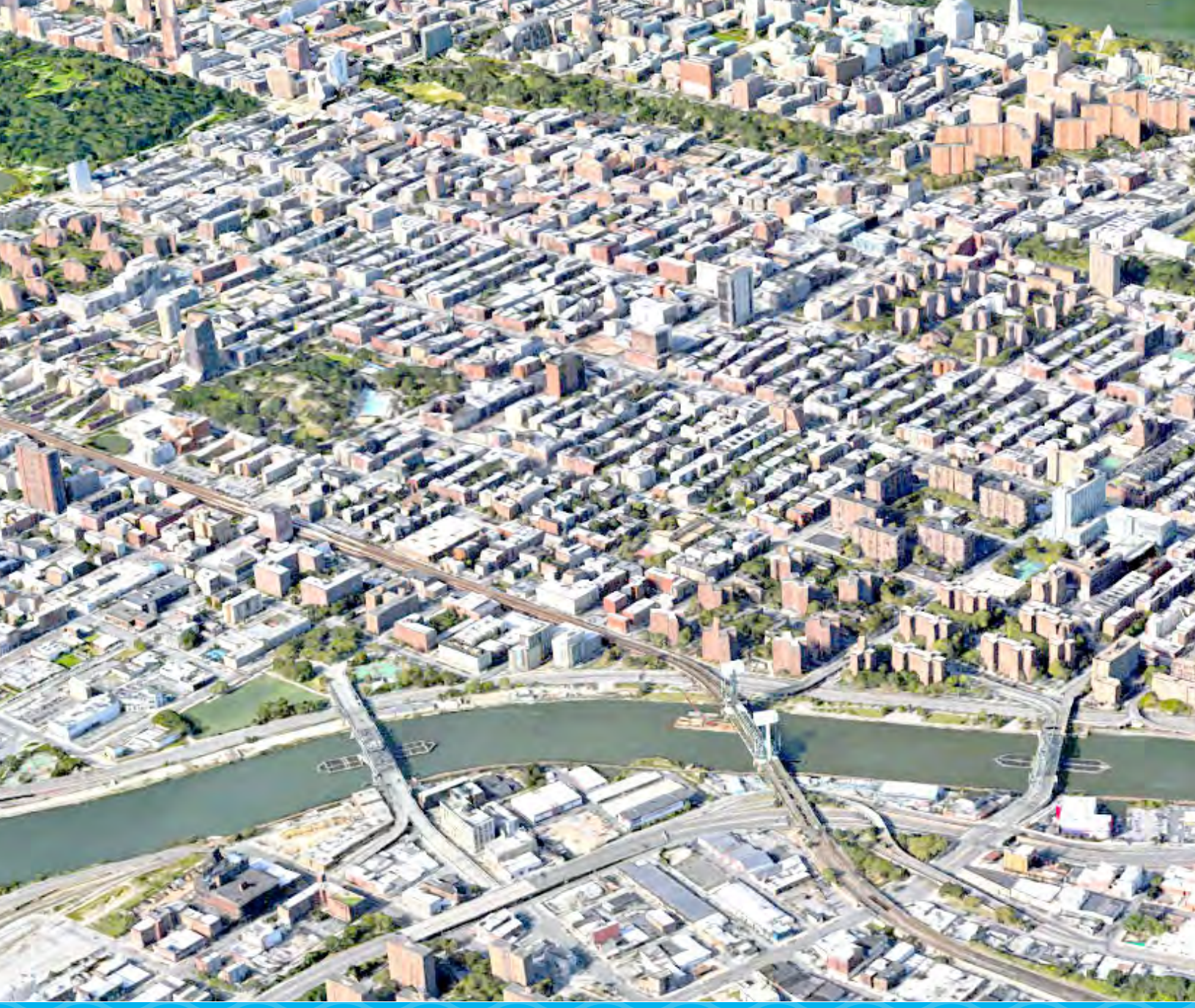

# Vision Plan for a Resilient East Harlem

NYC Parks

NYC Mayor's Office of Recovery

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*Outreach meeting, April 2018.*

# Foreword

*A Vision Plan for a Resilient East Harlem* is the culmination of a study led by NYC Parks and the NYC Mayor's Office of Resiliency (MOR), in close collaboration with the NYC Department of Environmental Protection (DEP) and NYC Department of Transportation (DOT). It is the intent and hope for the recommendations outlined in this Vision Plan to be explored further in ongoing and future projects. Additional study, community engagement, as well as capital funding is needed to realize these recommendations.




## Acknowledgments

NYC Parks and the Mayor's Office of Resiliency would like to acknowledge the contributions of NYC Department of Environmental Protection (DEP), NYC Department of Transportation (DOT), as well as the involvement of NYC Housing Authority (NYCHA), NYC Emergency Management (EM), NYC Department of City Planning (DCP). We would also like to thank all who participated in our public engagement efforts, including Community Boards 8, 10, 11, elected officials, DREAM Charter School, numerous community organizations, and members of the community.

The study underpinning A Vision Plan for a Resilient East Harlem was led by a multi-disciplinary design team led by Starr Whitehouse Landscape Architects and Planners + One Architecture and Urbanism, with support from Langan Engineering, New York University Institute for Public Knowledge, Sam Schwartz Engineering, Urbanomics, VJ Associates, Sherwood Design Engineers, and Jacobs Engineering Group.

# Executive Summary

East Harlem is a diverse and vibrant neighborhood that is vulnerable to climate change threats. This Vision Plan considers increasing resiliency to address four key climate risks: sea level rise, storm surge, extreme rain, and extreme heat.

Bordered by the Harlem River on the east and encompassing several historic wetlands and creeks, East Harlem is vulnerable to flooding from extreme rain, sea level rise, and storm surge. Although not subject to large amounts of wave action, East Harlem is low-lying and consequently has a large coastal floodplain. Managing inland drainage is a critical priority because water can be easily trapped in low-lying areas.

East Harlem also experiences high average summer time surface temperatures, due to a variety of physical factors including high density. Extreme heat, exacerbated by gradually rising global temperatures, presents challenges to sustaining a healthy and livable neighborhood.

A Vision Plan for a Resilient East Harlem identifies a set of future recommendations, ranging from neighborhood-level infrastructure projects to open space improvements and community programs that can help the community adapt and mitigate future risks to climate change. These recommendations are grouped into the following three categories:

### 1. Manage Stormwater

Invest in large-scale, centralized stormwater management systems with decentralized stormwater management infrastructure within public spaces. These systems comprise of stormwater retention, conveyance and storage, and pumping.

### 2. Create Resilient Public Spaces

Seek opportunities for social infrastructure improvements to support robust public spaces that help reduce vulnerability to heat and flooding risks.

Examples include:

- Develop and renovate public spaces to be resilient through careful site design, light-colored materials and subsurface drainage improvements
- Increase tree planting and stewardship
- Support community organizations and small businesses to provide emergency preparedness and climate resources and gathering spaces
- Increase public programming and design that targets more diverse and multi-generational use of open spaces to promote social cohesion

### 3. Adapt the Waterfront

The East Harlem waterfront presents both near-term and long-term resiliency challenges and opportunities:

- **Near-term:** Increase the elevations of low-lying sections of the waterfront through planned waterfront repair work to address sea level rise and low-level storms.
- **Long-term:** Seek opportunities to further elevate waterfront edges and make critical drainage improvements. Such changes offer an important opportunity to prevent flooding a while improving waterfront access. It is critical that managing neighborhood-level stormwater (Recommendation 1) is addressed in a manner that avoids creating a "bathtub" condition. For this reason, investment in stormwater management must precede investment in Long-term adaptation of the waterfront.

This Vision Plan highlights recommended actions to increase the resiliency of East Harlem, with a focus on the role NYC Parks can play in responding to climate change, and opportunities to partner with other agencies and stakeholders to further climate change readiness.



# Overview

# Vision Plan

The East Harlem Resiliency Study was undertaken by NYC Parks and the Mayor's Office of Resiliency in order to develop a vision plan for a climate-resilient East Harlem. This effort defined resilience as the ability of individuals, communities, and institutions to adapt, survive, and thrive in the face of shocks and stresses related to climate change. Building resilience is an ongoing process that touches all community sectors and stakeholders.

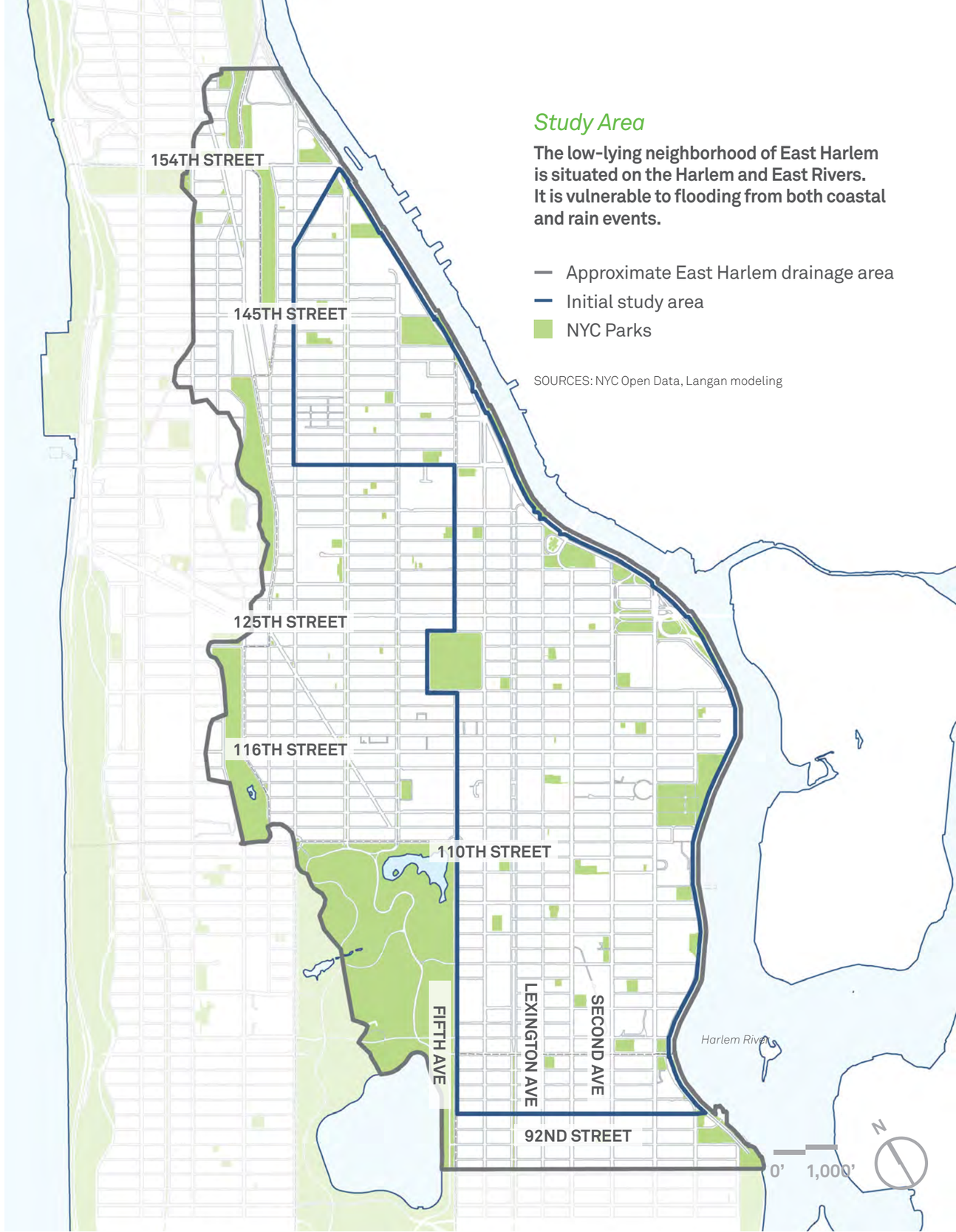
The East Harlem Resiliency Study is one of multiple neighborhood planning efforts the City of New York has conducted since Hurricane Sandy in 2012. "A Stronger, More Resilient New York" report, which the City published in 2013, established goals for citywide resilience planning and recommended the East Harlem neighborhood for study. This study serves to support the goals outlined in that report, as well as several other subsequent visioning documents including Vision 2020 (2011), the City's comprehensive waterfront plan, and the OneNYC (2014) and OneNYC 2050 (2019) strategies released under Mayor Bill de Blasio.

