Living Above the Street

Stewarding New York City's Historic Built Environment Towards Flood Resilience

DIGITAL REPORT 02

Adaptive Streetscape: Concept & Framework

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About

This report is part of the independent research project "Living Above the Street: Stewarding New York City's Historic Built Environment Towards Flood Resilience," which is supported by Onera Foundation under 2022 Onera Prize for Historic Preservation.

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Further Readings

To view and download the whole series of policy & design reports, please visit: https://www.livingabovethestreet.nyc/reports.

This Onera Prize research project is developed upon the author's M.S. Historic Preservation thesis:

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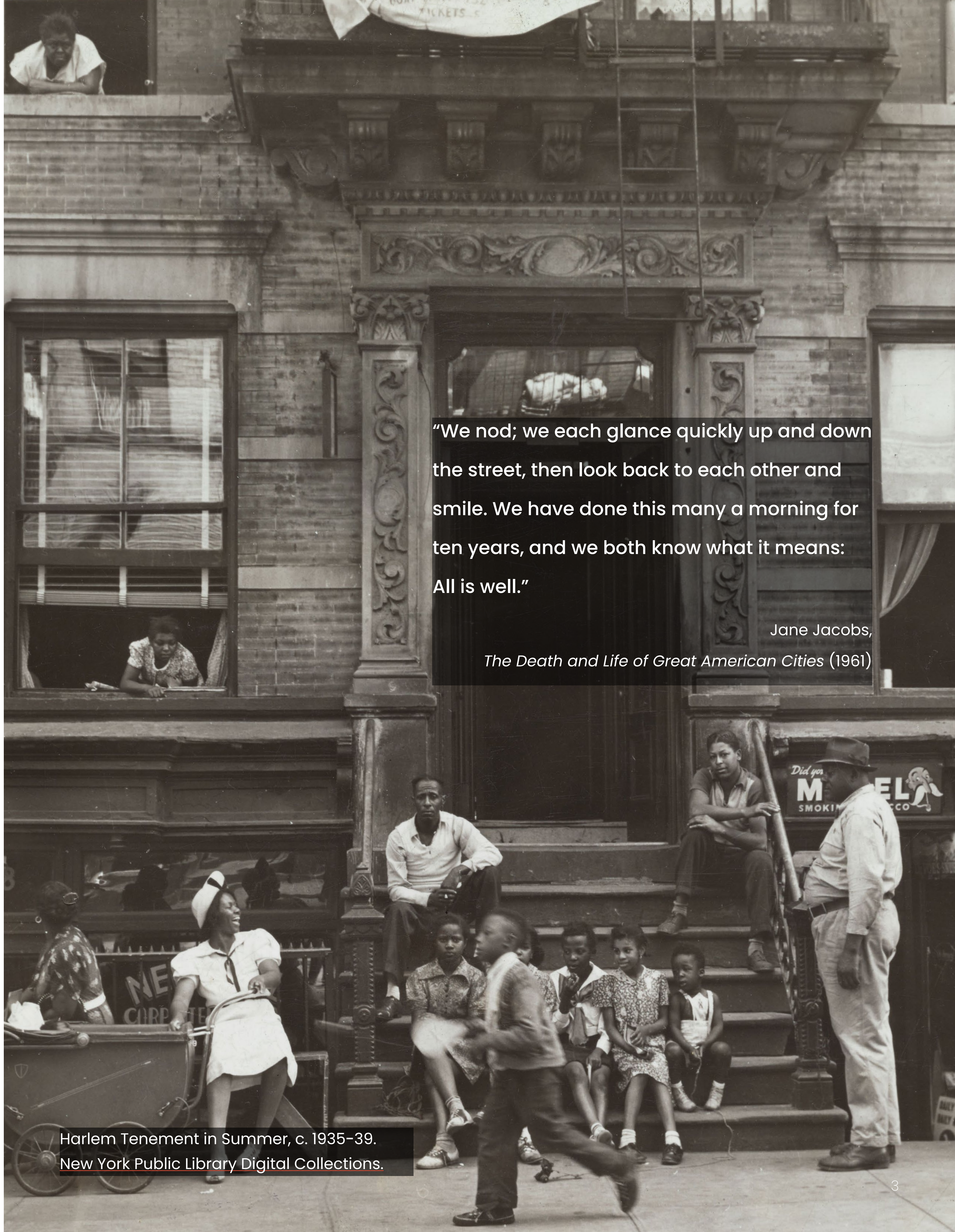
Cover Image:
Different Goals of Adaptive Streetscape Transformation, Visualized on the Elevation of Front Street in South Street Seaport. Illustration by the Author.



"We nod; we each glance quickly up and down the street, then look back to each other and smile. We have done this many a morning for ten years, and we both know what it means: All is well."

Jane Jacobs,
The Death and Life of Great American Cities (1961)

Harlem Tenement in Summer, c. 1935-39.
New York Public Library Digital Collections.

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Executive Summary

Among the multiple complications brought by flood adaptation on historic built environment as identified in Digital Report 01, **streetscape change** is the key area of tension. Typical flood retrofitting interventions such as structural elevation and wet-floodproofing directly diminish the visual and experiential qualities of historic streetscapes, which would potentially result in a significant loss of historic values embedded in New York City's human-scaled, vigorous and intimate historic streets.

Severe streetscape changes brought by flood retrofitting projects in New York City's waterfront communities are reminders of the fact that **flood resistance is not the only goal in the adaptation of New York City's historic structures, neighborhoods and districts, and that we must take a broader scope of heritage values into consideration**. As New York City's existing streetscape mitigation design guidelines are targeted at general existing structures, they often fail to address specific historic preservation concerns — such as visual consistency, historic authenticity and social-spatial relationship — in their design recommendations. To explore policy and design guidelines suitable for New York City's historic built environment, we must first develop a more comprehensive understanding of the goals and values involved in its transformation towards flood resilience.

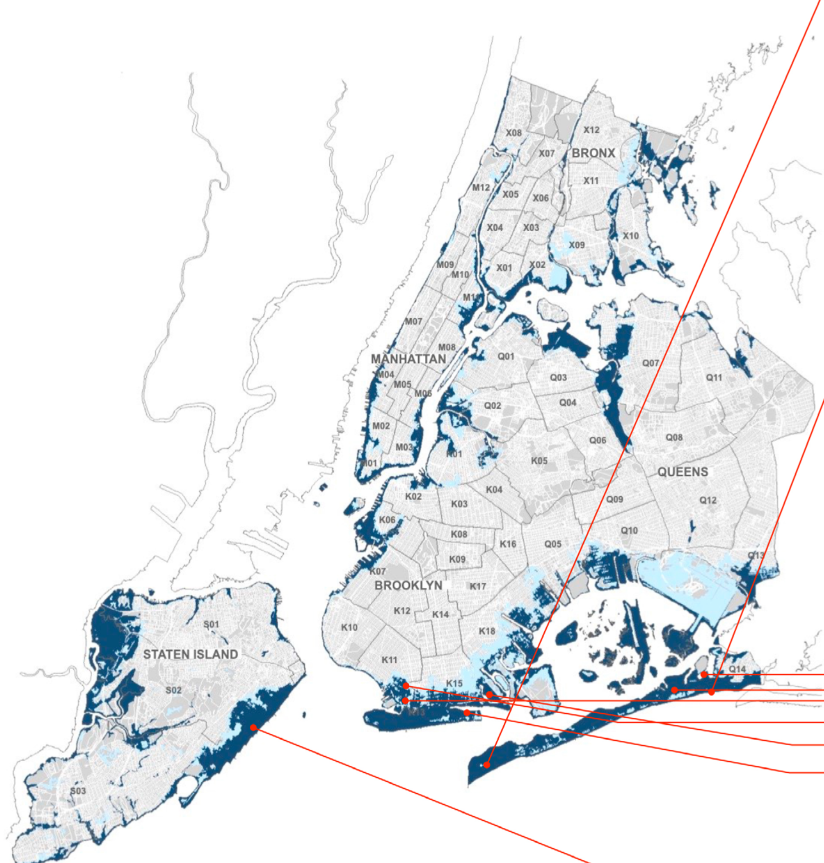
In response to the problem stated above, this report puts forward a framework for the understanding and evaluation of historic streetscape change under flood adaptation. Under the **"Adaptive Streetscape" concept**, key adaptation and preservation goals including **Flood Resilience, Building Integrity & Visual Consistency, Streetscape Experience & Social-Spatial Relationship, and Floor Area Transfer** are identified; a set of **semi-quantitative evaluation metrics** are then developed to facilitate a more accurate comparison of streetscape qualities before and after planned adaptation interventions.

