

Annual variable cost of the wastewater system is expected to increase from $125 million in FY11 to $193 million by 2021, while water system variable costs will increase from $26 million in 2011 to $78 million by 2021. Thus, each 1,000 gallon reduction in water demand and wastewater flows is estimated to reduce the water and wastewater services variable costs by $0.61 per gallon in 2021 (Figure 10). Using the system-wide 5% water use reduction of 61.25 million gallons per day, the estimated reduction in water and wastewater treatment cost is $13.63 million by 2021.

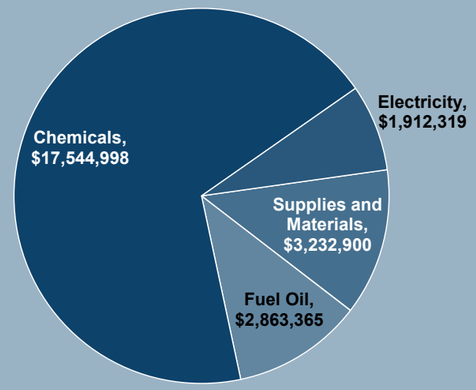
The majority of this projected cost increase is due to the Croton Water Filtration Plant and the Catskill/Delaware Ultraviolet Disinfection Facility going online in 2013. Additionally, DEP expects the cost of electricity to increase by 30% in 2014, which significantly raises the variable cost estimates for FY14. From 2015 to 2021, wastewater variable costs are anticipated to increase 3% per year given the projected 3% annual nominal growth in wastewater operating expenses during the same period.

From 2015 to 2016, water supply variable cost will increase by 3% each year and from 2017 to 2021, the variable cost will increase by 2% per year, reflecting DEP expectations for water cost increases.



Total Variable Cost: $125,300,175

Figure 8: DEP System-wide wastewater treatment cost in FY11.



Total Variable Cost: $25,553,582

Figure 9: DEP System-wide water supply variable costs in FY11.

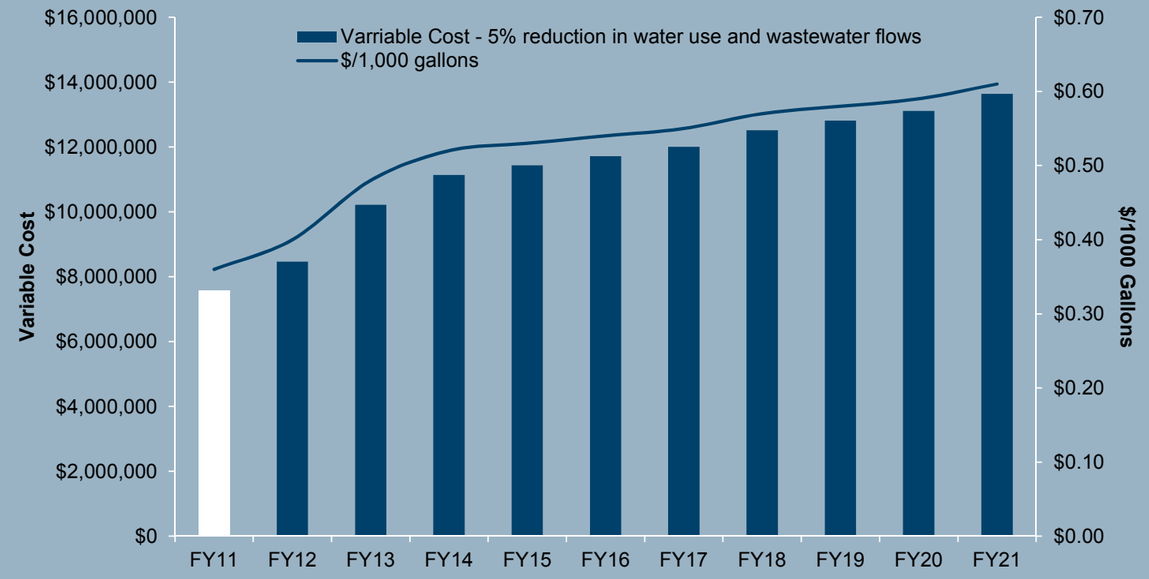


Figure 10: Actual and projected DEP system-wide 5% avoided variable cost - water and wastewater.

Description	Variable Cost[1]	Flow (mgd)[2]	Variable Cost per kgal	Flow Reduction (mgd)	Avoided Cost
Wastewater Collection & Treatment[3]	$125,300,175	1,152	$0.30	57.6	$6,265,009
Water Treatment[4]	$34,623,075	1,152	$0.08	57.6	$1,731,154
Water Supply[5]	$25,553,582	1,152	$0.06	57.6	$1,277,679
Total	**$185,476,832**		**$0.44**		**$9,273,842**

Table 1: Total variable costs per 1,000 gallons of water use and 5% avoided cost for reduction in water use.

1 Variable cost includes electricity, natural gas, fuel, chemicals, contracts, supplies and potable water.

2 MGD is average DEP system-wide daily water consumption which is approximately equal to the average daily dry weather flow entering all of DEP's WWTPs. The 1,152 MGD is the 2011 average system-wide daily flow from the entire water supply system (serving in-City and upstate customers). The average daily dry weather flow in 2010 was 1,196 MGD and the average daily water use in 2010 was 1,158 MGD. The 1,152 MGD provides a convenient yet reasonably accurate way to estimate the per unit costs of water and wastewater services.

3 Costs include all pump stations and wastewater treatment plants in the DEP system.

4 This is the estimated O&M expenses for the Croton Water Filtration Plant & the Catskill / Delaware Ultraviolet Disinfection Facility that will go online in 2013. The FY13 estimate of $35,847,000 was converted to 2011 dollars using GDP deflator of 0.97. Source is Stratus Consulting, "Assessment of the Impacts of State and Federal Mandates upon Water and Sewer Rate Affordability in New York City", draft, prepared for New York City Department of Environmental Protection, March 27, 2012.

5 Cost represents variable costs of supplying water system-wide (in-City and upstate customers). From Report on the Cost of Supplying Water to Upstate Customers for the 2013 Rate Year, Section 4.2.1.3.

6 Numbers may not add up to that indicated due to rounding.

Photo credit: Alexa Asakiewicz

STRATEGY 1:

Municipal Water Efficiency Program

Initiative 1:	Survey DEP's Wastewater Treatment Plants, Repair Inefficiencies, Find Water Saving Opportunities	**2.1 MGD**
Initiative 2:	Replace Fixtures in Schools and Increase Water Efficiency Awareness	**3.8 MGD**
Initiative 3:	Retrofit Spray Showers and Replace Fixtures in Recreation Centers	**1.1 MGD**
Initiative 4:	Replace Fixtures, Install Meters, and Perform Leak Detection in Public Housing	**1.5 MGD**
Initiative 5:	Replace Fixtures in Universities and Increase Water Efficiency Awareness	**0.75 MGD**
Initiative 6:	Replace Fixtures in Fire Houses and Continue Education Regarding Hydrant Security	**0.04 MGD**

Total Savings: 9.3 MGD

Bayside High School in Queens.

While it is easy to forget the demands placed daily upon our water supply infrastructure, we constantly rely on water for a variety of uses, whether it is for firefighting, spray showers and pools on hot days, sinks and toilets in public buildings, and general operations throughout our schools and public parks.

DEP understands the importance of making sure these facilities and institutions are operated efficiently and will continue to invest in water conservation through its ongoing partnerships and the Municipal Water Efficiency Program, a dynamic seven year program aimed at identifying applicable fixtures within older building stock and scaling up projects using best practices (Figure 11).

In particular, DEP has collaborated with other agencies and supported water efficiency projects in the properties of municipal entities such as the Departments of Parks and Recreation (DPR) and Education (DOE), the Fire Department of New York (FDNY), the School Construction Authority (SCA), the New York City Housing Authority (NYCHA), and the City University of New York (CUNY).

Through these partnerships, DEP has developed a plan to implement water efficiency measures in government-owned facilities citywide, including the replacement of older, inefficient toilets and urinals and retrofits for spray showers in the city's parks and playgrounds. Currently this program targets only toilets and urinals for replacement and will maintain this focus for the foreseeable future. In addition to replacing fixtures in buildings owned by other agency partners, DEP and DPR have developed a plan to retrofit spray showers in parks and playgrounds throughout the city.

Through this Municipal Water Efficiency Program, DEP will continue to advance a wide-ranging effort that incorporates water efficiency retrofits, education, curriculum development, metering, and water benchmarking.

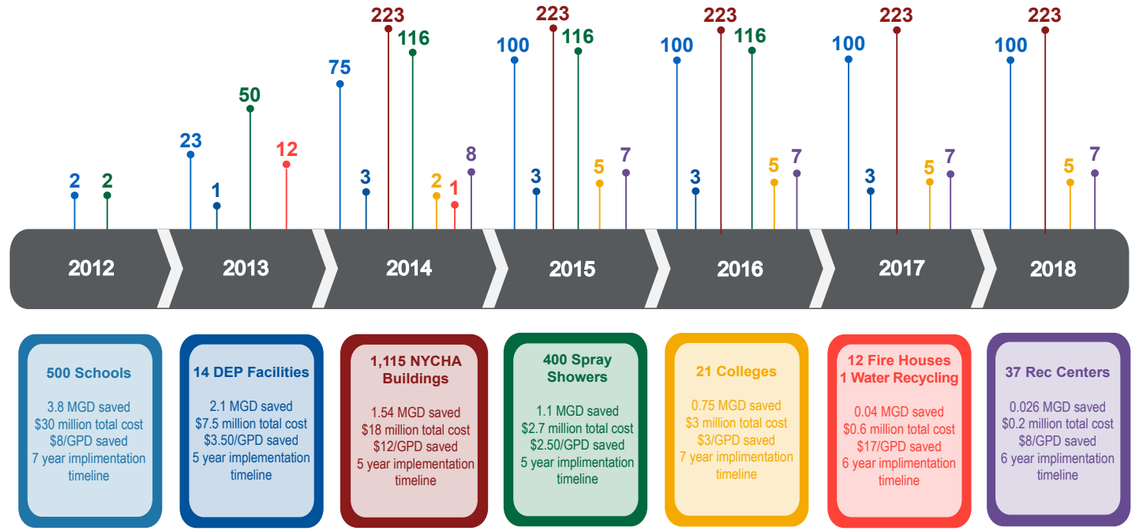


Figure 11: Municipal Water Efficiency timeline. The numbers shown in the timeline above represent the number of planned water efficiency projects per fiscal year, for each type of public facility or infrastructure in the program.

Initiative 1: Survey DEP Wastewater Treatment Plants, Repair Inefficiencies, Find Water Saving Opportunities

DEP owns and operates 14 in-city wastewater treatment plants that treat an average of 1.3 billion gallons of wastewater per day. These plants remove 85% to 95% of wastewater pollutants and rely on physical and biological processes similar to the natural systems used by wetlands, rivers, streams, and lakes. Treatment happens relatively quickly compared to natural processes, as it takes only seven hours to remove most of the pollutants from wastewater. In order to lead by example and increase water efficiency in our own facilities, DEP audited its wastewater treatment plants and developed a summary matrix (Table 2) of water conservation opportunities based on source inputs and surveys with plant operators.

Our agency then identified processes that currently use potable water but could switch to plant effluent. Our recommendations for potable water conservation were classified into three tiers: low cost, readily implementable options; medium cost or medium degree of difficulty options; and high cost or high degree of difficulty options.

Low cost, readily implementable options:

- Raise awareness of water conservation through staff training
- Keep a better record of water usage and submit monthly data sheets
- Install, replace, and/or calibrate flow meters on all water systems and conduct periodic audits
- Use effluent, if compatible with design, in dewatering facilities for pump seal water usage, polymer dilution, and odor control make-up water
- Conduct routine equipment maintenance, testing, inspection, and replacement to minimize water waste including faulty float valves, leaky boilers and hot water supply and return piping, and broken effluent strainers.
- Use effluent for ring flushing or decommission practice
- Discontinue water feed to odor control facilities that are not in operation

	Description	RH	OB	26W	TI	NR	OH	BB	PR	RK	CI	HP	JA	NC	WI
	Water Use as % of Dry Weather Flow	4.77%	1.76%	1.47%	0.69%	0.68%	0.66%	0.64%	0.63%	0.51%	0.45%	0.38%	0.35%	0.34%	0.21%
MSP	Ring Flushing		E		Op		E		E	Op	E	E	E		
Secondary	Glycerol Dilution			Op											
	Foam Control-Aeration Tanks	E	E	E		E	E	E	E	E	E	E	E	E	E
	Foam Control-Final Settling Tanks		Op											E	E
	Cooling Water (Blowers)	C	E	C	Op	C		C	E	C	Op	C	C	E	C
Hypo	Foam Control- Chlorine Contact Tanks			Op										E	
	Hypochlorite Dilution Carry Water	Op		E		E	E	E	E	E		E	E		E
Solids Handling	Agitation Water/Grit Suspension/Hoppers	Op				E			E	Op		E		E	Op
	Grit Washing		E	Op	Op	Op	Op	Op	Op		Op	Op	E	E	Op
	Foam Control-Gravity Thickeners		Op	Op									E		
	Gravity Thickeners Balance Water	E	E	E	E	E	E	E	E	E	E	E	E		E
	Sludge Blockage Removal	E				E		E						E	
Dewatering	Pump Seal Water	Op	Op	Op		Op		Op				Op		E	Op
	Centrifuge Flushing	Op	E	E		E		E				E		E	E
	Centrifuge Cooling	C	C	C		C		C				C		E	C
	Polymer Mixing/Wetting	Op	Op	E		Op		Op				E		Op	E
	Polymer Dilution	Op	E	E		Op		E				E		Op	
	Odor Control Makeup		E	C				C				C			C
Heating/Cooling	Cooling Water (A/C, Chillers, Compressor)	Op	E		Op	E	E	E			E		C	C	C
	Cooling Water (Engines)				C	C	E		C		E				C
	Waste Heat Exchange System	C		C	C	C			E				E	E	
Plant-Wide	Pump Seal Water	Op	E	Op	Op	Op	Op	Op	Op	Op	Op	Op	Op	Op	Op
	Odor Control Scrubber Water					Op					Op		Op		

C City Water | E Plant Effluent Water | Op Opportunity to Reduce Water

Table 2: Conservation strategies matrix for all wastewater treatment plants. Plant names can be found in the acronym list.

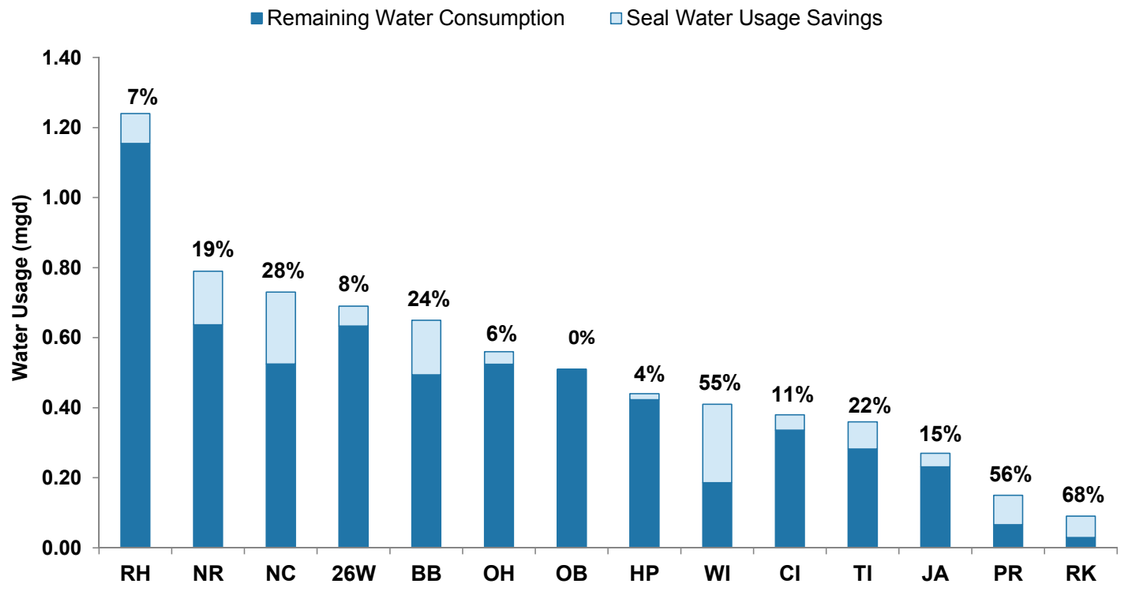


Figure 12: Analysis of Mechanical Seal Retrofits at Red Hook Wastewater Treatment Plant. This figure shows the potential percentage reductions in potable water usage at each of the 14 DEP plants if pumps were to be retrofitted with mechanical seals, as well as the overall potential reductions in potable water usage system-wide.

Medium cost or medium difficulty options:

- Consider mechanical seals when pumping systems are replaced or upgraded (Figure 12)
- Use effluent for grit suspension, grit washing, and agitation water
- Use effluent for foam control in process tanks (aeration, final settling, chlorine contact, gravity thickener)

High cost or high difficulty options:

- Use effluent for blower and compressor cooling pretreatment
- Use effluent with appropriate pretreatment (such as the use of screens/strainers with finer mesh size) to supply pump seal water
- Use effluent with appropriate pretreatment (such implementing filtration and high level disinfection) to supply cleaning water at dewatering facilities, influent screens, etc.

Initiative 2: Replace Toilets and Urinals in 500 New York City Schools and Increase Water Efficiency Awareness

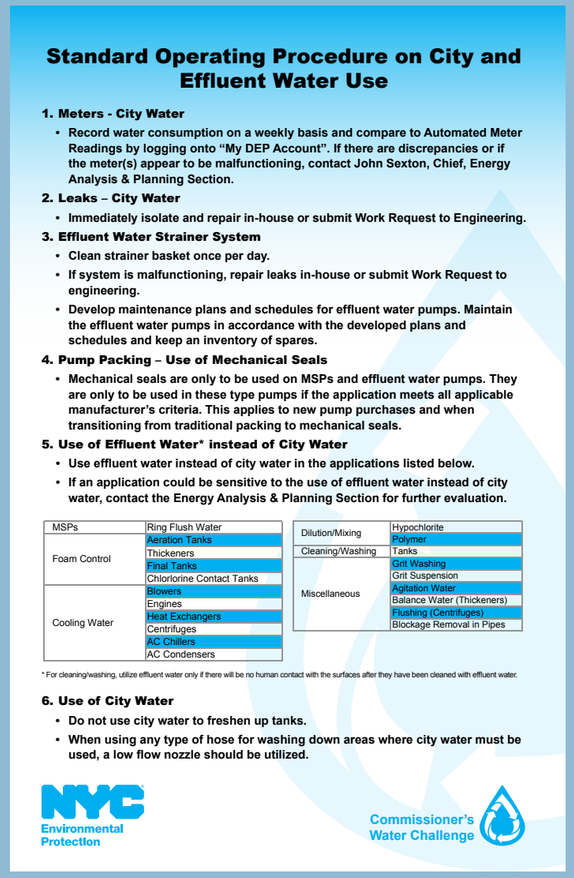
New York City's Department of Education operates and manages the largest system of public schools in the United States, serving approximately 1.1 million students in more than 1,700 schools. The majority of school-age children's waking hours are spent inside these buildings and the city is responsible for ensuring that this infrastructure functions and operates efficiently. DOE has already made great strides in many areas of sustainability, including energy efficiency, recycling programs, green curriculum, and increased ecological awareness. Local Law 86 requires all newly constructed DOE buildings to consider water efficiency and conservation within their construction plan and to achieve a minimum potable water use reduction of 20% to 30% based on standards set in the U.S. Environmental Protection Agency Energy Policy Act of 1992 (EPA Act 1992). In addition, all buildings will achieve a minimum Silver rating under the U.S. Green Building Council's Leadership in Energy

Case Study 1: DEP's Commissioner's Water Challenge at Wastewater Treatment Plants

In addition to establishing inter-agency partnerships with other city agencies and forming public and private partnerships to reduce water demand in New York City, DEP has targeted water saving opportunities in its own facilities. In 2012, DEP designed a water audit and surveyed water usage across the 14 wastewater treatment plants that consume approximately 7.3 million gallons a day.

As a result of the audit, former DEP Commissioner Strickland issued a Water Challenge in March 2013 to wastewater treatment plants to reduce water usage by 10% from 2012 baseline water consumption. The Commissioner's Water Challenge will primarily take place over the next seven years but will extend out to 2021. Four plants, all with one year of viable water consumption data, will participate in the first year of the challenge: Coney Island, Oakwood Beach, Jamaica, and Wards Island. A 10% reduction in daily water consumption at these four plants could yield a total savings of approximately 238,154 gallons of water per day (Table 3). To meet the 10% reduction goal, the participating plants must reduce their potable water usage, measured in gallons, by implementing water conservation standard operating procedures. Each plant will target an additional 5% reduction beyond their previous year's water consumption. DEP's Bureau of Wastewater Treatment issued Standard Operating Procedures in June 2013 to guide plant staff on water conservation and efficiency measures.

DEP has committed $7.6 million for plant retrofits and necessary equipment repairs to enable these facilities to use effluent water wherever possible. DEP's water audit revealed that replacing old pumps that use packing with pumps that use mechanical seals would yield significant water savings. In light of these findings, DEP continues to replace pumps at the North River plant and has changed its Design Guidelines to specify that all new pumps must use mechanical seals.



Standard Operating Procedure on City and Effluent Water Use

1. Meters - City Water
- Record water consumption on a weekly basis and compare to Automated Meter Readings by logging onto "My DEP Account". If there are discrepancies or if the meter(s) appear to be malfunctioning, contact John Sexton, Chief, Energy Analysis & Planning Section.

2. Leaks – City Water
- Immediately isolate and repair in-house or submit Work Request to Engineering.

3. Effluent Water Strainer System
- Clean strainer basket once per day.
- If system is malfunctioning, repair leaks in-house or submit Work Request to engineering.
- Develop maintenance plans and schedules for effluent water pumps. Maintain the effluent water pumps in accordance with the developed plans and schedules and keep an inventory of spares.

4. Pump Packing – Use of Mechanical Seals
- Mechanical seals are only to be used on MSPs and effluent water pumps. They are only to be used in these type pumps if the application meets all applicable manufacturer's criteria. This applies to new pump purchases and when transitioning from traditional packing to mechanical seals.

5. Use of Effluent Water* instead of City Water
- Use effluent water instead of city water in the applications listed below.
- If an application could be sensitive to the use of effluent water instead of city water, contact the Energy Analysis & Planning Section for further evaluation.

MSPs	Ring Flush Water
Foam Control	Aeration Tanks
	Thickeners
	Final Tanks
	Chlorlorine Contact Tanks
Cooling Water	Blowers
	Engines
	Heat Exchangers
	Centrifuges
	AC Chillers
	AC Condensers

Dilution/Mixing	Hypochlorite
	Polymer
Cleaning/Washing	Tanks
Miscellaneous	Grit Washing
	Grit Suspension
	Agitation Water
	Balance Water (Thickeners)
	Flushing (Centrifuges)
	Blockage Removal in Pipes

* For cleaning/washing, utilize effluent water only if there will be no human contact with the surfaces after they have been cleaned with effluent water.

6. Use of City Water
- Do not use city water to freshen up tanks.
- When using any type of hose for washing down areas where city water must be used, a low flow nozzle should be utilized.

NYC Environmental Protection

Commissioner's Water Challenge

Plant	2012 Average Gallons per Day	10% Reduction from 2012 Baseline
Coney Island	252,906	25,291
Jamaica	177,790	17,779
Oakwood Beach	431,107	43,111
Wards Island	1,519,738	151,974
Total	**2,381,541**	**238,154**

Table 3: Potable water savings at wastewater treatment plants in the Commissioner's Water Challenge.

Typical flush valve in New York City public schools, 4.5 gpf

and Environmental Design (LEED®) rating system. As of June 2012, DOE and SCA have built four LEED® certified institutions:

- Early Childhood Center 361 (ECC 361), Bronx
- Mott Haven Academy Charter School, Bronx
- Public School 59 (Beekman Hill International School), Brooklyn
- Public School 62, Staten Island

While the City has made great progress toward ensuring that newly built public schools are sustainable, operation and maintenance challenges persist in older school buildings. When DEP analyzed DOE's water consumption using water meter data, we found that 85% of schools with the highest usage were built prior to 1970, when standard flow rates for toilets and urinals were typically five gallons per flush and three gallons per flush, respectively.

Many inefficient fixtures still exist in schools today and continue to consume large volumes of water. In 2012, DEP worked with SCA and DOE to initiate proof-of-concept water efficiency projects in two high schools in Queens. These pilot projects provided a detailed understanding of potential water savings and what it would take to expand the toilet and urinal replacement program to approximately 500 schools across the City. Additionally, DEP will work with DOE to repair or replace leaking faucets with 0.50 gallons per minute models and install 0.35 gallons per minute aerators where possible. The Municipal Water Efficiency Program presents an opportunity to make our public buildings more water efficient while educating students about water efficiency.

Initiative 3: Retrofit 400 Spray Showers and Replace Toilets and Urinals in 37 Recreation Centers, Increase Water Awareness through Signage

The city's parks and playgrounds are some of its most critical pieces of urban infrastructure and provide communities with a place to exercise or relax, a place for children to play and learn, and a place of respite from the fast pace of city life. Collectively, New Yorkers have access to more than 52,000 acres of city, state, and federal parkland. It is critical that we keep our parks and playgrounds clean and safe while using resources efficiently and with minimal impact on the natural environment.

Potable water is an important park amenity, as the Park Department's drinking fountains, public pools, and spray showers require that large volumes of water be readily available. Children can cool off and play in as many as 30 outdoor pools and 750 spray showers, which typically consume up to 7,000 gallons of water per day. These manually operated spray showers are running continuously and could be timed selectively to save potable water.

As part of an effort to reduce citywide water consumption by 50 million gallons per day under the Water for the Future Program, DEP and DPR have partnered to improve parks and water intensive playground infrastructure. Retrofits were already completed in the spring and summer of 2012 on two initial project sites, and DEP and DPR will continue to install automated timers on spray showers in playgrounds. The selected spray shower technologies, such as push-button timers or hydraulic activation bollards, were chosen based

Glendale Playground, automated water saving spray shower.

Photo credit: Uli Seit for NYTimes.

Case Study 2: Bayside High School and Hillcrest High School

Bayside and Hillcrest High Schools in Queens each have student populations in excess of 3,000 students and operate for most of the day. Bayside High School is an older building, constructed in the 1930s during the Great Depression era. The school has 33 bathrooms for students and faculty, all of which have older plumbing fixtures that consume large quantities of water. Fixtures in these bathrooms have not been subject to an overarching replacement program and can use between 3.5 to 5 gallons per flush. Hillcrest High School was built in the 1970s and has 26 bathrooms, the majority of which have water inefficient plumbing fixtures. Even in summer months, both schools are open and operating due to summer school programs that take place throughout the day. High occupancy rates and inefficient current plumbing fixtures make Bayside High School and Hillcrest High School ideal candidates for water conservation proof-of-concept projects.

After selecting these two candidate schools, DEP performed a full pre-construction survey of all bathrooms in each facility, during which all plumbing fixtures were characterized, evaluated and inventoried. Using the information on toilets and urinals from the pre-construction surveys, DEP developed a cost-benefit analysis for conserving water in the two schools. Total estimated water savings calculated as part of this cost benefit analysis are shown in Table 4. In order to validate the cost benefit analysis for fixture replacements, DEP also evaluated existing water service lines and installed meters on any unmetered lines feeding the sites to measure baseline water usage. DEP is in the process of collecting and analyzing water consumption data at both schools.

Fixture replacement work at Bayside High School began early in summer 2012 with the installation of new, high efficiency toilets. All 33 bathrooms at Bayside High School were completed within three weeks. Work at Hillcrest High School presented more challenges as fixtures were wall mounted, making removal and replacement more difficult. In addition to wall mounted fixtures throughout the building, nearly 50% of the plumbing, valves, and piping connected to the Hillcrest fixtures were concealed behind walls, further complicating replacement work. These proof-of-concept projects provided the basis for cost estimates and allowed DEP, SCA, and DOE to develop a streamlined process for future work.

School	Total Toilet Retrofits	Total Urinal Retrofits	Total Water Saved (GPD)	Total Water Saved (GPY)
Bayside HS	179	-	13,768	2,891,365
Hillcrest HS	89	28	14,900	3,129,024

Table 4: Total projected water savings for Bayside and Hillcrest High Schools, in gallons per day and gallons per year.

Bayside High School, Queens NY.

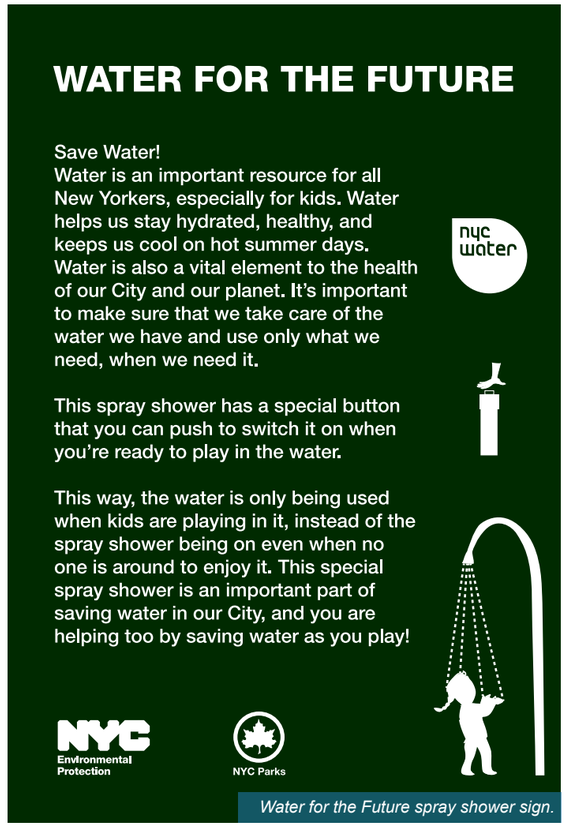
Photo credit:Alexa Asakiewicz

Hillcrest High School, Queens NY.

Photo credit:Alexa Asakiewicz

on locational feasibility and proximity of showers to comfort stations and restrooms.

The initial project sites are profiled as case studies in the following section under “Case Study 4”. DEP and DPR have since begun implementing a citywide Spray Shower Retrofit Program to retrofit 400 spray showers by 2016. These retrofits not only save drinking water but also ease pressure on the city’s wastewater treatment plants. In order to help promote this effort and to help children understand the significance of these changes in their parks and playgrounds, DEP and the Parks Department have added an educational component through signage that will inform park users of new features, the importance of saving water, and how children can play a role in water conservation. In addition to automating spray showers throughout the city, DEP and DPR will replace fixtures in 37 recreation centers. Since many of these facilities were built in the early to mid-1900s, many require water efficiency upgrades, and DEP will partner with the Parks Department to install water efficient toilets, urinals, and faucets.



Water for the Future spray shower sign.

Initiative 4: Replace Fixtures, Perform Leak Detection, and Meter Remaining Facilities in Public Housing Complexes

On January 20, 1934, New York City Mayor Fiorello H. La Guardia filed a certificate establishing NYCHA as the first public housing authority in the country. Less than two years later on December 3, 1935, a ribbon-cutting ceremony was held for First Houses, the city’s first public housing development, containing 123 new apartments each with a private kitchen and bath, electrical outlets, an electric refrigerator, and a stove. Eleven thousand New Yorkers submitted applications for the first apartments.

NYCHA’s core mission is to provide affordable, safe, and secure housing for low and moderate-income city residents. Today, nearly 420,000 New Yorkers or more than 5% of the city’s population live in 345 NYCHA developments throughout the five boroughs. As the city’s largest residential landlord, NYCHA manages and maintains a vast system of buildings, grounds, and mechanical and technological infrastructure to provide housing for its residents. NYCHA residents and management thus play crucial roles in the social, cultural, educational, and physical environment of the city.

Many NYCHA properties are old and have inefficient toilet fixtures that use anywhere from 3.5 to 6 gallons per flush. These buildings can also be densely populated, with larger dwelling units that have two or more toilets per unit. Although 103,000 toilets were replaced in NYCHA developments under the 1994-1997 Toilet Rebate Program, the remaining NYCHA units that were not able to participate are still operating with inefficient toilet fixtures. As part of the Municipal Water Efficiency Program, DEP is working with NYCHA to identify NYCHA properties in need of toilet fixture retrofits.

NYCHA has an incentive to pursue conservation measures in their properties as they transition from frontage rates to the Multi-family Conservation Program, which requires participants to implement specific conservation measures to remain on flat-rate billing. Under program eligibility rules, at least 70% of each type of fixture (i.e. toilets, showerheads, and faucets) must be high-efficiency in existing properties and WaterSense® certified fixtures must be installed in all newly constructed or substantially renovated units. Properties must have a contemporary water meter and an Automatic Meter Reading device installed by January 2014

Case Study 3: SolarOne Water Teacher's Guide

The Green Design Lab is a program offered by SolarOne, an organization that promotes urban sustainability through education. SolarOne serves simultaneously as a park steward, a green education center, and a green jobs training organization. Specifically, the Green Design Lab program focuses on teaching students how to make city schools more sustainable. Students are educated about a variety of subjects, including the hydrologic cycle, water end uses, and various approaches to water conservation. Several examples of hands-on activities include mapping, water testing, and school water audits.

