NYC Environmental Protection

Combined Sewer Overflow Long Term Control Plan For

CITYWIDE/OPEN WATERS

RECOMMENDED PLAN SUMMARY

January 29, 2020

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1. Introduction

CSO Program

The waters surrounding New York City are cleaner and healthier than they have been since the Civil War. Over the last several decades, the City has invested more than $45 billion in the construction and upgrade of critical infrastructure to improve the health of our City's vital ecosystems. These improvements can be seen throughout the five boroughs; seals exploring the Bronx River, whales splashing in the Upper New York Bay, and millions of New Yorkers and tourists flocking to waterways for recreation. In recent years, the City has committed an additional $9 billion to continue the legacy of innovation and investment to usher in a new era of environmental protection for the harbor.

On March 8, 2012, the New York State Department of Environmental Conservation (DEC) and the New York City Department of Environmental Protection (DEP) signed a groundbreaking agreement to reduce combined sewer overflows (CSOs) using a hybrid green and grey infrastructure approach. As part of this agreement, DEP has developed 10 waterbody-specific Long Term Control Plans (LTCPs). The goal of each LTCP is to identify appropriate combined sewer overflow controls necessary to achieve waterbody-specific water quality standards, consistent with the Federal CSO Policy and the water quality goals of the Clean Water Act (CWA). More information about the City's CSO program can be found in Attachment 1 and Attachment 2 of this Summary.

Long Term Control Plan

identifies appropriate CSO controls to achieve applicable water quality standards consistent with the federal CSO Policy and Clean Water Act.

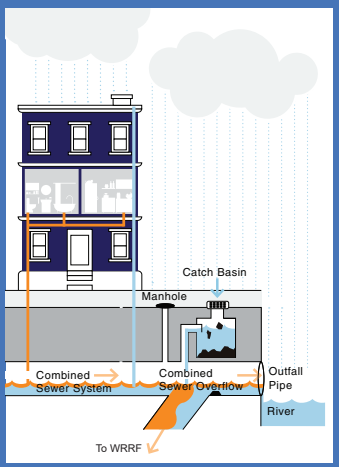
CSO Consent Order

an agreement between NYC and DEC that settles past legal disputes without prolonged litigation. DEC requires DEP to develop LTCPs and mitigate CSOs.

Combined Sewer Overflow

NYC's sewer system is approximately 60% combined, which means it is used to convey both sanitary and storm flows.

When the sewer system is at full capacity, a diluted mixture of rain water and sewage may be released into the local waterways. This is called a combined sewer overflow.

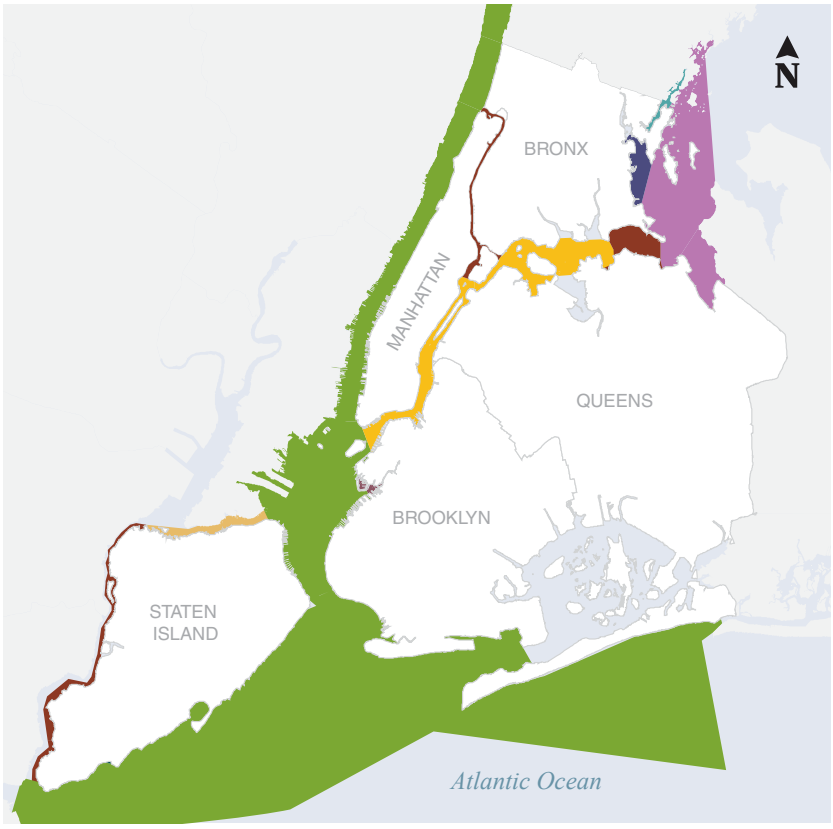


Citywide/Open Waters LTCP Areas

This Summary is for the Citywide/ Open Waters LTCP which is due to DEC in March 2020. It is the largest LTCP, touching all five boroughs and covering the Hudson River, Harlem River, Upper and Lower New York Bay, Arthur Kill and Kill van Kull, East River, and the western portion of Long Island Sound. The development of this LTCP began in 2016 and included water quality sampling, water quality modeling, collection system modeling, a review of existing CSO projects, alternatives analysis and robust public outreach.

- *Harlem River*
- *Hudson River*
- *East River/Long Island Sound*
- *Upper and Lower New York Bay*
- *Arthur Kill and Kill van Kull*

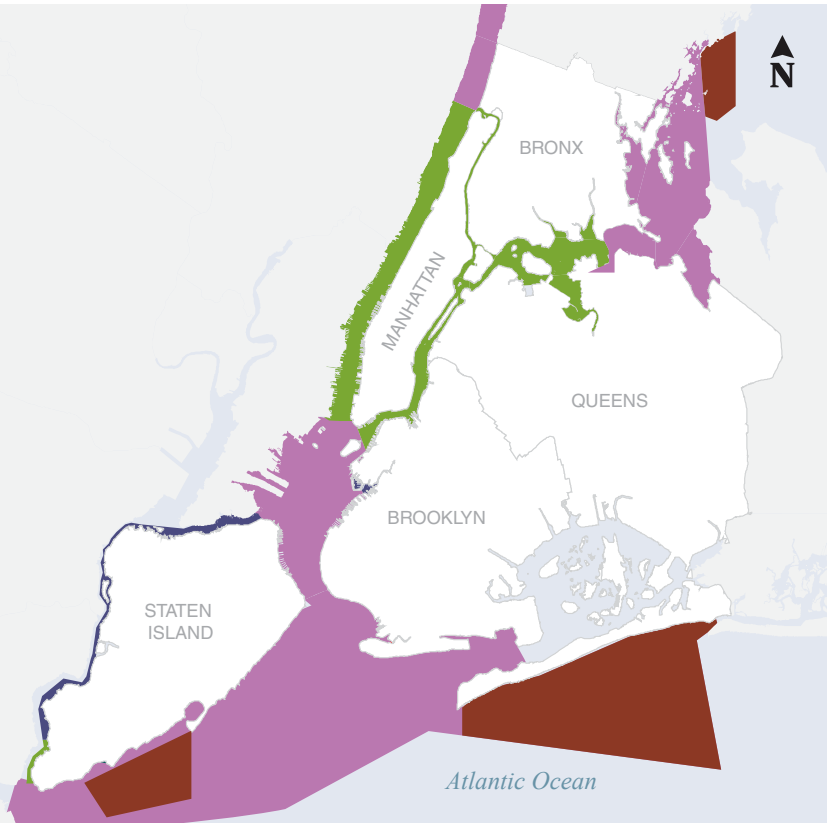
Causes of Impairment



Section 303(d) of the Clean Water Act requires states to identify impaired waters where specific designated uses are not fully supported. Based on the 2016 Final 303(d) list, Upper and Lower New York Bay, and Hudson River are not listed as impaired, while Harlem River, East River/Long Island Sound, Arthur Kill and Kill van Kull are listed as impaired for the pollutants shown in the adjacent map.

- *Floatables*
- *Dissolved Oxygen and Floatables*
- *Dissolved Oxygen and Nitrogen*
- *Pathogens*
- *Not Listed as Impaired*

Waterbody Classifications



In accordance with the provisions of the Clean Water Act, the State of New York (the "State") has established water quality standards for all navigable waters within its jurisdiction. The State has developed a system of waterbody classifications based on designated uses that include five classifications for saline waters. Water quality in Class SA and Class SB classifications support primary and secondary contact recreation and fishing. Classes SC, I and SD support aquatic life and recreation, and water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

- *Class SA (Shellfishing, F, B and Ba)*
- *Class SB (F, B and Ba)*
- *Class SD (F)*
- *Class I (F and B)*

F = Fishing B = Boating Ba = Bathing

Water Quality Criteria

Class	Bacteria			Dissolved Oxygen
	Total Coliform	Fecal Coliform(1)	*Enterococci*(2)(3)	
SA	Median ≤ 70 MPN/10mL	-	30-day GM ≤ 35/100mL STV ≤ 130cfu/100mL	> 4.8 mg/L (daily avg) ≥ 3.0 mg/L
SB	Monthly Median ≤ 2,400/100mL 20% ≤ 5,000/100mL	Monthly GM ≤ 200/100mL	30-day GM ≤ 35/100mL STV ≤ 130cfu/100mL	> 4.8 mg/L (daily avg) ≥ 3.0 mg/L
SD	Monthly Median ≤ 2,400/100mL 80% ≤ 5,000/100mL	Monthly GM ≤ 200/100mL	-	≥ 3.0 mg/L
I	Monthly Median ≤ 2,400/100mL 80% ≤ 5,000/100mL	Monthly GM ≤ 200/100mL	-	≥ 4.0 mg/L

(1) Applies on an annual basis calculated based on geometric mean (GM).

(2) Applies in the recreational season (May 1st to October 31st).

(3) Enterococci criteria only applies to coastal primary contact recreational waters. Hudson River north of Harlem River is a class SB non-coastal recreational water.

Water quality criteria corresponding to the waterbody classifications are shown in the adjacent table.

Total and fecal coliform bacteria concentrations are the criteria that DEC uses to establish whether a waterbody supports recreational uses in non-coastal waterbodies, while fecal coliform and *Enterococci* criteria apply to coastal primary contact recreational waters.

Dissolved Oxygen (DO) is the numerical criterion that DEC uses to establish whether a waterbody supports aquatic life uses.

Citywide/Open Waters Key Waterfront Access Points

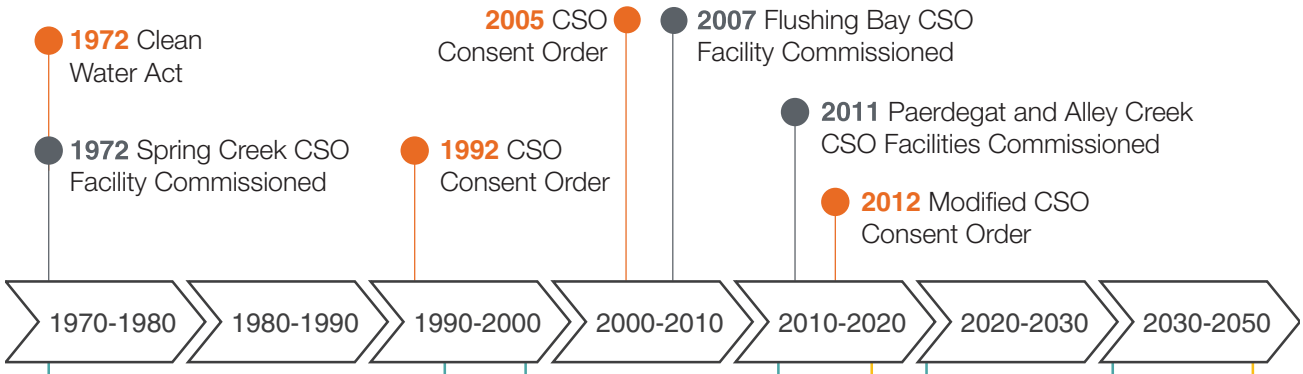
Waterfront access points along the shorelines of the Citywide/Open Waters waterbodies include beaches, kayak launch sites, marinas, and parkland located along the shoreline. Uses at these access points range from primary contact (swimming) at beaches, to secondary contact (boating), and passive, non-contact recreation along shoreline parks. The Citywide/Open Waters LTCP has evaluated water quality and CSO impacts at or adjacent to these waterfront access points as part of the overall assessment of CSO controls.

Investment and Success to Date

Historical Major Capital Investments in Wastewater Infrastructure

Improving New York Harbor's water quality has been a City and DEP priority for decades. According to the City's most recent Harbor Survey Report, the Harbor is cleaner now than at any time in the last 100 years. Continued improvements to the City's 14 wastewater resource recovery facilities (WRRFs), and ongoing investments have resulted in an 80% reduction in combined sewer overflows since the mid-1980s. With nine LTCPs approved, one pending, and this current one being submitted in March 2020, current and planned infrastructure investments will result in even further water quality improvements.

$45 Billion
in historic capital investments has led to
80% Reduction
in annual CSO discharges since the mid-1980's



1973-2011 Upgraded 12 WRRFs to Secondary Treatment and built 2 new WRRFs

$40B[1]

1999-2022 Upgraded Biological Nitrogen Removal at 8 out of 14 WRRFs

$1.1B[1]

1995-2030 Existing Grey/Green Infrastructure Projects to Mitigate Combined Sewer Overflows (CSOs)

$4.3B[1]
$1.6B green[2]
$2.7B grey[3]

2018-2050 LTCP Projects

$5.2B[4]

This timeline summarizes the **major historical ($45 billion)** and **planned ($5.2 billion)** capital investments in wastewater infrastructure across NYC.

[1] *Based on Office Management and Budget Records and 10-yr Capital Plan*

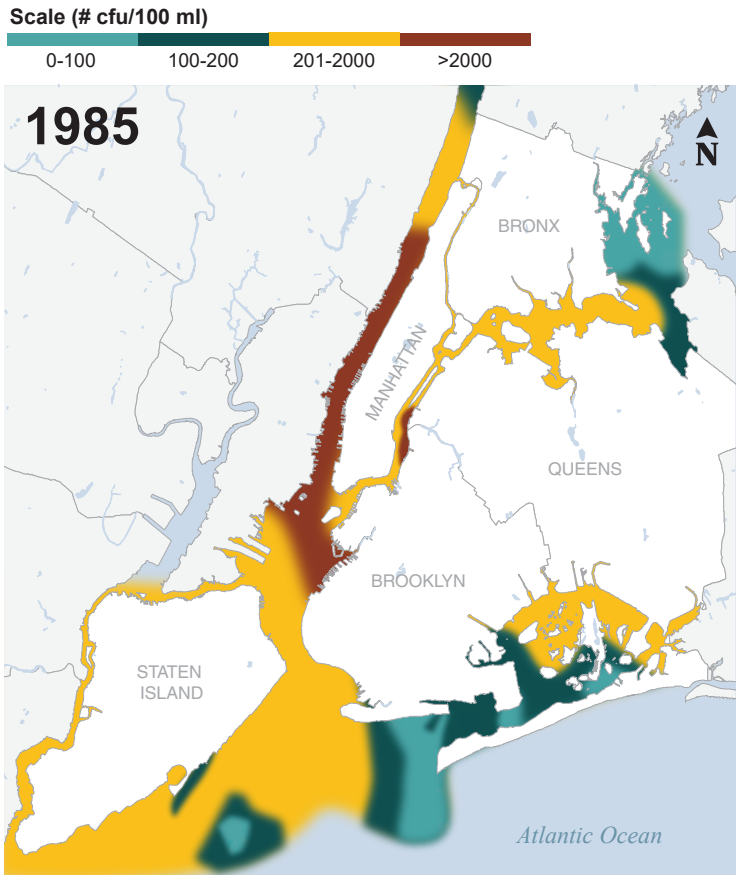
[2] *Based on 2019 LTCP estimated costs*

[3] *Projects committed to under the Waterbody/Watershed Facility Plan Reports (WWFPs)*

[4] *Approved and submitted LTCPs*

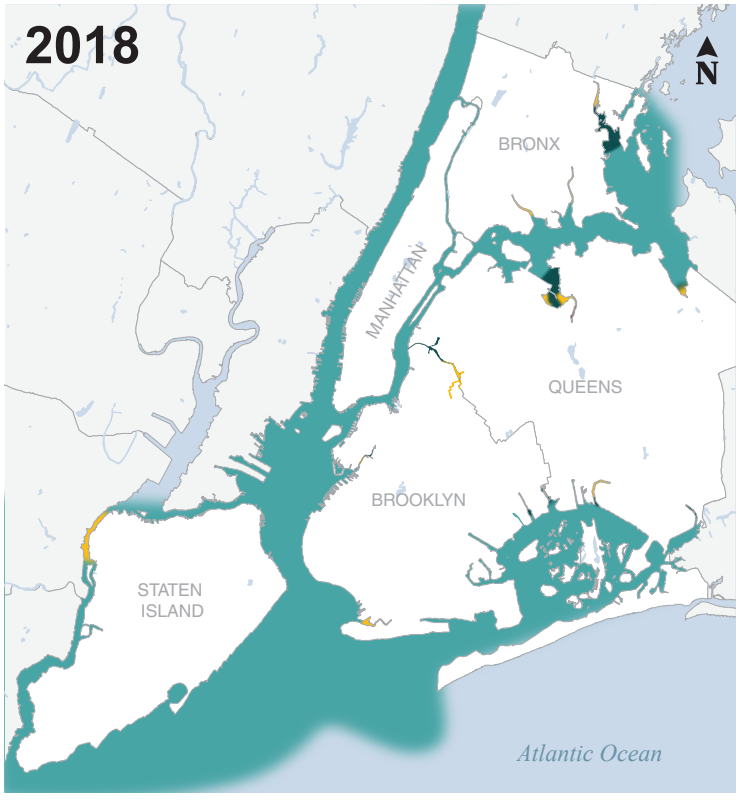
Water Quality Improvements Over Time

Fecal Coliform Summer Geometric Means (GM) from Harbor Survey Monitoring Program Sampling data



> 200 cfu/100ml
GM fecal coliform concentrations in Citywide/Open Waters

> 2,000 cfu/100ml
GM fecal coliform concentrations in portions of the Hudson River, East River, and Upper New York Bay



< 100 cfu/100ml
GM fecal coliform concentrations in most waterbodies

The additional $5.2 billion investment in projects in the current CSO LTCP Program will result in further water quality improvement.

2. CSO Best Management Practices

CSO Best Management Practices (BMPs) address operation and maintenance procedures, maximizing use of existing systems and facilities, and related planning efforts to maximize capture of CSO and to reduce contaminants in the combined sewer system, thereby reducing water quality impacts. The State Pollutant Discharge Elimination System (SPDES) permits require DEP to report annually on its progress in implementing the 13 CSO BMPs summarized below.

The BMP Annual Reports are available on DEP's website:
https://www1.nyc.gov/site/dep/water/combined-sewer-overflows.page

BMP 1 - CSO Maintenance and Inspection Program

Schedule regular inspections of the CSO regulator structures and perform required repair, cleaning, and maintenance to minimize dry-weather overflows and to maximize flow to the WRRFs.

BMP 2 - Maximum Use of Collection System for Storage

Enable regulators and weirs to be adjusted to maximize system capacity for CSO storage through hydraulic capacity evaluations, along with cleaning and flushing to remove and prevent solids deposition within the collection system.

BMP 3 - Maximize Flow to Publicly Owned Treatment Plant

Maximize flow to WRRFs per the operating targets established by the SPDES permits for each WRRF to receive and treat a minimum of two times the design dry-weather flow during wet-weather events.

BMP 4 - Wet Weather Operating Plan

Develop Wet Weather Operating Plans (WWOPs) for each WRRF sewershed to maximize treatment during wet-weather events. DEP has submitted to DEC all WWOPs required by the Additional CSO BMP Special Conditions.

BMP 5 - Prohibition of Dry Weather Overflow

Abate and report any dry weather overflow event to DEC within 24 hours. Dry weather overflows from the combined sewer system are prohibited.

BMP 6 - Industrial Pretreatment

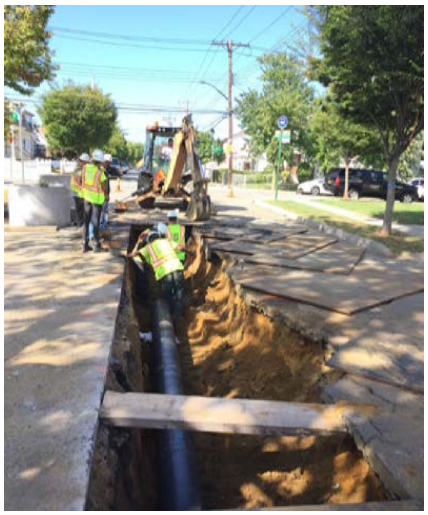
Maximize treatment of persistent toxics from industrial sources upstream of CSOs by regulating the discharges of toxic pollutants from unregulated, relocated, or new Significant Industrial Users (as defined by EPA under federal law) tributary to CSOs.

BMP 7 - Control of Floatable and Settleable Solids

Eliminate or minimize the discharge of floating solids, oil and grease, or solids of sewage origin that cause deposition in receiving waters through implementation of these four practices: Catch Basin Repair and Maintenance, Catch Basin Retrofitting, Booming, Skimming and Netting, and Institutional, Regulatory, and Public Education.

BMP 8 - Combined Sewer System Replacement

Replace combined sewers with separate sanitary and storm sewers whenever possible. All combined sewer replacements are to be approved by the New York City Department of Health and Mental Hygiene and to be specified within DEP's Master Plan for Sewage and Drainage.



BMP 9 - Combined Sewer Extension

Extend combined sewers through implementation of separate sewers whenever possible to minimize stormwater from entering the combined sewer system. If separate sewers must be extended from combined sewers, analyses must be performed to demonstrate that the sewage system and WRRFs are able to convey and treat the increased dry weather flows with minimal impact on receiving water quality.

BMP 10 - Sewer Connection and Extension Prohibitions

Prohibit, upon letter notification from DEC, sewer connections and extensions that would exacerbate recurrent instances of either sewer back-ups or manhole overflows. Wastewater connections to the combined sewer system downstream of the last regulator or diversion chamber are also prohibited.

BMP 11 - Septage and Hauled Waste

Prohibit discharge or release of septage or hauled waste upstream of a CSO. These wastes may only be discharged at designated manholes that never drain into a CSO, and only with a valid permit.

BMP 12 - Control of Runoff

Discharge only allowable flows into the combined or storm sewer system. All sewer certifications for new development must comply with DEP rules and regulations, be consistent with the DEP Master Plan for Sewers and Drainage, and be permitted by DEP.

BMP 13 - Public Notification

Place signage at or near CSO outfalls, with contact information for DEP, to allow the public to report observed dry weather overflows. DEP has a system in place to determine the nature and duration of an overflow event and notifies stakeholders of any resulting, potential harmful conditions.

3. Grey Infrastructure Strategies

Large-scale, centralized or end-of-pipe controls such as retention tanks or sewer modifications are called grey infrastructure. Recent DEP construction projects have included upgrades in key WRRFs, pump station improvements, storm sewer expansions, and the construction of several large CSO retention tanks to further mitigate CSO discharges. The following examples of grey infrastructure strategies have been or will be implemented across the watersheds included in the CSO LTCP Program.

Paerdegat Basin
CSO Retention Facility

Retention Tanks

CSO retention tanks are large facilities that capture CSO during a wet weather event, store it, and pump it back to a WRRF for treatment after the storm when capacity in the sewer system is restored. NYC has four existing CSO retention tanks located at Alley Creek, Flushing Creek, Paerdegat Basin and Spring Creek.

Example of a CSO Tunnel
in Portland, OR

Tunnels

CSO storage tunnels function similarly to CSO retention tanks. The underground large diameter tunnel captures and temporarily stores the CSO. After the storm is over, the flow stored in the tunnel is pumped to the WRRF for treatment. NYC does not currently have any existing CSO storage tunnels.

Example of a Typical
Disinfection System

Disinfection

CSO disinfection kills bacteria in CSOs using a sodium hypochlorite solution (similar to concentrated bleach), often followed by dechlorination using sodium bisulfite. Disinfection facilities include chemical storage and feed equipment and a means to provide “contact time” between the disinfectant and the CSO, typically either in tank or in a suitably-sized outfall pipe. Chlorination of sewage remains the most common and effective wastewater disinfection practice, but can be challenging at CSO facilities.

Laurelton Sewer Upgrade

Increasing Pipe Capacity

Providing larger combined sewer pipes can provide capacity to convey more flow to the WRRFs, or to relocate CSOs to less sensitive discharge locations.

Bergen Basin CSO Bending Weirs

Weir Modifications

Bending weirs, fixed weirs and regulator orifice modifications can prevent CSOs from discharging during smaller rainfall events. During a large rainfall event, the bending weir will bend or open, thus allowing a CSO to occur without increasing the risk of upstream flooding.

Glen Oaks Storm Sewer Extension

High Level Storm Sewers

High level storm sewers can be constructed to capture and divert stormwater from the combined sewer system, freeing up wet weather capacity in the combined sewers and reduces the volume and frequency of CSO activations.

Jamaica Bay Floating Boom and DEP Skimmer Boat

Floatables Control

Floatables controls include structural controls such as booms, nets, screens or underflow baffles to prevent the discharge of floatables to waterbodies, as well as programmatic source controls such as catch basin improvements, street sweeping and public education campaigns to keep these materials out of the sewer system.

Upgraded Avenue V Pump Station

Pump Station Modifications

Pump station modifications can increase the conveyance of combined sewer flows to the WRRFs for treatment and can also relocate CSOs to less-sensitive discharge locations. The Gowanus and Avenue V Pump Stations in Brooklyn were previously upgraded, resulting in reduced CSOs to Gowanus Canal and Coney Island Creek.

26th Ward WRRF

Wastewater Resource Recovery Facility Upgrades

Upgrades to WRRFs can result in additional capture and treatment of combined sewage during wet weather events, resulting in a decrease of the volume and frequency of CSOs to local waterways.

4. Green Infrastructure Strategies

The New York City Green Infrastructure (GI) Program was launched in January 2011 and committed $1.6 billion in funding through 2030 to manage stormwater and reduce CSOs in NYC. GI also provides many co-benefits such as neighborhood beautification, air quality improvements and cooler temperatures in hot summer months.

Green Infrastructure strategies detain stormwater runoff through capture and controlled release into the sewer system. GI may also retain runoff through capture and infiltration into the ground below or vegetative uptake and evapotranspiration.

Details on the GI Program elements and progress are described in the NYC Green Infrastructure Annual Reports available here: www.nyc.gov/dep/greeninfrastructure.

The GI Program entails four key strategies as summarized below:

Highlights

$1.6 Billion
GI Investment
Through 2030

4,585
Assets constructed
or in construction

~5,000
Assets going into
construction in 2019

Right-of-way Green Infrastructure

Rain Garden in Brooklyn

The public right-of-way (ROW) includes sidewalks, parking lanes, medians and the roadway. It makes up approximately 30% of the impervious cover in the city and generates stormwater runoff during rain events. In 2012, DEP launched area-wide GI projects, in partnership with DOT and DPR. In addition to rain gardens, DEP constructs infiltration basins, porous pavements, green strips and stormwater greenstreets. To date, over 4,000 GI practices in the ROW have been constructed and nearly 5,000 more will begin construction in 2019.

Public Property Retrofits

Green Infrastructure Playground at JHS 218K

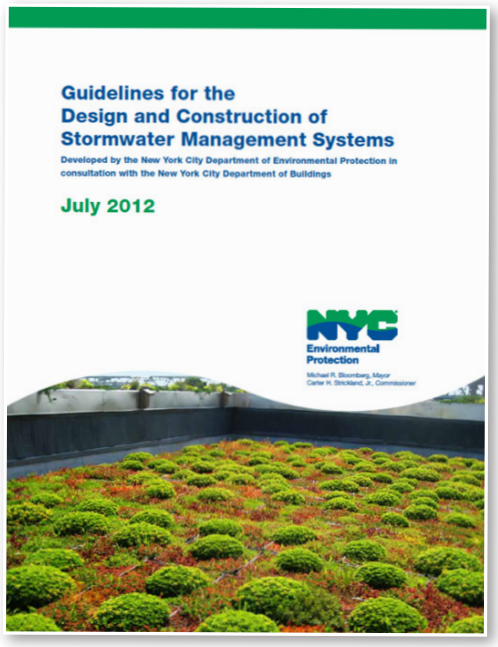
DEP partners with the Departments of Design & Construction, Parks & Recreation and Education and the New York City Housing Authority to design and construct "on-site" green infrastructure, meaning GI within the property lines of City-owned properties. Typical on-site green infrastructure types include rain gardens, turf fields, porous pavements and subsurface infiltration and storage. To date, over 70 on-site projects are constructed or in-construction and over 400 more are in design.

Private Property Incentives

Brooklyn Navy Yard Green Roof

Since 2011, DEP has offered a Grant Program to fund the design and construction of GI on non-City owned property. To date the Grant Program has committed over $13M to 32 projects. In November 2018, DEP issued a Request for Proposals to select a Program Administrator and initiate a new Private Property Retrofit Incentive program, marking a significant expansion of DEP's private incentives for GI. The program will focus on properties over 50,000 square feet (sf) in total lot area to maximize the cost effectiveness of the GI practices constructed under this program. Projects are expected to begin in 2020.

Stormwater Rules



In 2012 DEP promulgated rules that required new development and redevelopment projects to meet reduced stormwater release rates of 0.25 cubic feet per second or 10% of the allowable flow, whichever is greater. In order to create a citywide stormwater management policy, utilizing lessons learned from the GI Program, and the Municipal Separate Storm Sewer System (MS4) Program, DEP has initiated the process for a new Unified Stormwater Rule. The Unified Stormwater Rule will require more effective on-site stormwater management as part of new and redevelopment, with updated requirements for stormwater quantity and flow rates and new requirements for water quality. Specific to GI, new and redevelopment projects that are greater than 20,000 sf will be required to infiltrate stormwater runoff on-site, when feasible. The Unified Stormwater Rule will result in more consistency across NYC stormwater regulations for public and private property and allow for more flexibility in design options.

5. Summary of Submitted LTCPs

Grey Infrastructure Implementation Plans

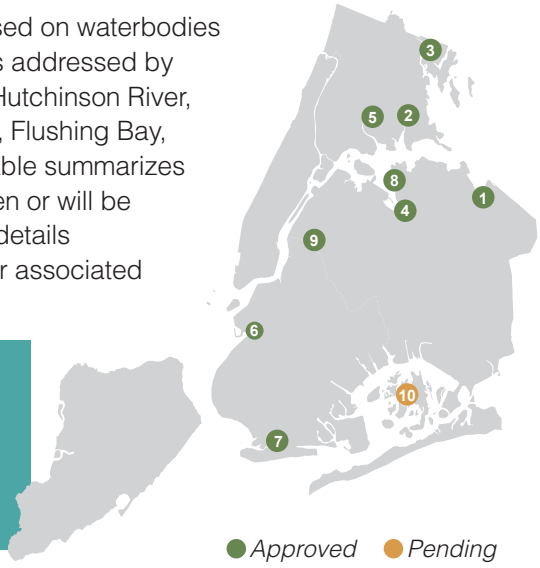
Prior to submittal of this LTCP, DEP submitted ten LTCPs that focused on waterbodies that are tributary to the open waters waterbodies. The waterbodies addressed by the ten previous LTCPs include: Alley Creek, Westchester Creek, Hutchinson River, Flushing Creek, Bronx River, Gowanus Canal, Coney Island Creek, Flushing Bay, Newtown Creek and Jamaica Bay and Tributaries. The adjacent table summarizes the existing and planned grey infrastructure projects that have been or will be implemented for these waterbodies. Attachment 2 provides more details regarding these cost-effective grey infrastructure projects and their associated benefits to each of the tributary waterbodies.

