

Cloudburst Management in NYC

for Long-Term Resilience

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Agenda

Part 1: Understanding

- What is Cloudburst Management?
- How the City Manages Stormwater Every Day
- Pilot Projects
- Long Term Planning

Part 2: Process

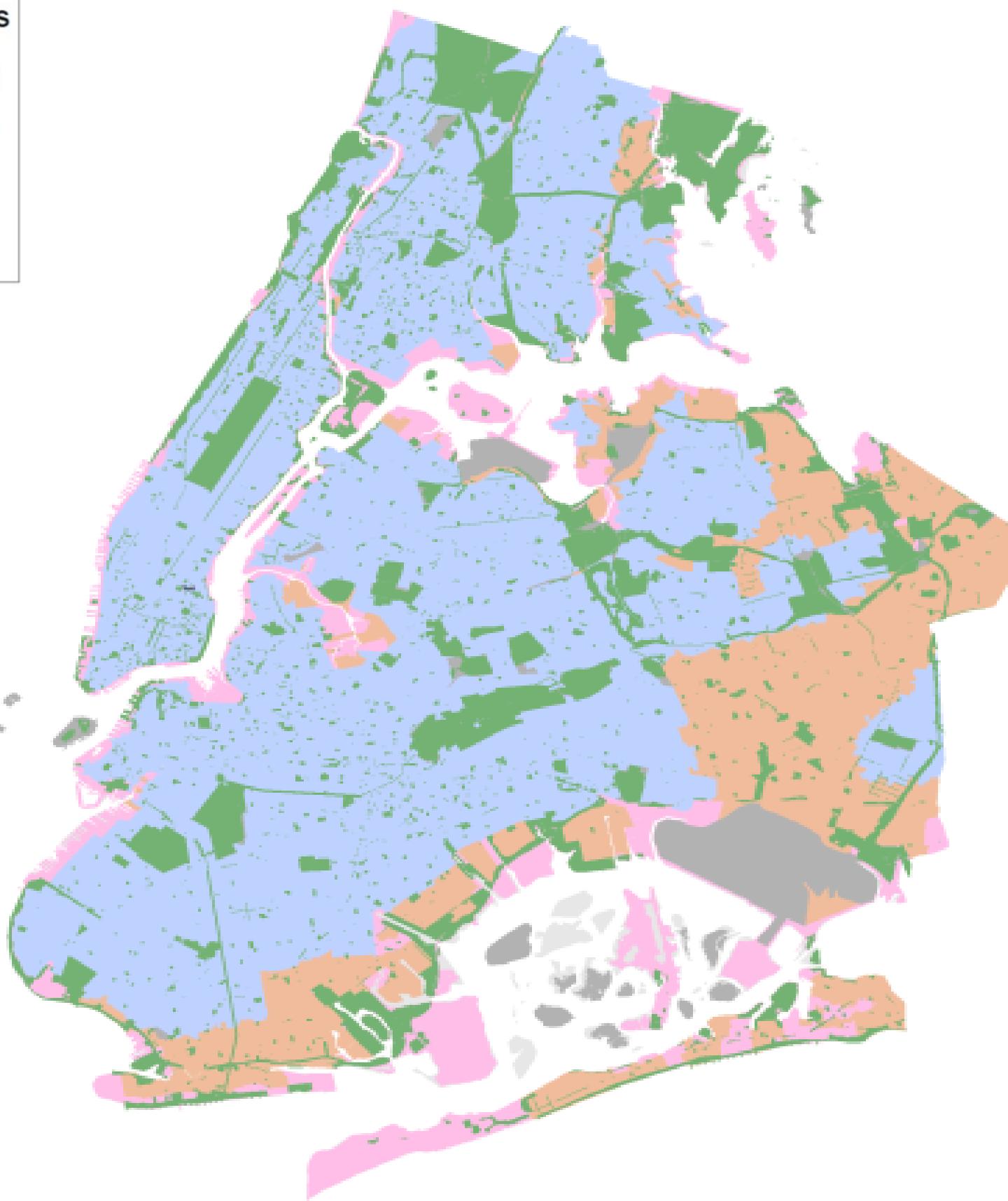
- What is a Cloudburst Hub?
- Factors the City Considers
- Planning Process
- Case Study

Part 3: Next Steps

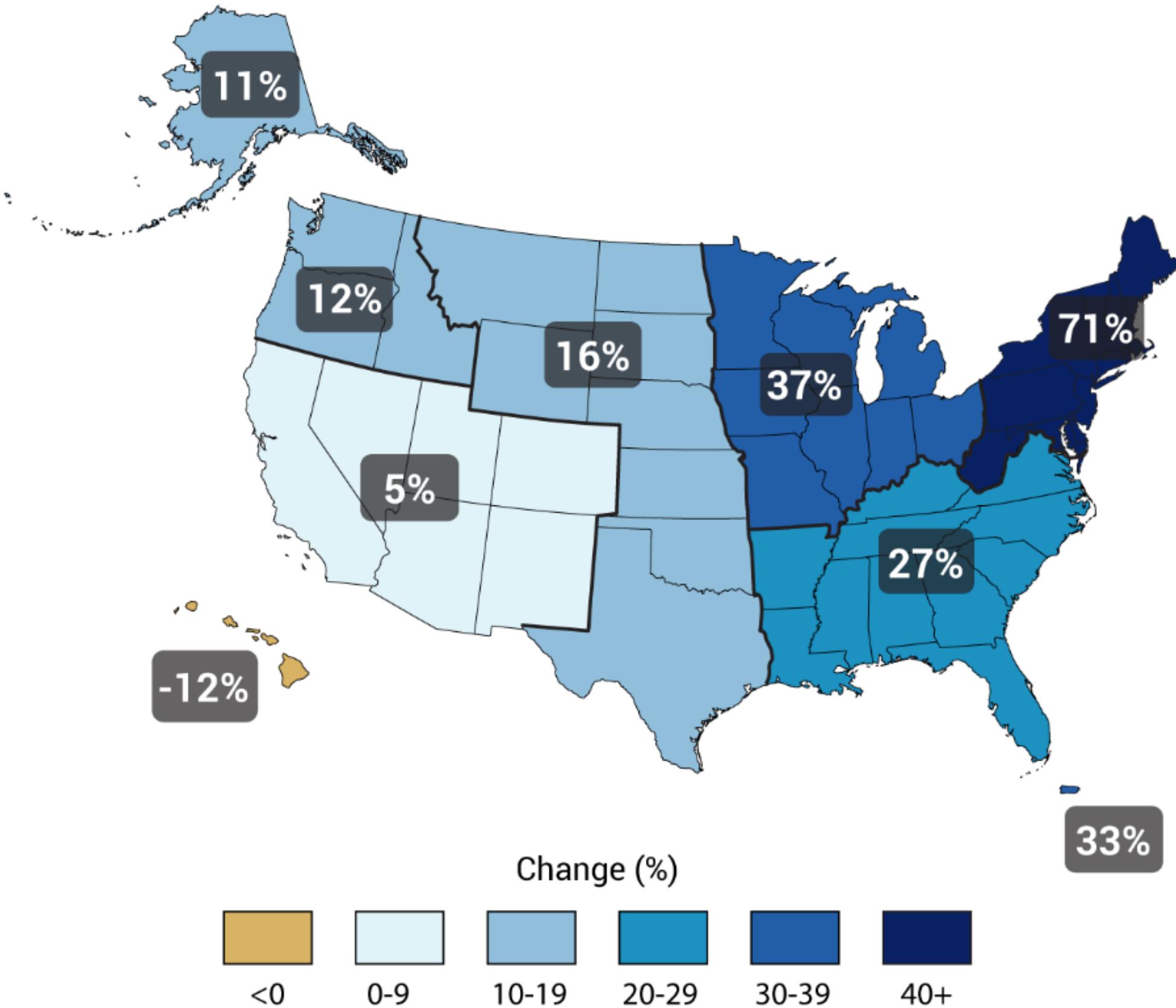
- Progress Update

Sewer System

Much of our city's stormwater eventually flows into storm drains and from there into the sewer system. The City has two sewer systems. The Combined Sewer System has pipes that carry the flow of wastewater and stormwater to a local wastewater treatment plant. The Municipal Separate Storm Sewer System (MS4) has pipes for connecting wastewater directly to the wastewater treatment plant for further processing, and pipes for connecting stormwater directly to local waterways.



Observed Change in Very Heavy Precipitation



Heavy Precipitation Trends (1958-2012)

The National Climate Assessment calculates a 71% increase in the annual amount of precipitation from heavy rain events* from 1958 to 2012 in the Northeast.

*The National Climate Assessment defines “heavy precipitation” as the top 1% of daily precipitation values

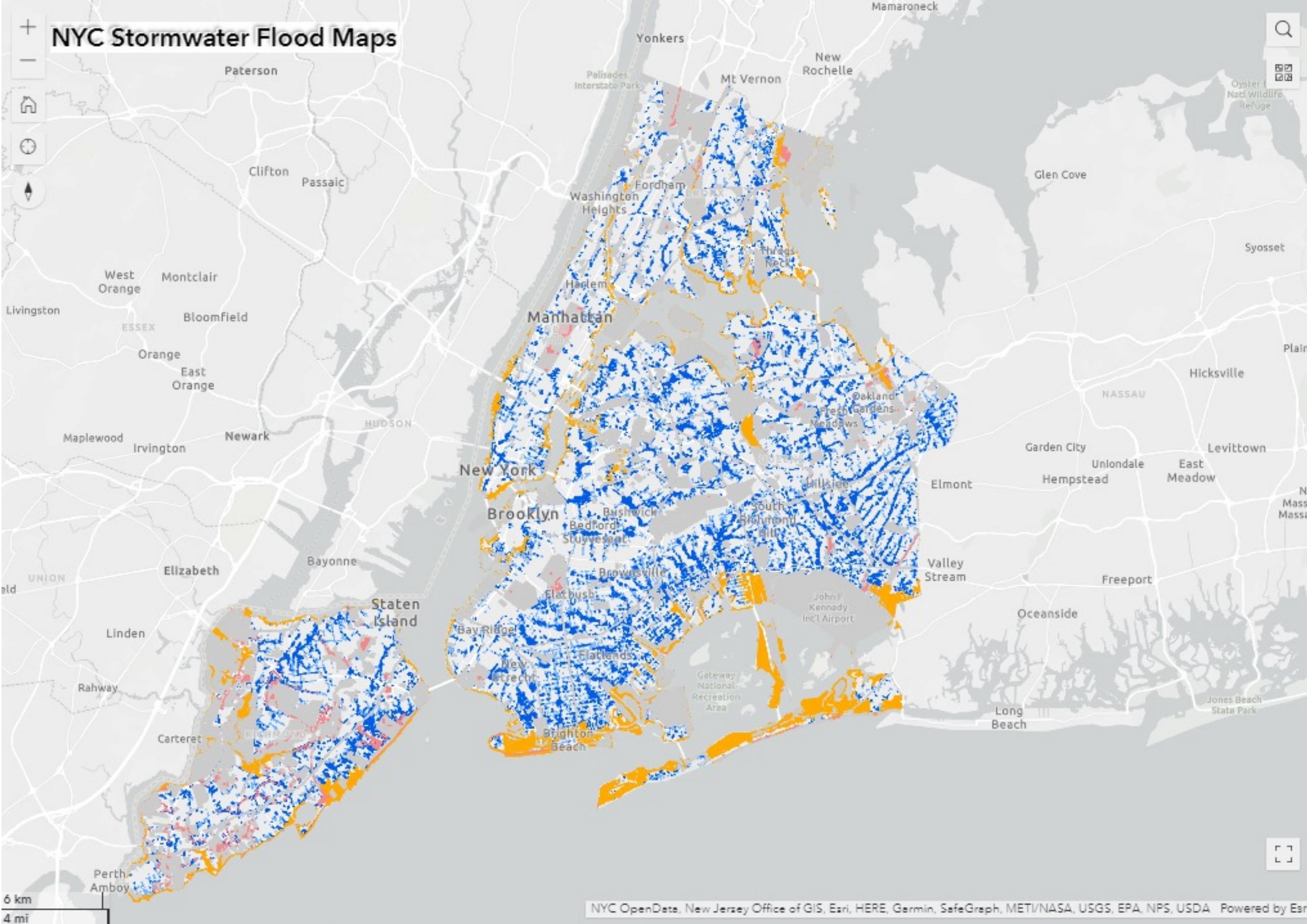
NYC Stormwater Flood Maps

Three scenarios:

Moderate Stormwater Flood with Current Sea Levels

Moderate Stormwater Flood with 2050s Sea Levels

Extreme Stormwater Flood with 2080s Sea Levels



Moderate Stormwater Flood with Current Sea Levels

Moderate Stormwater Flood with 2050 Sea Level Rise

Extreme Stormwater Flood with 2080 Sea Level Rise

Area not included in analysis
Future High Tides 2080
National Wetlands Inventory
Deep and Contiguous Flooding (1ft and greater)
Nuisance Flooding (greater or equal to 4 in and less than 1ft)



