



IMPROVING NEW YORK CITY'S WATERWAYS

Reducing the Impacts of
Combined Sewer Overflows

FALL 2017



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OVERVIEW

With over 522 miles of shoreline, the waterways in and around New York City are critical to where we live, work and play. The City first began testing water quality in the harbor over 100 years ago, and since that time real progress has been made to improve the water quality of New York’s waterbodies through planning, investment, innovative technologies, and stakeholder participation focused on controlling “combined sewer overflow” or CSO.

The New York City Department of Environmental Protection (DEP) leads these efforts as part of its responsibility to protect public health and the environment by ensuring supplies of clean drinking water and collecting and treating wastewater for the 8.5 million residents of New York City. Every day, DEP collects and treats 1.3 billion gallons of wastewater through a vast network of pipelines and pump stations that deliver wastewater to 14 treatment plants. In approximately 60 percent of the City, the sewers combine sanitary flow, created each time a New Yorker turns on a tap or flushes a toilet, with runoff that enters the sewers whenever it rains or snows, serving an essential role in protecting public health and the environment. While the Waste Water Treatment Plants (WWTPs) are designed to treat twice the permitted dry weather flow, during some rain events the system can become overburdened. When this occurs, a mix of stormwater and untreated wastewater may discharge directly into surrounding waterbodies as combined sewer overflow, or CSO to protect the treatment process at the WWTP.

In 2012, a groundbreaking consent order between DEP and the New York State Department of Environmental Conservation initiated development of 11 Long Term Control Plans (LTCPs), which are comprehensive evaluations of long term solutions to reduce CSO events and to continue to improve water quality in New York City’s waterbodies. Each LTCP is unique and seeks to develop approaches for each waterbody to achieve applicable New York State water quality standards. LTCPs are or will be implemented using a hybrid green and grey infrastructure approach to address, measure, and mitigate the effects of CSO events.

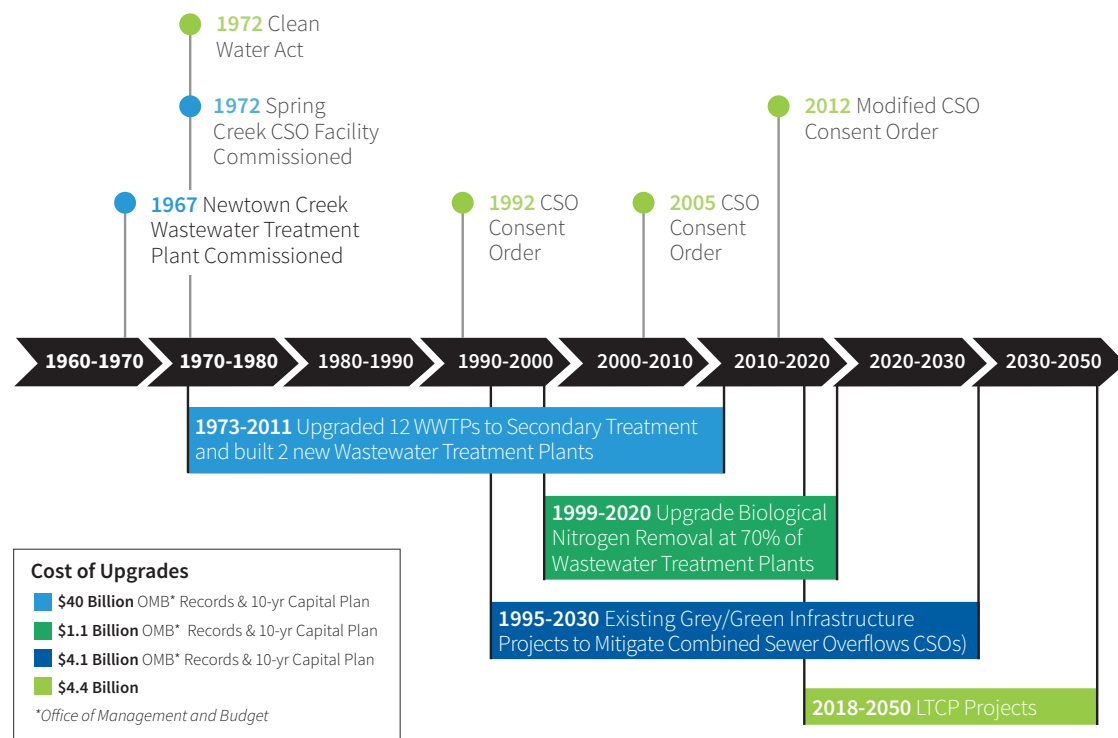
Since the beginning of the LTCP process, DEP has actively sought public participation in the development of each LTCP and has worked with a variety of stakeholders across the City.

After significant programming and billions of dollars in investment, testing of harbor water quality is better today than it has been in more than 100 years. But there are still improvements to be made. The following describes progress made to date to reduce CSOs, ongoing efforts underway to further reduce CSOs, and ways you can be involved to improve water quality in NYC.

Historical Waterbody Investments

Improving New York Harbor's water quality has been a City and DEP priority for decades. Over \$45 billion in investments has led to an 80 percent reduction in annual CSO volume. With several LTCPs approved and more in the pipeline, current and planned infrastructure investments will result in significant water quality improvements.