It's also important to acknowledge that **intricate tradeoffs and conflicts exist among the multiple goals identified in the flood adaptation of historic streetscapes, and that different goals will likely lead to different retrofitting treatments and design choices.** In other words, a specific retrofitting treatment (such as structural elevation) may have positive effect on some goals (e.g. flood resilience), but negative impacts on others (e.g. streetscape quality). **These tensions speak for the meaning of the Adaptive Streetscape framework in producing balanced solutions acknowledging multiple values and conflicting goals.** The Adaptive Streetscape concept and metrics constructed in this report will be actively referenced in the literature review, design study and policy analysis featured in upcoming reports, serving as a foundation for this project's exploration of design and policy tools.

02

Key Issue: Streetscape Change

Post-Sandy Built Projects & Associated Streetscape Change



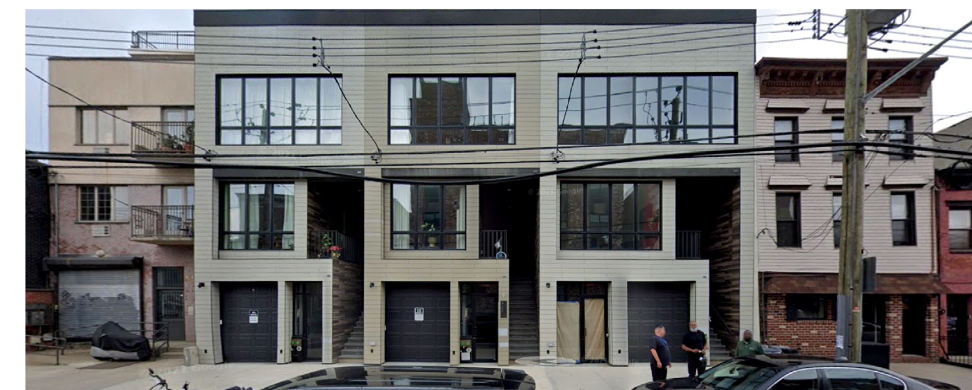
New York City's 1% Floodplain
(2007 FIRM & 2015 PFIRM Combined)

Breezy Point Streetscape, 2021

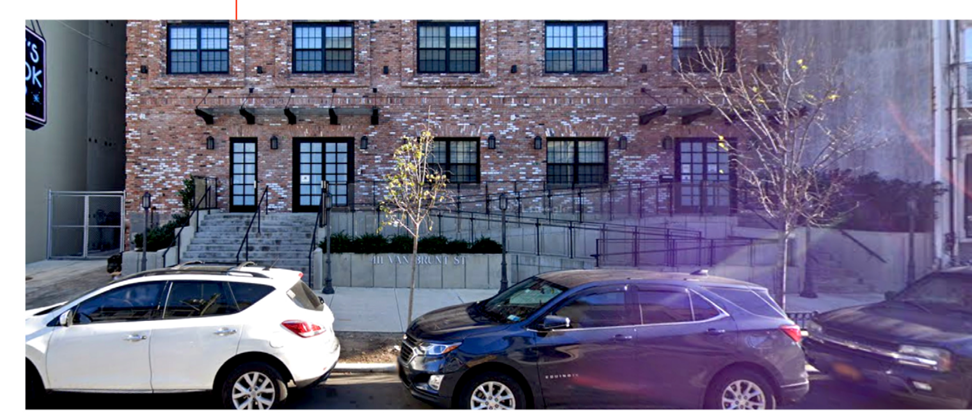
Selected NYC *Build It Back* Projects, 2016-2019

Post-Sandy Retrofitting and Reconstructions

Hotel, 2013, Far Rockaway



Walk-Up Residential Houses, 2018, Red Hook



Community Facility, 2017, Red Hook

Post-Sandy New Constructions

Image Sources: NYCDCP 2019d, 4 (floodplain map); Instagram @nycbuilditback; Google Maps.
Compiled by Ziming Wang, Aug. 2022.
For full analysis, see Digital Report 01: *Flood Risk of New York City's Historic Built Environment*, Chapter 3.

2.1

Streetscape Tensions in Flood Adaptation

Streetscape Tensions in Flood Adaptation

In Digital Report 01, the author has raised several conflicts and challenges that flood adaptation interventions pose on historic built environment, including the lack of innovative design strategies and systematic policy mechanism, the exemption of designated historic buildings from retrofitting mandates, as well as the lack of financial incentives. Among the multiple complications brought by the underdeveloped design and policy framework at the intersection of flood adaptation and historic preservation, **streetscape change** seems to be the key area of tension. Typical retrofitting interventions — including structural elevation and wet-floodproofing — immediately and directly diminish the visual and experiential qualities of historic streetscapes, which would potentially result in a significant loss of historic values embedded in New York City's human-scaled, vigorous and intimate historic streets. Specifically, the streetscape discourse is of key importance for the following reasons:

- **Streetscape Change is the Most Significant Impact Brought by Flood Adaptation.** Compared to relatively minor interventions such as the relocation of critical systems and the installation of dry-floodproofing anchors, streetscape changes brought by the elevation of habitable spaces (as required by New York City's Post-Sandy Building and Zoning Codes) often result in a complete alteration of historic characters including style, proportion and street relationship, as well as significant reworking on historic fabrics. These interventions tend to create completely new, out-of-context and sometimes alienating urban forms, and are often far beyond the acceptance of New York City's local design review standards which are strictly based on formal quality and material authenticity.

- **Streetscape Tensions Involve Multiple Forms of Heritage Values.** Beyond the formal quality and material authenticity stressed by local Landmark Law and preservation standards, historic street spaces actually represent a broader range of heritage values. For example, intimate historic streets often house a variety of functions and activities including window-shopping, dining, plantation, and resting; they may also serve as a vehicle of community connections, as demonstrated by the "sidewalk ballet" recorded by Jane Jacobs.[1] Furthermore, these functions and activities are often paired with specific types of physical spaces along the street: for example, the retail storefronts at street-level or in cellars, the row house lobbies above street level accessed by a stoop, and storage space in the cellar accessed by an alleyway. If all these functions and activities are removed, the characters of a historic streetscape would be significantly reduced even if all its visual and spatial qualities have largely remained. All these examples speak for the value of the vigor, interactivity and social-spatial relationships embedded in historic streets.

- **Streetscape Change is a Unique Challenge Faced by the Preservation Enterprise.** Given the acute tensions between flood adaptation interventions and the potential loss of heritage values, streetscape change has become a thorny issue peculiar to the preservation enterprise. As new adaptation designs and projects are proposed, architects and planners are creating drastically new urban forms to incorporate flood resilience; since retrofitting guidelines made for general existing structures typically don't identify historic preservation as an aim, design recommendations promoted in these guidelines won't be sufficient to address the loss of streetscape values in the context of historic built environment. Therefore, it's ultimately the preservation enterprise's responsibility to develop innovative design and policy solutions to steward our historic streetscapes towards flood resilience while retaining their visual, material, and social-spatial qualities.

Building on New York City's Post-Sandy building and zoning policy framework and associated streetscape change outcomes analyzed in Digital Report 01, this section seeks to elaborate the vital importance of streetscape preservation in the flood adaptation of historic built environment. For a full analysis on streetscape change brought by New York City's Post-Sandy Building and Zoning Codes, please refer to Chapter 3 of *Digital Report 01: Flood Risk of New York City's Historic Built Environment*.

The importance of the streetscape discourse can also be demonstrated by existing nationwide design guidelines on the flood retrofitting of historic structures, which more than often identify streetscape mitigation strategies as a key focus area. For example, Charleston, SC's *Design Guidelines for Elevating Historic Buildings* (2019) has adopted streetscape design as its key consideration, promoting detailed site, entrance and foundation design recommendations and successful local practices to help facilitate an appropriate transformation of historic urban forms; similarly, New Jersey and Newport's design guidelines on the elevation of historic buildings have also identified streetscape change as a key preservation challenge, and have both put forward design and zoning recommendations that help to preserve the streetscape expression of historic structures (see NJSHPO 2019a, 9-4, 9-5, 3-10; NJSHPO 2019b, 21, 26; Newport HDC 2020). These existing design solutions may serve as a valuable reference for New York City's flood adaptation and historic preservation policy-making, and will be further synthesized in *Digital Report 03: Streetscape-Sensitive Design Strategies*.