How the City Manages Stormwater Every Day

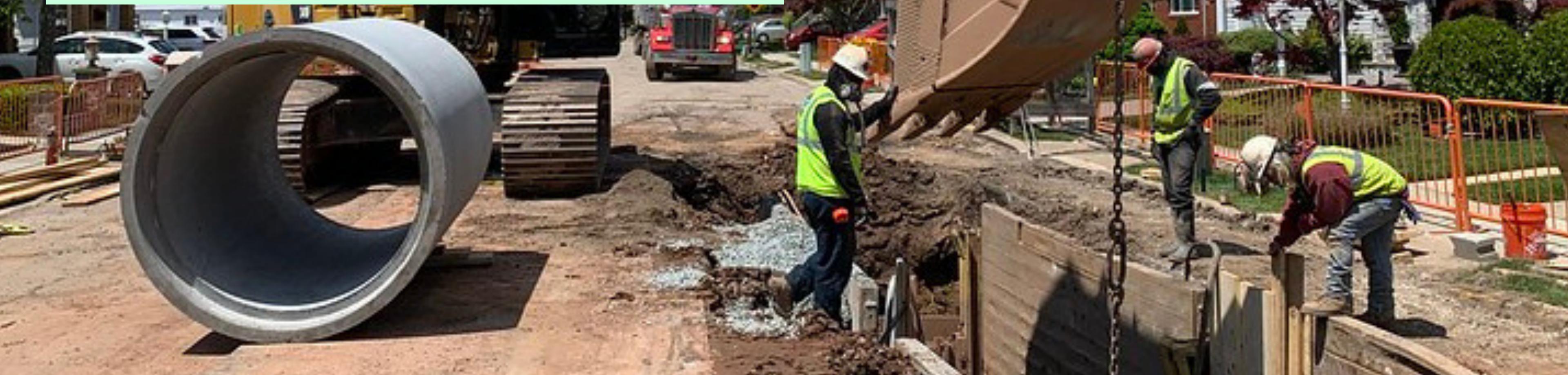
Cloudburst Management is one of many ways the City is working to make neighborhoods more resilient to stormwater flooding and improve water quality. There is a broad citywide effort to better manage stormwater to improve the health of our local waterways and prevent flooding.

The City manages stormwater on public land, like parks and roads, through the sewer system, green infrastructure, and Bluebelts. The City also develops stormwater management requirements for private property owners throughout the city.

Sewer Upgrades

The City is building out sewers in underserved areas, accelerating catch basin cleanings to improve functionality, and will upgrade 70 miles of sewers per year (1% of the system).

When planning for future drainage infrastructure, DEP will consider projected sea level rise and rainfall intensity as well as environmental justice.



Sewer Maintenance

Our crews are enhancing catch basin inspections to make sure they are working properly. Our vacuum trucks remove garbage, debris, and grease build-ups.

DEP will continue data driven approaches to system maintenance and monitoring to optimize current performance.



Green Infrastructure Program

Green infrastructure collects stormwater from streets, sidewalks, and other hard surfaces before it can enter the sewer system or cause local flooding. By reducing the amount of stormwater that flows into the Sewer System, green infrastructure helps prevent Sewer Overflows and improves the health of local waterways.

2030 Goal: 1.67 BGY CSO Reduction

2021 Accomplishments:

- 507 MGY CSO reduction
- 11,050 Assets
- 1,504 Greened Acres

Resilient NYC Partners



Environmental

- Demonstrate commitment to sustainability and community
- Improve water quality and health of local waterways
- Enhance stormwater management on site
- Increase biodiversity with green projects



Social

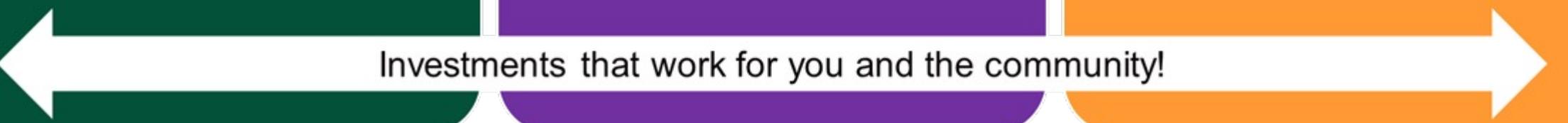
- Create customer interest and increase public safety
- Partner with the City in stormwater and resiliency initiatives
- Reduce ponding on paved surfaces used by customers and staff



Economic

- Lower flood risk and liability
- Receive funding for parking lot resurfacing, tree plantings, or other site improvements
- Guard against future costs such as more restrictive stormwater regulations

Investments that work for you and the community!



- \$53M contract to target highly impervious lots >50,000 SF
- Awarded to 3rd party administrator to incentivize cost-effective aggregation of projects
- Pay-for-performance framework
 - \$250,000 per greened acre + bonus payments

Goal: 200 Greened Acres in 5 years.



RESILIENT NYC PARTNERS

NYC provides the funding and the expertise, you provide the property.

Resilient NYC Partners is an NYC-funded program that helps you improve your property and NYC meet its resiliency goals. Property owners can use these funds for projects like:

- Building green roofs and rain gardens
- Fixing drainage issues and reducing ponding
- Resurfacing or replacing pavement
- Building subsurface stormwater storage

These projects can help to improve your community and promote your commitment to a resilient and sustainable NYC.

Partnering with us is easy!

We know construction can be a big undertaking. Our expert team has worked with property owners on similar projects. We know how to streamline the process and make it work for you, your residents, tenants, employees, and other property users.

Assessment

1 We will schedule a site visit with you to better understand your property to tailor a project that fits your needs.

Planning & Review

2 We will develop detailed plans for your review. Together, we will refine and finalize your project.

Scheduling & Approvals

3 Once a project is agreed upon, we will work with you to make a construction plan and obtain permits.

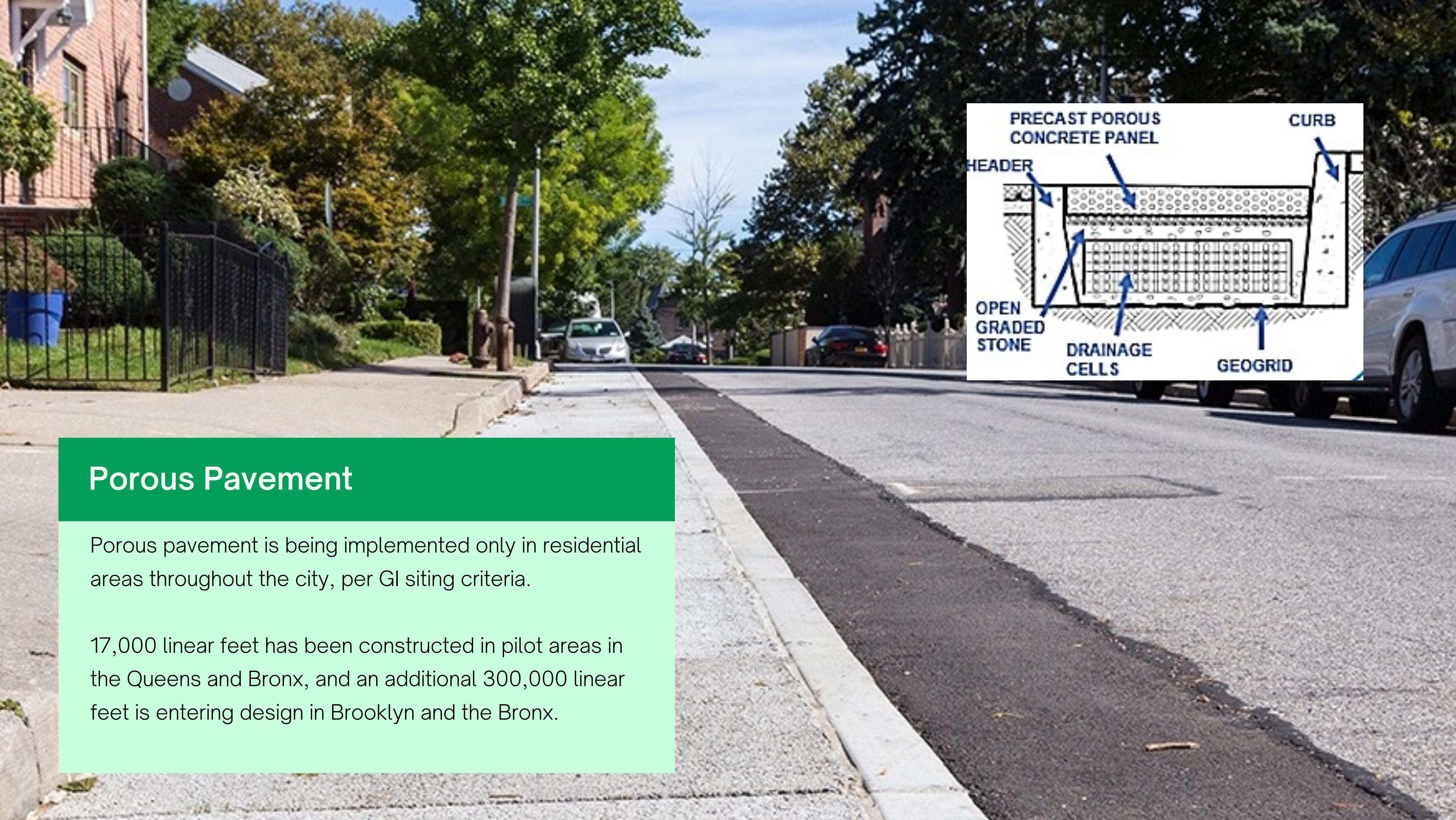
Construction

4 Build it! Construction typically lasts 4-6 weeks. We will work with you to make sure everyone is safe and minimally disrupted.

Don't miss out on this opportunity—funds are limited!

Contact our team at info@resilientpartners.nyc to schedule a meeting or visit resilientpartners.nyc for more information.





Porous Pavement

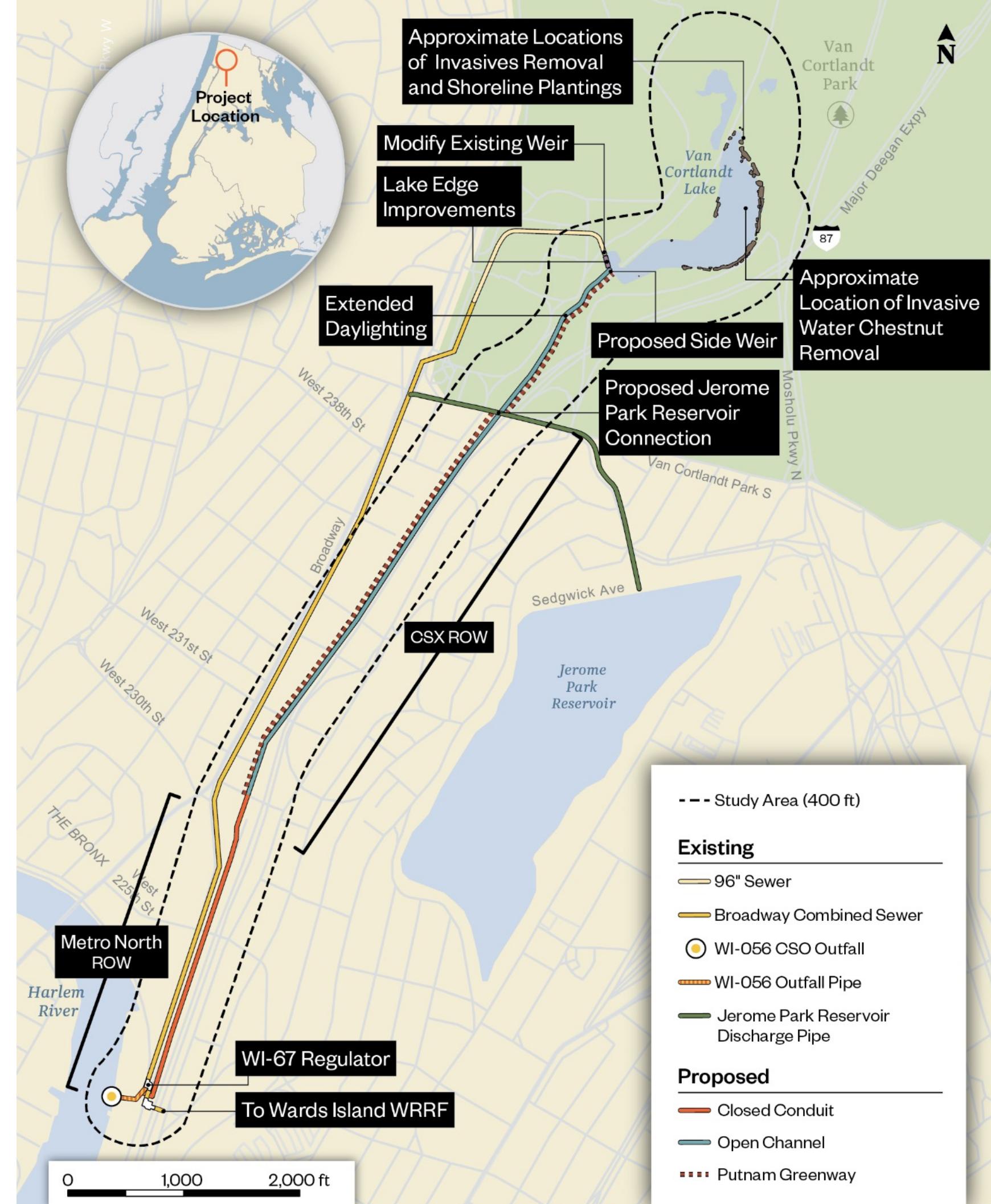
Porous pavement is being implemented only in residential areas throughout the city, per GI siting criteria.