Major Historical Timeline for Wastewater Infrastructure



Wastewater

Every day, wastewater goes down sinks, tubs, showers, toilets, and other drains and then flows into New York City's sewer system. WWTPs remove pollutants to meet state and local water quality requirements, before releasing the treated water to the City's waterbodies and watersheds. At the WWTPs, physical and biological processes closely duplicate how wetlands, rivers, streams, and lakes naturally clean and filter water. Treatment at these plants is quick, taking only about seven hours to remove most of the pollutants.



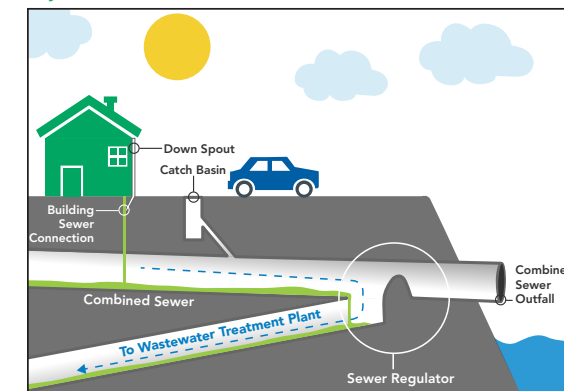
Stormwater

Stormwater runoff is generated from rain and melting snow which is conveyed over impervious surfaces such as rooftops, streets, and sidewalks that prevent rain and other water from being absorbed into the ground. As a result, much of the stormwater in New York City flows as runoff into the combined sewer system which is designed to accept stormwater and minimize local flooding.

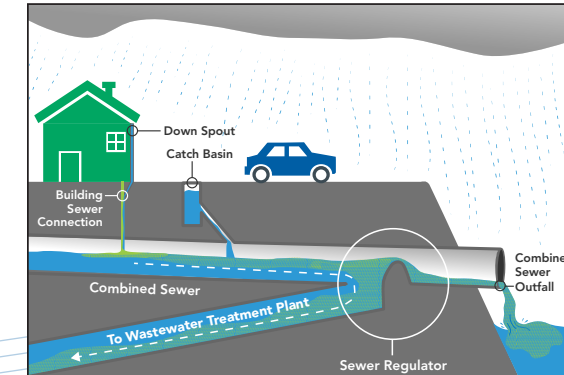
Combined Sewer Overflow

The combined flow of wastewater and stormwater runoff is conveyed to one of DEP's 14 WWTPs for treatment. When the combined sewer system is overburdened during a storm event, a mix of stormwater and untreated wastewater is discharged directly into surrounding waterbodies at certain outfalls as a "combined sewer overflow," or CSO. CSOs can be problematic because of their negative effect on water quality and can hinder recreational uses in local waterbodies.

Dry Weather Conditions



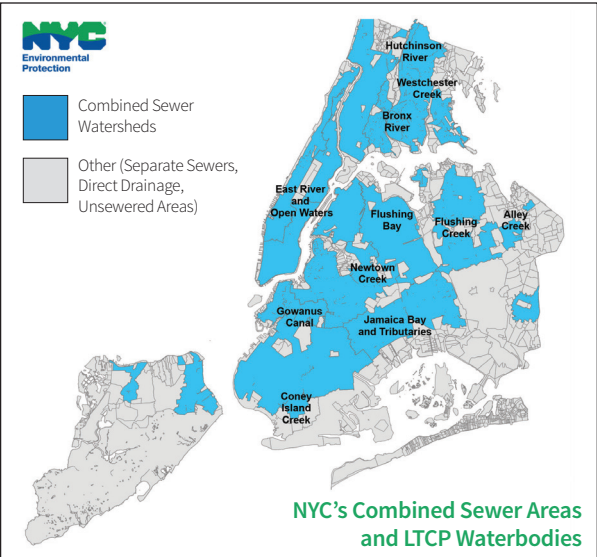
Wet Weather Conditions



New York City invests in grey and green infrastructure practices to improve water quality.

Grey Infrastructure

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 wastewater treatment facilities, storm sewer expansions and the construction of several large CSO retention tanks to further mitigate this chronic source of pollution. One or more of the following project types, described in further detail below, have been or will be implemented for the 11 waterbodies included in this program.



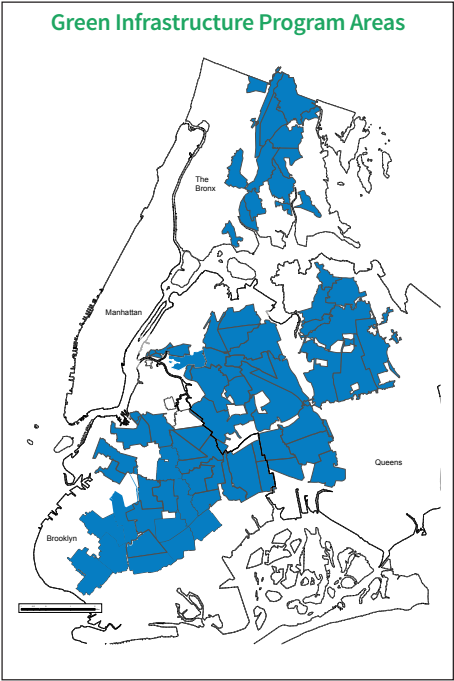
- Tanks** CSO retention tanks are large facilities that capture CSO discharge during a wet weather event and pump it back to a wastewater treatment facility after the storm when there is capacity in the sewer system. NYC has four existing CSO tanks: Alley Creek, Flushing Creek, Jamaica Bay tributaries: Paerdegat Basin, Spring Creek.
- Tunnels** CSO storage tunnels function similarly to CSO retention tanks. The underground large diameter pipe or tunnel has the capacity to hold combined sewage and rain water during most storms, helping to reduce CSO events. After the storm is over, the flow stored in the tunnel is pumped back into the wastewater treatment facility. NYC does not have any existing CSO storage tunnels. The Newtown Creek and Flushing Creek LTCPs propose significant tunnels.
- Disinfection** CSO disinfection is provided by killing bacteria in CSOs. Chlorination of sewage remains the most common and effective wastewater disinfection practice. The Alley Creek and Flushing Creek LTCPs propose disinfection at their existing