The Teacher's Guide is a tool that can be used to assist educators with development and implementation of a sustainability curriculum. The guide provides specific lesson plans for particular subject areas relating to our natural environment. The Teacher's Guide for the Water Unit is a particularly relevant tool in the context of the *Water Demand Management Plan*. It provides lesson modules for teaching students about water and contains a series of hands-on activities designed to help students apply what is learned in the classroom to their own schools and environments.

After learning where their water comes from, students hear about the many end uses of water and how best to conserve it. The modules emphasize simple behavioral changes, like turning off faucets while brushing teeth, refraining from illegally opening fire hydrants, and taking short showers instead of baths. School water audits teach students how to investigate water usage in their school. For example, if leaks are discovered in school bathrooms, students are taught to record the rate at which the fixture is leaking in drops per minute. Students are then asked to estimate how much water is wasted per day due to the leak and develop different ways to fix and prevent future leaks.

The goal of the Green Design Lab is to teach students how to preserve and protect natural resources while learning more about the impact of their ecological footprint. The Green Design Lab is an excellent example of an educational tool to explain water efficiency and raise conservation awareness in city schools. DEP hopes to implement a similarly successful education program across all city schools as part of the fixture replacement projects under the Municipal Water Efficiency Program.

Rainwater harvesting.

Photo credit: Matismehdi

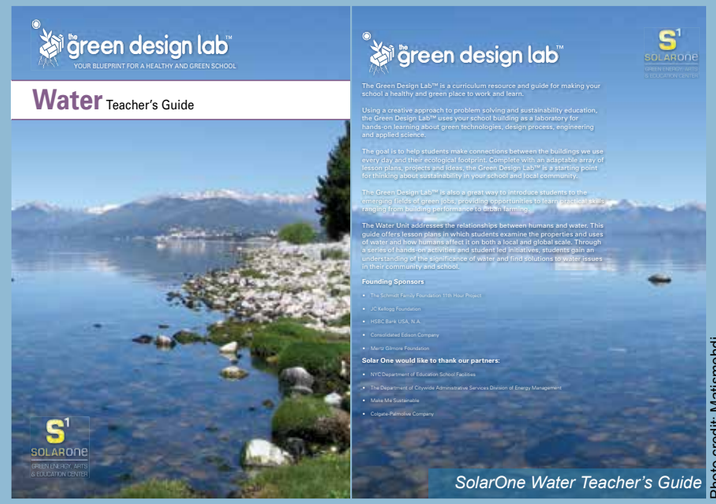


Photo credit: Matismehdi

and high-efficiency plumbing fixtures installed in 70% of all units by June 2015. Toilets installed as a part of DEP's original 1994-1997 Toilet Rebate Program do count toward this requirement.

DEP will partner with NYCHA to distribute notification flyers and perform interior leak detection surveys on a random sample of units. Through this effort, DEP will work with housing complexes comprised of at least three buildings to complete these perimeter leak detection surveys, essentially inspections of the underground service lines connecting buildings in a complex to the water main in the street.

DEP has also partnered with NYCHA to meter its remaining facilities and help facility managers track their water usage, a significant task given that NYCHA accounts for approximately 4% of the city's total consumption or 38 million gallons per day. Metering these facilities and detecting inefficiencies will be crucial, especially during the shutdown of the Delaware Aqueduct.

Initiative 5: Replace Fixtures in Universities and Increase Water Efficiency Awareness

CUNY is the third largest university system in the United States, with nearly 550,000 students at campuses located throughout the five boroughs. The system consists of 11 senior colleges, seven community colleges, and seven graduate and professional schools. Originally known as the Free Academy and later renamed the City College of New York (CCNY) the first CUNY campus was established in 1847 to offer an affordable education to public school students in New York City. CCNY remains the oldest institution among all CUNY colleges and to date has nearly 16,000 students (undergraduate and postgraduate) and approximately 3,000 faculty and staff members.

Given the year round operations and the sizeable student body, CCNY is an ideal candidate for water conservation. Campus planning and facilities management staff at CUNY already operate and manage a large portfolio of buildings throughout the entire university system. In order to assure a more sustainable CUNY and a sustainable New York, executive staff established the CUNY Task Force on Sustainability. CUNY has committed to investing the necessary resources to construct, retrofit, and maintain more sustainable and green facilities. All 23 CUNY Institutions and their leaders, with the support of the Task Force, have worked to establish specific and measurable ten year sustainability plans in order to reach their energy goals by 2017. As part of the Mayor's Carbon Challenge, the CUNY Sustainability Project, and the Municipal Water Efficiency Program, DEP and CCNY have established a mutually beneficial partnership to implement water conservation projects at CUNY campuses citywide. Through this partnership, DEP will work with CUNY to reduce water usage through installation of high efficiency toilets and urinals. DEP will additionally support efforts to repair or replace faucets with 0.50 gallons per minute models or 0.35 aerators and to install meters in remaining facilities.

Aerial view, CCNY campus.

Photo credit: CCNY

Brooklyn College Library.

Photo Credit: Anna Hadjigeorgiou

Case Study 4: Maple Playground and Glendale Playground

In the spring of 2012, DEP and DPR identified a significant and mutually beneficial water conservation opportunity under the Municipal Water Efficiency Program. DPR had previously completed spray shower automation retrofits on a handful of spray showers throughout the city, but limited funds prevented DPR from proceeding with planned system-wide retrofits.

Under the Water for the Future and Municipal Water Efficiency Programs, DEP is seeking a reduction of 50 million gallons per day in citywide water consumption by the year 2020. Based on detailed analyses, DEP and DPR estimated that retrofitting 400 spray showers throughout the city over the next four years would yield savings of approximately 1.5 million gallons per day.

DEP and DPR then worked together to identify two DPR sites to implement spray shower automation retrofits and assess consequent water savings. Maple Playground and Glendale Playground in Queens were selected based on their respective site characteristics, which would allow both types of spray shower retrofit technologies to be tested. A push-button retrofit device was installed for the spray shower at Maple Playground and an activation bollard retrofit device was installed for the spray shower at Glendale Playground. After checking that water meters were properly functioning on service lines at both sites, Automatic Meter Reading transmitter devices were installed to enable the data collection of baseline water consumption numbers.

Water service was turned on at both sites in mid-May, prior to the beginning of the Memorial Day to Labor Day spray shower season, and meter data was collected until retrofit work began in July. Once both spray shower retrofit projects were completed by mid-July, former DEP Commissioner Carter H. Strickland, Jr. and former DPR Commissioner Adrian Benepe held a press event at Glendale Playground to celebrate the program.

Former Commissioner Strickland commented on DEP's commitment to the implementation of a citywide spray shower retrofit program by stating, "New York City water is one of the city's most precious resources, and it's important that we conserve it wherever we can while also enhancing opportunities for New Yorkers to enjoy water outdoors. By retrofitting spray showers at playgrounds throughout the five boroughs we will improve sewer capacity and reduce waste." Commissioner Benepe remarked, "The Parks Department is pleased to partner with DEP to promote sustainability through green infrastructure and water conservation. The installation of timers at spray showers across New York City will conserve water and reduce the amount of runoff that enters our sewers, helping to prevent sewer overflows and water pollution during heavy rains."

Maple Playground in Queens. Photo credit:Alexa Asakiewicz

Glendale Playground in Queens. Photo credit:Alexa Asakiewicz

Engine Co. 224, Brooklyn, NY. Photo credit: FDNY Photo Unit.

Engine Co. 201, Brooklyn, NY. Photo credit: FDNY Photo Unit.

Initiative 6: Replace Inefficient Fixtures in Firehouses, Implement Water Recovery Project, and Increase Hydrant Security

The Fire Department, City of New York has 218 fire houses throughout the five boroughs where battalions of firefighters, commanding officers, and executive staff sleep, shower, eat, and exercise between shifts. The garages in these fire houses are also used to store and wash trucks and refill water tanks on the city's fire engines. FDNY also maintains a large facility on Randall's Island where many firefighters are trained and equipment is tested and maintained. The FDNY Training Center uses large volumes of water to test equipment and train new and existing firefighters.

DEP is working with FDNY to identify plumbing fixtures that can be replaced with newer, high efficiency models. In the spring of 2012, the two agencies collaborated to identify a group of 12 fire houses that are larger in size, serve large numbers of FDNY staff, and did not have a recent bathroom fixture upgrade. FDNY staff then surveyed the bathrooms in each of the fire houses to assess the type and flow rate of toilets and urinals. The results of the FDNY survey indicated that most of the fixtures in the bathrooms in the 12 fire houses were older models, using 3.0 to 3.5 or more gallons per flush. DEP provided funding for the fixture replacements, while FDNY contributed in-house resources to perform the installation work

The Fire Academy at Randall's Island has grown in size and class capacity in recent years. Classes, equipment testing, and training activities at the Academy are conducted year round, using water daily when the weather is above freezing. The Chauffeur School, Probationary School, and Tactical Training units implement training and equipment testing modules that consume vast quantities of water. DEP is exploring additional water conservation measures with FDNY at the Training Academy facility on Randall's Island. The FDNY Training Center uses significant volumes of water to test equipment and train new and existing firefighters. Operating seven days a week at peak training months, the Training Facility can use over 40 million gallons of water per year. FDNY has proposed a Water Recovery Project to capture and reuse the water that is currently being used for training or testing fire suppression equipment. FDNY has identified the Chauffeur School as consuming the largest volume of water, at approximately 14.5 million gallons per year. The school trains future engine chauffeurs through a nine day course and tests the water pump systems on all FDNY apparatuses.

Case Study 5: City College of New York and Bronx Community College

Photo credit: CCNY.

Shepherd Hall, CCNY campus.

Photo credit: BCC

Aerial view, Bronx Community College.

CCNY is an important strategic partner of DEP with a firm commitment to sustainability in their campus and facility planning. One ongoing project involves the replacement of about 840 inefficient toilets and urinals on campus with new high efficiency models. 500 standard flow toilets consuming at least 3.5 gallons per flush and 340 urinals consuming at least 1.5 gallons per flush will be replaced by CCNY maintenance staff. The new, efficient toilets (1.28 gallons per flush) and urinals (0.125 gallons per flush) will result in total estimated savings of 11,570,000 gallons of water per year and a 71% reduction in overall water consumption. CCNY and DEP staff are also coordinating the initial stages of fixture replacement work at CCNY. Prior to commencing work in any of the bathrooms, DEP will have water meters and Automatic Meter Reading devices installed on all service lines feeding the CCNY campus. We will also monitor water consumption through meters to establish baseline consumption levels. DEP and CCNY plumbing staff have conducted a survey of existing meters and water lines servicing all buildings on campus.

DEP has also established a similar partnership with Bronx Community College (BXCC) and has identified approximately 570 toilets and urinals in approximately 30 buildings on the BXCC campus. DEP staff are working with engineering staff from the college to install water meters and Automatic Meter Reading transmitters on selected water lines to begin tracking current water usage. DEP will provide funding to retrofit toilets and urinals in BXCC facilities with high efficiency models (1.28 gallons per flush and 0.125 gallons per flush, respectively).

DEP and FDNY will also work together to continue educational outreach on illegally opened fire hydrants. An analysis of 311 calls regarding illegally opened or leaking fire hydrants revealed that they contributed to a loss on average of between three million gallons per day in November and December and 40 million gallons per day in June and July from 2003 to 2010. During each summer of this same eight year period, illegally opened fire hydrants wasted a volume of water equal to 7.3% of the 2020 projected daily average consumption of 1,093 million gallons per day (Table 5). In 2010, 40% of the 311 open or leaking hydrant calls were immediately investigated and the average response time from time of call to time of repair fell from approximately 22 hours to just seven minutes. The average amount of water lost per open hydrant fell by 99% from 368,000 gallons to 5,000 gallons. Reducing the 311 response time to seven minutes on average is estimated to save 18.37 million gallons per day during summer months.

DEP has also partnered with community groups to implement education programs on proper hydrant use and water conservation. In 2011, DEP partnered with the South Bronx Overall Economic Development Corporation to expand the Hydrant Education Action Team (HEAT) program, a community-based program that provides employment and community service opportunities to residents and young professionals eager to make a positive difference in people's lives. The program, first started in 2007, targets communities that historically have had the highest number of open fire hydrants: Manhattan Community Board 12 (Washington Height/Inwood), Bronx Community Board 4 (Grand Concourse), and Bronx Community Board 5 (Fordham).

The HEAT program aims to educate community residents and stakeholders about the problems surrounding the illegal use of fire hydrants. The program's Street Teams distribute educational flyers and posters and promote the use of sprinkler caps to safely and legally open fire hydrants. The teams also suggest alternative methods of staying cool, such as going to a local park or pool. Through these means of local engagement, DEP hopes to give everyone a chance to learn about the Hydrant Education Action Team mission and actively experience it as stakeholders within their community.

Demonstrating the effectiveness of hydrant spray caps.

Randall's Island FDNY training facility.

As % of 1,093 mgd of Projected 2020 In-City Average Daily Water Use

Month	2003	2004	2005	2006	2007	2008	2009	2010
January	0.40%	0.50%	0.20%	0.30%	0.50%	0.40%	0.40%	0.30%
February	0.30%	0.60%	0.50%	0.40%	0.50%	0.20%	0.50%	0.20%
March	0.20%	0.30%	0.30%	0.40%	0.50%	0.40%	0.30%	0.20%
April	0.40%	0.40%	0.50%	0.50%	0.40%	0.50%	0.60%	0.30%
May	0.40%	1.00%	0.50%	1.40%	2.40%	0.40%	0.70%	1.00%
June	1.60%	4.90%	6.90%	3.10%	3.80%	4.50%	0.80%	3.50%
July	1.40%	3.20%	3.30%	7.60%	3.70%	3.30%	3.50%	2.30%
August	1.90%	2.40%	3.60%	3.20%	2.00%	1.80%	7.30%	2.10%
September	0.40%	0.70%	1.20%	0.60%	1.10%	0.60%	0.40%	0.70%
October	0.30%	0.40%	0.40%	0.50%	1.10%	0.50%	0.30%	0.30%
November	0.20%	0.40%	0.40%	0.30%	0.30%	0.40%	0.20%	0.30%
December	0.20%	0.30%	0.20%	0.30%	0.20%	0.20%	0.30%	0.20%

Table 5: Water lost from illegally-opened fire hydrants in the city as a % of 1,093 MGD of projected 2020 in-city average daily water use. Based on duration of open hydrants.

STRATEGY 2:

Residential Water Efficiency Program

Initiative 1:	Initiate Toilet Replacement Program to Replace Inefficient Toilets in Multi-Family Conservation Program Properties	**10 MGD**
Initiative 2:	Replace the Remaining Inefficient Toilets in Residential Properties	**20 MGD**
Initiative 3:	Install water conserving fixtures in homes under the NYC Build It Back Program	**0.8 MGD**
Initiative 4:	Continue Residential Water Surveys and Distribution of Home Water Savings Kits	**0.4 MGD**

Total Savings: 31.2 MGD

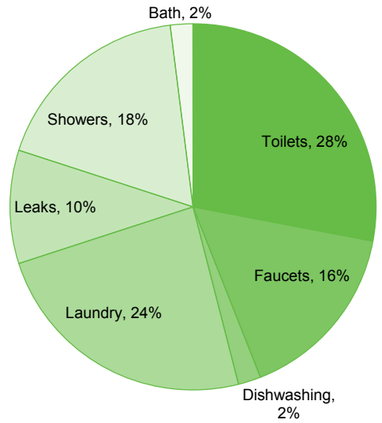
STRATEGY 2

RESIDENTIAL WATER EFFICIENCY PROGRAM

Multi-family buildings, Queens, NY.

Residential properties make up one of the most water intense land use categories in New York City. In order to determine the best conservation plans for specific sectors, DEP undertook a rigorous analysis of water usage using meter and Automatic Meter Readings. The data showed how different types of land use exhibit varying degrees of water consumption. DEP used this information to select programs that would meet the aggressive and accelerated conservation goals under the Water for the Future program. Since New York City is undeniably a vertical city, we understood that most of our gains would come from indoor residential uses. Figure 13 shows that multi-family buildings have the highest citywide water demand, accounting for 325 million gallons per day. The residential sector as a whole accounts for 80% of the city's total water demand (approximately 666 million gallons per day).

Looking at specific opportunities for indoor water savings, it became clear that toilet use comprised the largest percentage of water consumption. Surveys show that toilet use accounts for 28% of indoor water use in the average single family home and even more in multi-family dwellings. Laundry, showers, and faucets trail closely behind in percentages of water consumed through inefficiencies like toilet and faucet leaks. Under the following initiatives, DEP will provide incentives, create partnerships, and promote simple housekeeping practices to keep our residential buildings as water efficient as possible.



For reference (Figure 2): Indoor water use in a typical single family home.

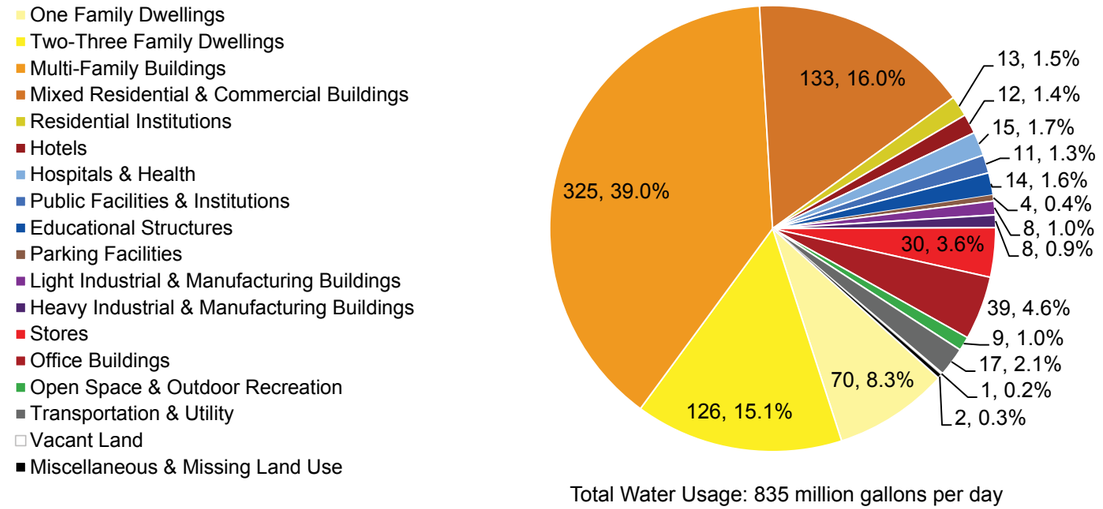


Figure 13: Total water usage in New York City by land use (This does not include unaccounted for water, which is approximately 21%).

Initiative 1: Initiate Toilet Replacement Program to Replace Inefficient Toilets in Multi-Family Conservation Program Properties

DEP began the original Toilet Rebate Program in the Bronx in early 1994, scaling up a pilot throughout the five boroughs within a few months. Toilet replacements took place in more than 6,000 multifamily buildings and 1,500 one-to-three person family homes, as well as in commercial properties. DEP estimates indicate that this program saved the city approximately 90 million gallons in water use per day at a fraction of the cost to finance additional water supply and wastewater treatment infrastructure projects.

The newly designed Toilet Replacement Program will be modeled on the successful 1994 program and administered in two phases. Phase I of the program, which will begin in 2014 and has a capital funding commitment of approximately $20 million, is estimated to reduce citywide water demand by 10 million gallons per day in the years leading up to the temporary shutdown of the Delaware Aqueduct. The program is intended to reap substantial water savings at low cost by helping private sector residential buildings reach a minimum 70% installation rate for high-efficiency toilets. DEP estimates that benefits will extend to approximately 250,000 dwelling units in the first phase of this two year effort specifically designed for customers working to meet the requirements established by the Multi-family Conservation Program.

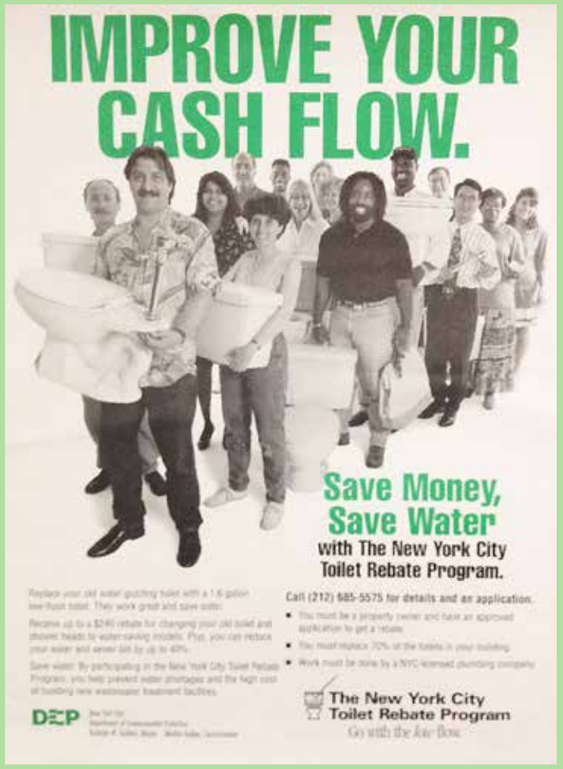
To service customers participating in the Toilet Replacement Program, DEP will contract with five to ten wholesale plumbing supply vendors throughout New York City. The vendors will work with DEP to accept customer vouchers, provide adequate plumbing fixtures, and track sales in order to report on the program's progress. DEP has designed an online portal that will serve as an easy and convenient means of communication for property owners and wholesalers to address toilet voucher issuance and compensation. The web portal will also provide a list of approved high-efficiency toilet models that meet the design specification requirements of the voucher program. Program participants will be able to apply on the online portal for vouchers in the amount of $125 per toilet.

Applicants can log on to My DEP Account to submit their application. If the application is approved upon DEP review, we will send an e-mail to both the property owner and the TRP Authorized Representative. The participant has 90 days from the approval date to purchase approved fixtures with their vouchers. Once the voucher has been deactivated and the fixtures have been purchased, all fixtures must be installed within 90 days. DEP program managers will also be able to track and monitor the status of vouchers and documentation of confirmed installations in a dedicated interface on the portal.

Case Study 1: Toilet Rebate Program of the 1990s

In 1994 DEP initiated the Toilet Rebate Program to incentivize fixture retrofits in low-income, high-density apartment buildings. Based on internal research, DEP found that water savings could be maximized by installing low-flow toilets in low-income apartment buildings with traditionally high operating cost to rent ratios, in areas of the city with historically high levels of water consumption and wastewater flows. Many wastewater treatment plants were operating at or over capacity when DEP decided to implement the Rebate Program. As noted in Figure 14, the dry weather flows were reduced dramatically over the course of the Rebate Program, which targeted building owners and managers, licensed plumbing companies, and energy and water service companies. Through the program, DEP offered a rebate of the installation cost up to $240 for the first toilet and showerhead replaced in a residential dwelling unit, and $150 for additional bathrooms in the same dwelling unit. For the purposes of this program, a dwelling unit was defined as an individual apartment or a private home. Commercial occupancies received a rebate of $150 per toilet replaced. In order to qualify for the rebate, applicants with multi-family residential and commercial properties were expected to plan replacements for at least 70% of the buildings' toilets.

To participate in the Toilet Rebate Program, customers first had to have their rebate application approved, after which they could purchase toilets and showerheads as necessary. Upon completion of fixture installations, toilets removed from multifamily residential and commercial buildings were required to be delivered to designated drop-off sites by a licensed commercial waste carter. Program participants then submitted a Post Installation Package detailing the work performed. DEP conducted installation verification inspections and issued a rebate check once a DEP inspector approved all conditions. The Toilet Rebate Program replaced a total of 1.3 million toilets and reduced citywide water consumption by approximately 90 million gallons per day. As noted in Figure 14, additional water savings resulted from other efficiency measures such as metering and leak detection.



A promotional poster for the original Toilet Rebate Program.

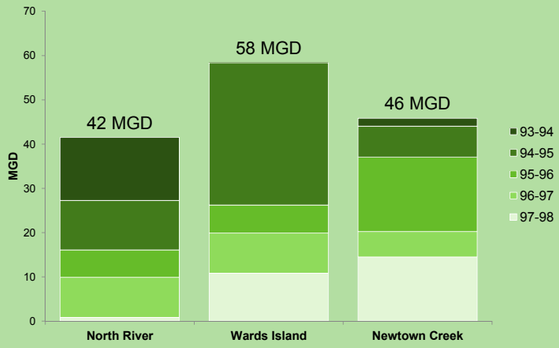


Figure 14: Total water savings in selected wastewater treatment plant drainage areas during the original Toilet Rebate Program. Total water savings represented in this graphic are attributable to the Toilet Rebate Program as well as other water conservation measures implemented at the time.

WaterSense® labeled high-efficiency toilets are the only toilets eligible to be purchased under the Toilet Replacement Program; the one exception extends to residential flushometer toilets with matched valves and bowls that are rated 1.28 gallons per flush by appropriate national standards and Maximum Performance (MaP) Tested with a score of at least 350 grams. WaterSense® certified high-efficiency toilets have been defined by the plumbing industry and EPA as those that use an average of 20% less water per flush than the industry standard of 1.6 gallons per flush, and which meet requirements for minimum flush performance and adjustability.

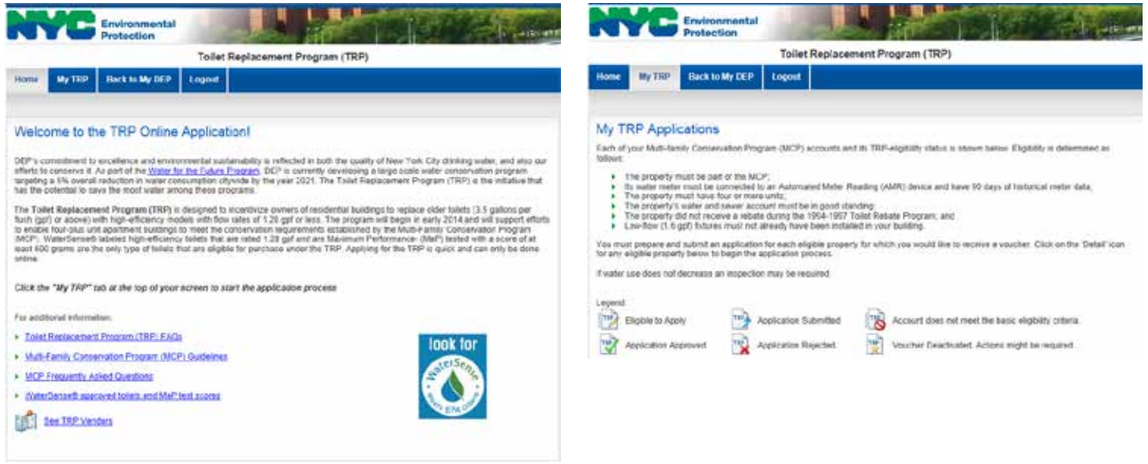
Initiative 2: Replace the Remaining Inefficient Toilets in Residential Properties

While Phase I of the Toilet Replacement Program was designed to accommodate the transition of buildings to the Multi-family Conservation Program, Phase II is designed to incentivize toilet replacements in all remaining housing that did not participate in Phase I or in the original Rebate program of the 1990s. DEP estimates that there are approximately 500,000 units in residential buildings that could benefit from voucher based incentives.

Phase II should produce the greatest results of all proposed conservation programs detailed in this Plan, with water savings totaling approximately 20 million gallons per day. Given that most of the Phase II components, such as the web portal and vendor relationships, will be set up and tested in the preceding phase, DEP will be able begin this portion of the program shortly after completing Phase I. Since this phase will target a larger pool of customers, it will be administered over the course of three years starting in 2016.

In addition to partnering with wholesaler plumbing supply vendors that accommodate large buildings likely to participate in Phase I, DEP will contract with smaller retailers accessible to lower density housing. DEP will revisit standards and may require new standards by 2016 as technology evolves and new information emerges. For example, on November 2012, MaP Testing announced the development of a new PREMIUM label for the highest performing water-efficient products, which include tank-type toilets, home water softeners, showerheads, urinals, home humidifiers, and on-demand hot water distribution systems.

MaP PREMIUM toilet fixtures are intended for residential use only. MaP Testing is dedicated to identifying the most efficient indoor water-using products that also meet high performance thresholds; product testing for MaP is performed by seven qualified independent laboratories situated in Asia and North America. The MaP PREMIUM label will identify products that set themselves apart based on their high level of efficiency and exceptional performance. The label has already been assigned to 73 different residential toilet fixture models offered by 22 different brands. Each of these PREMIUM toilet fixtures qualified with flush levels of 1.06 gallons (4.0 liters) or less, achieving a MaP score of at least 600 grams (21 ounces) of waste, and has been independently certified to meet the U.S. EPA WaterSense® Program specification for tank-type toilets.



Examples of the functionality of the Toilet Replacement Program Online Application. Participants in the program can use this online portal to apply for and redeem vouchers.

Case Study 2: Recycle Discarded Toilets from DEP's Toilet Replacement Program

According to DEP estimates, the Toilet Replacement Program could generate as many as 750,000 discarded toilets over the next five years. From the onset of the program, DEP has committed extensive resources to ensuring that material from discarded toilets can be reused. Porcelain material, in many ways similar to glass, can be incorporated into numerous processes that require aggregate-like material. When crushed and processed, the resulting byproduct can be used as sub-base in sidewalks, in DEP's own Green Infrastructure Program, and even in oyster beds. DEP estimates that Phases I and II will produce 10,500 tons and 22,500 tons of crushed porcelain, respectively.

To manage this anticipated waste stream, DEP partnered with the New York City Department of Design & Construction (DDC) and DPR to process and recycle the discarded toilets and incorporate the porcelain into municipal capital and green infrastructure projects. DDC has modified design specifications for city sidewalk projects to allow contractors to use coarse aggregate and crushed porcelain mixture as sub-base material. Initial calculations indicate that DDC can use an average of up to 700,000 toilets per year of scheduled projects, assuming sub-base recycled mixture accounts for 20% of the total.

To meet the goals of *NYC's Green Infrastructure Plan* released in September 2010, DEP will control stormwater runoff from 10% of impervious pavement by 2030. With the support of various partnerships, DEP proposes to meet this goal by achieving 1.5% impervious area capture by 2015, an additional 2.5% by 2020, an added 3% by 2025 and the remaining 3% by 2030. DEP is working closely with DPR and the Department of Transportation (DOT) to install thousands of right-of-way bioswales (Figure 15). Right-of-way bioswales are similar to existing tree pits, and are built within sidewalks upstream of existing catch basins to capture runoff from the street and sidewalk. Given the overlaps between water conservation and stormwater management through green infrastructure, DEP has been able to incorporate what might otherwise be waste into our green infrastructure projects, showcasing our commitment to resource management. DEP is in the process of evaluating the material for use as subsurface storage media in the city's right-of-way bioswale projects.

In addition, DEP and other environmental organizations are currently piloting several oyster demonstration studies within the New York-New Jersey Harbor Estuary. These studies have already shown that sediment movement can impact the quality and survival of oysters and additional substrate structure is required to avoid sediment accretion. To reduce mortality, the oyster bed is typically raised off the harbor bottom to avoid sediment deposition, but conducting this process with shell and rock can be expensive or hindered by limited materials. By using crushed toilets as a substitute substrate structure to help oysters survive and reproduce, DEP will reduce these costs and provide a sustainable replacement option.

Close up of crushed toilets.


Crushed porcelain.

Crushed toilets in a roll off dumpster.

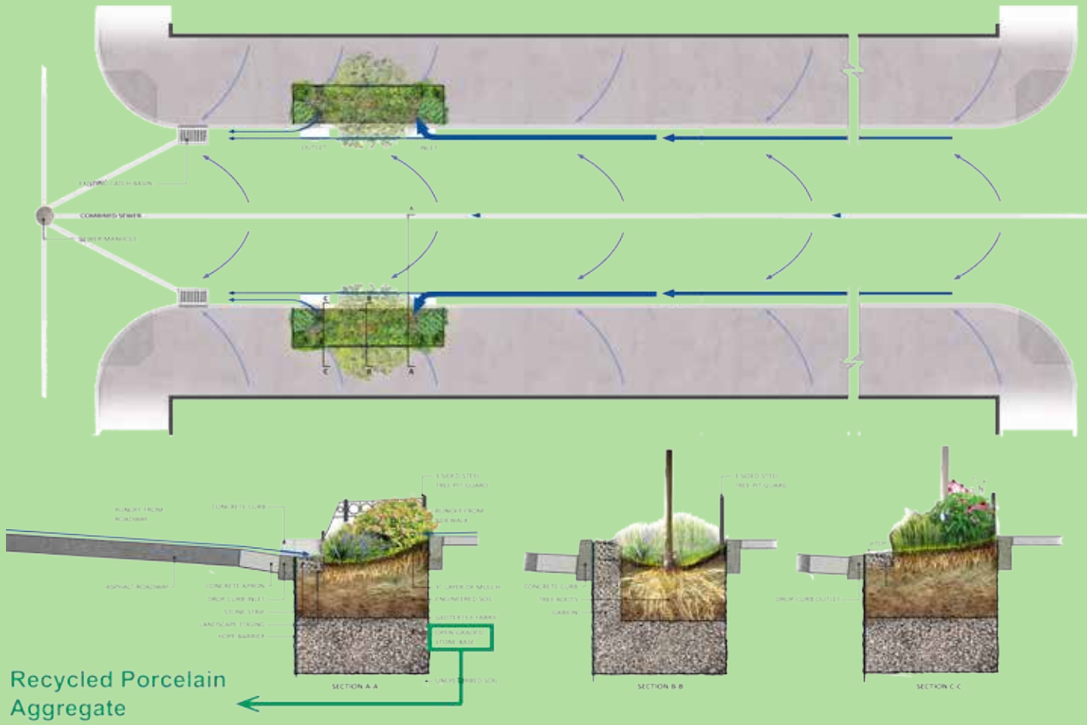


Figure 15: Cross-section of Right-of-way Bioswale. Open-graded stone base would be substituted with recycled porcelain aggregate.