17,000 linear feet has been constructed in pilot areas in the Queens and Bronx, and an additional 300,000 linear feet is entering design in Brooklyn and the Bronx.

Daylighting

Stream daylighting is the process of restoring a stream to a more natural state by removing any obstructions covering it, such as concrete or pavement.

Design is underway for Tibbets Brook in the Bronx that will have an anticipated 214-220 MGY reduction of CSO to the Harlem River.



Bluebelt Program

Bluebelts are ecologically rich and cost-effective drainage systems that naturally handle stormwater on our streets and sidewalks. As New York City prepares for rising sea levels and heavier rains due to climate change, Bluebelts offer a natural and effective solution for stormwater management. 84 Bluebelts have been constructed, and a new city-wide plan is underway.



Part 1

Understanding Cloudburst Management

NYC Cloudburst Management | 9/20/2022





What is a cloudburst?

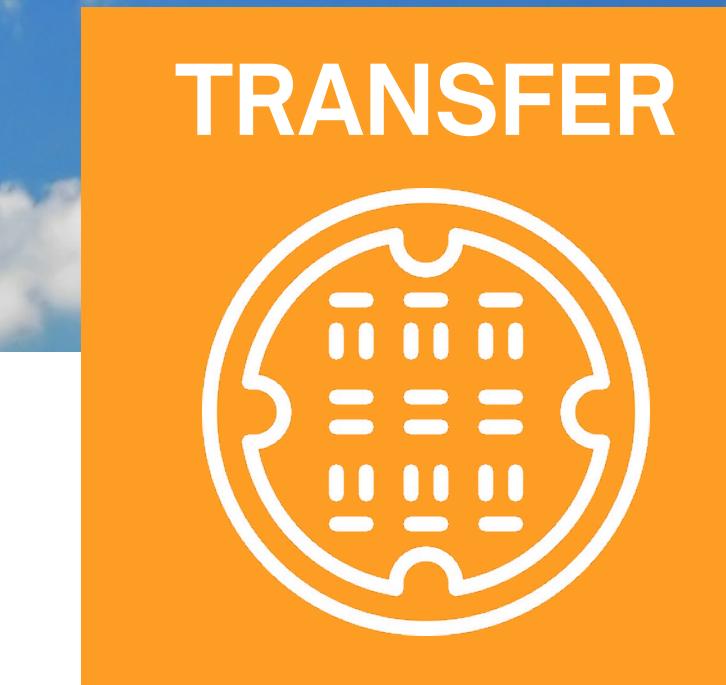
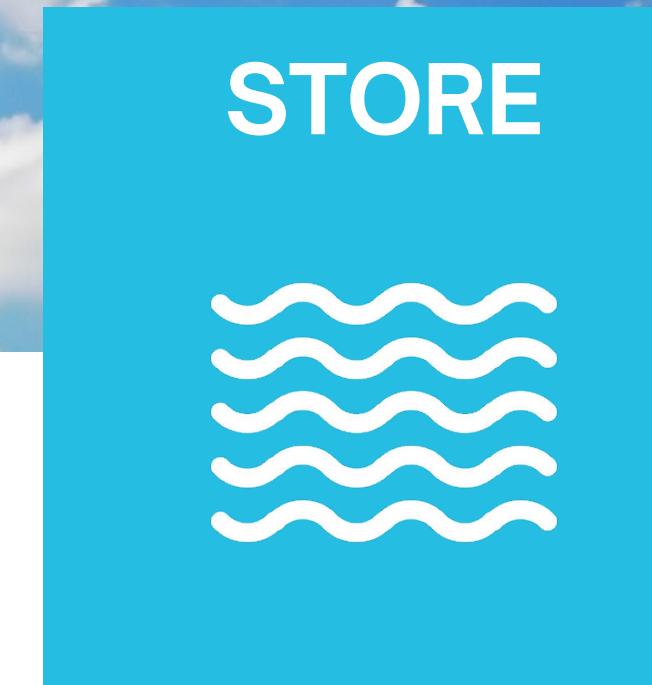
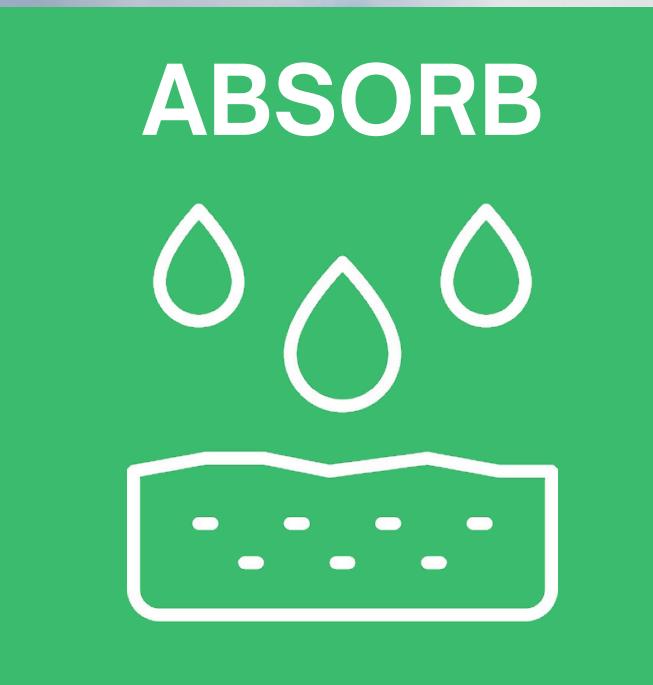
A cloudburst is a sudden, heavy downpour where a lot of rain falls in a short amount of time. Cloudbursts can cause flooding, damage property, disrupt critical infrastructure, and pollute New York's rivers and Harbor.



What is Cloudburst Management?

Cloudburst Management is a way of absorbing, storing, and transferring stormwater to minimize flooding from heavy rain events. Cloudburst Management uses a combination of grey infrastructure, like drainage pipes and underground tanks, and green infrastructure, like trees and rain gardens. These projects consider larger volume storage, typically building for up to the future 10-yr (2.3 inches/hour) and provide CSO reduction benefits as well as stormwater resilience.

During heavy rain events, Cloudburst Management can minimize damage to property and infrastructure by reducing pressure on the sewer system.

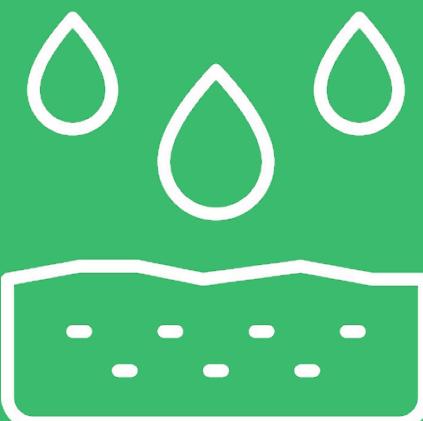


What are examples of Cloudburst Management projects?

The City considers different Cloudburst Management projects to absorb, store, and transfer stormwater.

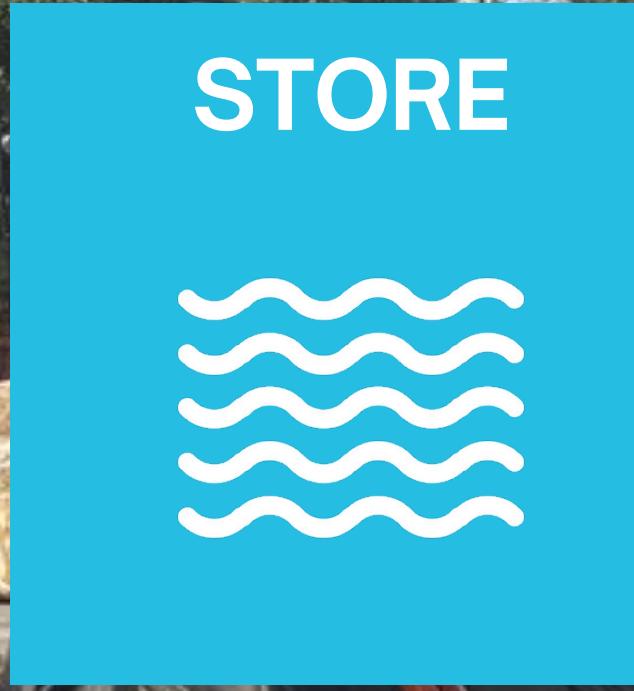


ABSORB

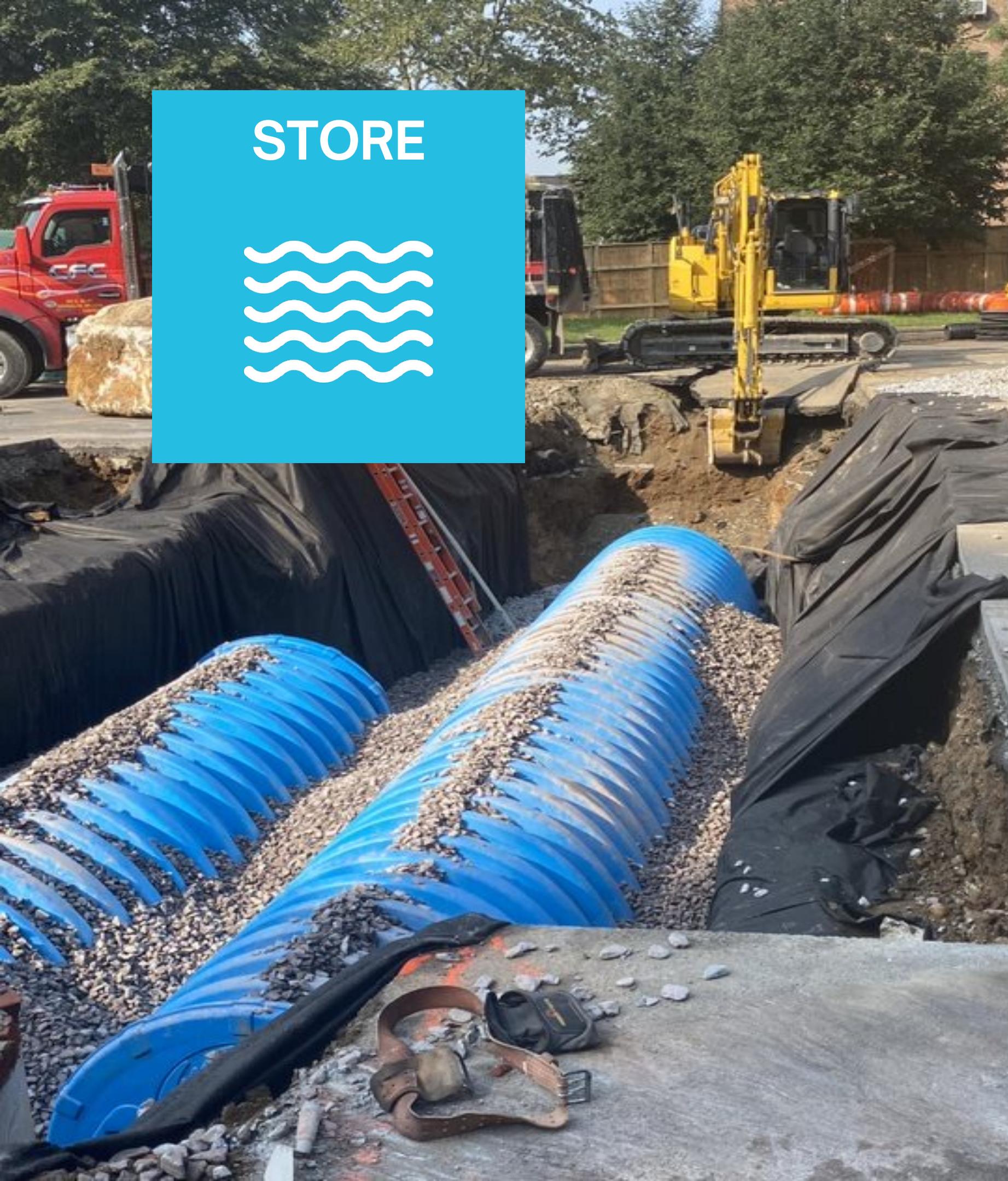
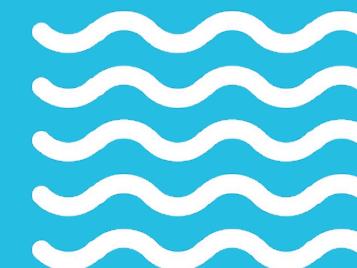


Projects that allow for surface water to enter the soil or ground

These include green infrastructure like, porous pavement and rain gardens. Pictured here is an example of a rain garden project in Brooklyn.