- existing CSO retention tanks. In-pipe disinfection is proposed for Hutchinson River and for an additional outfall to Flushing Creek.
- Pipe Capacity** Providing larger combined sewer pipes can provide capacity to convey more flow to the WWTPs, or to relocate CSOs to less sensitive discharge locations. The Bronx River LTCP includes projects to increase pipe capacity.
- Weir Modifications** Bending weirs and weir modifications prevent smaller rainfall events from tipping into the receiving waters. During a large rainfall event, the structure will bend or open, thus allowing a CSO to occur and prevent upstream flooding.
- Floatables Control** Floatables controls could include nets or screens at the end of a pipe, or underflow baffles to keep the materials in the combined sewers, as well as source controls such as catch basins to keep these materials out of the sewer system.
- Sewer Separation** Sewer separation is used to prevent storm flow from getting into the combined sewers, freeing up capacity in the combined sewers and reducing overflows.

Green Infrastructure (GI) is a set of techniques that detain stormwater runoff through capture and controlled release before entering the sewer system. GI may also retain runoff through capture and infiltration into the ground below or vegetative uptake and evapotranspiration. GI also has many co-benefits such as neighborhood beautification, air quality improvements, and cooler temperatures in hot summer months.

Through its GI program, DEP works to saturate priority watersheds with GI based on the specific opportunities each watershed presents. Many projects are Right-of-Way Green Infrastructure (ROW GI), which includes area-wide implementation of rain gardens in streets and sidewalks. As part of the GI program, DEP also maintains constructed GI in the ROW, conducts research and development and tracking on the performance of GI. DEP also retrofits City-owned property such as schools, parks and public housing with green roofs, permeable pavements, synthetic turf fields and other GI techniques. The City offers a grant program that funds the design and construction of GI on private property. The City has committed \$1.5 billion to green infrastructure through 2030.

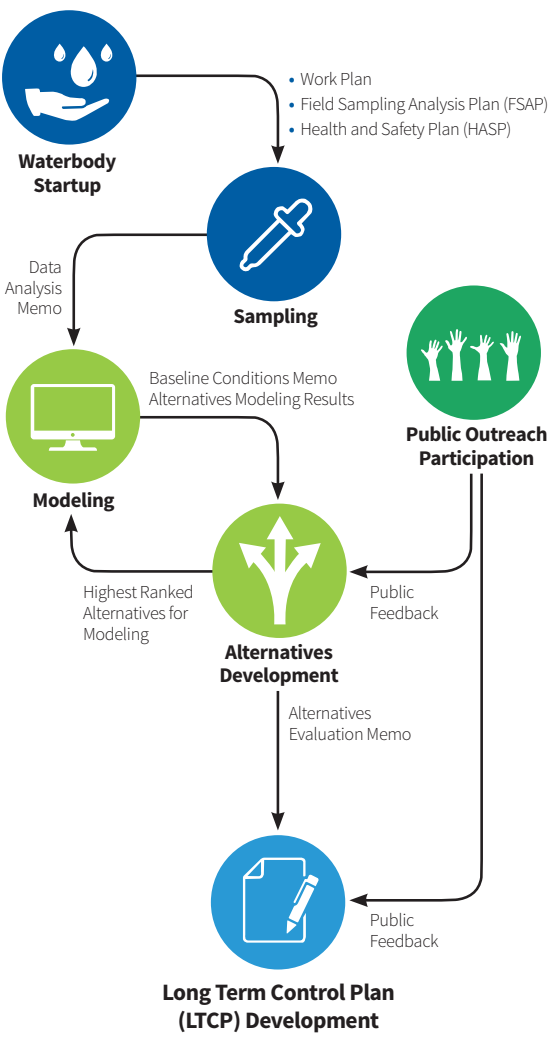
Visit nyc.gov/greeninfrastructure to download the latest GI Annual Report and learn about green infrastructure in each of the LTCP waterbodies.