Case Study 3: MaP Testing

Maximum Performance (MaP) testing establishes standard performance thresholds for bulk waste removal in high-efficiency toilet models. Using a realistic test media consisting of toilet paper and a soybean paste imitation of human waste, each toilet model is ranked based on performance against the established criteria. The original minimum performance benchmark adopted by MaP was 250 grams of waste (plus toilet paper), indicating that an efficient toilet fixture should completely evacuate at least 250 grams of waste from the fixture in a single flush action. Minimum performance thresholds of 250 grams (approximately 9 ounces) and 350 grams (about 12 ounces) were chosen based on numerous studies that measured the amount of solid waste deposited at each 'sitting'. Initial MaP recommendations set a 250 gram performance minimum for toilets to be 'qualified' as acceptable, and later increased the minimum to 350 grams; the U.S. EPA's WaterSense® Program also selected 350 grams for their tank-type toilet specification.

Since the inception of the MaP Testing method, more than 3,000 different fixture models have been tested by approved laboratories and the current database of fixtures includes over 2,700 different models such as single flush, dual-flush, ultra-low flush, high-efficiency toilets, tank-type, and commercial flushometer valve and bowl combinations. The MaP test protocol has been well received by consumers, water providers, architects and engineers, builders, retailers, and manufacturers alike. Many water agencies and municipalities in the U.S. and Canada consider the results of MaP testing when evaluating which toilet models to promote, subsidize, or rebate.

Initiative 3: Install water conserving fixtures in homes under the NYC Build It Back Program.

In June 2013, Mayor Bloomberg announced the opening of registration for the NYC Build it Back Program, New York City's program to assist homeowners, landlords, and tenants in the five boroughs whose homes and properties were damaged by Hurricane Sandy. Funded by the US Department of Housing and Urban Development (HUD), NYC Build It Back provides several pathways to help affected residents return to permanent, sustainable housing by addressing unmet housing recovery needs in several categories. One component of the NYC Build it Back Program provides for installation of water conserving fixtures in the entire home. DEP has committed to providing $5 million dollars of additional funding to the NYC Build it Back Program to provide high-efficiency water fixtures which will be installed by program contractors in storm damaged homes. The Department of Housing Preservation and Development (HPD), the Mayor's Office of Housing Recovery and DEP estimate that installation of high efficiency fixtures in all of the homes registered under the Build It Back Program could save approximately 1 million gallons of water per day.

More than 22,000 New Yorkers have already registered for the NYC Build It Back Program. This partnership gives DEP the opportunity to assist an ongoing program through promoting water savings in homes affected by Hurricane Sandy while making a substantial impact toward broader water conservation goals. With the help of Federal support, and collaboration between City agencies and the Mayor's Office, we can repair and rebuild more sustainable, water efficient and resilient homes and buildings with benefits to the natural environment, to our water system and to all New Yorkers.

Initiative 4: Continue Residential Water Surveys and Distribution of Home Water Savings Kits

DEP believes in the importance of educating our customers on water saving opportunities in their own homes and businesses and as part of our commitment, will continue to provide free Residential Water Surveys and Home Water Savings Kits upon request. Certain small commercial properties such as restaurants also qualify for these kits. A written report summarizing the findings is then distributed to the owner or manager of the property.

Customers can request a Residential Water Survey by contacting DEP's Bureau of Customer Services Call Center and can submit a written request for a Home Water Savings Kit to the Bureau of Customer Service. The Residential Water Survey Request Form is also available on the DEP website and can be mailed, faxed, scanned, or emailed to DEP.

As part of the Water Demand Management Program, DEP will improve its existing Residential Water Survey model by developing a web application that allows property owners to replicate methodology used by DEP's contractors. Through these efforts, DEP will expand access to residential water surveys and increase education around residential water conservation techniques.

Customers should look for the WaterSense® logo on certified models when replacing older fixtures.

Case Study 4: EPA WaterSense® Program

WaterSense® is an EPA partnership program that seeks to protect our nation's water supply by offering a certification program for water-efficient products. The program seeks to help consumers make smarter water choices that save money and conserve water without compromising performance. Products and services with the WaterSense® label have been certified to be at least 20% more efficient while continuing to meet industry performance standards and are backed by independent third party certification. The WaterSense® label can be found on the following types of products:

- Bathroom sink faucets and accessories
- New homes
- Showerheads
- Weather-based irrigation controllers
- Toilets & urinals

The WaterSense® program has developed product performance standards in water efficiency for outdoor, new home, commercial and consumer product based applications. Toilets are a major focus of the WaterSense® program given that they account for nearly 30% of an average home's indoor water consumption. The WaterSense® label is awarded to toilets that consume 1.28 gallons per flush, compared to older, inefficient models that can use as much as 6 gallons per flush. According to the WaterSense® website, the replacement of all inefficient toilets in the United States with WaterSense® labeled models would generate about 520 billion gallons per year in water savings, a volume of water equivalent to that flowing over the Niagara Falls in about 12 days.

WaterSense® and EPA are working to expand the number of products and service programs that qualify for the label, and current qualified products can be viewed on the EPA WaterSense® website. EPA also features newly certified water-efficient products on the Pipeline section of the EPA WaterSense® website

Photo credit: InterContinental Hotel

STRATEGY 3:

Non-Residential Water Efficiency Program

Initiative 1:	Promote Water Conservation Efforts in Various Sectors	**0.04 MGD**
Initiative 2:	Develop a Cost Sharing Program	**1.0 MGD**

Total Savings: 1.04 MGD

Photo credit: Carlton Hotel

Carlton Hotel, Manhattan, NY.

STRATEGY 3

NON-RESIDENTIAL WATER EFFICIENCY PROGRAM

Beyond the Municipal and Residential Water Efficiency Programs, DEP will work with non-residential sectors on water conservation efforts and develop informed, mutually-beneficial policies that incentivize water efficiency, reuse, and alternative water use. In its efforts to establish these partnerships and corresponding policies, DEP will conduct cost-benefit analyses, establish long-term compliance management and maintenance requirements, develop reporting mechanisms and benchmark indicators, and, where appropriate, incentivize water efficiency. This strategy represents an exciting opportunity for water conservation projects, and DEP has already begun to collaborate with private industry groups whose members manage large individual properties and portfolios of properties in New York City.

Initiative 1: Promote Water Conservation Efforts in Various Sectors

On April 22nd, 2013, DEP partnered with the Hotel Association of NYC, Inc. and the Mayor's Office to develop the Mayor's Water Challenge to Hotels – a public-private partnership designed to encourage hotels to reduce their annual water consumption by 5%. Established in 1878, the Hotel Association of NYC (HANYC) is one of the oldest professional trade associations in the nation. Its membership includes more than 260 of the finest hotels in the city, representing more than 70,000 rooms and 32,000 employees. The HANYC is an internationally recognized leader in the city's $5 billion tourism industry, and is the first private sector group to partner with the City on reaching water reduction goals.

As the DEP has provided support to the hotels in the Challenge to date to reduce their water consumption, the hotels have in turn identified ways in which DEP may adapt the Challenge for future participants so that it may best enable participating hotels to reduce their consumption. One recommendation of this year's participants is that DEP provide water conservation education to future participants several months in advance of the commencement of the next Challenge, so that hotels may include any investments necessary to enable significant savings (such as the replacement of inefficient bathroom fixtures or dishwashers) in their upcoming annual budgets. DEP is committed to the continual improvement of its efforts, and will do its best to follow this and other recommendations as it plans and implements future initiatives to partner with hotels and other groups of commercial customers.

The Mayor's Carbon Challenge is a comparable initiative that was launched in 2007 as part of the PlaNYC sustainability plan; the challenge targets energy efficiency in buildings in order to reduce citywide greenhouse gas emissions 30% by 2030.

While DEP has begun by partnering with hotels, the ability to establish additional partnerships with other groups of commercial customers will also play a key role in achieving these reductions. About 35% of all non-residential water consumption comes from large commercial buildings in the city, which use approximately 57 million gallons per day. A 25% reduction in demand from these large water users would translate to roughly 14 million gallons per day. Commercial buildings have a significant opportunity to realize such water savings due to the scarcity of past efforts to target water efficiency in tenant spaces. The water use in toilets, sinks, and kitchens within these large non-residential buildings demonstrates the potential for financial savings and conservation efforts. The Mayor's Water Challenge plans to invite New York City's commercial tenants to join hotels; commercial entities such as restaurants, universities, hospitals, and office buildings to reduce their per square foot water usage by 5%.

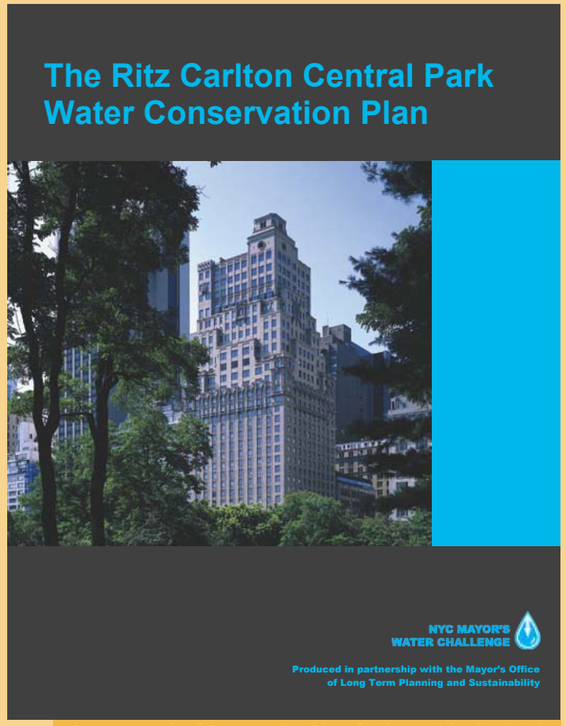
Initiative 2: Develop a Cost Sharing Program

DEP hopes to unveil a new cost sharing program by 2015 and is currently in the process of evaluating and developing criteria. Benefits from incentivizing water reuse and alternative use extend to the deferred capital costs of large-scale water, wastewater, and stormwater infrastructure, reduced loadings to sewers and water bodies, improved environmental stewardship, and increased capability to manage demand on the water supply system. The program will be designed to target water efficiency in the non-residential sector, and will encompass a diverse set of technologies that address: water-cooled refrigeration in food related businesses, hotels or health care facilities, reuse of water in laundry and car wash facilities, steam condensate use for toilet or urinal flushing, cooling tower makeup water or other non-potable uses, increasing cycles of concentration in cooling towers, changes to water industrial processes, climate based smart irrigation controls, and water reuse for non-potable applications, such as toilet flushing and irrigation.

Case Study 1: Tracking Progress Mayor's Water Challenge to Hotels

The Mayor's Water Challenge to Hotels is a twelve month sustainability challenge inviting the private sector to partner with the City and the Mayor's Office to implement water conservation measures in their properties. Eleven hotels accepted the Challenge in its' inaugural year, and many other hotels throughout the city have expressed an interest in participating in the future. Since the start of the Challenge six months ago, DEP has been working with program participants to track, monitor and report on changes in water consumption attributable to implementation of new water conservation measures. Challenge participants were asked to submit a formal Water Conservation Plan, which summarizes the facility plan for achieving the targeted 5% reduction in water use from the baseline water year.

The Mayor's Water Challenge is a voluntary challenge to private sector groups to match the city's goal to reduce citywide water usage by 5% over the next seven years. Through this initiative, our private sector partners will reduce their water usage, measured in terms of water usage intensity, by 5% from their baseline year over the course of one year. A Challenge kick-off meeting was held on June 5th with the representatives of hotels that have elected to participate; 11 of the city's premier hotels have accepted the Challenge in its inaugural year. If all 11 hotels are successful in achieving the targeted 5% water use reduction over the next 12 months, total potential water savings could exceed 12 million gallons of water within a year. In addition to potential recognition for their water efficiency efforts, hotels may realize significant financial savings from these reductions. The 11 participating hotels consumed between 50,000 and 320,000 gallons of water per day during the last 12 months, and could realize savings of between $10,000 and $70,000 in annual water and sewer costs if the 5% reduction goal is met.



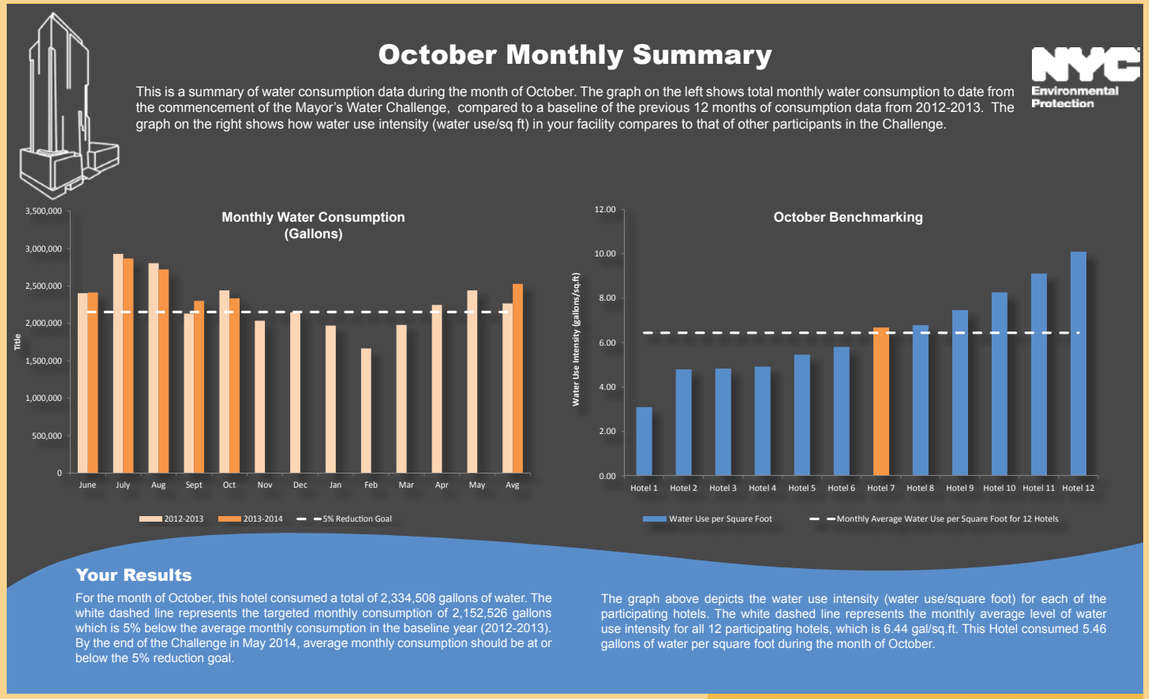
Cover example of Conservation Plans for the participating hotels.

As part of the program, participants will track water use, develop a Water Conservation Plan, attend regular meetings with other Water Challenge participants, attend annual one-on-one meetings with Mayor's Office and DEP staff, and convene voluntary working groups with DEP and the Mayor's Office.

Each hotel has had an Automated Meter Reading device installed for more than 12 months to track water consumption and establish a baseline profile of water use. As part of this project, the city will facilitate regular meetings with industry experts and ancillary organizations to provide the contacts, best practices, and technical assistance needed to realize meaningful reductions in water use and costs. Water reduction strategies may include good housekeeping techniques such as finding and repairing leaks quickly, and developing literature that encourages hotel visitors to practice water conserving behavior. Physical upgrades such as the replacement of inefficient plumbing fixtures will be considered, in addition to the adoption of new technologies that minimalize water use. DEP will track Automated Meter Reading data to determine how various water reduction strategies are affecting each hotel's overall water consumption.

An additional benefit of participating in the Challenge is a Monthly Summary Progress and Benchmarking report, provided to each participant. DEP staff compile monthly consumption data for all 11 participating hotels and distributes a personalized report to the accountable hotel managers. This report shows the current monthly consumption levels for each hotel, as well as the water use intensity metric (gal/sq.ft.) benchmarked against the other hotels in the Challenge. These reports are customized for each hotel so participants can only view the water data belonging to their specific facility, but can see an anonymous comparison of their hotel to the other hotels in the Challenge.

Hotels in the Challenge that developed Conservation Plans and implemented identified water conservation strategies have achieved to date an average reduction of 7.5% in their water use against their consumption in the baseline year.



Monthly Summary Progress and Benchmarking Report.

STRATEGY 4:

Water Distribution System Optimization

Initiative 1:	Expand the Leak Detection Program	**0.83 MGD**
Initiative 2:	Optimize Pressure Management	**VARIABLE**
Initiative 3:	Optimize Metering and Automatic Meter Reading Infrastructure	**2.5 MGD**
Initiative 4:	Replace Large Meters Where Necessary to More Accurately Quantify Water Usage	**VARIABLE**

Total Savings: 3.33 MGD

STRATEGY 4

WATER DISTRIBUTION SYSTEM OPTIMIZATION

Sonar leak detection equipment helps staff determine the likely location of leaks.

Through the Universal Metering Program, DEP and its customers have been able to monitor water usage, detect inefficiencies, and track water demand citywide. The infrastructure that provides water to our customers every day is massive and primarily underground, hidden from view. Mains and service connections that range in size from one to 96 inches carry water from three main in-city tunnels to the city's residences, business, and institutions. This massive infrastructure must be continually monitored, maintained, repaired, and eventually replaced. DEP continues to search for ways to improve our water system and to ensure that New Yorkers are receiving top quality water in the most sustainable way.

Initiative 1: Expand Leak Detection Program

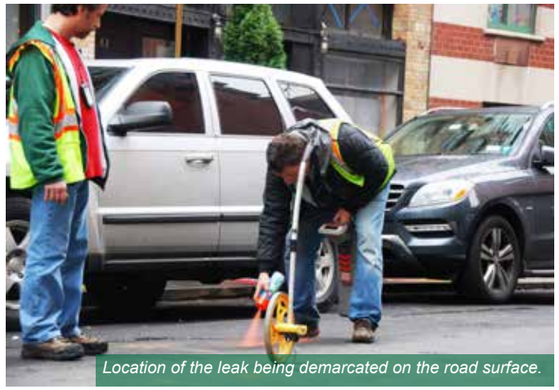
In the late 1970s, DEP created a Leak Detection Unit to prevent water loss and property damage by identifying leaks throughout the city's water distribution system. Roughly 40 years later, DEP's Bureau of Water and Sewer Operations continues to investigate infrastructure leaks and replace water mains as necessary. DEP's Field Operations personnel are equipped with cutting-edge sound monitoring equipment that identifies leaks without excavation by listening to the flow of water through water mains. As water escapes from the pipes, the equipment detects a distinct noise and alerts the crew members to the origins of the leak. Once identified, the pipe can be repaired before the leak develops into a larger water main break.

In 2011, DEP surveyed approximately 2,648 miles of water mains, and replaced 20.6 miles of water main lines. Leak detection crews reduced the volume of influent flow entering wastewater treatment plants by discovering unreported and undetected leaks, thereby preventing drinking water from unnecessarily leaching into the ground and getting into the sewer system.

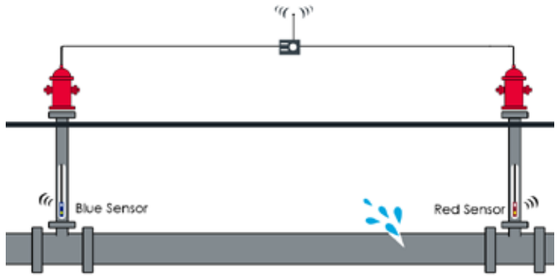
The main device used by leak detection crews is the Digital Correlator, which consists of two sounding devices placed on either side of the suspected leak. Each device is attached to an access point in the distribution system, located at every intersection and fire hydrant. The sounding devices transmit signals to the Digital Correlator handheld base station, which uses sound waves to calculate and pinpoint suspected problems in the system.

DEP Field Operation Personnel perform two important functions regarding leak detection: responding to complaints and implementing preventative programmatic work. When a suspected leak is reported to 311, DEP deploys crews to investigate the source of the leak. Crews also perform programmatic leak surveys as part of a proactive approach toward unreported water leaks. In particular, the water distribution system's older cast iron pipes are most problematic and result in more leaks than the newer, ductile iron pipes that have since been institutionalized.

In 2009, more than 4,000 miles of water mains were investigated and 389 leaks were located. By successfully detecting and repairing those leaks, DEP saved more than 60 million gallons of water per day. Due to the success of the Leak Detection Program and the potential for significant water savings, DEP is considering an expansion of the program to service connections on campus-like properties such as public-housing developments and educational institutions like CUNY. Existing leak detection efforts have typically targeted leaks in city water mains and connections in piping that run under streets and roadways. By expanding these efforts to private water lines and interconnections serving campus-like properties, DEP would be able to locate potential leaks before the water registers at a water meter on the property.



Location of the leak being demarcated on the road surface.



The leak detection equipment used in the field by DEP relies on sophisticated sonar senors and a correlation device to allow crews to pinpoint the exact location of a suspected leak on a service line.

Digital Correlator handheld base station.

Case Study 1: Leak Notification Program

In 2011, DEP launched the Leak Notification Program to proactively alert customers to potential water leaks. The program is largely made possible by the advance of technologies such as DEP's recently installed Automatic Meter Reading system. The program sends enrolled customers an email informing them of potentially costly leaks whenever their water consumption triples for five consecutive days. The Leak Notification Program was originally limited to owners of one, two, and three family homes. In February 2012, the program was expanded to include properties with four or more families and mixed-use properties. These large property owners have the option to customize their own alert parameters. Currently, all residential DEP customers with an Automated Meter Reading device are eligible for the Leak Notification Program.

DEP has sent more than 40,000 notifications and has saved its customers more than $33.5 million in otherwise wasted water or damaging leaks - the equivalent of 2.8 billion gallons. DEP will continue to develop new technological applications to help New Yorkers save time and money, and increase convenience as part of the city's commitment to making government more efficient, cost effective and customer friendly.

Initiative 2: Optimize Pressure Management

Pressure in the water distribution system is largely supplied by gravity. Downward pressure from Hillview Reservoir in Yonkers, which is roughly 300 feet above sea level, forces water through tunnels and into a network of water mains throughout the five boroughs. Pressure in the water distribution system is then controlled by a series of regulators and valves that are designed to supply and maintain reliable pressure throughout the city. In 2007, DEP began a program to reassess the system's different pressure zones in an effort to prevent sudden pressure spikes that can cause water mains to leak or break.

While breaks in water mains are inevitable, driving the number of breaks down is essential to ensuring that the city remains a desirable place to live and do business. To that end, DEP has employed cutting edge technology and increased preventative maintenance over the past several years, leading to a record low number of breaks in 2012.

Since the beginning of the pressure management program in 2007, water main breaks have decreased by more than 40%. In 2012, there were 347 breaks in the city's network of nearly 7,000 miles of water mains, a notable decrease from a high of 632 breaks in 2003. This average of less than six breaks per 100 miles of pipe is well below the accepted industry average of 23 to 25 breaks per 100 miles per year.

In 2010, DEP also reorganized its Valve and Regulator Repair Unit to more proactively inspect equipment and make repairs, which has helped minimize unintended spikes in water pressure and contributed to the reduction in water main breaks. In 2011, the network of remote sensors that monitor pressure at water tunnel shafts and key regulators was expanded to include every pressure zone in the city. The sensors send a signal to DEP headquarters and allow engineers to identify potential problems and make repairs before the water distribution system can be damaged. In 2012, DEP performed more than 5,300 preventative maintenance inspections on the City's roughly 500 water pressure regulators and rebuilt almost 90 of them.

Code	Description	Code	Description
K02	Regulated Low (K2)	Q06	Regulated Very High (Q6)
K03	Regulated Intermediate (K3)	Q07	Pumped Low (Q7)
K05	Unregulated High (K5)	Q08	Pumped Intermediate (Q8)
K06	Pumped Low (K6)	Q10	Rockaway Low
M01	Low (M1)	R03	Regulated Intermediate (R3)
M02	South Intermediate (M2)	R04	Regulated High (R4)
M03	Middle Intermediate (M3)	R05	Gravity (R5)
M04	North Intermediate (M4)	R07	Pumped Low (R7)
M06	Unregulated High (M6)	R08	Pumped Intermediate (R8)
M07	Tower (M7)	R09	Pumped High (R9)
Q01	QueensLow(Q1)	X01	Low (X1)
Q02	Regulated Low (Q2)	X03	Intermediate (X3)
Q03	Regulated Intermediate (Q3)	X04	Marble Hill Intermediate (X4)
Q04	Boosted Pumped (Q4)	X06	Unregulated High (X6)
Q05	Regulated High (Q5)	X07	Boosted High Riverdale P.S. (X7)

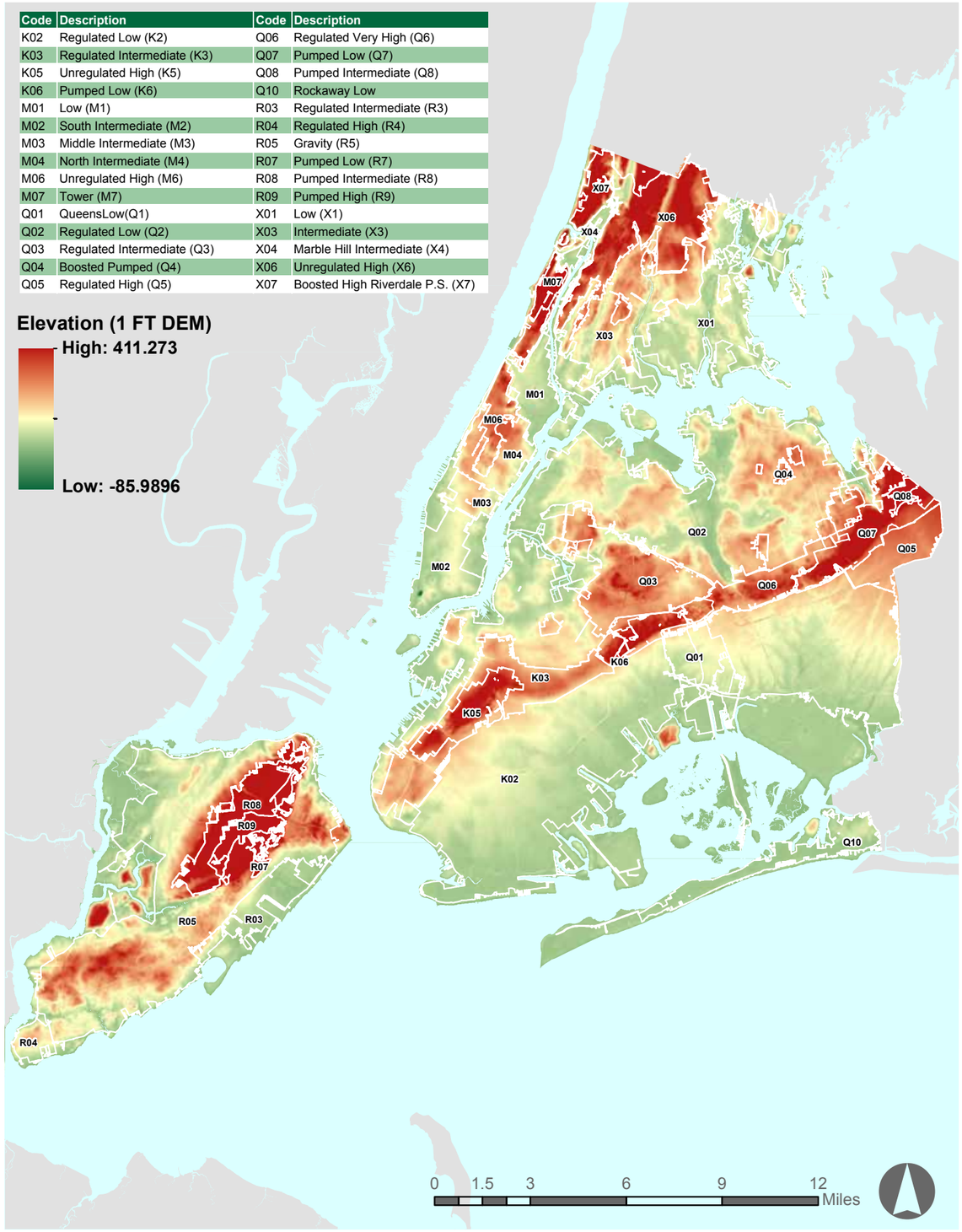


Figure 16: Pressure Management Zones and associated codes, citywide.

Initiative 3: Optimize Metering and Automatic Meter Reading Infrastructure

In FY10 and FY11, properties on a fixed charge accounted for approximately 30% of overall daily water demand in the City, as shown in Figure 17. By converting high consumption multi-family buildings from fixed charges to the Multi-family Conservation Program, DEP hopes to further expand its water meter and Automatic Meter Reading infrastructure through the program's conservation requirements. DEP will also be able to improve tracking and monitoring of water demand in this segment of the customer population.

For the launch of the program in 2009, DEP planned to install Automatic Meter Reading devices on all 836,000 customer accounts in three years. In 2012, DEP substantially completed the installation of its Automatic Meter Reading system for over 800,000 customers. DEP is working to further optimize metering and Automatic Meter Reading infrastructure, with the ultimate goal of monitoring an additional 30% of overall daily water consumption associated with non-volumetric customer accounts.

Under the Multi-family Conservation Program, owners of multiple family housing of four or more dwelling units once billed on a fixed charge based on building frontage can now be billed on a fixed charge per dwelling unit basis, in lieu of conversion to metered billing, if the owner implements required conservation efforts. The automatic conversion for frontage to the Multi-family Conservation Program occurred on June 30, 2012, and any qualifying property owner may now enroll.

To meet the eligibility requirements of the Multi-family Conservation Program and remain in the program, a multi-family complex of four or more dwelling units per building must have a DEP approved water meter and Automatic Meter Reading transmitter device installed on the entire property. This includes separate metering of substantial commercial customers that operate in a portion of the building (usually ground floor). To meet these metering stipulations, multi-family properties that were formerly unmetered will now be required to install meters and Automatic Meter Reading devices and observe water conservation requirements in their facilities.

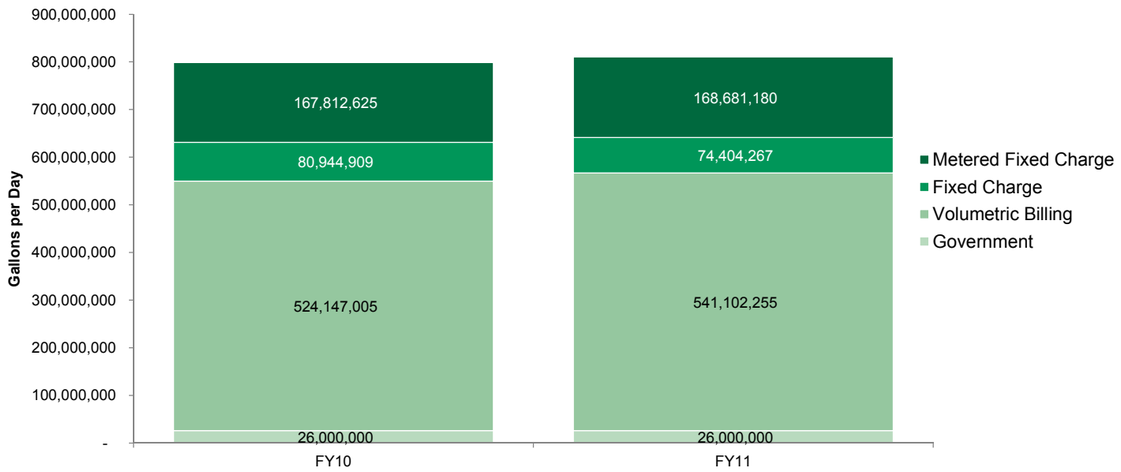


Figure 17: Consumption by account type, FY10 and FY11.

Initiative 4: Replace Large Meters Where Necessary to More Accurately Quantify Water Usage

Water meter parts tend to wear down over time and, as a result, may under register the amount of water being used. To track consumption accurately citywide, DEP developed a program to identify and replace older, less accurate meters, particularly in properties that consume significant amounts of water. Since properties in the city are billed based on consumption of water and sewer services, the impact of a bill depends on the conditions of the meter; accurate meters result in accurate water bills.

Maintaining reliable water meters is critical given that city consumption is 1.2 billion gallons per day. If the water meter data is incorrect by even 1% of that amount, DEP would be unable to account for approximately 12 million gallons per day.

In order to replace these meters, DEP has relied upon its own contractors since the 1990s and also allows property owners to replace their meters using their own Licensed Master Plumbing Company under the Reimbursable Metering Program.

DEP has invested in the modernization of its infrastructure by replacing older meters with new ones that utilize more efficient and durable technology. Our agency continues to replace old water meters with new technology meters such as single-jet, electronic and advanced vertical turbine meters. Compound meters and two inch positive displacement meters are just two examples of older meters that are being replaced; meters can also be oversized, which can be a source of flaws in reporting.