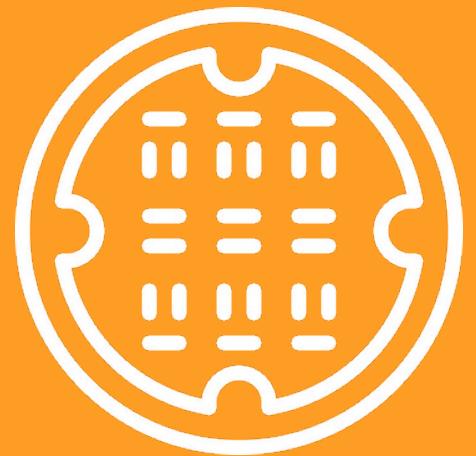
STORE



Projects that hold rainwater

These include water squares, tanks, and dry ponds. Pictured here is an example of an underground storage system in Jamaica, Queens.

TRANSFER



Projects that move water from one place to another

These include on-site drainage and regrading streets. Pictured here are catch basins used to convey runoff from the street in Gowanus, Brooklyn.

Benefits of Cloudburst Management

Cloudburst Management benefits local communities economically, socially, and environmentally.



ECONOMIC

Reduces costly negative impacts of extreme stormwater events, such as physical damages to infrastructure.



SOCIAL

May provide public amenities and open space that can be used when it's not raining. They can also minimize flooding from heavy rain events



ENVIRONMENTAL

Improves water quality and vegetated elements reduce the amount of carbon dioxide in the atmosphere.

Cloudburst Management Pilot Projects

To complement storm sewer and green infrastructure work, DEP initiated a cloudburst study to assess risks, prioritize response, develop location-specific solutions, and assign costs and benefits for managing cloudbursts.

As a result of the study, DEP is testing the implementation of Cloudburst Management at the NYC Housing Authority's (NYCHA) South Jamaica Houses, and has also begun to implement several other cloudburst pilot projects throughout the city.

South Jamaica Houses

South Jamaica Houses includes 8 city blocks in South Jamaica, Queens and is home to around 2,600 residents. South Jamaica Houses were chosen to provide relief upstream to allow for more flow to enter the sewer system downstream and reduce flooding.

This project will maximize storm water capture for up to 2.3 inches of rainfall per hour. Aside from flood mitigation, this pilot shows how cloudburst infrastructure can offer many co-benefits to communities.

As of September 2022, this project has reached 100% design and is proceeding to construction.



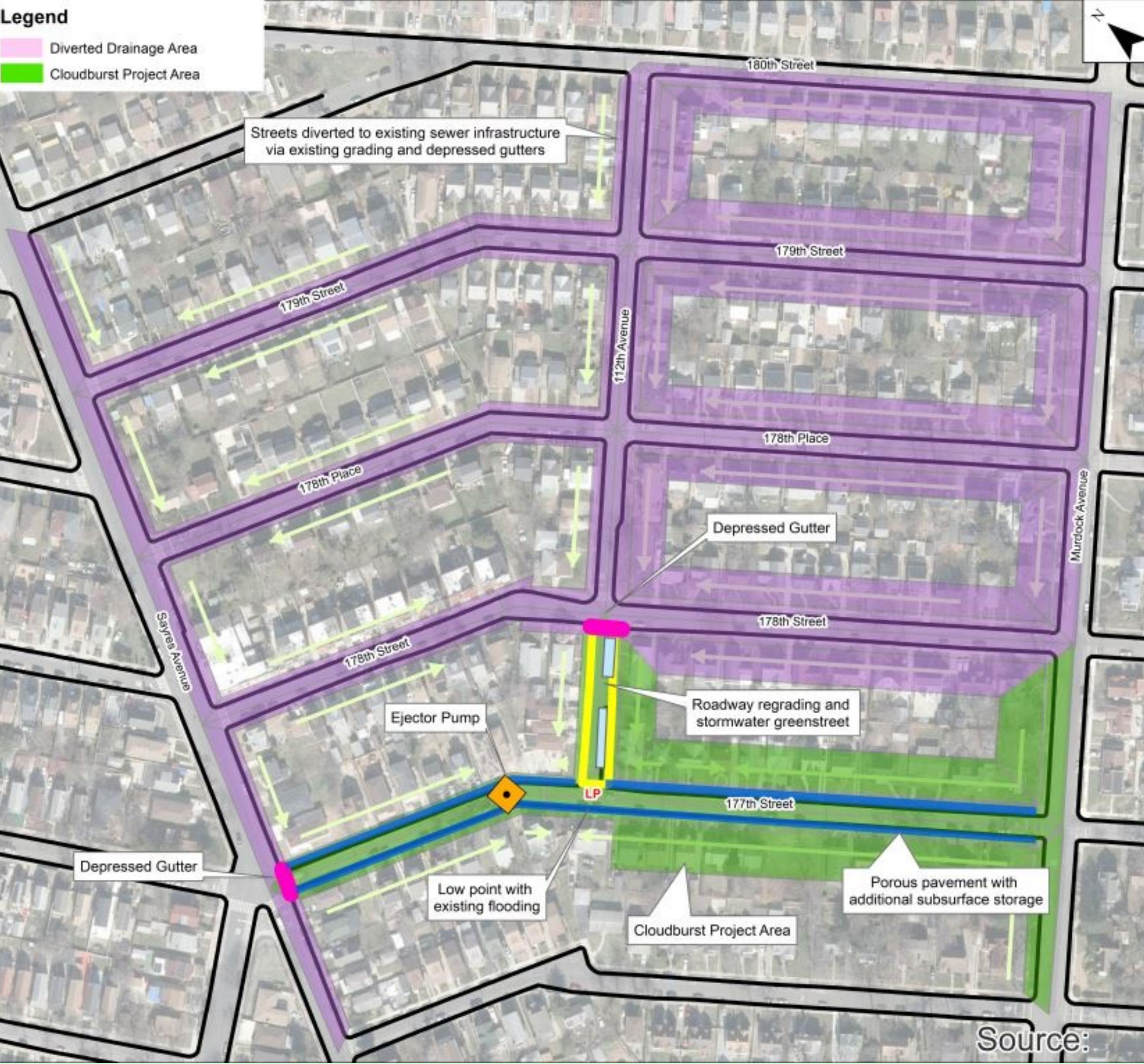
St. Albans, Queens

The neighborhood of St. Albans, Queens is prone to frequent flooding, particularly at the low-point near the intersection of 177th Street and 112th Avenue. During heavy rain events, the pumping station cannot manage street runoff outside of the Direct Tributary Drainage Area, so runoff would bypass existing catch basins (street drains), leading to additional runoff at the intersection.

The cloudburst demonstration project proposed involved a combination of green infrastructure and roadway changes, including depressed gutters.

In addition to helping prevent flooding, this project would also help roadway safety, making conditions safer for pedestrians and vehicles.

As of September 2022, design is underway with construction anticipated to start in 2024.



Clinton Houses

The NYCHA Clinton Houses in East Harlem was built on fill and at low elevations, putting it and nearby streets at high flood risk during heavy rain events. DEP collaborated with NYCHA on a project to reduce damages from flooding. The goal of the project was to move excess rainfall into a series of underground storm water storage systems located in existing spaces, such as basketball courts, parking lots and others, while improving these spaces with nature-based planting and amenities, such as depressed enclosed seating that can store water during extreme rainfall events.

As of September 2022, the city was awarded \$8.3M from FEMA to construct this Cloudburst project.



Part 2

Cloudburst Planning Process

NYC Cloudburst Management |
9/20/2022



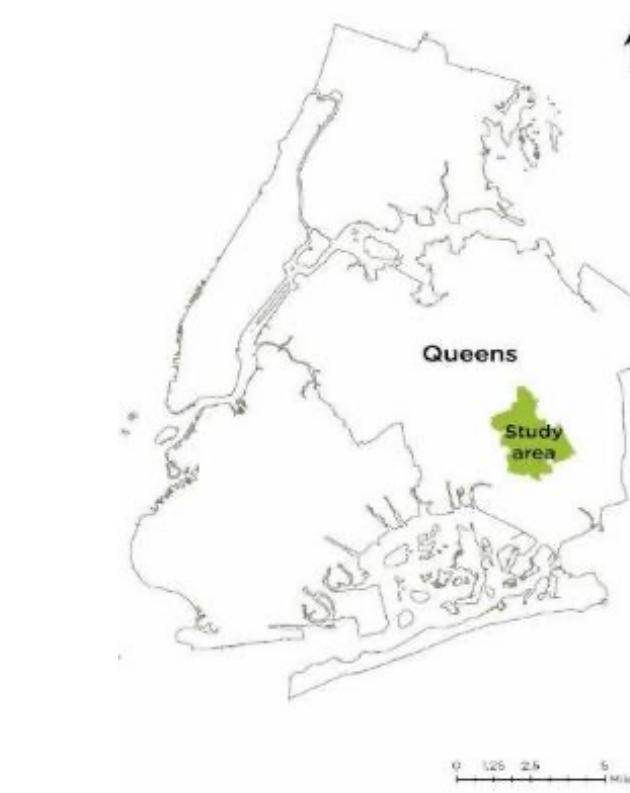
CLOUDBURST RESILIENCY PLANNING STUDY

EXECUTIVE SUMMARY



Cloudburst Study

In 2017 DEP published the Cloudburst Resiliency Planning Study based on Copenhagen's Cloudburst Management. The conceptual plan focused on Southeast Queens and featured potential solutions to manage stormwater for both everyday and extreme rain events, leveraging stormwater features to enhance outdoor spaces and neighborhood connectivity .



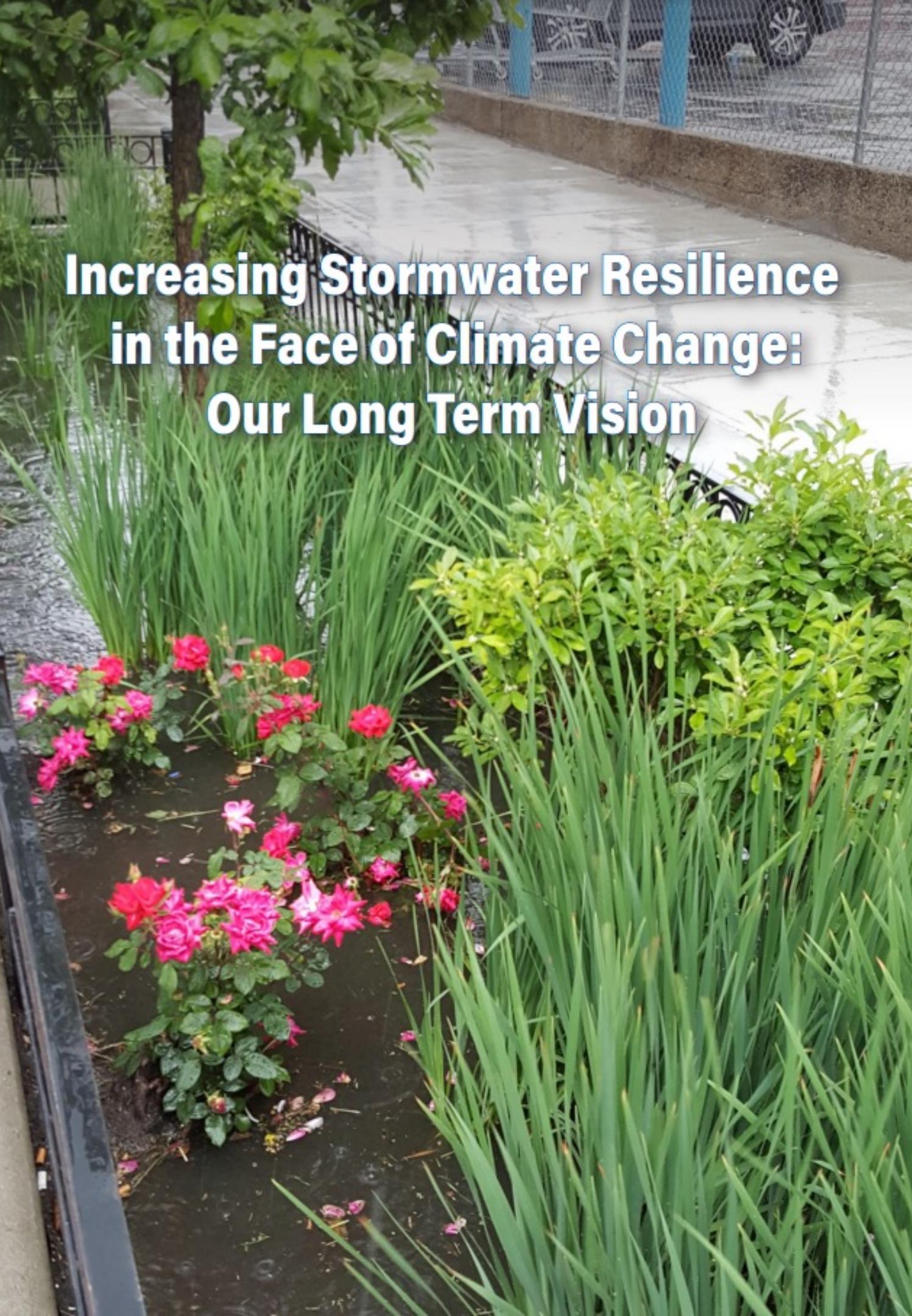
An aerial photograph showing a street completely submerged in floodwater. A yellow double line on the asphalt is visible, and a small portion of a car is seen at the bottom right. The surrounding area is lush green trees.