The Vision Plan resulting from this study considers the area spanning from East 92nd Street to East 154th Street, roughly correlating with the boundaries of the 2050s 100 year floodplain.

The boundaries are more expansive than what is generally considered East Harlem, and factors in dynamics of the broader Northern Manhattan watershed.

Due to the breadth of the project scope, the team engaged city agencies including the NYC Department of Environmental Protection (DEP), the NYC Department of Transportation (DOT), the NYC Department of City Planning (DCP), NYC Emergency Management (EM), the New York City Housing Authority (NYCHA), and the NYC Metropolitan Transit Authority (MTA), among others, through briefings, information sharing, and planning and design visioning workshops. The study team also engaged community members through a series of public community forums, outreach events, mobile engagement, as well as through a semester-long resiliency curriculum taught at DREAM Charter School.

A unique aspect of this effort was the team's research into social resilience in the neighborhood, conducted through community engagement activities as well as qualitative sociological research. East Harlem is a community that has experienced historical disinvestment and contains a high concentration of low-income residents. These challenges and vulnerabilities will be compounded by climate change, making neighborhood resiliency planning a critical and urgent need. Despite existing vulnerabilities, East Harlem benefits from an extensive and diverse network of community-led organizations and social services. These range from community-based health centers, cultural organizations, and religious institutions to branch libraries and more.

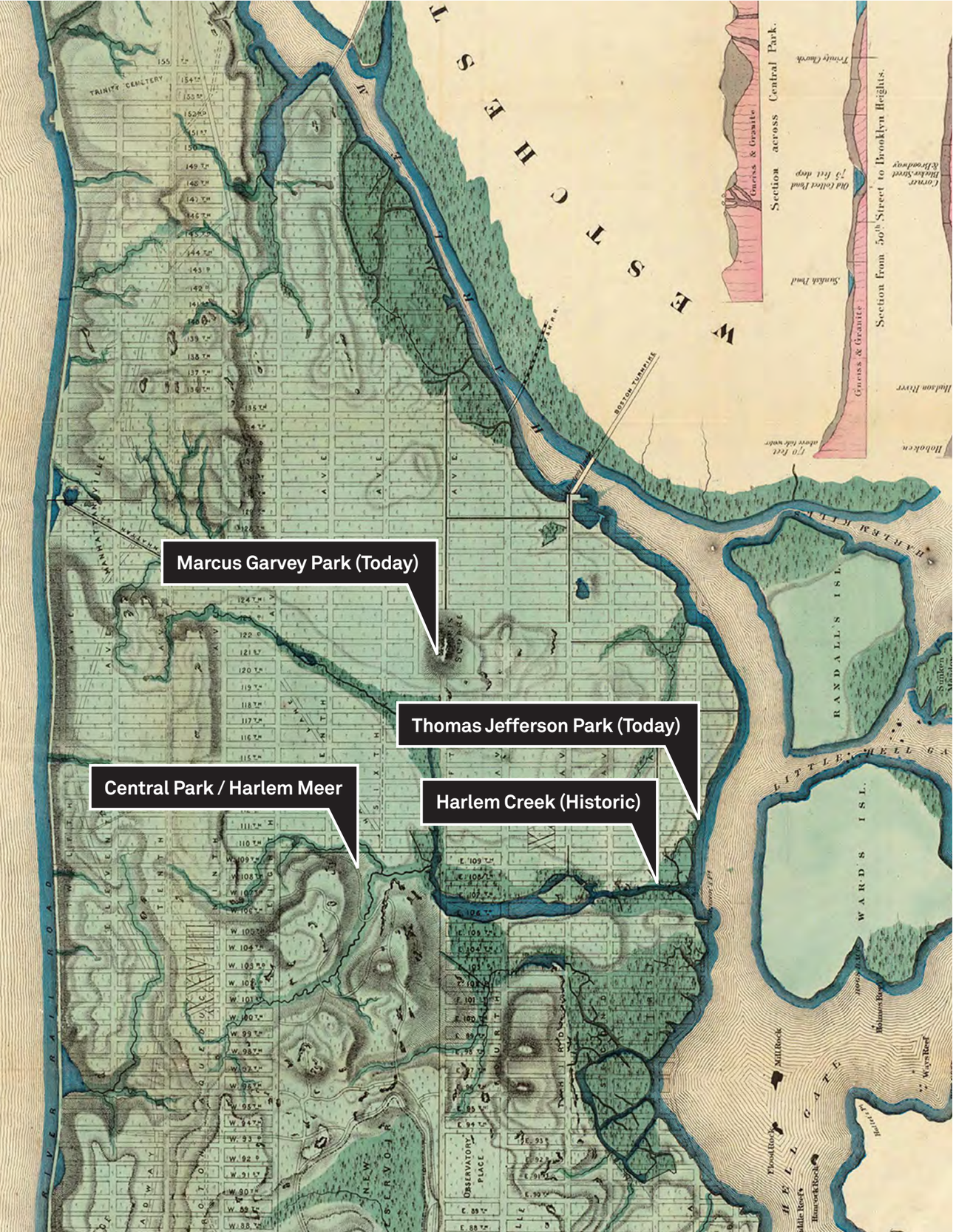



## *Study Area*

**The low-lying neighborhood of East Harlem is situated on the Harlem and East Rivers. It is vulnerable to flooding from both coastal and rain events.**

- Approximate East Harlem drainage area
- Initial study area
- NYC Parks

SOURCES: NYC Open Data, Langan modeling




## History

East Harlem is a diverse and vibrant neighborhood that is already facing impacts from weather-related events and is vulnerable to greater risk from climate change in the coming decades.

The neighborhood is bordered by the Harlem River on the east, encompasses several historic wetlands and creeks, and has a low-lying topography, making it vulnerable to flooding from extreme rain, sea level rise, and storm surge. Extreme heat from gradually rising temperatures in a dense urban environment also presents challenges to building and sustaining a healthy, livable neighborhood.

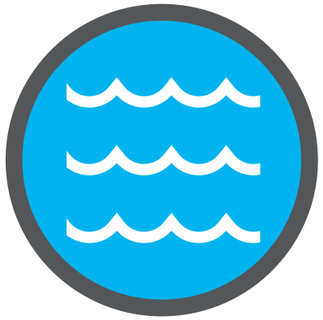
As with many neighborhoods in New York City, the density of structures and condition of existing infrastructure in East Harlem shapes the opportunities and challenges to creating a more resilient neighborhood. Relevant factors include the size and distribution of open spaces, the elevation and widths of the street network and the waterfront esplanade and highway, as well as the capacity of underground sewers. This study examined physical infrastructure, as well as the state of social resiliency, or the ways in which community organizations and resources play a role in building a more resilient neighborhood.

A Vision Plan for a Resilient East Harlem identifies a set of future needs, ranging from neighborhood-level infrastructure projects to open space improvements and community programs that can help the community adapt to climate change and mitigate future risks. This plan highlights transformations that can take place to make neighborhoods resilient in the face of climate change, with a focus on the role NYC Parks can play in responding to climate change, and opportunities to partner with other agencies and stakeholders to further climate change readiness.

*Viele Water Map of 1865 ("Sanitary and Topographical Map of the City and Island of New York"); courtesy of Wikimedia Commons.*

## Climate Risks

This Vision Plan examined the neighborhood through four key climate risks.



**Sea Level Rise** Sea levels are projected to rise due to melting glaciers, ice caps, subsidence, and the fact that warmer water expands. High end projections of sea level rise indicate that we may see approximately 6 feet in sea level rise by 2100 in NYC.

**Storm Surge** Winds and atmospheric pressure changes from storms push water on land and cause flooding. More intense coastal storms are expected to increase in frequency.

**Extreme Rain** Precipitation frequency and intensity are projected to increase with climate change. 30% more extreme precipitation events are projected for the 2050s.

**Extreme Heat** Heat Waves are three or more consecutive days with maximum temperatures at or above 90°F. New York City will see the number of days above 90 (degrees) trip by the 2050s.



# Findings

# Summary of Findings

East Harlem is a diverse and growing neighborhood that is vulnerable in the face of climate change. Taking action to build resiliency now is important given the increasingly unpredictable nature of the current climate.

East Harlem is a diverse and growing neighborhood that is vulnerable in the face of climate change. Taking action to build resiliency now is important given the increasingly unpredictable nature the current climate. Given the density of population, buildings, businesses, critical infrastructure, community facilities, transportation assets and parks in East Harlem, the potential cost of inaction in the face of climate change events over the next 50 years is approximately **$3.2 billion.***

A technical analysis of climate risks in East Harlem examined rain storms, coastal storm surge, sea level rise, and extreme heat. This analysis revealed that stormwater and drainage issues are a key local threat due to the low-lying topography of the neighborhood and the historic streams and wetlands that underlie much of the area. While East Harlem has approximately three miles of waterfront, flooding challenges are and will continue to be most acute inland, along the location of the low-lying, historic Harlem Creek (centered around East 106th Street.) These drainage challenges will increase with future storm surge, extreme rain, and sea level rise risk.