Highlights

CSO Volume Reductions

5.6 BGY	2.8 BGY*
WWFP CSO and GI Programs	LTCP CSO Program

**An additional 0.7 BGY receives disinfection treatment, making the total untreated CSO volume reduction 3.5BGY.*



1 Alley Creek

3 Hutchinson River

5 Bronx River

7 Coney Island Creek

9 Newtown Creek

2 Westchester Creek

4 Flushing Creek

6 Gowanus Canal

8 Flushing Bay

10 Jamaica Bay and Tributaries

LTCP Program Commitments and Benefits

Waterbody	Existing Grey Infrastructure Projects	Dollars Spent (Millions)	CSO Volume Reduction (%)	LTCP Project	Escalated Capital Costs (Millions)[1]	Additional CSO Volume Reduction (%)[2]	Additional CSO Bacteria Reduction (%)[2]	Additional Treated CSO Volume (MGY)[2]
Alley Creek	CSO Storage Facility and Other Sewer Improvements	$141	60%	Seasonal Disinfection of Existing CSO Storage Tank	$12	-	59%	78
Westchester Creek	Weir Modifications and Parallel Sewer	$126	63%	None	$0	-	-	-
Hutchinson River	Hunts Point WRRF Headworks	$3	11%	Seasonal Disinfection and Floatables Control for New Outfall	$167	-	14%	65
Flushing Creek	CSO Storage Facility and Vortex Facilities	$363	50%	Seasonal Disinfection of Existing CSO Storage Tank and Outfall	$92	-	51%	584
Bronx River	Maximize Flow to WRRF and Floatables Control	$46	9%	Hydraulic Relief and Floatables Control	$185	37%	37%	-
Gowanus Canal	Flushing Tunnel and Pump Station Reconstruction	$198	44%	None per LTCP process; CSO Storage Tanks required per Superfund	$1,180	56%	56%	-
Coney Island Creek	Pump Station Expansion and Wet Weather Force Main	$197	68%	None	$0	-	-	-
Flushing Bay	Sewer Diversion, Dredging, and Regulator Modifications	$71	19%	CSO Storage Tunnel	$1,616	51%	51%	-
Newtown Creek	Sewer and WRRF Improvements and Aeration	$262	20%	CSO Storage Tunnel and Upgrade of Borden Ave Pump Station	$1,335	61%	61%	-
Paerdegat Basin	CSO Storage Facility and Dredging	$394	57%	None	$0	-	-	-
Jamaica Bay & Tributaries	Sewer Improvements, CSO Storage Facility and Dredging	$706	9%	GI, Dredging, and other Environmental Improvements	$579	1%	10%	0
Open Waters	Facility, Conveyance, and Regulator Improvements	$196	-	System Optimization	$72	2%	2%	0
TOTALS		**$2.7 Billion**			**$5.2 Billion**			

[1] Escalated costs include design, design services during construction, construction, and construction management costs, escalated per the implementation schedule.

[2] Additional reductions beyond existing grey infrastructure projects.

Existing Green Infrastructure Program Total
$1.6 Billion
(thru 2030)

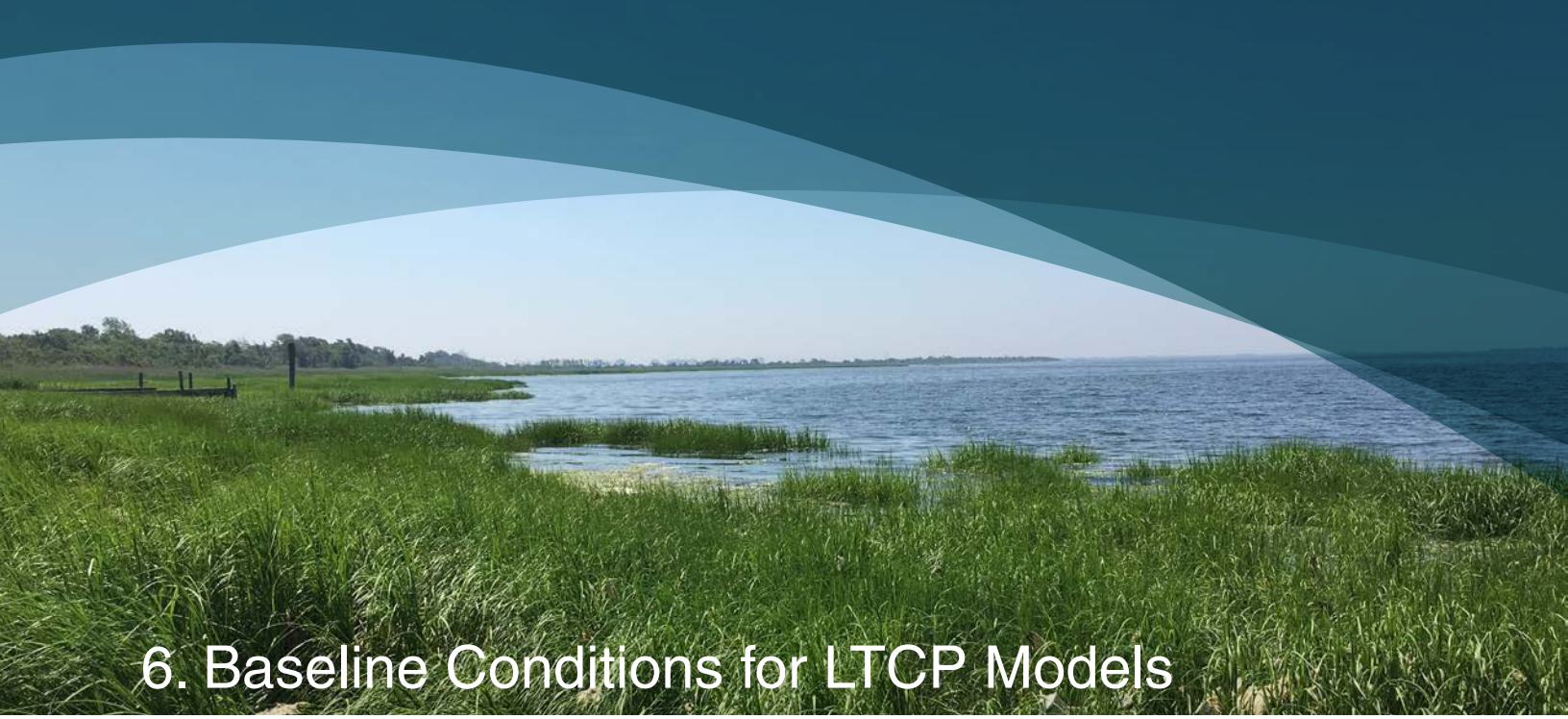
+

Existing Grey Infrastructure Projects
$2.7 Billion

=

Pre-LTCP CSO Program Total
$4.3 Billion

LTCP CSO Program Total
$5.2 Billion



6. Baseline Conditions for LTCP Models

Consistent with each of the previously-submitted LTCPs, a set of Baseline Conditions were established for this LTCP from which the potential benefits of additional CSO controls on the Open Waters waterbodies could be assessed. Most of the elements of the Baseline Conditions for this LTCP, such as the future dry weather flows, WRRF capacities and GI implementation, are similar to the Baseline Conditions established for the previously-submitted LTCPs. The one unique aspect of the Baseline Conditions for the Citywide/Open Waters LTCP is that for this LTCP, the recommended plans from the previously-submitted LTCPs are also included.

InfoWorks Model – Collection System Baseline Conditions

InfoWorks Model Level of Detail. The InfoWorks Model was developed to represent the sewer system on a macro scale, including conveyance elements generally greater than 48-inches in equivalent diameter, along with regulator structures and CSO outfall pipes. Smaller-diameter sewers were included for specific areas where greater model definition was desired.

Planning Horizon and Population. Year 2040 was established as the planning horizon and population for that time was developed by the Department of City Planning and the New York Metropolitan Transportation Council.

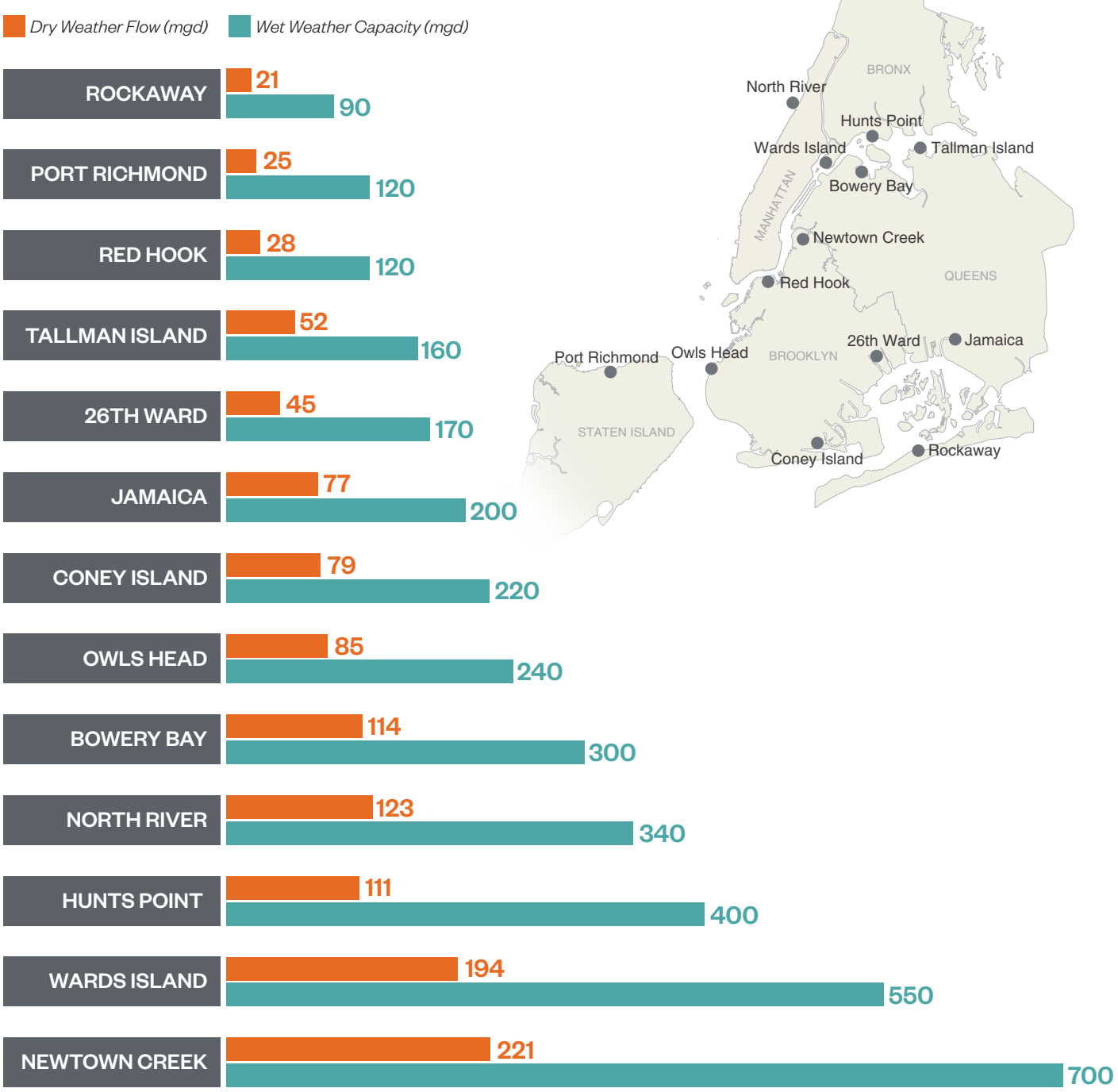
Submitted LTCP Recommended Plans and Existing Grey Infrastructure. Conditions in the tributaries to the Citywide/Open Waters waterbodies assume implementation of the recommended plans from the previously submitted LTCPs. The cost-effective grey infrastructure projects included are summarized in Attachment 2.

Green Infrastructure. Constructed or planned GI projects, as well as daylighting of Tibbetts Brook and potable water demand management projects for Central Park and Prospect Park were included in the baseline conditions for Citywide/Open Waters LTCP. The total anticipated CSO reduction benefit from the NYC GI program is 1.67 BGY.

Dry-Weather Flows. Year 2040 dry-weather wastewater flows to the WRRFs were established based on the 2040 population projection figures for each WRRF sewershed and DEP's projected 2040 dry weather per capita wastewater flow. These projections account for water conservation measures that have already significantly reduced flows to the WRRFs and freed up capacity in the conveyance system.

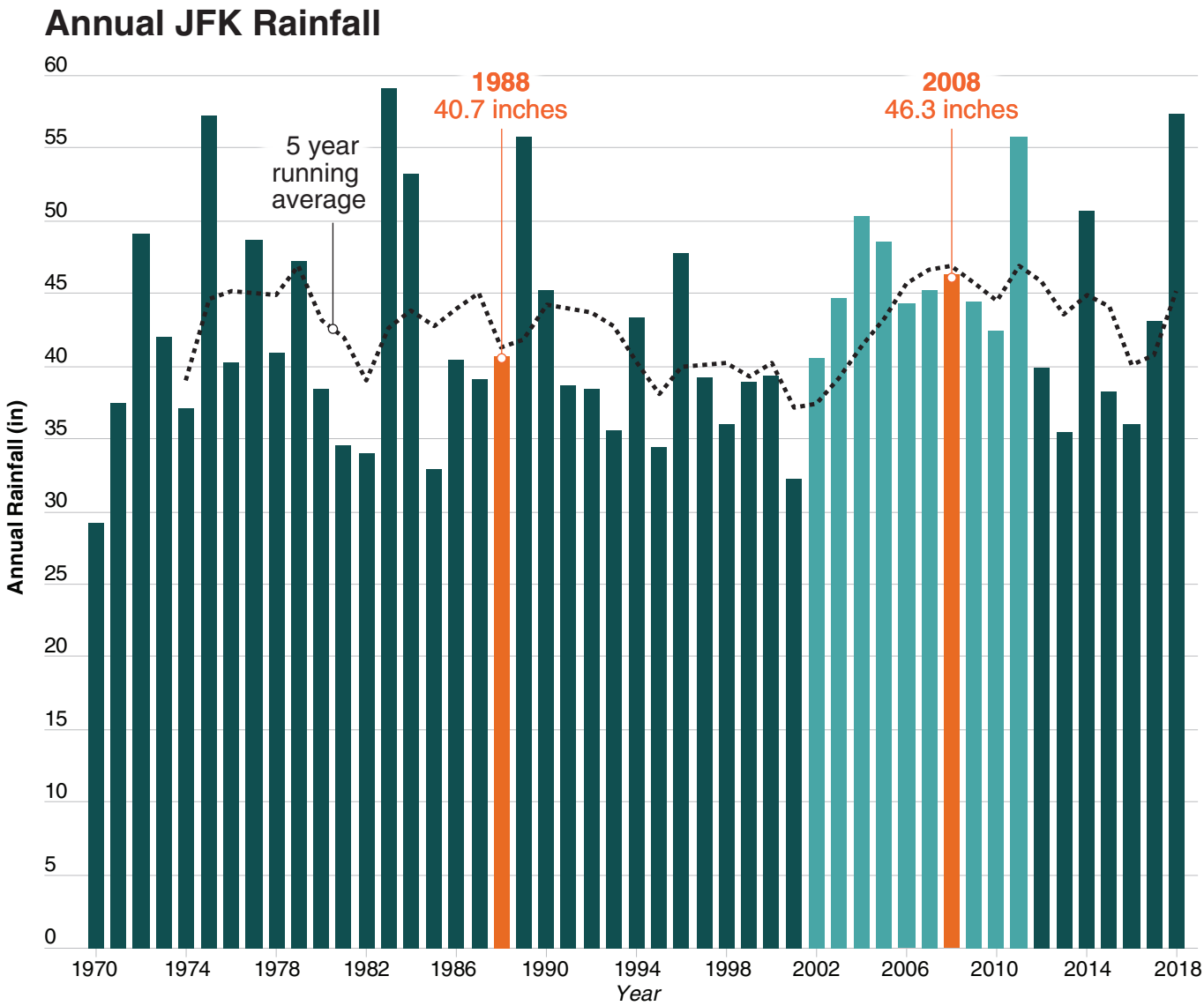
WRRF Capacities. The wet weather (peak) rated capacity for each WRRF was based on two times the design dry-weather flow (2xDDWF) of each WRRF. The chart below summarizes the 2040 projected dry weather flows and SPDES rated wet weather capacities for the WRRFs. The Oakwood Beach WRRF serves a separate sanitary system with no CSOs and is therefore not addressed in this LTCP.

WRRF 2040 Dry Weather Flow and SPDES Rated Capacity



Typical Year Rainfall. The 2008 rainfall from the JFK rainfall gauge was selected as the typical year rainfall. The 2002-2011 JFK rainfall period was also used to assess performance over a wider range of rainfall conditions. Tide data corresponding to the same timeframes as the rainfall were also incorporated into the InfoWorks Model. As indicated in the chart below, the JFK 2008 rainfall includes almost six inches more rainfall than the JFK 1988 rainfall that was used in previous CSO planning for the WWFP evaluations, and is more consistent with recent rainfall trends.

InfoWorks Model Calibration. The InfoWorks models of the combined sewer systems with CSOs that discharge to the Open Waters waterbodies were calibrated to flow meter data from a total of 37 CSO regulators distributed throughout the combined sewer systems. The calibration process involved comparing modeled flows and volumes to the values measured at the 37 regulators for specific storms that occurred during the flow monitoring period. Minor adjustments to modeling parameters such as pipe roughness or runoff coefficients were made as appropriate to improve the match between the model and the meters. In some cases, field inspections were conducted to confirm the system configuration and to resolve differences between the meter and model data.



Water Quality Model – Water Quality Baseline Conditions

Pollutant Loadings. The Water Quality Model uses pollutant loadings that were generated by applying fecal coliform, *Enterococci*, and biological oxygen demand (BOD) concentrations to the projected flows from the InfoWorks Model. The concentrations were developed by employing either a mass balance procedure, or a statistical randomization of measured CSO concentrations.

CSO Bacteria Concentrations. Bacteria concentration data were collected at a total of 14 CSO outfalls that discharge directly to the Citywide/Open Waters waterbodies.

Stormwater Bacteria Concentrations. Bacteria concentration data were collected at a total of 20 stormwater outfalls that discharge to the Citywide/Open Waters waterbodies and tributaries

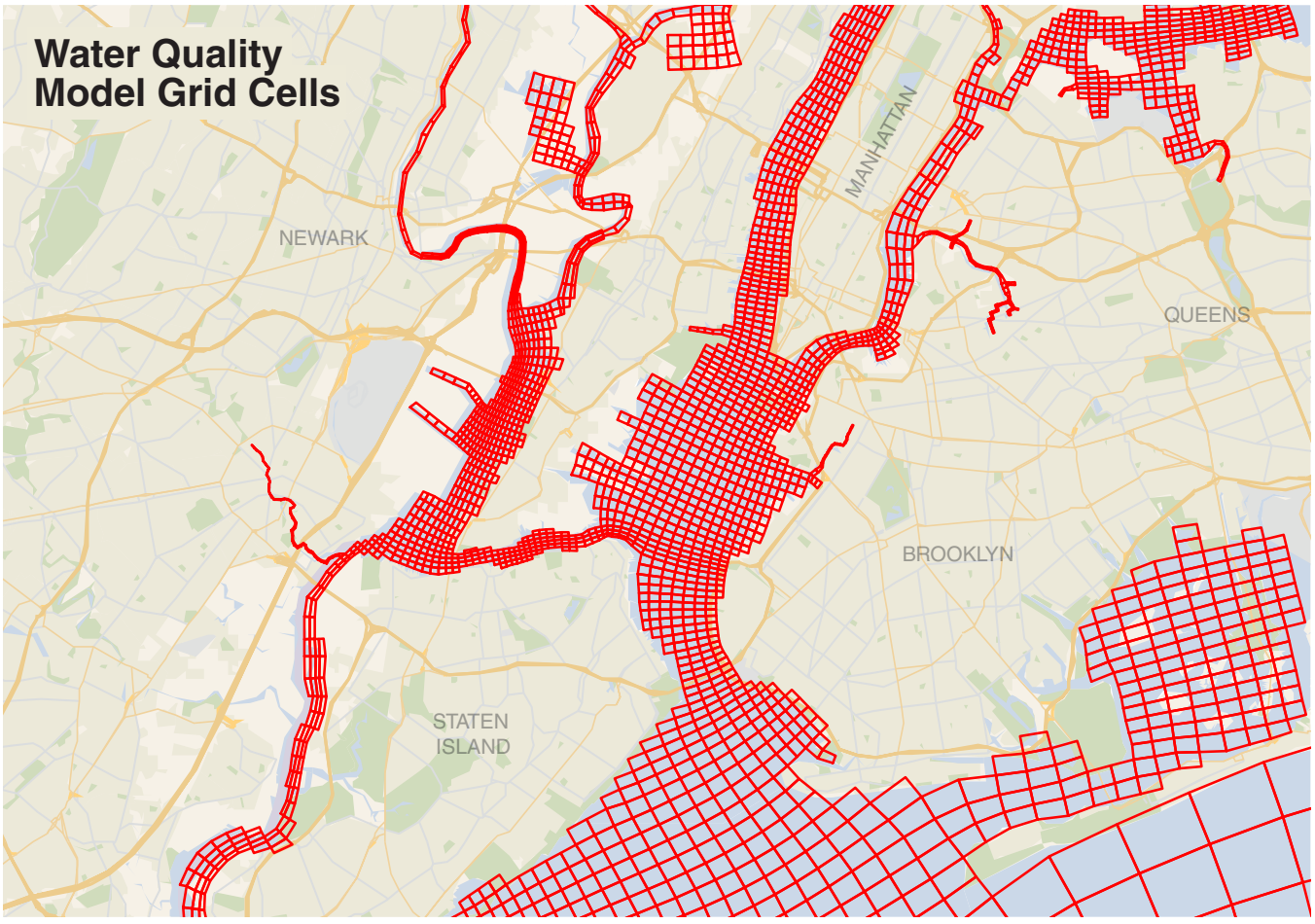
.

Direct Drainage Bacteria Concentrations. Bacteria concentrations in direct drainage areas were based on a range of literature sources.

WRRF Effluent Bacteria Concentrations. WRRF effluent bacteria concentrations were based on 2016 measurements, using a statistical selection of daily averages for fecal coliform and median of several months for *Enterococci*. BOD concentrations were based on model results.

New Jersey Pollutant Loadings. Pollutant loadings from New Jersey outfalls were provided by the Passaic Valley Sewerage Commission, and reflect baseline conditions for New Jersey, without implementation of future CSO control projects that may be identified in future New Jersey based LTCPs.

Water Quality Model Calibration. The water quality model was calibrated to sampling data collected from the Open Waters waterbodies through the LTCP program, as well as from the DEP's Harbor Survey Monitoring and Sentinel Monitoring Programs. Collectively, these programs provided sampling data from over 150 locations throughout the Open Waters waterbodies.



Tibbetts Brook Daylighting

Daylighting would re-route the flow from Van Cortlandt Lake from its current path through the Broadway Sewer to an open channel stream along the former railroad right-of-way and pass over three sewer crossings.

Cost estimate: $63 million*

**2019 $, does not include site acquisition costs.*

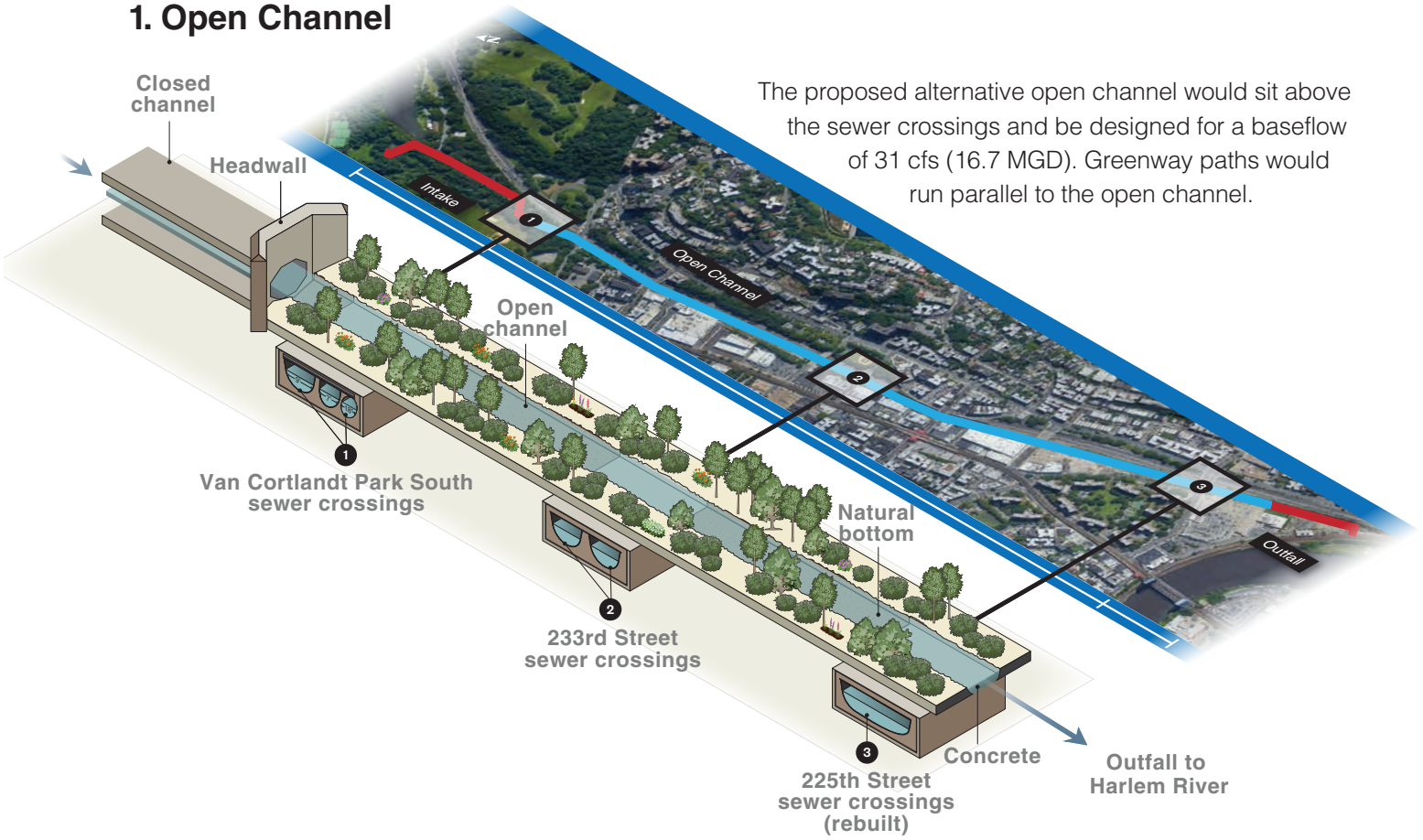
Benefits:

1. Reduces CSO discharges to Harlem River by 228 MGY
2. Reduces the dry weather flow to Wards Island WRRF associated with the lake overflow

Two components of the project:

1. Open Channel 2. Van Cortlandt Lake Improvements

1. Open Channel



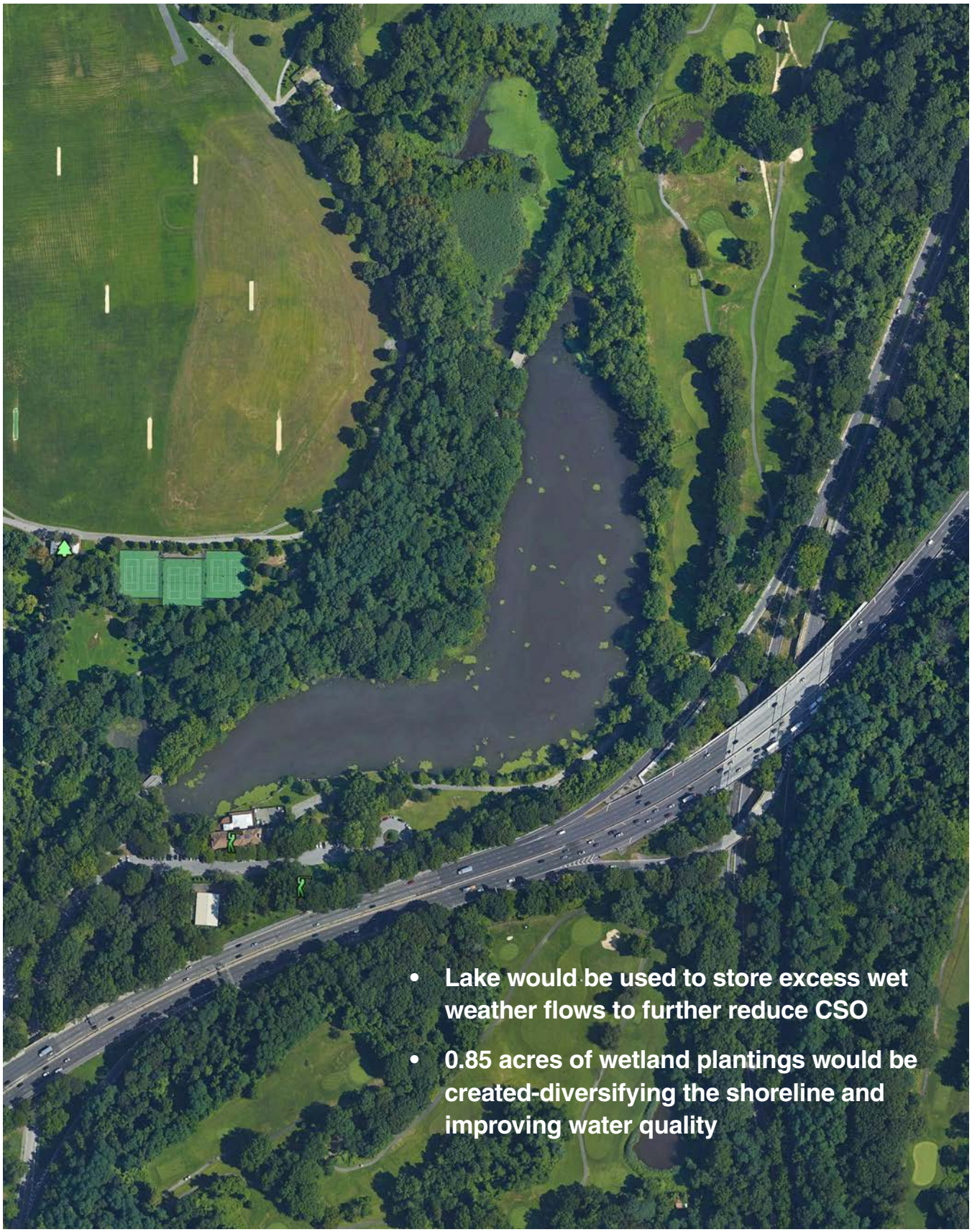
The proposed alternative open channel would sit above the sewer crossings and be designed for a baseflow of 31 cfs (16.7 MGD). Greenway paths would run parallel to the open channel.

Flow from Van Cortlandt Lake would be diverted through a new sewer in the park before daylighting into an open channel

Existing outlet structure

Southern end of Van Cortlandt Lake near outlet structure

2. Van Cortlandt Lake Improvements



7. WQS Attainment and Alternatives Screening

Before starting on the analysis of CSO control alternatives for the Citywide/Open Waters waterbodies, it was important to establish baseline water quality (WQ) conditions, identify gaps between baseline water quality and attainment of water quality standards (WQS), and to determine if further CSO controls could close any identified gaps. The assessment of baseline water quality conditions identified future bacteria and DO levels assuming no additional control of the CSOs discharging directly to the Citywide/Open Waters waterbodies beyond those already required under the CSO Order as of the date of this LTCP. This baseline condition, however, also included implementation of the recommended plans for the 10 LTCPs covering tributary waterbodies previously submitted under the DEP's LTCP Program. Simulations were then performed to determine bacteria and DO levels under the assumption of 100% control of CSOs discharging directly to the Citywide/Open Waters waterbodies. The results of the baseline simulation were compared to the 100% CSO control simulation, to determine whether bacteria and DO WQ criteria could be attained through the implementation of CSO controls. For bacteria, the gap was assessed for fecal coliform and for coastal primary recreational waters, *Enterococci*. As detailed below, a ten-year simulation using 2002-2011 JFK Airport rainfall was performed for the assessment of WQS attainment for bacteria and a one-year simulation was performed for DO using 2008 JFK Airport rainfall. These simulations served as the basis for the evaluation of the CSO control alternatives presented in Section 8.0.

Summary of WQ Standards Compliance

✓ *yes* ✗ *no* *not applicable*

		Fecal Coliform Monthly GM(1)		Enterococci 30-day GM(2)		Enterococci 30-day STV(2)		Dissolved Oxygen (DO)	
Waterbody	**Classification**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**
Harlem River	Class I	✓	✓					✓	✓
Hudson River	Class SB	✓	✓					✓	✓
	Class I	✓	✓					✓	✓
East River/LIS	Class SB	✓	✓	✓	✓	✓	✓	✓	✓
	Class I	✓	✓					✓	✓
New York Bay	Class SB	✓	✓	✓	✓	✗	✓	✓	✓
Kill van Kull	Class SD	✗ (3)	✗ (3)					✓	✓
Arthur Kill	Class SD	✗ (3)	✗ (3)					✓	✓
	Class I	✗ (3)	✗ (3)					✗ (3)	✗ (3)

(1) Fecal Coliform attainment is assessed on an annual basis. (2) Enterococci attainment is assessed for the recreational season (May 1st – Oct 31st).
(3) 100% CSO removal by NYC will not fully attain WQS due to other sources such as stormwater and New Jersey discharges.