THE NEW NORMAL: COMBATING STORM-RELATED EXTREME WEATHER IN NEW YORK CITY

Ida's Impact

After the devastation caused by Hurricane Ida, the City issued a report called, [The New Normal Report: Combating Storm-Related Extreme Weather In New York City.](#)

The report prioritized stormwater resilience initiatives, including bringing Cloudburst Management projects into areas vulnerable to flooding from heavy rain.



Increasing Stormwater Resilience in the Face of Climate Change: Our Long Term Vision

Long Term Vision

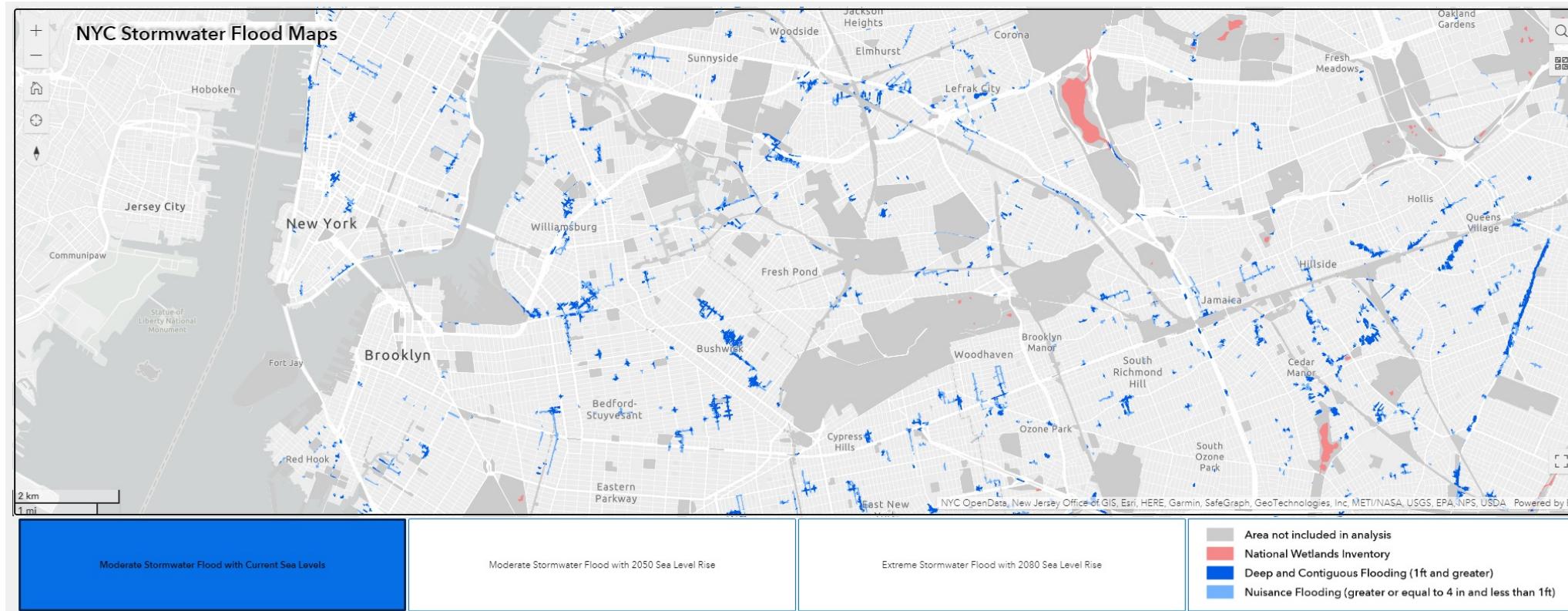
On September 1, 2022, one year after Ida, DEP released a long term stormwater vision for NYC.

The report includes a vision for expanding cloudburst design principles wherever feasible and introduces the concept of Cloudburst Hubs.



What is a cloudburst hub?

Individual or clustered cloudburst management projects that are concentrated around a local flooding hotspot



Cloudburst Considerations

The City looks at many factors when investing in Cloudburst infrastructure, such as:

Physical Features Including the mix of both natural and constructed physical features	Storm Drains and Sewer Pipes Including the number and size of storm drains and sewer pipes	Available Space The City will assess the space available for new projects within the area
Below Ground Conditions Including soil quality and existing utility infrastructure	Green-Grey Infrastructure The City will assess the possibility of connecting green and grey infrastructure	Social and Economic Factors The City will consider the local conditions of people and businesses

Planning Process

Desktop Analysis

Complete desktop review to assess physical and socioeconomic vulnerability and identify planning areas.

Feasibility Studies

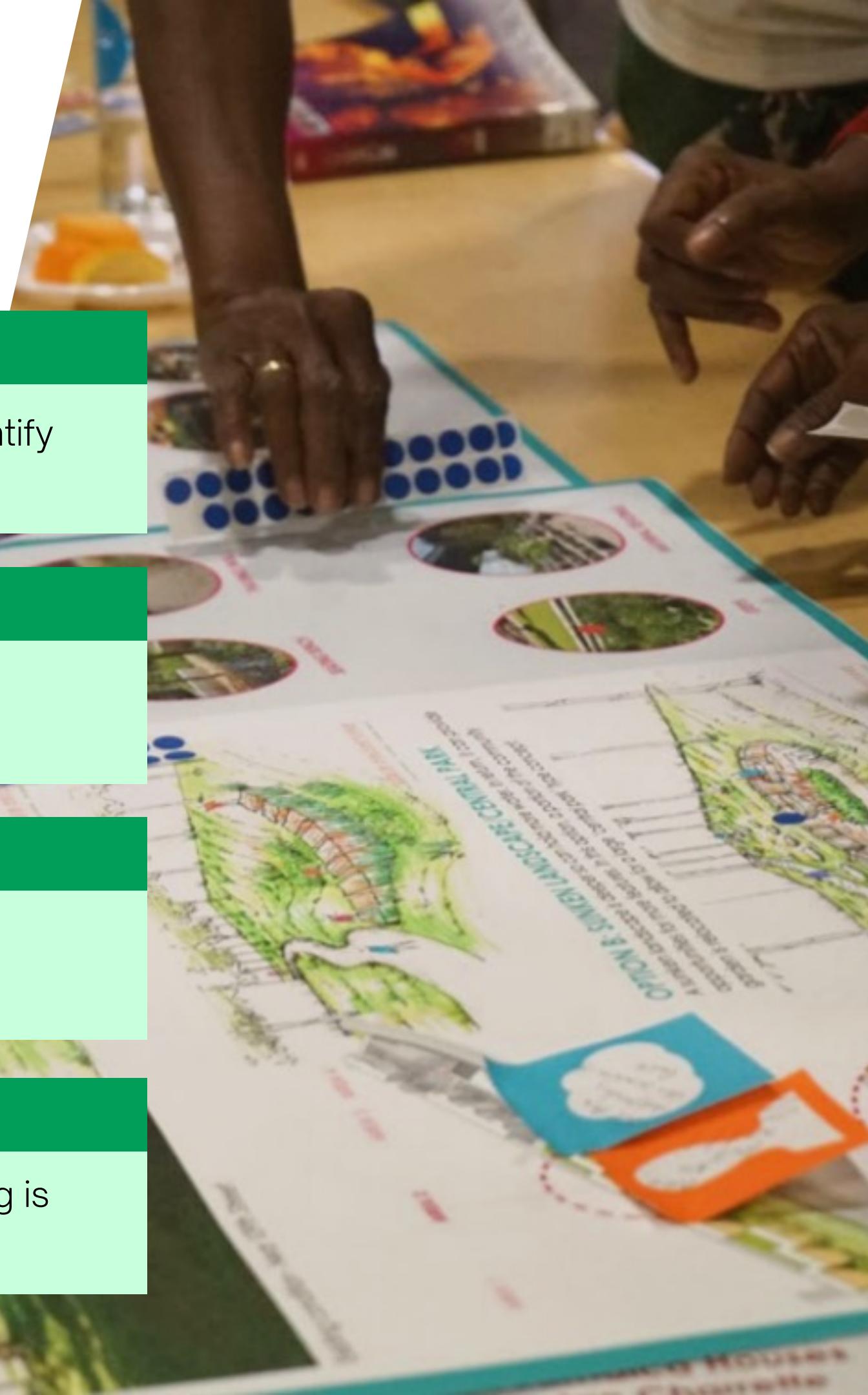
Quantify opportunities to reduce and transfer stormwater from flooded areas, conduct field assessments, and analyze below ground conditions.

Conceptual Designs for 10 Cloudburst Hubs

Initiate site-specific analysis and conceptual designs in 10 initial Cloudburst Hubs, identifying costs and benefits of potential solutions. Federal funding support needed

Design and Construction of 4 Cloudburst Hubs

Begin implementation of 4 initial Cloudburst Hubs, with potential to add more as funding is secured.





Desktop Analysis Review

The Desktop Analysis involved assessing the physical, social, and operational factors that contribute to planning areas being vulnerable to flooding from heavy rain. The assessment included local conditions and opportunities, as well as current and planned City projects.

This analysis helped identify priority planning areas to be considered for Cloudburst Hubs.

Cloudburst Framework

1. Physical Vulnerability

- Flooding hotspots, historically and in recent rainfall events
- Predicted modeled conditions using stormwater flood maps

2. Operational Feasibility

- Understanding local conditions and opportunities by including locations prone to flooding, major investments in priority areas, current or planned projects in priority areas, existing partnerships, or other areas of interest

3. Social Vulnerability

- Considering social factors that may increase vulnerability to stormwater flooding

Physical Vulnerabilities

Objective

Identify flooding hot spots, balancing historic complaint data, modeled current and future precipitation scenarios and complaint/impact data from 2021 events.

Results

The majority of flooding hotspots are in Queens, Staten Island, and Brooklyn, but impacts are seen across all 5 boroughs.

Identification of physically vulnerable areas across the five boroughs.

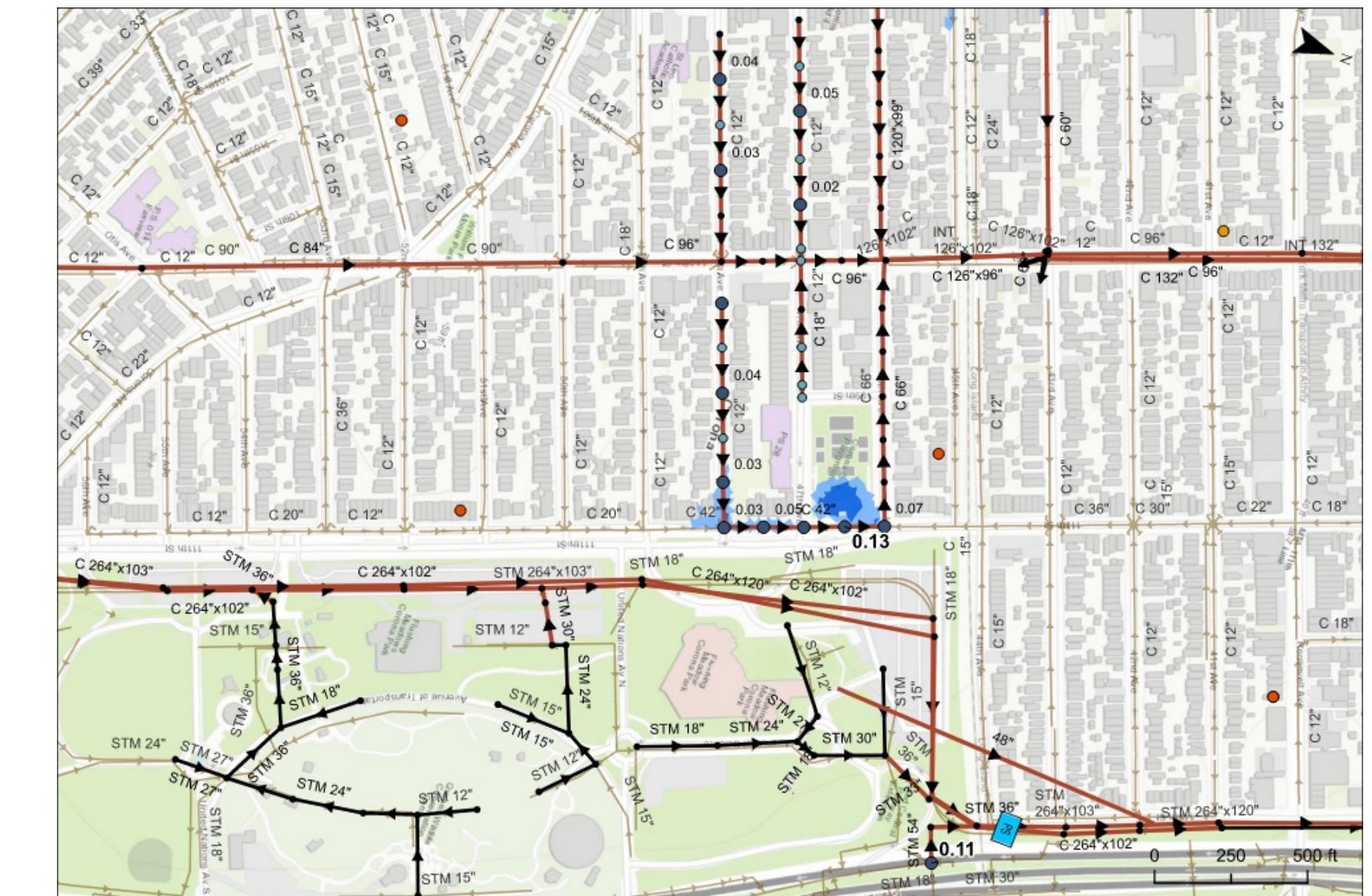
Operational Feasibility

Objective

Understanding immediate opportunities and agency feasibility for implementation

Results

Submissions for agency synergistic opportunities across the 5 boroughs, particularly from NYCHA, Parks, and DOT



