Memo

SUBJECT
LMCR – Design Flood Elevation Approach

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COPIES TO
Jordan Salinger, MOCEJ
Rachel Aaronson, NYCEDC
Erin Tou, NYCEDC

TO
Blake Monteith, NYCEDC

OUR REF
FiDi Seaport Master Plan

PROJECT NUMBER
30031683

FROM
Roni Deitz, PE, Arcadis of New York
Joseph Marrone, PE, Arcadis of New York
Mathew Staudt, AIA, ONE Architecture

This memorandum is intended to provide detail on the development of coastal resilience projects within the Lower Manhattan Coastal Resiliency (LMCR) portfolio, including how the design flood elevations (DFEs) were developed for each project.

Much of the background information and context included in this document was provided directly by the City of New York via www.nyc.gov.

Executive Summary

On October 29, 2012, Hurricane Sandy hit New York City, bringing storm surge, flooding, and associated impacts that were, and remain, unparalleled by any coastal storm in modern history. The City of New York began responding immediately, recognizing it needed the support of the state and federal government to expedite the recovery and make New York City more resilient. And this effort is still underway today – in summer of 2022, the City was awarded $50 million of FEMA BRIC funds for the Seaport Coastal Resilience Project (SPCR), one of three projects nationwide to receive the maximum award amount.

While these programs have a shared goal of protecting vulnerable areas against climate hazards, each agency (i.e., FEMA and HUD), as well as the programs administered by each agency (e.g., BRIC versus CDBG-DR), has slightly different design criteria and implementation requirements. To move swiftly and tactically, the City has worked with respective communities to develop projects that meet both the criteria of each individual grant program as well as local laws and industry best practices, while respecting the community needs and priorities and unique site conditions of each geographic area.

As a result of these different funding sources and approaches to design criteria (e.g., if a project is seeking FEMA accreditation), it may appear as though there is a lack of consistency in how the design flood elevations have been developed. However, each project builds upon the same fundamental principles – understanding the stillwater elevation for the study area based on FEMA guidance, selecting a sea level rise projection based on NPCC guidance, and better understanding the wave climate and potential wave impacts. And, in areas where a long-term project has yet to be identified, designed, funded, and/or permitted, the City is taking action to implement projects in the near-term that minimize the risk from more frequent coastal storms, as well as daily tidal flooding. In these instances, the near-term projects are studied in relation to the broader LMCR portfolio, ensuring compatibility and synergy with the overall LMCR vision – a more resilient Lower Manhattan.

Background and Context

This section provides a brief overview on Hurricane Sandy and the City's response, relevant federal funding programs that support the implementation of recovery and resiliency projects, and an overview of the Lower Manhattan Coastal Resiliency Strategy.

Hurricane Sandy and the City's Response

On October 29, 2012, Hurricane Sandy ("the Hurricane" or "Superstorm Sandy") hit New York City, bringing storm surge, flooding, and associated impacts that were, and remain, unparalleled by any New York area coastal storm in modern history. Over the course of 48 hours, wind, rain, and water destroyed approximately 300 homes, damaged 69,000 residential units, and left hundreds of thousands of New Yorkers without power or access to critical infrastructure and facilities. Based on statistics provided by the City of New York, the storm resulted in the deaths of 44 City residents and an estimated $19 billion (2013 USD) in damages and lost economic activity around the City.[1]

The City of New York began responding immediately to the impacts of the hurricane, including rebuilding and reinforcing homes and critical infrastructure, as well as developing a plan to better understand what happened during Hurricane Sandy and why, and what could possibly happen in the future. The City also began to strengthen coastal defenses, critical facilities (e.g., transportation, telecommunications, water, and wastewater) and other critical networks.

The initial plan, "A Stronger, More Resilient New York," launched in 2013, identified billions in resiliency and recovery investments to be implemented over a 10-year time horizon. The cost to not only rebuild and recover but to become *resilient*, required that the City leverage funds beyond City Capital – most notably federal programs.