- Blue/Green Roofs** Green roofs consist of a vegetative layer that grows in an engineered soil, which sits on top of a drainage layer. Green roofs are capable of absorbing large amounts of stormwater and provide other ancillary benefits, such as reduced heat island effect. A blue roof regulates stormwater runoff from the roof to the sewer system and provides temporary storage and detention of stormwater.
- Bioinfiltration** Bioinfiltration systems include rain gardens or constructed wetlands that consist of a vegetated space with specially engineered soils and native plant species that are used to absorb water and filter associated urban runoff pollutants.
- Rain Gardens** Installed in the sidewalk, rain gardens utilize

- engineered soils and native plants to absorb water and filter pollutants flowing along the curb.
- Rain Barrels** Rain barrels capture stormwater from roofs and store it for future non-potable use, such as watering lawns or gardens.
- Porous Pavement** Porous pavement systems allow rainfall to infiltrate through the pavement surface material while providing a subsurface gravel storage zone to encourage infiltration into the subsoil and slow outflow.
- Subsurface Infiltration** A subsurface infiltration practice uses pipes, stone and/or chambers to hold and filter stormwater before it is released into underlying soils. Water is usually carried into the system by inlets and drains.

LTCP Planning Process



Long Term Control Plans (LTCPs) identify and evaluate solutions to reduce the impacts of CSOs and improve water quality in New York City's waterbodies and watersheds. Each LTCP builds on existing or planned projects from previous water quality and restoration efforts.

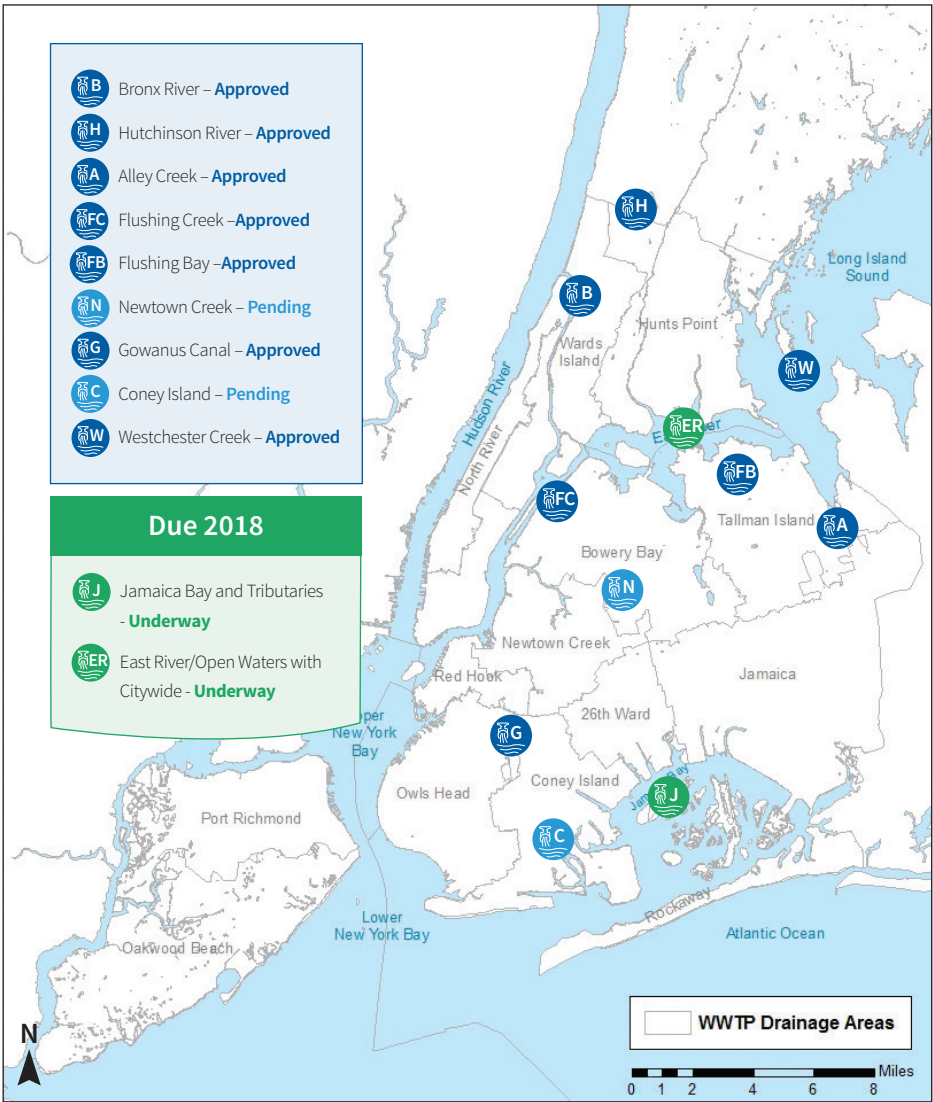
The LTCP process:

- Assesses the attainability of current water quality standards, next highest standards and fishable/swimmable goals of the Clean Water Act;
- Identifies an appropriate balance of grey and green infrastructure for different watersheds; and
- Includes a robust, targeted process to involve residents and interested stakeholders in determining the highest desired use for each waterbody.

LTCP Modeling

Multiple modeling tools provide information about how stormwater runoff and sanitary wastewater flows move and consequently discharge into waterbodies, helping us understand how water quality could be impacted. As each LTCP is initiated for each waterbody, the models are updated to reflect:

- Updated sewer system flow and water quality information, as needed, based on recent field monitoring data;
- Revised sanitary flows based on 2040 population projections and most recent water usage projections; and
- Reevaluated rainfall conditions to incorporate recent wet weather events.