Social Vulnerabilities

Objective

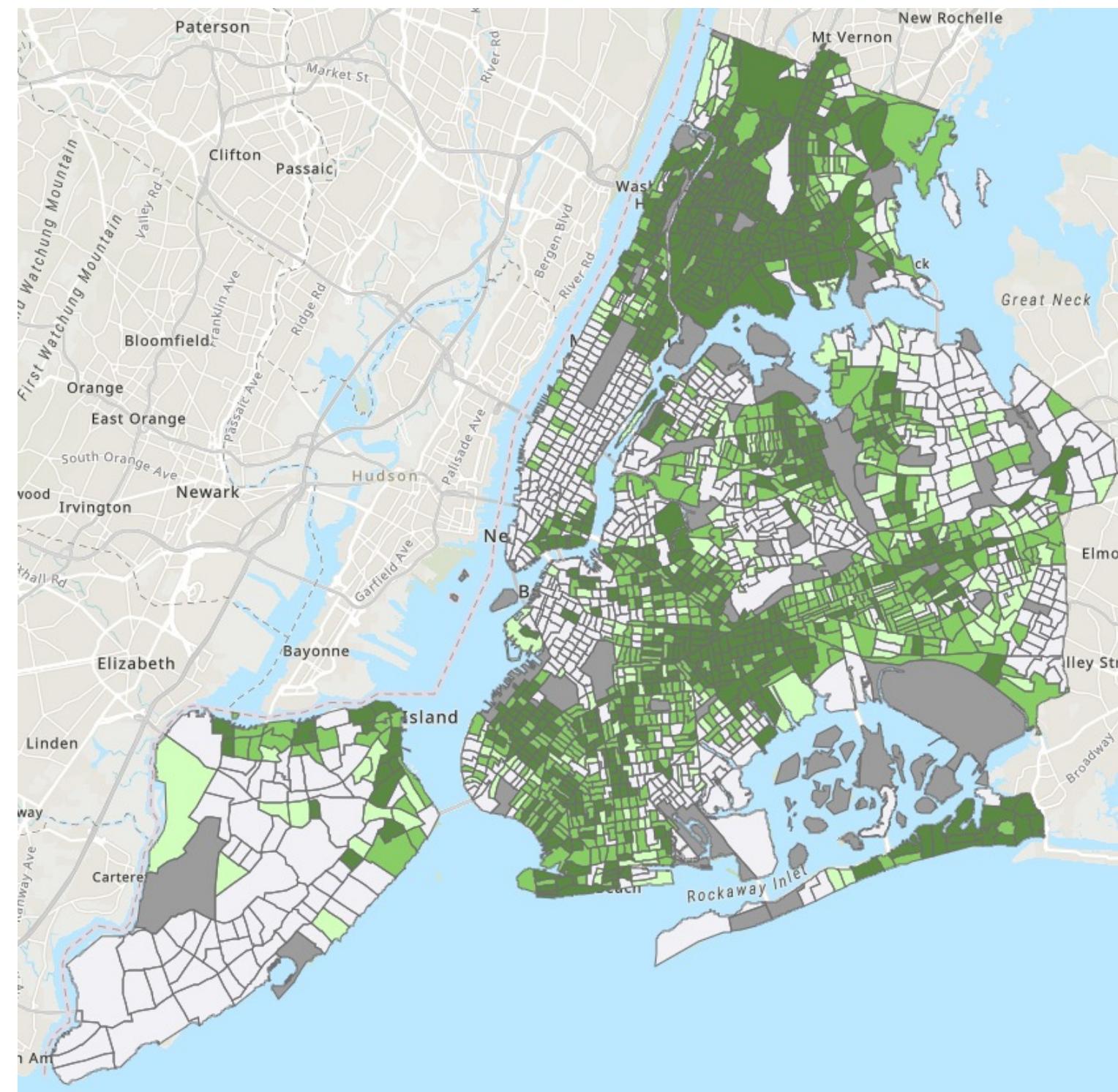
Consider social factors that may increase vulnerability to stormwater flooding that will impact ability to prepare for floods.

Results

Using the CDC's Social Vulnerability Index to identify vulnerable areas and prioritize for federal and state funding opportunities.

Learn more:

<https://www.atsdr.cdc.gov/placeandhealth/svi/index.html>





Feasibility Studies

The Feasibility Studies are currently underway and will include field assessments and the analysis of below ground conditions in the priority planning areas.

This process will contribute to the identification of Cloudburst opportunities for which the City will conduct conceptual designs.

Cloudburst Adaptation Toolbox

Aggregated Asset Types

✓ **Flow Diversion/ Conveyance**

- Raised crosswalk
- Raised intersection
- Depressed gutters
- Supplemental street drainage

✓ **ROW Storage**

- Non-vegetated sidewalk storage
- Vegetated sidewalk storage
- Vegetated median lane
- Enhanced tree pits

✓ **Offline Storage**

- Surface storage
- Subsurface storage

✓ **Porous Pavement Storage**

- Porous parking lane
- Porous pedestrian ramps
- Porous median
- Porous bike lane/greenway

Process for Assigning Specific Adaptations

Determine Cause of Flooding at Hotspots

1. Review existing drainage infrastructure
2. Assess how water flows through the sewers and over land

Identify Cloudburst Management Opportunities

3. Review future planned infrastructure
4. Identify and assess feasibility of interventions

Estimate Benefits of Interventions

5. Stormwater volume managed
6. Community benefits

Potential Metrics for Prioritization/Design

All Cloudburst Hubs will be screened for the potential of highest stormwater volume capture in order to reduce flooding as much as possible, and as well as screened for social vulnerability using the CDC's Social Vulnerability Index. Additional metrics (draft table below) will then be used to identify Hubs with added benefits. The initial Hub locations will be announced by the end of 2022.

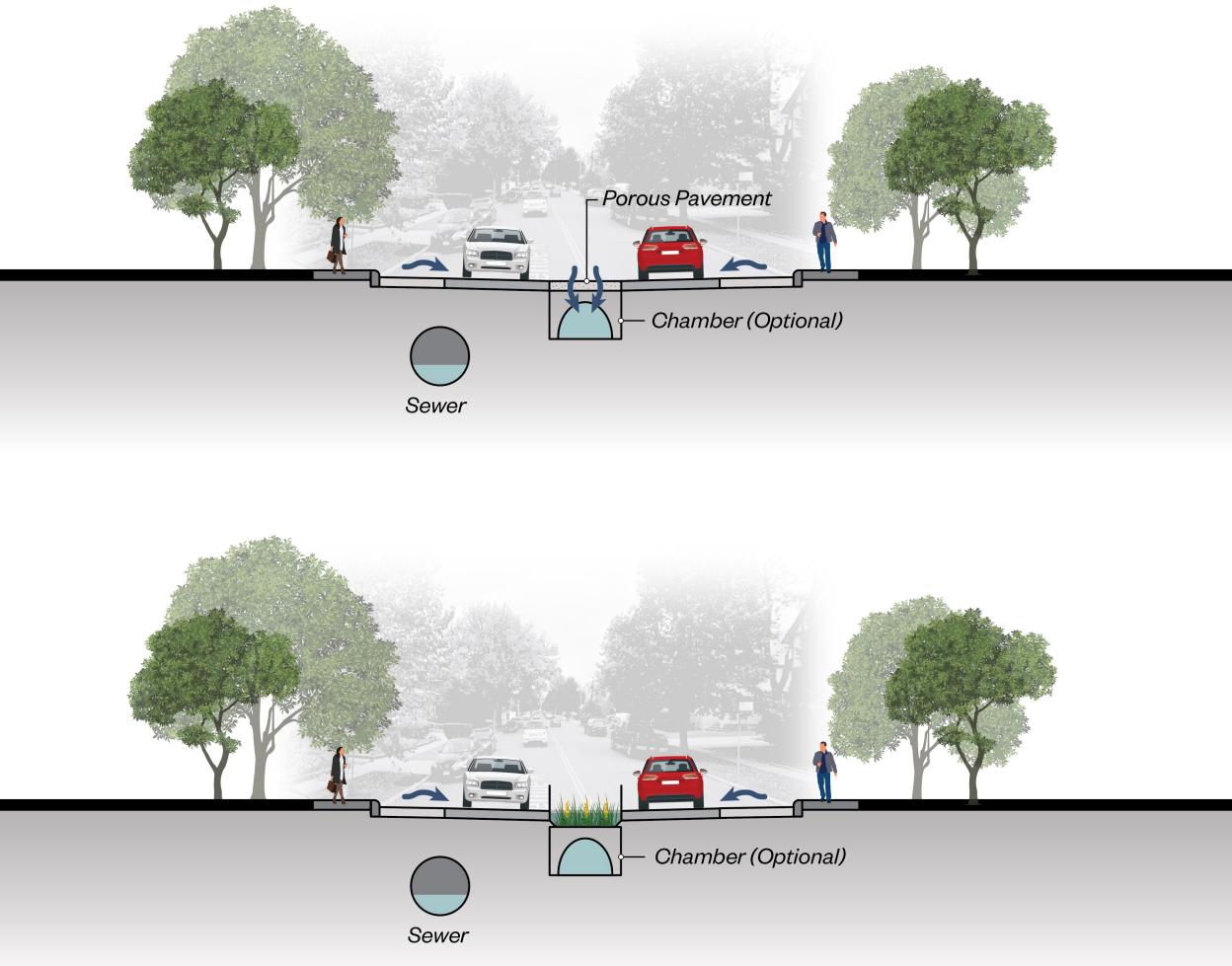
Category	Metric	Description
Physical	Critical facilities (number)	Number of critical facilities that potentially experience reduced flood risk due to cloudburst projects.
Social	Population density	Population density served nearby to cloudburst hub.
Environmental	Additional potential GI projects (sf)	Additional potential green infrastructure (GI) square footage (sf) that could be included in cloudburst hub design
Cost	(Cost)/(Stormwater volume managed)	The cost per gallon of stormwater managed, as a ratio
Operational	Alignment with near-term capital projects	This analysis of existing resiliency projects or programs near flooding hot spots allows the city to maximize funding and accelerate implementation.
	Alignment with other resiliency programs	This analysis of existing agency projects near flooding hot spots allows the city to maximize funding and accelerate implementation.