Currently, actual minute-by-minute flows are being studied to determine how much water is consumed in buildings at different flow rates. This information, along with results of accuracy tests on old meters, has allowed our agency to better understand which meter types lose the most accuracy with age, and at which flow rates. DEP has begun to systematically replace old meters based on this developing model to maximize meter accuracy and improve conservation signals. The newer and more accurate meter types, such as single-jet and electronic meters, have fewer moving parts

A typical 2 inch single jet meter.

Meter testing facility.

and require less maintenance. Certain models, if customized by building owners, can feed meter data directly into building energy management systems for monitoring, benchmarking, and leak detection.

DEP also has a new testing facility where it is testing newer models, such as single jet and electromagnetic meters that have been installed in the last five years, for accuracy and quality of performance. A number of factors such as age, volume of water that has passed through the meter and the type of meter can affect overall accuracy, and the testing facility maintains a large database of this information on old water meters.

STRATEGY 5:

Water Supply Shortage Management

Initiative 1:	Establish City Agency Responsibilities to Lead the Water Use Reduction Efforts	**VARIABLE**
Initiative 2:	Develop a Public Outreach Program to Inform Customers of Water Supply Status	**5.04 MGD**
Initiative 3:	Adopt Emergency Rates	**VARIABLE**
Initiative 4:	Update Mandatory Water Use Restriction by Emergency Stage and Create Provisions to Allow for Scheduled Shutdowns And Infrastructure Repairs	**VARIABLE**
Initiative 5:	Provide Customers with Easy and Timely Access to Their Water Usage Data	**VARIABLE**

Total Savings: 5.04 MGD

STRATEGY 5

WATER SUPPLY SHORTAGE MANAGEMENT

Cannonsville Reservoir during the 2001 drought.

New York City has experienced approximately nine drought periods of record over the last 75 years. Over time, water efficiency and conservation measures have become increasingly important during drought times. Water shortage relief efforts have played a significant role in reducing demand when water supply has been limited. In order to ensure a coordinated and rapid response to water supply shortage conditions, DEP has developed and implemented standard operating procedures and water use restrictions for periods of shortage. As our water supply infrastructure ages and as climate and weather patterns become more difficult to predict and increasingly severe in magnitude, it is crucial that DEP re-evaluate existing water use restrictions and adapt them to address the changing landscape of current and future conditions.

In addition to potential future water shortages due to natural hydrologic conditions, DEP will also temporarily shut down the Delaware Aqueduct in 2021. Through the Water for the Future program, DEP is working to ensure that sufficient water is available during such construction and through drought periods. The new plan will effectively reduce water use based on the type of water supply shortage condition. As part of this process, DEP is revisiting its existing water supply shortage management plan to incorporate updated information regarding water end uses and to allow the city to implement the updated rules and plan during scheduled and unscheduled infrastructure repairs.

DEP initiated the rules and plan update process by revising existing 1998 documents and proposing that the revised rules and plan be renamed the “Water Supply Shortage Management and Contingency Plan and Rules”. This title is meant to convey the message that water shortages can occur due to temporary water infrastructure construction activities, planned outages, drought conditions, or other emergencies that affect water supply. Before developing rules and a new plan, DEP staff conducted an in-depth analysis of the impacts of water supply shortages, demand reduction potential, emergency rate structures, and water conservation measures of the city drinking water supply and DEP customers. Based on the results of this analysis, DEP has developed a set of recommended improvements to the existing rules and plan that will be incorporated when the rules are promulgated and the plan is updated.

Water shortage rules are meant to provide the greatest water savings with the least amount of customer inconvenience. DEP is proposing a five-pronged approach to water supply shortage management as an effective way to reach customers and encourage them to reduce water use during planned and unplanned water shortage emergencies. This approach aims to:

- Establish city agency responsibilities to lead water use reduction efforts
- Develop a Communications Strategy to inform customers of water supply status
- Establish an emergency rate structure for each stage
- Update mandatory water use restrictions for each emergency stage and create provisions to allow for scheduled shutdowns and infrastructure repairs
- Provide customers with easy and timely access to their water usage data

The estimated water savings generated by this five-pronged approach includes those associated with mandatory water use restrictions and additional voluntary indoor water use reductions. Residential and non-residential customers were evaluated separately. The analysis behind this recommended approach includes the use of DEP’s Automatic Meter Reading data to estimate the effectiveness of irrigation water use restrictions.

A summary of the estimated water savings from the proposed mandatory restrictions and voluntary water reduction practices by emergency stage is provided in Table 6 for the summer (or peak season) months of May to October and Table 7 for the winter (or base season) months of November to April.

Sector and Use	(% of 1,182 average daily mgd in summer (a))		
	Stage I	Stage II	Stage III
Mandatory use restrictions - All Customers Other Than NYC Agencies (b)	39.65	56.15	65.17
	(3.35%)	(4.75%)	(5.51%)
Mandatory use restrictions - NYC Agencies (b)	20.8	21.8	22.35
	(1.76%)	(1.84%)	(1.89%)
Additional water use reductions from actions other than mandatory restrictions:			
Residential - In-City (c)	31.82	47.74	63.65
	(2.69%)	(4.04%)	(5.38%)
Non-Residential - In-City (c)	6.52	9.78	13.05
	(0.55%)	(0.83%)	(1.1%)
Customers outside NYC responding to Emergency Water Rate	0.08	0.23	0.52
	(0.01%)	(0.02%)	(0.04%)
Total	**98.87**	**135.7**	**164.73**
	(8.36%)	**(11.48%)**	**(13.94%)**

Table 6: Potential summer water use reductions by DEP Customers during water shortage emergency in average daily MGD by Stage
(a) Summer is May to October. The 1,182 MGD of In-city summer use projected for 2020 was used instead of the total 1,321 In-City plus Upstate Customer summer use. This is because the water use reductions of the upstate customers reported in this table is very small. The In-city summer water consumption may provide a more useful metric. The average annual water use of upstate customers was 120 MGD from July 2011 to June 2012 and 139 MGD when averaged over the summer months of July to October 2011 and May to June 2012.
(b) For all mandatory restrictions, 100% compliance is assumed.
(c) Residential and Non-Residential in-city water use reductions from measures other than the mandatory restrictions assume a customer participation of 20% under Stage I; 30% under Stage II; and 40% under Stage III. For example, a customer participation of 20% means that 20% of customers are implementing these measures 100% of the time or that 100% of the customers are implementing these measures 20% of the time or some combination in between.

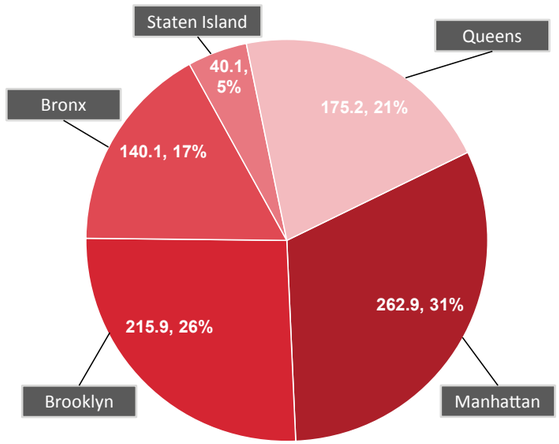
Sector and Use	(% of 1,024 average daily mgd in winter(a))		
	Stage I	Stage II	Stage III
Mandatory use restrictions - All Customers Other Than NYC Agencies (b)	20.8	20.81	20.81
	(2.03%)	(2.03%)	(2.03%)
Mandatory use restrictions - NYC Agencies (b)	5.27	5.27	5.27
	(0.51%)	(0.51%)	(0.51%)
Additional water use reductions from actions other than mandatory restrictions:			
Residential - In-City (c)	31.82	47.74	63.65
	(3.11%)	(4.66%)	(6.22%)
Non-Residential - In-City (c)	6.52	9.78	13.05
	(0.64%)	(0.96%)	(1.27%)
Customers outside NYC responding to Emergency Water Rate	0.08	0.23	0.49
	(0.01%)	(0.02%)	(0.05%)
Total	**64.49**	**83.82**	**103.26**
	(6.30%)	**(8.19%)**	**(10.08%)**

Table 7: Potential winter water use reductions by DEP Customers during water shortage emergency in average daily MGD by Stage
(a) Winter is November to April. The 1,024 MGD of In-city winter use projected for 2020 was used instead of the total 1,125 MGD In-City plus Upstate Customer winter use. This is because the water use reductions of the upstate customers reported in this table is very small. Use of the In-city winter water consumption may provide a more relevant metric. The average annual water use of upstate customers was 120 MGD from July 2011 to June 2012 and 101 MGD when averaged from November 2011 to April 2012.
(b) For all mandatory restrictions, 100% compliance is assumed.
(c) Residential and Non-Residential in-city water use reductions from measures other than the mandatory restrictions assume a customer participation of 20% under Stage I; 30% under Stage II; and 40% under Stage III. For example, a customer participation of 20% means that 20% of customers are implementing these measures 100% of the time or that 100% of the customers are implementing these measures 20% of the time or some combination in between.

Distribution of Demand

As part of the analysis of recommended updates to the rules and plan, DEP performed geographic analysis of water consumption throughout the five boroughs which examined consumption patterns by land use, by groups of large water users, as well as trends in seasonal usage. The focus of the study was to evaluate spatial and sectoral patterns of water demand. By analyzing water usage at various levels of aggregation, we were able to better understand where demand management opportunities exist, both geographically and by customer type.

Figure 18 shows the distribution of water demand by borough, using water consumption data from 2011. Understanding that the greatest proportion of water demand in New York City comes from Manhattan, would allow DEP to customize a public outreach and communications plan to target the customers in Manhattan and tailor the message to address the types of predominant water end uses found in that borough.



Total Water Usage: 835 million gallons per day

Figure 18: Distribution of water demand by borough, FY11 data (This does not include unaccounted for water, which is approximately 21%).

Initiative 1: Establish City Agency Responsibilities to Lead Water Use Reduction Efforts

In the event that a water supply shortage condition is declared, city agencies responsible for demand reductions will be among the first to respond to the situation through implementation of mandatory and voluntary water use restrictions. As a part of the ongoing revisions process, DEP will be gathering input on the revisions and providing all city agencies with the final rules and plan, so that all responsible agencies can incorporate relevant restrictions and standard operating procedures into their own emergency operations and maintenance protocols. In addition to DEP's rules and plan, many city agencies have existing drought emergency plans that are more stringent and specific to the nature of their operations. Primary action items for DEP and city agencies during each phase of water supply shortage will change with as stages progress. During the 'Watch' phase, DEP's responsibilities are primarily operational. Once the City declares a water shortage, DEP must apprise New York State Department of Health, the Department of Environmental Conservation (DEC), the Department of Health and Mental Hygiene (DOHMH), upstate communities, and Delaware River Basin Commission on system status, institute a city and regional water supply shortage awareness campaign, and initiate dialogue with the Mayor's Office, Office of Emergency Management (OEM), and other city agencies concerning actions to be taken in the next phase (Warning). In collaboration with OEM, DEP will contact each of the required agencies to confirm that standard operating procedures for demand management under water supply shortage conditions have been reviewed, updated and are in place.

If and when DEP is required to elevate a water shortage to the Warning stage, DEP will prepare water supply augmentation infrastructure to be brought online according to shortage conditions, increase coordination with upstate communities and city agencies, and reduce fleet washing activities and water usage at DEP facilities. In order to lead emergency conservation measures by example, DEP and required agencies will undertake activities that in past droughts were executed under emergency stages. During the Warning stage, the Department of Sanitation (DSNY) will suspend all street flushing activities and reduce fleet washing. The New York City Police Department (NYPD) and FDNY will assist in closing illegally opened hydrants and reduce fleet washing. DPR will limit water use for fountains and golf courses and cease providing make-up water for artificial ponds and lakes, unless the feature is a pre-existing animal habitat. NYCHA and HPD will request plumbing leak surveys and appropriate repair work, seek installation of water efficient fixtures, and restrict lawn watering. The Metropolitan Transportation Authority (MTA) will reduce fleet washing activities. DOE will initiate water supply shortage condition awareness programs for students. The Department of Citywide Administrative Services (DCAS) will conduct leak survey and repair activities where necessary in city facilities and cease building-washing activities. DOHMH will consider providing additional supply from groundwater wells and assist in notifications to food service establishments on water use restrictions.

Department / Agency	Action	Water Use in Annual MGD (a)	Estimated Savings in Average Daily MGD				
			Watch	Warn-ing	Stage I	Stage II	Stage III
Citywide Administrative Services	Mandatory Restrictions	0.18	0.00	0.01	0.01	0.01	0.01
Education	Mandatory Restrictions	6.67	0.00	0.24	0.24	0.34	0.39
Environmental Protection	Priority Hydrant Closure	Not Used	18.37	18.37	18.37	18.37	18.37
Environmental Protection	Mandatory Restrictions	4.28	0.00	0.15	0.15	0.22	0.25
Fire / Emergency Management (b)	Mandatory Restrictions	0.48	0.00	0.02	0.02	0.02	0.03
Health and Mental Hygiene	Mandatory Restrictions	0.1	0.00	0.00	0.00	0.01	0.01
Housing Authority	Mandatory Restrictions	42.47	0.00	1.51	1.51	2.14	2.48
Housing Preservation & Development	Emergency Restrictions	2.72	0.00	0.10	0.10	0.14	0.16
Metropolitan Transportation Authority	No Vehicle Washing (c)	0.1	0.00	0.01	0.01	0.01	0.01
Parks and Recreation	Mandatory Restrictions	2.77	0.00	0.10	0.10	0.14	0.16
Police	Mandatory Restrictions	0.96	0.00	0.03	0.03	0.05	0.06
Sanitation	Mandatory Restrictions	0.19	0.00	0.01	0.01	0.01	0.01
Zoos and Gardens	Mandatory Restrictions	2.73	0.00	0.10	0.10	0.14	0.16
All Other (d)	Mandatory Restrictions	4.11	0.00	0.15	0.15	0.21	0.24
Total			**18.37**	**20.80**	**20.80**	**21.80**	**22.35**

Table 8: Estimated water savings by New York City Departments and Agencies during summer months.

Department / Agency	Action	Water Use in Annual MGD (a)	Estimated Savings in Average Daily MGD				
			Watch	Warn-ing	Stage I	Stage II	Stage III
Citywide Administrative Services	Mandatory Restrictions	0.18	0.00	0.00	0.00	0.00	0.00
Education	Mandatory Restrictions	6.67	0.00	0.15	0.15	0.15	0.15
Environmental Protection	Priority Hydrant Closure	Not Used	3.78	3.78	3.78	3.78	3.78
Environmental Protection	Mandatory Restrictions	4.28	0.00	0.09	0.09	0.09	0.09
Fire / Emergency Management (b)	Mandatory Restrictions	0.48	0.00	0.01	0.01	0.01	0.01
Health and Mental Hygiene	Mandatory Restrictions	0.1	0.00	0.00	0.00	0.00	0.00
Housing Authority	Mandatory Restrictions	42.47	0.00	0.92	0.92	0.92	0.92
Housing Preservation & Development	Emergency Restrictions	2.72	0.00	0.06	0.06	0.06	0.06
Metropolitan Transportation Authority	No Vehicle Washing (c)	0.1	0.00	0.01	0.01	0.01	0.01
Parks and Recreation	Mandatory Restrictions	2.77	0.00	0.06	0.06	0.06	0.06
Police	Mandatory Restrictions	0.96	0.00	0.02	0.02	0.02	0.02
Sanitation	Mandatory Restrictions	0.19	0.00	0.00	0.00	0.00	0.00
Zoos and Gardens	Mandatory Restrictions	2.73	0.00	0.06	0.06	0.06	0.06
All Other (d)	Mandatory Restrictions	4.11	0.00	0.09	0.09	0.09	0.09
Total			**3.78**	**5.27**	**5.27**	**5.27**	**5.27**

Table 9: Estimated water savings by New York City Departments and Agencies during winter months.
(a) Water Use is estimated 2007 from City of New York, Water / Sewer Charge Report, March 2007, Table 1 except for Housing Authority which is from 2011 customer consumption data.
(b) Water used for firefighting and hydrant testing is not included in this water use estimate. The water use number represents water use for kitchens, showers, and bathrooms and water used under the Spray Cap Program of 0.03 MGD as indicated in Table 9 of the Water / Sewer Charge Report.
(c) According to the Water / Sewer Charge Report, vehicle washing and small construction is estimated to use 0.015 average daily MGD. 95% of this use is assumed to be vehicle washing.
(d) All other includes all other New York City agencies and departments included in Table 1 of the Water / Sewer Charge Report.

If and when the DEP is required to elevate a water shortage to the Emergency Stage, all actions described in prior stages will become mandatory. In addition to these initiatives, DEP will enforce Stages I-III Emergency Rules as appropriate, and invoke water restrictions and rules in upstate communities consistent with those in effect in the city. The agency will also continue activating water supply augmentation infrastructure, conducting leak and waste inspections, increasing enforcement capacity, and complying with the mandatory water use restrictions for the declared Emergency Stage. FDNY will conduct leak and waste reports during routine fire inspections, and NYCHA and HPD will encourage voluntary installation of water efficient fixtures.

Priority items for DEP, DSNY, FDNY, DPR, and MTA in particular pertain to closing of illegally opened hydrants, and curtailment and prohibition of street cleaning, irrigation, and vehicle washing. Tables 8 and 9 display estimated water savings by city agencies during the summer and winter months from various water reduction efforts taken during shortage conditions. DEP, the Mayor's Office, and other city agencies will lead by example in curtailing water usage during a declared water supply shortage, while striving to minimize shortfalls in public services provided to 8.3 million New Yorkers each day. The efforts of city government, combined with the implementation of a comprehensive public outreach program, will be imperative to managing water demand in these difficult circumstances.

WATCH

Accountable Agency	Priority Action
DEP	- Apprise NYSDOH, NYSDEC, NYCDOHMH, upstate communities, and DRBC on system status - Institute a City and regional water supply shortage awareness campaign - Initiate dialogue with NYC Mayor's Office and other City agencies concerning actions to be taken in the next phase (Warning). - Confirm that SOPs for demand management under water supply shortage warnings have been reviewed, updated and are in place. - Initiate OEM & DEP Water Shortage Condition Task Force (WSCTF) conference calls.

WARNING

Accountable Agency	Priority Action
DEP	- Increased coordination with upstate communities and city agencies and reduce fleet washing activities and water usage at DEP facilities. - Operational preparation for water supply augmentation infrastructure to be brought online. - Comply with Stage I Emergency Rules.
DSNY	- Suspend all street flushing activities. - Reduce fleet washing.
NYPD & FDNY	- Assist closing illegally opened hydrants . - Reduce fleet washing.
DPR	- Limit water use for fountains and golf courses, and cease providing make-up water for artificial ponds and lakes, unless the feature is a pre-existing animal habitat. -Pools must recirculate and be filled one time per year with minimal topping off.
NYCHA & HPD	- Request plumbing leak surveys and appropriate repair work and seek installation of water efficient fixtures. - Assist with issuing violations per Water Penalty Schedule - Restrict lawn watering.
MTA	- Reduce fleet washing activities.
DOE	- Initiate water supply shortage condition awareness programs for students.
DCAS	- Conduct leak survey and repair activities where necessary at City facilities & cease building washing activities. - Post necessary signage and assist with issuing violations per the Water Penalty Schedule.
DOHMH	- Maintain water quality regulation and assist w/ notifications to food service establishments. - Expedite approval for additional supplies from groundwater wells and other alternative water use proposals.

EMERGENCY

Accountable Agency	Priority Action
DEP	- Enforce Stages I-III Emergency Rules as appropriate. - Invoke water restrictions and rules with upstate communities consistent with those in effect in the city, conduct leak and waste inspections and increase enforcement capacity. -Implement public communication and outreach program for residents, businesses and industry in accordance with Emergency stage restrictions.
NYPD & FDNY	- Conduct leak and waste reports during routine fire inspections.
NYCHA & HPD	- Encourage voluntary installation of water efficient fixtures.

ALL CITY AGENCIES ARE EXPECTED TO COMPLY WITH PRIORITY ACTIONS IN WATCH AND WARNING STAGES, IN ADDITION TO EMERGENCY STAGE ACTIONS.

Initiative 2: Communications Strategy

During emergencies such as water supply shortages, it can be a challenge to adequately communicate the inherent complexities of such events to customers. New York State and New York City are tremendously diverse in population, culture, and industry. The messaging decisions associated with declaring a water supply shortage condition require close evaluation as these decisions will have corresponding effects on quality of life and commerce in the five boroughs and upstate communities.

To meet this challenge, DEP will use a combination of traditional and new media to inform customers about prevailing water shortage circumstances and their role in helping to conserve water and reduce overall demand. Messages intended for residents, community groups, elected officials, or other governments will be approved by DEP and may require additional approval by City Hall's Legislative Office. Additionally, DEP and the Mayor's Press Office must approve messages intended for traditional or social media. By instituting a formal message approval process with multiple stages of review, DEP will ensure consistency of information distributed to the public, that communications target the appropriate audience and are tailored to match the level of water shortage condition (i.e. Watch, Warning or Emergency).

DEP's Communication Strategy will utilize a range of tools to deliver information to a target audience. These include, but are not limited:

- Media announcements and social/digital media posts
- Notifications to elected officials/community boards/ civic organizations/religious institutions/service providers
- Direct community outreach/community meetings
- Direct mail/ marketing pieces/paid media
- Phone calls
- Emergency alerts or broadcasts/Notify NYC

The Communication Strategy will consist of a simple and efficient three step process to guide DEP staff through the messaging decision process. Identifying these steps as part of a formal strategy will enable rapid implementation of messaging and information distribution if and when a water shortage condition arises. These pre-defined messaging protocols are an essential piece of DEP's Communication Strategy and will enable the Agency to effectively engage the public in water conservation and demand management efforts when necessary.

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.

Water shortage conditions can vary in intensity and duration, depending on the cause of the shortage, level of water demand, and available auxiliary supplies. A shortage condition can arise due to hydrologic conditions in the watershed preventing our reservoirs from filling to appropriate levels, localized distribution system failures, or a conveyance infrastructure malfunction or failure which could cause an unplanned citywide water shortage condition requiring immediate response.

If there is a severe drought and DEP is asking all customers to conserve as much water as possible DEP will follow the three-step Messaging Decision process to reach a broad audience with a specific message. In this situation would use as many communications vehicles as possible to spread the message. However, since this is not an immediate threat to public health or safety it does not require the use of emergency alerts or broadcasts. DEP can determine if the message is being received by monitoring media reports and seeing if consumption declines.

Alternatively, DEP may encounter a scenario where the message needs to be tailored and delivered to a targeted customer group. For instance, when there is a service line break outside a building that is home to many elderly residents. The repair is complicated and the residents will be without water service for a week. In this example, the problem is localized so citywide media announcements are not appropriate and will not receive attention. In addition, the audience may not have access to computers, smart phones, or cable television. In this case, direct community outreach, phone calls, and flyers are a good way to reach the audience.

In the event of an unplanned failure of large-scale system infrastructure, DEP will take the most direct and rapid approach to administering the Communications Strategy. If an equipment malfunction at a fluoridation facility caused 40,000 gallons of fluoride to enter the water supply, the City would issue an order to not drink the water immediately. In this example there is an immediate threat to public health and safety. Messages would need to be timely, concise, accurate, and provide specific instructions. In this case, emergency alerts/

Case Study 1: Operations Support Tool

Heavy rain and snow affect our water supply by suddenly changing the quantity and quality of the water in New York City's upstate reservoirs. For example, heavy rain can cause an increase in turbidity that might affect how DEP uses the Catskill, Delaware, and Croton watersheds to meet the demands of its nine million customers. Lack of rain can cause water supply issues that lead to drought regulations.

Today's decisions on managing water supply require information about where the water supply will be months in advance. Reservoirs have dynamic elevation targets that change annually to account for seasonal variations in weather and past, current, and future inflow projections. DEP's new Operations Support Tool is a collection of predictive modeling and data acquisition tools that help DEP more accurately monitor reservoir levels east and west of the Hudson River. Whereas DEP previously used information on water quality, anticipated amounts of rain and snow, and current reservoir levels to calculate new balance targets several times a year, the Operations Support Tool automatically delivers continuous, real-time projections. For example, if heavy rain increases turbidity in one part of the supply system, the Operations Support Tool can predict how long it will take for water quality to improve, and just as importantly, how long we can sustain the volume drawn from a different reservoir to meet demand. In addition to expanding the calculations DEP already uses, the Operations Support Tool will eventually draw on newly-improved forecasts from the National Weather Service.

The City must also continually balance the needs of downstream communities while anticipating unpredictable factors such as prolonged droughts and infrastructure disruptions. The Operations Support Tool will enable DEP to divert or release water from each of its reservoirs at the best times. This not only protects downstream habitats and helps provide a cushion for storm impacts, but it also guarantees a reliable amount of the highest quality water is delivered to a growing city both now and into the future.

broadcasts should be considered and a press conference to provide the details of the event should be immediately scheduled. In addition to providing an update, a briefing schedule should be established at the press conference to let the press and public know when they will receive more information. During prolonged or serious emergencies, the Mayor's Office may activate the City's Joint Information Center at the Office of Emergency Management to create a multi-agency press office to handle communications about the incident.

Initiative 3: Adopt Emergency Rates

DEP has also evaluated the option of instituting an emergency water rate that would be applied during each water shortage stage, when the rate charged for water use above a health and safety threshold is significantly higher than under normal water supply conditions. Establishing an emergency water rate structure for each of the three emergency stages is an important component of the water supply shortage management plan and allows DEP to:

- Communicate the seriousness of the water shortage emergency;
- Encourage compliance with mandatory and voluntary water use restrictions;
- Recover revenue requirements when water use is temporarily reduced; and
- Recover additional costs of mitigating the water shortage.

The emergency rate would be used primarily to encourage water conservation. However it will also allow DEP to collect sufficient utility revenues to maintain operations while water shortages and restrictions are in place. An emergency water rate enables DEP to hedge against potential revenue shortfall during the period of water shortage and to protect the public from a resulting water and sewer rate increase.

The water use reduction expected under emergency rates represents price-responsive behavior on the part of customers. Water savings associated with emergency water rates will be embedded in the overall estimates associated with mandatory water use restrictions and voluntary reductions. An emergency rate is effective only when coupled with public communication, education programs, and the implementation of appropriate price signals.

Case Study 2: Lawn Irrigation Restrictions

To estimate the average frequency of lawn watering, daily water use data recorded from January 2011 to December 2011 by DEP's Automatic Meter Reading network was evaluated using a stratified random sample of 265 one family dwelling units in the five boroughs. The data showed that lawns associated with one family dwelling units are irrigated no more than 2.6 times per week on average, even during the peak irrigation season (Table 10). This yielded the conclusion that New York City lawns are not usually watered as frequently as the original restriction language implies, even during peak summer months of June through August.

The change to the Stage I lawn watering restriction is based on the subsequent assumption that no water use reduction should be expected under Stage I of the current Drought Rule. Under Stage I of the current rule, lawn watering is restricted to every other day. For this restriction to truly impact water use, the city's residents and businesses would need to be currently watering their lawns with that frequency. According to a Cornell University study, most lawns in New York require only 1 to 2 inches of water per week and much of this requirement is satisfied by rainfall.

Borough	Irrigation Season April-November	Peak Irrigation Season June-August	Shoulder Months April, May, Sept, Oct. & Nov.
Manhattan	1.37	1.82	1.1
Bronx	1.78	2.38	1.41
Brooklyn	2.09	2.39	1.92
Queens	1.88	2.49	1.51
Staten Island	1.73	2.33	1.38
All	1.85	2.58	1.76

Table 10: Estimated Average Days per Week of Lawn Irrigation CY 2011.
Weighted using the distribution of the types of one family dwelling units within each borough obtained from the PLUTO data. The weighted average over all boroughs will not necessarily be in the range of the weighted averages for the individual boroughs because of the significant differences in the distribution of the types of dwelling units within each borough such as two stories, one story, city residence, large suburban residence, detached or semi-detached, and miscellaneous. These distributions in each borough and in total will affect the weights and the weighted average.

Under the proposed Water Supply Shortage Management Plan 2013, the Stage I lawn watering restriction will be changed to one day per week on a designated day. This is expected to reduce the amount of water used on lawns and turf by about 42% during the months of May through October. This restriction is not expected to harm the City's lawns and will be an effective way to reduce in-city water use. Lowering water use with Stage I methods that are cost-effective to customers can potentially delay or prevent the need for the more restrictive Stages II and III.

The 2006 Drought Rules prohibit the use of potable water for lawn watering under Emergency Stage II. Under the 2013 proposed Water Supply Shortage Management Plan, playgrounds and athletic fields, other than golf courses, are exempt from this prohibition but must follow Stage I restrictions of one day per week watering. The water use associated with these activities is comparatively small and is likely to reap greater public benefits than those that would accrue from prohibiting this use.

Initiative 4: Update Mandatory Water Use Restrictions by Emergency Stage; Create Provisions to Allow for Scheduled Shutdowns and Infrastructure Repairs

In preparation for the shutdown of the Delaware Aqueduct, DEP has recommended changes to the Water Supply Shortage Management and Contingency Plan. There are 13 mandatory water use restrictions covering the use of potable water, which will be implemented in three water shortage stages (Table 11).

Because of the age of the city's water supply infrastructure and the need for adequate supply during weather related drought and scheduled and unscheduled repair events, DEP recognized the need to amend the Drought Rules to apply in all water shortage situations. All potable water must be re-circulated under normal watch and warning conditions when used for ornamental purposes such as for ponds, waterfalls, and reflecting pools. However, water use is prohibited unless the feature is a preexisting animal habitat.

Under Stage I, swimming pools must recirculate and may be filled once a year; under Stage II and III, water use is prohibited, except for pools open to the public that utilize recirculating equipment. Stage III water use is prohibited for all pools, with the exception of minimal topping off in pools open to the public so that recirculating equipment can operate properly.

Under the new water supply shortage emergency rules, Stage I restricts lawn watering to one designated day and golf courses may water only trees and greens. Under Stage II, lawn watering is prohibited except on playgrounds and athletic play fields. Stage III prohibits potable water usage for all uses. Similarly, watering of non-turf plants is restricted to one day per week under Stage I. Under Stage II, the use of potable water is prohibited except in hand-held containers for watering; one exception is the use of recycled water that comes from non-prohibited uses. Under Stage III, all potable water use is prohibited. Plant watering by nurseries and commercial plant users such as botanical gardens are prohibited from using potable water under these Stages, except in hand-held containers with recycled water from non-prohibited uses under Stage III.

Under Stages I-III, potable water cooled air conditioning and refrigeration units must be inspected to make sure that the water recycling system is functioning and free of leakage.

The Rules and Plan have three levels of severity: Watch, Warning, and Emergency, which are invoked sequentially as water supply shortage conditions worsen. Under the 2006 Plan, a Watch is declared when there is a less than 50% probability that either of the two largest reservoir systems, the Delaware or Catskill, will fill by the start of the water year. A Warning stage is declared when there is a less than 33% probability that the reservoir systems will fill, and finally, the Emergency stage is declared when there is reasonable probability that, without the implementation of stringent measures to reduce consumption, a protracted dry period would drain the city's reservoirs and result in a shortage of water.

Since the Delaware and Catskill Systems will be full during the shutdown period, DEP is working to develop new metrics for updated thresholds that indicate when it is appropriate to initiate each water shortage stage. These metrics will not only be used during the shutdown in 2021, but also in any other water shortage situation.

Initiative 5: Provide Customers with Easy and Timely Access to Their Water Usage Data

One effective way to achieve short term water use reductions is to give the customer access to his or her current water use with a comparison to past and baseline use. Currently, DEP bills its water customers quarterly but is conducting a pilot program to evaluate monthly billing. Monthly billing would allow customer water use data to be reported on the bill in a more timely manner.

The existing billing framework and My DEP Account already provide daily, and in some cases hourly, information. DEP's website makes it easy for customers to track how their behavioral changes are affecting their water use and to help them identify leaks. This allows customers who do not directly receive a water bill to track water use at their residence.

If a specific percentage cutback is desired, the customer webpage may also display the percentage change in the customer's water use relative to baseline use with a comparison to the percent water use reduction goal.

Water Use Restriction for City-Provided Water	Proposed Water supply Shortage Rule/Plan *(Changes relative to the current Drough Emergency Rule adoped in 2004 are in Bold Italics)*			
	Normal, Watch, & Warning No Change from existing Rule	Water Shortage Stage		
		I	II	III
(1) Public Communication & Education Program	Normal, ongoing public communication and education	Encourage voluntary reduction in water use by: 5%	10%	15%
(2) Vehicle Washing	Non-commercial: Hose must have self-closing nozzle. Commercial: At least 75% of water must be re-circulated or well water.	Prohibited except as required by law or health & safety rules or if 100% well water used & "sign" displayed		
(3) Washing Streets, Sidewalks, Driveways, Steps or Building using active water source such as hose or hydrant	Prohibited Nov. 1 - March 31, and during other months from 11 am to 7 pm.	Prohibited except as required by law, building code, or health & safety rules.		
(4) Ornamental Purposes such as ponds, waterfalls & reflecting pools	Water must be re-circulated.	Prohibited, unless feature is a pre-existing animal habitat.		
(5) Swimming Pools	Normal water use subject to RCNY.	Must re-circulate. Fill 1 time / year. Top off minimally.	Prohibited except pools open to public may follow Stage I.	
(6) Watering Lawns/ Turf	Hoses & sprinklers prohibited 11/1 – 3/31, & other months 11am-7pm. Auto sprinklers must have rain sensor.	Restricted to 7-9 am and 7-9 pm ***1 day per week on designated day.*** Golf course, playgrounds, and athletic fields must reduce by: 15%	30%	50%
(7) Watering Non-Turf Plants	Hoses & sprinklers prohibited 11/1 – 3/31, & other months 11am-7pm. Auto sprinklers must have rain sensor.	If nozzle tip hoses, flow regulators, hand held containers or water conserving systems used, then watering allowed ***1 day per week*** on designated day.	Prohibited except hand-held ***containers for plant foods*** or if carrying recycled water from non-prohibited uses.	Prohibited except ***hand-held containers with recycled water*** from non-prohibited uses.
(8) Plant watering by nurseries & commercial plant users such as botanical gardens	Normal water use subject to RCNY.	Nursaries must reduce water by: 5%	10%	15%
(9) Hydrant Use	Prohibited without DEP permit except for fire- fighting purposes.			
(10) City water cooled Air conditioning and Refrigeration (b)	For refrigeration units 10 hp or greater and AC units 2 tons or greater, water must be re-circulated.	***All units must be inspected to make sure that water recycling system is functioning & there is no leakage.***		Same as Stage I & II. Also, for all water cooled A/C units, indoor air dry-bulb temp must be 79 degrees minimum.
(11) Leaks Prohibited	Prohibited from any water pipe, fixture, equipment or appurtenance connected to the Water Supply System.			
(12) Water Served to Patrons	Water may be served to Patrons only at their request.			