Highlights

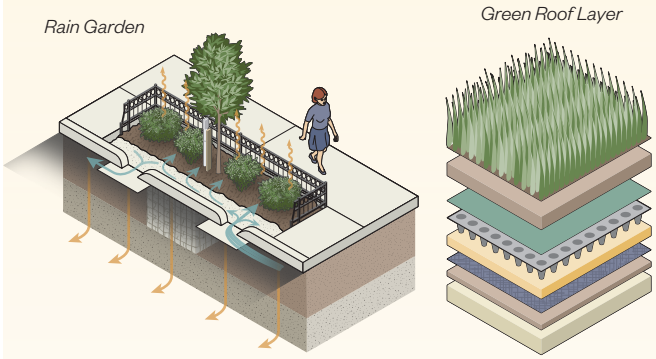
- **Over $9B** in investments have been made or committed as part of the CSO Program to date
- **Total CSO discharge to open waters is about 11 BGY**. This is a small fraction (5%) compared to the total 251 BGY that is captured and treated at the city's East River/Open Waters WRRFs
- Baseline WQ shows high levels of attainment with applicable WQS with exception of:
  - Upper/Lower Bay WQ shows some localized exceedances of the new (2019) Enterococci STV criteria
  - Arthur Kill and Kill van Kull (located between NY and NJ) shows some non-attainment with the fecal coliform criteria
    - Staten Island is primarily MS4
    - 100% CSO removal by NYC will not fully attain WQS due to other bacterial sources such as stormwater and New Jersey discharges
- Large-scale, expensive CSO control alternatives will provide minimal improvement in WQS attainment in most areas
- **Citywide/Open Waters LTCP will focus on lower-cost system optimization** alternatives, but 50/75/100% Control was assessed per CSO Policy, through tunnel storage

Consistent with previous LTCPS, the alternatives process begins with a toolbox of alternatives to evaluate. These alternatives are subject to a series of screening steps where infeasible or less favorable alternatives are screened out and retained alternatives are subject to further evaluation. The toolbox for the Citywide alternatives is presented below.

CSO Mitigation	Toolbox of Alternatives				
Source Control	Green Infrastructure		Storm Sewers		
System Optimization	Regulator Modifications	Parallel Interceptor Sewer	Bending Weirs or Control Gates	Pump Station Optimization	Pump Station Expansion
CSO Relocation	Gravity Flow Diversion to other Watersheds	Pumping Station Modifications	Flow Diversion with New Conduit and/or Pumping		
Water Quality/ Ecological Enhancement	Floatables Control	Environmental Dredging	Wetland Restoration and Daylignting		
Satellite Treatment	Outfall Disinfections	Retention Treatment Basin (RTB)	High Rate Clarification (HRC)		
Centralized Treatment	WRRF Expansion				
Storage	In-System		Tank	Tunnel	

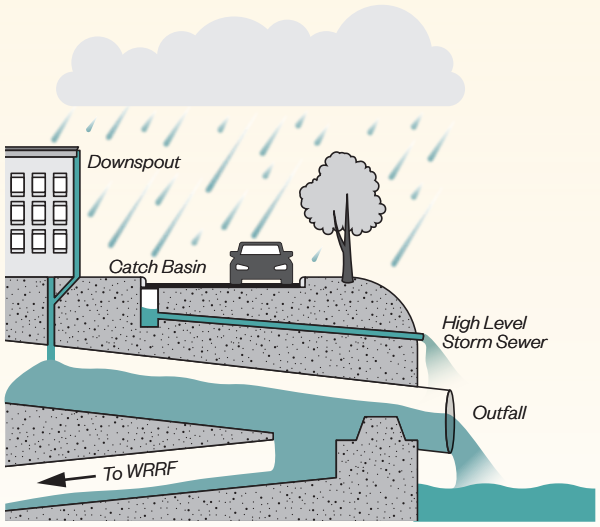
Retained Alternatives | Screened-out Technologies | Ongoing Projects

Ongoing Projects



Green infrastructure

Green infrastructure is being implemented throughout the Citywide/Open Waters waterbodies in accordance with the GI Implementation Plan. Opportunities for GI continue to be evaluated through the various outreach and incentive programs offered by DEP.



Storm Sewers

High level storm sewers and/or sewer separation will continue to be evaluated throughout the Citywide/Open Waters waterbodies as a means to address drainage level of service issues and in conjunction with potential new development.

Screened-out Technologies

Pump Station Optimization/ Expansion

These alternatives were considered using optimization software but no viable alternatives were identified.

WRRF Expansion

WRRF expansion was evaluated for each WRRF using the collection system models, but no substantial reduction in CSO discharge was identified.

Environmental Dredging

Solids deposition from CSOs was not identified as an aesthetic issue. As a result, no locations for environmental dredging were identified.

Outfall Disinfection

Outfall Disinfection was screened out due to insufficient length/volume within existing outfalls and little potential improvement to attainment with WQS.

Retention Treatment Basin (RTB)

RTBs were screened out due to limited potential impact on WQS attainment.

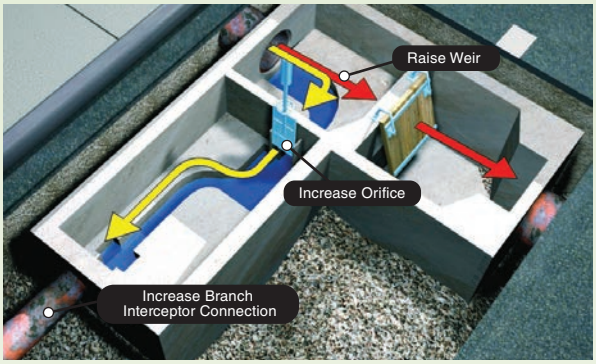
In-System

In-System storage within CSO outfalls was screened out due to insufficient length/volume to provide meaningful volume reduction.

Flow Diversion with New Conduit and Pumping & Pump Station Modification

No cost-effective opportunities for CSO relocation via flow tipping (flow relocation to a less-sensitive receiving water) with a conduit/tunnel and pumping or via pump station modification were identified.

What is Being Retained



System Optimization

System optimization measures include relatively low-cost modifications to CSO regulators or the connections between the regulators and the interceptors. These modifications typically include raising/lengthening overflow weirs and/or removing hydraulic restrictions. These modifications can reduce CSOs by allowing more flow into the interceptor for conveyance to the downstream WRRF.

Storage Tunnels

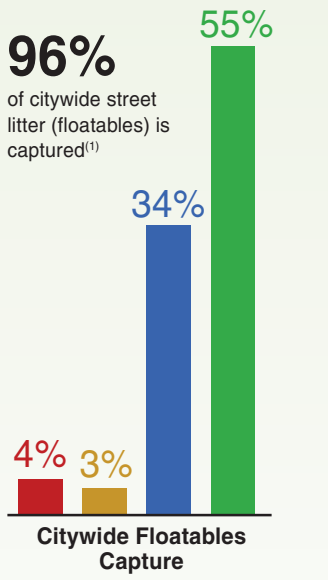
Storage tunnels can capture large volumes of CSO for storage. Drop shafts are provided to convey the CSO from the surface piping to the storage tunnel, and a dewatering pumping station is typically provided at the downstream end of the tunnel for pumping the stored flow to a WRRF. For the sizes of the storage tunnels described in this LTCP, separate treatment systems would be required to treat the dewatered flow, to prevent over-taxing the WRRF treatment systems.

Street Sweeping

Catch Basin Hooding

Netting/Booms

Wastewater Resource Recovery Facility (WRRF)



(1) **Source**: NYC Stormwater Management Program, NYCDEP, August 2018

Floatables Control

Floatables control approaches can include capturing materials at or near the end of the pipe, using screens, nets or booms, and can also include actions and programs implemented to keep floatables and trash from entering the sewer system. These programs can include street sweeping, catch basin hooding and cleaning, and public awareness campaigns to reduce street litter. These programs, which the DEP has been implementing for a number of years, have been demonstrated to significantly reduce the quantities of floatables released to the surrounding waterbodies. DEP intends to continue and expand upon these and other programs to address floatables control in the Open Waters.

8. Waterbody Snapshots and Retained Alternatives

Harlem River

Hudson River

East River/Long Island Sound

Lower and Upper New York Bay

Arthur Kill and Kill van Kull

Harlem River

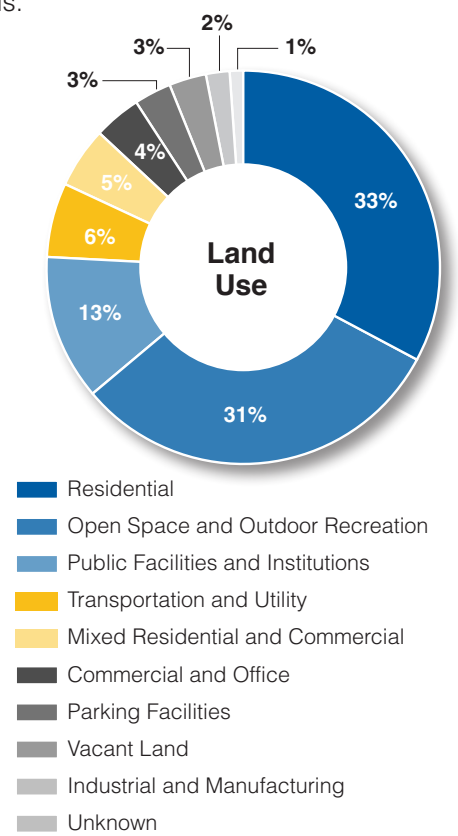
Introduction

The Harlem River is an 8-mile long, navigable tidal channel which separates the island of Manhattan from the Bronx, and connects the Hudson River to the East River. The sewershed within NYC tributary to the Harlem River (the "sewershed") is approximately 9,674 ac and is served by combined and storm sewer systems. The shorelines of Harlem River are composed of a mix of bulkheads, rip-rap, and natural areas.

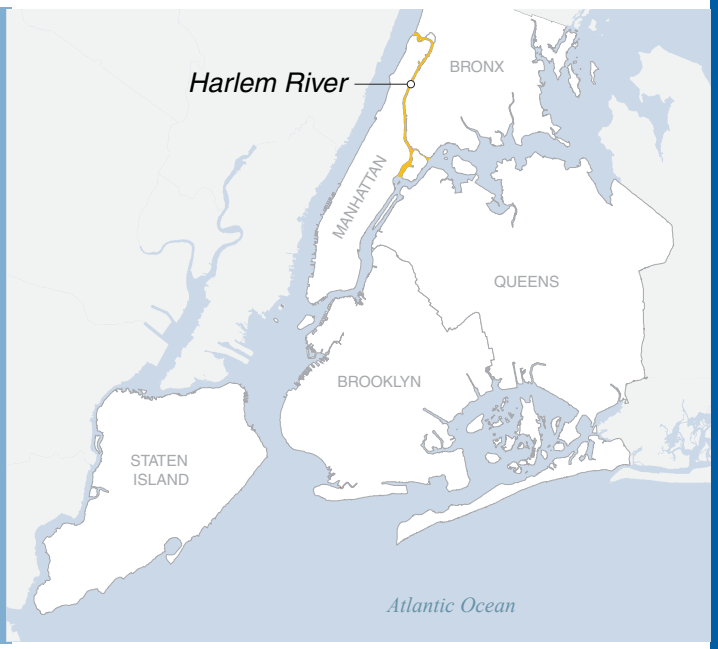
Parts of the collection systems of the Ward's Island and North River WRRFs are located within the Harlem River sewershed. During wet weather, if the sewer system or WRRF is at full capacity, a diluted mixture of combined storm and sanitary flow may discharge through one or more of the 65 SPDES-permitted CSO outfalls to the Harlem River. No MS4 outfalls are located along the Harlem River.

DEC has classified Harlem River as a Class I waterbody, where best uses are secondary contact recreation and fishing, and the waters should be suitable for fish, shellfish, and wildlife propagation and survival. Water quality in Class I waters should also be suitable for primary contact recreation, although other factors may limit the use for these purposes. Water quality in the Harlem River is influenced by CSO discharges, direct drainage runoff and tidal exchanges with the Hudson River and the East River.

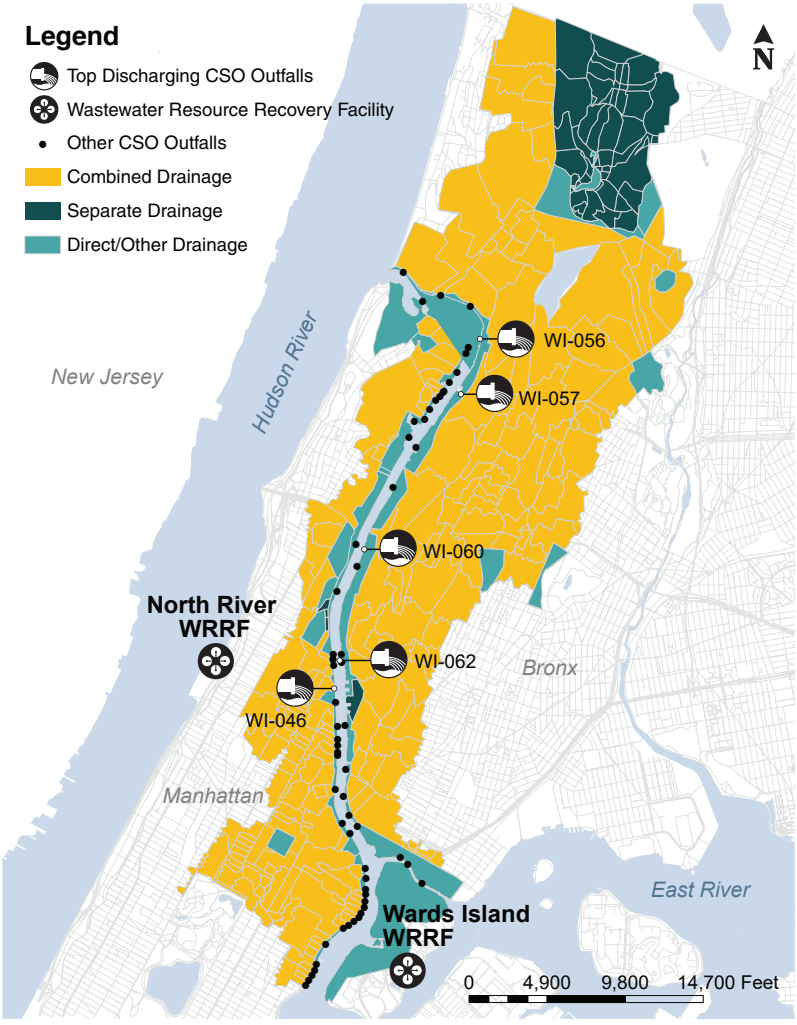
The multiple bridges over the Harlem River tend to limit the use of the Harlem River as a route for large commercial/industrial marine vessels. Boat traffic along the Harlem River generally tends to be mostly private recreational vessels or smaller commercial vessels.



The Harlem River is located at the north end of Manhattan, separating the island from the Bronx. The 8-mile long tidal strait flows between the Hudson River and the East River.

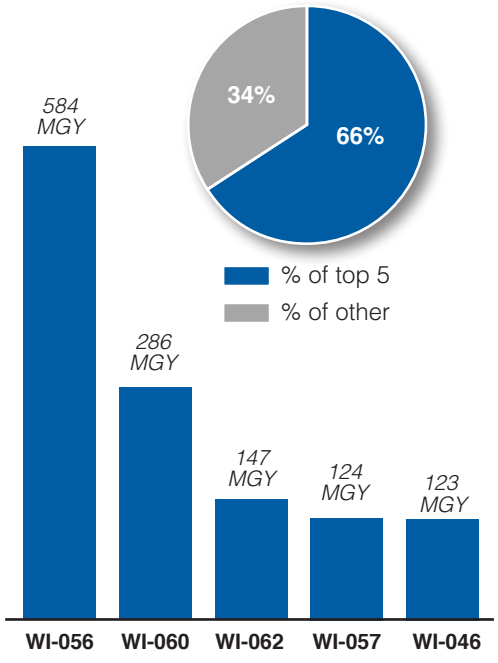


Harlem River Sewershed CSO Outfalls

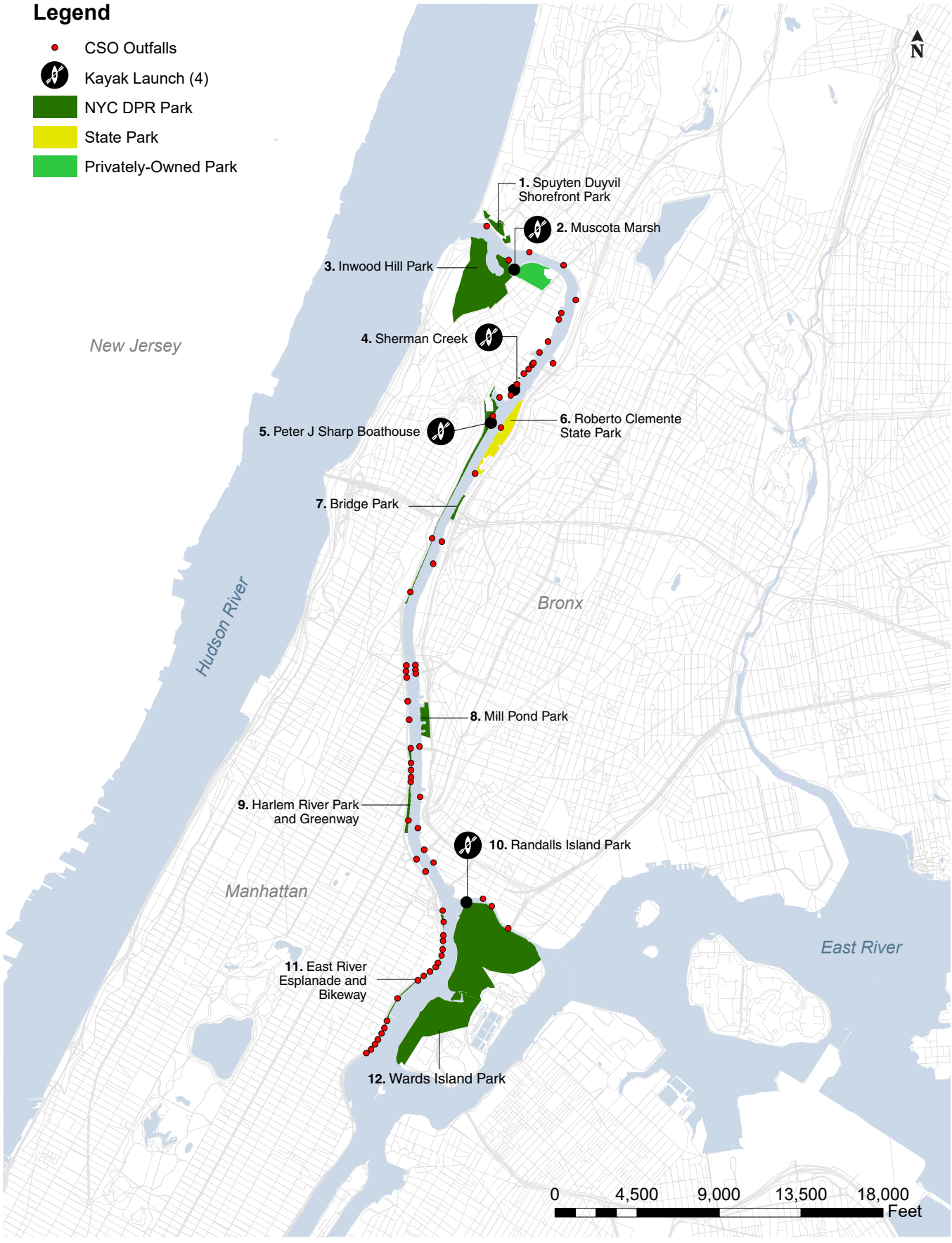


Top Discharging CSO Outfalls

A total of 65 CSO outfalls are located along the shorelines of the Harlem River. The total CSO discharge volume is about 1,900 million gallons per year (MGY). The top 5 discharging CSO outfalls account for 66% of this total volume and their associated average annual discharge volumes are shown in the bar chart below.



Key Waterfront Access Points



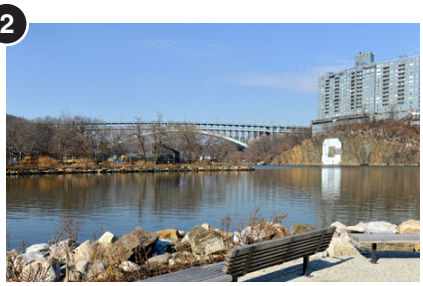
Open Space/Outdoor Recreation Areas

The Harlem River sewershed is highly urbanized and is primarily composed of residential and open space/outdoor recreational areas within the boroughs of Bronx and Manhattan. Open space and recreation make up 31 percent of the sewershed, due to the numerous City parks which cover a significant fraction of the area. The most notable outdoor recreation areas within this sewershed include the Roberto Clemente State Park and City-owned parks such as Randalls Island Park, Wards Island Park, Inwood Hill Park, and the Harlem River Park and Greenway. The map on the left highlights the key waterfront access points with some associated photos shown below.

1

Spuyten Duyvil Shorefront Park

2

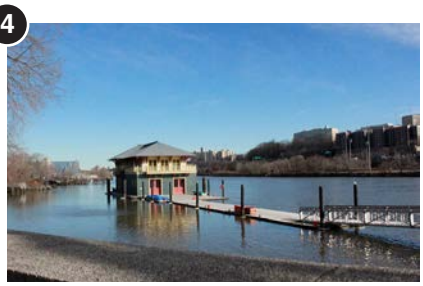


Muscota Marsh

3

Inwood Hill Park

4



Sherman Creek

5

Peter J Sharp Boathouse

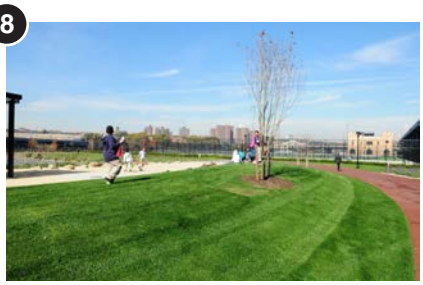
6

Roberto Clemente State Park

7

Bridge Park

8



Mill Pond Park

9

Harlem River Park and Greenway

10

Randalls Island Park

11

East River Esplanade and Bikeway

12

Wards Island Park

Harlem River Retained Alternatives

As described in the WQS Attainment and Alternatives Screening section, a range of alternatives were considered for the Harlem River. These alternatives went through a sequential screening process to arrive at a list of alternatives to be retained for cost performance evaluations. The retained alternatives for the Harlem River are summarized below. The locations of the regulators to be modified under these alternatives are shown in the figure below.

Retained Alternative HAR-1

Optimization of regulators associated with Outfalls NR-008, NR-009, NR-010, NR-017 and NR-007; upsizing the main interceptor in the vicinity of NR-008 and NR-010. This alternative results in a reduction of 16 MG of CSO to the Harlem River in the typical year.

Retained Alternative HAR-2

Optimization of regulators associated with Outfalls NR-008 and NR-010; upsizing the main interceptor in the vicinity of NR-008 and NR-010. This alternative results in a reduction of 15 MG of CSO to the Harlem River in the typical year.

Location of the regulators to be modified under HAR-1 and HAR-2

Retained Alternative HAR-3 through HAR-5

These alternatives consist of storage tunnels sized to provide a range of 50/75/100 percent control of CSO volume to the Harlem River. The table below summarizes the dimensions of these tunnels. Alternative HAR-5 consists of two parallel tunnels.

	HAR-3	HAR-4	HAR-5
Level of CSO Control	**50%**	**75%**	**100%**
WRRF Outfalls Captured	Wards Island	Wards Island	Wards Island, North River
Length (mi)	5	6	2 x 6
Diameter (ft)	28	33	28
Volume (MG)	132	202	291
# of Outfalls Captured	3 of 5 Top Discharge Outfalls	5 of 5 Top Discharge Outfalls 5 Other Outfalls	5 of 5 Top Discharge Outfalls 58 Other Outfalls

Summary of Retained Alternatives

The table below summarizes the CSO volume reduction and estimated cost associated with each of the retained alternatives for the Harlem River.

Alternative	Net CSO Volume Reduction (MGY)	Estimated Probable Bid Cost (2019 $M)	Cost Effective[1]	No Additional CSO to Tributaries
HAR-1: Optimization	16	$35	✗	✓
HAR-2: Optimization	15	$31	✗	✓
HAR-3: 50% Tunnel	986	$1,900	✗	✓
HAR-4: 75% Tunnel	1,538	$3,500	✗	✓
HAR-5: 100% Tunnel	2,070	$7,700	✗	✓

(1) An alternative is defined as cost-effective if it provides substantial reduction in CSO volume and/or improvement in WQS attainment relative to its cost.

Summary of WQ Standards Compliance

✓ *yes* ✗ *no* *not applicable*

		Fecal Coliform Monthly GM[1]		Enterococci 30-day GM[2]		Enterococci 30-day STV[2]		Dissolved Oxygen (DO)	
Waterbody	**Classification**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**
Harlem River	Class I	✓	✓					✓	✓

(1) Fecal Coliform attainment is assessed on an annual basis. (2) Enterococci attainment is assessed for the recreational season (May 1st – Oct 31st).

Retained Alternatives Selected for the Recommended Plan

The Tibbetts Brook Daylighting project, part of the baseline conditions for the LTCP, will result in 228 MG reduction in CSO volume to the Harlem River in the typical rainfall year. None of the five retained alternatives for grey infrastructure were selected for the Recommended Plan, as none were determined to be cost-effective in terms of CSO volume controlled or change in WQS attainment.

For more information on Tibbetts Brook Daylighting project please see page 19.

Hudson River

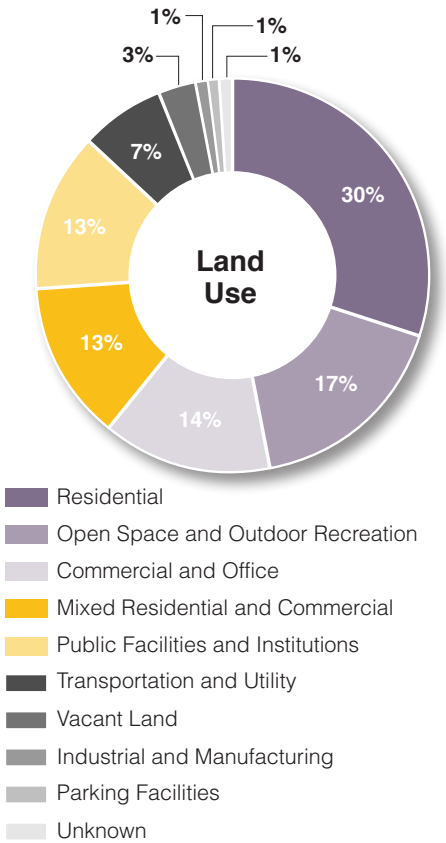
Introduction

This LTCP focuses on the 21-mile long portion of the Hudson River that flows along New York City, from Riverdale in the Bronx, into the Upper New York Bay at The Battery. The sewershed within New York City tributary to the Hudson River is approximately 6,635 acres. The shorelines of the Hudson River are composed of a mix of bulkheads, rip-rap, and natural areas.

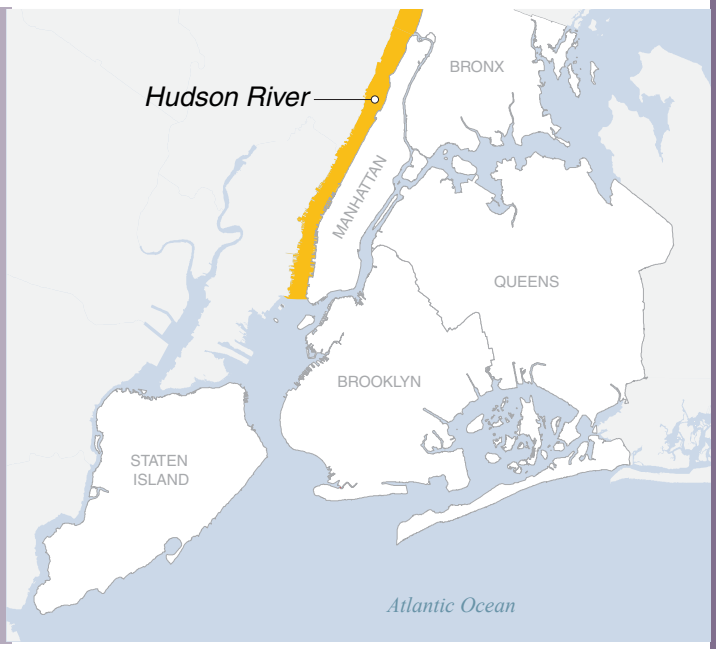
Parts of the collection systems of the Wards Island, North River, and Newtown Creek WRRFs are located within the Hudson River sewershed. During wet weather, a diluted mixture of combined storm and sanitary flow may discharge through one or more of the 52 New York City SPDES-permitted CSO outfalls to the Hudson River. Two New York City MS4 outfalls are located along the Hudson River.

DEC has classified the Hudson River north of Spuyten Duyvil as a Class SB waterbody, and the portion south of Spuyten Duyvil to The Battery as a Class I waterbody. Best uses for Class SB waterbodies are primary and secondary contact recreation and fishing, while best uses for Class I waterbodies are secondary contact recreation and fishing. Both Class SB and Class I waterbodies should be suitable for fish, shellfish, and wildlife propagation and survival. Water quality in Class I waters should also be suitable for primary contact recreation, although other factors may limit the use for these purposes. Water quality in the Hudson River is influenced by CSO, stormwater, New Jersey sources, and tidal exchanges.

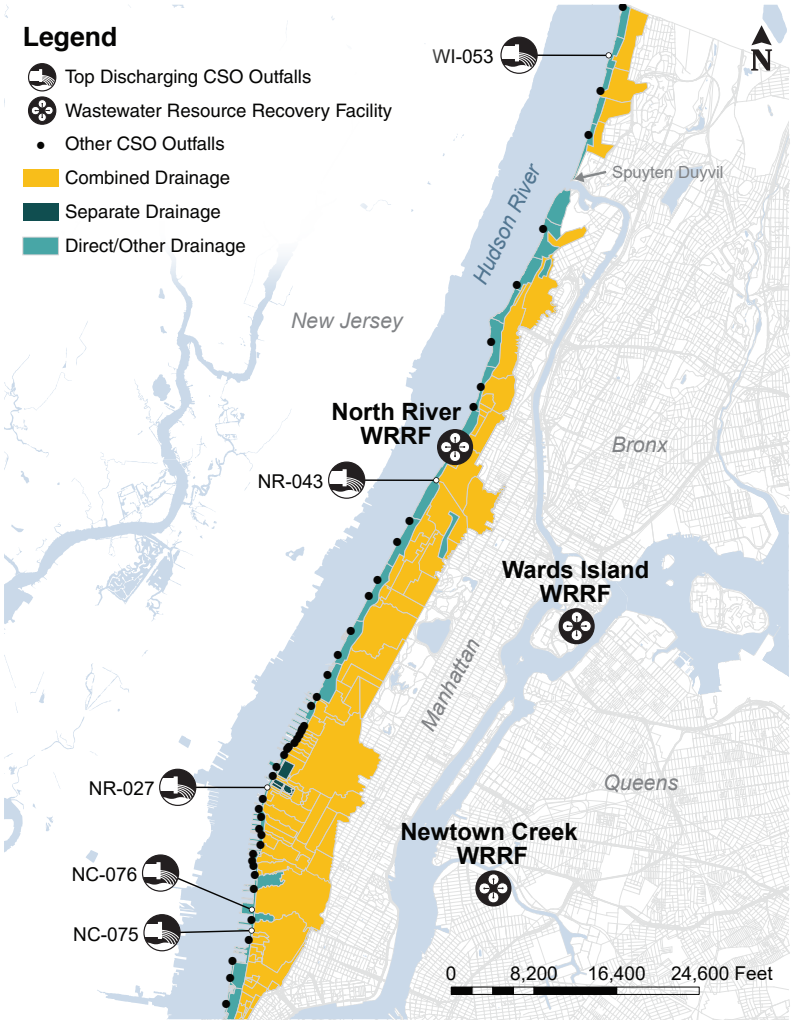
Boat traffic along the Hudson River can include commercial/industrial marine vessels such as tankers, barges, tugboats, cruise ships and ferries, in addition to private recreational vessels.