Hydraulic Relief



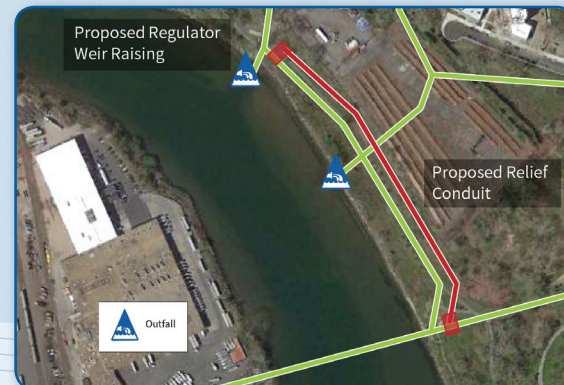
Bronx River Long Term Control Plan

Investments Made Prior to the LTCP Process: Sewer system upgrades to maximize flow to the wastewater treatment plant; outfall netting and screens to control floatable materials; and green infrastructure. The cost of the constructed grey infrastructure projects is \$46 million.

Approved LTCP: \$185 million investments for sewer modifications to provide hydraulic relief and additional floatables control. The approved LTCP Project is predicted to provide an additional 149 MG (33%) reduction in annual CSO volume and bacteria load to the Bronx River. *Expected completion: 2026.*

Future Water Quality Benefit: The overall reduction in CSO volume to the Bronx River from the Pre-Existing Projects condition is predicted to be 194 MG (39% reduction).

Green Infrastructure: Continue to identify GI opportunities.



Disinfection

Hutchinson River Long Term Control Plan

Investments Made Prior to the LTCP Process: Hunts Point WWTP headwork improvements and green infrastructure. The cost of the constructed grey infrastructure project is \$3 million.

Approved LTCP: \$167 million investment for seasonal disinfection with dechlorination, floatables control, and construction of an extension of outfall HP-024 along with continued implementation of green infrastructure. The approved LTCP Project is predicted to provide an additional 14% reduction in the annual bacteria load by treating 65 MGY of CSO volume discharging to the Hutchinson River. *Expected completion: 2030.*

Future Water Quality Benefit: The overall reduction in CSO volume to the Hutchinson River from the Pre-Existing Projects condition is predicted to be 39 MGY (11% reduction).

Green Infrastructure: Continue to identify GI opportunities.



Disinfection

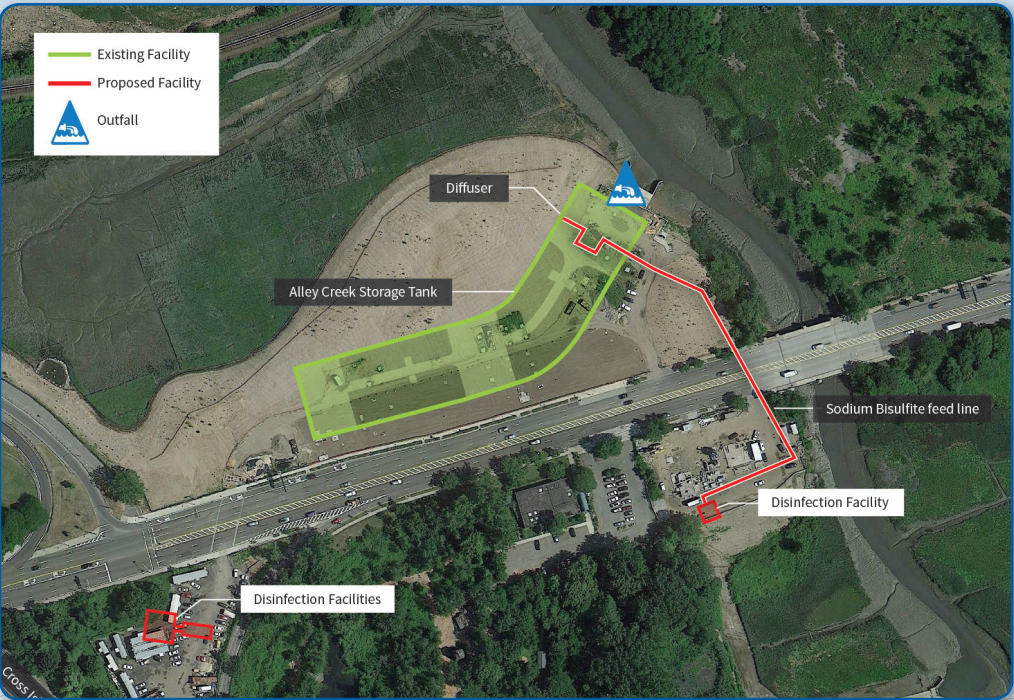
Alley Creek Long Term Control Plan

Investments Made Prior to the LTCP Process: A CSO storage facility and other sewer system improvements. The cost of the constructed grey infrastructure project is \$139 million.

Approved LTCP: \$12 million investment for seasonal disinfection with dechlorination of the discharge from the existing CSO storage facility. The approved LTCP Project is predicted to provide an additional 59% reduction in the annual bacteria load by treating 78 MGY of CSO volume discharging to Alley Creek. *Expected completion: 2024.*

Future Water Quality Benefit: The overall reduction in CSO volume to Alley Creek from the Pre-Existing Projects condition is predicted to be 198 MGY (60% reduction).

Green Infrastructure: Continue to identify GI opportunities.