Let us know what you think! Please respond to our survey on which metrics are most important to you by 10/26/22 here:

<https://outreached.wufoo.com/forms/cloudburst-metrics-survey/>

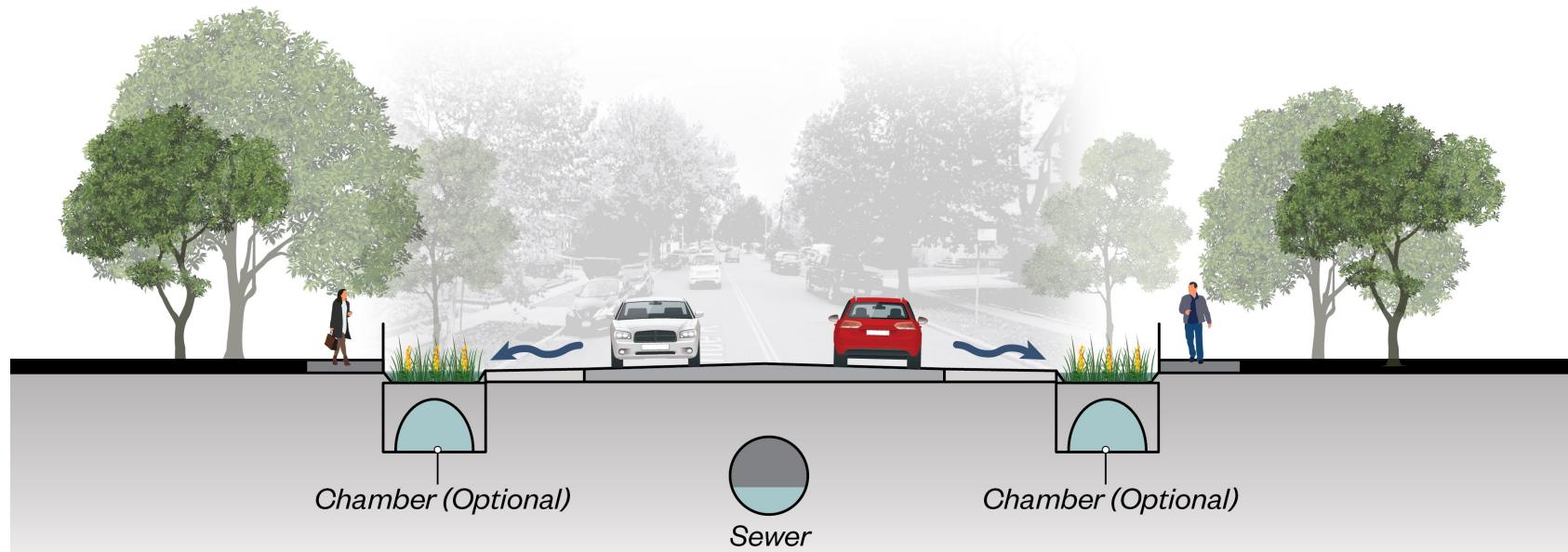
Median Storage

Provides temporary storage of stormwater during cloudburst events



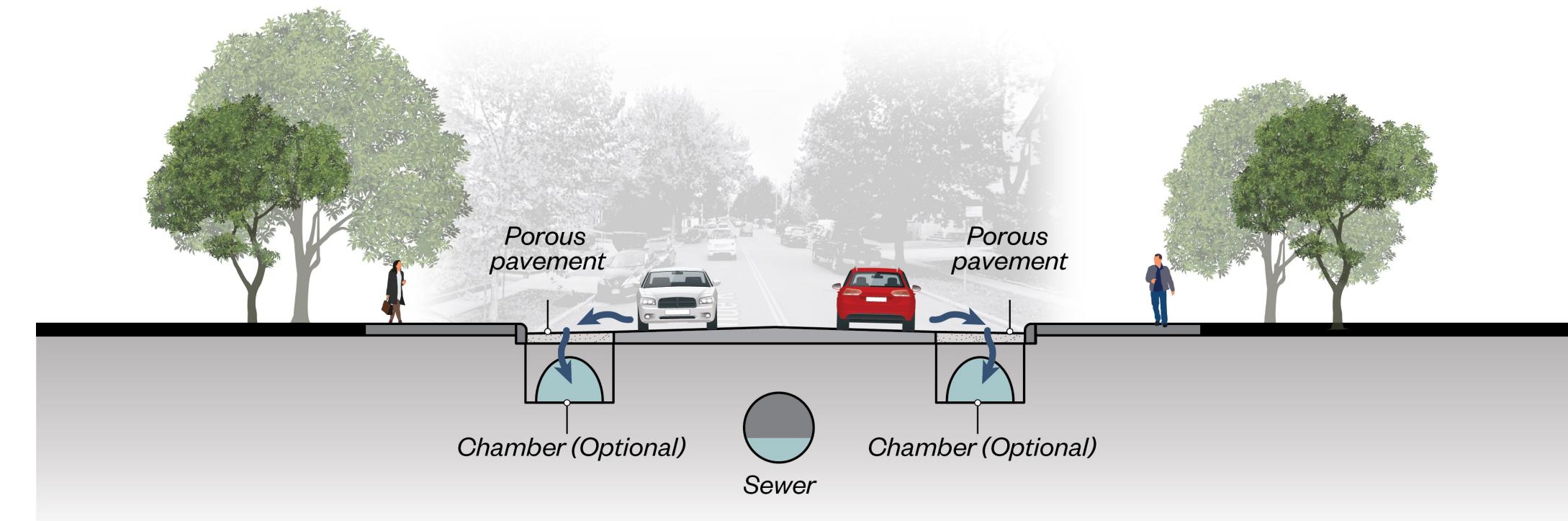
Infiltration and Rain Gardens

Provides temporary storage of stormwater during cloudburst events



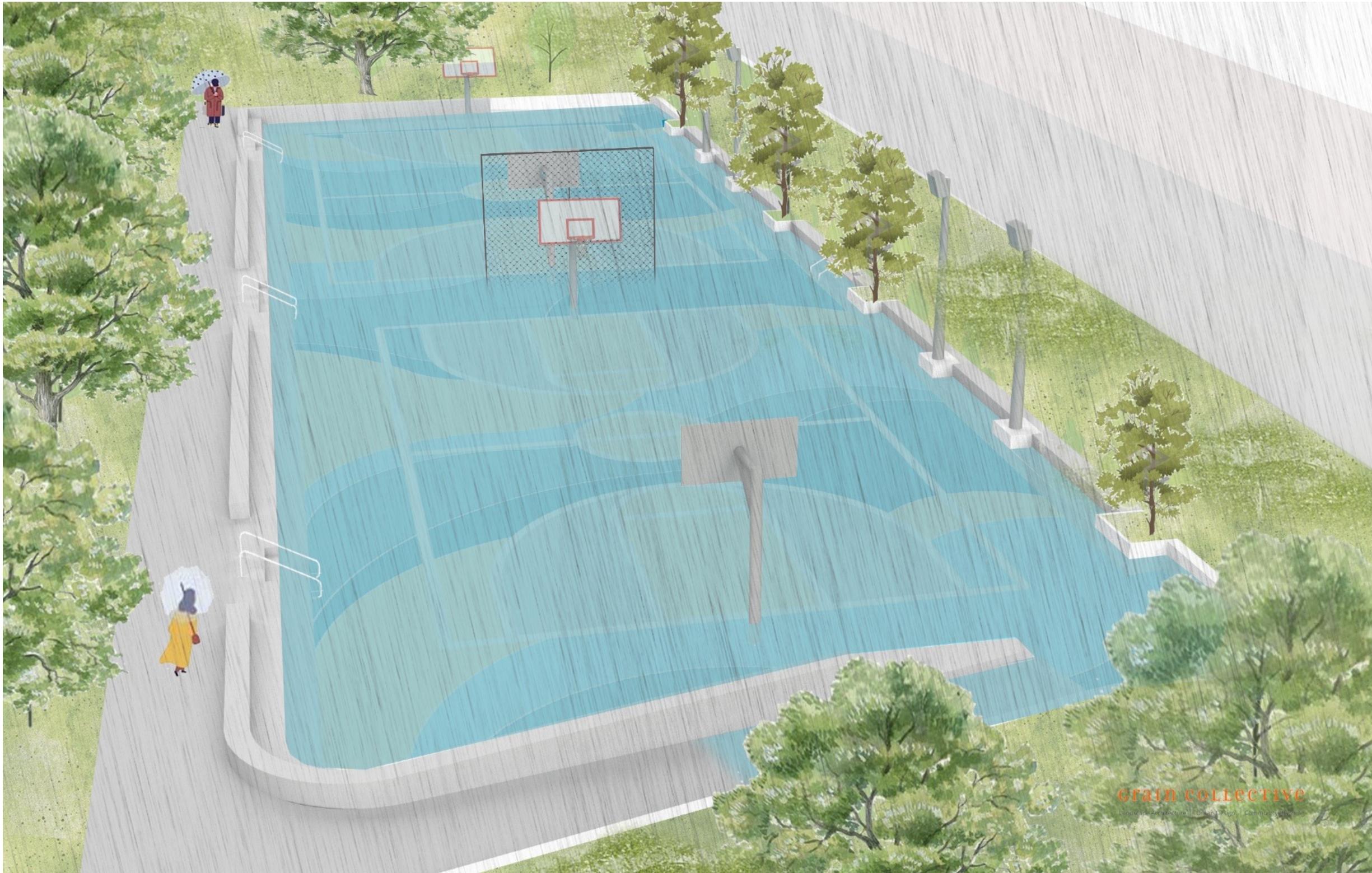
Porous Pavement / Asphalt

Provides temporary storage of stormwater during cloudburst events



Surface/ Subsurface Storage

Provides temporary storage of stormwater during cloudburst events



Rendering of Sunken Basketball Court at South Jamaica Houses

Innovative Opportunities

High volume capture, non-traditional opportunities from lessons learned around the world

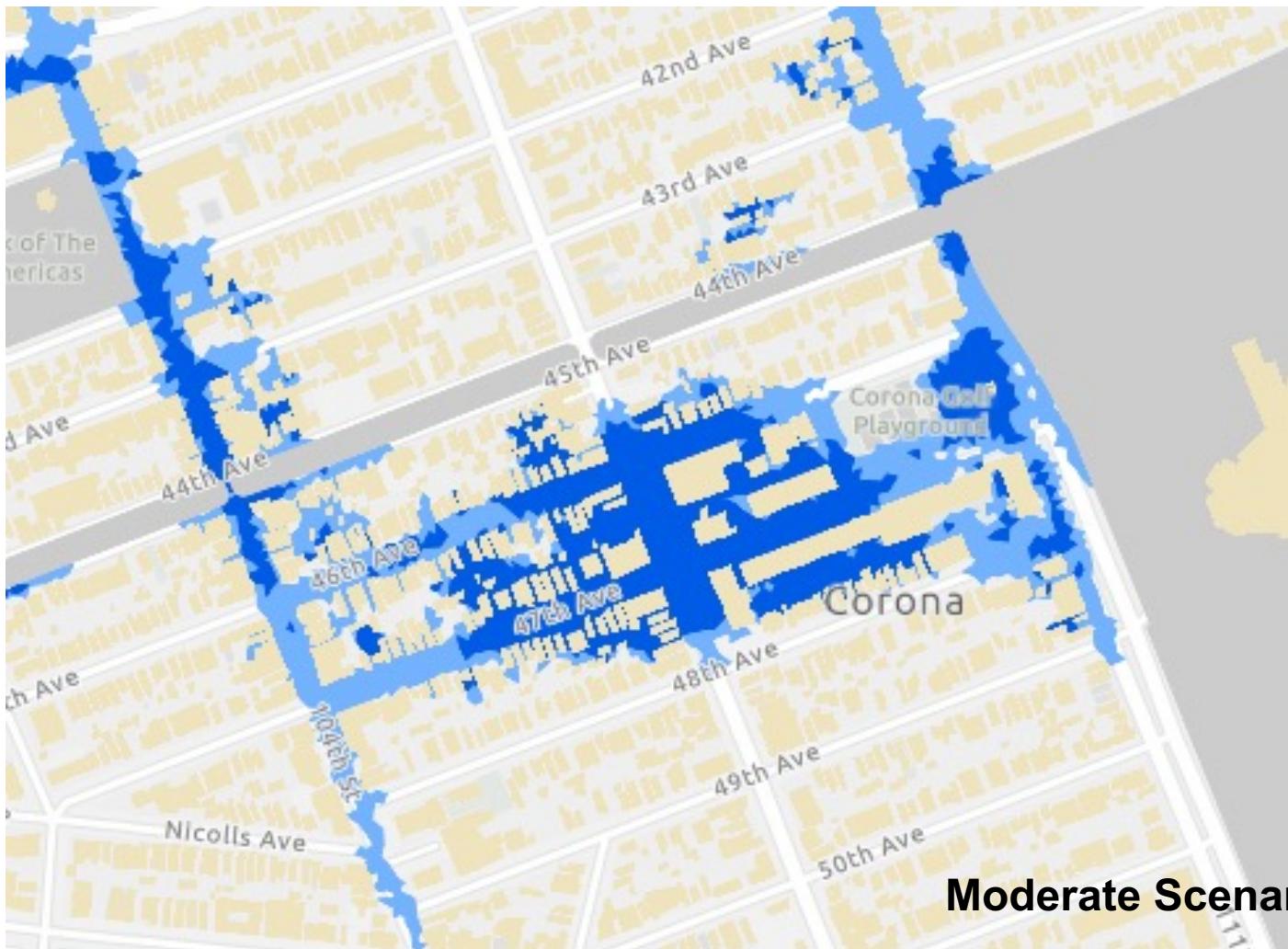
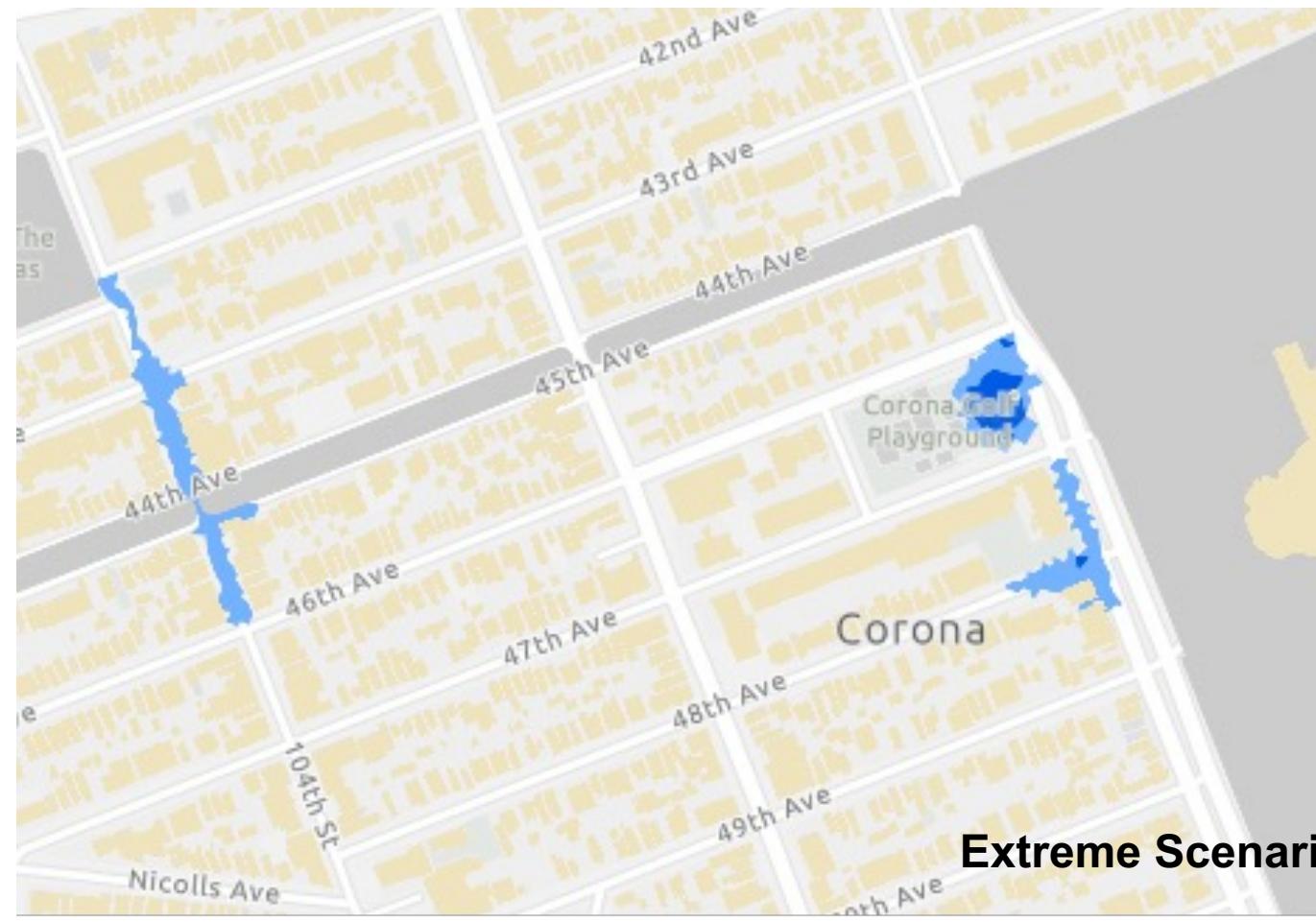
Pictured: Miami cloudburst open street