The Hudson River is located along the west shoreline of Manhattan, running between Manhattan and New Jersey.

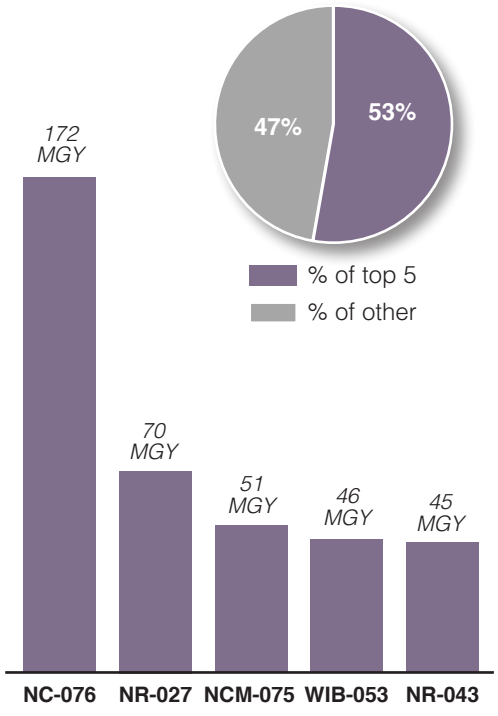


Hudson River Sewershed CSO Outfalls

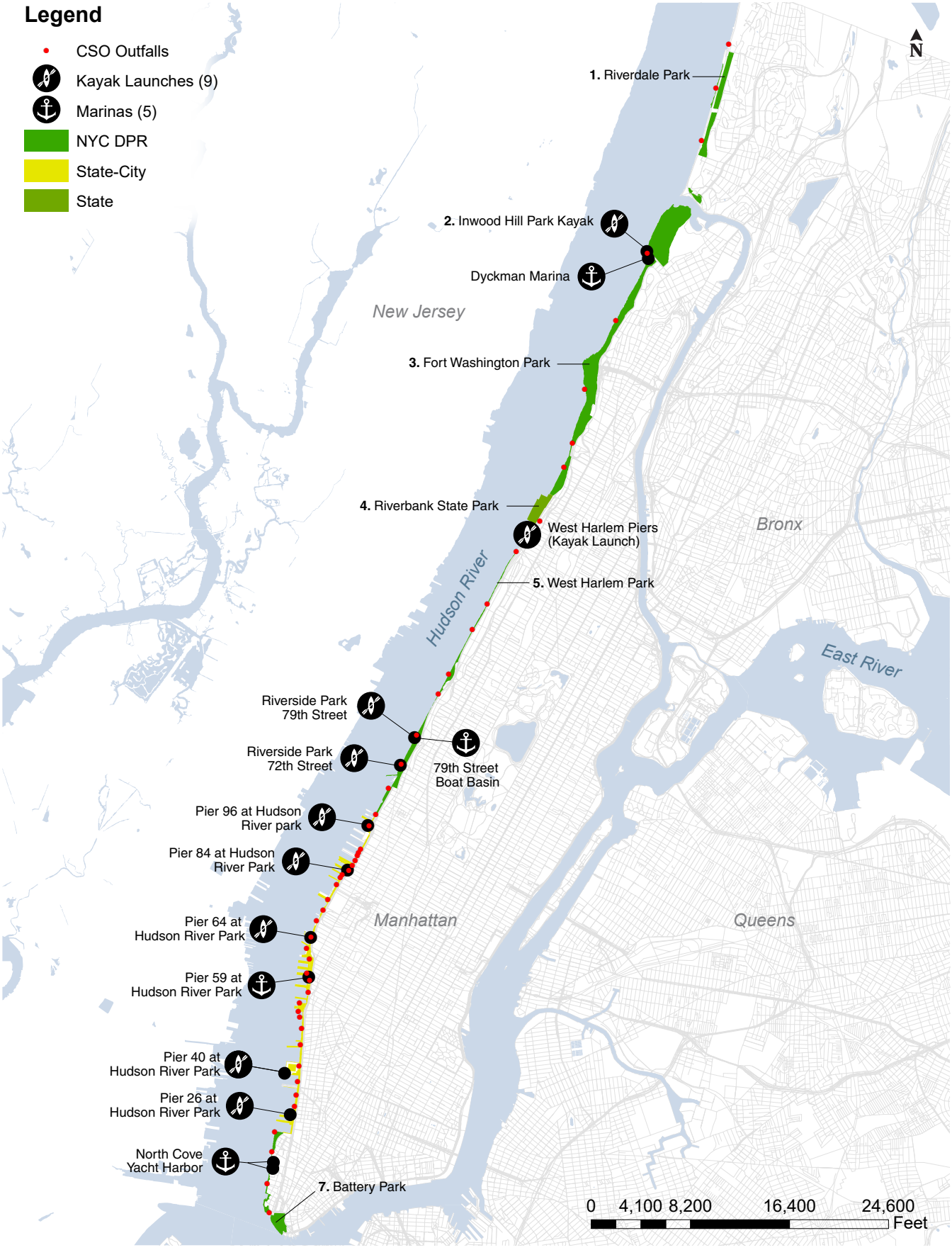


Top Discharging CSO Outfalls

A total of 52 CSO outfalls are located along the shoreline of the Hudson River. The total CSO discharge volume is about 725 million gallons per year (MGY). The top 5 discharging CSO outfalls account for 53% of this total volume and their associated average annual discharge volumes are shown in the bar chart below.



Key Waterfront Access Points



Open Space/Outdoor Recreation Areas

The Hudson River sewershed is highly urbanized and is primarily composed of residential and open space/ outdoor recreational areas within the boroughs of Bronx and Manhattan. Open space and recreation make up 17 percent of the sewershed, due to the numerous City parks which cover a significant fraction of the area. The most notable outdoor recreation areas within this sewershed include the State-owned Riverbank State Park and City-owned parks such as Inwood Hill Park, Fort Washington Park, Riverside Park, and Battery Park. The map on the left highlights the key waterfront access points with some associated photos shown below.

1

Riverdale Park

2

Inwood Hill Park

3

Fort Washington Park

4

Riverbank State Park

5

West Harlem Park

6

Pier 96

7

Battery Park

Hudson River Retained Alternatives

As described in the WQS Attainment and Alternatives Screening section, a range of alternatives were considered for the Hudson River. These alternatives went through a sequential screening process to arrive at a list of alternatives to be retained for cost performance evaluations. The retained alternatives for the Hudson River are summarized below. The location of the regulators to be modified under these alternatives are shown in the figure below.

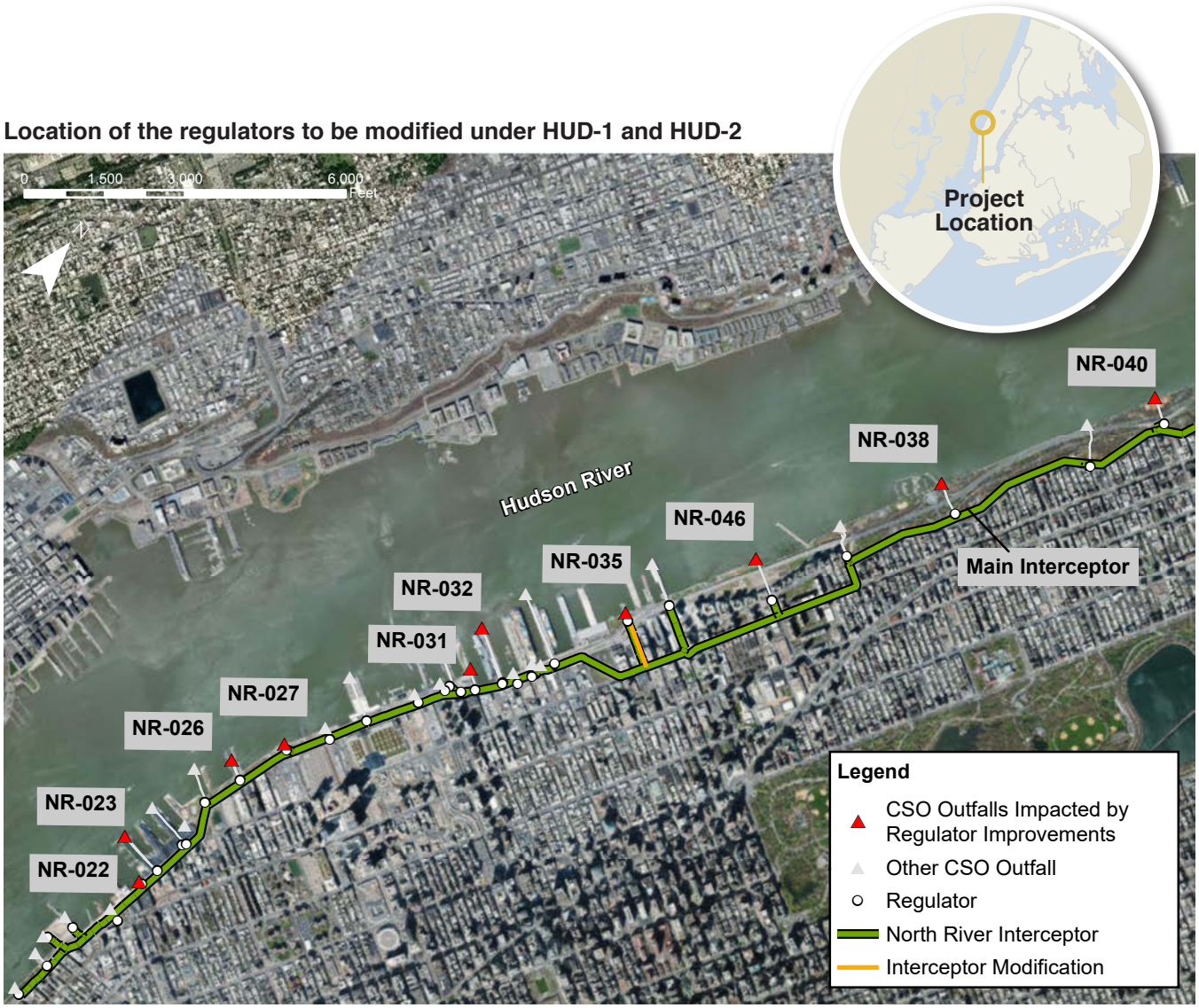
Retained Alternative HUD-1

Optimization of regulators associated with Outfalls NR-040, NR-038, NR-046, NR-035, NR-032, NR-031, NR-027, NR-026, NR-023 and NR-022. This alternative results in a reduction of 12 MG of CSO to the Hudson River in the typical year. This reduction is partially offset by a 3 MG increase to the Harlem River, resulting in a net 9 MG reduction.

Retained Alternative HUD-2

Optimization of regulators associated with Outfalls, NR-040, NR-038 and NR-046. This alternative results in a reduction of 10 MG of CSO to the Hudson River in the typical year. This reduction is partially offset by a 3 MG increase to the Harlem River, resulting in a net 7 MG reduction.

Location of the regulators to be modified under HUD-1 and HUD-2



Retained Alternative HUD-3 through HUD-5

These alternatives consist of storage tunnels sized to provide a range of 50/75/100 percent control of CSO volume to the Hudson River. The table below summarizes the dimensions of these tunnels.

	HUD-3	HUD-4	HUD-5
Level of CSO Control	**50%**	**75%**	**100%**
WRRF Outfalls Captured	Newtown Creek, North River	Newtown Creek, North River	Newtown Creek, North River, Wards Island
Length (mi)	7	11	15
Diameter (ft)	19	18	18
Volume (MG)	79	110	148
# of Outfalls Captured	4 of 5 Top Discharge Outfalls • 1 Other Outfall	4 of 5 Top Discharge Outfalls • 13 Other Outfalls	5 of 5 Top Discharge Outfalls • 44 Other Outfalls

Summary of Retained Alternatives

The table below summarizes the CSO volume reduction and estimated cost associated with each of the retained alternatives for the Hudson River.

Alternative	Net CSO Volume Reduction (MGY)	Estimated Probable Bid Cost (2019 $M)	Cost Effective[1]	No Additional CSO to Tributaries
HUD-1: Optimization	9[2]	$19	✗	✗
HUD-2: Optimization	7[3]	$3	✓	✓
HUD-3: 50% Tunnel	383	$1,500	✗	✓
HUD-4: 75% Tunnel	575	$2,900	✗	✓
HUD-5: 100% Tunnel	770	$4,700	✗	✓

(1) An alternative is defined as cost-effective if it provides substantial reduction in CSO volume and/or improvement in WQS attainment relative to its cost.
(2) 12 MGY reduction to Hudson River, and 3 MGY increase to Harlem River (3) 10 MGY reduction to Hudson River, and 3 MGY increase to Harlem River

Summary of WQ Standards Compliance

✓ *yes* ✗ *no* *not applicable*

		Fecal Coliform Monthly GM[1]		Enterococci 30-day GM[2]		Enterococci 30-day STV[2]		Dissolved Oxygen (DO)	
Waterbody	**Classification**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**
Hudson River	Class SB	✓	✓					✓	✓
	Class I	✓	✓					✓	✓

(1) Fecal Coliform attainment is assessed on an annual basis. (2) Enterococci attainment is assessed for the recreational season (May 1st – Oct 31st).

Retained Alternatives Selected for the Recommended Plan

Alternative HUD-2 was selected for inclusion in the Recommended Plan, as this alternative provides a cost-effective reduction in CSO volume to the Hudson River. HUD-1 was less cost-effective than HUD-2, and the tunnel alternatives (HUD-3, HUD-4, HUD-5) all carried very high costs without substantially changing the level of WQS attainment.

East River/Long Island Sound

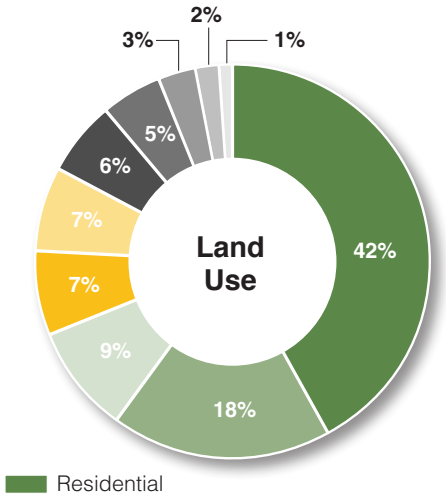
Introduction

The East River is 16 miles long, connecting Upper New York Bay to Long Island Sound. The portion of Long Island Sound addressed in this LTCP extends from the East River to Eastchester Bay. The sewershed tributary to the East River/Long Island Sound (ER/LIS) is approximately 30,000 acres. The shorelines of the ER/LIS include a mix of bulkheads, rip-rap, marinas, piers, natural areas and several beaches located along Eastchester Bay.

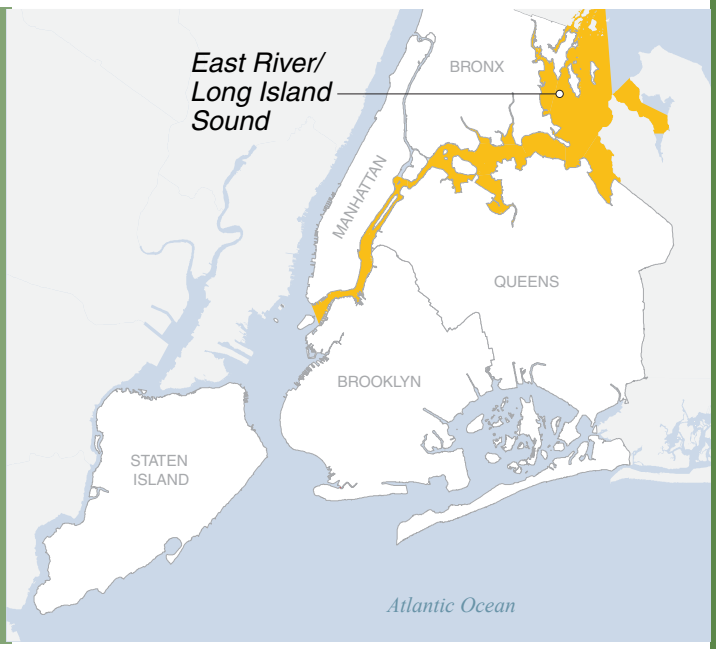
Parts of the collection systems of the Hunts Point, Ward's Island, Tallman Island, Bowery Bay, Newtown Creek, and Red Hook WRRFs are located within the ER/LIS sewershed. During wet weather, a diluted mixture of combined storm and sanitary flow may discharge through one or more of the 139 SPDES-permitted CSO outfalls to the ER/LIS. A total of 28 MS4 outfalls are located along the ER/LIS.

DEC has classified the LIS and the ER east of the Whitestone Bridge as Class SB, while the remainder of the ER is designated Class I. Best uses for Class SB waterbodies are primary and secondary contact recreation and fishing, while best uses for Class I waterbodies are secondary contact recreation and fishing. Both Class SB and Class I waterbodies should be suitable for fish, shellfish, and wildlife propagation and survival. Water quality in Class I waters should also be suitable for primary contact recreation, although other factors may limit the use. Water quality in the ER/LIS is influenced by CSO, stormwater, tidal exchanges, and the various tributaries feeding into the ER/LIS.

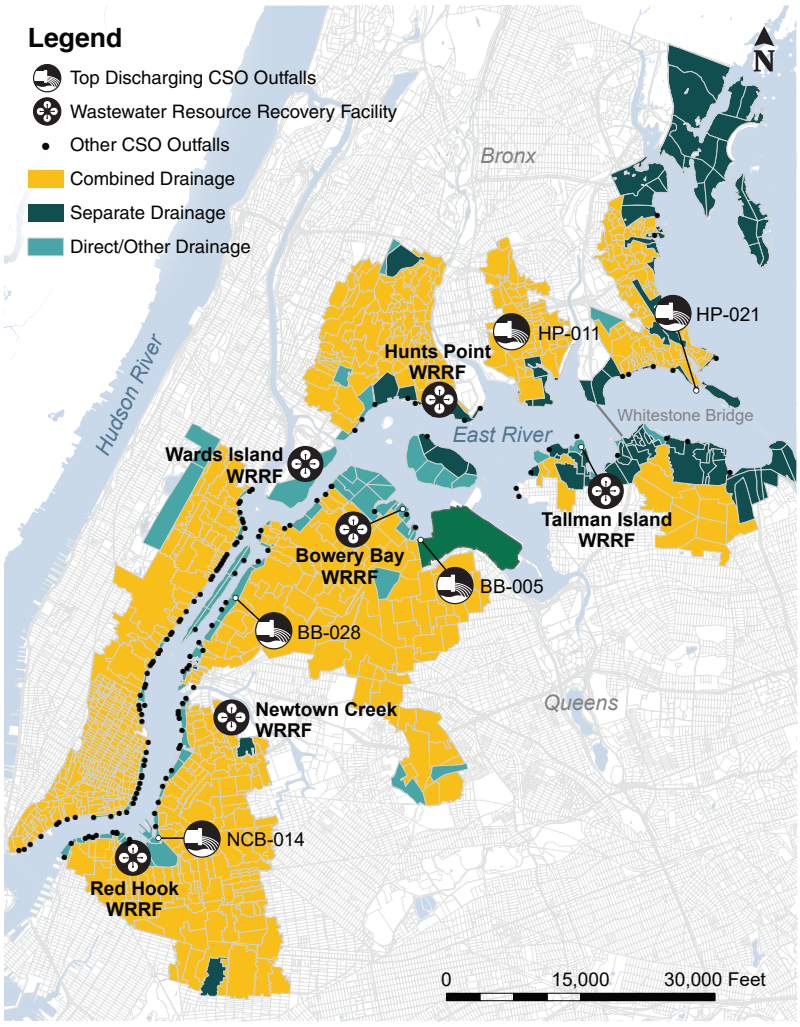
Boat traffic along the East River can include commercial/industrial marine vessels such as tankers, barges, tug boats, cruise ships, and ferries, in addition to private recreational vessels.



The East River is a navigable tidal strait which connects Long Island Sound to Upper New York Bay and separates the boroughs of Queens and Brooklyn from Manhattan and the Bronx. Long Island Sound is a tidal estuary of the Atlantic Ocean located between the eastern shore of the Bronx, southern shore of Connecticut, and northern shore of Long Island.

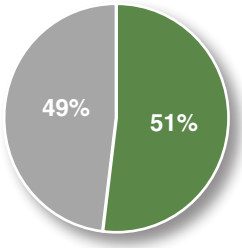


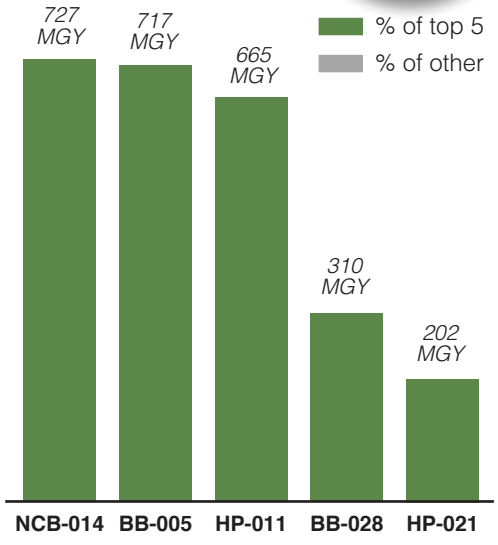
East River/Long Island Sound Sewershed CSO Outfalls



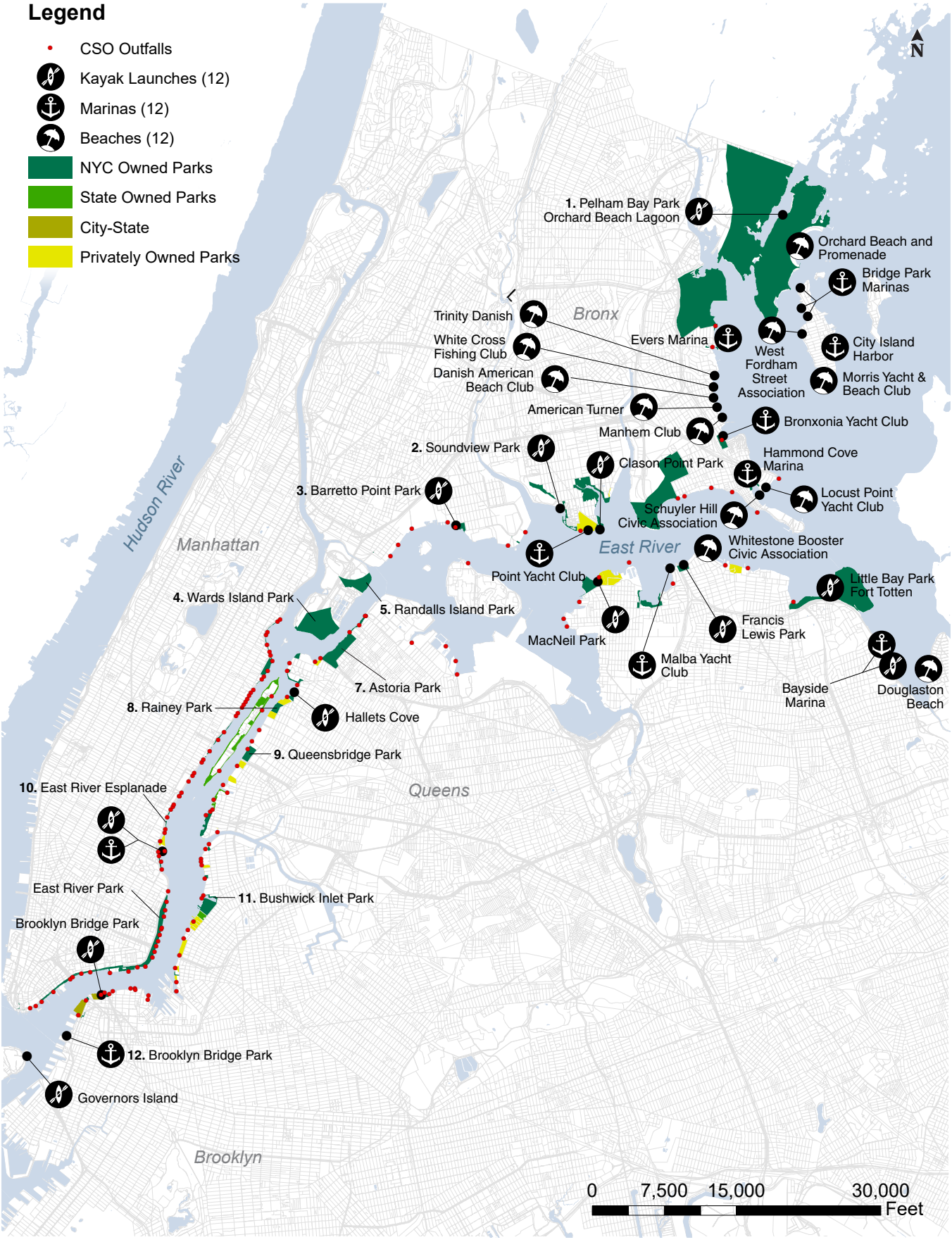
Top Discharging CSO Outfalls

A total of 139 CSO outfalls are located along the shorelines of the East River and western portion of Long Island Sound. The total CSO discharge volume is about 5,130 million gallons per year (MGY). The top 5 discharging CSO outfalls account for 51% of this total volume and their associated average annual discharge volumes are shown in the bar chart below.





Key Waterfront Access Points

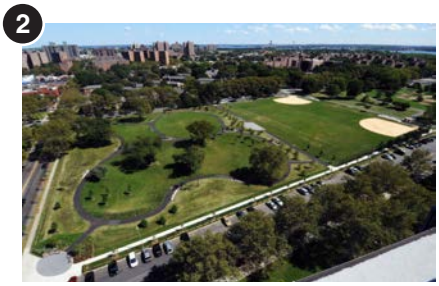


Open Space/Outdoor Recreation Areas

The East River and Long Island Sound sewershed is highly urbanized and is primarily composed of residential and open space/outdoor recreational areas within the boroughs of Bronx, Manhattan, Queens, and Brooklyn. Open space and recreation make up 18 percent of the sewershed, due to the presence of state, city, and local park properties and facilities. The most notable outdoor recreation areas within this sewershed include State and City-owned parks such as Pelham Bay Park, Ferry Point Park, Randalls Island, Wards Island Park, and several parks on Roosevelt Island. The map on the left highlights the key waterfront access points with some associated photos shown below.

1

Pelham Bay

2

Soundview Park

3

Barretto Point Park

4

Wards Island Park

5

Randalls Island Park

6

Francis Lewis Park

7

Astoria Park

8

Rainey Park

9

Queensbridge Park

10

East River Esplanade

11

Bushwick Inlet Park

12

Brooklyn Bridge Park

East River Retained Alternatives

As described in the WQS Attainment and Alternatives Screening section, a range of alternatives were considered for the East River. These alternatives went through a sequential screening process to arrive at a list of alternatives to be retained for cost performance evaluations. The retained alternatives for the East River are summarized below. The location of the regulators to be modified under these alternatives are shown in the figure below.

Retained Alternative ER-1

Optimization of regulator associated with Outfall HP-025. This alternative reduces CSO volume to the East River by 45 MG in the typical year. This reduction is offset by a 14 MG increase in volume to the Bronx River, and a 1 MG increase in volume to Westchester Creek.

Retained Alternative ER-2

Optimization of regulators associated with Outfalls HP-016, HP-018, HP-019 and HP-025. This alternative reduces CSO volume to the East River by 45 MG in the typical year. This reduction is offset by a 14 MG increase in volume to the Bronx River, and a 1 MG increase in volume to Westchester Creek.

Retained Alternative ER-3

Optimization of regulators associated with Outfall TI-003 and TI-022. This alternative reduces CSO volume to the East River by 44 MG, and reduces untreated CSO volume to Flushing Creek by 58 MG in the typical year. This alternative increases the total treated volume to Flushing Creek at TI-010 and TI-011 by 77 MG.

Retained Alternative ER-4

Optimization of regulators associated with Outfalls TI-003, TI-022 and TI-023. This alternative reduces CSO volume to the East River by 55 MG, and reduces untreated CSO volume to Flushing Creek by 67 MG in the typical year. This alternative increases the total treated volume to Flushing Creek at TI-010 and TI-011 by 77 MG.

Retained Alternative ER-5

Installation of a bending weir at the regulator associated with Outfall TI-023. This alternative reduces CSO volumes to the East River by 42 MG in the typical year.

Retained Alternative ER-6

Alternative ER-5 plus optimization of the regulator associated with Outfall TI-003. This alternative reduces CSO volume to the East River by 86 MG in the typical year.

Location of the regulators to be modified under ER-1 to ER-6

Retained Alternative ER-7 through ER-9

These alternatives consist of storage tunnels sized to provide a range of 50/75/100 percent control of CSO volume to the East River. The table below summarizes the dimensions of these tunnels

	ER-7
Level of CSO Control	**50%**
WRRF Outfalls Captured	Hunts Point, Bowery Bay, Newtown Creek
Length (mi)	15
Diameter (ft)	28
Volume (MG)	371
# of Outfalls Captured	5 of 5 Top Discharge Outfalls

	ER-8		
Level of CSO Control	**75%**		
WRRF Outfalls Captured	Hunts Point, Bowery Bay, Newtown Creek	Tallman Island	Hunts Point, Bowery Bay, Newtown Creek
Length (mi)	8	3	11
Diameter (ft)	37	17	22
Volume (MG)	344	24	161
# of Outfalls Captured	3 of 5 Top Discharge Outfalls • 6 Other Outfalls	0 of 5 Top Discharge Outfalls • 2 Other Outfalls	2 of 5 Top Discharge Outfalls • 3 Other Outfalls

	ER-9		
Level of CSO Control	**100%**		
WRRF Outfalls Captured	Bowery Bay, Newtown Creek, Red Hook	Tallman Island	Hunts Point, Bowery Bay, Newtown Creek
Length (mi)	10	4	16
Diameter (ft)	37	14	26
Volume (MG)	402	24	332
# of Outfalls Captured	3 of 5 Top Discharge Outfalls • 47 Other Outfalls	0 of 5 Top Discharge Outfalls • 6 Other Outfall	2 of 5 Top Discharge Outfalls • 77 Other Outfall

Summary of Retained Alternatives

The table below summarizes the CSO volume reduction and estimated cost associated with each of the retained alternatives for the East River.

Alternative	Net CSO Volume Reduction (MGY)	Estimated Probable Bid Cost (2019 $M)	Cost Effective[1]	No Additional CSO to Tributaries
ER-1: HP Optimization	30[2]	$16	✓	✗
ER-2: HP Optimization	30[3]	$24	✓	✗
ER-3: TI Optimization	102[4]	$4	✓	✗
ER-4: TI Optimization	122[5]	$7	✓	✗
ER-5: TI Bending Weir	42	$3	✗	✓
ER-6: TI Bending Weir & Optimization	86	$6	✓	✓
ER-7: 50% Tunnel	2,699	$4,700	✗	✓
ER-8: 75% Tunnels	3,847	$8,000	✗	✓
ER-9: 100% Tunnels	5,198	$18,400	✗	✓

(1) An alternative is defined as cost-effective if it provides substantial reduction in CSO volume and/or improvement in WQS attainment relative to its cost.

(2) Alternative ER-1 reduces CSO volume to the East River by 45 MG. This reduction is offset by a 14 MG increase in CSO volume to the Bronx River and a 1 MG increase in CSO volume to Westchester Creek, for an overall net reduction of 30 MG.

(3) Alternative ER-2 reduces CSO volume to the East River by 45 MG. This reduction is offset by a 14 MG increase in CSO volume to the Bronx River and a 1 MG increase in CSO volume to Westchester Creek, for an overall net reduction of 30 MG.

(4) Alternative ER-3 reduces CSO volume to the East River by 44 MG and results in a reduction in untreated CSO volume to Flushing Creek of 58 MG for a total overall untreated CSO reduction of 102 MG. This alternative results in an increase in treated CSO volume at TI-010 and TI-011 of 77MG.

(5) Alternative ER-4 reduces CSO volume to the East River by 55 MG and results in a reduction in untreated CSO volume to Flushing Creek of 67 MG for a total overall untreated CSO reduction of 122 MG. This alternative results in an increase in treated CSO volume at TI-010 and TI-011 of 77MG.