Coastal floods from sea level rise, tides, and extreme rain further exacerbate the inland drainage challenge, and grow in risk by the end of the century. This study identifies strategies to address nuisance flooding related to sea level rise, tides, and frequent storms. The study also identifies the need to engage in broad, transformative thinking of our waterfronts to address open space, access, and stormwater infrastructure needs in a changing environment.

Climate change may introduce new risks and exacerbate existing challenges in East Harlem. Increasing neighborhood social resilience here is critical, given underlying social vulnerabilities, including household median incomes that are lower than the NYC average, and a large numbers of seniors and recent immigrants who may be difficult to reach, particularly in times of emergency. There are a wide array of community facilities and services that support neighborhood social resiliency throughout East Harlem, however knowledge of facilities is highly localized. Improvements could be made to make these spaces more accessible, resilient, and connected to preparedness and recovery resources.

*This cost represents the sum of the Present Value at Risk for several storm events. The Present Value is calculated by identifying the Value at Risk (an aggregation of the monetary value of all damages for any given storm event), multiplying it by the annual frequency rate of that event, and inputting these values into the FEMA HAZUS Benefit Cost Analysis (BCA) software, a standard BCA calculation tool.



# Flooding

Flooding presents a growing risk to many areas within East. There are three climate risks—sea level rise, storm surge, and extreme rain—that can result in flooding.

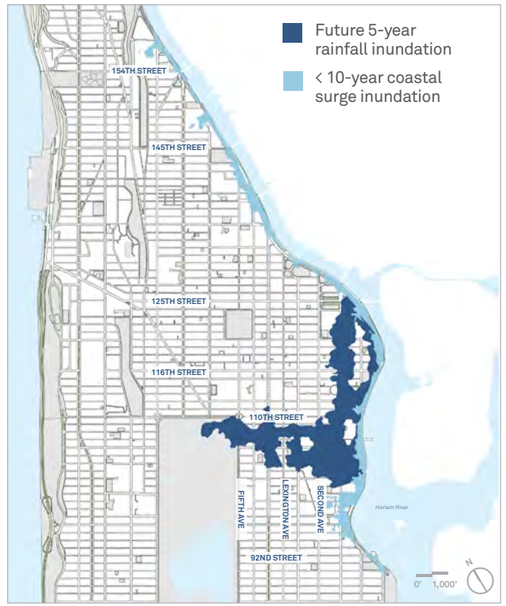
This study examined two scenarios through combined coastal and stormwater modeling: a future (2050s) frequent storm event and a future (2050s) extreme storm event. In both scenarios, the same areas were found to face the highest flood risk due to the neighborhood's low-lying topography.

**This analysis found that stormwater and drainage issues are the most acute flood threat due to the low-lying topography of the neighborhood.**

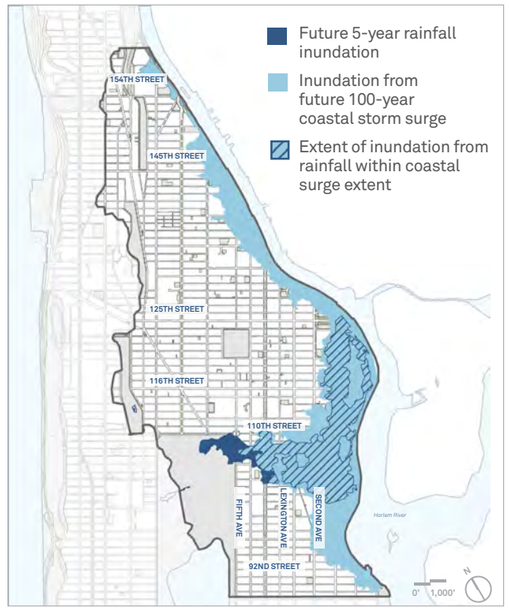
Drainage infrastructure is a critical consideration in East Harlem. Elevating the coastal edge through a wall or levee without addressing drainage in this area could worsen flooding from upland storm runoff or wave overtopping by trapping water within the neighborhood. This is commonly known as the "bathtub effect."

Note: This modeling took a conservative approach and assumed scenarios in which rain and surge events happen concurrently.

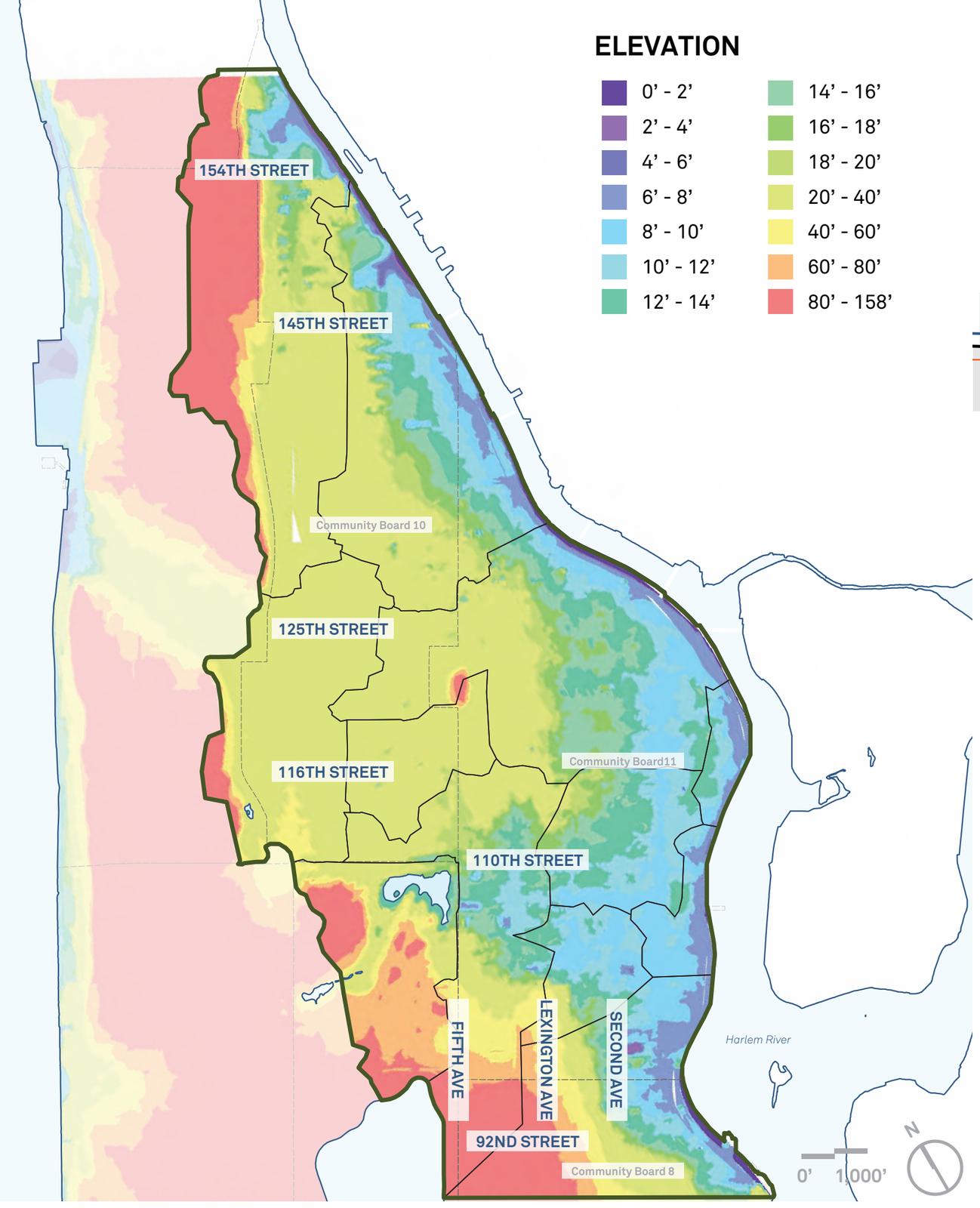
*Future 5-Year Rain* and Future 10-Year Coastal Surge Event*



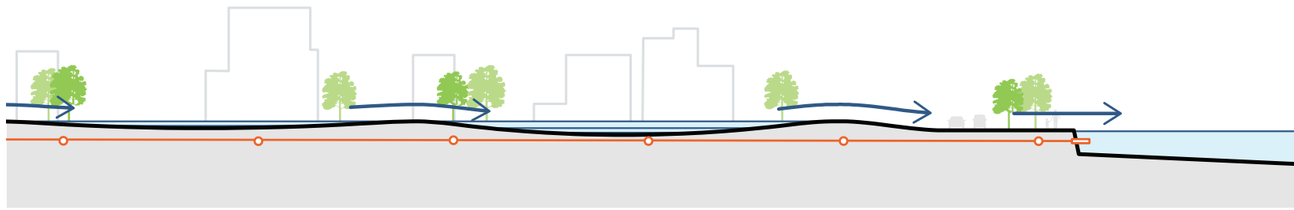

*Future 5-Year Rain* and Future 100-Year Coastal Surge Event*




SOURCES: NPCC, Langan Engineering Modeling
*Future 5-year rain event = 5.88" rain in 24 hours)