Streetscape-Friendly Elevation Design of a Historic Home in Charleston, SC.
Source: Photograph by the Author.

1 For "Sidewalk Ballet," see Jacobs 1961, 50-51.

Context of the Streetscape Discourse

As this project focuses its lens on the streetscape changes of historic built environment brought by flood adaptation, it would be important to locate the streetscape discourse in the broader realm of flood adaptation and historic preservation fields; by doing so, this project's findings will be able to better connect with and more effectively contribute to the larger picture of heritage resilience planning and policy-making. From macro to micro scale, this section briefly examines the context of the streetscape change discourse pursed by this project.

Flood Hazard Mitigation: Managed Retreat, Relocation and In-Situ Adaptation

The top-level decision making regarding flood risk involves a choice whether to move people and buildings away from flood-prone areas, or adapt the existing flood-threatened built environment *in-situ*. As a community-level collective action, **managed retreat** means "the strategic relocation of structures or abandonment of land"; on single-building or single-site scale, **relocation** means a strategy where historic properties and cultural resources are moved to new sites with low flood risk (Hino, Field, and Mach 2017, 364; FEMA 2005, 3-17). Although experimental projects of managed retreat and relocation have both been carried out, **in-situ adaptation** is still today's mainstream strategy; in recent years, U.S. cities have built or proposed levees and sea walls, elevated streets and buildings, and implemented building floodproofing treatments to facilitate flood-resilient, in-situ development into the future.[2]

In-Situ Flood Adaptation: Strategies under Different Scales

In-situ adaptation strategies incorporate a wide range of solutions from city scale to building/lot scale. As one of the most densely populated and developed coastal city in the world, New York City has thus far engaged with adaptation projects and proposals of almost all different scales. Notable Post-Sandy adaptation projects in New York City include:

- The **city-scaled** *New York-New Jersey Harbor and Tributaries Coastal Storm Risk Management* study (2019) by U.S. Army Corps of Engineers, which proposes an up-to-6-mile long seawall that protects the city's waterfront area under extreme stormwater events (see Barnard 2020);
- The **neighborhood-scaled** East Side Coastal Resiliency Plan designed by architectural firm BIG in 2014, which features a landscaped levee that spans over 2.5 miles on Manhattan's Lower East Side shoreline and serves as part of the continuous flood protection infrastructure (along with the Lower Manhattan Coastal Resiliency Plan, LMCR) that surrounds lower Manhattan (Bjarke Ingels Group n.d.);
- NYC Department of City Planning's **neighborhood and street-scaled** flood adaptation planning studies, such as *Resilient Neighborhoods: West Chelsea* (2016) and *Resilient Retail* (2016);
- The **building-scaled** NYC Build It Back program carried out by NYC Mayor's Office of Housing Recovery Operations (HRO) since 2013, which has provided assistance to around 32,000 households impacted by Sandy as of 2021 (NYC Recovery 2021), and "has rebuilt and elevated over 1,300 homes to today's stringent regulations for flood compliance," often elevating homes to 10 to 14 feet above sea level (NYC Mayor's Office of Housing Recovery Operations n.d.).

Among the multiple solutions discussed above, individual-building retrofitting is by far the most widely carried out adaptation method. Under NFIP's floodplain management regulations, local municipalities have enforced flood-resistant building standards in their Building Codes; building elevation and retrofitting are also given a central place in NFIP's insurance policies, as well as FEMA's guidelines for homeowners and planners (see for example, FEMA 2014; FEMA 2008).

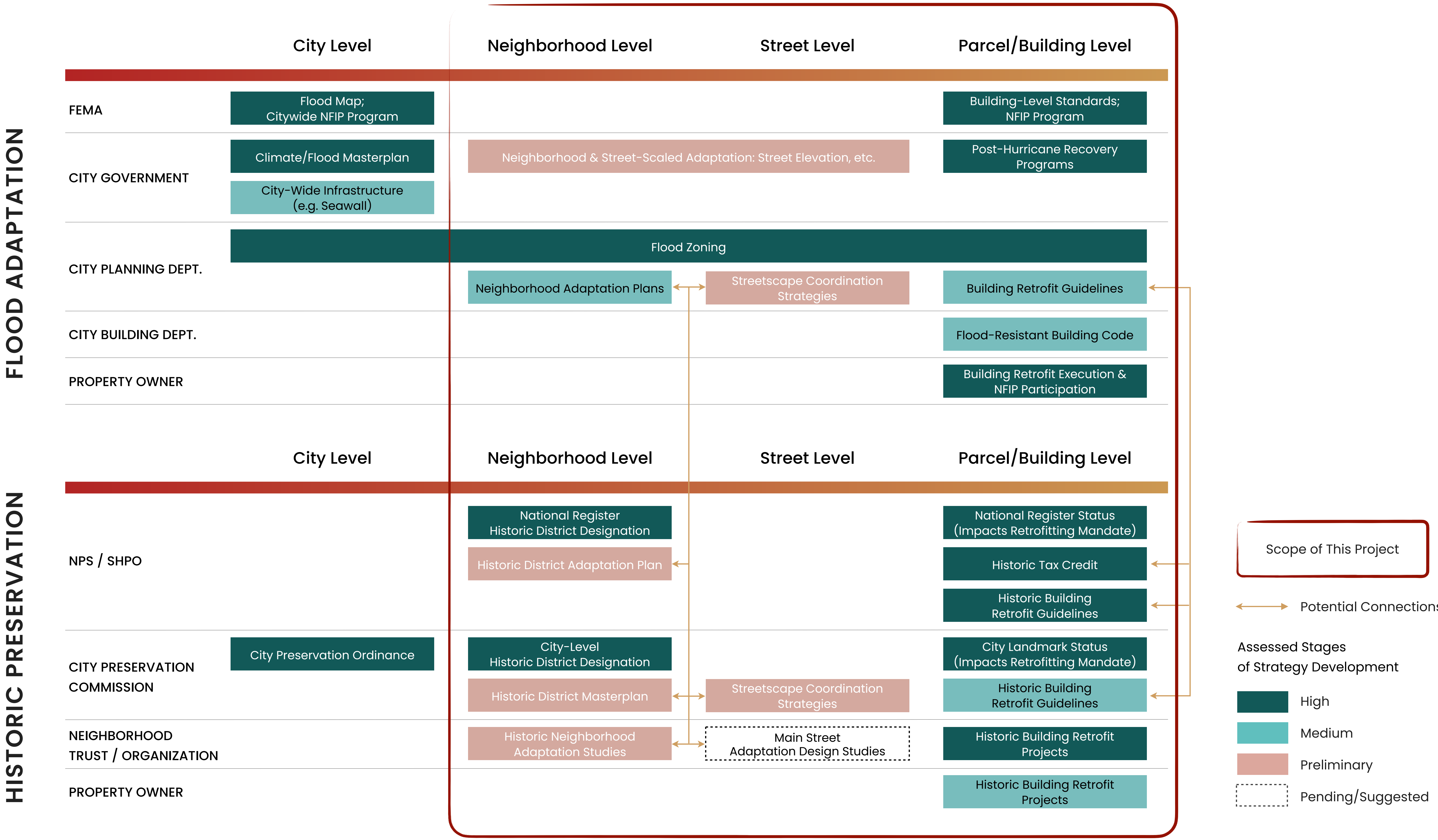
The Role of Historic Preservation

Multiple cities and communities in the United States (such as Newport, RI, Charleston, SC, St. Augustine, FL and Nantucket, MA) have their historic downtowns within flood-threatened areas, and have thus seen flood retrofitting projects launched on structures with historic significance or landmark status. These retrofitting projects, along with associated policy-making and research efforts, have created some connections between the discourses of flood adaptation and historic preservation.