Table 11: Drought Rules Matrix

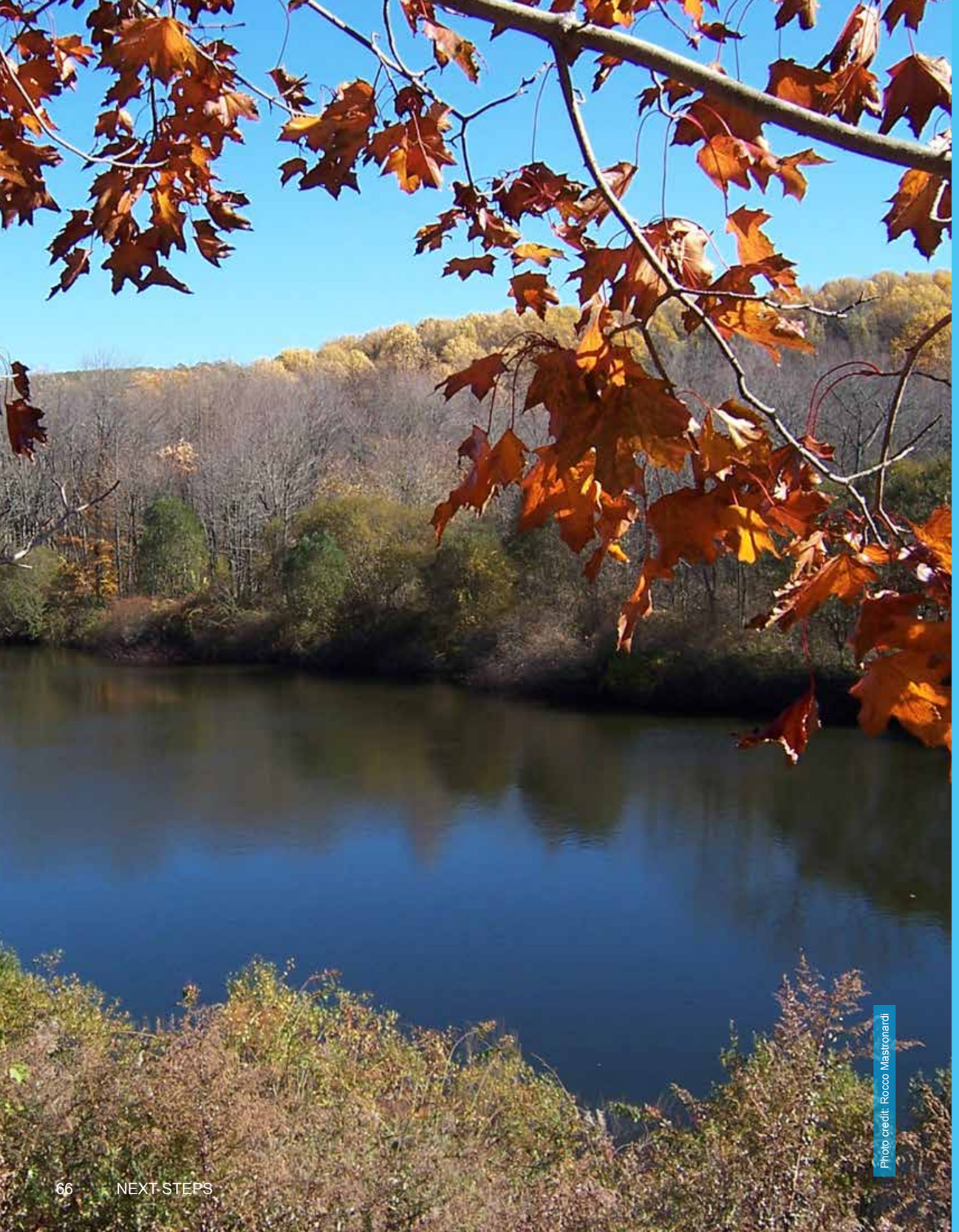


Photo credit: Rocco Mastronardi

Next Steps

DEP is currently in the development phase of an Upstate Water Conservation Program, which will help lower water demand for non-New York City communities consuming city water. The New York City water supply system currently supplies about one million consumers in 55 communities north of the city. The communities' right to receive city water was originally stipulated in the Water Supply Act of 1905 and is now codified in section 24-360 of the New York City Administrative Code.

On average, upstate community consumption has been decreasing over the last decade. For the period between July 2001 and July 2012, average consumption decreased about 14% from 126 to 109 million gallons per day; in-city consumption dropped by 17% over the same period. While the overall water consumption in upstate communities continues to decrease, the comparison to in-city consumption reveals the potential for additional reduction measures. Therefore, the goal of the Upstate Water Conservation Program is to achieve a 5% reduction in overall upstate city water consumption by 2021. To achieve this goal, DEP will work with its relevant customer base on a number of strategic initiatives, including developing community conservation plans, implementing plan recommendations, improving wholesale metering accuracy, determining non-revenue water fractions, advocating for wise water usage, and sharing mass media messaging.

The Upstate Water Conservation Program pilot is expected to commence in 2014 and will initially target communities using the largest amount of city water. The communities served by city water exhibit a wide range of land-use types. More concentrated, population-dense urban centers like the cities of Yonkers and White Plains would likely benefit most from conservation programs that largely mirror those of New York City. Other smaller communities that tap from the city supply are more suburban in nature. To further conservation efforts in these areas, a conservation plan will need to be tailored to endemic water usage patterns, for example increasing metered billing rates or instituting irrigation best management practices.

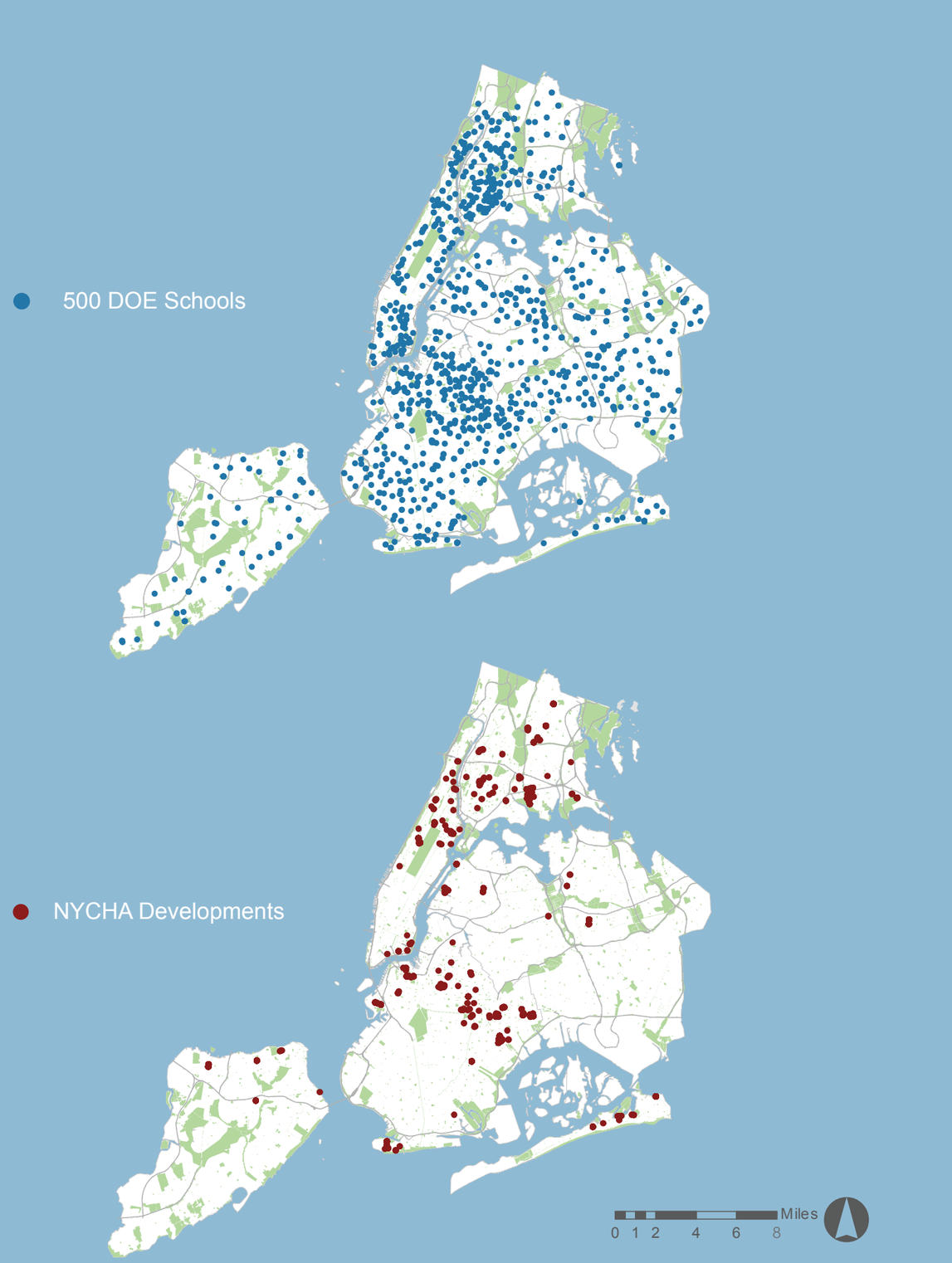
Opportunities

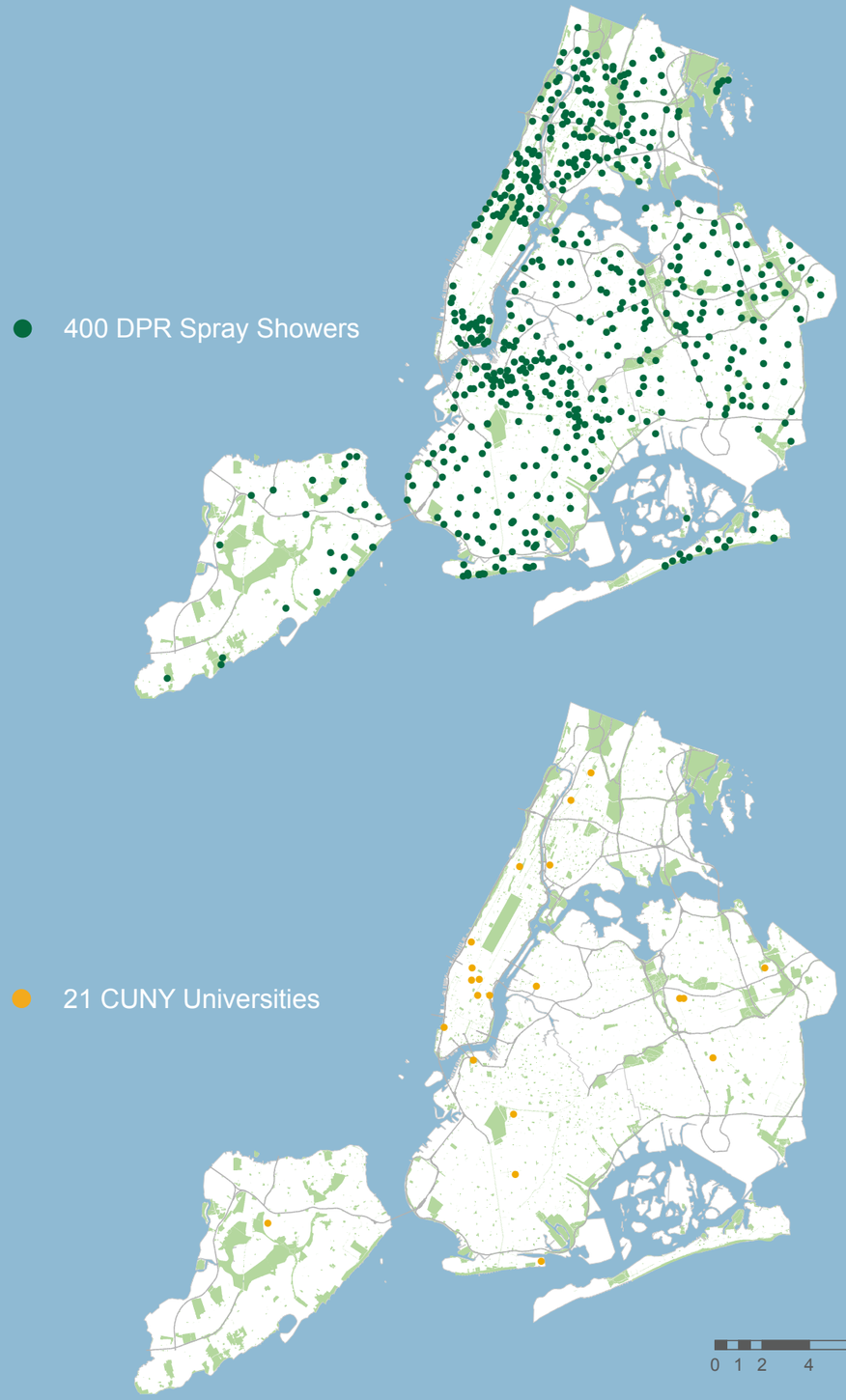
The maps in this section show the locations of future water conservation and water efficiency opportunities under the Water for the Future and Demand Management programs. Data in these maps is represented by type of facility or infrastructure. The locations identified on these maps depict projected water conservation and demand management opportunities for DEP over the course of the next five years. Opportunities were identified under each Strategy of the *Water Demand Management Plan*: implementation of the Municipal Water Efficiency Program, launching of Residential Water Efficiency Program, establishing Non-Residential Water Efficiency Program, improving operational efficiency and maintenance of infrastructure through Water Distribution System Optimization, and developing a framework for Water Supply Shortage Management. These maps were developed to provide DEP with neighborhood water demand profiles, areas of high water use intensity, seasonal variability in water usage, and opportunities for implementation of water conservation projects under each of the main strategies in the plan.

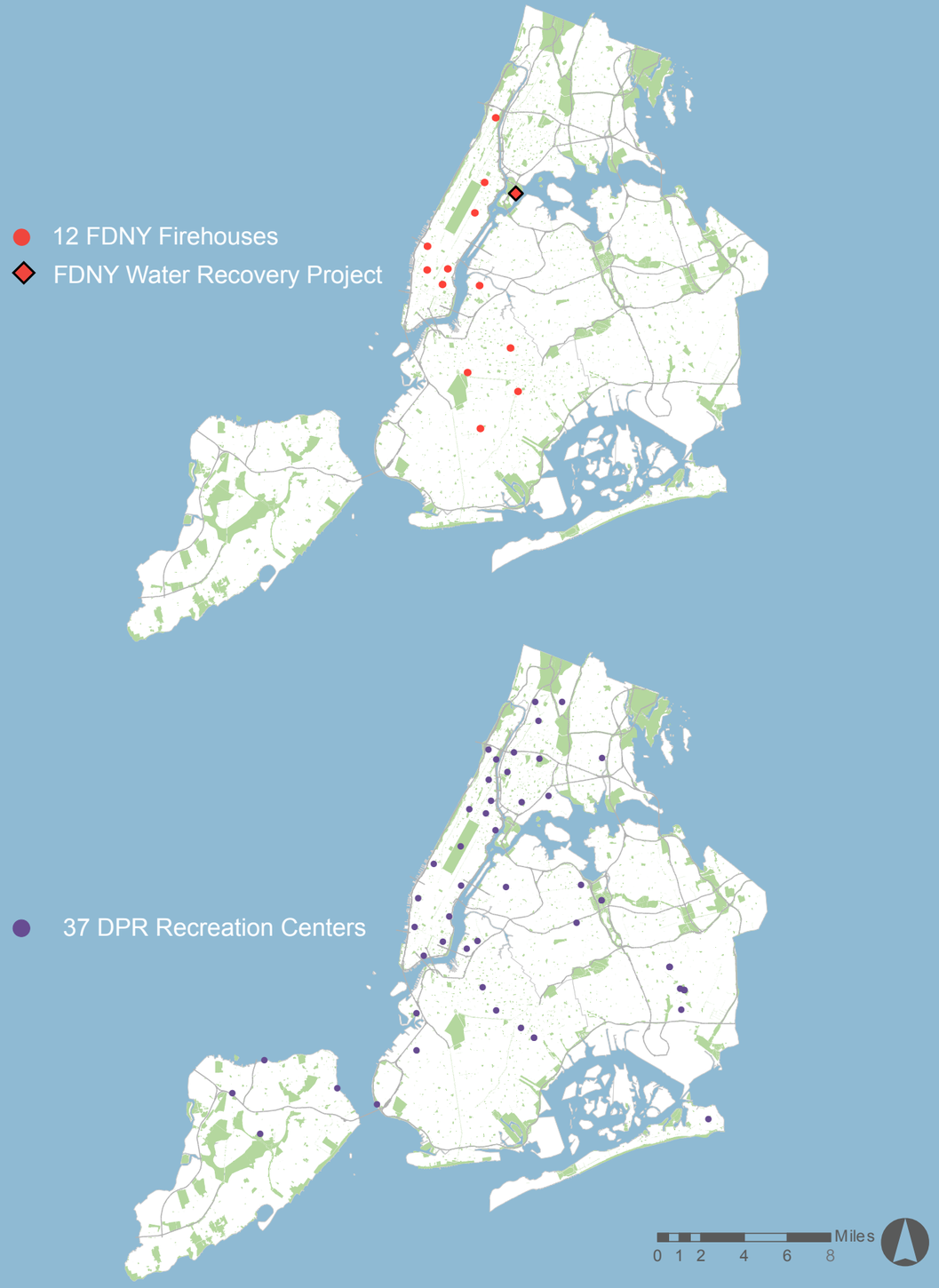
STRATEGY 1:

Municipal Water Efficiency Program Opportunities

During the next five years, DEP is targeting more than 1,800 municipally owned buildings for implementation of water conservation and water efficiency projects. Over the past year, DEP has established multiple inter-agency partnerships and has put the appropriate mechanisms in place to ensure that the Municipal Water Efficiency Program will grow each year. With continued cooperation amongst municipal partners and effective project management, DEP will have the ability to monitor and track water savings generated by the program each year. Municipal services are important to New Yorkers. Every day, over 8.3 million rely on the schools, parks and playgrounds, housing, public facilities, universities, fire houses, and water supply infrastructure that create the foundation for quality of life in our city. Therefore, it is the responsibility of local officials and policy-makers to ensure that these resources are not only of the highest caliber, but that they are also environmentally sustainable and contribute to the future health of this great city and its residents. It is with this responsibility in mind that DEP is strengthening its commitment to protecting our drinking water through programs that will make our drinking water supply more efficient and plentiful. The maps in the Municipal Water Efficiency Program Opportunities section show the locations of various types of municipal facilities across the city, where DEP will be implementing water efficiency projects over the next five years.




400 DPR Spray Showers
21 CUNY Universities
Miles
0 1 2 4 6 8

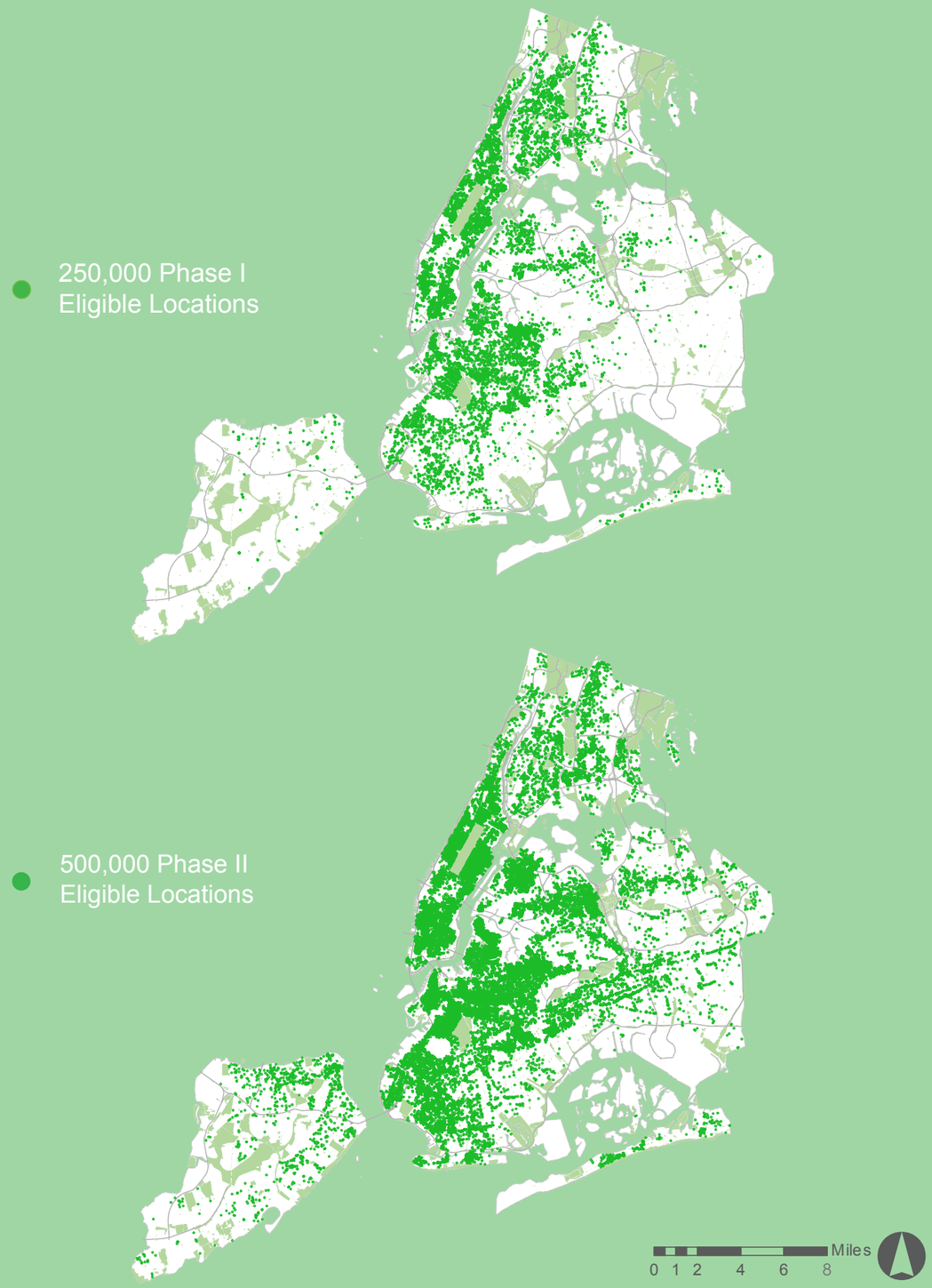

12 FDNY Firehouses
FDNY Water Recovery Project
37 DPR Recreation Centers
Miles
0 1 2 4 6 8

STRATEGY 2:

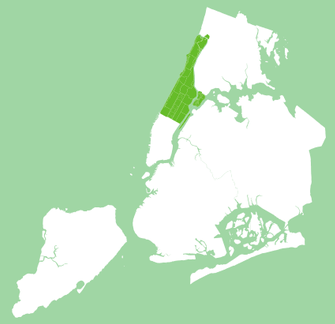
Residential Water Efficiency Program Opportunities

DEP will be targeting significant water savings from residential building stock in the city over the next five years. Phase I and II of the Toilet Replacement Program will cumulatively target approximately 750,000 properties. Because New York City is a vertical city where the majority of water use occurs indoors, programs that incentivize water efficiency in residential buildings are critical to achieving targeted reduction goals under the *Water Demand Management Plan*. The maps in this section show the number of properties citywide that meet the eligibility requirements for each Phase of the Toilet Replacement Program. The data used to create these maps comes from DEP's internal databases. Phase I will target mostly multi-family buildings with older plumbing fixtures, while Phase II will expand the program to smaller building owners and single-family homes.

Multi-family buildings have the highest overall water demand citywide accounting for 325 million gallons per day. Each map presents the distribution of water demand by land use type by borough. Multi-family buildings are the single highest ranked land use class citywide.