SOURCES: NPCC, Langan Engineering Modeling



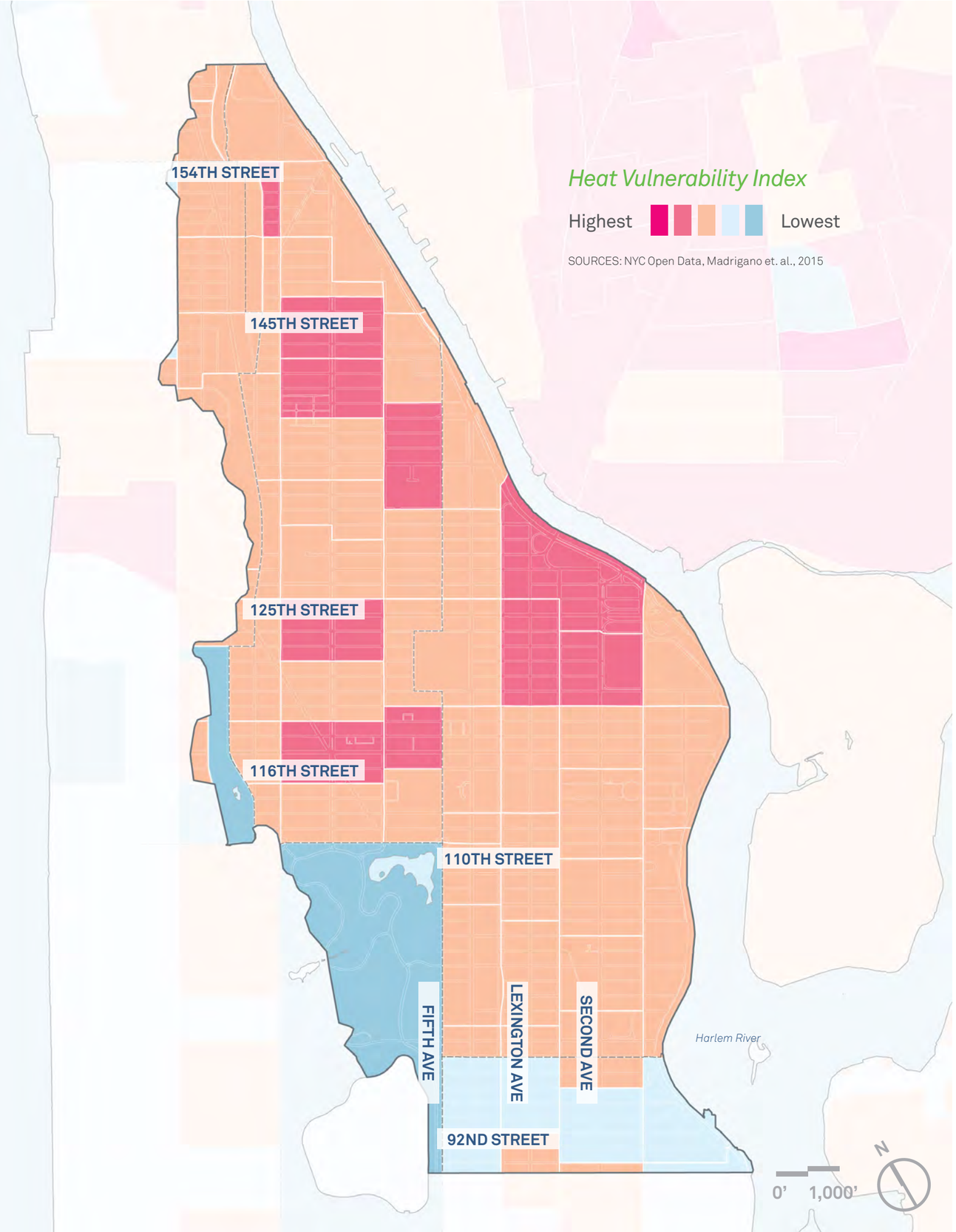
*Representative section showing low-lying basin conditions in East Harlem.*

East Harlem is a waterfront neighborhood with varying topography and low-lying basins, vestiges of the area’s historic salt marsh and waterways. In future large rain events, the existing gravity-fed sewers may see reductions in functionality due to high tide or sea level rise that block the combined sewer outfalls. In these cases, inland stormwater may back up, causing flooding. The modeling undertaken by this study shows that existing low-lying basins may fill up to a point where they spill over into adjacent lower-lying areas downhill, causing a cascading effect.

In a future extreme rain event scenario, wherein storm sewers are surcharged (i.e. filled with water and not draining) a volume of up to 40 million cubic feet of water could pond in low-lying areas of East Harlem.* For context, this amount of water would more than fill the Empire State Building (approximately 37 million cubic feet). Without intervention, some of the flooded areas may reach depths of three feet or higher, with an average of one to two feet of ponding along historic waterways that roughly align with today’s East 106th Street and First Avenue. Flooding would slowly abate over the course of approximately six hours, after tides recede and storm sewers resume functionality.

While the amount of precipitation or extent of storm surge in future events cannot be precisely predicted, these analytical models indicate important dynamics and neighborhood impacts that are likely to occur in future storms. The basin condition described above informs how resilient stormwater management systems may need to be configured in the future.

*This model assumed a severe case scenario of a future five-year rain event or constant rainfall for over 24 hours and 5.88” of total rainfall, surcharged local sewers, tide gates on all outfalls, and coastal protection measures preventing coastal storm surge.




# Extreme Heat

## By the 2050s, the number of 90 °F or higher days in New York City may increase from an average of 18 days per year to as many as 57 days per year.*

East Harlem residents may feel these changes more acutely. Today, the average surface temperature in East Harlem in August is over two degrees higher than that of NYC overall. Key contributing factors include East Harlem's lower than average vegetation cover (tree canopy and grass), as compared to NYC overall.**

In New York City, and the country as a whole, extreme heat is the number one cause of mortality from extreme weather. The City's Heat Vulnerability Index (HVI), which is adapted from a study by researchers at the Department of Health and Mental Hygiene (DOHMH) and Columbia University, dentifies the neighborhoods with a higher risk for heat-related deaths during extreme heat events considering both physical and social risks and informs how the City directs resources to these communities. The HVI map of Northern Manhattan illustrates vulnerabilities to heat-related deaths and illnesses based on environmental and social-demographic factors on a census tract level. Residents in parts of East and Central Harlem are currently highly vulnerable to extreme heat events.


*Facing south, Second Avenue at 120th Street. Streets that lack vegetation can contribute to the urban heat island effect and limit infiltration and evaporative cooling.*

*New York City Panel on Climate Change, Building the Knowledge for Climate Resiliency (2015).

**NYC Department of Health and Mental Hygiene, Community Health Profile (2015).

# Social Resilience

Social Resilience is enabled when a vibrant grouping of community organizations, public spaces, and social connections allow communities to withstand and emerge stronger from shocks like extreme weather events.

Social Resilience is enabled by the landscape of community organizations, public spaces, and social connections, which allow communities to withstand and emerge stronger from shocks like extreme weather events

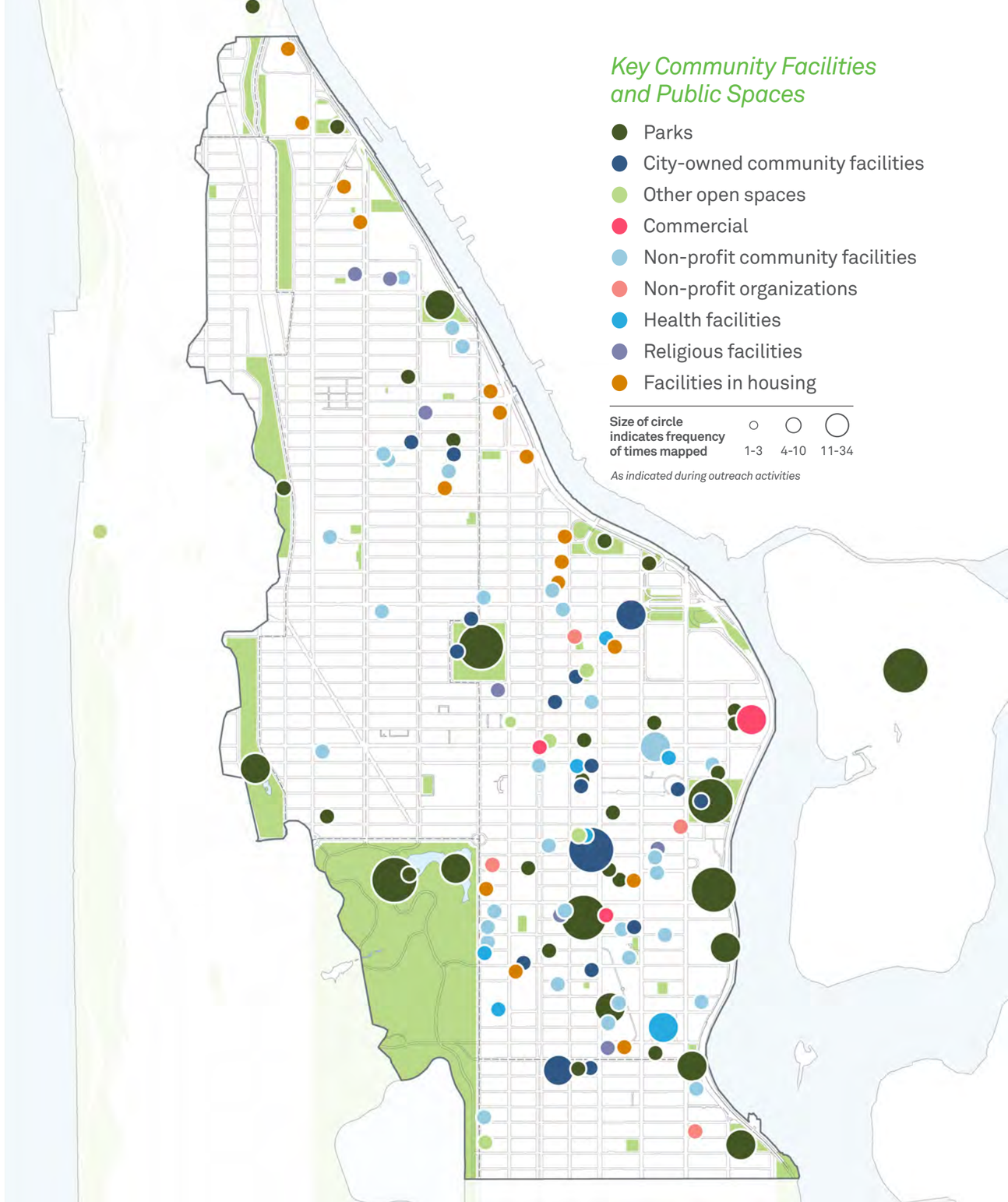
As part of this plan, a team from NYU conducted stakeholder interviews, observations, community engagement ac-tivities, mapping exercises, and facility assessments to analyze social resiliency in East Harlem. This research identi-fied recent demographic changes and vulnerable populations including, undocumented immigrants, people dis-placed by Hurricane Maria, single-headed households, and people 65 years or older. It also identified key social infrastructure, and assessed its current conditions, needs, and vulnerabilities in relation to climate change.

Results indicated that the neighborhood has an extensive network of community facilities and services that foster information sharing and social resilience. The network of social infrastructure is decentralized in nature, with no dominant social hub, and knowledge and use of these places tends to be highly localized. The map on the right iden-tifies open space and community facilities that were identified by participants at a series of public meetings, and outreach activities. This map illustrates the locations of these social hubs and the size of the dots illustrates the number of participants who mentioned a specific hub. This map is not intended to be a comprehensive list of East Harlem's social infrastructure, however it points to spaces, many of them parks that play an important role in serving the community before, during, and after extreme weather events.