In recent years, historic preservation agencies from Federal to local level have published a variety of **flood retrofitting design guidelines for historic structures** — including National Park Service's recently updated *Guidelines on Flood Adaptation for Rehabilitating Historic Buildings* (2nd ed., NPS 2021); historic building retrofitting guidelines made by New Jersey (2019), Maryland (2018), and Louisiana (2015) SHPOs; local design and review standards published in cities such as Boston (2018), Charleston (2019), Newport (2020), and St. Augustine (2021). Summarizing successful local practices and putting forward recommended design treatments, these guidelines have provided insight on how historic buildings may be retrofitted for flood resilience; nevertheless, given the building stock in local communities, most of these guidelines are focused on detached single homes.

Meanwhile, homeowners of historic structures and local preservation organizations have played an active role in carrying out **real-world retrofitting projects**. Successful elevation and retrofitting projects on historic structures include the Greek-Revival house in Owego, NY raised by homeowner Julie Nucci (NPS 2021, 88; Roby 2015); Newport Restoration Foundation's experimental projects on retrofitting and elevating Colonial homes (NRF 2016;

2 For an example of managed retreat, see Acquisition and Buyout Program under NYC Build It Back (Maldonado 2021; NYC Mayor's Office of Housing Recovery Operations n.d.); for an example of relocation, see the relocation of the Bachman Wilson House designed by Frank Lloyd Wright (Florida Department of Economic Opportunity 2015, 63).



Context of the Streetscape Discourse.
Source: Author's Illustration.

Dean 2019); and the 113 Calhoun Street retrofitting project in Charleston, carried out by a collaboration between the City of Charleston, Clemson University, and South Carolina Sea Grant Consortium (FEMA 2008, 14). Cities previously hit by hurricanes — such as New Orleans and Charleston — have seen more retrofitting projects on historic buildings.[3]

Although most of the current research and practice are concentrated on building scale, there have been some recent studies seeking to **incorporate neighborhood-scale strategies** into the flood adaptation of historic built environment. For example, the *Manayunk Main Street Historic District Flood Guide* (2020) commissioned by the Pennsylvania SHPO has adopted a neighborhood-scaled perspective targeting at the major building types within Philadelphia's Manayunk Main Street Historic District; Newport Restoration Foundation's *74 Bridge Street* study (2016) advocates for elevating the street together with buildings as a strategy to ensure long-term resilience and protect historic characters; the City of Miami Beach's Buoyant City guideline (2020) addresses urban form change and streetscape change through extensive neighborhood and street-scaled design illustrations. In addition, **conferences** such as Keeping History Above Water (nationwide) and Preservation in a Changing Climate (Salem, MA) are also being held to exchange knowledge on the flood adaptation of historic built environment.

The Context of the Streetscape Discourse

Among the flood adaptation strategies of different scales, **individual-building based retrofitting is mostly likely to cause drastic streetscape changes**. Coordinating retrofitting design options of individual buildings, street and neighborhood scaled strategies are also closely related to the issue of streetscape change. Therefore, this project focuses its lens on streetscape changes associated with building, street and neighborhood-level flood adaptation treatments, and engages New York City's historic buildings, neighborhoods and districts as its subject.

The diagram on pages 14-15 graphically examines this project's scope, and maps it within projects and policies implemented by major stakeholders in the realms of flood adaptation and historic preservation. The diagram also reveals opportunities for further connection between the two fields, as well as the fact that street and neighborhood-scaled heritage resilience research and policy-making have been relatively scarce. **Engaging both building and street/neighborhood-scaled perspectives**, this project seeks to make design and policy inquiries towards the potential streetscape changes in New York City's historic built environment brought by flood adaptation, and develop design and policy tools that facilitate an adaptive transformation of New York City's historic streetscape towards flood resilience.

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3 For examples of elevation projects in New Orleans, see project gallery of local contractor Roubion Elevation + Shoring; for an example of historic building retrofitting in Charleston, see the timelapse of 1 Water Street in Charleston (which will be further discussed as a case study in Digital Report 03).

2.2 New York City's Existing Regulations & Guidelines on Streetscape Mitigation

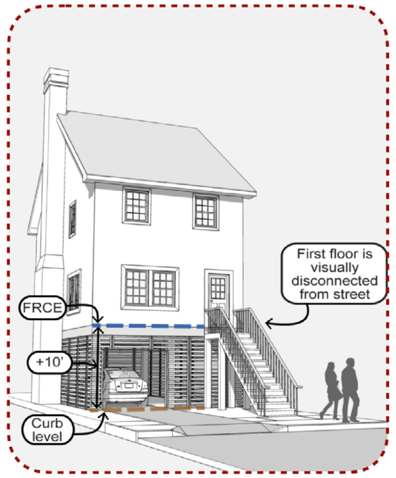
Although this project seeks to leverage nationwide regulations, guidelines and built projects to develop flood adaptation strategies for New York City's historic built environment, New York City's local regulations and guidelines remain as a keystone for the project's research and findings. Building on New York City's Post-Sandy flood regulation framework elaborated in Section 3.1 of Digital Report 01, this section briefly examines the specific streetscape design provisions in New York City's two **Flood Zonings** (which are currently mandatory for all projects in the city's floodplain), and streetscape **design guidelines** promoted in NYCDCP's 2014 *Retrofitting Buildings for Flood Risk* report. These regulations and guidelines represent New York City's most comprehensive and up-to-date policy-making at the intersection of flood adaptation and streetscape change.

Streetscape Provisions in the 2013 Flood Zoning Amendment

As a temporary Zoning Amendment put forward to support Post-Sandy development and reconstruction, New York City's 2013 Flood Zoning Text Amendment didn't fail to notice potential negative streetscape impacts brought by the city's new flood-resistant Building Code. In fact, it provided several streetscape design recommendations for **two typical building/rebuilding scenarios** — the structural elevation of a 1-2 family detached home, and the new construction of a relatively large-scaled multi-family building and community facility building (NYCDCP 2013b, 29-34). In the detached home scenario, treatments such as planting, stair turn, new porch, and raised yard are listed as recognized streetscape mitigation strategies, and homeowners are required to choose 1 or 2 of these strategies while elevating their homes; in the new construction scenario, planting, streetfront transparency, and screened parking are required (see figures on page 18). Although these regulations only respond to a very limited number of scenarios, they nevertheless serve as a starting point for New York City's streetscape mitigation regulation, and were also designed with different heights of first-floor elevation in mind (for example, a detached home raised by 10 feet need to incorporate more mitigation treatments than it would if raised by 5 feet).

Streetscape Provisions in the 2019-21 Zoning for Coastal Flood Resiliency (ZCFR)

In its campaign to produce the updated Zoning for Coastal Flood Resiliency (ZCFR, 2019-2021), NYCDCP evaluated its 2013 streetscape design menu and called it "laudable," but nevertheless "rather limited" (NYCDCP 2019b, 13). In New York City's current flood zoning, a **point system** is used to ensure adequate streetscape mitigation treatment. A larger variety of design features — including "Wide Stairs," "Entrance Close to the Grade," "Recessed



Elevated Situation
(Without Streetscape Mitigation)

Planting

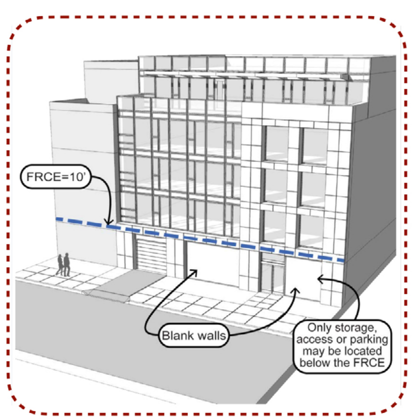
Stair Turn

Unenclosed Porch

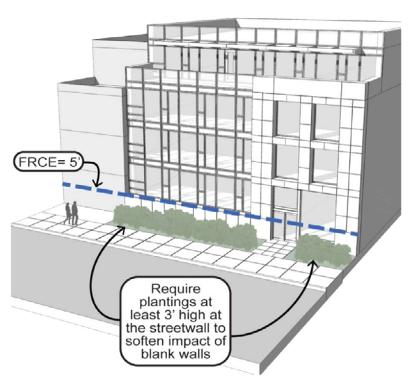
Roofed Porch

Raised Yard

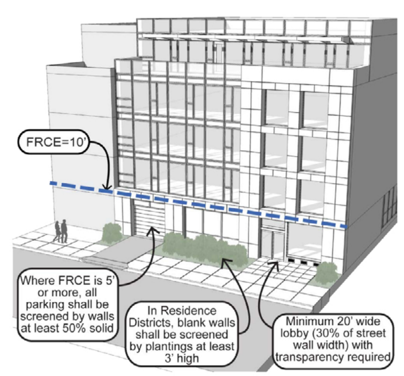
Streetscape Mitigation Design Menu for the Structural Elevation of Detached Homes in New York City's 2013 Zoning Text Amendment.
Source: NYCDCP 2013b, 31.