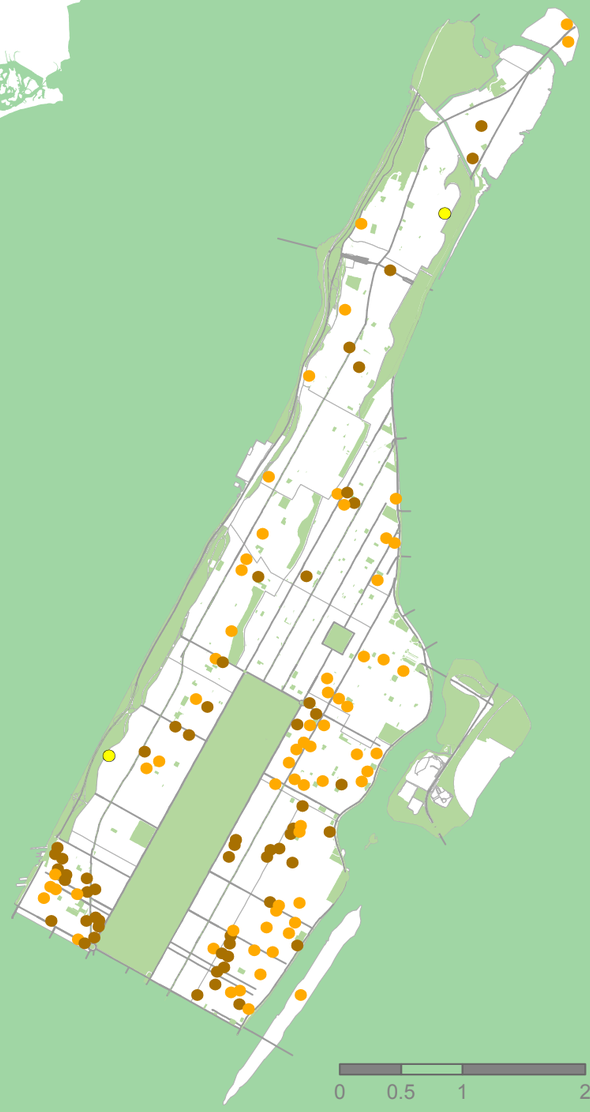


Large Users - Manhattan North

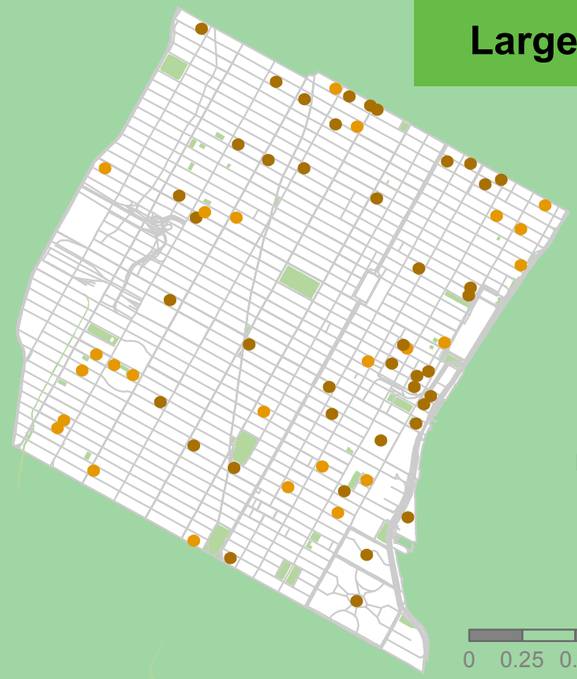


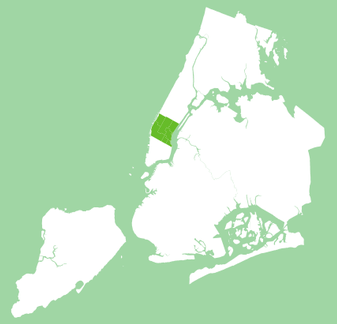
Residential Land Use Classes

- Multi-Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions



Large Users - Manhattan Midtown

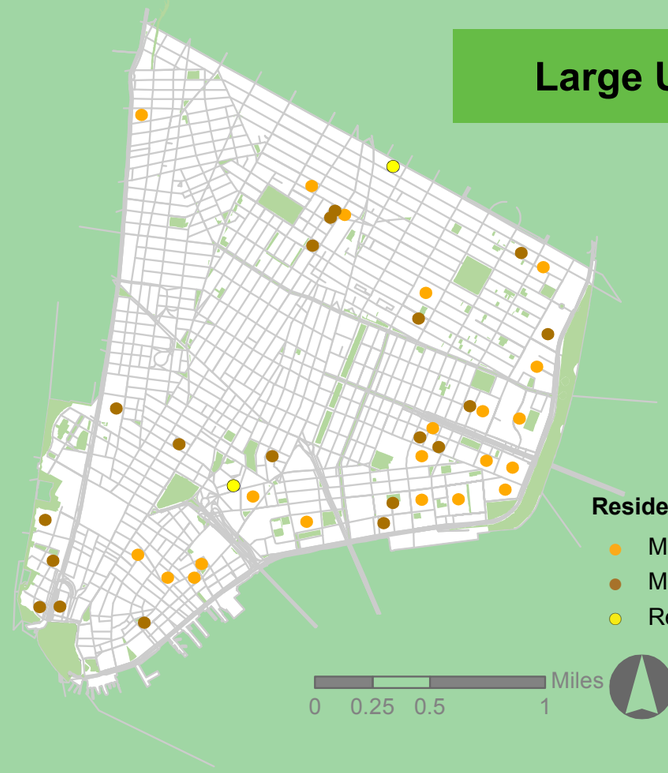


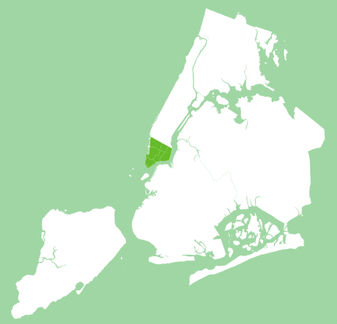


Residential Land Use Classes

- Multi-Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions

Large Users - Manhattan South





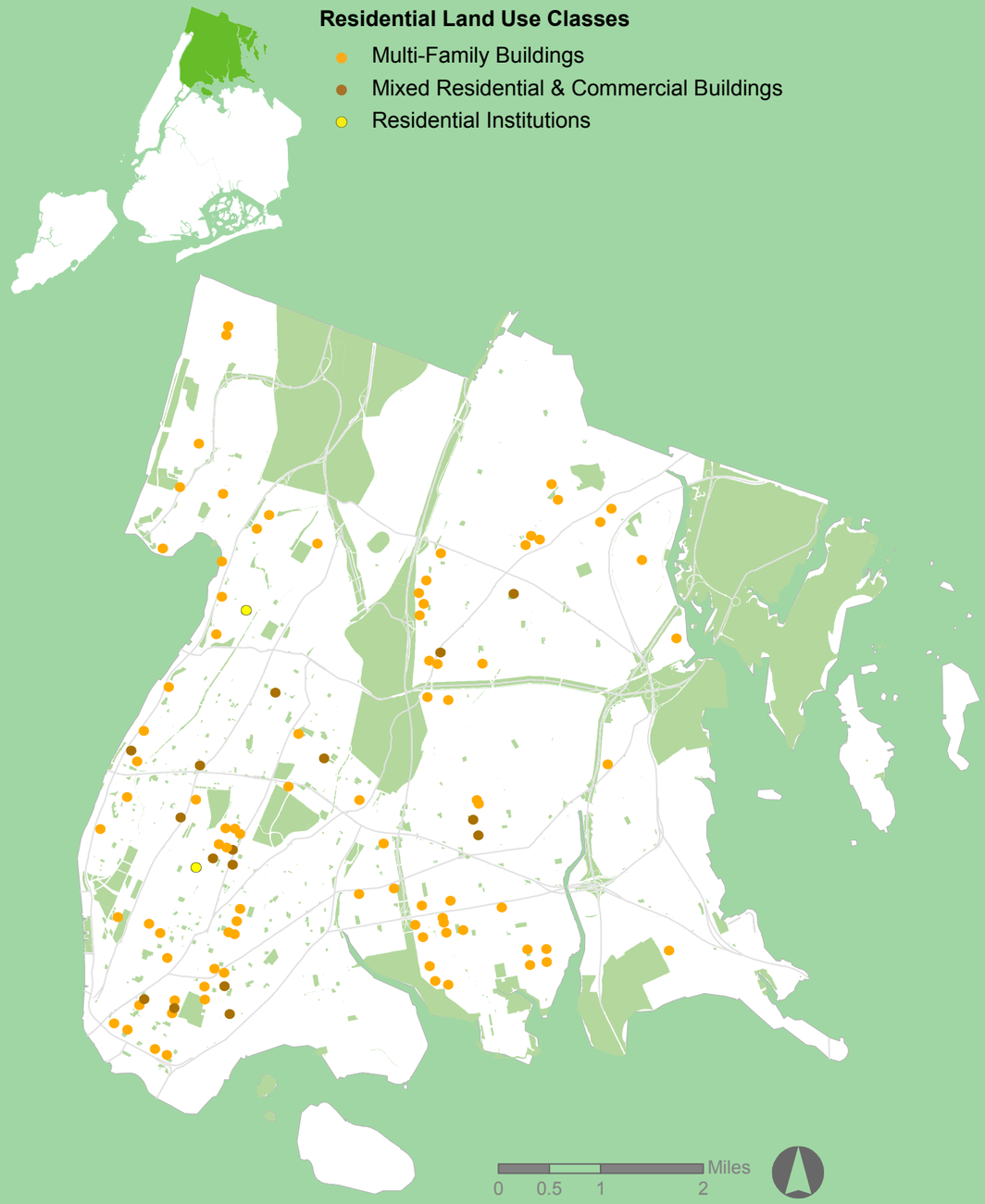
Residential Land Use Classes

- Multi-Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions

Large Users - Bronx

Residential Land Use Classes

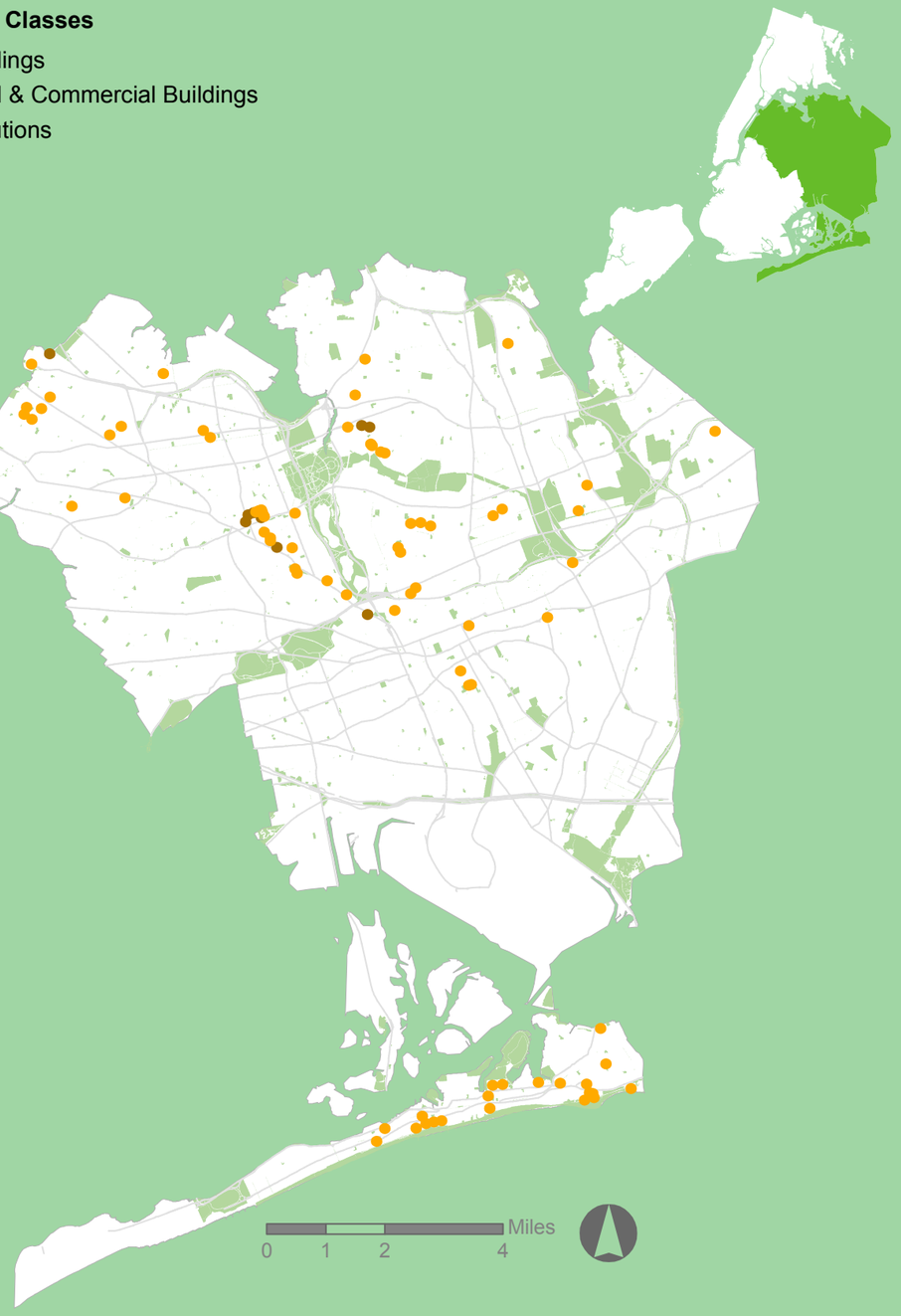
- Multi-Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions



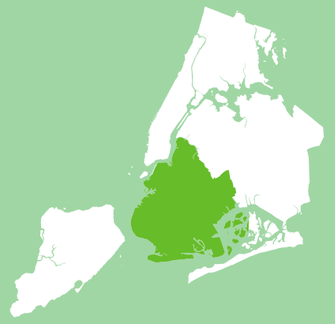
Large Users - Queens

Residential Land Use Classes

- Multi-Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions

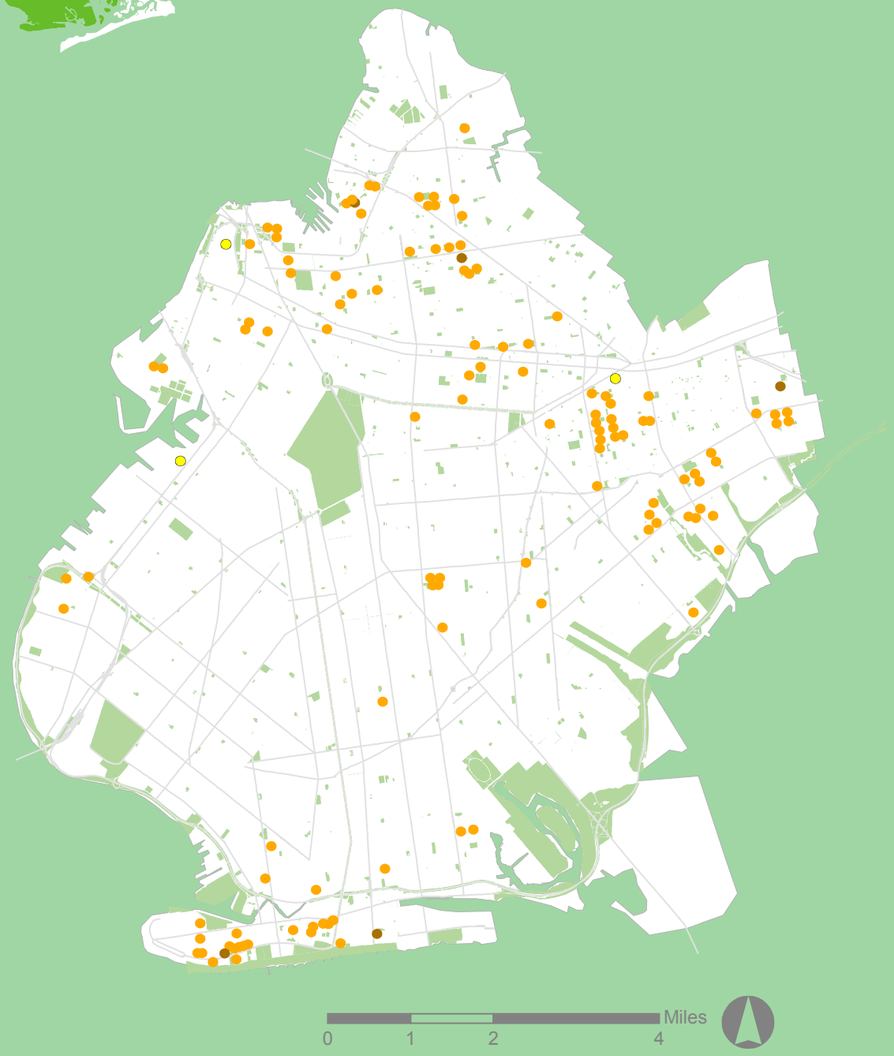


Large Users - Brooklyn



Residential Land Use Classes

- Multi-Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions



Large Users - Staten Island

Residential Land Use Classes

- Multi-Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions

STRATEGY 3:

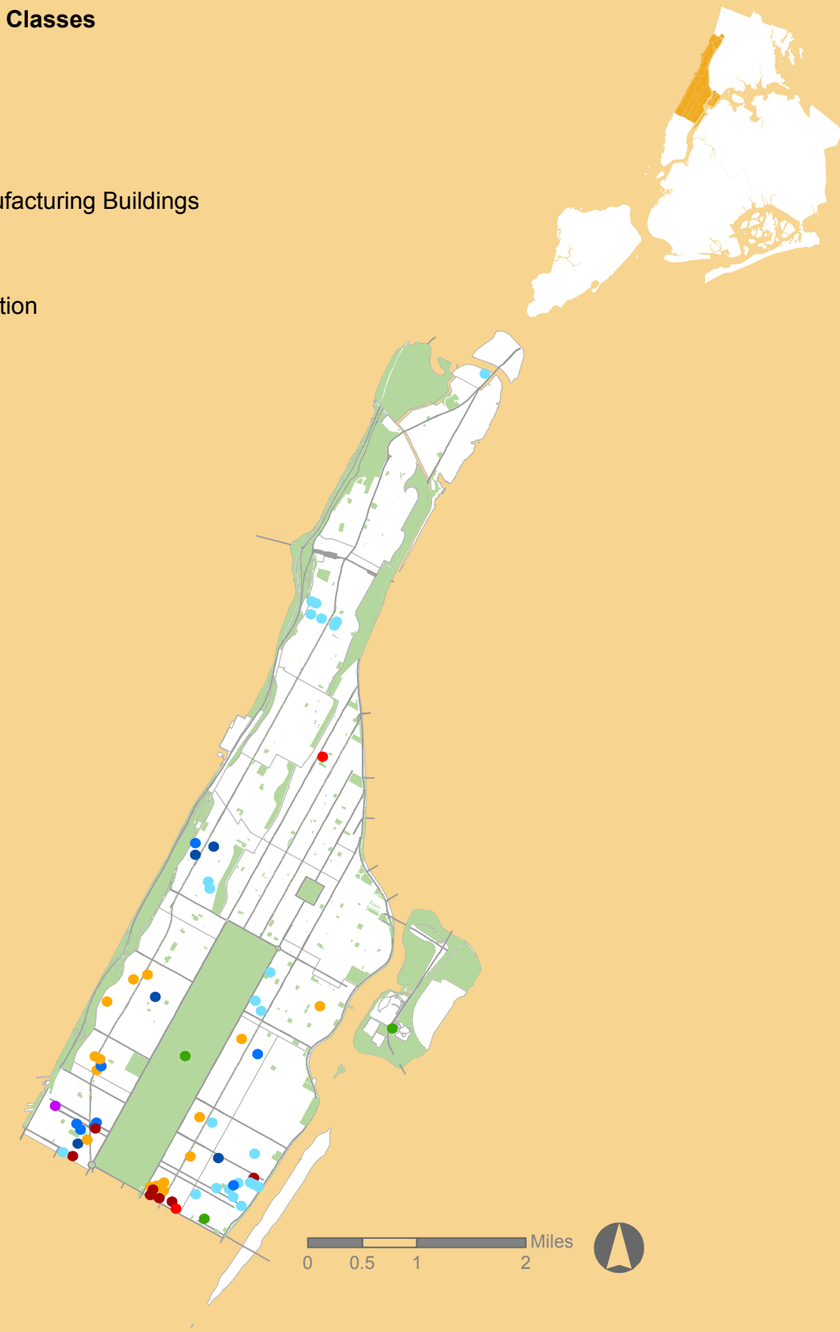
Non-Residential Municipal Water Efficiency Program Opportunities

As part of designing the Non-Residential Water Efficiency Programs, DEP organized and analyzed water consumption data for identifying large water users by residential and non-residential land use classes for each of the five boroughs. The maps in the following section show a visual depiction of water consumption data categorized accordingly. A full year of water consumption data from DEP's Automatic Meter Reading database was utilized to develop daily water consumption metrics which were aggregated and classified by land use class. Displaying water consumption readings visually reveals trends in the data and allows opportunities for demand management to emerge. Clusters of large users in a particular area, informs our overall program design and outreach efforts. By understanding where non-residential large users are located, DEP will be able to tailor non-residential water conservation programs and policies to account for the unique characteristics of specific customers and geographies.

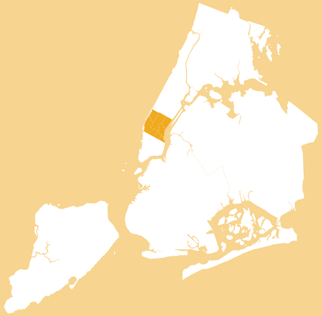
Large Users - Manhattan North

Non-Residential Land Use Classes

- Hotels
- Hospitals & Health
- Public Facilties
- Educational Structures
- Light Industrial & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Recreation

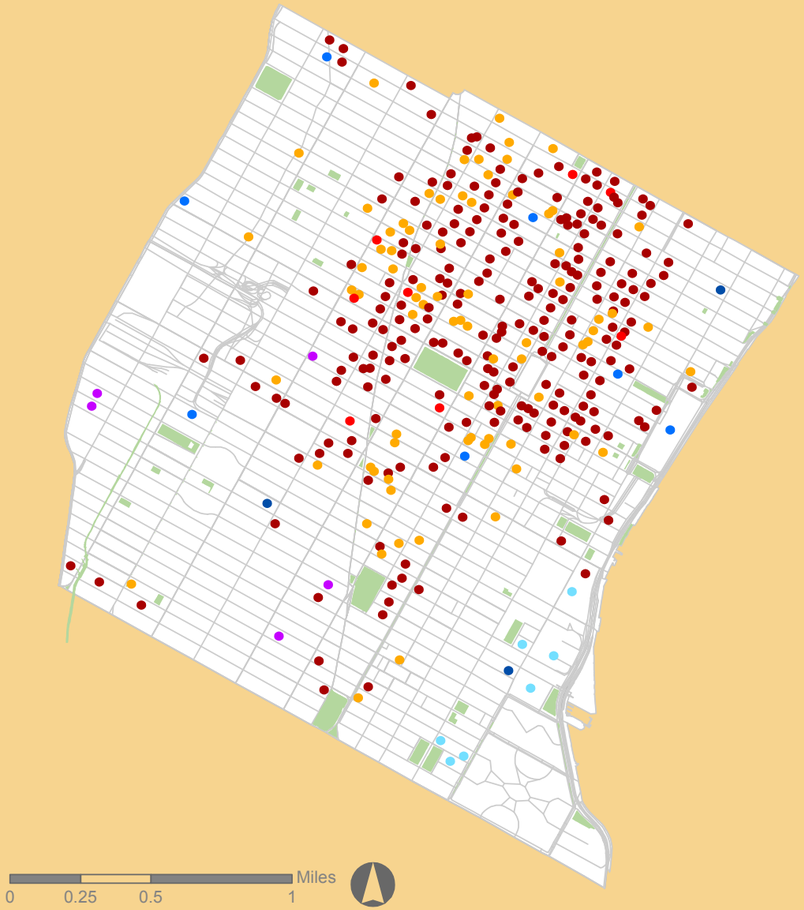


Large Users - Midtown Manhattan



Non-Residential Land Use Classes

- Hotels
- Hospitals & Health
- Public Facilties
- Educational Structures
- Light Industrial & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Recreation



Large Users - Manhattan South

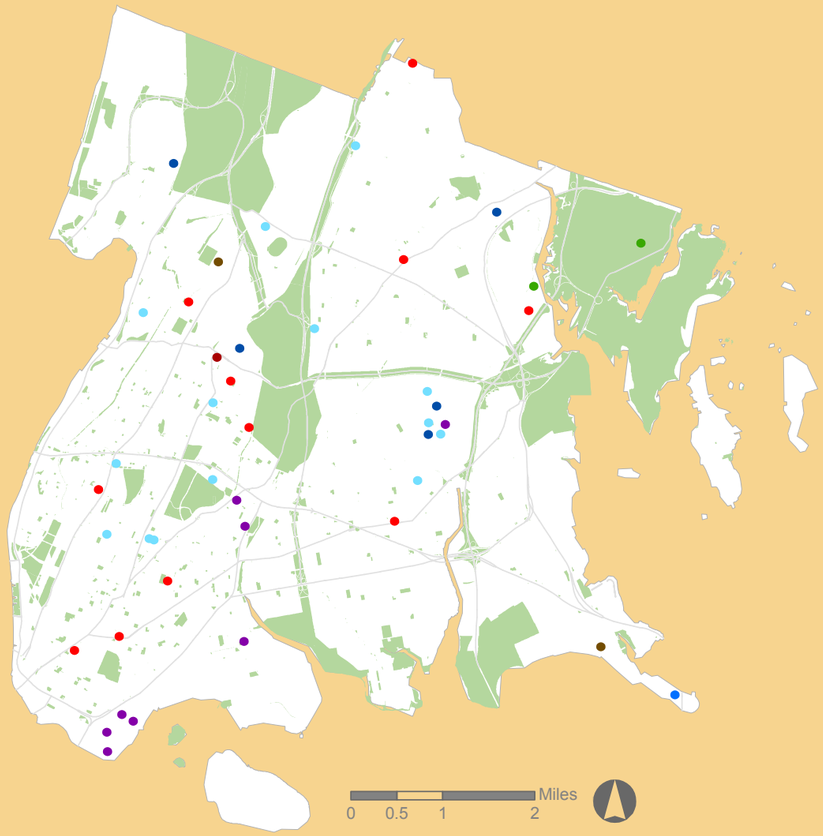
Non-Residential Land Use Classes

- Hotels
- Hospitals & Health
- Public Facilties
- Educational Structures
- Light Industrial & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Recreation

Large Users - Bronx

Non-Residential Land Use Classes

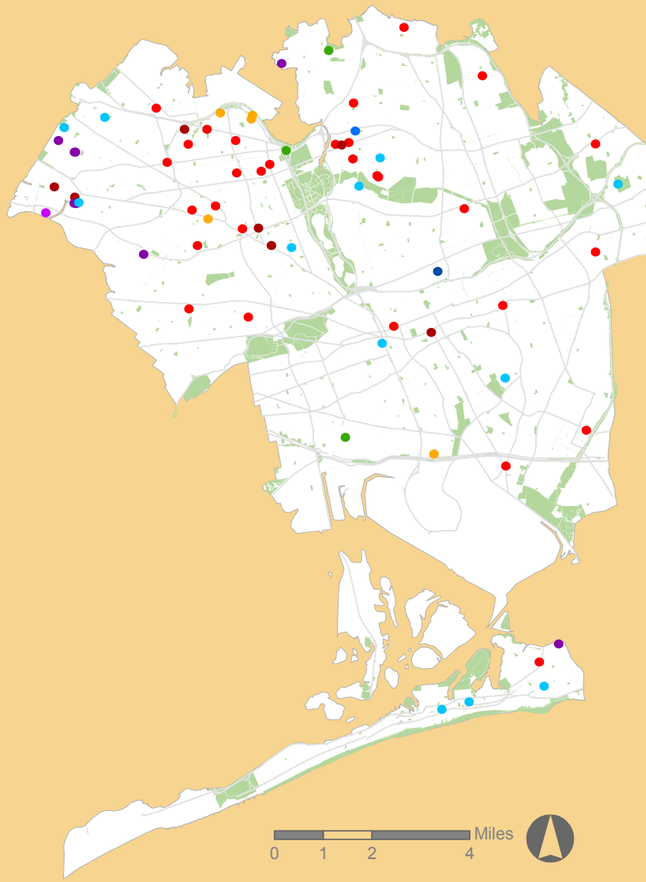
- Hotels
- Hospitals & Health
- Public Facilties
- Educational Structures
- Light Industrial & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Recreation



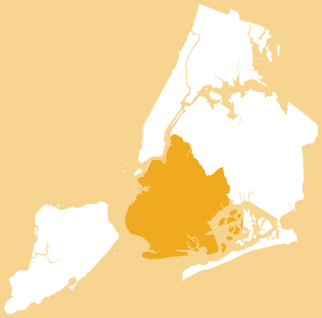
Large Users - Queens

Non-Residential Land Use Classes

- Hotels
- Hospitals & Health
- Public Facilties
- Educational Structures
- Light Industrial & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Recreation

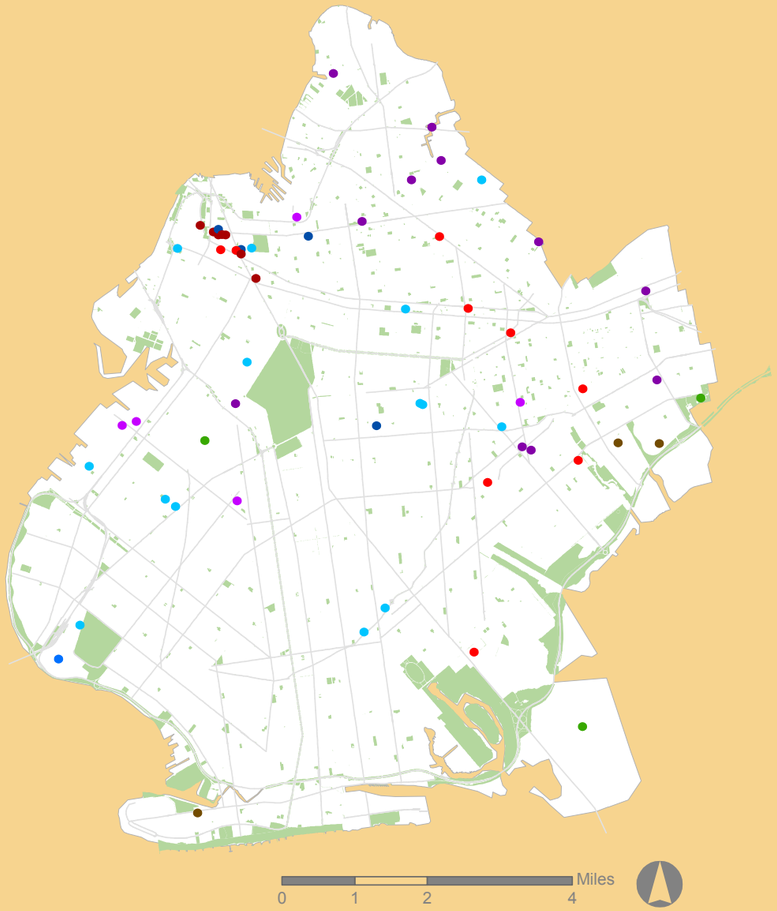


Large Users - Brooklyn



Non-Residential Land Use Classes

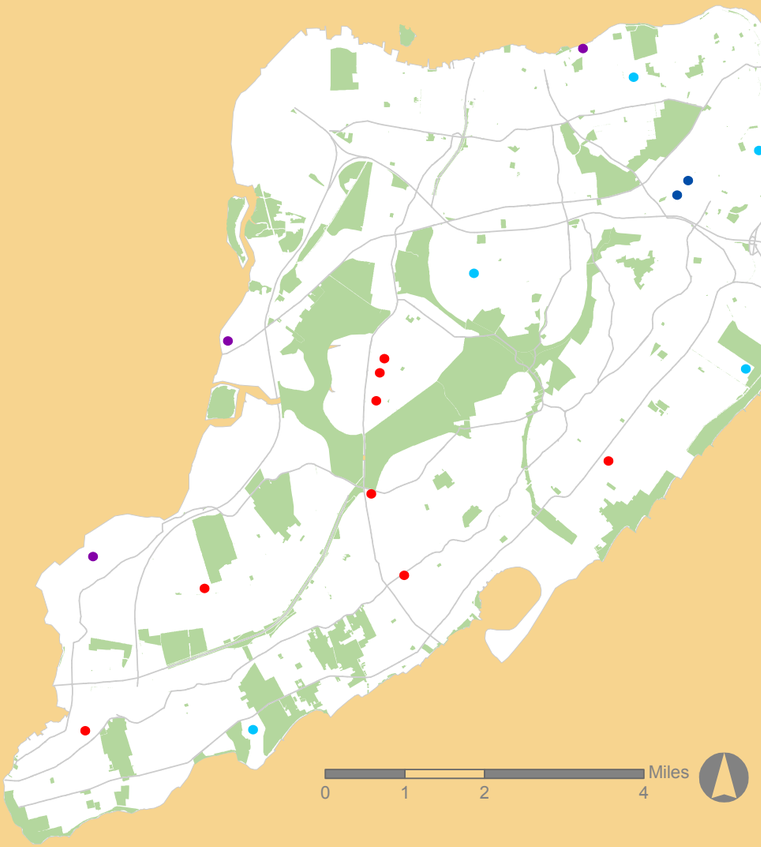
- Hotels
- Hospitals & Health
- Public Facilties
- Educational Structures
- Light Industrial & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Recreation



Large Users - Staten Island

Non-Residential Land Use Classes

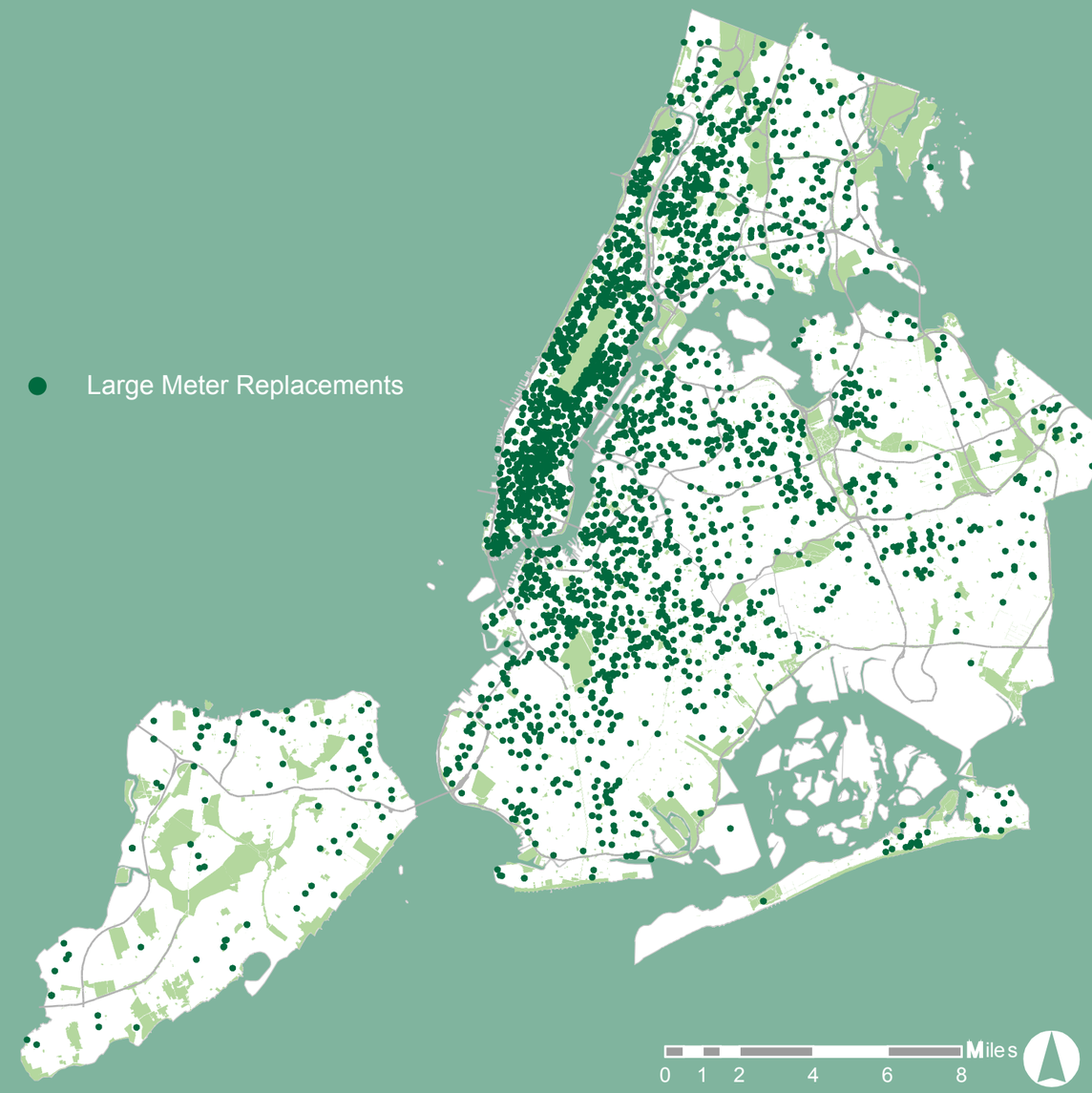
- Hotels
- Hospitals & Health
- Public Facilties
- Educational Structures
- Light Industrial & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Recreation



STRATEGY 4:

Water Distribution System Optimization Opportunities

DEP will continue to replace old water meters across the City in order to ensure the meters are accurately recording water usage. Through continued maintenance and monitoring of large meter infrastructure, DEP will ensure that large meters are registering properly and thus improving our ability to account for water use among our largest customers. DEP continues to explore and research water end uses amongst large water users in the city, and is developing a more clear understanding of why certain customers use more water than others. Some customers require large volumes of water in order to do business or to accommodate large tenant populations. It is DEP's responsibility to ensure that water is being tracked accurately within this particular customer population, in order to prevent significant water losses and improve intelligence regarding unaccounted-for-water. The map in this section shows the distribution of customers citywide that are eligible for large meter replacements. By implementing continuous quality improvement through system optimization on a large scale, DEP will prevent against leakage and water wastage amongst this segment of its customer population.