**This assessment found that there is limited knowledge of East Harlem's ecological history and vulnerability to climate change amongst local stakeholders.** East Harlem residents also report feeling disconnected from natural landscapes like the waterfront, despite the neighborhood's riverfront location. This contributes to limited local awareness of how residents are connected to and impacted by their ecological context. Climate change risks were not a primary concern for most respondents, however the framework of resilience and the language of preparing for unex-pected shocks resonated.

**Results indicated that the neighborhood has an extensive network of community facilities and public spaces that foster information sharing and social resilience.** The network of spaces is de-centralized in nature, with no singular major hub, and knowledge and use of these spaces tends to be highly localized. It is critical that these spaces are resilient to flooding and heat so that they can serve the community before, during, and after extreme weather events.

*Note: Social infrastructure is "the set of physical places and organizations that shape interactions. When social infrastructure is robust, it fosters contact, mutual support, and collaboration among friends and neighbors—the kinds of ties that determine who lives and who dies in extreme weather events, for instance, and also whether people are willing to act to promote the common good. When social infrastructure is degraded, it inhibits social activity and connectivity, leaving families and individuals to fend for themselves." —Klinenberg, E. Adaptation.* The New Yorker *(2013)*




SOURCES: PAC Meeting (April 10, 2018), Community Forum (May 15, 2018); Tabling at City of Water Day (July 14, 2018), Councilmember Diana Ayala's East Harlem Youth Day (July 31, 2018), NYPD National Night Out (Aug. 7, 2018), NYCHA Taft Houses Family Day (Aug. 25, 2018); COAD Go-Bag Event (Sept. 29, 2018); Party on Park (Sept. 30, 2018)

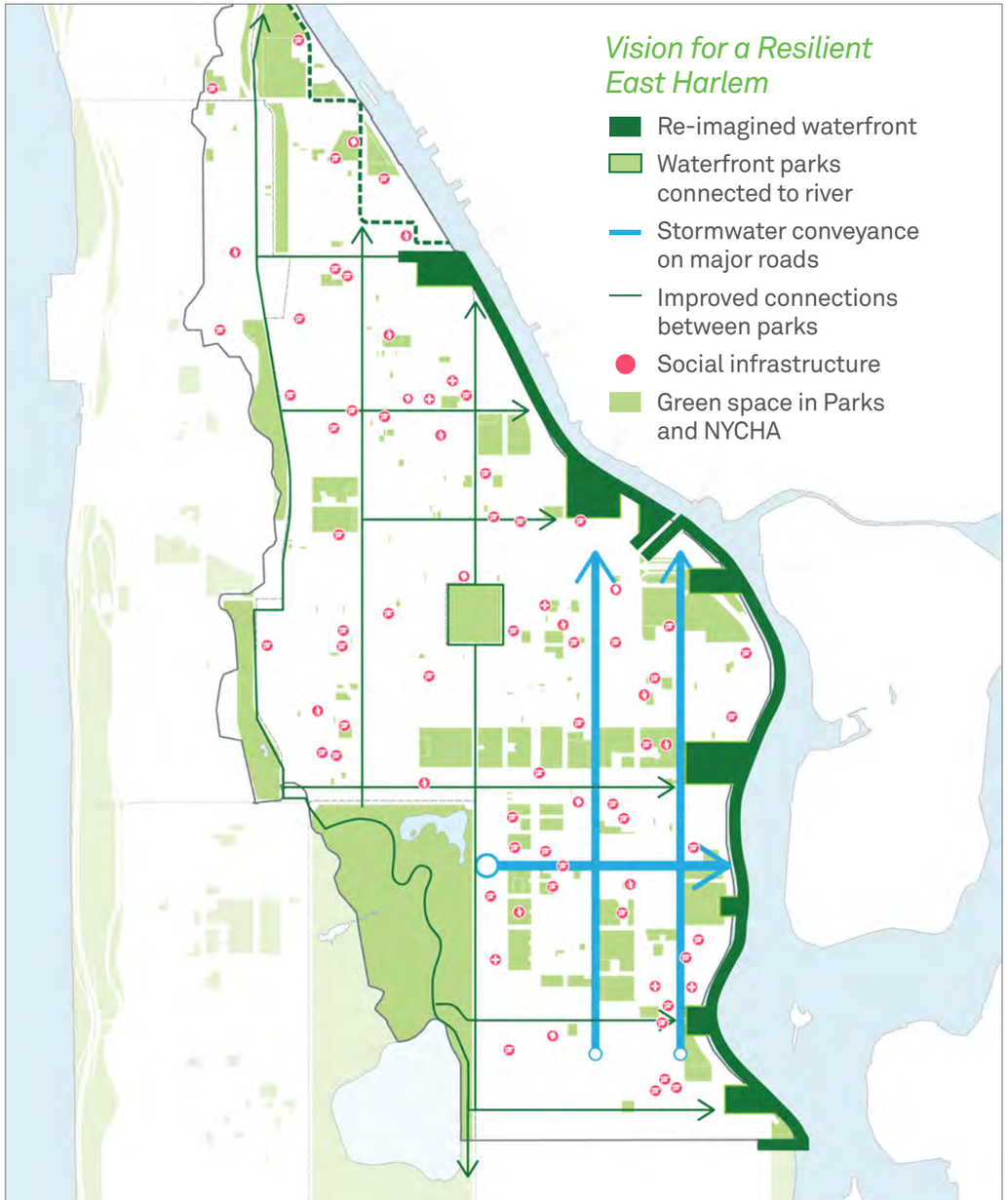
# A Vision Plan for East Harlem

## The Vision

A Vision Plan for a Resilient East Harlem is guided by three key principles:

1. **Manage Stormwater**
2. **Create Resilient Public Spaces**
3. **Adapt the Waterfront**

Given the range of risks posed by climate change, building resiliency will entail complementary efforts that can be undertaken throughout neighborhood's parks and public spaces.



# Manage Stormwater

## Definitions

Stormwater can be managed through using large-scale and small-scale approaches. Integrating both approaches is the most effective way to holistically manage stormwater issues and prevent flooding.

**Centralized measures** are large-scale interventions that impact the stormwater management infrastructure system more broadly.

**Decentralized measures** are smaller-scale interventions that address site-specific issues and can function as standalone improvements. They can also be combined with centralized measures as part of a larger, integrated system.

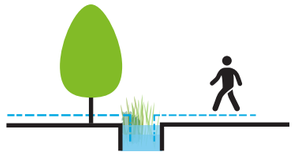
Stormwater infrastructure is also often described as either green or gray.

**Green infrastructure** describes practices that use or mimic natural systems to manage stormwater runoff.

**Gray infrastructure** refers to conventional engineering measures such as treatment facilities, sewer systems, and storage basins.

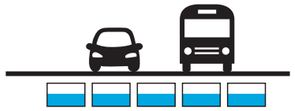
### Stormwater Retention

Water infiltration through green streets



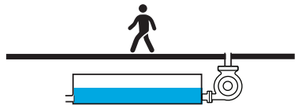
### Conveyance And Storage

Subsurface water storage under roadbed

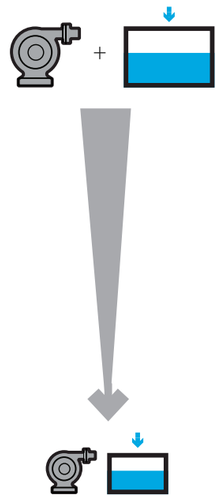


### Pumping

Subsurface pumping can be implemented depending on the size of storage



### Size of Pumping and/or Large-Scale Storage



*Stormwater retention, conveyance and storage, and pumping are examples of green and gray infrastructure as decentralized solutions.*

## Recommendations

**Reduce flood risk from stormwater flooding by creating an integrated network of centralized and decentralized stormwater management interventions comprised of both green and gray infrastructure.**

**This is a critical resiliency priority for East Harlem.**

1. Explore large-scale, centralized stormwater management systems along low-lying streets to manage large amounts of water in conjunction with the existing sewer network. Further site analysis of major low-lying thoroughfares such as East 106th Street, First Avenue, Second Avenue, and Third Avenue will be necessary to identify feasibility, including sufficient space within the roadbed.

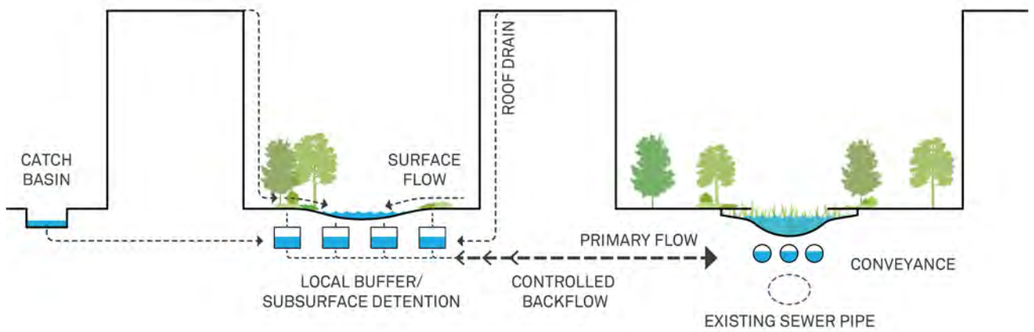
2. Continue to reduce flood risk and improve community benefits of existing low-lying streets by incorporating decentralized stormwater management measures including but not limited to green infrastructure in parks, streets, NYCHA developments, and private properties along these corridors.

*Inland ponding on East 103rd Street after a storm in March 2018.*

## Recommendations:
## Integrated Decentralized and Centralized Measures

**The scale of future flood risk in East Harlem necessitates an integrated stormwater management system that incorporates large-scale centralized measures with decentralized infrastructure in public spaces like streets and parks.**

Building subsurface infrastructure in low-lying corridors is one way to organize and connect decentralized measures, as they can connect standalone sites like parks and open spaces to each other, and to larger centralized measures. Integrated stormwater management presents one potential solution to reducing flood risk, with tradeoffs such as impact to parking spaces.