Elevated Situation
(Without Streetscape Mitigation)



Mitigation Design for
A 5' Elevation



Mitigation Design for
A 10' Elevation

Streetscape Mitigation Design Menu for the New Construction of a Multi-Family and Community Facility Building in New York City's 2013 Zoning Text Amendment. Source: NYCDCP 2013b, 33-34.

Access," "Multiple Entrances," "Terraced Yard," "Wall Treatment," "Additional Fenestration," and "Accessory Residential Use" — have become recognized by the Flood Zoning and are added to the design menu, with each feature worthing 1-2 points. Projects with the level of first story above flood elevation (FSAFE) below 5 feet are required to score at least 1 point, while projects with an FSAFE of 5 feet or more are required to score at least 3 points contributed by design features under both the "Access" category and the "Ground Floor Level" category (see figure below). According to the final adopted zoning text, these streetscape regulations apply to "all zoning lots containing flood-resistant buildings" (NYCDCP 2021, Section 64-50).

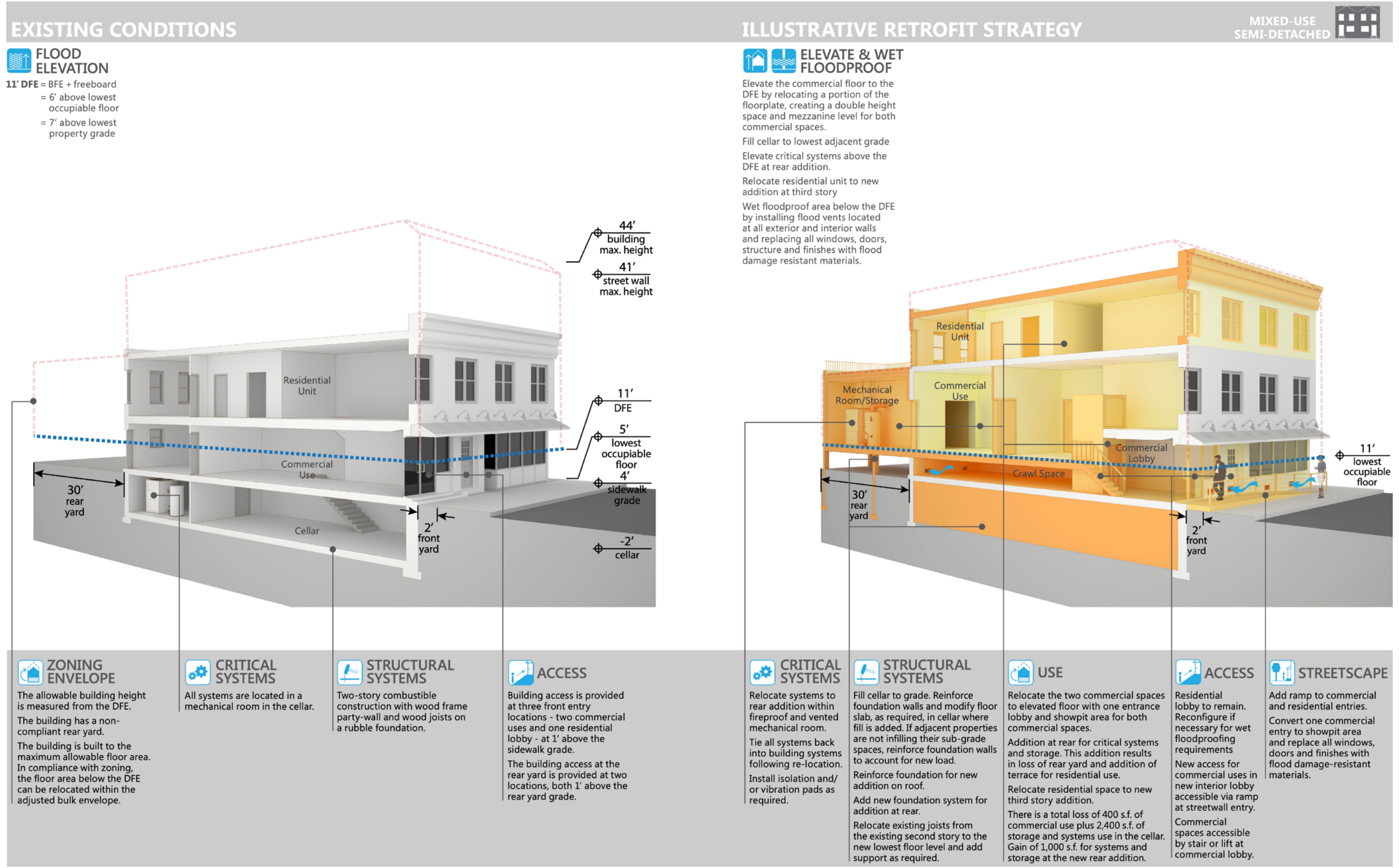
Level of the first story above the flood elevation	Streetscape Requirements		Total Points
	Access	Ground Floor	
Below 5'			1
5' or above	✓	✓	3

New Design Options in the 2019-2021 Flood Zoning

Updated Streetscape Design Menu in New York City's 2019–2021 Flood Zoning for Coastal Flood Resiliency (ZCFR).
Source: NYCDCP 2019c, 60-61.

Streetscape Guidelines in NYCDCP's Retrofitting Buildings for Flood Risk Report (2014)

As introduced in Digital Report 01, NYCDCP's *Retrofitting* report (2014) is the most comprehensive flood retrofitting design guideline to date targeted at New York City's floodplain building stock. Despite being only a design study with no legal effect, the report successfully put forward 10 real-world flood retrofitting design case studies that cover different floodplain building types and a wide range of considerations (Use, Access, Structural Systems, Critical Systems, Parking, and Streetscape & Visual Connectivity; see NYCDCP 2014, 32-36). The report also features statistic data that describe the profile of New York City's floodplain building stock, and discussions on alternative adaptation strategies for each case study.



A Flood Retrofitting Design Case Study ("Mixed-Use Semi-Detached") in New York City's 2014 *Retrofitting Buildings for Flood Risk* Report.
Source: NYCDCP 2014, 84-85.

Although New York City is regarded as having "the most progressive climate resiliency-focused land-use proposal" of any city in the U.S. (see Grace and Marvilli 2021), its streetscape mitigation provisions and guidelines — which are targeted at general existing structures and new constructions in the floodplain — may still be insufficient for the flood adaptation of the city's historic built environment. On the one hand, the city's Flood Zonings are designed as general rules offering great flexibility to individual projects, and are therefore unable to indicate specific challenges and strategies in the retrofitting design of different types of historic structures; on the other hand, many innovative design treatments in the *Retrofitting* report are creating new, out-of-context urban forms, as it doesn't aim at any historic preservation goals. Building on New York City's current policy-making efforts and learning from nationwide resources, *Digital Report 03: Streetscape-Sensitive Design Strategies* will develop **a streetscape design toolbox** applicable to New York City's floodplain building stock prioritizing preservation and streetscape considerations.

03

Adaptive Streetscape: Concept and Framework

3.1

Valorizing Historic Streetscape

Extensive streetscape changes in New York City's waterfront communities are reminders of the fact that **flood resilience is not the only goal in the adaptation of New York City's historic built environment.** Retrofitting strategies used in projects like *NYC Build It Back* are not suitable for historic buildings, neighborhoods and districts, although they may be able to achieve high flood resilience. Instead, **we must take a broader scope of heritage values into consideration**; as architects and planners strive to create new urban forms that accommodate flood resilience, it's the task of preservationists to justify the significance of historic urban forms.