Relevant Federal Funding Programs

After Hurricane Sandy, and still to this day, the City has acted quickly and swiftly to leverage funds beyond City capital to implement resilience projects across New York City. In response to Hurricane Sandy, congress allocated over $50 billion to fund recovery efforts. Per the City of New York, nearly $15 billion of this funding has been earmarked for projects in New York City.[2] Two programs, FEMA Public Assistance and HUD Community Development Block Grant Disaster Recovery account for nearly 95% of the $15 billion allocated. These programs, as well as other programs that have been established since Hurricane Sandy, like FEMA's Building Resilient Infrastructure and Communities (BRIC) program, help to buy down risk in vulnerable communities. These programs ensured that the City was able to quickly respond to the impacts of Hurricane Sandy, and that the City is able to continue advancing projects to protect vulnerable areas from future coastal storms, floods, heat, and other hazards.

While these programs have a shared goal of protecting vulnerable areas against climate hazards, each agency (i.e., FEMA and HUD), as well as the programs administered by each agency, has slightly different design criteria and implementation requirements. To move swiftly and tactically to leverage federal funds, the City has worked with respective communities to develop projects that meet both the criteria of each individual grant program as

[1] https://www1.nyc.gov/site/cdbgdr/about/About%20Hurricane%20Sandy.page#:~:text=The%20storm%20resulted%20in%20the,New%20Yorkers%20were%20temporarily%20displaced.
[2] https://www1.nyc.gov/content/sandytracker/pages/overview

well as local laws and industry best practices, while respecting the community needs and priorities and unique site conditions of each geographic area.

A brief summary of key federal programs is provided below, while more information on how specific grants impacted the development of specific projects within the LMCR portfolio is provided later in the document.

- FEMA Public Assistance: FEMA's Public Assistance (FEMA-PA) Program provides supplemental grants to state, tribal, territorial, and local governments, and certain types of private non-profits so communities can quickly respond to and recover from major disasters or emergencies. After an event like a hurricane, tornado, earthquake or wildfire, communities need help to cover their costs for debris removal, life-saving emergency protective measures, and restoring public infrastructure. FEMA also encourages protecting these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process.[3]

- HUD CDBG-DR: HUD provides flexible Community Development Block Grant Disaster Recovery (CDBG-DR) funds to help cities, counties, and states to recover from Presidentially declared disasters. This special appropriation provides funds to the most impacted and distressed areas for: disaster relief; long term-recovery; restoration of infrastructure; housing; and economic revitalization. Funds are awarded to state and local governments which become grantees. CDBG-DR funding supplements other Federal recovery assistance programs administered by FEMA, the Small Business Administration (SBA), and the United States Army Corps of Engineers (USACE). CDBG-DR funds may also be used to match other federal resources and can also be used in combination with the Department of Health and Human Services (HHS) Social Services Block Grants (SSBGs).[4]

    - HUD NDRC: In 2014, HUD announced the National Disaster Resilience Competition – a two-phased competition process, led by HUD, to award $1 billion in federal funding to eligible communities across the U.S. for disaster recovery and long-term community resilience. The Rockefeller Foundation provided targeted technical assistance to eligible states and communities and supported a stakeholder-driven process, informed by the best available data, to identify recovery needs and innovative solutions.[5]

- FEMA BRIC: Building Resilient Infrastructure and Communities (BRIC) supports states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards.[6] Different from FEMA-PA or CDBG-DR, the BRIC grant program gives states, local communities, tribes, and territories funding to address future risks to natural disasters, including flooding, hurricanes, heat, and drought, as compared to declarations after a disaster. Addressing risks prior to a disaster declaration can significantly lessen the impacts, including physical damages, emotional distress, and loss of economic activity.

[3] https://www.fema.gov/assistance/public
[4] https://www.hudexchange.info/programs/cdbg-dr/
[5] https://www.hudexchange.info/programs/cdbg-dr/resilient-recovery/
[6] https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities#:~:text=BRIC%20is%20a%20competitive%20FEMA,local%20communities%2C%20tribes%20and%20territories.