*Centralized and decentralized methods including, subsurface storage and conveyance, can be combined to manage large volumes of rainfall.*

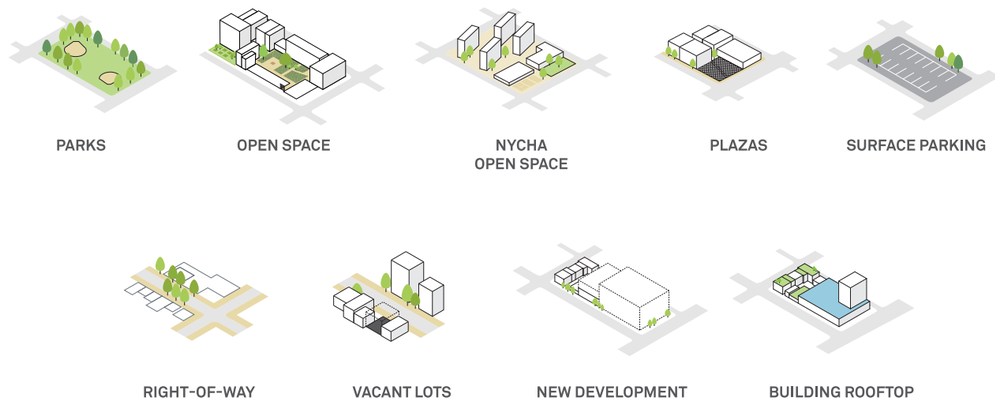


## Recommendations:
## Decentralized Measures

**Decentralized measures are suited to application on an array of sites, either as standalone measures, or as part of a system.**

This study assessed different types of sites across East Harlem to identify, at a high-level, the opportunities and limitations of managing stormwater through decentralized stormwater infrastructure. These opportunity sites include parks, plazas, streets, and parking lots, among others.

According to City analysis, widely deployed decentralized measures could only capture at most one-third of the 40 million cubic feet in anticipated volume from a future five-year rainfall event in East Harlem. Therefore, in order to address the neighborhood-wide risk, these decentralized measures should be integrated with large-scale centralized measures.




*Opportunity sites for decentralized measures.*

*Rain gardens are an example of green infrastructure that helps reduce runoff and stormwater volumes locally. (West 22nd Street, Manhattan)*

Parks can play a role by incorporating decentralized stormwater management measures into local open spaces. In this case, a community engagement process would be conducted to determine the best use of space for both recreation and stormwater management.

The scale of future stormwater flood risk, the low-lying nature of East Harlem, and the limitations of small, decentralized infrastructure, point to a need to further investigate large-scale infrastructure approaches as well implications for maintenance and operation in partnership with NYC Department of Environmental Protection. These may include large-scale pumping and storage.

***From top:*** *Large-scale subsurface detention crates can store volumes of stormwater; high-capacity, large-scale interceptors can store and convey large volumes of rainfall and connecting outfalls. Interceptors can connect centralized and decentralized measures.*



# Create Resilient Public Spaces

## Recommendations

**Invest in social infrastructure improvements to support robust public spaces that help reduce climate change vulnerability, particularly in the face of heat and flooding risks.**

Parks, as an example of social infrastructure, can play a key role in this as spaces where ecology, engagement, and infrastructure meet.

**1. Cool streets and public spaces** by increasing tree planting and stewardship, and decreasing the urban heat island effect.

**2. Expand the use of light-colored roof and pavement materials** in all public projects, where feasible, to reduce ambient temperatures.

**3. Support community organizations and small businesses** to provide emergency preparedness and climate resources and gathering spaces.

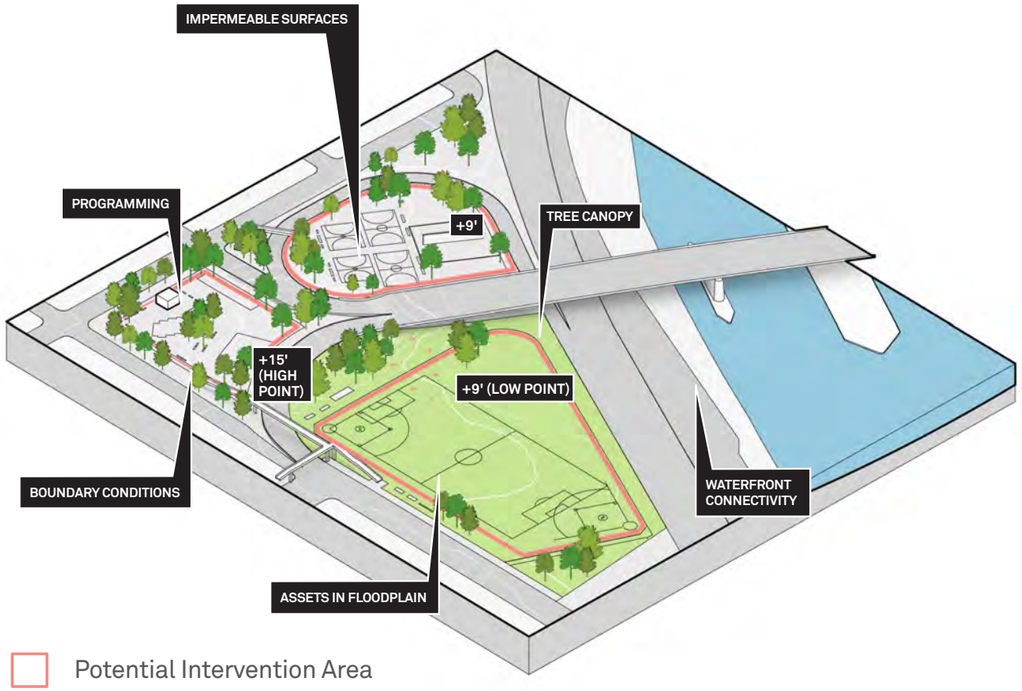
**4. Increase public programming and design** that targets more diverse and multi-generational use of open spaces to promote social cohesion.

**5. Develop and renovate open spaces to be resilient,** in accordance with NYC Parks; Design and Planning for Flood Resiliency: Guidelines for NYC Parks and the NYC Climate Resiliency Design Guidelines including:

- Locate playgrounds and outdoor fitness areas outside the floodplain where possible.
- Consider playground designs that rely less on standard play equipment structures and more on landforms, plantings, and resilient materials that are easy to maintain.
- Increase subsurface drainage around the site.
- Consider lowering fence heights or using less fencing around play and fitness facilities to minimize the repair or replacement costs if damaged by a storm.

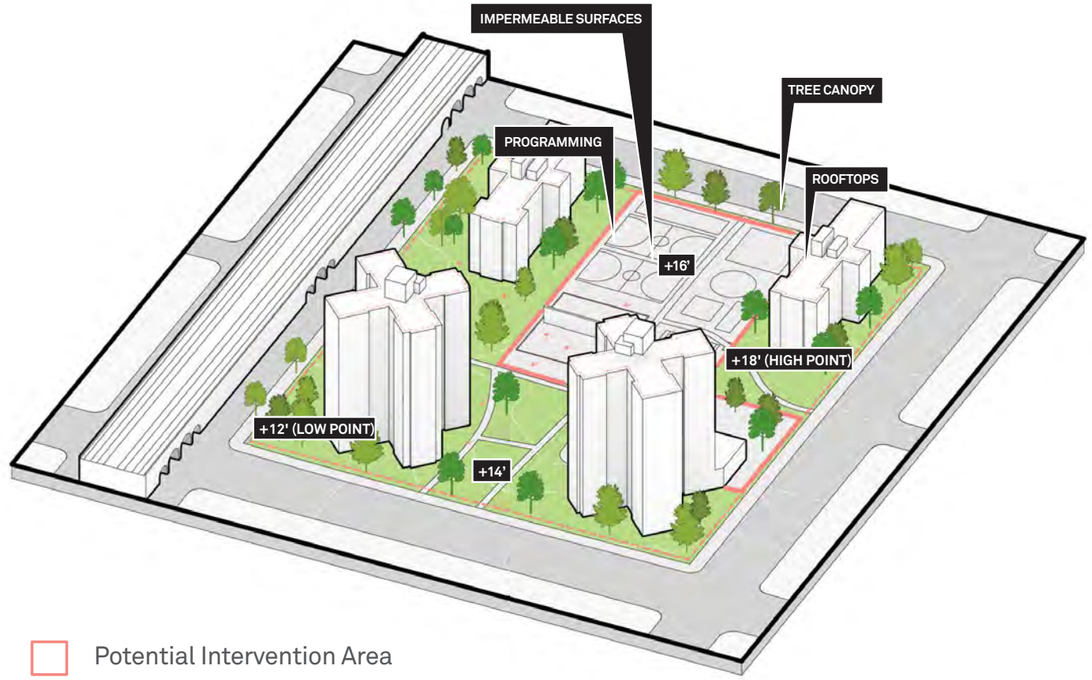
*Note: Actual interventions would be subject to site analysis, design, and funding availability.*

# Create Resilient Public Spaces




Potential Intervention Area

Parks, such as the one shown above (Harlem River Park, between East 128th and East 131st Streets), can be evaluated to identify opportunities to implement site-specific resiliency improvements.




Potential Intervention Area

Green spaces, such as parks and recreational areas within or adjacent to NYCHA, also offer opportunities to implement resiliency improvements. Above are the NYCHA Carver Houses at E Madison Ave, between 104th St and 106 St, and Mae Grant Playground. In total, there are approximately 26 NYCHA developments in this area, one of the highest concentration of NYCHA developments in the city.

*Note: Actual interventions would be subject to site analysis, design, and funding availability.*

# Adapt the Waterfront

## Recommendations
### Near Term: Raise the Waterfront

**In the near term, the neighborhood can be made more resilient by elevating low-lying sections of the waterfront in conjunction with planned esplanade repair work.**

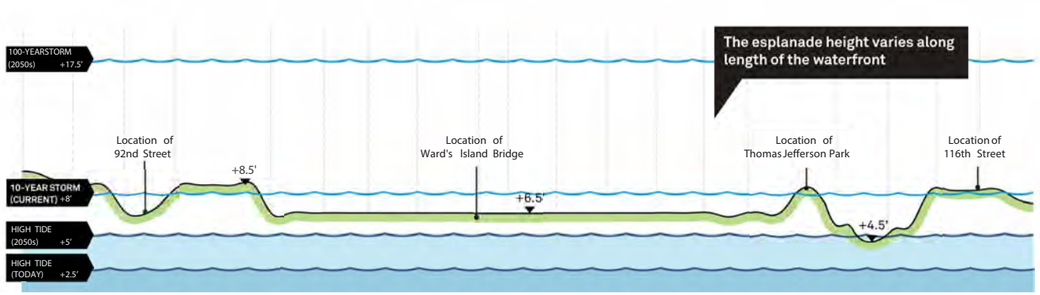
While the most acute flood risks in East Harlem result from inland drainage and rain events, storm surge from the Harlem River also contributes to flood risk in the neighborhood. Additionally, as sea levels rise, low-lying portions of the waterfront may be subject to increased chronic tidal flooding.

Modest changes in elevation could be implemented over time and as funding becomes available, allowing for a gradual adaptation of the waterfront in response to a changing environment.

The current waterfront esplanade ranges in elevation from approximately 4.5’ to 9.4’ NAVD88, above sea level.