Disinfection

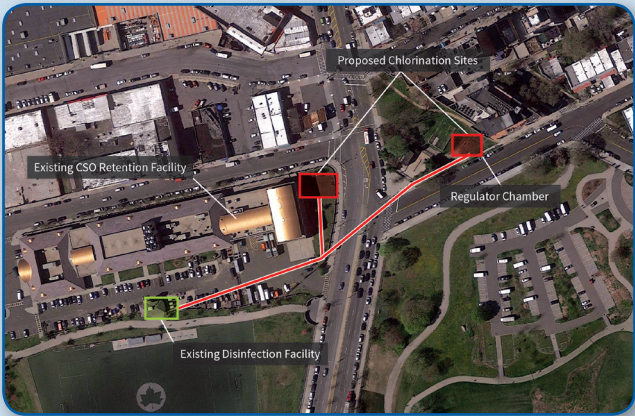
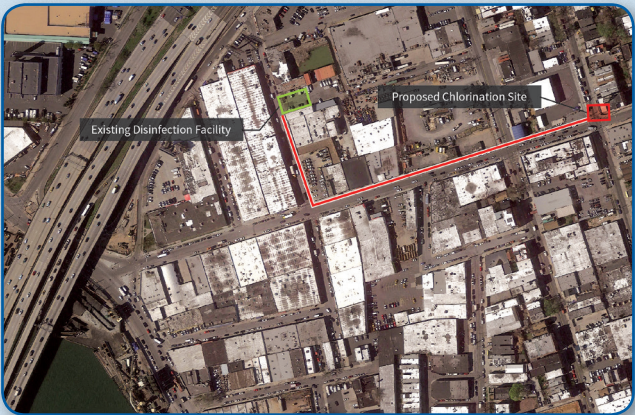
Flushing Creek Long Term Control Plan

Investments Made Prior to the LTCP Process: A CSO storage facility, other sewer system improvements and green infrastructure. The cost of the constructed grey infrastructure project is \$363 million.

Approved LTCP: \$18 million investment for seasonal disinfection with dechlorination of the discharge from the existing CSO storage facility; seasonal disinfection with dechlorination at outfall TI-011; and continued implementation of green infrastructure. The approved LTCP Project is predicted to provide an additional 51% reduction in the annual bacteria load by treating 584 MGY of CSO volume discharging to Flushing Creek. *Expected completion: 2025.*

Future Water Quality Benefit: The overall reduction in CSO volume to Flushing Creek from the Pre-Existing Projects condition is predicted to be 1,212 MGY (50% reduction).

Green Infrastructure: Continue to identify GI opportunities.



Tunnels

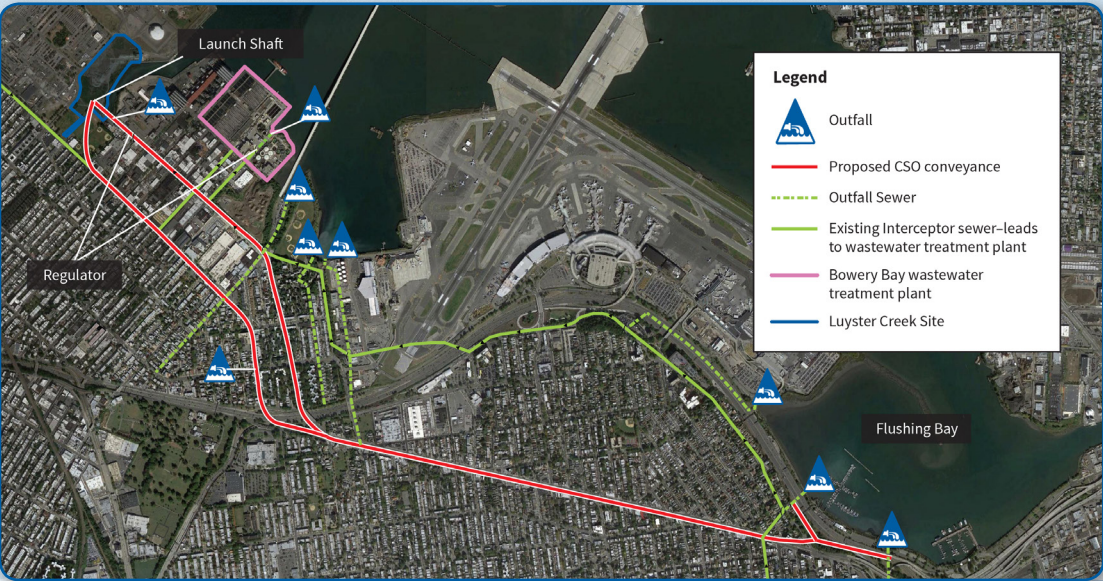
Flushing Bay Long Term Control Plan

Investments Made Prior to the LTCP Process: Sewer improvements including diverting low-lying sewers and regulator modifications; dredging and restoration of Flushing Bay; and green infrastructure. The estimated cost of the ongoing grey infrastructure projects is \$69 million.

Approved LTCP: \$1,616 million investment for a 25 MG CSO storage tunnel along with continued implementation of green infrastructure. The approved LTCP Project is predicted to provide an additional 747 MGY (51%) reduction in annual CSO volume and bacteria load to Flushing Bay. *Expected completion: 2035.*

Future Water Quality Benefit: The overall reduction in CSO volume to Flushing Bay from the Pre-Existing Projects condition is predicted to be 1,094 MGY (61% reduction).