To answer this question, this Chapter raises an "Adaptive Streetscape" framework that lays out different values and goals in the adaptation of historic streetscapes towards flood resilience. To start the discussion, this section examines the heritage value of historic streetscapes through policy and literature review and a critical analysis.

Formal and Material-Based Values

Formal and material-based values have long been given a central place in heritage value assessment. Formal qualities such as style, proportion, site relationship (or street relationship) and character-defining features distinguish historic districts and neighborhoods from contemporary urban forms, and reflect the architectural significance of historic buildings. Original material and construction of historic buildings demonstrate the concept of authenticity and integrity, both of which are key aspects of heritage value traditionally held dear by the historic preservation profession.

Formal and material-based values are explicitly protected by Federal and local-level preservation laws and regulations. The designation criteria of National Register of Historic Places and LPC Individual Landmarks have stressed the importance of "distinctive characteristics" and "aesthetic value," as well as the concept of "integrity" (National Park Service 1997, 2; NYCLPC n.d.). Meanwhile, LPC's design review standards are strictly based on an intention to preserve formal and material-based qualities: as a general rule, repair is preferred over replacement, and any replacement "must match the physical and aesthetic characteristics of the original or historic materials and features," in terms of "design, detail, texture, tooling, dressing, color, and finish" (NYCLPC 2019, 1.6).

A historic district or neighborhood is not merely a collection of historic buildings. Therefore, formal and material-based values don't only exist in individual buildings, and can be extended to urban forms and streetscapes. The formal values of historic streetscapes are also acknowledged in today's historic preservation regulation, mostly through rules for historic district designations; in fact, the concept of historic district itself implies that there are specific importances associated with built elements outside, surrounding, or found commonly among the designated buildings. Specifically, The designation criteria for LPC historic districts stress the necessity of "a distinct sense of place" and "a coherent streetscape"; similarly, New York SHPO explains National Register historic district as a group of properties that "are not usually significant individually, but gain meaning from their proximity and association with each other" (NYCLPC n.d.; NYSHPO n.d.). The acknowledgement of formal and material-based values of individual buildings and historic streetscapes is central to the evaluation of streetscape impacts brought by flood retrofitting intervention.

Experiential and Social-Spatial Values

Significant as formal and material-based values are, they don't represent the whole range of values associated with historic streetscapes. In fact, much significance of historic streetscapes is connected to the experience of people (both visitors and residents), and the pairing of human activities with physical spaces. These experiential and social-spatial values parallel the formal and physical values discussed above, and to a great extent contribute to the vigor and charm of historic streetscapes.

Intimate, human-scaled historic streets corridors are often known for housing a wide variety of functions and activities, and serving as a vehicle of community connections. Activities such as window-shopping, outdoor dining, and recreation associated with neighborhood commercial corridors and the interaction between residents along residential streets are not only valuable qualities by themselves, but also reflect a unique sense of place and even valuable historic lifestyle. These social-spatial significances have been well documented by urban researchers such as Jane Jacobs and Mindy Fullilove: Fulliove, in her *Main Street* (2020) study, recorded a myriad of activities in the often historic main streets (Fullilove 2020, 45); Jacobs, in her account of "Sidewalk Ballet," recalled how residents of different age, occupation and origin greeted each other on the street every morning, demonstrating the role of street space as a tie connecting community members (Jacobs 1961, 50-51; see also Fullilove 2016, 20). If all these functions and activities are removed, the characters of a historic streetscape would be significantly reduced even if all its visual and spatial qualities have largely remained.

Acknowledging the vigor and interactivity embedded in historic street space may **not only supplement** the understanding of formal and material-based values, **but also challenge it** — for example, flood retrofitting strategies aimed at preserving streetscape vigor and interactivity may to a larger extent modify the spatial layout of historic buildings and sacrifice their material authenticity. The tensions and tradeoffs among different forms of streetscape values will be further discussed in the next section, as the author attempts to establish a framework balancing different goals in the flood adaptation of historic streetscapes.

3.2

Adaptive Streetscape: Concept and Framework

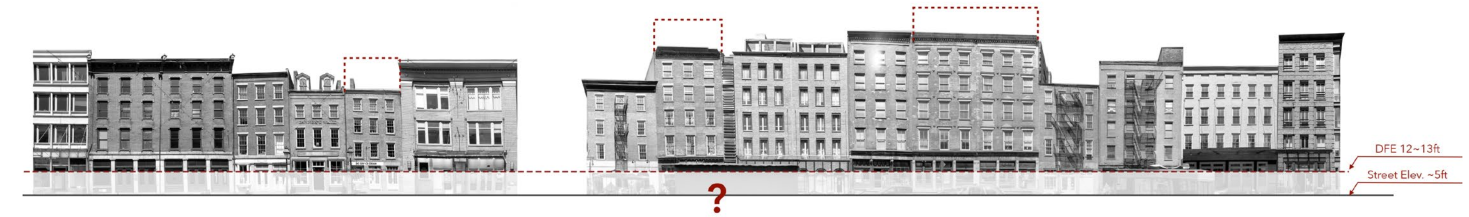
Discussions in Section 3.1 have revealed that beyond flood resilience, there are multiple heritage values associated with historic streetscapes that must be taken into account in their flood adaptation; in other words, the flood adaptation of historic streetscapes is ultimately a multi-criteria decision-making process. Synthesizing findings from both flood adaptation and historic preservation discourses, this section raises the concept of "Adaptive Streetscape" and establishes a framework that lays out different values and goals in the adaptive transformation of historic streetscapes towards flood resilience.

Upon reviewing existing flood adaptation and retrofitting guidelines as well as the examination of streetscape theory in the historic preservation realm, the author has identified four key goals in the "Adaptive Streetscape" transformation: **Flood Resilience; Building Integrity and Visual Consistency; Streetscape Experience and Social-Spatial Relationship; and Floor Area Transfer.** As each of these goals represents distinct resilience or heritage values, there are **intricate tradeoffs and conflicts** between them; moreover, **different goals are likely to lead to different retrofitting treatments and design choices.** In this section, the intentions, design outcomes and tradeoffs associated with each Adaptive Streetscape goal are laid out in detail; the Adaptive Streetscape framework will also serve as a foundation for streetscape quality evaluation and flood adaptation decision-making in the whole project's exploration of design and policy tools.

Goal No. 1: Flood Resilience

Flood Resilience is the key target of all flood adaptation interventions. Typical flood retrofitting treatments recognized by Federal and New York City-level regulation often involve structural elevation, the elimination of active uses and residential uses on street level, basement fill, and wet or dry floodproofing.

Outcomes, Tradeoffs and Mitigation Strategies: As demonstrated by many Post-Sandy built projects in New York City's floodplain, the application of flood resistant construction standard may bring about significant negative impacts to the character of historic streetscapes and individual buildings. For example, exorbitant heights of structural elevation may inevitably undermine the quality of a building's streetscape expression by impacting its scale and the transparency, accessibility and interactivity of its street floor (NJSHPO 2019b, 17, 26); the elimination of active uses on street floor or in cellars may bring about considerable challenges to the social-spatial relationship between pedestrians and retail storefronts, and thus diminish the vigor of commercial corridors. Generally speaking, retrofitting strategies that focus excessively on flood resistance may cause **significant**



Goal 1

Flood Resilience

Intention: Implement Retrofitting Treatments Recognized by Federal/Local Regulations; Eliminate High Risk/Active Use under DFE.

Tradeoffs: Building Integrity & Visual Consistency; Streetscape Experience & Social-Spatial Relationship.

Goal 2

Building Integrity & Visual Consistency

Intention: Apply Streetscape Mitigation Design Treatments; Preserve the Formal and Material-Based Values of Historic Buildings & Streetscape.

Tradeoffs: Streetscape Experience & Social-Spatial Relationship; Floor Area Transfer.

Goal 3

Streetscape Experience & Social-Spatial Relationship

Intention: Prioritize Street-Level Interactivity and Accessibility Over Building Integrity; Allow Necessary Modifications to Streetfront Structures.

Tradeoffs: Flood Resilience; Building Integrity & Visual Consistency; Floor Area Transfer

Goal 4

Floor Area Transfer

Intention: Minimize Floor Area Loss Caused by Flood Retrofitting, and Mitigate Such Loss Through the Execution of Rooftop Additions.