Case Study: Corona Cloudburst Hub

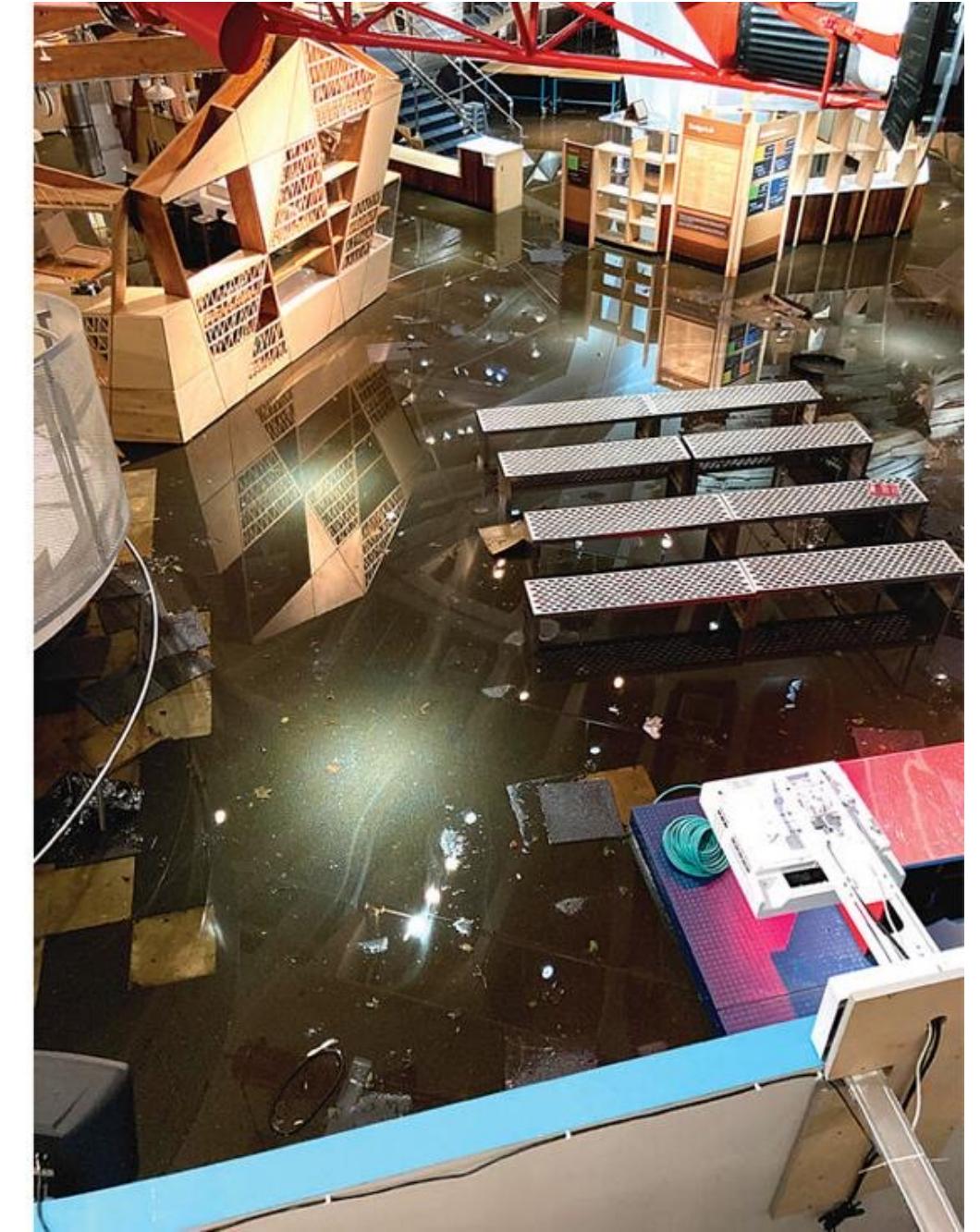
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BB-15
Planning Area
Corona
Demonstration Hub

Hurricane Ida destroyed about 50% of the museum's exhibits



Coordination with Ongoing Infrastructure Improvements

Subject to site investigations – for discussion only

45th Ave

46th Ave

47th Ave

48th Ave

49th Ave

50th Ave

NY Hall of Science Parking
Access Improvements

Q369 Pre-K
Construction

New York
Hall of Science

111th St Safety Improvements

Image © 2022 Maxar Technologies

Google Earth

Potential Cloudburst Management Opportunities

Subject to site investigations – for discussion only

45th Ave

46th Ave

47th Ave

48th Ave

49th Ave

50th Ave

Tennis Court
Storage

Front
Lawn
Storage

New York
Hall of Science

Parking Lot
Subsurface Storage

Image © 2022 Maxar Technologies

LEGEND

Surface/Subsurface Storage

Subsurface Storage Only

Porous Concrete Parking Lane

Porous Asphalt Bike Lane

Supplemental Street
Drainage

Raised Crossing

Constructed GI

111th St and 47th Ave

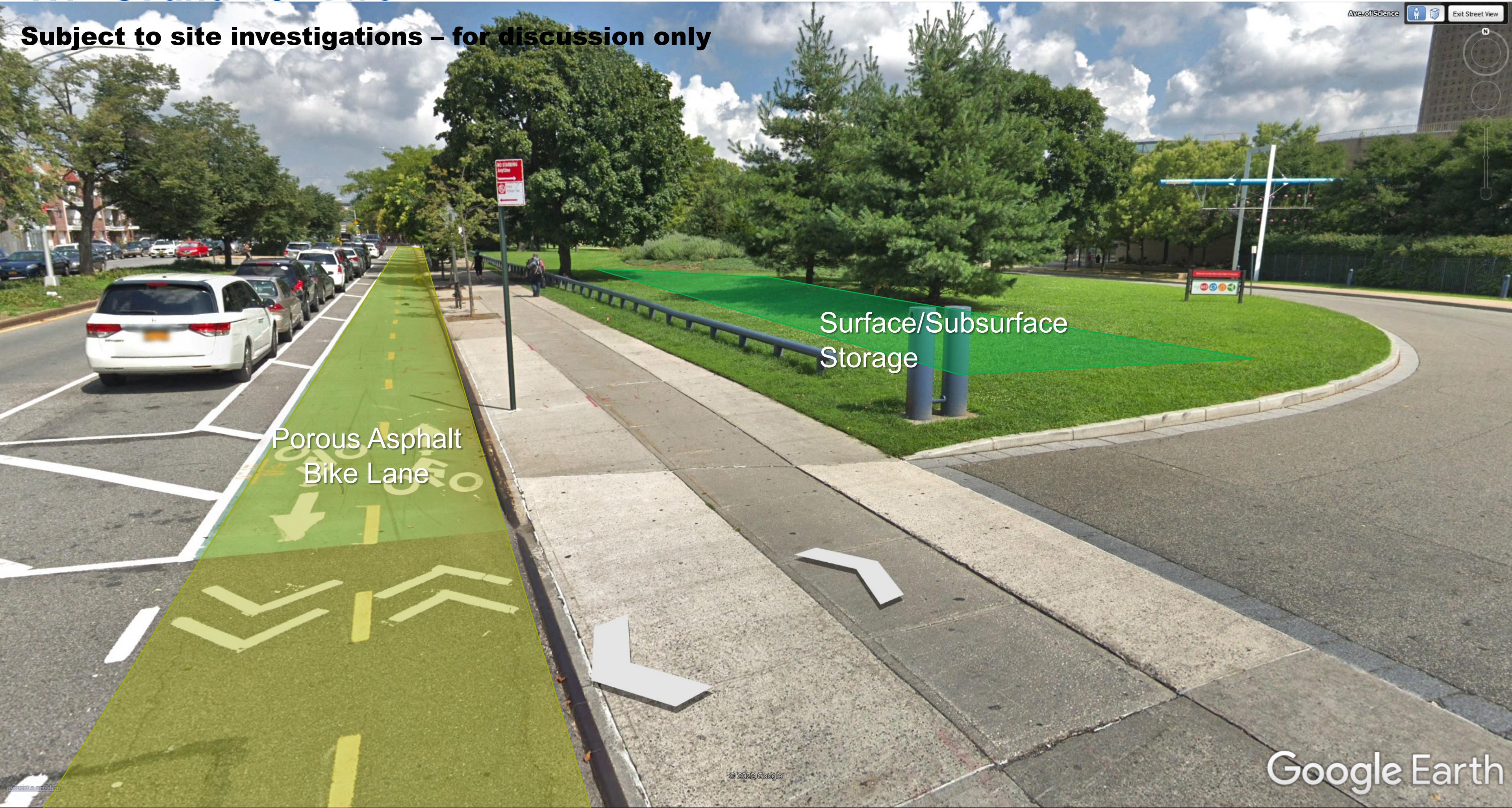
Subject to site investigations – for discussion only



111th St and 49th Ave

Ave. of Science  Exit Street View 

Subject to site investigations – for discussion only



Parking Lot of New York Hall of Science

Subject to site investigations – for discussion only





Next Steps



Next Steps

Fall 2022: Results of initial feasibility studies

End of 2022: Announcement of initial cloudburst hubs

Q1-Q2 2023: Stakeholder engagement and site visits

April 2023: Strategic Plan Released

2025: Construction of initial cloudburst hubs



Contact us if there
are any questions.

Thank you
for your time!

Website
nyc.gov/dep/cloudburst

Phone Number
Report flooding issues by calling 311.

Email Address
onewater@dep.nyc.gov