Green Infrastructure: Continue to identify GI opportunities.



Tunnels

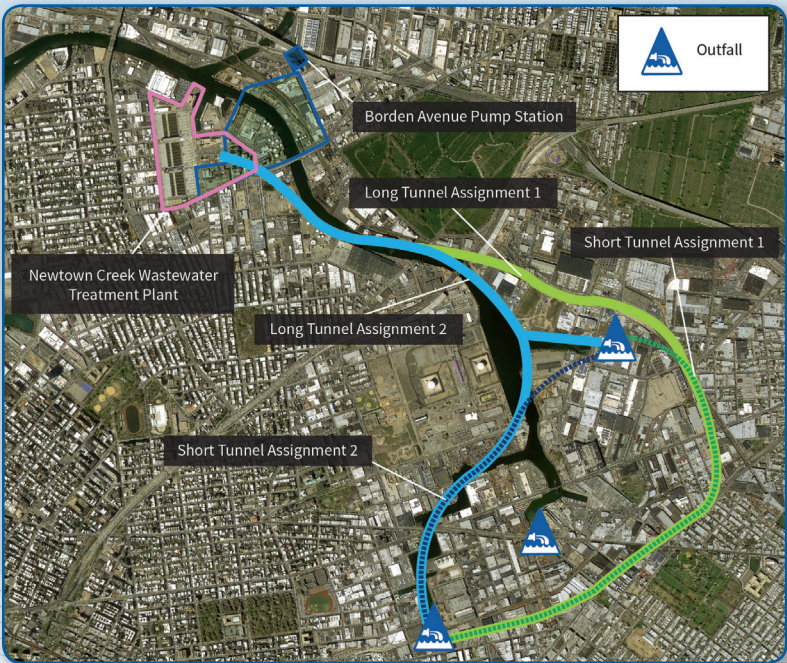
Newtown Creek Long Term Control Plan

Investments Made Prior to the LTCP Process: Sewer system improvements including bending weirs and floatables control; WWTP expansion; in-stream aeration; and green infrastructure. The estimated cost of the ongoing grey infrastructure projects is \$259 million.

Approved LTCP: \$1,422 million investment for a 39 MG CSO storage tunnel and an expansion of the Borden Avenue Pump Station along with continued implementation of green infrastructure. The LTCP recommended plan is predicted to provide an additional 691 MGY (60%) reduction in the annual CSO volume and bacteria load to Newtown Creek. *Expected completion: 2042.*

Future Water Quality Benefit: The overall reduction in CSO volume to Newtown Creek from the Pre-Existing Projects condition is predicted to be 1,001 MGY (69% reduction).

Green Infrastructure: Continue to identify GI opportunities.



Tanks

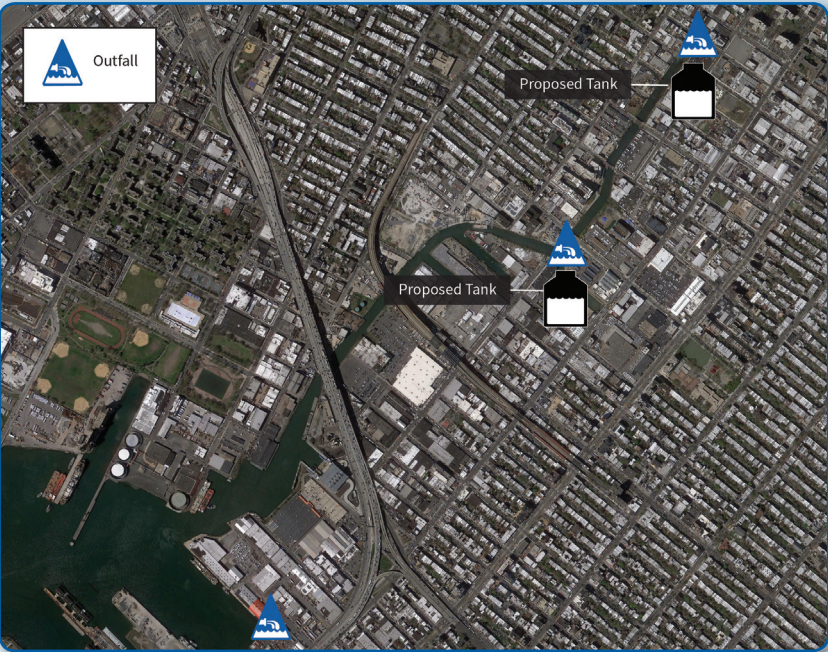
Gowanus Canal Long Term Control Plan

Investments Made Prior to the LTCP Process: Sewer system improvements including the restoration of the flushing tunnel and reconstruction of the Gowanus Pumping Station and green infrastructure. The cost of the completed grey infrastructure projects is \$194 million.

Approved LTCP: 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 will be constructed at an estimated cost of \$932 million. The Superfund plan is predicted to provide an additional 148 MGY (56%) reduction in the annual CSO volume and bacteria load to the Gowanus Canal.

Future Water Quality Benefit: The overall reduction in CSO volume to Gowanus Canal from the Pre-Existing Projects condition is predicted to be 344 MGY (75% reduction).