Tradeoffs: Building Integrity & Visual Consistency; Streetscape Experience & Social-Spatial Relationship.

Multiple Goals of the Adaptive Streetscape, Illustrated on the Elevation of Front Street in South Street Seaport Historic District.
Source: Illustration by the Author.

tradeoffs in the goals of Building Integrity & Visual Consistency, and Streetscape Experience & Social-Spatial Relationship.

To address these challenges, elevated buildings or buildings with elevated interior space should be carefully designed for streetscape mitigation treatments; in mixed-use and commercial corridors, incremental and partial retrofitting as well as design features adding to the interactivity of streetscape (e.g. transparent display windows on street level) shall be considered as preferable strategies (see NYCDCP 2016b, 38-39; 77-80).

Goal No. 2: Building Integrity & Visual Consistency

This goal ties to the most widely acknowledged concerns in building-scale flood retrofitting — blank street walls, out-of-context piers and exterior stairs, the "lollipopping effect" among elevated and un-elevated buildings, etc. Focusing on the formal and material-based values of historic streetscape, this goal seeks to apply streetscape mitigation design treatments to retain historic structures' human scale, street relationship, visual consistency, spatial layout, and material integrity. On street and neighborhood scale, this goal asks for the coordination of streetscape expressions among similar structures along a street corridor or in the same historic neighborhood through creative planning and policy tools. Specific design treatments that create friendly streetscape expressions compatible with historic urban context will be further discussed in Digital Report 03: *Streetscape-Sensitive Design Strategies*.

Outcomes, Tradeoffs and Mitigation Strategies: The Building Integrity & Visual Consistency goal prioritizes flood retrofitting strategies that preserve a building's spatial layout, material integrity and architectural significance, **which may cause potential tradeoffs with the goals of Streetscape Experience & Social-Spatial Relationship and Floor Area Transfer.** For example, the abandonment of a whole floor may be prioritized over extensively reworking a building's interior floor plates and non-structurally raising its interior program, even if the latter brings about more vigor and interactivity on street level (see figure on this page); meanwhile, rooftop additions — which are considered as an important way to mitigate floor area loss — may also be discouraged, as they are changing historic buildings' original fabric, proportion and style.

A design scheme in NYCDCP's 2014 *Retrofitting* report that achieved streetscape friendliness at the cost of extensive formal and structural changes, revealing the tension between Integrity & Streetscape goals.

Source: NYCDCP 2014, 85.

To balance these conflicts, retrofitting treatments that to a certain extent help retain historic structures' architectural characters may be considered as preferable strategies; such treatments include building additions executed in compatible style, or the reconstruction or preservation of key character-defining features.

Goal No. 3: Streetscape Experience & Social-Spatial Relationship

Contrary to the Building Integrity & Visual Consistency goal discussed above, the Streetscape Experience & Social-Spatial Relationship goal focuses on the preservation of experiential and social-spatial values associated with historic streetscapes. This means that active uses should be visually and experientially as close to the street level as possible to facilitate street-level activities such as window-shopping, recreation and daily interaction, and that these uses should be physically accessible from street level (for example, through street-level lobbies and ADA-compliant access).

Outcomes, Tradeoffs and Mitigation Strategies: The Streetscape Experience & Social-Spatial Relationship goal may in some cases **conflict with the Building Integrity & Visual Consistency goal.** Let's reexamine the case study discussed in Goal No. 2: under a streetscape-oriented scenario, streetscape-friendly strategies that involve extensive interior space alteration may be favored, even if they create significant impact on building's historic fabric and architectural layout; since streetscape-friendly retrofitting strategies such as interior elevation often requires creating double-height spaces or incorporating interior stairs and ramps (see figure on page 26), they may also result in the **loss of active floor area.** To mitigate these issues, spatial alterations shall be made with respect to the original architectural style and layout, and rooftop additions may be considered when possible.

Furthermore, the principle that active uses should be as close to the street level as possible brings conflict with **the flood resilience goal.** As discussed in Goal No. 1: Flood Resilience, the height to which structures or uses are elevated should always be decided under careful consideration.

Goal No. 4: Floor Area Transfer

As basements are filled, spaces under DFE are elevated or abandoned, double-height spaces are created, and new egress or access systems are introduced within existing structures, flood retrofitting interventions often result in the loss of active or usable floor area. The loss of active floor area may make retrofitting projects even less feasible in financial terms, and discourage property owners to carry out retrofitting undertakings. To address this issue, the Floor Area Transfer goal seeks to minimize floor area loss created by retrofitting treatments, and to mitigate such loss through physical additions within a building's zoning parcel.

As a key financial factor, floor area has been given much attention in New York City's flood adaptation policy-making. For example, NYCDCP's 2014 *Retrofitting* report has provided detailed floor area change calculation for each design scenario, where rooftop addition is often adopted as a solution; New York City's Flood Zoning Amendments also offer some flexible rules regarding building height and floor area calculation, exempting street-floor areas that are floodproofed or occupied by access use, and allowing floor areas to be transferred through additions (NYCDCP 2019c, 42-43, 50-54).

Outcomes, Tradeoffs and Mitigation Strategies: The design schemes in DCP's *Retrofitting* report sometimes feature rooftop additions as much as two stories tall (NYCDCP 2014, 66-67), causing vast changes in the building's characters; the potential of out-of-context and out-of-scale additions indicates **tradeoffs with the Building Integrity & Visual Consistency goal.** Nevertheless, those negative impacts may be to a considerable extent mitigated through thoughtfully designed additions that are either invisible from street level or compatible with the original style of historic structures (see Digital Report 03 for further discussions). On the other hand, since many streetscape-friendly retrofitting strategies often operate on the cost of active floor area, **conflicts may also emerge between the goals of Floor Area Transfer and Streetscape Experience & Social-Spatial Relationship.**

Discussions above reveal the resilience, heritage and economic values represented by each goal listed under the Adaptive Streetscape framework, as well as the outcomes, conflicts and tradeoffs between different goals. In the next section, the author will continue to develop the conceptual Adaptive Streetscape framework into a set of semi-quantitative metrics, which can be used to measure the quality change of New York City's historic streetscapes before versus after flood adaptation.

3.3

Adaptive Streetscape: Evaluation Metrics

Given the multiple conflicting goals in the flood adaptation of historic built environment, tradeoffs and tensions among different goals must be carefully examined and evaluated in order to produce balanced solutions that both achieve flood resilience and respect heritage values. Building on the *qualitative* discussions made in Section 3.2, this section develops the multiple goals of Adaptive Streetscape into a rating scale consisting of ***semi-quantitative metrics***, so that the quality of historic streetscapes before and after flood adaptation may be numerically measured. The rating system will be used in this project's upcoming neighborhood design studies, serving as a foundation for the evaluation of proposed design schemes.

The concept of a *measurable* system that evaluates the quality of urban space is inspired by Ewing and Clemente's *Measuring Urban Design* (2013) study. In this study, Ewing and Clemente established correlation between experiential features of streetscapes (e.g. "imageability" or "complexity," which are rated by invited urban design experts on a 1-5 scale) with physical and countable characters (e.g. proportion of historic buildings, proportion of first floor with windows, and the number of street furniture), and used statistic measures to prove such correlation. They found that the overall walkability of urban streetscape is predominantly decided by five experiential features: imageability, enclosure, human scale, transparency, and complexity; each feature was then correlated with multiple physical characters, each numerically measurable and has a particular coefficient value.

The Ewing and Clemente model has provided much insight for this project's effort to establish Adaptive Streetscape metrics, as they demonstrated that the desired visual and experiential impressions of urban streetscape can be quantitatively measured through a statistic regression of countable, physical features. Following this path, this research puts forward 24 individual metrics that contribute to the quality of historic streetscape under the 4 Adaptive Streetscape goals: **Flood Resilience, Building Integrity & Visual Consistency, Streetscape Experience & Social-Spatial Relationship, and Floor Area Transfer.** Each individual metric is classified with a 5-point rating scale, where 1 point means least desirable, and 5 points means most desirable; the score of each Adaptive Streetscape goal will be the unweighted average of all individual metrics falling under it.