Summary of WQ Standards Compliance

✓ *yes* ✗ *no* *not applicable*

		Fecal Coliform Monthly GM[1]		Enterococci 30-day GM[2]		Enterococci 30-day STV[2]		Dissolved Oxygen (DO)	
Waterbody	**Classification**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**
East River	Class SB	✓	✓	✓	✓	✓	✓	✓	✓
	Class I	✓	✓					✓	✓

(1) Fecal Coliform attainment is assessed on an annual basis. (2) Enterococci attainment is assessed for the recreational season (May 1st – Oct 31st).

Retained Alternatives Selected for the Recommended Plan

Alternative ER-6 was selected for inclusion in the Recommended Plan, as this alternative provides a cost-effective reduction in CSO volume to the East River. ER-5 was not cost-effective and the other East River optimization alternatives were not selected for the Recommended Plan because each one would have resulted in an increase in CSO volume to one of the tributaries to the East River (Westchester Creek, Bronx River, or Flushing Creek). The tunnel alternatives all carried very high costs without substantially changing the level of WQS attainment.

Lower and Upper New York Bay

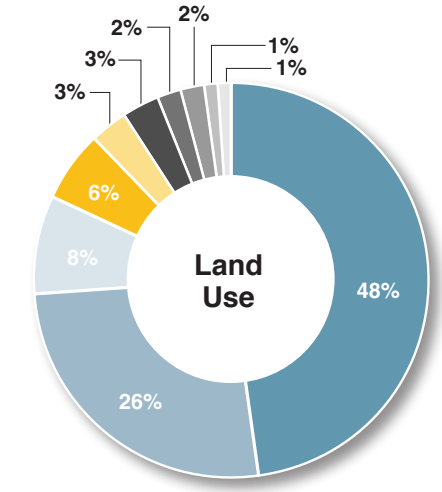
Introduction

New York Bay is an approximately 146,000-acre natural harbor bordering on portions of the boroughs of Manhattan, Brooklyn, and Staten Island. The Upper Bay is fed by the waters of the Hudson River and East River, while the Lower Bay opens directly into the Atlantic Ocean. The land area within New York City served by combined and separate storm sewer systems that are tributary to New York Bay (the "sewershed") is approximately 30,000 acres. The New York Bay shorelines are primarily composed of a mix of piers, bulkhead and riprap, with natural shoreline and beaches along the Lower Bay.

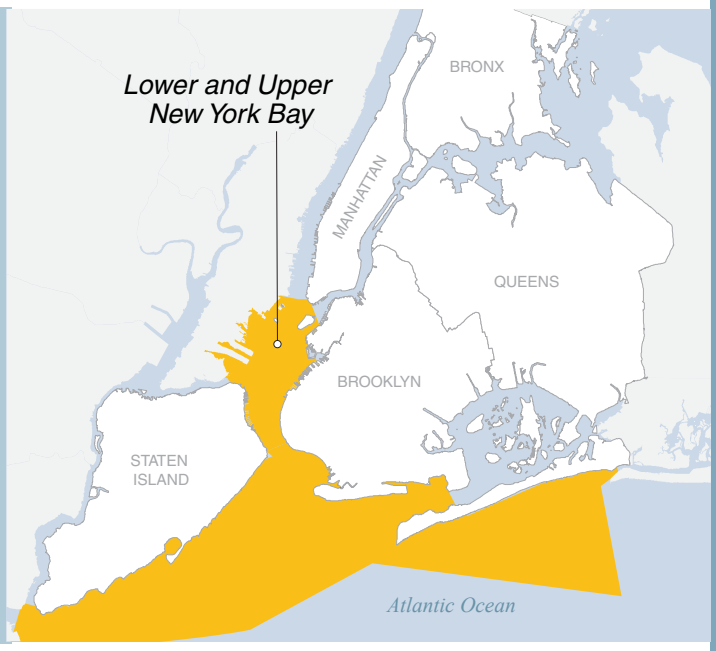
Parts of the collection systems of the Red Hook, Owls Head, Port Richmond and Oakwood Beach WRRFs are located within the New York Bay sewershed. During wet weather, a diluted mixture of combined storm and sanitary flow may discharge through one or more of the 39 SPDES-permitted CSO outfalls to New York Bay. No CSOs are associated with the Oakwood Beach WRRF. A total of 41 MS4 outfalls are located along New York Bay.

DEC has classified Upper and Lower New York Bay as a Class SB waterbody. Best uses for Class SB waterbodies are primary and secondary contact recreation and fishing. Class SB waterbodies should be suitable for fish, shellfish, and wildlife propagation and survival. Water quality in New York Bay is influenced by CSO, stormwater, and tidal exchanges with the Hudson River, East River, Kill van Kull, Jamaica Bay, and the Atlantic Ocean.

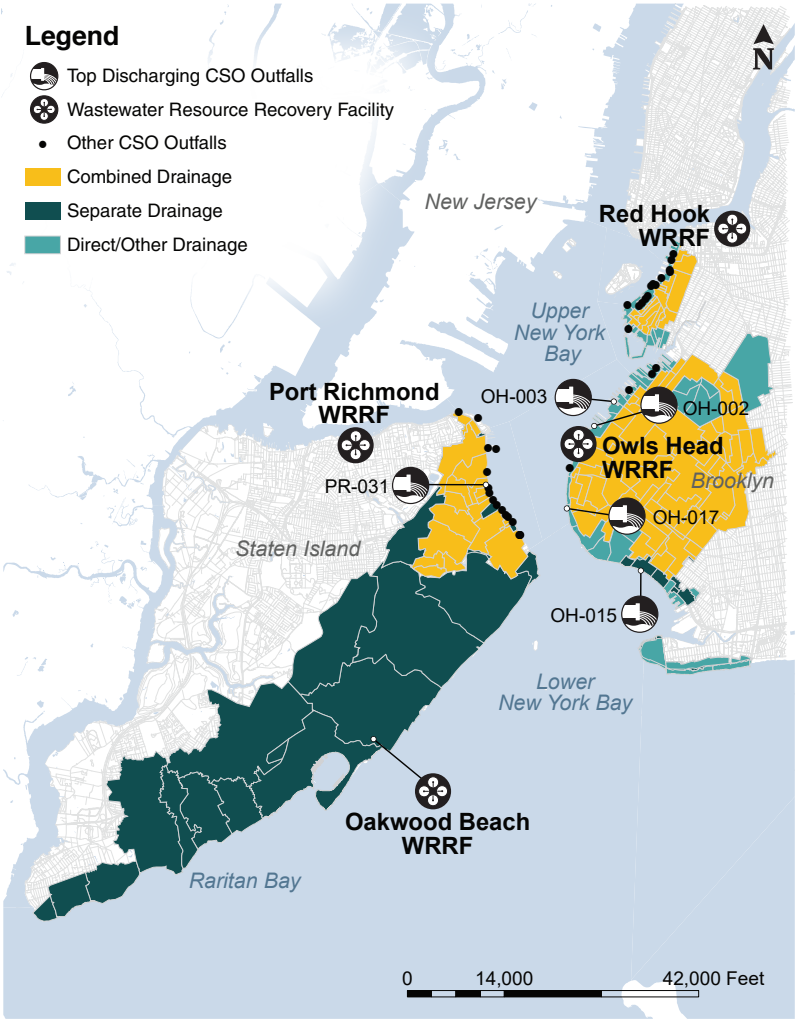
Boat traffic in New York Bay can include commercial/industrial marine vessels such as container ships, tankers, tug boats, barges, cruise ships, and ferries, in addition to private recreational vessels.



The New York Bay is a large natural harbor bordering on portions of Manhattan, Brooklyn, and Staten Island. The Upper Bay is fed by the waters of the Hudson River and East River, while the Lower Bay opens directly into the Atlantic Ocean.

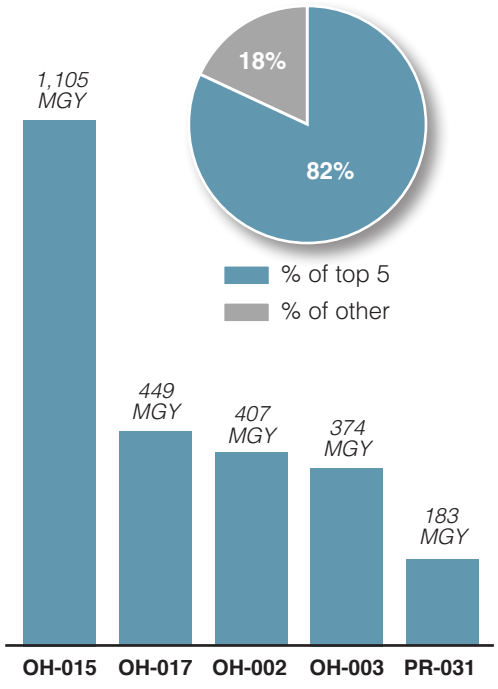


New York Bay Sewershed CSO Outfalls

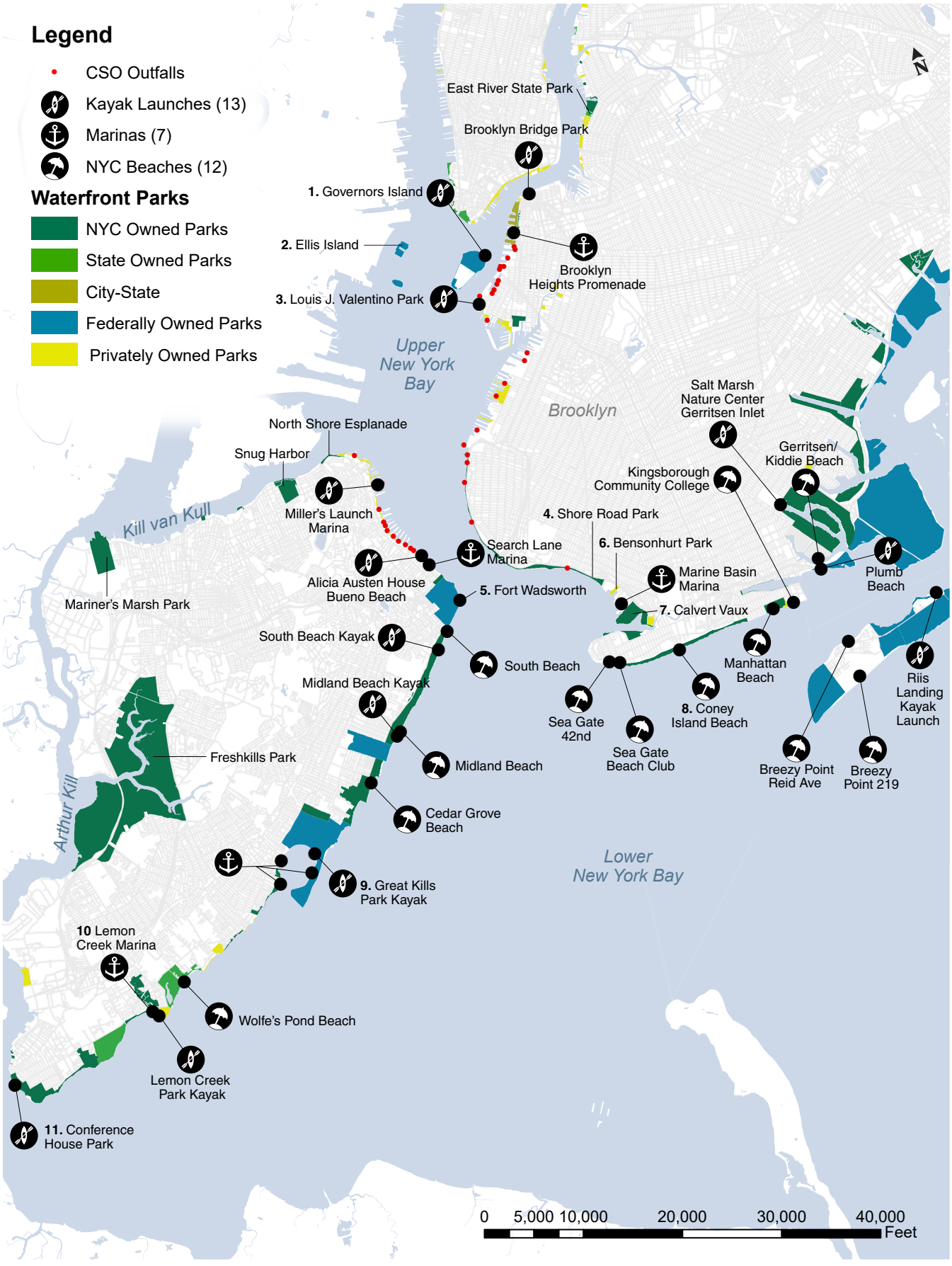


Top Discharging CSO Outfalls

A total of 39 CSO outfalls are located along the shorelines of the Upper and Lower New York Bay. The total CSO discharge volume is about 3,060 million gallons per year (MGY). The top 5 discharging CSO outfalls account for 82% of this total volume and their associated average annual discharge volumes are shown in the bar chart below.



Key Waterfront Access Points



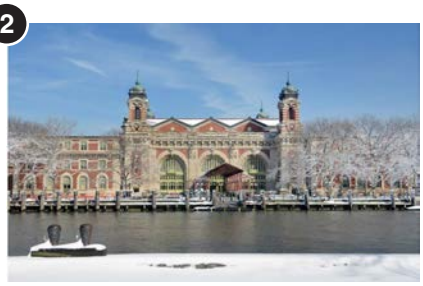
Open Space/Outdoor Recreation Areas

The New York Bay sewershed is highly urbanized and is primarily composed of residential and open space/recreation areas within the boroughs of Manhattan, Brooklyn, and Staten Island. Open space and recreation make up 26 percent of the sewershed, due to the presence of federal, state, city, and local park properties and facilities. The sewershed contains several beaches along Staten Island and Coney Island. The most notable outdoor recreation areas within this sewershed include Ellis Island, Governors Island, Liberty Island, and Great Kills Park in Staten Island. The map on the left highlights the key waterfront access points with some associated photos shown below.

1

Governors Island

2



Ellis Island

3

Valentino Park & Pier

4

Shore Road Park

5

Fort Wadsworth

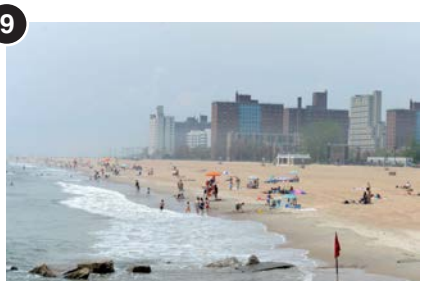
6

Bensonhurt Park

7

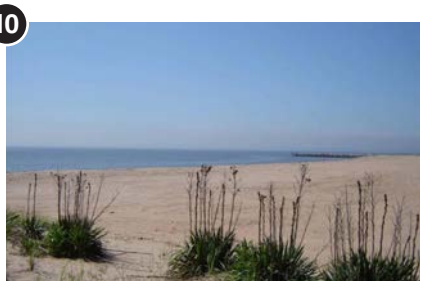
Calvert Vaux

9



Coney Island Beach

10

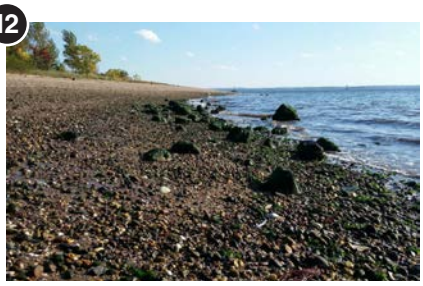


Great Kills Park

11

Lemon Creek Park

12



Conference House Park

New York Bay Retained Alternatives

As described in the WQS Attainment and Alternatives Screening section, a range of alternatives were considered for New York Bay. These alternatives went through a sequential screening process to arrive at a list of alternatives to be retained for cost performance evaluations. The retained alternatives for New York Bay are summarized below.

Retained Alternative NYB-1

Optimization of regulators associated with Outfall RH-005 and RH-014. The locations of the regulators to be modified under this alternative are shown in the figure below. This alternative reduces CSO volume to New York Bay by 15 MG in the typical year.

Retained Alternative NYB-2

The Hannah Street Pumping Station Bypass alternative consist of construction of a gravity flow connection between the Victory Blvd combined sewer and the East Interceptor. This alternative will divert dry and wet weather flow around the Hannah Street Pumping Station, reducing flows to the pump station as well as CSO volume at Outfall PR-013. The location of the proposed bypass is shown in the figure below. This alternative reduces CSO volume to New York Bay by 43 MG in the typical year.

Retained Alternative NYB-3

Remotely-controlled gate at regulator 9C, associated with Outfall OH-15. The location of this regulator is shown in the figure below. This alternative reduces CSO volume to New York Bay by 90 MG in the typical year.

Location of the regulators to be modified under NYB-1 and NYB-3, and location of bypass pipe for NYB-2

Retained Alternative NYB-3 through NYB-5

These alternatives consist of storage tunnels sized to provide a range of 50/75/100 percent control of CSO volume to New York Bay. The table below summarizes the dimensions of these tunnels. Alternatives NYB-4, NYB-5, and the Owls Head/Red Hook tunnel for NYB-6 each consists of two parallel tunnels. The Port Richmond tunnel for NYB-6 is a single bore.

	NYB-4	NYB-5	NYB-6	
Level of CSO Control	**50%**	**75%**	**100%**	
WRRF Outfalls Captured	**Owls Head**	**Owls Head**	**Owls Head/ Red Hook**	**Port Richmond**
Length (mi)	2 x 5	2 x 5	2 x 9	3
Diameter (ft)	23	28	23	25
Volume (MG)	152	263	305	60
# of Outfalls Captured	2 of 5 Top Discharge Outfalls	4 of 5 Top Discharge Outfalls	4 of 5 Top Discharge Outfalls • 18 Other Outfalls	1 of 5 Top Discharge Outfalls • 14 Other Outfall

Summary of Retained Alternatives

The table below summarizes the CSO volume reduction and estimated cost associated with each of the retained alternatives for the New York Bay.

Alternative	Net CSO Volume Reduction (MGY)	Estimated Probable Bid Cost (2019 $M)	Cost Effective(1)	No Additional CSO to Tributaries
NYB-1: RH Optimization	15	$6	✓	✓
NYB-2: Hannah Street PS Bypass	43	$22	✓	✓
NYB-3: OH-15 Control Gate	90	$5	✓	✓
NYB-4: 50% Tunnel	1,555	$3,000	✗	✓
NYB-5: 75% Tunnels	2,333	$4,300	✗	✓
NYB-6: 100% Tunnels	3,082	$8,600	✗	✓

(1) An alternative is defined as cost-effective if it provides substantial reduction in CSO volume and/or improvement in WQS attainment relative to its cost.

Summary of WQ Standards Compliance

✓ *yes* ✗ *no* *not applicable*

		Fecal Coliform Monthly GM(1)		Enterococci 30-day GM(2)		Enterococci 30-day STV(2)		Dissolved Oxygen (DO)	
Waterbody	**Classification**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**
New York Bay	Class SB	✓	✓	✓	✓	✗	✓	✓	✓

(1) Fecal Coliform attainment is assessed on an annual basis. (2) Enterococci attainment is assessed for the recreational season (May 1st – Oct 31st).

Retained Alternatives Selected for the Recommended Plan

Alternatives NYB-1, NYB-2 and NYB-3 were all selected for inclusion in the Recommended Plan. Each of these alternatives provides a cost-effective reduction in CSO volume to New York Bay. The tunnel alternatives all carried very high costs, and only the 100% control tunnel, with an un-escalated probable bid cost of $8.6 billion, would substantially change the level of attainment with the Enterococci STV criteria. This tunnel is not considered a cost-effective alternative.

Arthur Kill and Kill van Kull

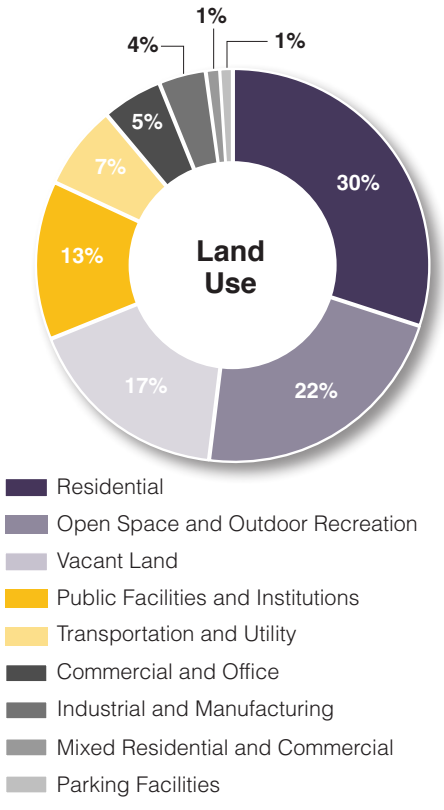
Introduction

Arthur Kill (AK) is a 10-mile long, navigable tidal channel connecting Newark Bay with Raritan Bay. Kill van Kull (KVK) is a 4.5-mile long, navigable tidal channel connecting Newark Bay with Upper New York Bay. The sewershed within NYC tributary to AK/KVK is approximately 20,000 acres. The Staten Island shoreline along AK/KVK includes piers, bulkhead, rip-rap and natural areas.

Parts of the collection systems of the Port Richmond and Oakwood Beach WRRFs are located within the AK/KVK sewershed. During wet weather, a diluted mixture of combined storm and sanitary flow may discharge through one or more of the 19 NYC SPDES-permitted CSO outfalls to KVK. No CSOs discharge directly to AK from NYC. No CSOs are associated with the Oakwood Beach WRRF. A total of 12 NYC MS4 outfalls are located along AK/KVK.

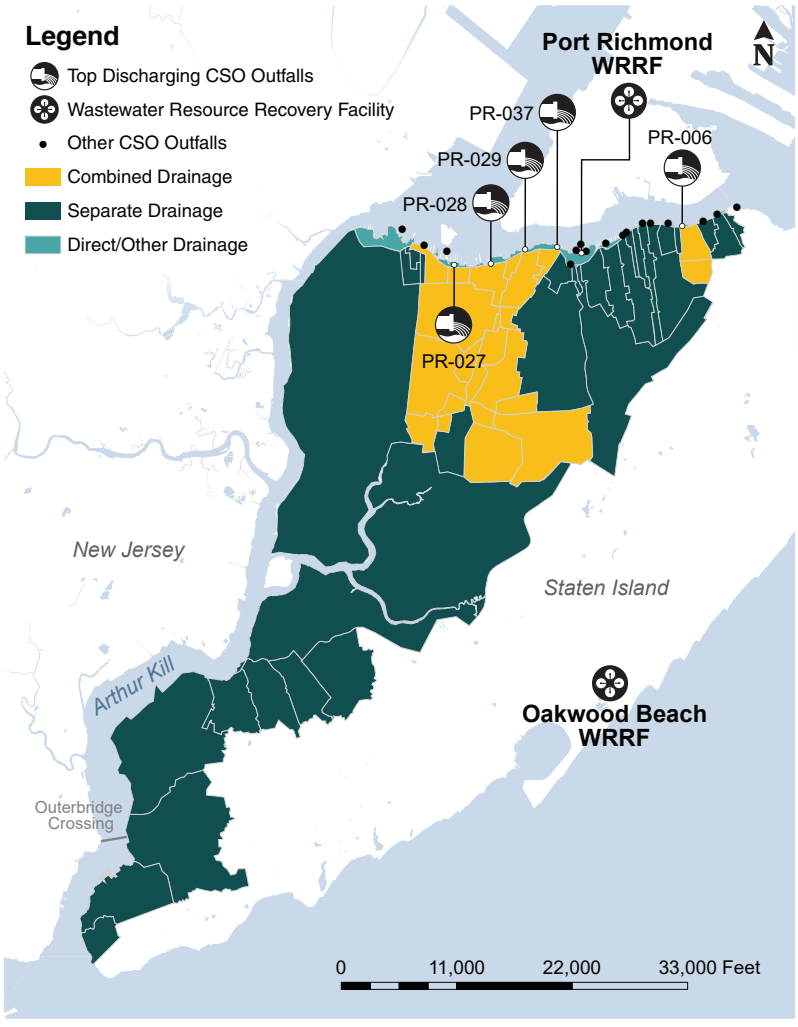
DEC has classified KVK and most of AK as Class SD waterbodies. South of the Outerbridge Crossing Bridge, AK is designated as Class I. The best use for Class SD waterbodies is fishing, while for Class I it's secondary contact recreation and fishing. Class SD waterbodies should be suitable for fish, shellfish and wildlife survival, while Class I waters also support propagation. Both water quality in Class SD and Class I waters should be suitable for primary contact recreation, although other factors may limit the use. Water quality in AK/KVK is influenced by stormwater, New Jersey loadings and tidal exchanges, while KVK is also influenced by CSO from NYC.

Boat traffic in Author Kill and Kill van Kull can include commercial/industrial marine vessels such as container ships, tankers, barges, and passenger ships in addition to private recreational vessels.



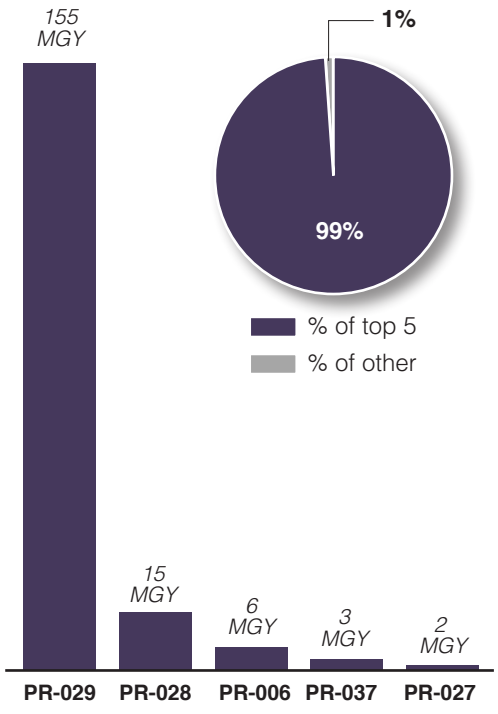
Arthur Kill is a 10-mile long tidal strait located between the west coast of Staten Island, and Union and Middlesex Counties in NJ. Kill van Kull is approximately 3 miles long and located between the north coast of Staten Island, and Bayonne County in NJ.

AK/KVK Sewershed CSO Outfalls

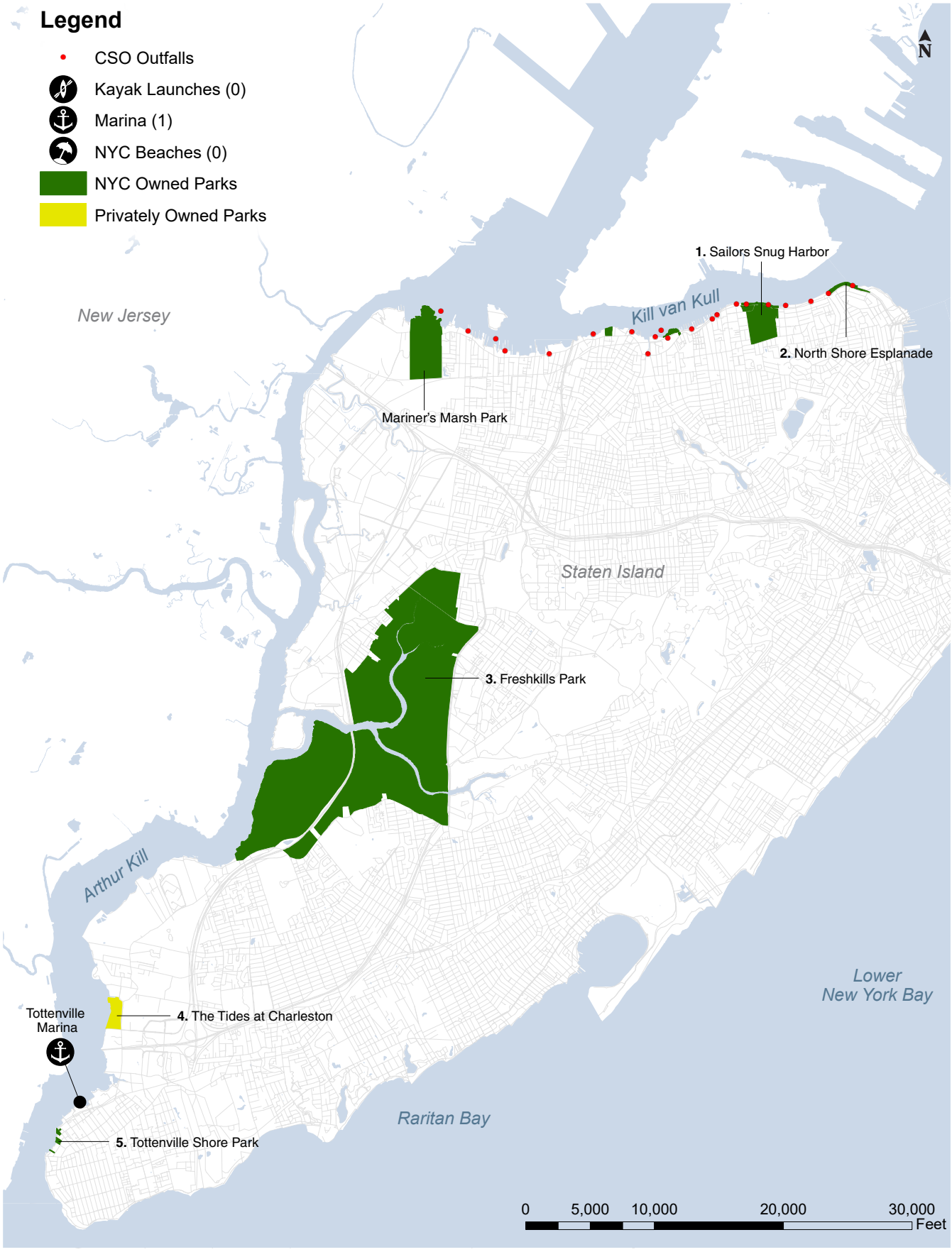


Top Discharging CSO Outfalls

A total of 19 CSO outfalls are located along the shoreline of KVK. The total CSO discharge volume is about 182 million gallons per year (MGY). The top 5 discharging CSO outfalls account for 99% of this total volume and their associated average annual discharge volumes are shown in the bar chart below.



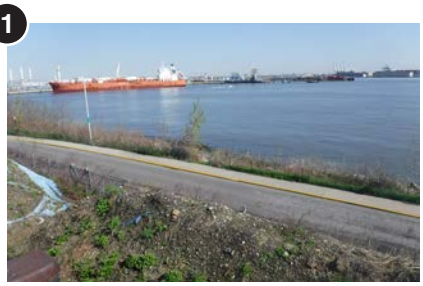
Key Waterfront Access Points



Open Space/Outdoor Recreation Areas

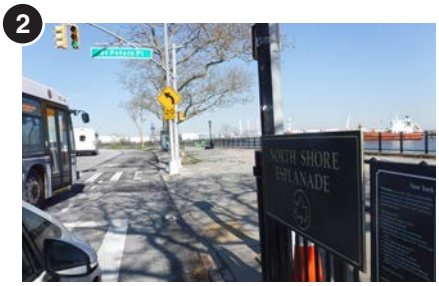
The Arthur Kill and Kill van Kull sewershed within New York City is highly urbanized and primarily composed of residential and open space/outdoor recreational areas. Open space and recreation make up 22 percent of the sewershed, due to the presence of state, city, and local park properties and facilities. The northern shoreline along Kill van Kull is the most urbanized part of Staten Island while the western shoreline is the least populated and most industrial. Along Kill van Kull, the most notable outdoor recreation areas include the Snug Harbor Botanical Garden and Alison Pond Park, in Staten Island. Along Arthur Kill, the most notable outdoor recreation areas include the Freshkills Park, North Mount Lorretto State Forest, Clay Pit Pond State Park Preserve, and Long Pond Park, in Staten Island. Several wetlands are also located within both channels along the New York and the New Jersey shorelines. This LTCP focuses on the New York portion of the Kill van Kull and Arthur Kill sewershed. The map on the left highlights the key waterfront access points with some associated photos shown below.