Modest changes in elevation to lower areas may reduce risk from sea level rise and frequent storm surge. Limited elevation changes may not trigger a bathtub effect and the associated need for inland drainage measures if existing drainage measures have sufficient capacity. A bathtub effect happens when upland storm runoff, water from tidal flooding or wave overtopping becomes trapped behind a barrier and cannot be managed by the existing drainage measures. Analysis of the optimal extent and height of elevation can be incorporated into future planned rehabilitation work at an incremental cost.

*Waterfront Esplanade Elevations: East 90th Street To East 116th Street*




*Current elevations (NAVD88) of the East River Esplanade from East 90th Street to East 116th Street.*

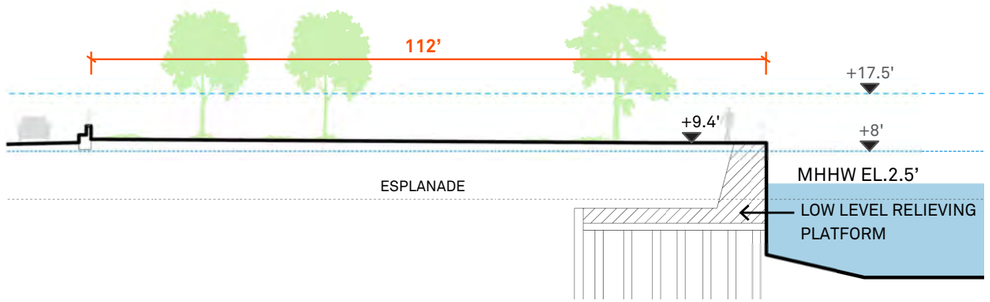


## Recommendations:
### Long Term: Integrate Elevation of Waterfront Edges With Inland Drainage and Public Space Improvements

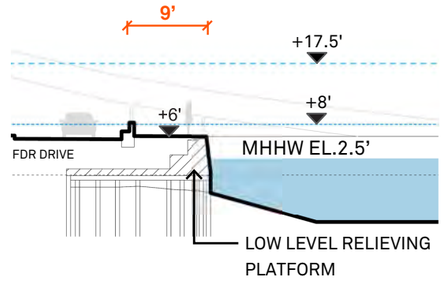
Increased climate risk may vastly transform the city’s waterfront in the long term. Rising seas may require a broad evaluation of existing waterfront edges, including associated open space, transportation, and subsurface infrastructure. Drastic increases in waterfront edge elevation alone (i.e. floodwalls, levees, gates) may not automatically result in a more resilient East Harlem if pursued in isolation. Measures to address coastal flooding rely on functional inland stormwater management systems in order to reduce neighborhood flood risk.

The interconnectedness of our waterfront areas, roadways, and drainage infrastructure means that any significant elevations of the waterfront must be paired with inland drainage measures, as well as public space improvements.

*Waterfront Edge Width and Elevations*




**AA’ - Widest And Highest Condition**
135TH STREET




**BB’ - Narrowest Condition**
97TH STREET

*The waterfront edge is complex, varying in elevation, width, and jurisdiction.*

*The East River Esplanade.*

Key considerations for long-term solutions are:

**Interior drainage:** Coastal edge protections address flooding from storm surge, but not extreme rain. In fact, if not paired with interior drainage measures, coastal resiliency measures may exacerbate inland flooding by creating a bathtub effect. Therefore, any increases to waterfront elevations must be paired with measures that sufficiently address inland drainage. This includes ensuring that critical assets like highways, access ramps to bridges, and streets are not flooded and that evacuation routes are clear. (See "Manage Stormwater" recommendations.)

**Limited waterfront width:** The waterfront esplanade is limited in width and ranges from approximately 9' to 112', with a typical width of approximately 30'. The general narrowness of the esplanade in East Harlem limits where elevations to address extreme storms can be accommodated. Proposals to modify the width and or location of the esplanade to incorporate resiliency measures will require an analysis of permitting requirements, studies of environmental, transportation, and urban design impacts, and close coordination with community stakeholders, as well as state and federal regulating agencies (i.e. NYS DOT, DEC, USACE, etc.)

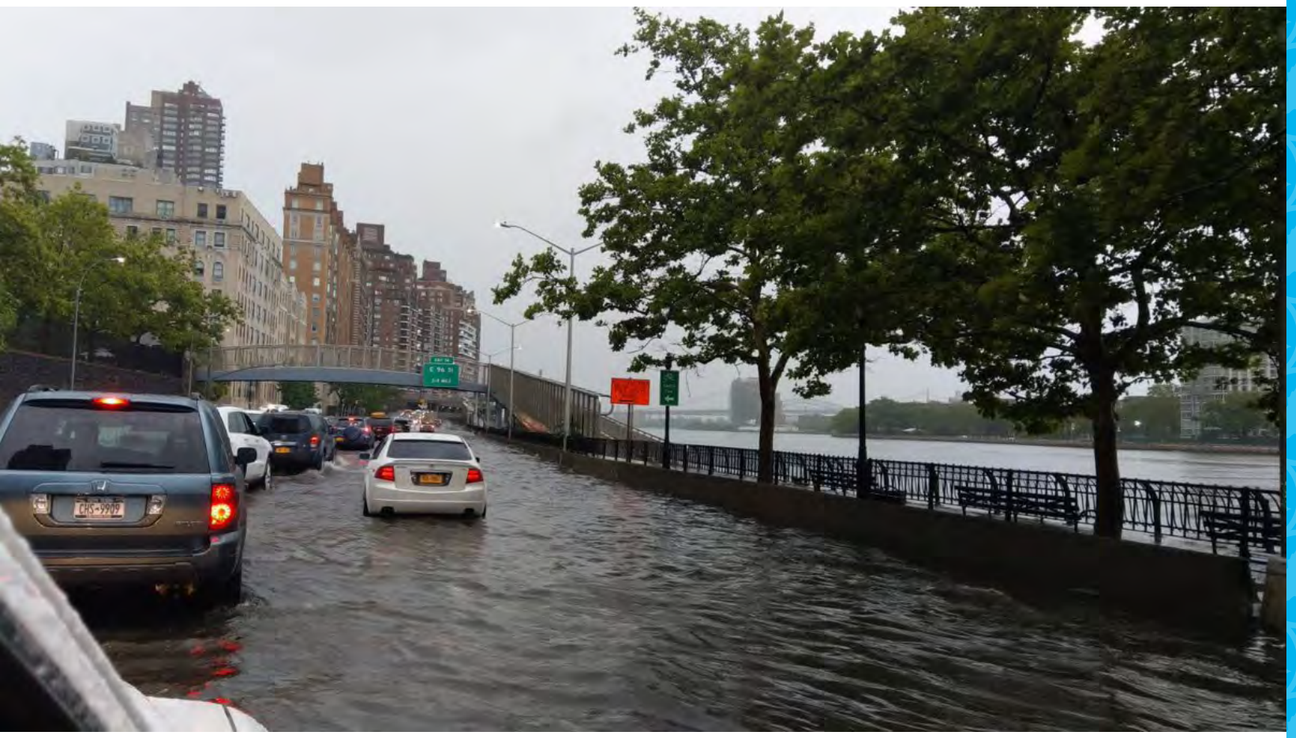
**Multiple owners:** The East Harlem waterfront is comprised of a mix of City and State-owned land, as well as privately owned segments. This is a key factor in design, implementation, maintenance, and access of waterfront measures.

**Tie-in to high ground:** Coastal resiliency measures must feature tie-ins that extend inland to meet higher ground to keep flood waters (of up to the design height) from entering the protected area. Tie-ins make it possible to form independent compartments.

Tie-ins are often sited where the floodplain is narrow as they can impact physical and visual access, transportation and urban design of a neighborhood. They must be sited and designed to avoid potential impacts to streets, open spaces, and neighboring buildings. In East Harlem, one potential location may be around East 127th Street. South of this point, the floodplain is deep and there are a high number of assets at risk. The floodplain is comparatively shallower north of this point, with fewer assets at risk.

**Access and urban design:** Ensuring that everyone can access, view, and interact with the water in a safe way has been and will continue to be a goal of the City of New York. Any changes along the waterfront must also accommodate access paths and ramps to meet ADA requirements. In addition, pedestrian bridges over the FDR drive/Harlem River Drive must meet the latest Federal safety requirements and clearance standards.

**As climate risks continue to evolve, further analysis and engagement is needed in order to refine technically feasible solutions and consider their costs and benefits. Future solutions may include creative combinations of existing tools, or more transformative proposals that leverage developing or yet-to-be developed technologies.**



*Waterfront highway flooding near E 96th Street, 2018*

# Building Resilience

# Next Steps

**This vision plan identifies a framework for creating climate resilience. Moving forward, there is continued need to:**

### ENGAGE

Continue conversations and coordination among local stakeholders, agencies, elected officials to refine needs and identify opportunities.

### PILOT

Test interventions as resources and opportunities become available.

### INTEGRATE

Make investments for the future by studying and incorporating best practices into projects and policies moving forward.

The City has already begun efforts in each of these key categories across the neighborhood and will continue to pursue future work to further engage the community in building resiliency.

The following examples demonstrate ongoing and completed work in East Harlem.



# Engage

### DREAM Charter School

The study team developed a semester-long curriculum about climate resiliency aimed at empowering young scholars at DREAM Charter School to be leaders in their community and advocates for resilience-building initiatives.