Two programs, HUD NDRC and FEMA BRIC, have provided significant funding to the LMCR portfolio. A brief comparison of the two programs is provided below.[7]

BRIC: Building Resilient Infrastructure in Communities

- FEMA grant program for eligible states, territories, and recognized tribal governments
- One of many hazard mitigation assistance grants
- Provides communities with hazard mitigation measures while promoting community resilience
- FEMA selects projects eligible for funding based on a composite score
- Program Criteria
    - BRIC Qualitative Evaluation Criteria (developed based on comments received through stakeholder engagement efforts)[8]
        - 35 points: Risk Reduction/Resilience Effectiveness
            - How are communities prepared for natural disasters?
            - DFE could fall under this criterion (how proposed project improves resilience)
        - 20 points: Climate Change and other future conditions
        - 15 points: Implementation measures
            - What human capital and financial resources are in place to ensure these projects are completed?
        - 25 points: Population impacted
            - What are the community-wide benefits?
        - 5 points: Community engagement and other outreach activities
        - 15 points: Leveraging partners
- Panelists access how sub-applications meet BRIC requirements
- Mitigation projects that meet multiple priorities are strongly encouraged
- Prioritization of programs that meet Justice 40 criteria in order to promote equity
- Financials
    - Communities can also receive non-financial direct assistance
    - FEMA will distribute up to $2.295 billion for the 2022 fiscal year, with a $50M cap per project

NDRC: National Disaster Resilience Competition

- Launched in 2014, for communities that have experienced natural disasters. NDRC provides funding for states and local governments to develop strategies to reduce risks for future natural disasters. Program promotes risk assessment and planning.
- Program criteria
    - Community must have been affected by a **qualified** natural disaster
    - Units of general local government who received CDBG-DR funding
    - Two phases to the competition
        - Phase 1: framing—link proposal to the eligible disaster the community is recovering from

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[7] Resources: FEMA BRIC Hazard Mitigation Funding Consulting | ICF; Fiscal Year 2021 BRIC and FMA Competitive Selections Project Overviews | FEMA.gov; Hazard Mitigation Assistance Grants | FEMA.gov; HUD National Disaster Resilience Competition | Adaptation Clearinghouse
[8] Source: FY22 BRIC Qualitative Evaluation Criteria PSM (fema.gov)

    - Phase 2: implementation—include a benefit-cost analysis of proposed project that incorporates social and ecological benefits
- Financials
    - Awarded nearly $1 billion in HUD Disaster Recovery funds to 13 states and communities across country
    - About $820 million for all states and local governments that experienced Presidentially-declared major natural disaster in 2011-2013
    - $180 million allocated for states in Hurricane Sandy affected region to compete for funding
    - Funding is from Community Development Block Grant disaster recovery (CDBG-DR) appropriation

Overview of Lower Manhattan Coastal Resiliency Strategy

The Lower Manhattan Coastal Resiliency (LMCR) Project is an integrated coastal protection initiative aimed at reducing flood risk due to coastal storms and sea level rise in Lower Manhattan.[9] The LMCR Project area spans the Lower Manhattan coast and seeks to increase resiliency while preserving access to the waterfront and integrating with public space. LMCR was informed by the Lower Manhattan Climate Resilience Study[10], and comprises the following project components:

- Brooklyn Bridge-Montgomery Coastal Resilience (BMCR)
- The Financial District and Seaport Climate Resilience Master Plan (FiDi Seaport)
- Seaport Coastal Resilience (SPCR)
- The Battery Coastal Resilience
- South Battery Park City Resiliency Project (South BPCR)
- North/West Battery Park City Resiliency Project (North/West BPCR)

Figure 1 provides a map of the LMCR projects. To realize these projects, the City is advancing over $1 billion in capital, and many of these projects will begin construction in the next few years. Given the unique site conditions of each project, including the wave climate, as well as the funding and financing strategy developed to implement each project, the design flood elevation varies across the LMCR portfolio.