1



Sailors Snug Harbor

2



North Shore Esplanade

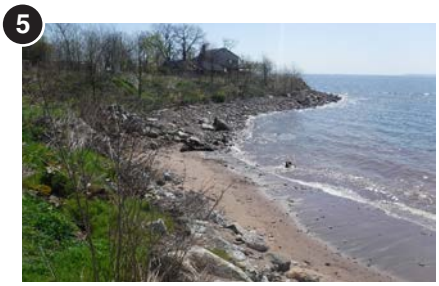
3

Freshkills Park

4

The Tides at Charleston

5



Tottenville Shore Park

Kill van Kull Retained Alternatives

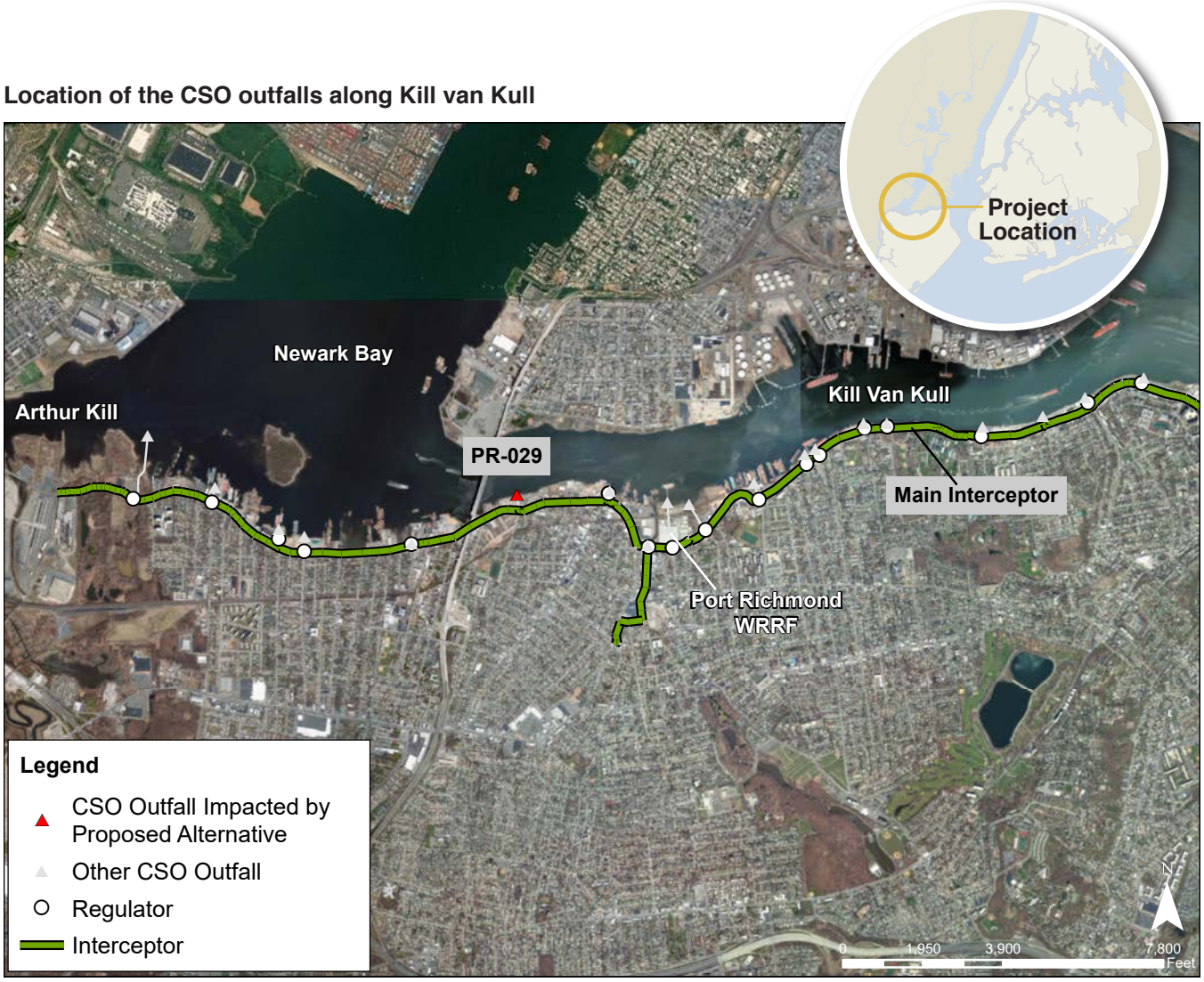
Since NYC CSO outfalls discharge directly to Arthur Kill, and the Oakwood Beach WRRF service area is separately-sewered with no CSOs, the alternative analysis for this area focused on the CSOs discharging to Kill van Kull. The alternatives went through a sequential screening process to arrive at a list of alternatives to be retained for cost performance evaluations. The retained alternatives for the Kill van Kull are summarized below.

Retained Alternative KVK-1 and KVK-2

These alternatives consist of storage tanks for Outfall PR-029, sized to provide 50 and 75 percent control of the total CSO volume to Kill van Kull, respectively. The table below summarizes the sizes of these tanks.

	KVK-1	KVK-2
Level of CSO Control	**50%**	**75%**
Volume (MG)	5	11
# of Outfalls Captured	1	1

Location of the CSO outfalls along Kill van Kull



Retained Alternative KVK-3

This alternative consists of a storage tunnel sized to provide 100 percent control of CSO volume to the Kill van Kull. The table below summarizes the dimensions of this tunnel.

KVK-3	
Level of CSO Control	**100%**
WRRF Outfalls Captured	Port Richmond
Length (mi)	4
Diameter (ft)	16
Volume (MG)	32
# of Outfalls Captured	5 of 5 Top Discharge Outfalls 1 Other Outfall

Summary of Retained Alternatives

The table below summarizes the CSO volume reduction and estimated cost associated with each of the retained alternatives for the Kill van Kull.

Alternative	CSO Volume Reduction (MGY)	Estimated Probable Bid Cost (2019 $M)	Cost Effective(1)	No Additional CSO to Tributaries
KVK-1: 50% Tank	91	$324	✗	✓
KVK-2: 75% Tank	137	$650	✗	✓
KVK-3: 100% Tunnel	182	$1,000	✗	✓

(1) An alternative is defined as cost-effective if it provides substantial reduction in CSO volume and/or improvement in WQS attainment relative to its cost.

Summary of WQ Standards Compliance

✓ *yes* ✗ *no* *not applicable*

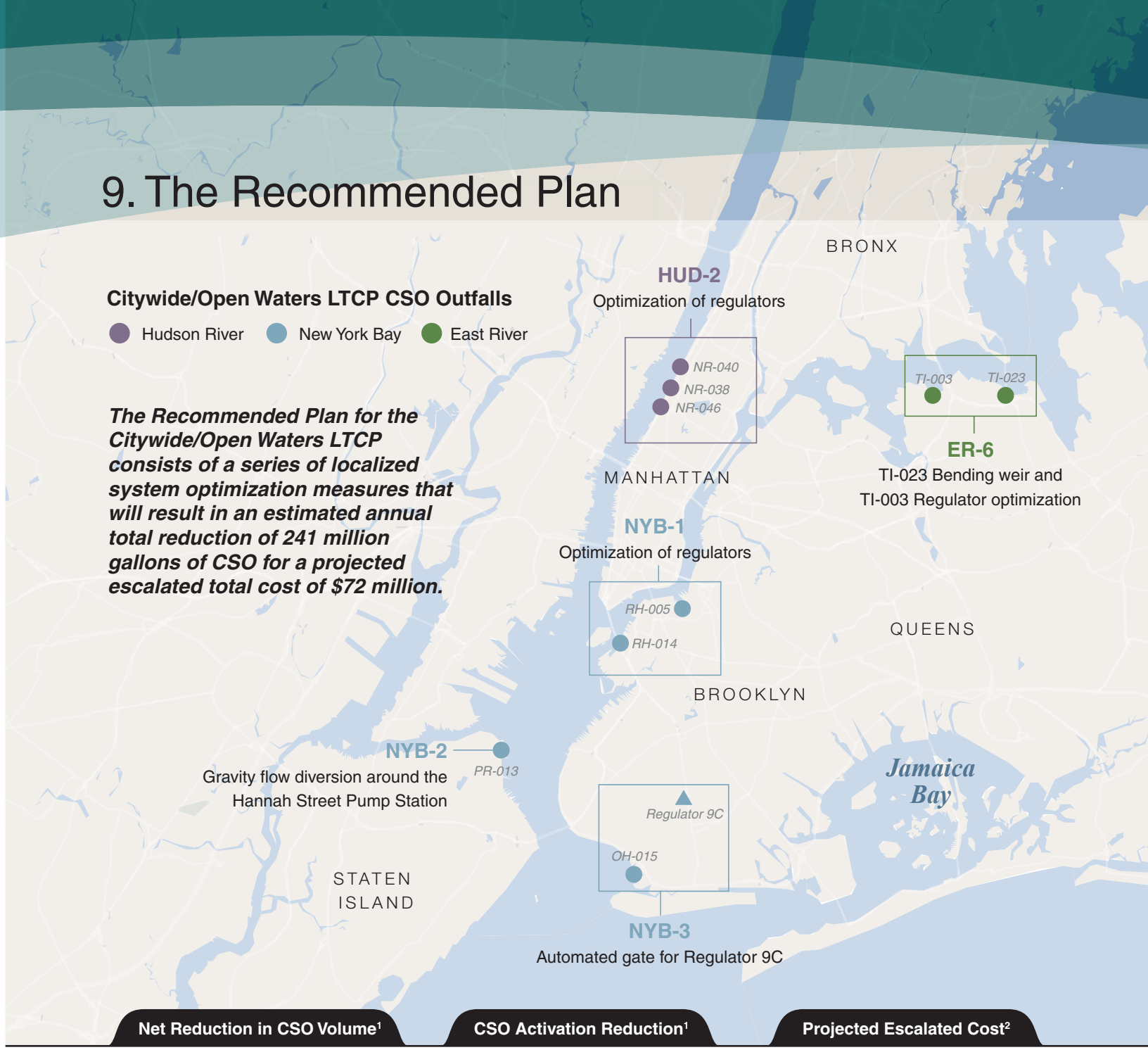
		Fecal Coliform Monthly GM(1)		Enterococci 30-day GM(2)		Enterococci 30-day STV(2)		Dissolved Oxygen (DO)	
Waterbody	**Classification**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**	**Baseline Conditions**	**100% CSO Control**
Kill van Kull	Class SD	✗(3)	✗(3)					✓	✓
Arthur Kill	Class SD	✗(3)	✗(3)					✓	✓
	Class I	✗(3)	✗(3)					✗(3)	✗(3)

(1) Fecal Coliform attainment is assessed on an annual basis. (2) Enterococci attainment is assessed for the recreational season (May 1st – Oct 31st).
(3) 100% CSO removal by NYC will not fully attain WQS due to other sources such as stormwater and New Jersey discharges.

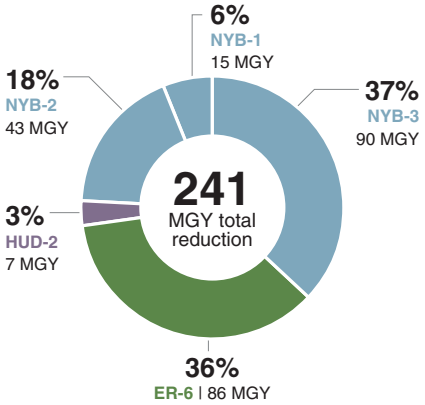
Retained Alternatives Selected for the Recommended Plan

None of the three retained alternatives were selected for the Recommended Plan, as none were determined to be cost-effective in terms of CSO volume controlled or improvement in WQS attainment.

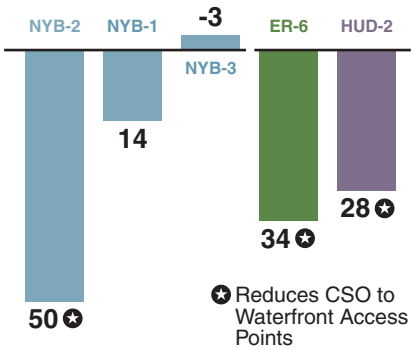
9. The Recommended Plan



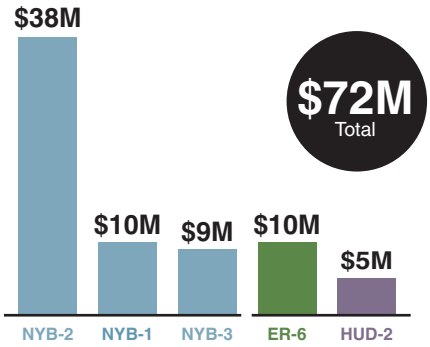
Net Reduction in CSO Volume[1]



CSO Activation Reduction[1]



Projected Escalated Cost[2]



(1) Based on CSO LTCP 2008 JFK Typical Year Rainfall
(2) Projected escalated costs includes design/DSDC escalated to mid-point of design and construction/CM escalated to mid-point of construction

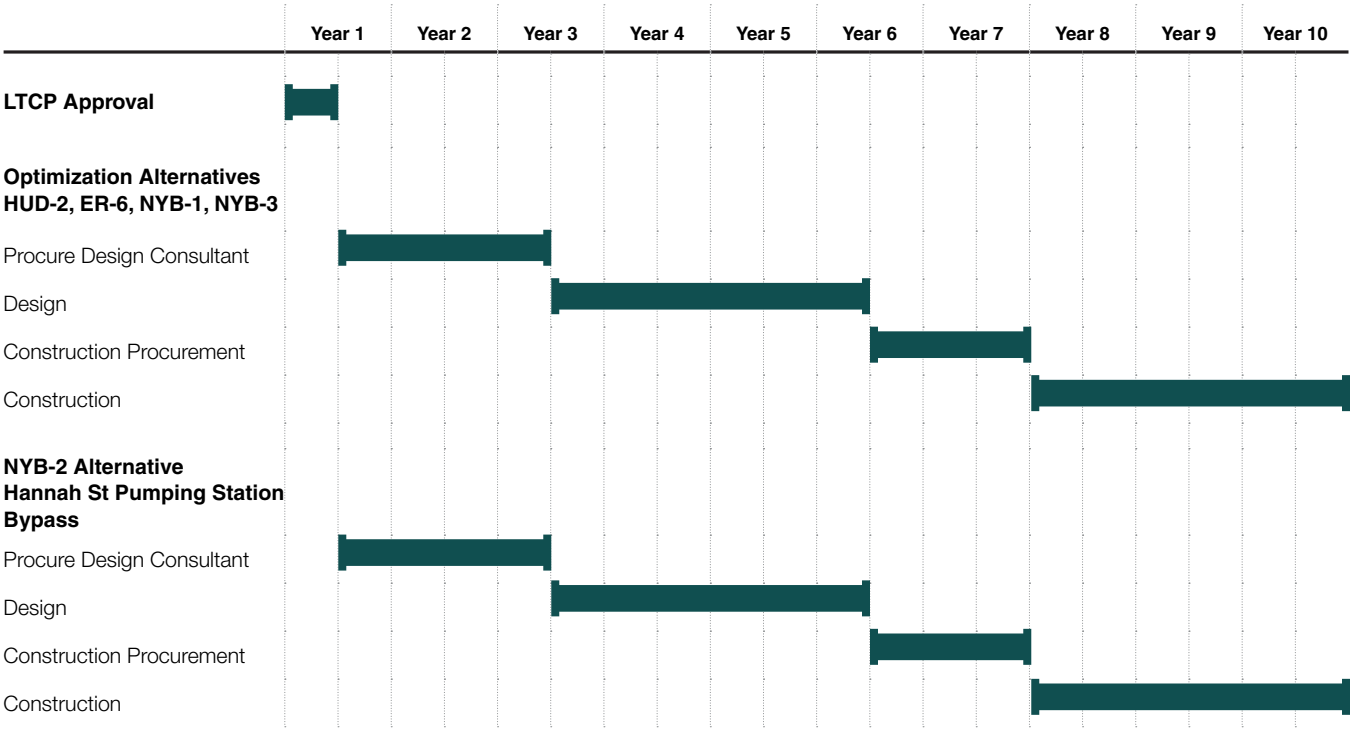
WQ Standards Compliance

✓ *yes* ✗ *no* ▭ *not applicable*

		Fecal Coliform Monthly GM[1]	Enterococci 30-day GM[2]	Enterococci 30-day STV[2]	Dissolved Oxygen (DO)
Waterbody	**Classification**	**Recommended Plan**	**Recommended Plan**	**Recommended Plan**	**Recommended Plan**
Harlem River	Class I	✓			✓
Hudson River	Class SB	✓			✓
	Class I	✓			✓
East River/LIS	Class SB	✓	✓	✓	✓
	Class I	✓			✓
New York Bay	Class SB	✓	✓	✗	✓
Kill van Kull	Class SD	✗[3]			✓
Arthur Kill/	Class SD	✗[3]			✓
	Class I	✗[3]			✗[3]

(1) Fecal Coliform attainment is assessed on an annual basis.
(2) Enterococci attainment is assessed for the recreational season (May 1st – Oct 31st) and applies only to coastal primary contact recreational waters.
(3) There are additional loadings other than NYC CSO discharges that prevent full attainment with WQS.

Preliminary Recommended Plan Schedule



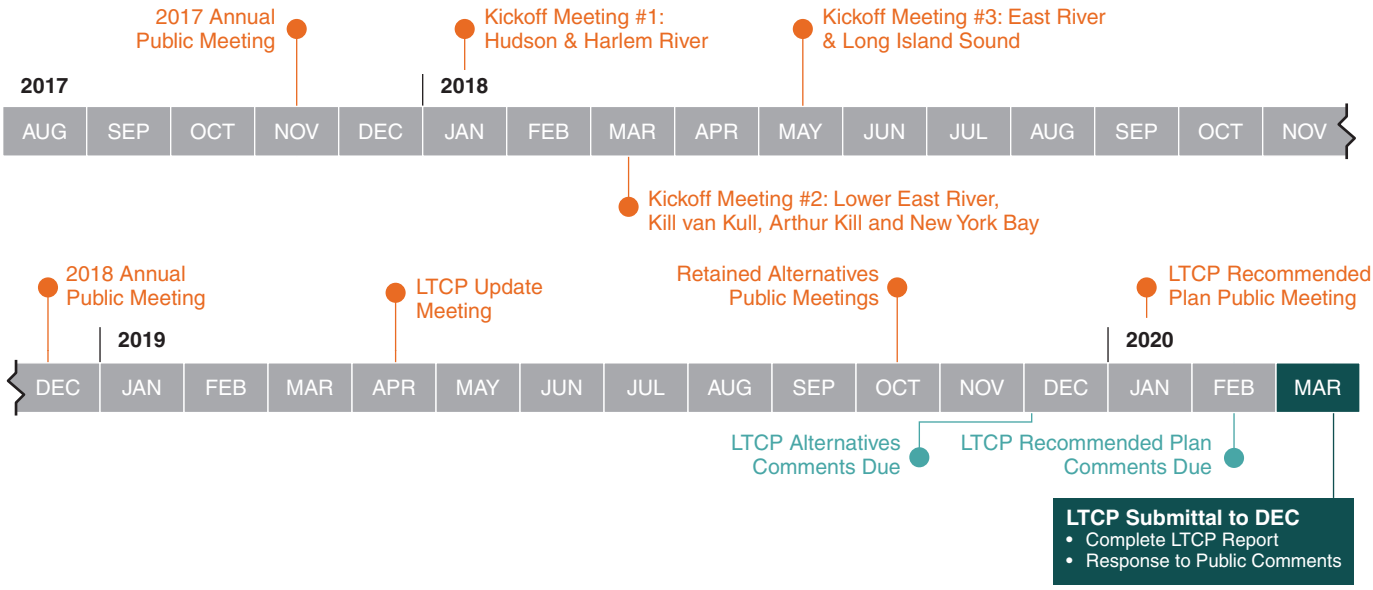
10. Public Outreach

DEP is committed to a proactive and robust program to inform the public about the development of watershed-specific and citywide LTCPs. Public outreach and public participation are important aspects of the plans, which are designed to reduce CSO-related impacts to achieve waterbody-specific water quality standards consistent with the Federal CSO Control Policy and the CWA, and in accordance with EPA and DEC mandates.

Public Outreach Goals

- Raise awareness about water quality conditions
- Increase understanding of DEP's historical and ongoing efforts
- Identify areas of concern
- Encourage public input on the retained CSO control alternatives
- Balance expectations associated with the costs of the LTCP program
- Provide timely and accessible information

Public Outreach Schedule



Public Engagement Mediums

Based on stakeholder feedback since 2012, DEP has continued to work to improve public engagement.

Waterbody Excursions & Videography

2016 Newtown Creek Canoeing with Newtown Creek Alliance

Expanded Meetings

Over 100 attendees at 2017 and 2018 Annual Meetings

Meeting Materials

Brochure and Fact Sheets

Improved Presentation Format

Display of Informative Posterboards

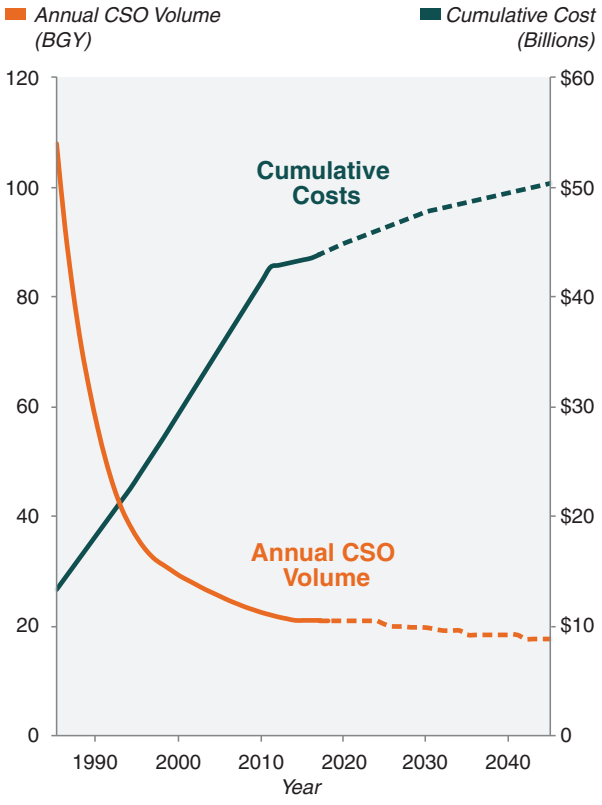
Enhanced Website and Social Media

11. Affordability and Financial Capability

DEP is fully focused on making critical investments to support our mission of protecting the health and safety of New Yorkers, while being mindful of rates. We seek to prioritize smart investments that produce the greatest social, economic and environmental benefits without putting undue financial burden on our rate payers.

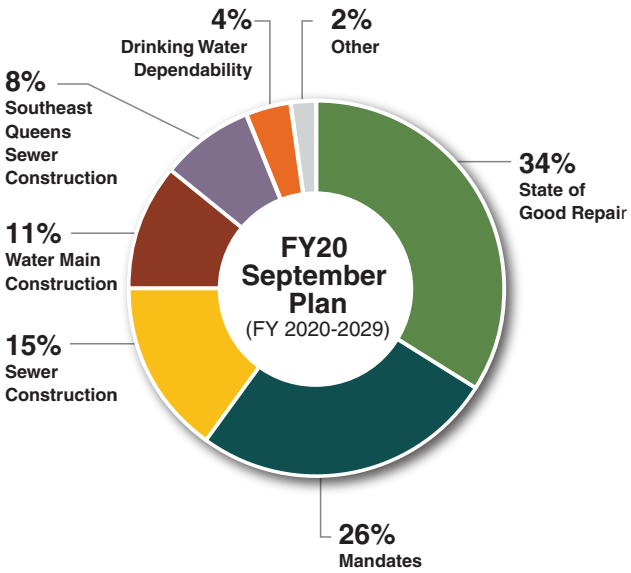
Investments in CSO Reduction

DEP investments have reduced CSO volumes by a total of over 80 billion gallons a year since the 1980s and resulted in substantial improvements in water quality. As CSO volumes have decreased, capturing further CSOs is becoming more challenging and expensive.



Future Capital Spending

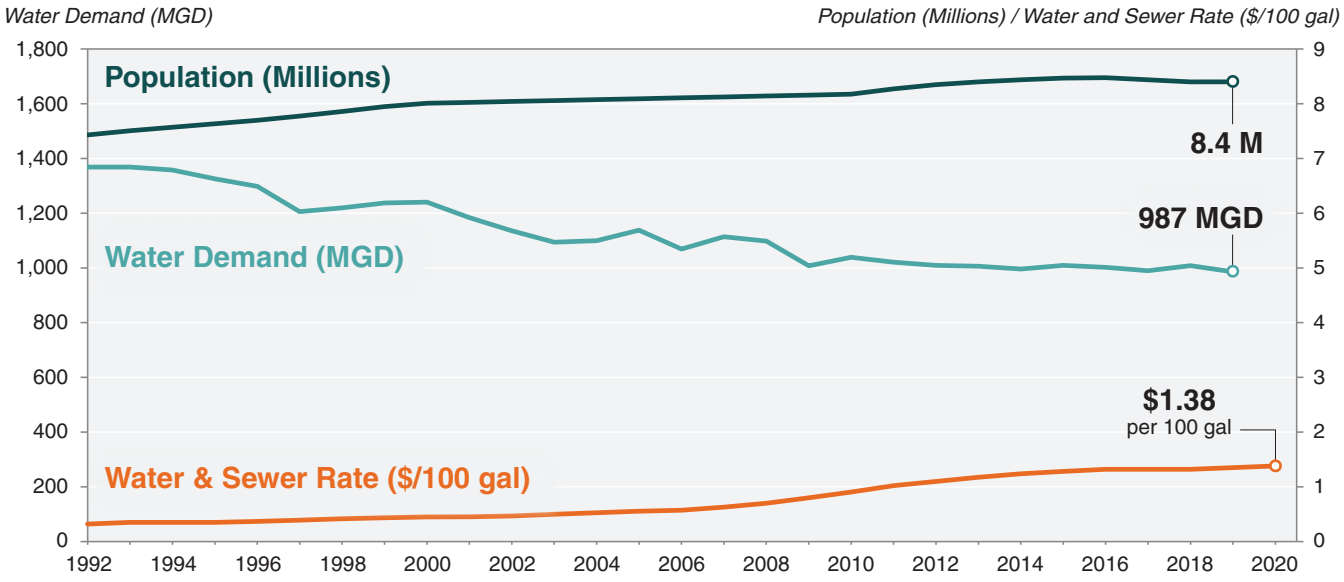
As DEP invests in attaining the highest water quality standards and most robust system possible, we must balance our investments in mandated projects, like the CSO program, with other critical investments that protect the health and safety of more than New Yorkers, such as maintaining and upgrading our century-old system (state of good repair) and sewer investments.



10-Year Plan ~$20 Billion

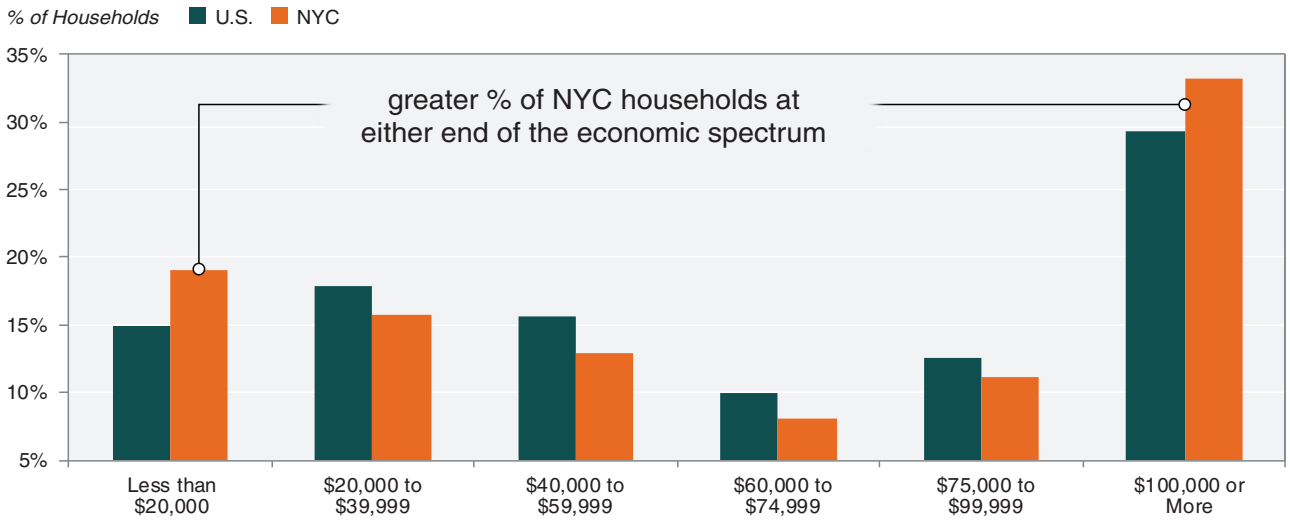
Water and Sewer Rates Over Time

DEP operations are funded almost entirely through rates paid by our customers. Water demand has declined more than 40% since 1990, despite a population increase of more than one million people. At the same time, DEP spending has increased to support mandated projects and critical investments in our water and wastewater infrastructure. As a result, water and sewer rates have increased by almost 108% (adjusted for inflation) since 2000 to meet the increasing cost of service.



Affordability Considerations

While the cost of NYC water is still less than the national average, New Yorkers are burdened by a high overall cost of living, in a city with one of the largest income gaps in the nation. Due to this, DEP must stay focused on managing the impacts our investments have on our rates, and in turn the wallets of average New Yorkers.



Source: *2018 American Community Survey 1-Year Estimates*

Attachment 1

Timeline of Key Events in CSO Planning for NYC

Timeline of Key Events in CSO Planning for NYC

CSO planning in New York City dates back to the 1950's, when conceptual plans for reduction of CSOs to the tributaries of Jamaica Bay and the East River were first initiated. Passage of the Clean Water Act in the 1970's and development of a National CSO Policy in 1994 triggered further planning and implementation of projects for CSO control.

An Administrative Consent Order signed in 1992 was followed by a series of CSO Orders on Consent to establish enforceable compliance schedules for elements of the CSO program. The current CSO LTCP program is driven by the 2005 Order on Consent, as modified by the 2012 Order on Consent and subsequent minor modifications.

WWFP and LTCP Acronyms

Alley Creek	**AC**	Flushing Creek	**FC**	Newtown Creek	**NC**
Bronx River	**BR**	Gowanus Canal	**GC**	Westchester Creek	**WC**
Coney Island Creek	**CIC**	Hutchinson River	**HR**		
Flushing Bay	**FB**	Jamaica Bay and Tributaries	**JBT**		

1950s

Developed 1st conceptual plans to reduce CSO discharges into the tributaries of Jamaica Bay and the East River

1972

Passage of the Clean Water Act

Establishment of the National Pollution Discharge Elimination System (NPDES) permit program

Completed construction of the Spring Creek CSO Facility


Spring Creek CSO Facility

1975

Initiated the State Pollution Discharge Elimination System (SPDES) permit program

1984

Developed a Citywide CSO Abatement Program

1992

Entered into an Administrative Consent Order **(1992 Consent Order)** with DEC

1993

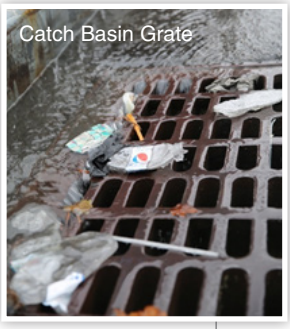
Completed Citywide Floatables Study Part 1 (1989 – 1993) – identified primary source of floatable trash is street litter reaching waterways through the sewer system

1994

EPA issued a National CSO Policy requiring development of CSO LTCPs

1995

Completed Citywide Floatables Study Part 2 (1993 – 1995) – identified street sweeping, catch basin grates and hoods, and end of pipe containment are effective floatable control strategies


Catch Basin Grate

1996

Passage of the Wet Weather Water Quality Act

EPA's National CSO Policy became law


Catch Basin Cleaning

Modified the 1992 Consent Order to include a catch basin maintenance and repair program

1997

Submitted a Floatables Abatement Plan

Submitted the Nine Minimum CSO Control Report

Completed construction of the Corona Avenue CSO Vortex Facility

2000

Entered into the **2005 CSO Consent Order** with DEC

Committed to developing 11 Waterbody/Watershed Facility Plans (WWFPs)

Submitted a Revised Floatables Abatement Plan

2005

Submitted 4 WWFPs: WC, NC, FB, JBT

Completed construction of the Paerdegat and Alley Creek CSO Facilities

DEC issued the 2014 CSO BMP Consent Order

Submitted 4 LTCPs: AC, WC, HR, FC

Completed CSO control upgrades at the Gowanus Pump Station and Flushing Tunnel

DEC approved the Revised Paerdegat LTCP

Submitted 2 WWFPs: HR and East River/ Open Waters

Completed construction of the Flushing Bay CSO Facility

Submitted 3 WWFPs: FC, AC, and CIC

Submitted 2 LTCPs: CIC, FB

Submitted Regulator CSO Monitoring Report

Submitted the JBT LTCP

DEC approved 2 LTCPs: CIC, NC

2006 2007 2008 2009 2010 2011 2012 2014 2015 2016 2017 2018

Submitted a Revised Paerdegat LTCP

Submitted GC WWFP

Submitted 2 LTCPs: BR, GC

Incorporated the 2014 BMP Order requirements into the SPDES permits for 13 WRRFs

Submitted the NC LTCP

DEC approved 7 LTCPs: AC, HR, FC, BR, FB, GC, WC

Submitted BR WWFP

Published the NYC Green Infrastructure Plan (GI Plan)

DEC approved the **2012 Modified CSO Consent Order** which incorporates DEP's strategy to further reduce CSOs by investing in green infrastructure

DEP committed to developing 11 CSO Long Term Control Plans

Completed construction of the Avenue V Pump Station

Submitte

Attachment 2

Submitted Long Term Control Plans

Alley Creek Westchester Creek

Hutchinson River

Flushing Creek

Bronx River Long

Gowanus Canal

Coney Island Creek

Flushing Bay

Newtown Creek

Jamaica Bay and Tributaries

Alley Creek Long Term Control Plan

Investments made Prior to the LTCP Process

Existing Cost-Effective Grey Investments: Commissioned a 5 million-gallon CSO storage facility along with other outfall and sewer system improvements.