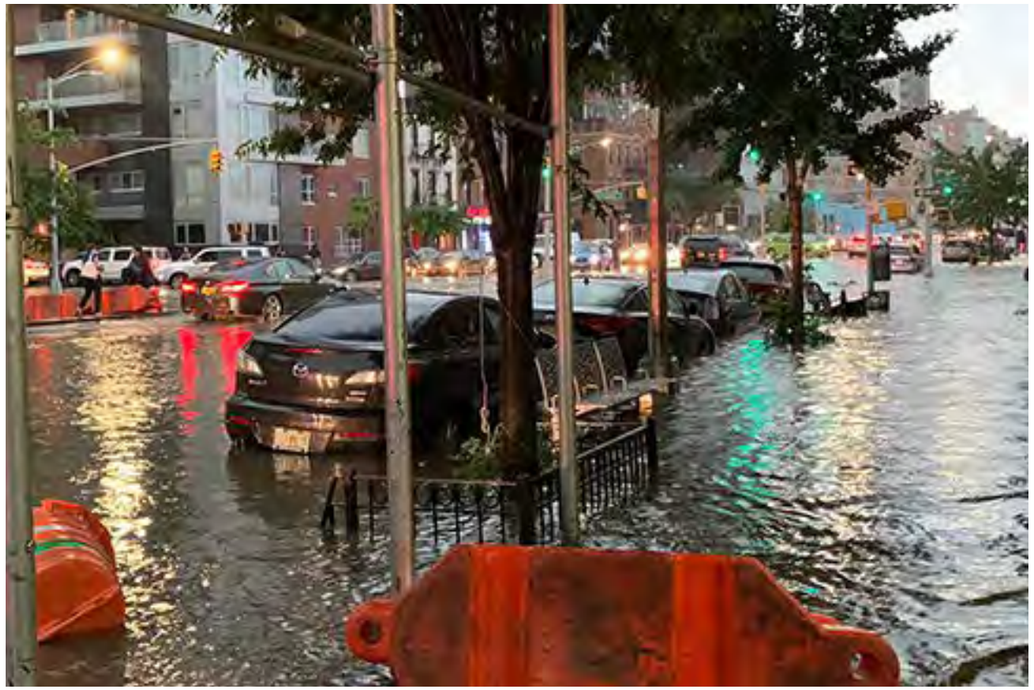


**1.** DREAM High School students worked with members of the Washington Houses Resident Council to install the garden in summer 2019. **2.** "Washington Houses Ready" illustrates how to prepare for a range of climate risks in East Harlem and provides information on how the diverse groups who live at Washington Houses can respond. A unique resilience building exercise, the pocket guide resulted from a collaboration of DREAM students, Washington Houses residents, and emergency preparedness groups active in East Harlem. **3.** Students participating in the climate resiliency curriculum at DREAM planned and designed a rain garden at the Washington Houses property. In a series of classroom workshops, students analyzed and designed the project site by testing the soil, conducting a percolation test, selecting appropriate plants, and considering stakeholders in the future use of the garden. **4.** In summer 2018, DREAM High School students worked with the Washington Houses Residents Council to conduct a survey of tenants about emergency and disaster concerns. The results of the survey informed the types of information that were included in the "Washington Houses Ready" emergency preparedness guide.

## Engage

### Citywide Studies

The Citywide Stormwater Study, led by MOR and DEP, will identify where flooding most frequently occurs due to heavy rain and will analyze how sea-level rise and stronger rainstorms expected in the future will impact the city's drainage network. It will also propose mitigation actions to alleviate urban flooding issues. Lessons learned through this process could be used to more precisely address the impacts felt on this community.



*Gowanus flooding in summer 2019.*

## Pilot

### Managing Stormwater

The City of New York received funding to pilot a study of decentralized stormwater retention opportunities in East Harlem. In 2019, NYCHAwas awarded FEMA Pre-Disaster Mitigation Advance Assistance grant funding to study the incorporation of stormwater retention opportunities, such as a water square, into renovations of the Clinton Houses basketball courts. A water square functions as a recreational space during blue sky days, while helping to reduce the amount of water overwhelming storm sewers during heavy rain events. This effort is jointly led by NYCHA and DEP, and will kick off in 2020.

*Example of a water square in Rotterdam; photo courtesy of DEP.*

# Integrate

## Adapt the Waterfront

NYC Parks, in partnership with the NYC Economic Development Corporation, is developing the Harlem River Greenway Link, a new seven-acre park from E. 125th to E. 132nd street that will create a continuous publicly accessible waterfront on the East Side from Northern Harlem to East Midtown. Resiliency will be a key consideration in the design of this brand new waterfront open space.

*Rendering of Harlem River Greenway.*

## Creating Resilient Spaces

NYC Parks has been transforming neighborhood parks like Playground 103 through the Community Parks Initiative, which strives to make a more equitable and accessible parks system by investing in underinvested parks located in neighborhoods of high poverty, density or growth.

The reconstruction expanded the children's play areas with accessible play equipment, fitness equipment and basketball courts to encourage active recreation. There is an area for relaxation; the shade trees and an array of accessible game and picnic tables form the heart of the park. Additionally, the site's green infrastructure elements were increased with native vegetation to address drought and salt tolerance, add habitat value, and beautify this location next to the East River Houses and the FDR Drive. NYC Parks partnered with DEP for the construction of six rain gardens and a subsurface detention system, an example of a decentralized approach that will capture up to 1.7 million gallons of stormwater that fall on the playground each year. By capturing the stormwater and keeping it out of the combined sewer system, the Green Infrastructure will help to improve the health of the East River. In addition to managing stormwater, green infrastructure helps to improve air quality while also providing shade and lowering summertime temperatures.

Through CPI, the City is renovating 67 parks citywide that have not undergone significant improvements in two decades. This program creates vibrant open spaces for families to spend recreational and respite time outdoors within neighborhoods of the highest need, increasing the social and physical resiliency of neighborhood residents.

*Playground 103 before reconstruction (left) and after (right).*



# Final Thoughts

**The East Harlem Resiliency Study is intended to serve as a framework for a stronger, safer, and more resilient community in the face of climate change. Creating resilience is a long-term process that is achieved through collaboration between residents, local leaders, and city agencies, among others.**

In East Harlem, there is no single, simple solution for community resilience as there are complex trade-offs that necessitate a comprehensive evaluation of site characteristics, risk, interior drainage, accessibility, and urban design.

While there is no silver bullet solution, the city will continue to build new assets in a resilient manner, explore new types of interventions, and advocate for additional resources.

# Resources

## General

**NYC Emergency Management Community Preparedness Teams**

The NYC Emergency Management's Community Preparedness Team offers community-based organizations and faith-based groups a variety of training classes, webinars, and conferences that focus on a range of emergency preparedness and response topics. These events provide community partners an opportunity to improve their local emergency planning capacity by offering a platform to network, share ideas, and best practices.

nyc.gov/site/em/ready/training-resources.page

**East Harlem Community Organizations Active in Disasters (COAD)**

The East Harlem COAD is a coalition of local organizations and businesses who work to prepare for, respond to, and recover from disasters that affect the lives of East Harlem residents. The COAD was established in 2015. Member organizations meet regularly to create plans, host trainings, and to conduct drills and exercises. If your organization or business is interested in joining the COAD, reach out to eastharlemcoad@gmail.com

**NYC Climate Resiliency Design Guidelines**

These guidelines provide step-by-step instructions on how to supplement historic climate data with specific, regional, forward-looking climate change data in the design of City facilities. All new projects and substantial improvements should assess risks to climate change hazards in the context of the project's purpose, asset type, site location, and funding, and then determine the appropriate resilient design strategies using the guidelines.

nyc.gov/assets/orr/pdf/NYC_Climate_Resiliency_Design_Guidelines_v3-0.pdf

**Design and Planning for Flood Resiliency Guidelines for NYC Parks**

This interdisciplinary manual was developed by NYC Parks and released in November 2017 to provide guidance for developing and renovating coastally resilient waterfront parks. The Guidelines are specifically tailored for NYC Parks with the hope that other planners, designers, consultant firms, agencies, communities, and homeowners can use them as a reference for coastally resilient park planning and design.

https://www.nycgovparks.org/planning-and-building/planning/resiliency-plans/flood-resiliency

**Stay Informed**

Notify NYC is New York City's dedicated emergency public communications program. The goal for Notify NYC is to provide the information you want to receive, the way you want to receive it.

nyc.gov/notifynyc

The NYC Advance Warning System provides emergency alerts and information to organizations that serve people with people with disabilities and others with access and functional needs.

Sign up for alerts:
advancewarningsystemnyc.org/aws/pub/registration.html

## Extreme Rain

**What You Can Do to Help Prevent Flooding**

Learn about steps you can take to protect our City from flooding.

nyc.gov/html/dep/html/stormwater/flooding_how_to_help.shtml

**Homeowner's Guide to Rain Event Preparedness**

Get tips to help prevent your home from flooding.

nyc.gov/html/dep/pdf/brochures/flood-preparedness-flyer.pdf

**Report Clogged Catch Basins**

Call 311 or fill out an online form.

nyc.gov/nyc-resources/service/1338/catch-basin-complaint

## Coastal Storms and Hurricanes

### Plan for Coastal Storm Hazards

Coastal storms, including nor'easters, tropical storms and hurricanes, can and do affect New York City. It's important New Yorkers take the time to prepare. All residents should have a plan in the event they need to evacuate or ride out the storm at home. Visit the Know Your Zone website for everything you need to know about hurricanes in New York City:

nyc.gov/assets/em/html/know-your-zone/knowyourzone.html

Get tips on what to do before and during a coastal storm:

nyc.gov/site/em/ready/coastal-storms-hurricanes.page

### Map Your Risk

A product of the New York City Department of City Planning, the NYC Flood Hazard Mapper provides a comprehensive overview of the coastal flood hazards that threaten the city today, as well as how these flood hazards are likely to increase in the future with climate change. It is intended to enable more informed decision-making by residents, property and business owners, architects and engineers, and policy-makers.

nyc.gov/floodhazardmapper

### Floodhelp NY

Funded through the New York Governor's Office of Storm Recovery and New York Rising, FloodhelpNY was created as a platform for engaging and informing New York City homeowners about how they can protect their home and finances from flooding that is expected to worsen with rising sea levels caused by climate change. A primary goal of the site is to connect eligible low- and middle-income homeowners with engineers in select coastal communities to provide resiliency audits so that they can make informed decisions about reducing their risk to future floods that will also help to lower their flood insurance rates

floodhelpny.org

## Heat Waves

### Plan for Extreme Heat Hazards—Beat the Heat

- Monitor the weather forecast for upcoming heat waves.
- Check on vulnerable family, friends, and neighbors to make sure they stay safe and cool.
- Stay in a cool place as much as possible. If you do not have an air conditioner, consider cooling off at a pool, or in an air-conditioned store, museum, library, or cooling center.
- Get more information on how to recognize and prevent heat illness:

nyc.gov/site/em/ready/extreme-heat.page

### NYC Cooling Center Finder

A cooling center is a facility where people may go to enjoy air-conditioned comfort during a heat emergency. Cooling centers are free and open to the public, and operate during daytime hours. You can find your nearest location by calling 311 or checking the Cooling Center finder during a heat wave.

maps.nyc.gov/oem/cc

### NYC CoolRoofs

NYC CoolRoofs offers cool roof installations at no cost or low cost to select buildings. The program also provides local jobseekers with training and work experience installing energy-saving reflective rooftops.

nyc.gov/nycbusiness/article/nyc-coolroofs

### Request a Street Tree

Trees provide shade and help reduce surface temperatures. Call 311 or fill out an online form.

nycgovparks.org/trees/street-tree-planting/request

### Fire Hydrant Spray Caps

FDNY can fit fire hydrants with spray caps for recreational use. Illegal opening of fire hydrants for sprinkler use can reduce water pressure in the system and produce a safety hazard. Applicants can complete a request form at their local FDNY firehouse. Find your local firehouse:

nyc.gov/nyc-resources/service/1670/find-a-firehouse