[9] https://www1.nyc.gov/site/lmcr/index.page
[10] https://edc.nyc/sites/default/files/filemanager/Projects/LMCR/Final_Image/Lower_Manhattan_Climate_Resilience_March_2019.pdf

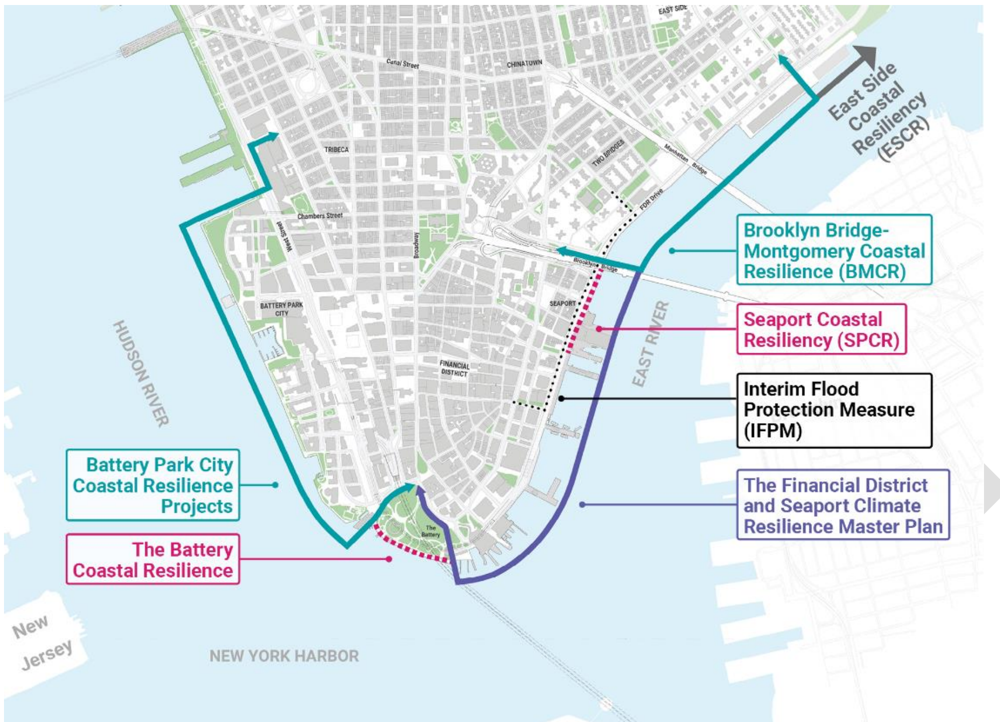

Figure 1: Overview of LMCR Projects

A Shared Goal of Protecting Lower Manhattan Against Climate Hazards

Throughout the LMCR portfolio of projects, there is a shared goal of protecting against climate hazards while addressing the unique conditions for each area. In some portions of Lower Manhattan where a design has been developed and an implementation strategy has been realized, these projects are advancing towards construction in the next few years. In areas where there is not yet a complete design and/or implementation strategy, the City is taking swift action to minimize risk in the most vulnerable areas while ensuring compatibility with efforts that can further reduce the risk of flooding from coastal storms in the future.

What is a Design Flood Elevation and How is it Determined?

As defined by the New York City Building Code, the design flood elevation, or the "DFE", is the minimum elevation to which a structure must be elevated or floodproofed.[11] Calculating the Design Flood Elevation requires a Stillwater Elevation for the selected Design Storm Event, a sea level rise projection, and an understanding of both wave runup and wave overtopping. A summary graphic is provided in Figure 2**,** with an explanation of what each variable means and how large of an impact it has on the design flood elevation described below.

[11] https://www1.nyc.gov/assets/planning/download/pdf/plans-studies/retrofitting-buildings/retrofitting_chapter1_keyterms.pdf