It should be noted that as a semi-quantitative, preliminary evaluation system, the streetscape scale developed in this project doesn't have as much statistical foundation as the Ewing and Clemente model has. First of all, not all individual metrics are numerically countable; instead, some of them may be quantified based on empirical assessments (for example, 1 point could mean "very low," 5 points could mean "high," "extensive," or "abundant"). Meanwhile, the correlation between individual metrics and the final streetscape qualities are not statistically tested, although further discussion will be made in this section regarding how individual metrics are established.

Flood Resilience

Provide rating (in 5-point system) for both the original streetscape and the retrofitted streetscape.
Overall rating is calculated through an unweighted average of individual metrics below.

Average lowest residential floor elevation as compared to BFE & DFE*	1 < BFE – 4ft	2 ≥ BFE – 4ft	3 ≥ BFE	4 ≥ DFE	5 ≥ DFE+1ft
Percentage of areas with active use (except for storage, parking and access) on street level	1 ≥ 80%	2 80 – 60%	3 60 – 40%	4 40 – 20%	5 < 20%
Percentage of flood-proofed area on street level	1 < 20%	2 20 – 40%	3 40 – 60%	4 60 – 80%	5 ≥ 80%
Percentage of basement area as compared to street-floor building floor area	1 ≥ 80%	2 80 – 60%	3 60 – 40%	4 40 – 20%	5 < 20%

* Recall that for easier evaluation, DFE is always estimated as BFE + 1ft in this research.

Building Integrity & Visual Consistency

Provide rating (in 5-point system) for both the original streetscape and the retrofitted streetscape.
Overall rating is calculated through an unweighted average of individual metrics below.

Percentage of identifiable historic structures along both sides of the street corridor	1 < 20%	2 20 – 40%	3 40 – 60%	4 60 – 80%	5 ≥ 80%
Current condition of historic structures	1 Poor	2 Fair	3 Average	4 Good	5 Excellent
Extent of existing modification to historic facades	1 Extensive	2 High	3 Medium	4 Low	5 Very Low
Number of identifiable historic architectural elements and ornaments on street level	1 Scarce	2 Few	3 Moderate	4 Frequent	5 Abundant
Permanent material impact brought by flood retrofitting (for retrofitted streetscape only)	1 Extensive	2 High	3 Medium	4 Low	5 Very Low
Permanent visual impact on street level brought by flood retrofitting (for retrofitted streetscape only)	1 Extensive	2 High	3 Medium	4 Low	5 Very Low
Permanent visual impact on rooftops brought by flood retrofitting (for retrofitted streetscape only)	1 Extensive	2 High	3 Medium	4 Compatible	5 Invisible
Permanent physical impact on street space brought by flood retrofitting (for retrofitted streetscape only)	1 Extensive	2 High	3 Medium	4 Compatible	5 Invisible

Evaluation Metrics of the Adaptive Streetscape Framework.
Source: Illustration by the Author.

Streetscape Experience & Social-Spatial Relationship

Provide rating (in 5-point system) for both the original streetscape and the retrofitted streetscape.
Overall rating is calculated through an unweighted average of individual metrics below.

Percentage of continuous street wall along both sides of the street corridor*	1 < 20%	2 20 – 40%	3 40 – 60%	4 60 – 80%	5 ≥ 80%
Percentage of street-level transparency (for mixed-use/commercial corridor only)	1 < 20%	2 20 – 40%	3 40 – 60%	4 60 – 80%	5 ≥ 80%
Percentage of active use (except for storage, parking and access) along both sides of the street*	1 < 20%	2 20 – 40%	3 40 – 60%	4 60 – 80%	5 ≥ 80%
Percentage of storefronts with outdoor dining/seating (for mixed-use/commercial corridor only)	1 < 20%	2 20 – 40%	3 40 – 60%	4 60 – 80%	5 ≥ 80%
Average main entrance elevation of structures on both sides of the street as compared to street level	1 ≥ 4ft	2 3–4ft	3 2–3ft	4 1–2ft	5 < 1ft
Identifiable architectural patterns (fenestration, pilasters, etc.) on street level	1 Scarce	2 Few	3 Moderate	4 Frequent	5 Abundant
Number of storefronts, awnings, canopies and signages (for mixed-use/commercial corridor only)	1 Scarce	2 Few	3 Moderate	4 Frequent	5 Abundant
Liminal space for pedestrian passage/ Ability to walk along the sidewalk	1 Very Low	2 Low	3 Acceptable	4 Good	5 High
Permanent visual impact on rooftops brought by flood retrofitting (for retrofitted streetscape only)	1 Extensive	2 High	3 Medium	4 Compatible	5 Invisible
Estimated pedestrian behavioral change/mind map change brought by flood retrofitting (for retrofitted streetscape only)	1 Extensive	2 High	3 Medium	4 Low	5 Very Low

* "Continuous Street Wall" means a solid street wall composed of individual structures with each facade offset by less than 2 ft from the primary street wall plane, disqualifying structures with recessed facades and ramps in front of them.

* For "Active Use" to be counted, the actively used space must have a floor elevation of less than 3 ft from the street level.

Floor Area

Provide estimated values of the following indicators for both the original streetscape and the retrofitted streetscape.

Average FAR of structures on both sides of the street corridor	(value)
Estimated overall floor area, and floor area gain/loss through flood retrofitting	(value in sq.ft)

The table on pages 30-31 shows individual metrics and quantification parameters developed in this project to evaluate streetscape change brought by flood adaptation under the Adaptive Streetscape framework. Besides adopting metrics established and tested in the Ewing and Clemente model, the metrics listed in the table also incorporated observations and findings made in the previous discussion regarding flood adaptation policy-making and the values of historic streetscapes:

- The Flood Resilience metrics have referenced the flood insurance premium model in New York City's Zoning for Coastal Flood Resiliency of 2019-2021 (NYCDCP 2019c, 20), as well as several key principles of New York City's current flood-retrofitting regulatory framework (eliminating active functions on street level, implementing floodproofing treatments, and filling basements or cellars).

- The Building Integrity and Visual Consistency metrics are designed to evaluate the abundance and physical condition of historic buildings and street-level architectural features within the original streetscape, as well as to evaluate impacts brought by flood retrofitting on key areas such as a building's street level, rooftop and street space.

- The Streetscape Experience and Social-Spatial Relationship metrics incorporate several criteria from the Ewing and Clemente model; key streetscape features (awnings, signages, storefronts, etc.) defined in NYCLPC's *Permit Guidebook* (2019) are also adopted, together with key elements of street relationship that are highlighted in NYCDCP (2019c) and Crankshaw (2009)'s studies. Metrics for the cognitive and social-spatial aspects of streetscape quality are inspired by Fullilove's *Main Street* (2020) study.

- The Floor Area metrics are built upon the building addition strategies and floor area transfer discussions in NYCDCP's *Retrofitting* report (2014) and Flood Zoning amendments (2013 & 2019–2021).

Metric:
Percentage of areas with active use on street level

Goal 1: Flood Resilience	1 ≥ 80%	2 80 – 60%	3 60 – 40%	4 40 – 20%	5 < 20%	↓
Goal 3: Streetscape Experience & Social-Spatial Relationship	1 < 20%	2 20 – 40%	3 40 – 60%	4 60 – 80%	5 ≥ 80%	↑

Metric:
Permanent visual impact on rooftops brought by flood retrofitting

Goal 2: Building Integrity & Visual Consistency	1 Extensive	2 High	3 Medium	4 Compatible	5 Invisible	↑
Goal 3: Streetscape Experience & Social-Spatial Relationship	1 Extensive	2 High	3 Medium	4 Compatible	5 Invisible	↑

Correlation and Contradiction Between Different Goals Demonstrated by Evaluation Metrics.
Source: Illustration by the Author.

The semi-quantitative metrics established in the table are able to directly demonstrate the correlation and contradiction between different Adaptive Streetscape goals, as previously analyzed in Section 3.2. For example, the Flood Resilience goal asks to limit active use on street level below DFE, while the Streetscape Experience goal encourages as much active use on street level as possible; in another case, the Building Integrity goal and the Streetscape Experience goal may both benefit from rooftop additions executed in compatible style with little visual impacts (see figure on page 32). The Adaptive Streetscape framework and metrics will be used throughout this project, to produce balanced design solutions that acknowledge multiple values and conflicting goals.

04

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