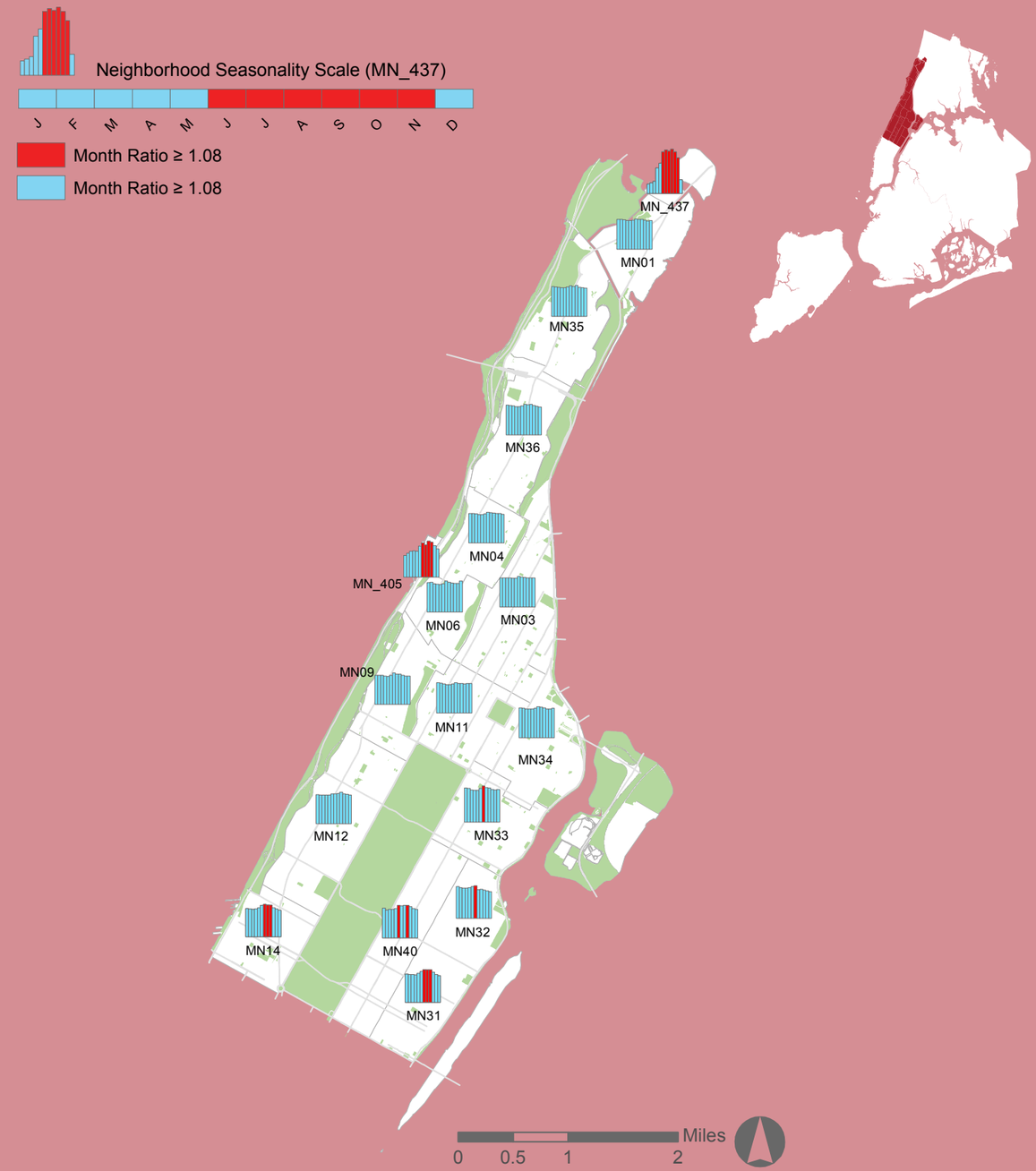


STRATEGY 5:

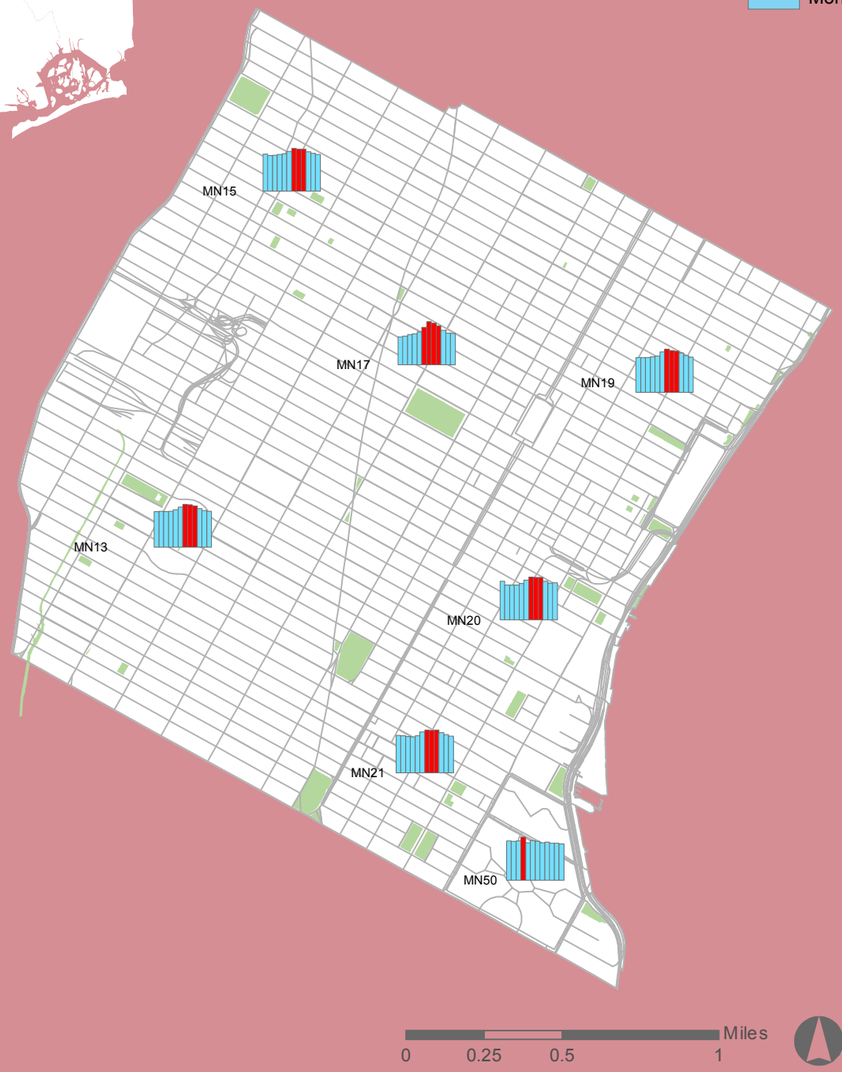
Water Supply Shortage Management Opportunities

In order to understand where water conservation opportunities may exist geographically and temporally in the city, water demand profiles were developed for every neighborhood in the five Boroughs by land use and seasonal variability. Water consumption data collected via DEP's Automatic Meter Reading system for 2011 was analyzed in order to show seasonally based consumption trends. Seasonal patterns of demand were assessed and mapped for each neighborhood in New York City using a sample of 508,695 locations with 12 full months of validated water consumption data. A set of seasonal ratios was calculated to create a simple index that relates measured water use in any given month to the average measured water use over the year of available Automatic Meter Reading data. Citywide, the months of June, July, August and September have the highest water use ratios, where all exceed a value of 1.0, indicating the average daily water use in these months exceeds the average annual daily use. This pattern is consistent with the warmest part of the annual growing season. July has the highest ratio citywide, where monthly use is 10%higher than the average daily use. Accordingly, July is found to be the peak month in all boroughs. In addition to developing seasonal variability indexes by neighborhood, DEP also created neighborhood water demand profiles categorized by land use. Some land uses are more water intensive than others, which can create "hot spots" of comparatively high water usage in a group of neighborhoods where a particular land use, or group of uses, predominates. The ability to portray the range of variability in water demand across neighborhoods has allowed DEP to understand how much elasticity, or potential for water savings, exists in the system. This information enables DEP to understand geographically, where the greatest potential for project opportunities exists.

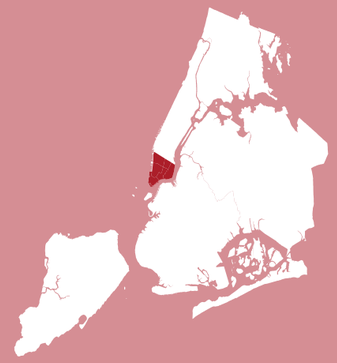
Seasonality - Manhattan North

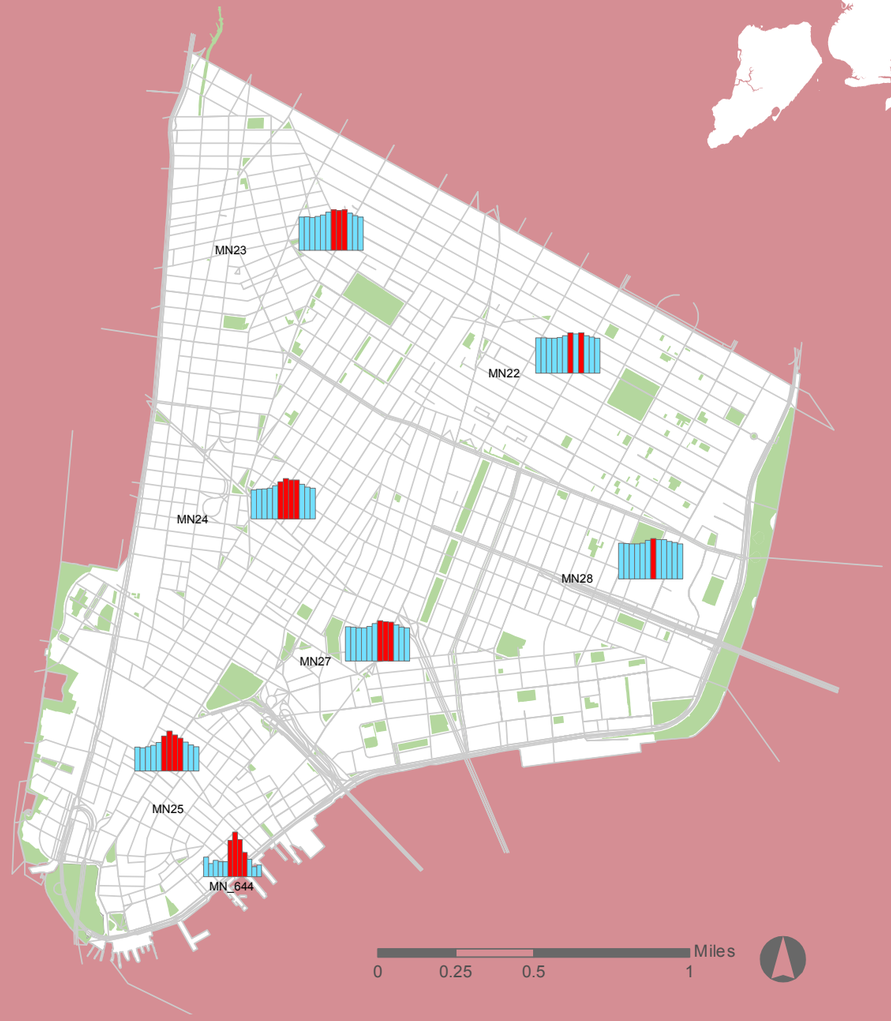


Seasonality - Manhattan Midtown



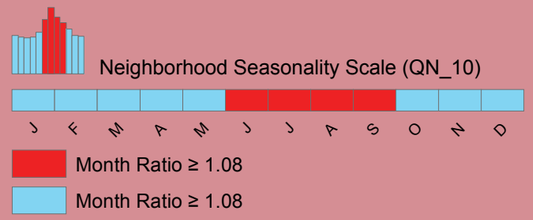
Seasonality - Manhattan South

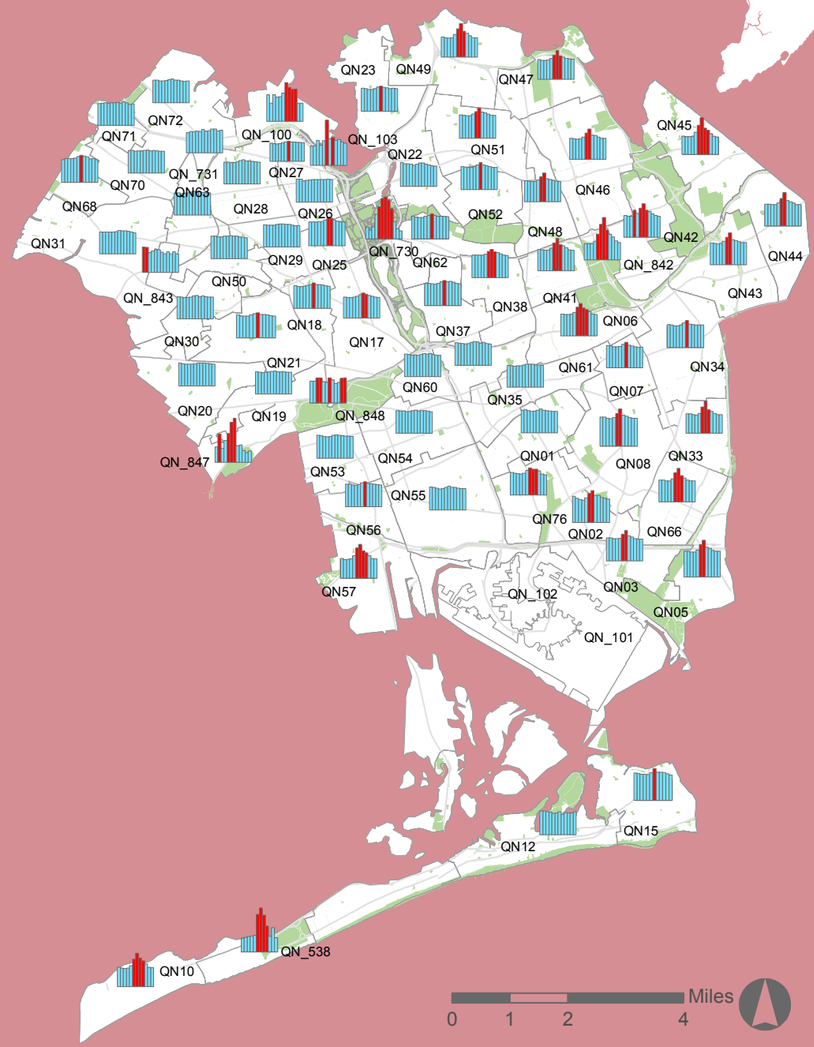




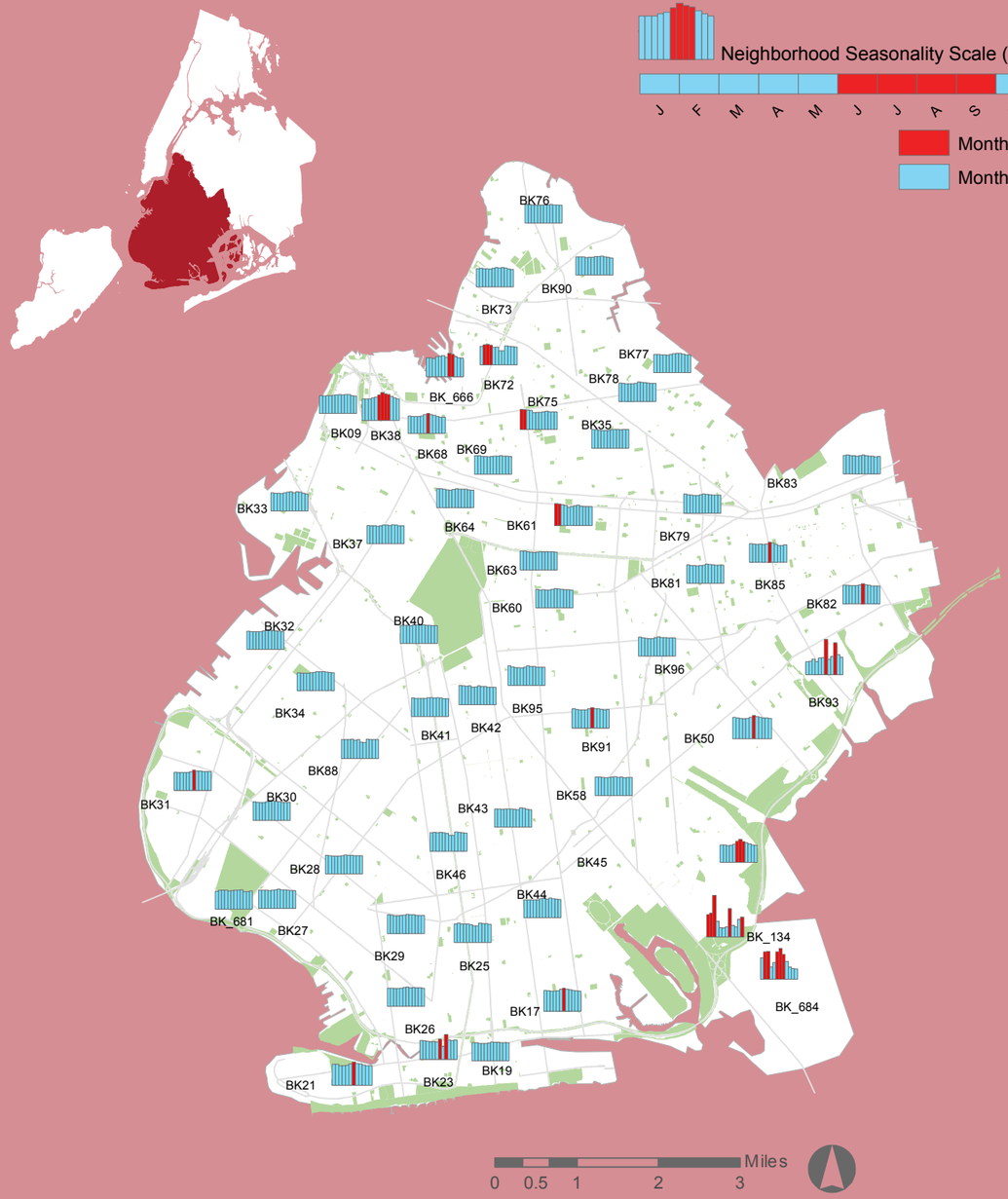
Seasonality - Bronx

Seasonality - Queens

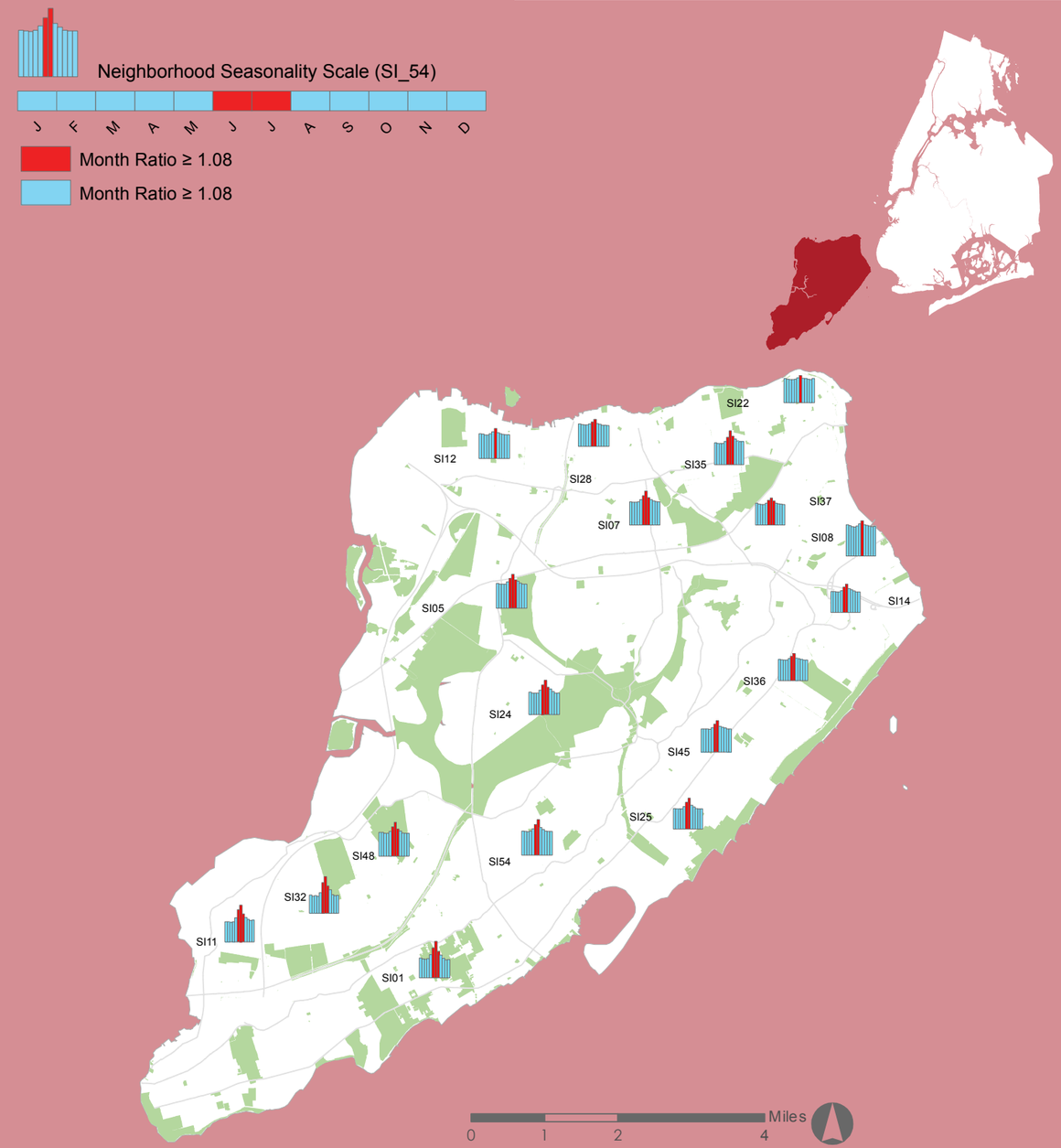




Seasonality - Brooklyn



Seasonality - Staten Island



Land Use - Manhattan North

Land Use Classes

- One Family Dwellings
- Two Three Family Residences
- Multi Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions
- Hotels
- Hospitals & Health
- Public Facilities & Institutions
- Educational Structures
- Parking & Facilities
- Light Industries & Manufacturing Buildings
- Heavy Industries & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Outdoor Recreation
- Transportation & Utility
- Vacant Land
- Miscellaneous

Land Use - Manhattan Midtown

Land Use Classes

- One Family Dwellings
- Two Three Family Residences
- Multi Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions
- Hotels
- Hospitals & Health
- Public Facilities & Institutions
- Educational Structures
- Parking & Facilities
- Light Industries & Manufacturing Buildings
- Heavy Industries & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Outdoor Recreation
- Transportation & Utility
- Vacant Land
- Miscellaneous

Land Use - Manhattan South

Land Use Classes

- One Family Dwellings
- Two Three Family Residences
- Multi Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions
- Hotels
- Hospitals & Health
- Public Facilities & Institutions
- Educational Structures
- Parking & Facilities
- Light Industries & Manufacturing Buildings
- Heavy Industries & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Outdoor Recreation
- Transportation & Utility
- Vacant Land
- Miscellaneous

Land Use - Bronx

Land Use Classes

- One Family Dwellings
- Two Three Family Residences
- Multi Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions
- Hotels
- Hospitals & Health
- Public Facilities & Institutions
- Educational Structures
- Parking & Facilities
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- Heavy Industries & Manufacturing Buildings
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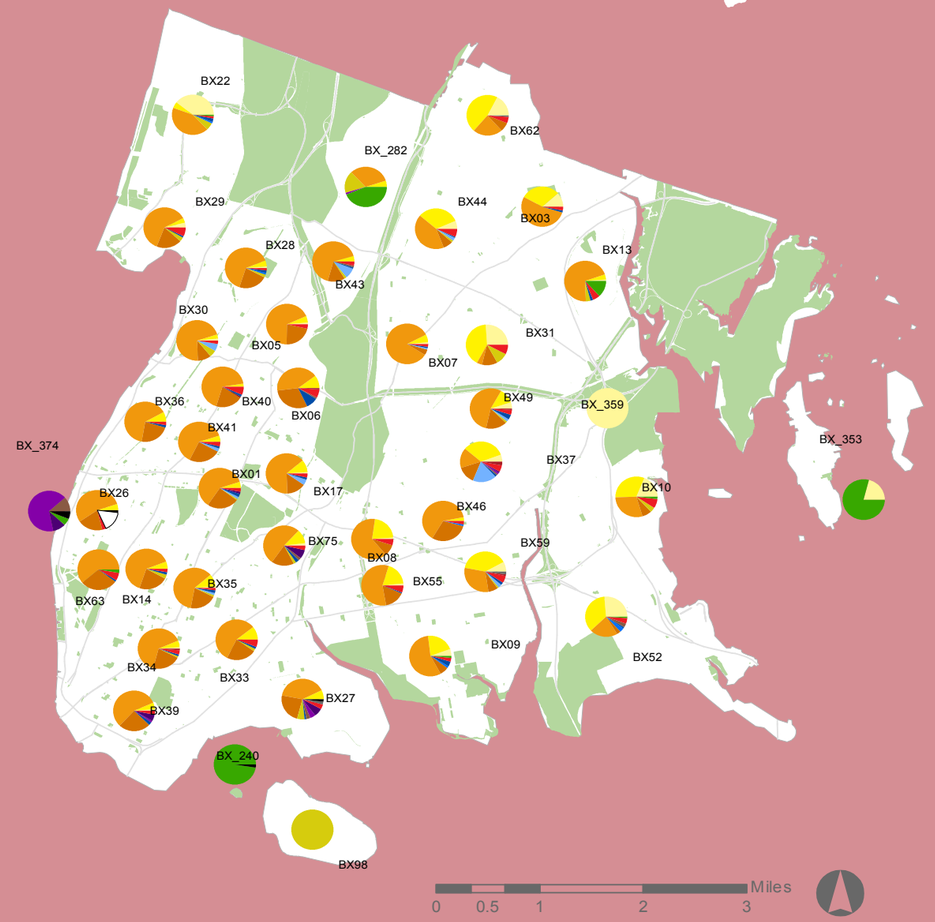
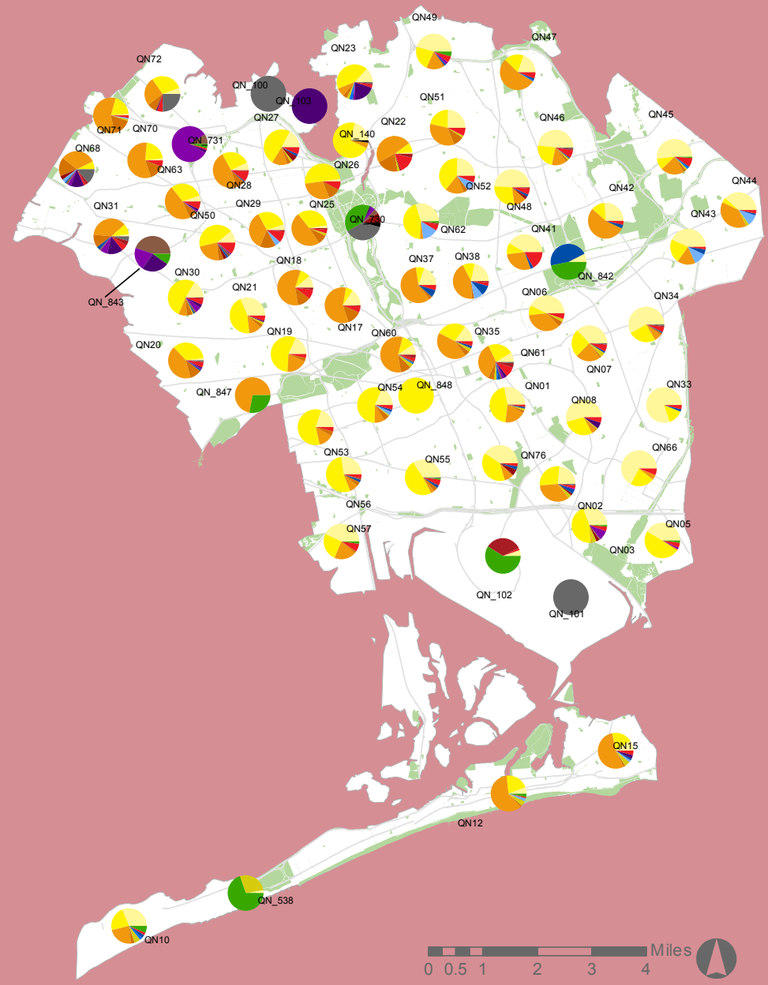
- Office Buildings
- Open Space & Outdoor Recreation
- Transportation & Utility
- Vacant Land
- Miscellaneous



Land Use - Queens

Land Use Classes

- One Family Dwellings
- Two Three Family Residences
- Multi Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions
- Hotels
- Hospitals & Health
- Public Facilities & Institutions
- Educational Structures
- Parking & Facilities
- Light Industries & Manufacturing Buildings
- Heavy Industries & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Outdoor Recreation
- Transportation & Utility
- Vacant Land
- Miscellaneous



Land Use - Brooklyn

Land Use Classes

- One Family Dwellings
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- Multi Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions
- Hotels
- Hospitals & Health
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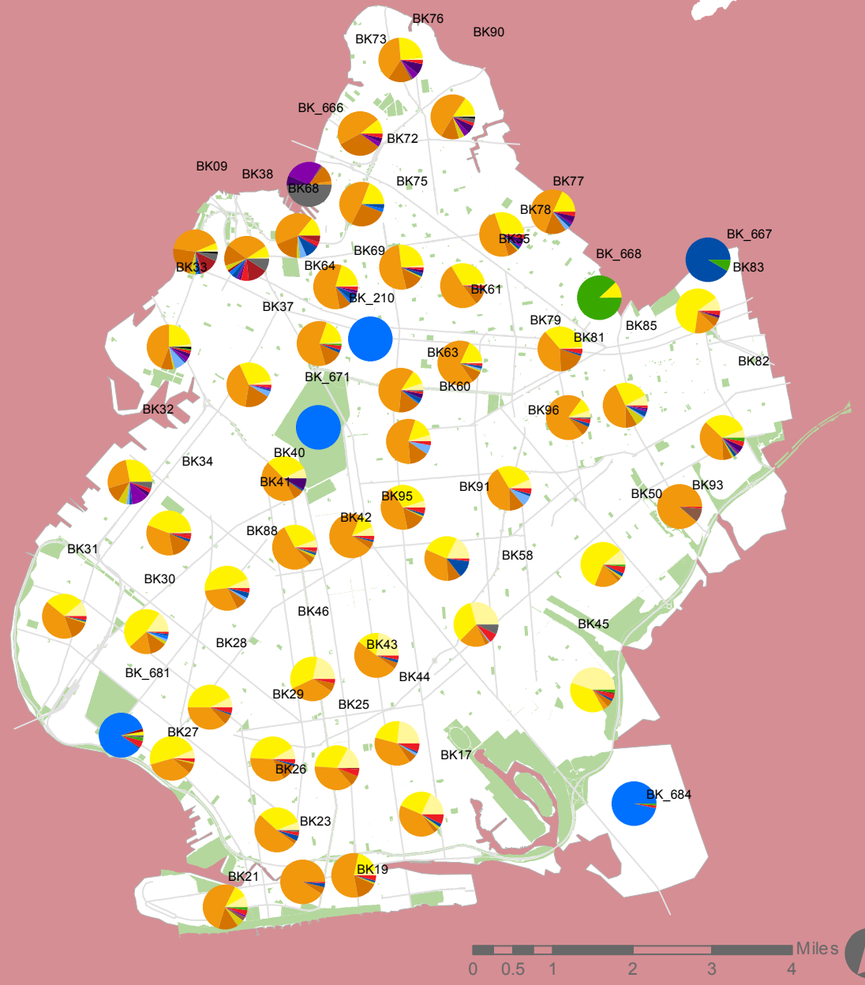
- Office Buildings
- Open Space & Outdoor Recreation
- Transportation & Utility
- Vacant Land
- Miscellaneous



Land Use - Staten Island

Land Use Classes

- One Family Dwellings
- Two Three Family Residences
- Multi Family Buildings
- Mixed Residential & Commercial Buildings
- Residential Institutions
- Hotels
- Hospitals & Health
- Public Facilities & Institutions
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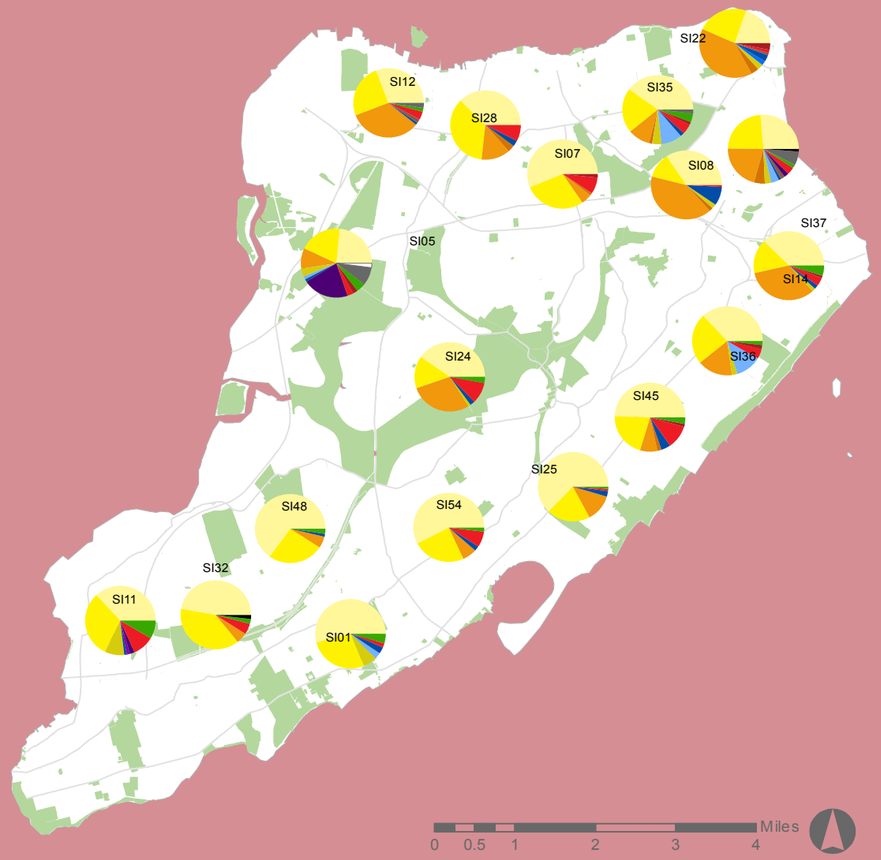
- Heavy Industries & Manufacturing Buildings
- Stores
- Office Buildings
- Open Space & Outdoor Recreation
- Transportation & Utility
- Vacant Land
- Miscellaneous