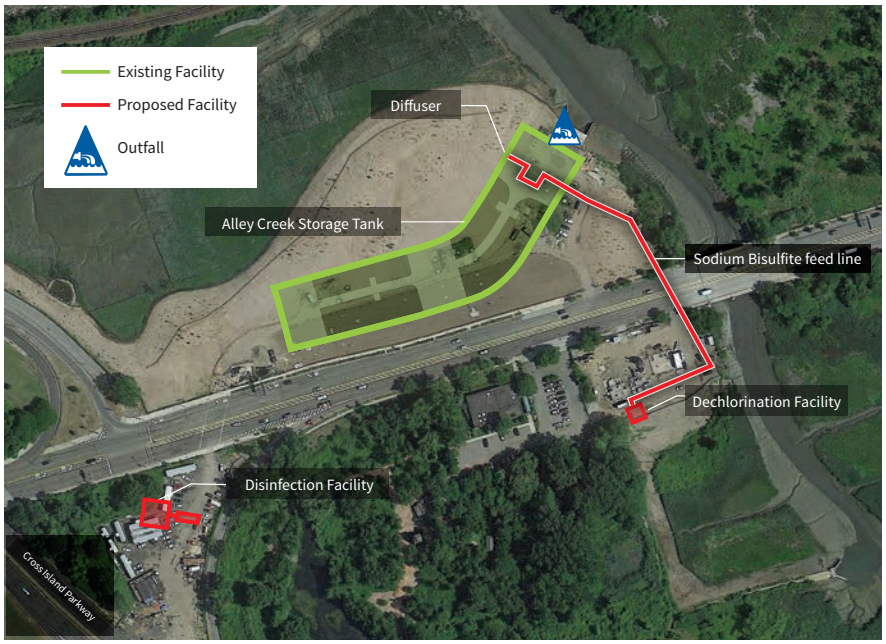
Status:

In Operation

Total Dollars Spent:

$141 Million

Approved LTCP Investments



Planned Cost-Effective Grey Investments: Provide seasonal (May 1st to October 31st) disinfection with dechlorination of the discharge from the existing CSO storage facility.

LTCP Approval Date:

March 2017

Anticipated Completion:

2024

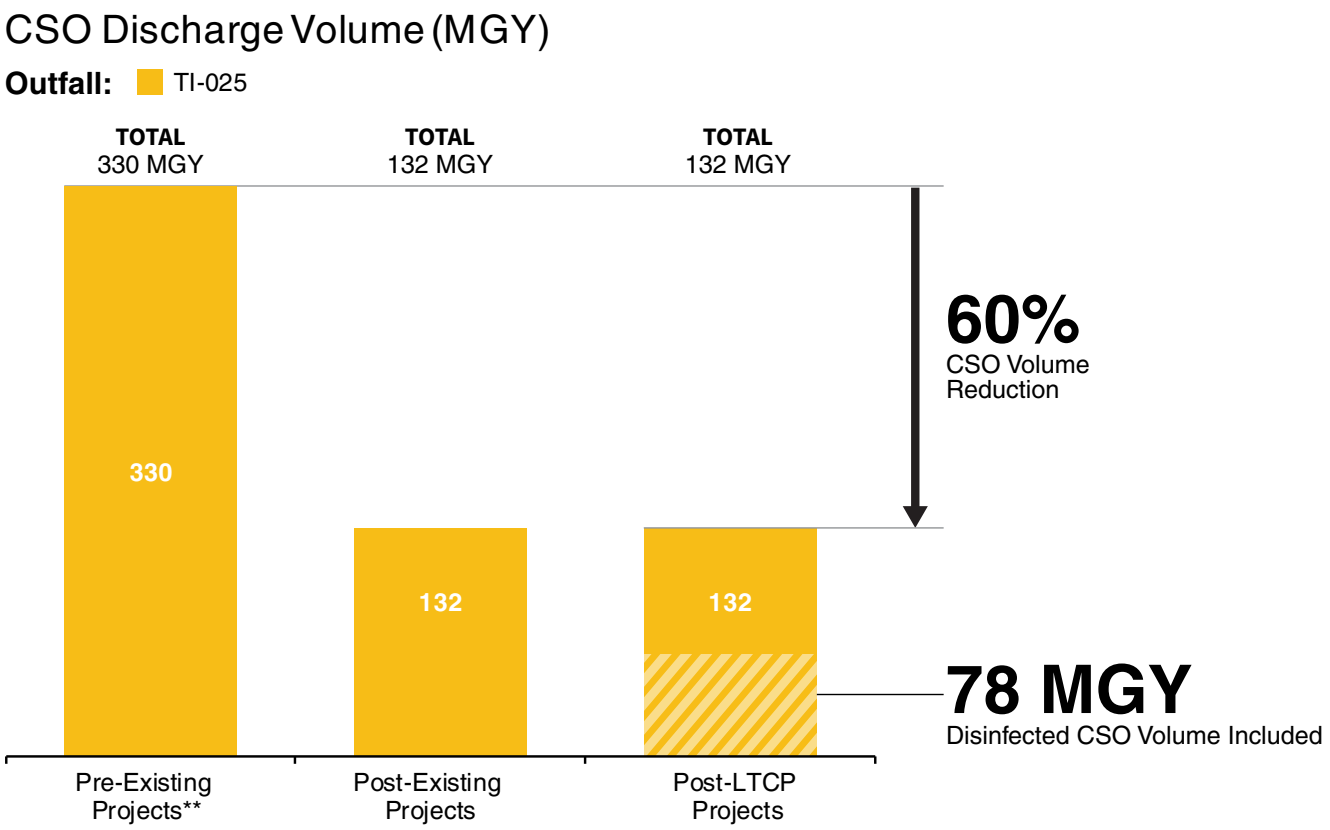
Total Escalated Cost*:

$12 Million

**Includes costs for design, design services during construction, construction, and construction management. All costs are escalated per the implementation schedule.*

Benefits to Alley Creek and Little Neck Bay

The overall reduction in CSO volume to Alley Creek from the Pre-Existing Projects condition is predicted to be 198 MGY (60% reduction). The approved LTCP Project is predicted to provide an additional 59% reduction in the annual bacteria load by disinfecting 78 MGY of CSO volume discharging to Alley Creek.



***Pre-Existing Projects CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure, and other sewer improvements.*

Model Calculated Water Quality Attainment Post-LTCP Projects

	Water Quality Criteria (as established by DEC)	Alley Creek (Class I)	Little Neck Bay (Class SB)
Fecal Coliform	Monthly GM ≤ 200 cfu/100 mL	Annual: 90% Seasonal(1): 98%	Annual: 97% Seasonal(1): 100%
Enterococci(2)	30-Day Rolling GM ≤ 35 cfu/100 mL	59%	92%
	30-Day 90th Percentile STV ≤ 130 cfu/100 mL	10%	29%
Dissolved Oxygen	Class SB acute never < 3.0 mg/L	-	99%
	Class SB daily average ≥ 4.8 mg/L	-	89%
	Class I acute never < 4.0 mg/L	98%	-

(1) The recreational season is from May 1st through October 31st.
(2) Enterococci criteria do not apply to Alley Creek and Little Neck Bay. Attainment with these criteria is shown for informational purposes only.

Westchester Creek Long Term Control Plan

Investments made Prior to the LTCP Process

Existing Cost-Effective Grey Investments: Sewer system improvements including weir modifications and Pugsley Creek parallel relief sewer.

Status:

Ongoing Construction

Total Dollars Spent:

$126 Million

Approved LTCP Investments

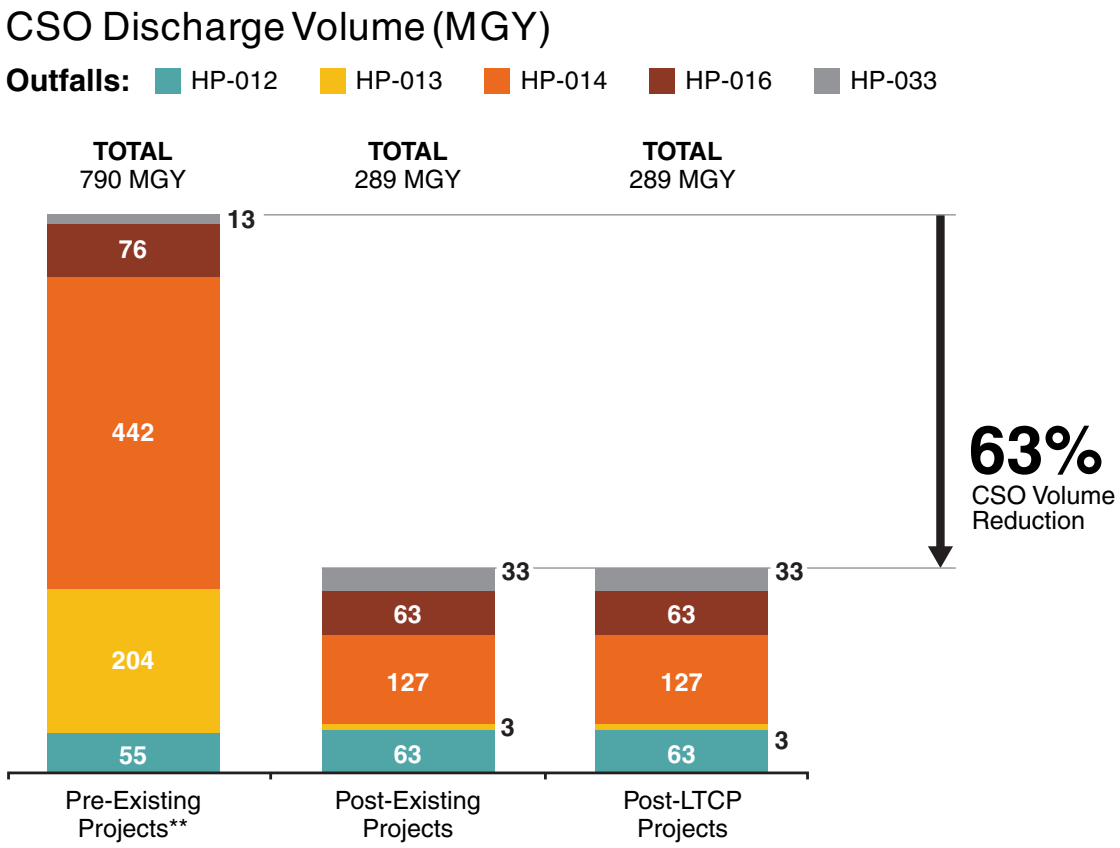
Planned Cost-Effective Grey Investments: The LTCP did not recommend an additional project for Westchester Creek beyond continued implementation of green infrastructure.

LTCP Approval Date:

August 2017

Benefits to Westchester Creek

The overall reduction in CSO volume to Westchester Creek from the Pre-Existing Projects condition is predicted to be 501 MGY (63% reduction).



***Pre-Existing Projects CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure, and other sewer improvements.*

Model Calculated Water Quality Attainment Post-LTCP Projects

	Water Quality Criteria (as established by DEC)	**Westchester Creek** (Class I)
Fecal Coliform	Monthly GM ≤ 200 cfu/100 mL	Annual: 93% Seasonal[1]: 95%
Enterococci[2]	30-Day Rolling GM ≤ 35 cfu/100 mL	88%
	30-Day 90th Percentile STV ≤ 130 cfu/100 mL	25%
Dissolved Oxygen	Class I acute never < 4.0 mg/L	80%

(1) The recreational season is from May 1st through October 31st.
(2) Enterococci criteria do not apply to Westchester Creek. Attainment with these criteria is shown for informational purposes only.

Hutchinson River Long Term Control Plan

Investments made Prior to the LTCP Process

Existing Cost-Effective Grey Investments: Commissioned headworks improvements to the Hunts Point Wastewater Resource Recovery Facility.

Status:

In Operation

Total Dollars Spent:

$3 Million


Headworks Improvements at Hunts Point WRRF

Approved LTCP Investments

Planned Cost-Effective Grey Investments: Provide seasonal (May 1st to October 31st) disinfection with dechlorination, floatables control, and construction of an extension of outfall HP-024.

LTCP Approval Date:

March 2017

Anticipated Completion:

2030

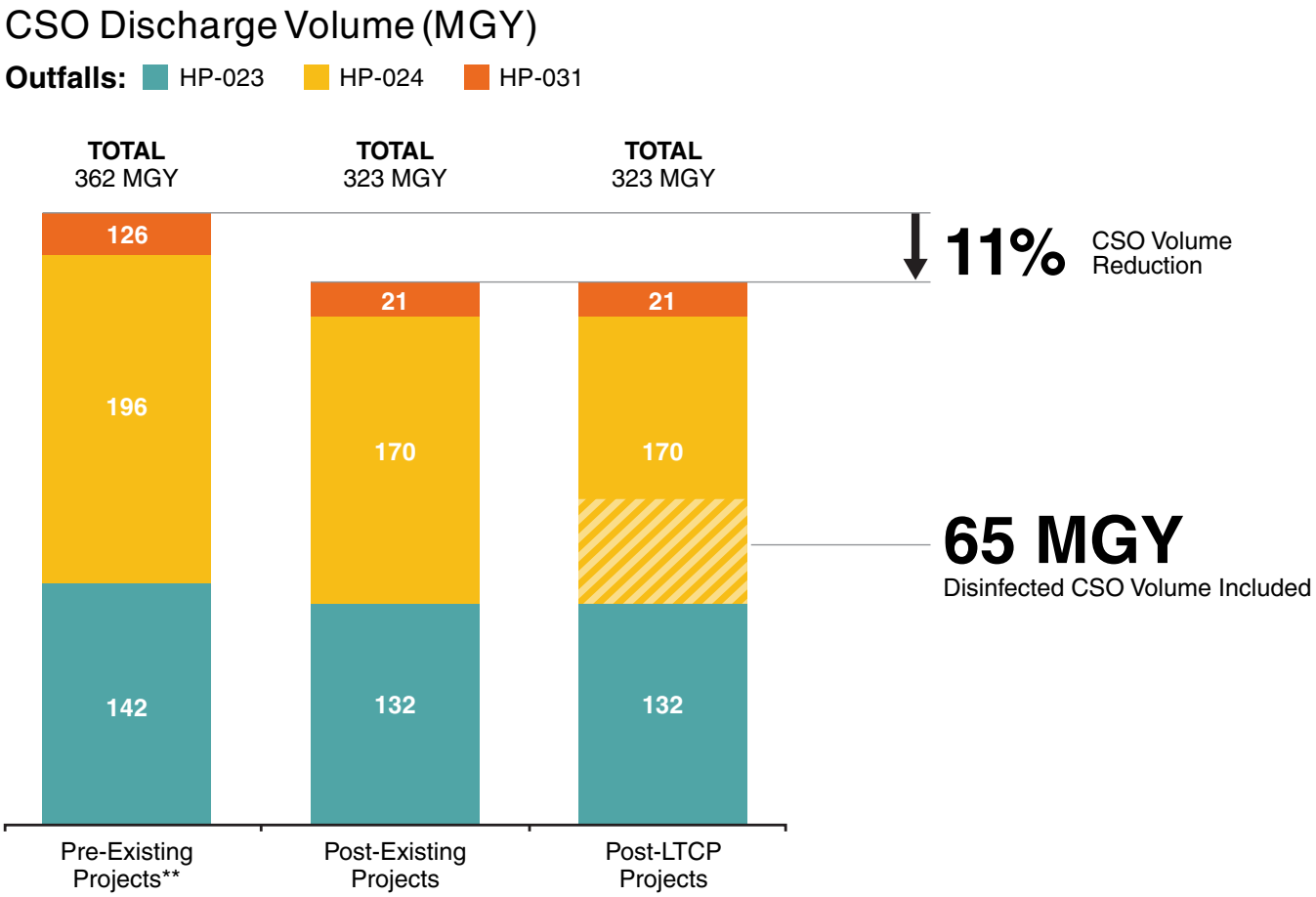
Total Escalated Cost*:

$167 Million

**Includes costs for design, design services during construction, construction, and construction management. All costs are escalated per the implementation schedule.*

Benefits to Hutchinson River

The overall reduction in CSO volume to the Hutchinson River from the Pre-Existing Projects condition is predicted to be 39 MGY (11% reduction). The approved LTCP Project is predicted to provide an additional 14% reduction in the annual bacteria load by disinfecting 65 MGY of CSO volume discharging to the Hutchinson River.



***Pre-Existing Projects CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure, and other sewer improvements.*

Model Calculated Water Quality Attainment Post-LTCP Projects

	Water Quality Criteria (as established by DEC)	**Hutchinson River** (Class SB)
Fecal Coliform	Monthly GM ≤ 200 cfu/100 mL	Annual: 84% Seasonal(1): 95%
Enterococci(2)	30-Day Rolling GM ≤ 35 cfu/100 mL	61%
	30-Day 90th Percentile STV ≤ 130 cfu/100 mL	5%
Dissolved Oxygen	Class SB acute never < 3.0 mg/L	97%
	Class SB daily average ≥ 4.8 mg/L	78%

(1) The recreational season is from May 1st through October 31st.
(2) Enterococci criteria do not apply to Hutchinson River. Attainment with these criteria is shown for informational purposes only.

Flushing Creek Long Term Control Plan

Investments made Prior to the LTCP Process

Existing Cost-Effective Grey Investments: Commissioned a 43 million-gallon CSO storage facility along with other sewer system improvements.

Status:

In Operation

Total Dollars Spent:

$363 Million

Approved LTCP Investments

Planned Cost-Effective Grey Investments: Provide seasonal (May 1st to October 31st) disinfection with dechlorination at the existing CSO storage facility and outfall TI-011, and floatables control.

LTCP Approval Date:

March 2017

Anticipated Completion:

2025

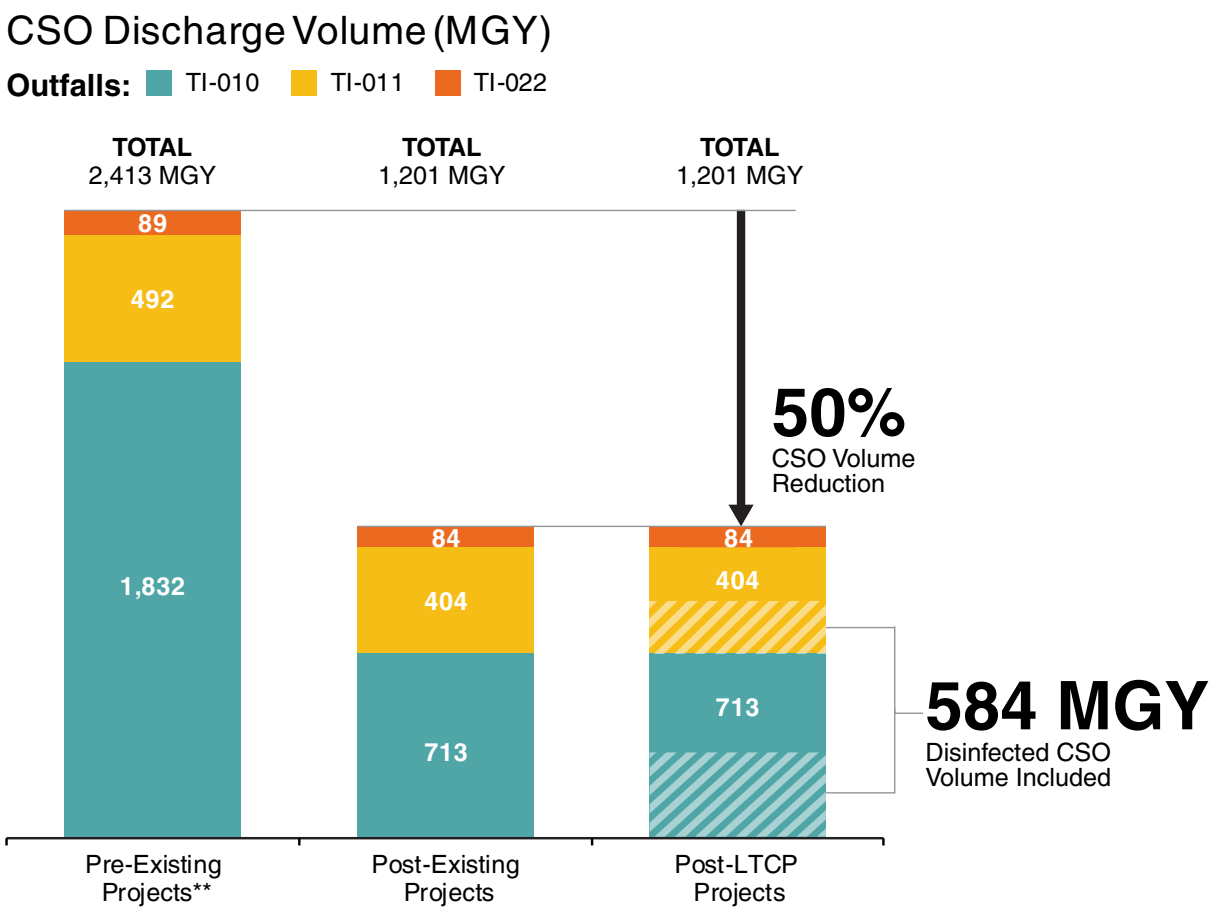
Total Escalated Cost*:

$92 Million

**Includes costs for design, design services during construction, construction, and construction management. All costs are escalated per the implementation schedule.*

Benefits to Flushing Creek

The overall reduction in CSO volume to Flushing Creek from the Pre-Existing Projects condition is predicted to be 1,212 MGY (50% reduction). The approved LTCP Project is predicted to provide an additional 51% reduction in the annual bacteria load by disinfecting 584 MGY of CSO volume discharging to Flushing Creek.



***Pre-Existing Projects CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure, and other sewer improvements.*

Model Calculated Water Quality Attainment Post-LTCP Projects

	Water Quality Criteria (as established by DEC)	Westchester Creek (Class I)
Fecal Coliform	Monthly GM ≤ 200 cfu/100 mL	Annual: 67% Seasonal(1): 78%
Enterococci(2)	30-Day Rolling GM ≤ 35 cfu/100 mL	69%
	30-Day 90th Percentile STV ≤ 130 cfu/100 mL	7%
Dissolved Oxygen	Class I acute never < 4.0 mg/L	85%

(1) The recreational season is from May 1st through October 31st.
(2) Enterococci criteria do not apply to Flushing Creek. Attainment with these criteria is shown for informational purposes only.

Bronx River Long Term Control Plan

Investments made Prior to the LTCP Process

Existing Cost-Effective Grey Investments: Commissioned sewer system upgrades to maximize flow to the Hunts Point Wastewater Resource Recovery Facility and implemented outfall netting and screens to control floatable materials.

Status:

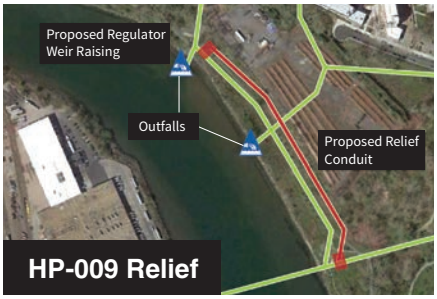
In Operation

Total Dollars Spent:

$46 Million

Approved LTCP Investments

Planned Cost-Effective Grey Investments: Implement sewer modifications to provide hydraulic relief at outfalls HP-007 and HP-009 and provide floatables control at outfall HP-011.



LTCP Approval Date:

March 2017

Anticipated Completion:

2026

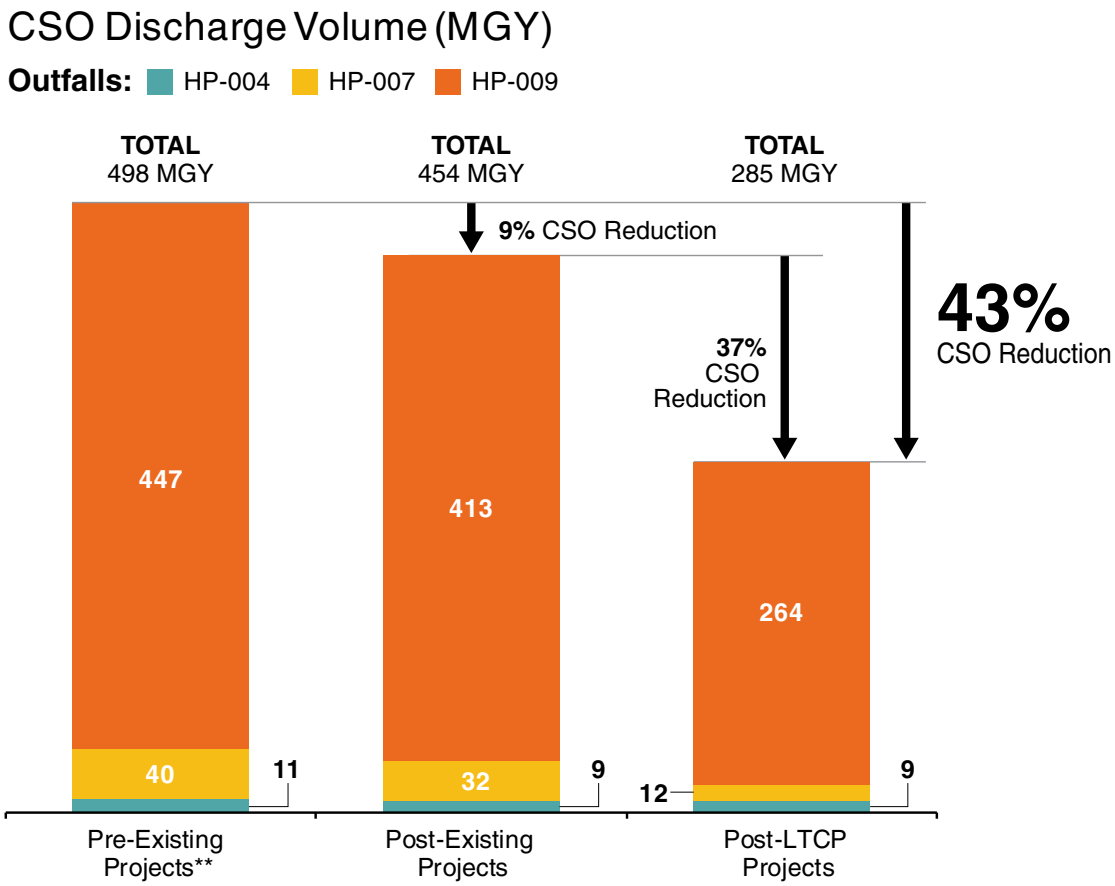
Total Escalated Cost*:

$185 Million

**Includes costs for design, design services during construction, construction, and construction management. All costs are escalated per the implementation schedule.*

Benefits to Bronx River

The approved LTCP Project is predicted to provide 169 MG (37%) reduction in annual CSO volume and bacteria load to the Bronx River from the Post-Existing Projects condition. The overall reduction in CSO volume to the Bronx River from the Pre-Existing Projects condition is predicted to be 213 MGY (43% reduction).



***Pre-Existing Projects CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure, and other sewer improvements.*

Model Calculated Water Quality Attainment Post-LTCP Projects

	Water Quality Criteria (as established by DEC)	**Bronx River** (Class I)
Fecal Coliform	Monthly GM ≤ 200 cfu/100 mL	Annual: 83% Seasonal(1): 87%
Enterococci(2)	30-Day Rolling GM ≤ 35 cfu/100 mL	84%
	30-Day 90th Percentile STV ≤ 130 cfu/100 mL	10%
Dissolved Oxygen	Class I acute never < 4.0 mg/L	95%

(1) The recreational season is from May 1st through October 31st.
(2) Enterococci criteria do not apply to Bronx River. Attainment with these criteria is shown for informational purposes only.

Gowanus Canal Long Term Control Plan

Investments made Prior to the LTCP Process

Existing Cost-Effective Grey Investments: Sewer system improvements including the restoration of the flushing tunnel and reconstruction of the Gowanus Pumping Station.

Status:

In Operation

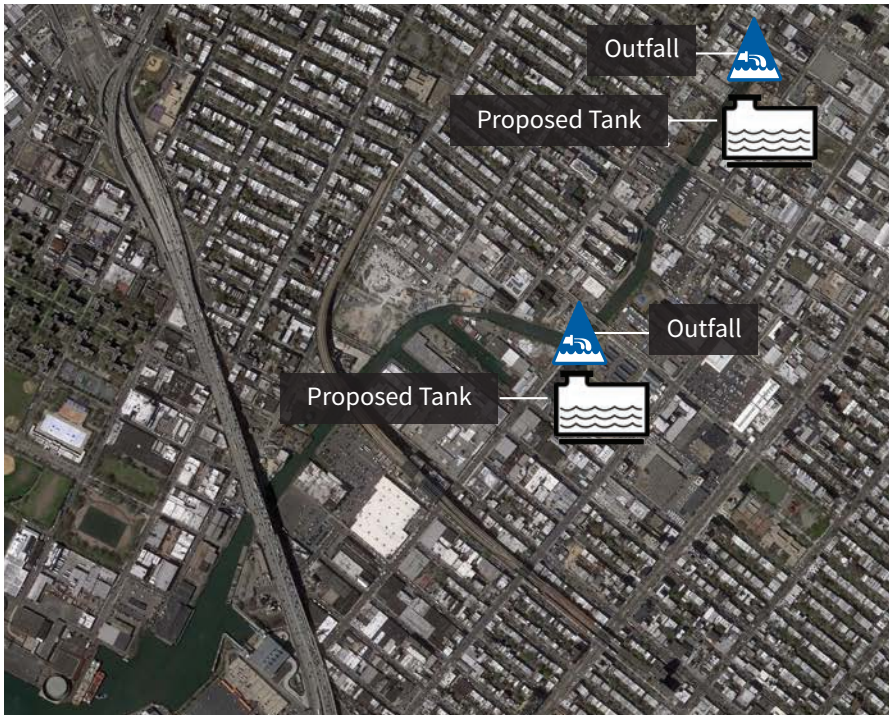
Total Dollars Spent:

$198 Million


Flushing Tunnel and Pumping Station Upgrade

Approved LTCP Investments

Planned Cost-Effective Grey Investments: The LTCP did not recommend an additional project for Gowanus Canal beyond continued implementation of green infrastructure, but as part of a Superfund program, two CSO storage tanks (8 MG and 4 MG) are proposed to be constructed.