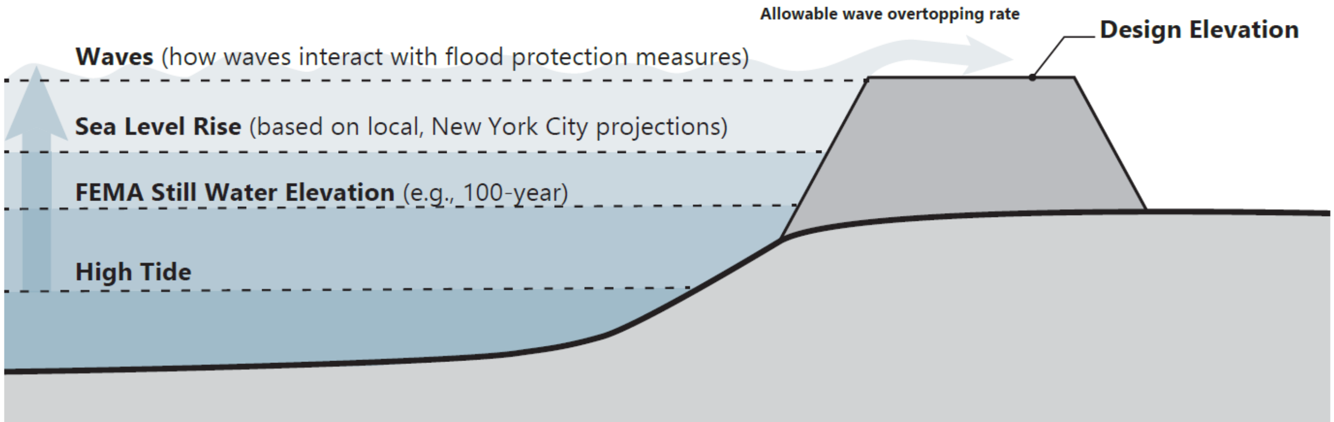

Figure 2: Information Graphic on Design Flood Elevation Components

While each project in the LMCR portfolio is unique because of different site conditions and constraints, the incorporation of community goals and priorities, as well as funding requirements, all LMCR projects leverage the best-in-science guidance from the City of New York when developing their design flood elevations.

Design Storm Selection

All three long-term projects – BMCR, FiDi-Seaport, and the Battery Park City Resilience Projects – are designed to provide immediate risk reduction for the 100-year storm. A 100-year storm has a 1% likelihood of happening in any given year. A 100-year storm on one day does not decrease the chance of a second 100-year storm occurring in that same year or any sequent year; rather, there is a 1 in 100 or 1% chance that a storm will reach or exceed this intensity in any given year.

Alternatively, the SPCR and The Battery Coastal Resilience projects will reduce risks from current storms, the design return period would be less than a 100-year storm (for example a 50-year storm / 2% exceedance probability in any given year or a 20-year storm / 5% exceedance probability in any given year). Another example, for comparison, is the NYC Office of Emergency Management's Interim Flood Protection Measures (IFPM), which has a design storm of approximately 15-year return period or a 7% chance of exceedance in any given year. What design storm a project is designed to can have a large impact on the design flood elevation.

Stillwater Elevations

For each project in the LMCR portfolio, the Project Team obtained stillwater elevations from the FEMA Preliminary Flood Insurance Rate Maps (PFIRMs) for New York City. FEMA establishes the stillwater elevation – the height of water during a flood event, not including wave activity – for a range of hypothetical storms, including the 10-, 50-, 100- and 500-year storm.

Depending on where the project is located within Lower Manhattan, the Project Team can locate a transect, or cross-section, closest to the study area to determine the stillwater elevation in that area (see Figure 3). However, it is important to note, based on the local site conditions, the stillwater elevations across Lower Manhattan vary, which is one of the reasons that design flood elevations vary across the portfolio of LMCR projects. Current 100-

year stillwater elevations vary from approximately 11 to 11.3 feet NAVD88 across the study area based on the preliminary Flood Insurance Study provided by FEMA (see Figure 4), meaning there is little variation in the stillwater heights across the LMCR projects for those designed to the same design storm event.