NH Code	Neighborhood Name	Jan Ratio	Feb Ratio	Mar Ratio	Apr Ratio	May Ratio	Jun Ratio	Jul Ratio	Aug Ratio	Sep Ratio	Oct Ratio	Nov Ratio	Dec Ratio
Bronx													
BX01	Claremont - Bathgate	1.04	1.01	0.98	0.96	0.95	0.97	1.09	1.03	1.02	0.99	0.97	0.98
BX03	Eastchester-Edenwald-Baychester	1.00	0.98	0.98	0.96	0.99	1.01	1.09	1.03	1.01	0.99	0.99	0.97
BX05	Bedford Pk - Fordham North	1.16	1.13	1.13	1.08	0.89	0.91	0.96	0.96	0.97	0.95	0.94	0.93
BX06	Belmont	1.01	1.00	0.96	0.96	0.96	0.98	1.04	1.03	1.04	1.02	1.01	0.99
BX07	Bronxdale	1.00	0.98	0.97	0.93	0.94	0.97	1.03	1.05	1.08	1.05	1.03	0.97
BX08	West Farms - Bronx River	1.02	1.01	0.99	0.98	0.97	0.99	1.03	1.00	1.01	0.99	1.00	1.01
BX09	Soundview-CastleHl-ClasonPt-HardngPk	1.06	1.06	1.03	0.98	0.98	1.01	1.07	1.00	0.97	0.95	0.94	0.94
BX10	PelhamBay-CountryClub-CityIslanc	0.96	0.94	0.93	0.95	1.01	1.08	1.16	1.05	1.03	0.98	0.96	0.94
BX13	Co-Op City	0.96	0.98	0.97	0.96	0.96	1.07	1.13	1.07	1.02	0.96	0.96	0.97
BX14	EastConcourse - ConcourseVillage	1.04	1.03	1.01	0.99	0.96	0.98	1.03	1.02	1.02	0.98	0.98	0.97
BX17	East Tremont	1.00	0.99	0.97	0.95	0.94	0.97	1.06	1.06	1.04	1.01	1.01	1.01
BX22	NorthRiverdale-Fieldston-Riverdale	0.93	0.92	0.91	0.91	1.00	1.08	1.22	1.09	1.09	1.00	0.94	0.90
BX26	Highbridge	1.03	1.02	1.00	0.98	0.96	0.98	1.03	1.01	1.02	1.00	0.98	0.98
BX27	Hunts Point	0.97	0.98	0.96	0.96	0.97	1.05	1.12	1.09	1.03	0.98	0.96	0.93
BX28	Van Cortlandt Village	1.07	1.05	1.04	1.00	0.95	0.97	1.00	0.99	1.01	0.97	0.97	0.97
BX29	Spuyten Duyvil - Kingsbridge	0.99	0.97	0.95	0.94	0.97	1.05	1.12	1.05	1.04	0.99	0.98	0.93
BX30	Kingsbridge Heights	1.01	0.99	0.98	0.98	0.95	0.99	1.05	1.00	1.03	1.01	1.01	1.01
BX31	Allerton - Pelham Gardens	0.98	0.97	0.95	0.95	0.99	1.02	1.12	1.05	1.03	0.99	0.98	0.98
BX33	Longwood	1.01	0.99	0.98	0.98	0.97	0.99	1.05	1.04	1.04	1.00	0.99	0.96
BX34	Melrose South - Mott Haven North	0.95	0.96	0.96	0.96	0.99	1.04	1.13	1.07	1.01	0.99	0.98	0.95
BX35	Morrisania - Melrose	1.03	1.02	1.00	0.97	0.97	0.98	1.05	1.03	1.02	0.98	0.96	0.98
BX36	University Heights - Morris Heights	1.04	1.01	0.99	1.00	0.99	0.99	1.02	1.00	1.00	0.99	0.99	0.99
BX37	VanNest-MorrisPk-WstcstrSq	0.96	0.96	0.94	0.96	1.00	1.02	1.07	1.04	1.03	1.01	1.00	0.99
BX39	Mott Haven - Port Morris	1.04	0.99	0.97	0.97	0.97	1.01	1.07	1.04	1.03	0.98	0.97	0.94
BX40	Fordham South	1.02	1.00	0.99	0.96	0.96	0.99	1.05	1.03	1.03	0.99	1.01	0.98
BX41	Mount Hope	0.99	1.00	0.98	0.97	0.96	0.97	1.03	1.02	1.03	1.07	0.99	0.97
BX43	Norwood	1.00	1.00	0.97	0.97	0.98	1.02	1.07	1.03	1.03	0.98	0.98	0.96
BX44	Williamsbridge - Olinville	1.01	1.01	0.97	0.95	0.96	0.99	1.07	1.03	1.03	1.00	1.00	0.99
BX46	Parkchester	0.95	0.94	0.98	0.97	1.00	1.02	1.04	1.09	1.07	1.02	0.99	0.94
BX49	Pelham Parkway	1.01	1.02	0.98	0.98	0.98	0.99	1.04	1.03	1.01	0.98	0.99	0.99
BX52	Schuylerville-ThrogsNk-EdgwaterPk	1.00	0.98	0.96	0.97	0.98	1.03	1.08	1.03	1.07	0.97	0.96	0.95
BX55	Soundview - Bruckner	1.04	1.00	0.97	0.96	0.95	0.99	1.05	1.04	1.02	0.99	1.00	0.98
BX59	Westchester - Unionport	0.96	0.97	0.96	0.95	0.99	1.03	1.08	1.05	1.04	1.00	0.99	0.98
BX62	Woodlawn - Wakefield	1.00	0.98	0.96	0.96	0.97	1.01	1.08	1.03	1.03	1.00	1.00	0.99
BX63	West Concourse	1.01	1.01	0.97	0.95	0.94	0.99	1.06	1.06	1.06	1.00	0.99	0.98
BX75	Crotona Park East	1.40	1.44	1.37	1.28	0.79	0.85	0.88	0.85	0.84	0.79	0.79	0.77
BX_112	Bronx Park	1.41	1.24	1.12	1.16	0.94	0.73	0.88	0.71	0.67	0.88	1.10	1.18
BX_222	Macombs Dam Park	0.18	0.30	0.54	1.29	1.69	0.83	3.92	0.71	1.11	0.62	0.28	0.45
BX_243	PELHAM BAY PARK	0.96	0.95	0.93	0.94	0.97	1.06	1.01	1.03	1.04	0.98	1.05	1.07
BX_282	park_cemetery_etc_BX	0.91	0.92	0.92	0.85	0.90	0.93	1.08	0.98	1.05	1.10	1.22	1.14
BX_359	park_cemetery_etc_BX	0.52	0.50	0.63	0.65	0.78	2.06	2.53	1.17	0.87	0.79	0.74	0.73
BX_374	park_cemetery_etc_BX	0.74	0.76	0.67	0.69	0.83	1.49	1.45	1.36	1.66	0.90	0.65	0.79
Brooklyn													
BK09	Brooklyn Heights - Cobble	0.97	0.96	0.97	0.97	1.00	1.02	1.05	1.03	1.05	1.04	0.98	0.96
BK17	SheepshdBy-GerritsenBch-MnhattnBch	0.99	0.98	0.96	0.96	0.98	1.04	1.10	1.05	1.02	0.99	0.97	0.95
BK19	Brighton Beach	1.00	1.00	0.97	0.97	0.97	0.99	1.04	1.02	1.03	1.00	1.00	1.00
BK21	Seagate - Coney Island	1.02	1.01	0.95	0.94	0.96	1.03	1.12	1.06	1.04	0.98	0.95	0.95
BK23	West Brighton	1.01	0.99	0.97	0.94	0.96	0.93	1.08	0.70	1.33	1.04	1.02	1.03
BK25	Homecrest	1.01	1.05	1.02	1.01	1.01	0.97	0.91	0.92	1.06	1.04	1.03	1.00
BK26	Gravesend	0.99	0.99	0.97	0.97	0.99	1.02	1.05	1.01	1.02	1.00	1.00	0.98
BK27	Bath Beach	1.00	1.00	0.99	0.98	0.99	1.01	1.06	1.01	1.01	0.99	0.98	0.98
BK28	Bensonhurst West	1.02	1.00	0.98	0.98	0.98	1.00	1.03	1.02	1.02	0.99	0.99	0.99
BK29	Bensonhurst East	1.03	1.00	0.97	0.96	0.98	1.01	1.04	1.02	1.02	0.99	0.98	0.98
BK30	Dyker Heights	1.00	0.98	0.97	0.97	1.00	1.02	1.06	1.02	1.02	0.99	0.98	0.99
BK31	Bay Ridge	0.97	0.96	0.96	0.96	0.95	1.00	1.08	1.03	1.03	1.02	1.01	1.01
BK32	Sunset Park West	1.00	0.97	0.97	0.98	0.98	1.01	1.04	1.03	1.04	1.01	1.00	0.97
BK33	CarrollGrdns-Columbia-RedHook	1.00	0.98	0.97	0.96	0.99	1.04	1.05	1.00	1.05	1.04	0.97	0.94
BK34	Sunset Park East	0.99	0.97	0.96	0.97	0.99	1.01	1.04	1.04	1.04	1.02	1.00	0.99
BK35	Stuyvesant Heights	1.02	1.01	0.99	0.96	0.96	0.96	1.00	1.02	1.03	1.00	1.02	1.02
BK37	Park Slope - Gowanus	1.01	0.99	0.98	0.96	0.98	1.02	1.03	1.01	1.04	1.02	0.99	0.97
BK38	DUMBO-VingrHl-DwntnBrkl-BoermHl	0.90	0.90	0.91	0.96	0.99	1.08	1.18	1.12	1.10	1.02	0.95	0.90
BK40	Windsor Terrace	1.00	1.00	0.99	0.98	1.02	1.02	1.03	1.02	1.00	0.99	0.97	0.98
BK41	Kensington - Ocean Parkway	1.01	0.98	0.98	0.99	0.99	1.02	1.03	1.00	1.03	1.01	0.97	0.97
BK42	Flatbush	1.06	1.04	1.02	1.03	0.95	0.98	1.04	1.00	0.99	0.96	0.96	0.96
BK43	Midwood	1.00	1.00	0.98	1.01	1.00	1.01	0.98	0.97	1.07	1.04	0.98	0.97
BK44	Madison	0.97	0.97	0.96	0.96	0.97	1.02	1.06	1.00	1.07	1.02	1.01	0.99
BK45	Grgetwn-MarinePk-BergnBch-MillBasn	0.93	0.94	0.89	0.91	0.97	1.14	1.24	1.11	1.06	0.99	0.93	0.91
BK46	Ocean Parkway South	1.02	1.04	1.02	1.04	1.03	0.99	0.87	0.87	1.06	1.05	1.02	1.01
BK50	Canarsie	1.01	0.99	0.97	0.95	0.97	1.02	1.10	1.05	1.02	0.98	0.98	0.97
BK58	Flatlands	1.02	1.01	0.99	0.97	0.99	1.01	1.03	1.00	1.01	0.98	0.99	0.99
BK60	Prospect-LeffertsGrdn-Wing	1.02	0.98	1.00	0.97	0.97	1.01	1.06	1.03	1.01	0.99	0.99	0.97
BK61	Crown Heights North	1.10	1.09	1.05	1.02	0.92	0.95	1.00	1.04	0.98	0.96	0.95	0.95
BK63	Crown Heights South	1.05	1.04	1.01	0.98	0.95	0.98	1.01	1.00	1.01	1.01	1.00	0.97
BK64	Prospect Heights	1.03	1.03	1.01	0.98	0.95	1.00	1.03	1.01	1.02	1.01	0.98	0.95
BK68	Fort Greene	0.98	0.97	0.97	0.97	0.99	1.06	1.13	1.07	1.03	0.96	0.93	0.92
BK69	Clinton Hill	1.02	1.03	0.99	0.98	0.97	0.98	1.01	1.01	1.03	1.01	1.00	0.98
BK72	Williamsburg	1.03	1.12	1.13	1.09	0.98	1.00	0.78	0.78	1.05	1.04	1.01	1.00
BK73	North Side - South Side	0.99	1.00	0.98	0.98	0.96	1.00	1.04	1.03	1.06	1.03	0.97	0.95
BK75	Bedford	1.11	1.09	1.07	1.05	0.93	0.95	0.94	0.97	1.01	0.97	0.96	0.96
BK76	Greenpoint	1.03	1.02	1.01	0.98	0.97	0.99	1.01	1.01	1.02	1.01	0.99	0.97

NH Code	Neighborhood Name	Jan Ratio	Feb Ratio	Mar Ratio	Apr Ratio	May Ratio	Jun Ratio	Jul Ratio	Aug Ratio	Sep Ratio	Oct Ratio	Nov Ratio	Dec Ratio
BK77	Bushwick North	0.99	0.99	0.98	0.97	0.96	1.00	1.04	1.05	1.05	1.01	0.98	0.98
BK78	Bushwick South	1.00	0.99	0.97	0.97	0.96	0.98	1.06	1.04	1.03	1.01	0.99	0.99
BK79	Ocean Hill	1.04	1.01	0.99	0.97	0.97	1.00	1.04	1.03	1.01	0.98	0.98	0.98
BK81	Brownsville	1.01	0.98	0.98	0.96	0.97	1.00	1.06	1.03	1.01	0.99	1.00	1.00
BK82	East New York (part A)	1.00	1.01	0.98	0.98	0.98	1.03	1.08	1.03	1.00	0.97	0.97	0.97
BK83	Cypress Hills - City Line	1.03	1.04	1.01	1.00	0.98	1.01	1.05	1.01	0.99	0.98	0.95	0.96
BK85	East New York (part B)	1.03	1.01	0.98	1.00	0.99	1.00	1.11	1.06	0.99	0.93	0.93	0.96
BK88	Borough Park	1.03	1.02	1.02	1.05	0.99	1.02	0.89	0.87	1.05	1.03	1.02	1.02
BK90	East Williamsburg	1.01	1.01	1.00	0.97	0.98	0.99	1.02	1.03	1.05	1.01	0.98	0.94
BK91	East Flatbush - Farragut	1.02	0.99	0.97	0.96	0.97	1.02	1.08	1.03	1.02	0.99	0.97	0.98
BK93	Starrett City	0.69	0.71	0.83	0.69	0.89	0.91	1.86	0.80	0.95	1.67	1.05	0.92
BK95	Erasmus	1.07	1.01	0.96	0.96	0.95	0.99	1.06	1.02	1.02	0.99	0.99	0.99
BK96	Rugby - Remsen Village	1.04	1.00	0.97	0.95	0.96	0.99	1.05	1.02	1.01	0.99	1.00	1.00
BK_134	FOUR SPARROW MARSH	1.23	1.31	2.28	0.85	0.51	0.49	0.55	1.54	0.64	0.56	0.96	1.08
BK_666	park_cemetery_etc_BK	0.95	0.95	0.91	0.99	1.02	1.05	0.97	1.16	1.11	1.00	0.94	0.93
BK_681	park_cemetery_etc_BK	0.96	1.04	1.03	1.02	0.98	1.00	1.03	1.02	1.05	0.94	0.95	0.98
BK_684	park_cemetery_etc_BK	1.07	1.37	1.40	0.61	0.83	1.37	1.55	1.25	0.90	0.62	0.53	0.52
Midtown Manhattan													
MN13	HudsnYds-Chelsea-Flatirn-UnionSq	0.93	0.94	0.93	0.94	0.98	1.05	1.12	1.11	1.08	1.01	0.96	0.94
MN15	Clinton	0.96	0.92	0.93	0.95	0.97	1.03	1.11	1.09	1.09	1.02	0.98	0.95
MN17	Midtown - Midtown South	0.81	0.84	0.88	0.91	0.96	1.10	1.26	1.22	1.14	1.01	0.93	0.92
MN19	Turtle Bay - East Midtown	0.92	0.92	0.92	0.94	0.96	1.07	1.14	1.10	1.09	1.04	0.97	0.93
MN20	Murray Hill - Kips Bay	1.01	0.91	0.91	0.91	0.95	1.04	1.12	1.11	1.11	1.01	0.96	0.97
MN21	Gramercy	0.96	0.95	0.93	0.92	0.95	1.05	1.10	1.09	1.10	1.03	0.98	0.94
MN50	StuyvesantTown-CooperVillage	1.02	1.01	1.02	1.12	0.97	1.03	1.01	0.97	0.99	0.96	0.96	0.94
Manhattan South													
MN22	East Village	0.96	0.96	0.95	0.95	0.97	1.02	1.09	1.07	1.09	1.02	0.98	0.95
MN23	West Village	0.92	0.93	0.91	0.94	0.98	1.06	1.12	1.10	1.12	1.03	0.96	0.92
MN24	SoHo-Tribeca-CivcCentr-LittleItaly	0.86	0.88	0.89	0.91	0.98	1.10	1.19	1.15	1.15	1.03	0.94	0.91
MN25	BatteryParkCity-LowerManhattan	0.82	0.80	0.83	0.88	0.98	1.20	1.38	1.24	1.13	0.99	0.90	0.84
MN27	Chinatown	0.96	0.95	0.93	0.93	0.97	1.05	1.13	1.10	1.09	1.01	0.95	0.93
MN28	Lower East Side	0.97	0.96	0.95	0.95	0.97	1.04	1.09	1.06	1.06	1.01	0.98	0.95
MN_644	park_cemetery_etc_MN	0.90	0.61	0.75	0.69	0.68	1.66	2.04	1.70	1.11	0.80	0.46	0.54
Manhattan North													
MN01	Marble Hill - Inwood	1.02	1.02	1.00	0.98	0.98	0.99	1.03	1.02	1.02	0.99	0.97	0.98
MN03	CentrlHarlemNorth-PoloGrounds	1.00	1.00	0.99	0.99	0.98	0.98	1.05	1.02	1.01	0.99	1.00	0.99
MN04	Hamilton Heights	1.00	1.00	0.99	0.97	0.96	0.99	1.05	1.03	1.02	1.00	1.00	0.98
MN06	Manhattanville	1.01	1.02	0.97	0.96	0.95	0.97	1.06	1.02	1.00	0.98	0.98	1.07
MN09	Morningside Heights	0.99	0.99	0.99	0.97	0.96	1.00	1.07	1.04	1.04	1.00	0.97	0.97
MN11	Central Harlem South	1.03	1.02	0.99	0.97	0.97	0.99	1.03	1.01	1.00	0.99	1.00	1.00
MN12	Upper West Side	0.99	0.97	0.98	0.97	0.97	1.02	1.02	1.03	1.07	1.02	1.00	0.97
MN14	Lincoln Square	0.97	0.95	0.94	0.95	0.99	1.07	1.11	1.09	1.08	0.99	0.95	0.91
MN31	Lenox Hill - Roosevelt Island	0.96	0.95	0.94	0.93	0.98	1.05	1.11	1.10	1.10	1.02	0.95	0.91
MN32	Yorkville	1.06	1.03	1.02	1.02	1.03	1.06	1.09	0.96	0.98	0.95	0.92	0.89
MN33	East Harlem South	1.02	1.01	0.97	0.96	0.96	1.01	1.08	1.04	1.03	0.98	0.97	0.98
MN34	East Harlem North	1.01	1.00	0.98	0.98	0.97	1.00	1.05	1.04	1.01	0.97	0.98	1.00
MN35	Washington Heights North	1.02	1.00	0.99	0.97	0.98	1.00	1.04	1.02	1.06	0.99	0.98	0.96
MN36	Washington Heights South	1.02	1.00	0.99	0.97	0.97	0.99	1.05	1.03	1.04	1.00	0.98	0.95
MN40	UpperEastSide - CarnegieHill	0.98	0.92	0.94	0.95	0.97	1.08	1.06	1.07	1.08	1.03	0.97	0.95
MN_208	HUDSON RIVER PARK	1.31	0.65	1.18	1.58	2.07	1.22	1.59	0.74	0.53	0.40	0.46	0.22
MN_405	park_cemetery_etc_MN	0.73	0.81	0.88	0.89	0.88	1.06	1.16	1.10	1.23	1.19	1.07	0.97
MN_437	park_cemetery_etc_MN	0.32	0.36	0.41	0.87	1.03	1.42	1.49	1.45	1.51	1.42	1.22	0.47
MN_632	park_cemetery_etc_MN	0.05	0.07	0.08	0.22	0.87	2.58	2.67	2.25	1.75	1.18	0.13	0.08
Queens													
QN01	South Jamaica	1.01	1.03	0.99	0.96	0.98	1.02	1.08	1.02	1.00	0.98	0.97	0.97
QN02	Springfield Gardens North	1.02	0.95	0.89	0.87	0.96	1.13	1.24	1.06	1.05	0.98	0.94	0.92
QN03	SpringfieldGrdns S-Brookvi	0.97	0.97	0.93	0.93	0.95	1.13	1.28	1.06	1.00	0.94	0.92	0.92
QN05	Rosedale	0.93	0.92	0.89	0.89	0.97	1.16	1.32	1.07	1.02	0.96	0.93	0.93
QN06	Jamaica Estates-Holliswood	0.90	0.88	0.88	0.89	0.96	1.17	1.32	1.14	1.08	0.99	0.90	0.88
QN07	Hollis	1.02	0.99	0.96	0.95	0.97	1.06	1.16	1.04	0.99	0.96	0.94	0.94
QN08	St. Albans	0.97	0.98	0.94	0.92	0.96	1.10	1.24	1.05	1.00	0.96	0.94	0.93
QN10	BrzyPt-BlleHrbr-RockwyPk-BrdChnl	0.85	0.82	0.80	0.81	0.93	1.20	1.48	1.26	1.14	1.00	0.86	0.84
QN12	Hammels-Arverne-Edgemere	1.06	1.07	1.02	1.00	0.96	0.97	1.03	0.92	0.99	0.97	0.98	1.03
QN15	Far Rockaway - Bayswater	1.00	0.99	0.96	0.96	0.94	1.02	1.16	1.03	1.03	1.01	0.97	0.93
QN17	Forest Hills	0.95	0.94	0.93	0.95	0.99	1.07	1.15	1.08	1.04	0.99	0.96	0.94
QN18	Rego Park	0.98	0.95	0.95	0.96	1.00	1.04	1.10	1.04	1.03	1.01	0.98	0.97
QN19	Glendale	1.01	0.99	0.97	0.98	1.01	1.03	1.04	1.00	1.01	1.00	0.99	0.98
QN20	Ridgewood	1.02	0.99	0.97	0.98	0.98	0.99	1.03	1.02	1.03	1.01	0.99	0.98
QN21	Middle Village	1.00	0.96	0.96	0.96	1.01	1.05	1.10	1.02	1.02	1.00	0.97	0.96
QN22	Flushing	1.07	1.02	1.02	1.00	0.95	1.00	1.06	1.06	1.01	0.97	0.93	0.92
QN23	College Point	0.99	0.97	0.95	0.95	0.98	1.05	1.09	1.03	1.02	0.98	1.00	0.98
QN25	Corona	0.95	0.96	0.96	0.97	0.97	1.04	1.14	1.10	1.03	0.98	0.96	0.95
QN26	North Corona	1.03	1.02	0.95	0.97	0.99	1.00	1.01	1.01	1.00	1.00	1.02	1.00
QN27	East Elmhurst	0.98	0.94	0.93	0.96	0.99	1.04	1.08	1.03	1.03	1.01	1.02	0.99
QN28	Jackson Heights	0.98	0.97	0.96	0.96	0.99	1.04	1.08	1.03	1.03	1.00	0.99	0.97
QN29	Elmhurst	1.00	0.99	0.98	0.99	1.01	1.03	1.04	1.02	1.02	0.99	0.97	0.96
QN30	Maspeth	1.00	0.98	0.97	0.96	0.99	1.03	1.05	1.01	1.03	1.01	0.98	0.98
QN31	HuntersPt-Sunnyside-WstMaspeth	0.99	0.99	0.98	0.99	0.98	1.00	1.05	1.04	1.03	1.01	0.98	0.95
QN33	Cambria Heights	0.90	0.90	0.87	0.85	0.93	1.24	1.51	1.10	1.02	0.92	0.87	0.87
QN34	Queens Village	1.00	0.97	0.95	0.95	0.98	1.07	1.17	1.02	0.99	0.97	0.97	0.97
QN35	Briarwood - Jamaica Hill	1.01	1.00	0.98	0.96	0.97	1.03	1.07	1.04	1.00	1.02	0.97	0.95

NH Code	Neighborhood Name	Jan Ratio	Feb Ratio	Mar Ratio	Apr Ratio	May Ratio	Jun Ratio	Jul Ratio	Aug Ratio	Sep Ratio	Oct Ratio	Nov Ratio	Dec Ratio
QN37	Kew Gardens Hills	0.98	0.97	0.95	0.94	0.97	1.04	1.10	1.04	1.07	1.02	0.97	0.96
QN38	Pomonok-FlushngHts-Hillcrest	0.94	0.94	0.94	0.94	0.98	1.09	1.19	1.08	1.04	0.99	0.94	0.93
QN41	Fresh Meadows - Utopia	0.91	0.89	0.88	0.88	0.96	1.19	1.37	1.11	1.06	0.98	0.90	0.87
QN42	Oakland Gardens	0.88	0.85	0.85	1.09	0.96	1.18	1.36	1.10	1.05	0.95	0.88	0.85
QN43	Bellerose	0.92	0.90	0.89	0.91	0.99	1.15	1.34	1.05	1.02	0.97	0.93	0.93
QN44	GlenOaks-FloralPk-NewHydePk	0.92	0.91	0.89	0.90	0.96	1.15	1.41	1.07	1.02	0.96	0.90	0.90
QN45	DouglsMnr-Douglston-LitlNeck	0.82	0.80	0.80	0.82	0.99	1.31	1.65	1.18	1.08	0.93	0.81	0.79
QN46	Bayside - Bayside Hills	0.93	0.90	0.89	0.90	0.98	1.15	1.32	1.07	1.04	0.97	0.93	0.92
QN47	FtTotten-BayTerrace-Clearview	0.92	0.89	0.89	0.90	0.98	1.12	1.32	1.08	1.03	0.97	0.95	0.94
QN48	Auburndale	0.95	0.93	0.91	0.92	0.98	1.13	1.30	1.05	1.01	0.96	0.93	0.92
QN49	Whitestone	0.89	0.85	0.84	0.86	1.00	1.24	1.47	1.14	1.05	0.94	0.86	0.85
QN50	Elmhurst - Maspeth	1.01	1.01	0.98	0.99	1.01	1.02	1.04	1.02	1.01	0.99	0.97	0.95
QN51	Murray Hill	0.96	0.93	0.92	0.92	0.98	1.08	1.23	1.07	1.03	0.99	0.94	0.93
QN52	East Flushing	0.98	0.96	0.95	0.95	0.99	1.06	1.15	1.06	1.01	0.98	0.95	0.95
QN53	Woodhaven	1.03	1.01	0.98	0.95	0.97	1.02	1.05	1.02	1.00	0.99	0.99	0.98
QN54	Richmond Hill	1.01	1.00	0.99	0.97	0.98	1.01	1.04	1.00	1.02	1.02	0.99	0.97
QN55	South Ozone Park	1.03	1.01	0.98	0.95	0.97	1.02	1.08	1.02	1.01	0.99	0.97	0.97
QN56	Ozone Park	1.00	1.00	0.96	0.95	0.98	1.04	1.10	1.03	1.02	0.99	0.97	0.96
QN57	Lindenwood - Howard Beach	0.86	0.80	0.81	0.83	0.98	1.30	1.46	1.18	1.10	0.97	0.85	0.84
QN60	Kew Gardens	1.03	1.01	0.97	0.98	0.97	1.00	1.04	1.02	1.04	1.00	0.97	0.97
QN61	Jamaica	0.99	0.97	0.96	0.97	0.97	1.01	1.05	1.04	1.05	1.01	1.00	0.98
QN62	Queensboro Hill	0.99	0.97	0.95	0.95	0.99	1.04	1.11	1.03	1.00	1.00	0.99	0.98
QN63	Woodside	0.98	0.98	0.96	0.97	0.98	1.02	1.06	1.04	1.04	1.00	0.98	0.98
QN66	Laurelton	0.92	0.91	0.88	0.88	0.97	1.23	1.41	1.10	1.00	0.92	0.89	0.89
QN68	Qnsbridge-Ravenswd-LngIslCityN	0.93	0.98	0.98	0.97	1.00	1.06	1.10	1.07	1.04	0.96	0.98	0.92
QN70	Astoria	1.02	1.02	0.98	0.99	0.99	1.02	1.03	1.00	1.01	0.99	0.98	0.98
QN71	Old Astoria	0.97	0.99	1.01	1.00	1.01	1.02	1.04	0.99	1.05	1.02	0.94	0.96
QN72	Steinway	1.01	1.00	0.97	0.97	0.99	1.03	1.07	1.01	1.01	0.98	0.96	0.97
QN76	Baisley Park	0.98	0.94	0.92	0.90	0.94	1.06	1.17	1.12	1.12	1.05	0.91	0.87
QN_103	La Guardia Parcel	0.99	0.68	0.99	0.90	0.92	1.05	1.43	1.26	1.18	1.20	0.68	0.68
QN_140	Grand Central Parkway	0.77	0.77	0.99	0.79	0.96	1.77	1.04	1.10	0.99	1.02	0.92	0.88
QN_538	park_cemetery_etc_QN	0.60	0.63	0.67	0.69	0.72	1.65	1.93	1.61	1.13	0.68	1.06	0.62
QN_730	park_cemetery_etc_QN	0.51	0.39	0.53	1.07	1.39	1.75	1.81	1.67	1.31	0.75	0.44	0.36
QN_731	park_cemetery_etc_QN	0.92	0.97	0.95	0.99	0.97	1.05	0.98	1.00	1.07	1.08	0.99	1.03
QN_842	park_cemetery_etc_QN	0.67	0.67	0.68	0.78	1.09	1.49	1.78	1.25	1.07	0.97	0.79	0.72
QN_843	park_cemetery_etc_QN	1.20	1.18	0.94	1.01	1.07	1.07	0.95	0.88	0.97	0.88	0.98	0.88
QN_847	park_cemetery_etc_QN	0.72	1.32	0.65	1.01	1.33	1.86	2.04	0.77	0.81	0.54	0.44	0.53
QN_848	park_cemetery_etc_QN	0.96	0.96	1.09	1.09	0.94	0.91	1.10	1.01	0.85	0.90	1.08	1.10
Staten Island													
SI01	Annadale-Huguent-PrincesBy-Eltingvl	0.88	0.83	0.82	0.85	1.02	1.33	1.62	1.16	1.01	0.86	0.79	0.81
SI05	NewSprngvil-Bloomfld-Travis	0.94	0.92	0.91	0.92	1.00	1.13	1.29	1.08	1.02	0.95	0.91	0.91
SI07	Westerleigh	0.91	0.90	0.90	0.91	1.00	1.16	1.34	1.08	1.00	0.95	0.92	0.91
SI08	GrymesHill-Clifton-FoxHills	0.98	0.94	0.92	0.92	0.99	1.12	1.22	1.09	0.99	0.95	0.94	0.93
SI11	Charleston-RichmondVly-Tottenvil	0.83	0.83	0.80	0.83	0.99	1.33	1.51	1.16	1.01	0.92	0.88	0.90
SI12	MarinrsHbr-Arlingtn-PtIvory-Granitvl	0.99	0.97	0.94	0.94	0.99	1.07	1.19	1.03	0.99	0.96	0.95	0.95
SI14	Grasmere-Arrochar-FtWadsworth	0.94	0.94	0.92	0.92	0.98	1.14	1.28	1.07	1.02	0.96	0.92	0.92
SI22	WstNewBrightn-NewBrightn-StGrge	1.00	0.98	0.96	0.96	0.98	1.03	1.12	1.02	1.00	0.97	0.96	1.00
SI24	TdtHll-EmrsnHl-HrtlndVillg-LghthseHl	0.91	0.88	0.87	0.88	0.99	1.21	1.39	1.11	1.04	0.94	0.88	0.88
SI25	Oakwood - Oakwood Beach	0.92	0.90	0.90	0.90	1.01	1.20	1.39	1.06	0.99	0.92	0.90	0.91
SI28	Port Richmond	1.00	0.97	0.96	0.96	1.00	1.09	1.20	1.02	0.99	0.94	0.94	0.93
SI32	Rossville - Woodrow	0.83	0.78	0.80	0.78	0.93	1.39	1.67	1.25	1.07	0.85	0.81	0.82
SI35	New Brighton - Silver Lake	0.89	0.86	0.86	0.87	0.94	1.12	1.38	1.16	1.05	0.97	0.94	0.95
SI36	OldTown-DonganHills-SouthBeach	0.97	0.95	0.93	0.94	1.01	1.12	1.23	1.03	0.99	0.96	0.94	0.94
SI37	Stapleton - Rosebank	1.02	0.99	0.95	0.94	0.98	1.05	1.15	1.02	1.00	0.98	0.95	0.96
SI45	New Dorp - Midland Beach	0.94	0.93	0.93	0.92	0.99	1.13	1.26	1.04	1.00	0.97	0.93	0.94
SI48	Arden Heights	0.95	0.94	0.90	0.91	0.98	1.17	1.35	1.08	0.99	0.92	0.91	0.90
SI54	Great Kills	0.93	0.91	0.90	0.92	1.01	1.17	1.36	1.06	0.99	0.93	0.91	0.91

ACRONYMS

CUNY	City University of New York
DDC	New York City Department of Design & Construction
DEC	New York State Department of Environmental Conservation
DOE	New York City Department of Education
DOHMH	New York City Department of Health and Mental Hygiene
DOT	New York City Department of Transportation
DPR	New York City Department of Parks and Recreation
DSNY	The City of New York Department of Sanitation
EPA	United States Environmental Protection Agency
FDNY	Fire Department of New York City
HANYC	Hotel Association of New York City
HEAT	Hydrant Education Action Team
HPD	New York City Department of Housing Preservation and Development
HUD	United States Department of Housing and Urban Development
LEED®	Leadership in Energy and Environmental Design
MaP	Maximum Performance
MTA	New York City Metropolitan Transportation Authority
NYCHA	New York City Housing Authority
NYPD	New York City Police Department
OEM	New York City Office of Emergency Management
SCA	New York City School Construction Authority

Wastewater Treatment Plant Names

26W	26th Ward Wastewater Treatment Plant
BB	Bowery Bay Wastewater Treatment Plant
CI	Coney Island Wastewater Treatment Plant
HP	Hunts Point Wastewater Treatment Plant
JA	Jamaica Wastewater Treatment Plant
NC	Newtown Creek Wastewater Treatment Plant
NR	North River Wastewater Treatment Plant
OB	Oakwood Beach Wastewater Treatment Plant
OH	Owl's Head Wastewater Treatment Plant
PR	Port Richmond Wastewater Treatment Plant
RH	Red Hook Wastewater Treatment Plant
RK	Rockaway Wastewater Treatment Plant
TI	Tallman Island Wastewater Treatment Plant
WI	Wards Island Wastewater Treatment Plant

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New York City Department of Education
New York City Housing Authority
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Fire Department of New York City
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