LTCP Approval Date:

March 2017

Anticipated Completion:

2030

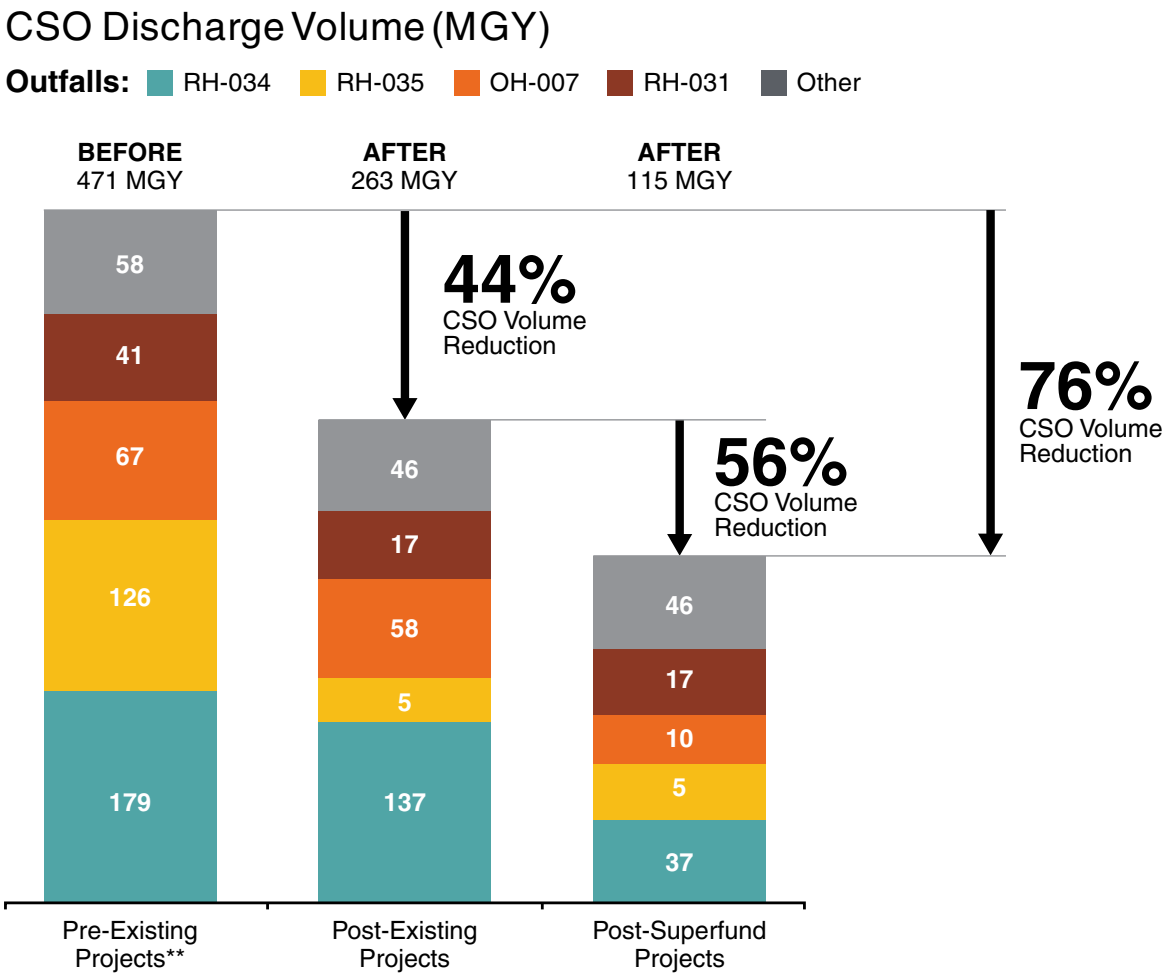
Superfund Project Total Escalated Cost*:

$1,180 Million

**Includes costs for design, design services during construction, construction, and construction management. All costs are escalated per the implementation schedule.*

Benefits to Gowanus Canal

The Superfund Project is predicted to provide 148 MGY (56%) reduction in the annual CSO volume and bacteria load to the Gowanus Canal from the Post-Existing Projects condition. The overall reduction in CSO volume to Gowanus Canal from the Pre-Existing Projects condition is predicted to be 356 MGY (76% reduction).



***Pre-Existing Projects CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure, and other sewer improvements.*

Model Calculated Water Quality Attainment Post-LTCP Projects

	Water Quality Criteria (as established by DEC)	Gowanus Canal (Class SD)
Fecal Coliform	Monthly GM ≤ 200 cfu/100 mL	Annual: 98% Seasonal[1]: 100%
Enterococci[2]	30-Day Rolling GM ≤ 35 cfu/100 mL	100%
	30-Day 90th Percentile STV ≤ 130 cfu/100 mL	90%
Dissolved Oxygen	Class SD acute never < 4.0 mg/L	100%

(1) The recreational season is from May 1st through October 31st.
(2) Enterococci criteria do not apply to Gowanus Canal. Attainment with these criteria is shown for informational purposes only.

Coney Island Creek Long Term Control Plan

Investments made Prior to the LTCP Process

Existing Cost-Effective Grey Investments: Sewer system improvements including the upgrade of the Avenue V Pumping Station and a new wet weather force main.

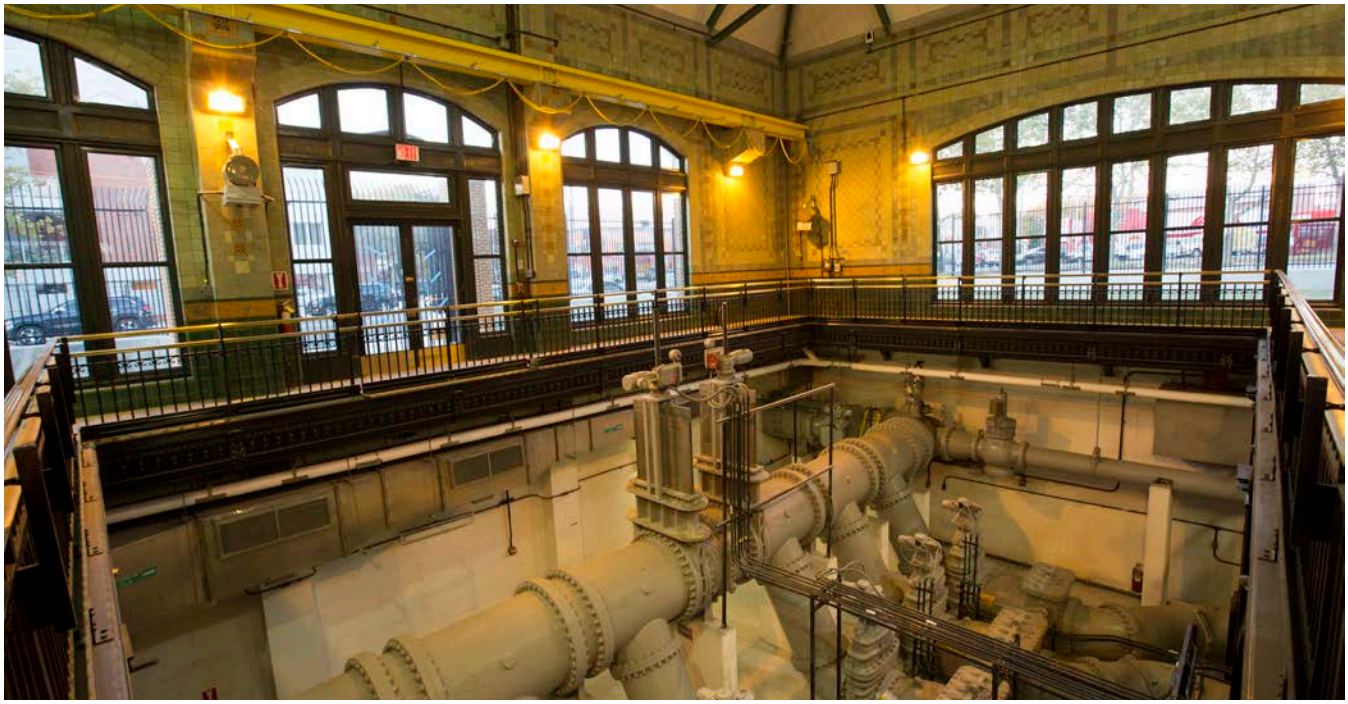
Status:

In Operation

Total Dollars Spent:

$197 Million


Avenue V Pumping Station



Approved LTCP Investments

Planned Cost-Effective Grey Investments: The LTCP did not recommend an additional project for Coney Island Creek. DEP will conduct ongoing illicit sewer connection trackdown, additional flow monitoring and MS4 prioritization.

LTCP Approval Date:

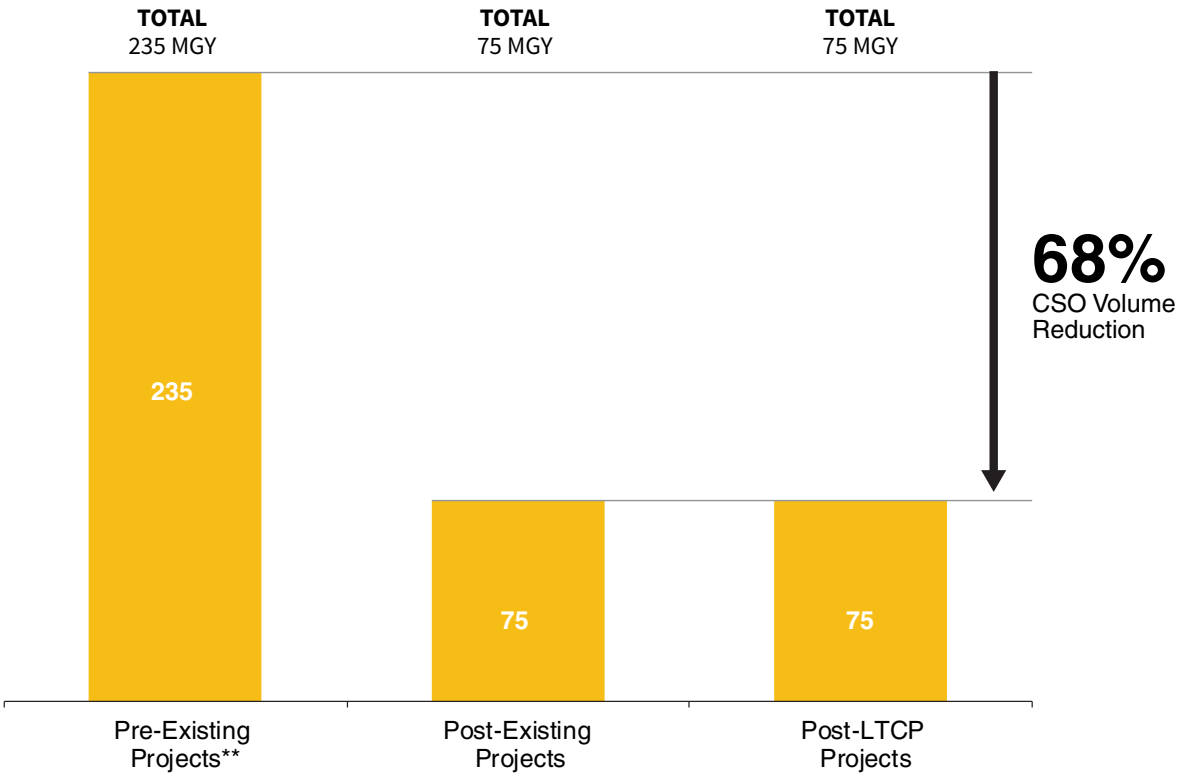
April 2018

Benefits to Coney Island Creek

The overall reduction in CSO volume to Coney Island Creek from the Pre-Existing Projects condition is predicted to be 160 MGY (68% reduction).

CSO Discharge Volume (MGY)

Outfall: OH-021



***Pre-Existing Projects CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure, and other sewer improvements.*

Model Calculated Water Quality Attainment Post-LTCP Projects

	Water Quality Criteria (as established by DEC)	Coney Island Creek (Class I)
Fecal Coliform	Monthly GM ≤ 200 cfu/100 mL	Annual: 56% Seasonal(1): 93%
Enterococci(2)	30-Day Rolling GM ≤ 35 cfu/100 mL	53%
	30-Day 90th Percentile STV ≤ 130 cfu/100 mL	3%
Dissolved Oxygen	Class I acute never < 4.0 mg/L	90%

(1) The recreational season is from May 1st through October 31st.
(2) Enterococci criteria do not apply to Coney Island Creek. Attainment with these criteria is shown for informational purposes only.

Flushing Bay Long Term Control Plan

Investments made Prior to the LTCP Process

Existing Cost-Effective Grey Investments: Sewer system improvements including diverting low-lying sewers and regulator modifications; and dredging and restoration of Flushing Bay.

Status:

Ongoing Construction and Restoration

Total Dollars Spent:

$71 Million

Approved LTCP Investments

Planned Cost-Effective Grey Investments: Commission a 25 million-gallon CSO storage tunnel with dewatering pumping station to capture overflows from outfalls BB-006 and BB-008.

LTCP Approval Date:

March 2017

Anticipated Completion:

2035

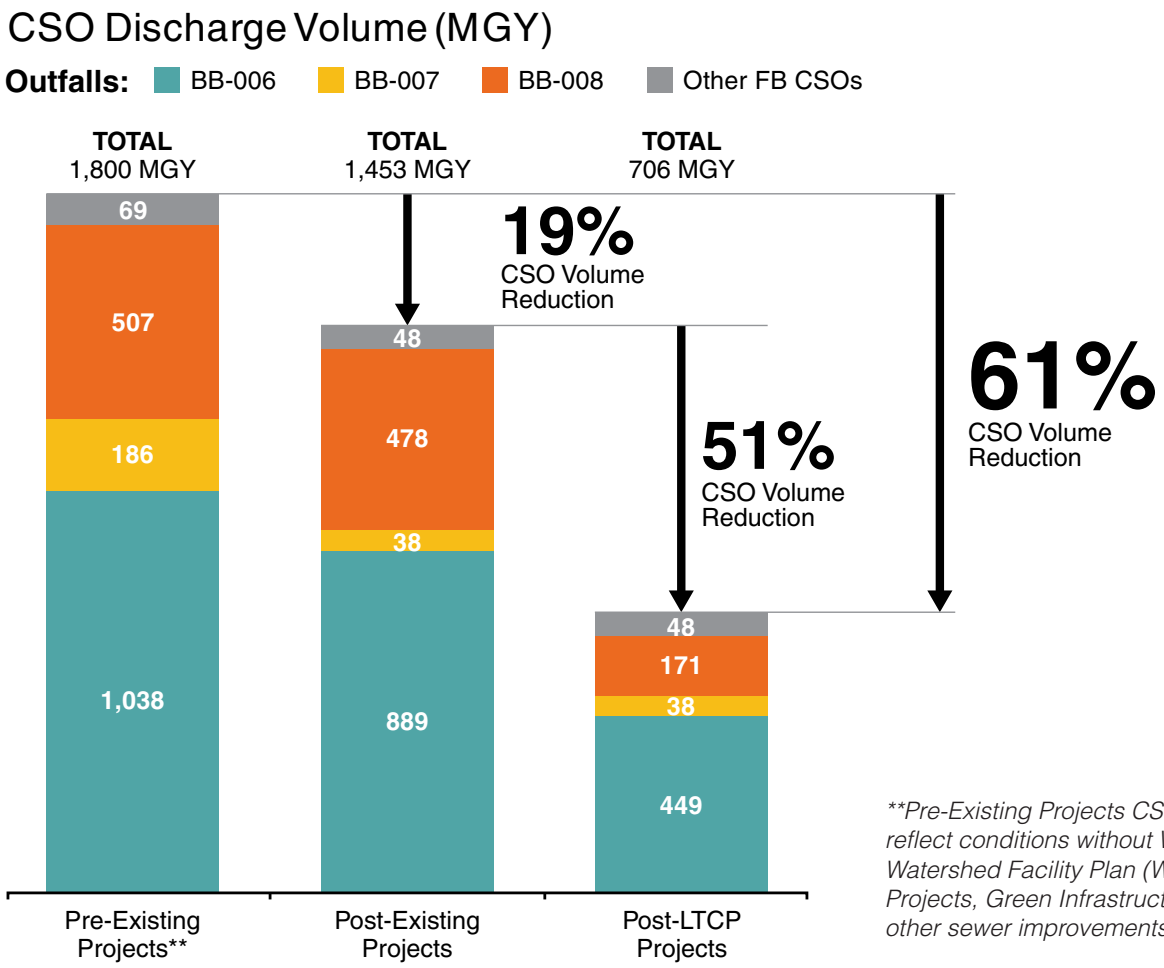
Total Escalated Cost*:

$1,616 Million

**Includes costs for design, design services during construction, construction, and construction management. All costs are escalated per the implementation schedule.*

Benefits to Flushing Bay

The approved LTCP Project is predicted to provide an additional 747 MGY (51%) reduction in annual CSO volume and bacteria load to Flushing Bay from the Post-Existing Projects condition. The overall reduction in CSO volume to Flushing Bay from the Pre-Existing Projects condition is predicted to be 1,094 MGY (61% reduction).



***Pre-Existing Projects CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure, and other sewer improvements.*

Model Calculated Water Quality Attainment Post-LTCP Projects

	Water Quality Criteria (as established by DEC)	Flushing Bay (Class I)
Fecal Coliform	Monthly GM ≤ 200 cfu/100 mL	Annual: 100% Seasonal[(1)]: 100%
Enterococci[(2)]	30-Day Rolling GM ≤ 35 cfu/100 mL	98%
	30-Day 90th Percentile STV ≤ 130 cfu/100 mL	55%
Dissolved Oxygen	Class I acute never < 4.0 mg/L	97%

(1) The recreational season is from May 1st through October 31st.
(2) Enterococci criteria do not apply to Flushing Bay. Attainment with these criteria is shown for informational purposes only.

Newtown Creek Long Term Control Plan

Investments made Prior to the LTCP Process

Existing Cost-Effective Grey Investments: Sewer system improvements including bending weirs and floatables control; Newtown Creek Wastewater Resource Recovery Facility headworks expansion; and in-stream aeration.

Status:

In Operation

Total Dollars Spent:

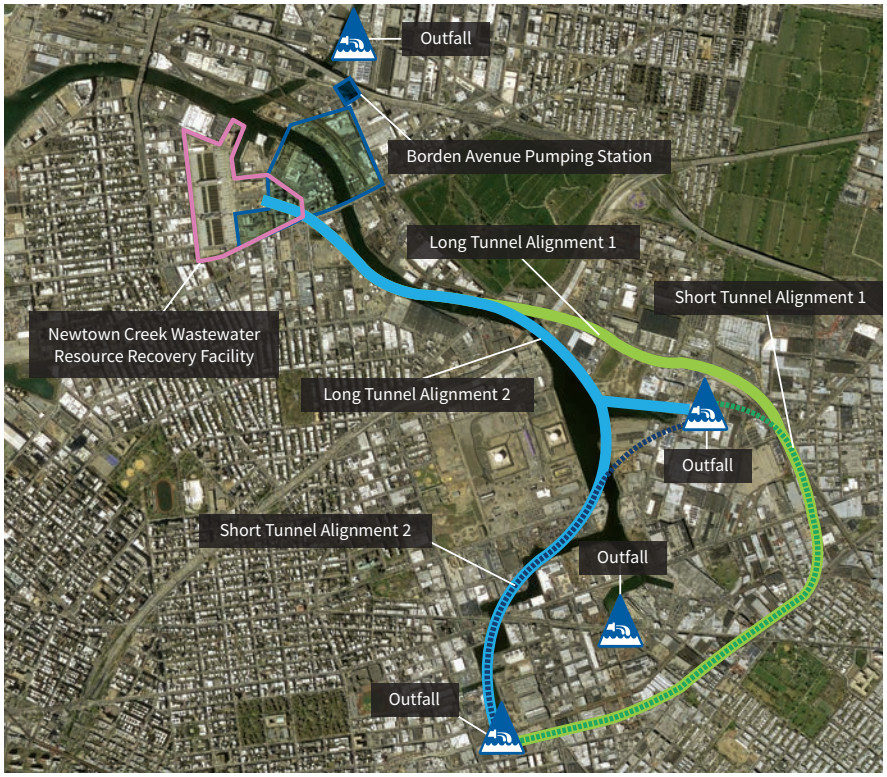
$262 Million


Headworks Expansion


In-Stream Aeration

Approved LTCP Investments

Planned Cost-Effective Grey Investments: Commission a 39 million-gallon CSO storage tunnel to capture overflows from outfalls NCB-015, NCB-083, and NCQ-077; and expansion of the Borden Avenue Pumping Station to reduce overflows at outfall BB-026.



LTCP Approval Date:

June 2018

Pumping Station Expansion Anticipated Completion:

2029

CSO Storage Tunnel Anticipated Completion:

2042

Total Escalated Cost*:

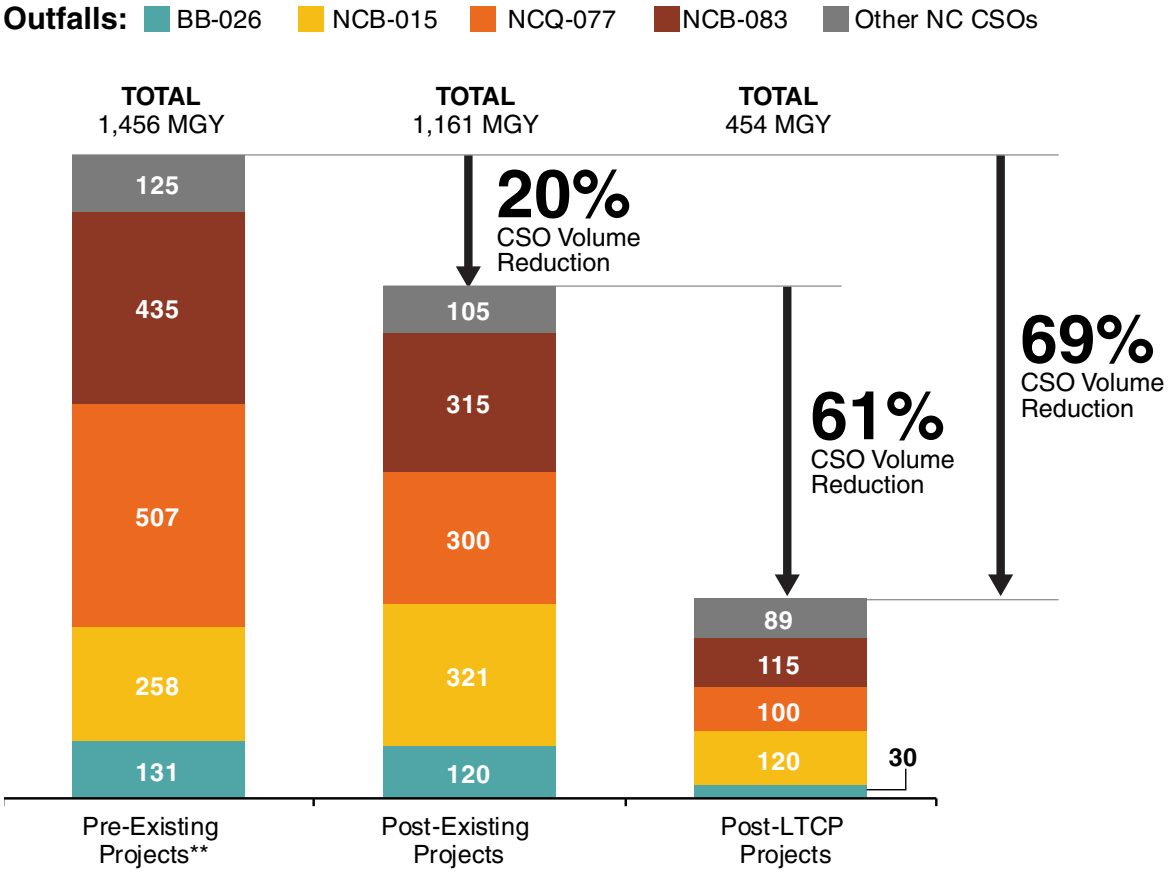
$1,335 Million

**Includes costs for design, design services during construction, construction, and construction management. All costs are escalated per the implementation schedule.*

Benefits to Newtown Creek

The approved LTCP Project is predicted to provide an additional 707 MGY (61%) reduction in annual CSO volume and bacteria load to Newtown Creek from the Post-Existing Projects condition. The overall reduction in CSO volume to Newtown Creek from the Pre-Existing Projects condition is predicted to be 1,001 MGY (69% reduction).

CSO Discharge Volume (MGY)



***Pre-Existing Projects CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure, and other sewer improvements.*

Model Calculated Water Quality Attainment Post-LTCP Projects

	Water Quality Criteria (as established by DEC)	**Newtown Creek** (Class SD)
Fecal Coliform	Monthly GM ≤ 200 cfu/100 mL	Annual: 83% Seasonal[1]: 83%
Enterococci[2]	30-Day Rolling GM ≤ 35 cfu/100 mL	78%
	30-Day 90th Percentile STV ≤ 130 cfu/100 mL	7%
Dissolved Oxygen	Class SD acute never < 4.0 mg/L	96%

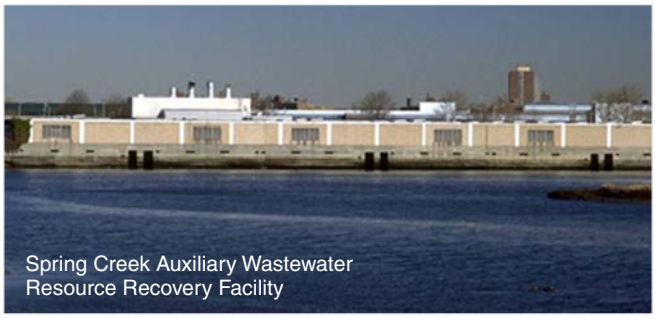
(1) The recreational season is from May 1st through October 31st.
(2) Enterococci criteria do not apply to Newtown Creek. Attainment with these criteria is shown for informational purposes only.

Jamaica Bay and Tributaries Long Term Control Plan

Investments made Prior to the LTCP Process

Existing Cost-Effective Grey Investments: Commissioned Spring Creek Auxiliary WRRF upgrade; 30 million-gallon Paerdegat CSO storage facility; Warnerville Pumping Station and forcemain; 26th Ward WRRF drainage area sewer cleaning; regulator improvements and bending weirs; a new parallel sewer to the west interceptor; Hendrix Creek and Paerdegat Basin dredging and Shellbank Basin destratification. On-going construction on Bergen Basin lateral sewer; and 26th Ward WRRF wet weather stabilization and high-level storm sewers.

Sewer Flushing



Spring Creek Auxiliary Wastewater Resource Recovery Facility

Status:

In Operation and Ongoing Construction

Total Dollars Spent:

$1,100 Million

Paerdegat CSO Storage Facility

Submitted LTCP Investments

Planned Cost-Effective Green Investments: Provide green infrastructure expansion and ribbed mussel colony creation in Bergen and Thurston Basins; environmental dredging in Bergen Basin; and wetland restoration in Spring Creek, Hendrix Creek, Fresh Creek, Paerdegat Basin, and Jamaica Bay.

LTCP Approval Date:

Pending

Total Escalated Cost*:

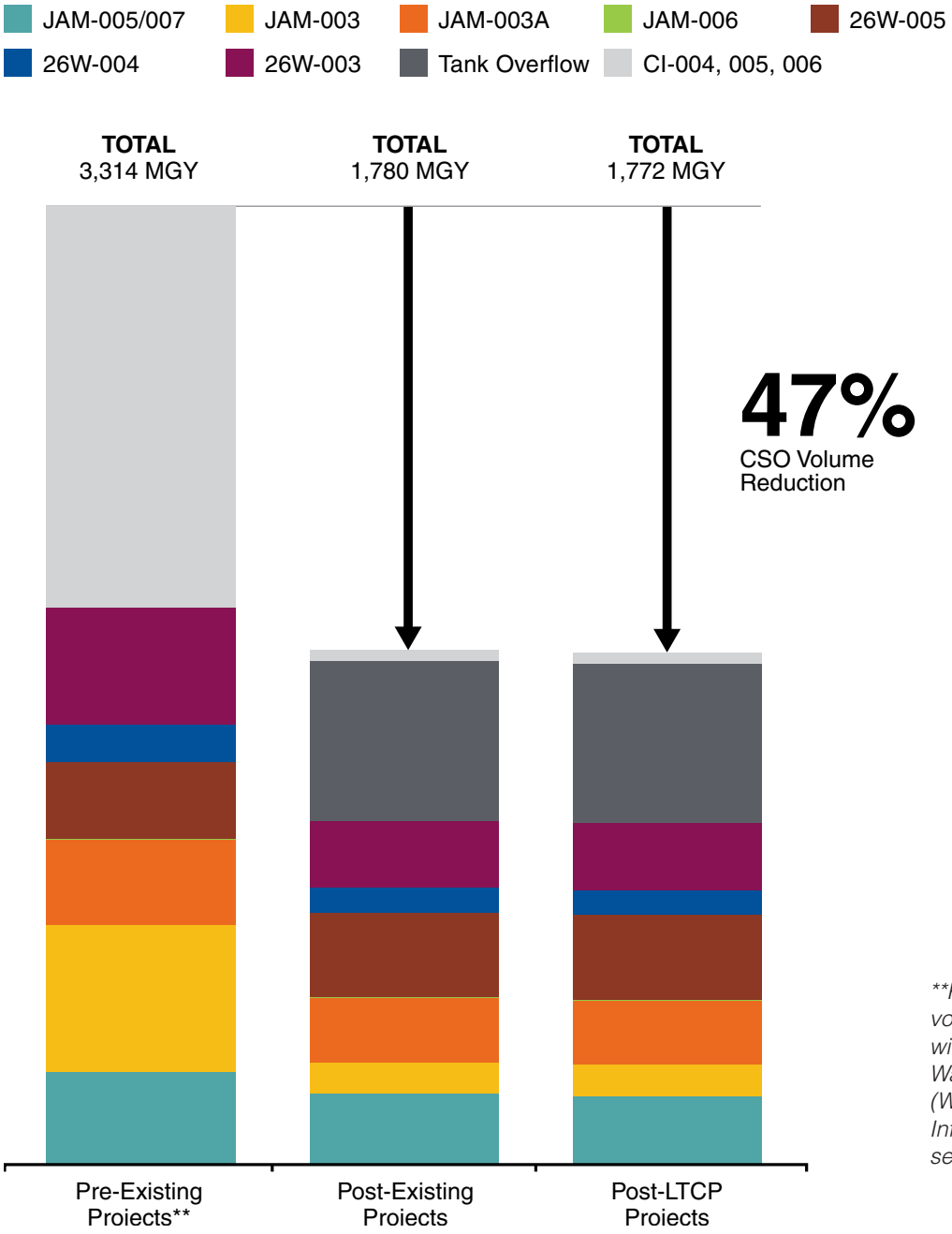
$579 Million

**Includes costs for design, design services during construction, construction, and construction management. All costs are escalated per the implementation schedule.*

Benefits to Jamaica Bay and Tributaries

The approved LTCP Project is predicted to provide an additional 15 MGY reduction in CSO volume and reduce the annual bacterial load by 10% from the Post-Existing Projects condition. The overall reduction in CSO volume to Jamaica Bay and Tributaries from the Pre-Existing Projects condition is predicted to be 1,542 MGY (47% reduction).

CSO Discharge Volume (MGY)



***Pre-Existing Projects CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure, and other sewer improvements.*

Model Calculated Water Quality Attainment Post-LTCP Projects

Waterbody	Water Quality Criteria (as established by DEC)				
	Fecal Coliform Monthly GM ≤ 200 cfu/100 mL	**Enterococci** 30-Day Rolling GM ≤ 35 cfu/100 mL	**Enterococci** 30-Day 90th Percentile STV ≤ 130 cfu/100 mL	**Dissolved Oxygen** Class SB acute never < 3.0 mg/L	**Dissolved Oxygen** Class SB daily average ≥ 4.8 mg/L
Jamaica Bay (Class SB)	Annual: 100% Seasonal(1): 100%	100%	57%	100%	99%

Tributaries (Class I)	Water Quality Criteria (as established by DEC)			
	Fecal Coliform Monthly GM ≤ 200 cfu/100 mL	**Enterococci(2)** 30-Day Rolling GM ≤ 35 cfu/100 mL	**Enterococci(2)** 30-Day 90th Percentile STV ≤ 130 cfu/100 mL	**Dissolved Oxygen** Class I acute never < 4.0 mg/L
Thurston Basin	Annual: 77% Seasonal(1): 88%	65%	5%	90%
Bergen Basin	Annual: 57% Seasonal(1): 72%	29%	0%	89%
Spring Creek	Annual: 100% Seasonal(1): 100%	100%	78%	99%
Hendrix Creek	Annual: 99% Seasonal(1): 98%	98%	32%	94%
Fresh Creek	Annual: 85% Seasonal(1): 93%	98%	16%	99%
Paerdegat Basin	Annual: 97% Seasonal(1): 95%	96%	28%	99%

(1) The recreational season is from May 1st through October 31st.
(2) Enterococci criteria do not apply to these tributaries. Attainment with these criteria is shown for informational purposes only.