Green Infrastructure: Continue to identify GI opportunities.



Other Investments to Date

Coney Island Creek Long Term Control Plan

Investments Made Prior to the LTCP Process: Sewer system improvements including the upgrade of the Avenue V Pumping Station and a new wet weather force main. The cost of the completed grey infrastructure projects is \$197 million.

Approved LTCP: The LTCP did not recommend an additional CSO project for Coney Island Creek. DEP will conduct ongoing illicit trackdown, additional flow monitoring and MS4 prioritization.

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

Green Infrastructure: Continue to identify GI opportunities.

Westchester Creek Long Term Control Plan

Investments Made Prior to the LTCP Process: Sewer system improvements including weir modifications; a Pugsley Creek parallel relief sewer; and green infrastructure. The estimated cost of the ongoing grey infrastructure projects is \$124 million.

Approved LTCP: The LTCP did not recommend an additional project for Westchester Creek beyond continued implementation of green infrastructure.

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

Green Infrastructure: Continue to identify GI opportunities.

► 18 PROJECT INFORMATION

Program Commitments and Outflow Reductions

Waterbody	Existing Grey Infrastructure Projects	Actual Incurred Costs (Millions)	CSO Volume Reduction (%)	LTCP Project	Escalated Capital Costs (Millions)	CSO Volume Reduction (%)	CSO Bacteria Reduction (%)	Treated CSO Volume (MGY)
Alley Creek	CSO Storage Facility and Other Sewer Improvements	\$139	60%	Seasonal Disinfection of Existing CSO Storage Tank	\$12	-	59%	78
Westchester Creek	Weir Modifications and Parallel Sewer	\$124	63%	None	\$0	-	-	-
Hutchinson River	Hunts Point WWTP 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	\$18	-	51%	584
Bronx River	Maximize Flow to WWTP and Floatables Control	\$46	39%	Hydraulic Relief and Floatables Control	\$185	33%	33%	-
Gowanus Canal	Flushing Tunnel and Pump Station Reconstruction	\$194	43%	Superfund CSO Storage Tanks	\$932	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	\$69	19%	CSO Storage Tunnel	\$1,616	51%	51%	-
Newtown Creek	Sewer and WWTP Improvements and Aeration	\$259	21%	CSO Storage Tunnel and Upgrade of Borden Ave Pump Station	\$1,422	61%	61%	-
Paerdegat Basin	CSO Storage Facility and Dredging	\$394	56%	TBD	-	TBD	TBD	TBD
Jamaica Bay & Tributaries	Sewer Improvements, CSO Storage Facility and Dredging	\$631	30%	TBD	TBD	TBD	TBD	TBD
East River/ Open Waters	Facility, Conveyance, and Regulator Improvements	\$196	-	TBD	TBD	TBD	TBD	TBD
*Pre-Existing Project CSO volumes reflect conditions without Waterbody Watershed Facility Plan (WWFP) Projects, Green Infrastructure and other sewer improvements.								
Existing Green Infrastructure Program Total \$1.5 billion		+	Existing Grey Infrastructure Projects \$2.6 billion	=	Pre-LTCP CSO Program Total \$4.1 billion	LTCP CSO Program Total \$4.4 billion <small>(as of Fall 2017)</small>		

HOW TO GET INVOLVED

Stakeholder engagement is a central part of LTCP development and DEP’s efforts to protect NYC’s waterbodies and watershed quality. There are plenty of ways to stay involved in the City’s efforts to protect and improve water quality in New York City.

Join the City’s Stormwater Advisory Group. Email LTCP@dep.nyc.gov to join the Group’s listserv. You’ll get invites to upcoming meetings and receive important stormwater related announcements.

Visit the City’s CSO Program Website. You can download presentations and even view some of the LTCP public meetings! Important documents such as the Long Term Control Plans are also available at nyc.gov/dep/ltcp.

Visit a Green Infrastructure Practice. The City has constructed thousands of green infrastructure practices. Visit nyc.gov/greeninfrastructure to view an online map and find a project near you!

Wait... We all need to use water every day. But when there’s a heavy storm and heavy household water usage, our sewers can reach capacity. When this happens, a mix of stormwater and wastewater can end up in our waterways. In 2016 DEP initiated a pilot program in which the City sent registered participants a message when there was a heavy storm so they knew to wait to use water until after the storm ended. Participants pledged to take shorter showers, delay laundry and dishwashing and if they were really brave... waited to flush the toilet. If you want to join a future Wait Pilot email us at wait@dep.nyc.gov.

Don’t Trash Our Waters. Trash in our harbor often begins as litter on our streets and sidewalks. Rain water can carry street litter to nearby storm drains, or catch basins, where it enters the City’s sewer system. This litter can eventually make its way to our waterways, which can hurt local wildlife and put human health at risk. To improve water quality and protect wildlife and local communities that rely on our waterways, DEP implements a variety of programs and works with other agencies to help keep trash and debris out of the sewer system and local waters. Citizens like you can also help to keep our waters trash free.

We encourage New Yorkers to:

- Generate less trash
- Adopt-a-Basket
- Adopt-a-Highway or Greenway
- Keep your street clean
- Adopt-a-Bluebelt

You can also learn more by visiting nyc.gov/trashfreewaters.