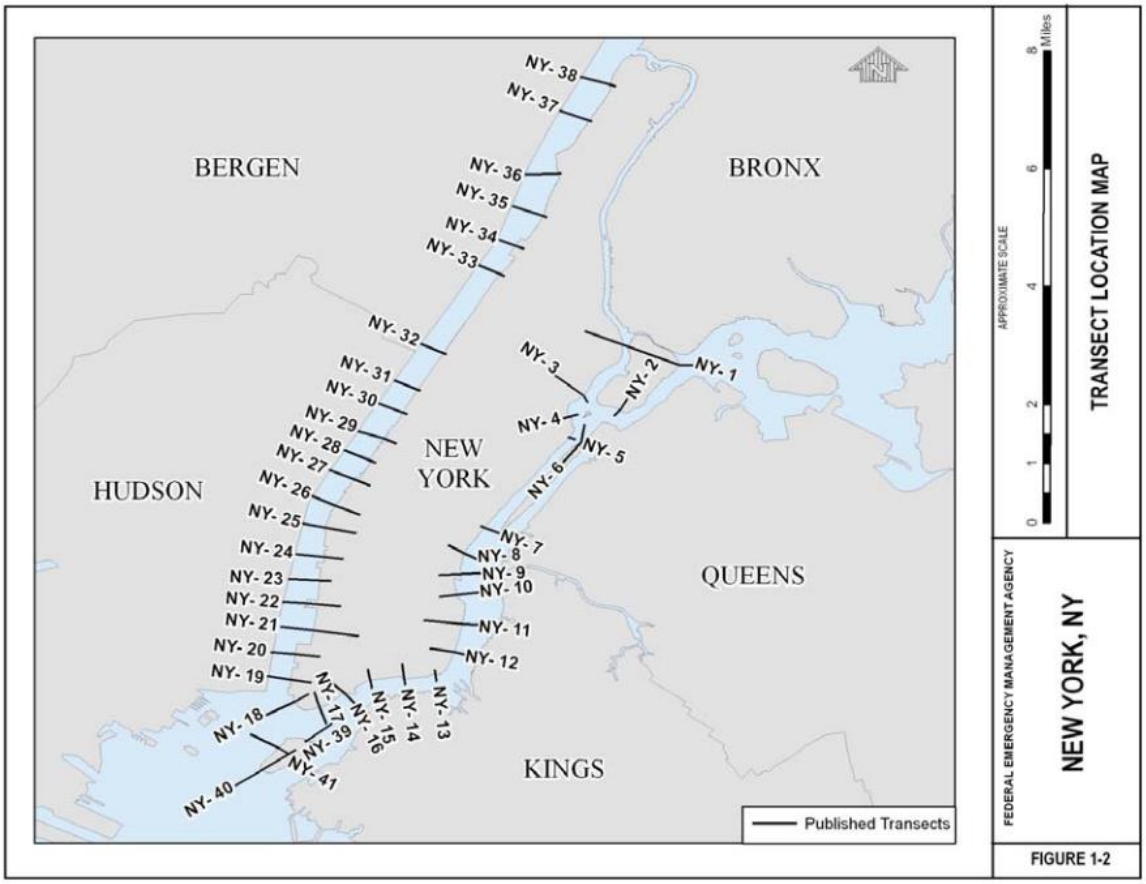

Figure 3: Transect Location Map from FEMA Preliminary Flood Insurance Study (FIS)

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations[1] (ft NAVD88) Range of Stillwater Elevations[2] (ft NAVD88)			
		Coordinates	Significant Wave Height (ft)	Peak Wave Period (sec)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
East River	NY-14	N 40.709185 W 73.987873	2.58	2.65	6.8 6.6 - 6.8	9.6	11 10.9 - 11	14.3 14.3 - 14.5
East River	NY-15	N 40.708799 W 73.997024	2.93	3.09	6.8 6.7 - 6.8	9.7	11.1 10.9 - 11.1	14.6
East River	NY-16	N 40.705313 W 74.003819	3.12	3.51	6.8 6.6 - 6.8	9.8 9.7 - 9.8	11.2 10.9 - 11.3	14.7 14.7 - 14.8
East River	NY-17	N 40.701590 W 74.010682	3.37	3.21	6.9 6.9 - 7.4	9.9	11.3 10.7 - 11.3	14.8 14.8 - 14.9
Upper New York Bay	NY-18	N 40.702983 W 74.017383	5.01	5.17	6.9	9.9	11.3 11 - 11.3	14.9 14.7 - 14.9
Hudson River	NY-19	N 40.709054 W 74.018613	5.02	5.81	6.9 6.9 - 7.3	9.8 9.1 - 9.8	11.3 10.5 - 11.3	14.8 14.3 - 15.1
Hudson River	NY-20	N 40.715891 W 74.017227	4.94	5.82	6.6	9.7	11.2 10.7 - 11.2	14.7 14.3 - 14.7
Hudson River	NY-21	N 40.722252 W 74.012398	4.71	5.27	6.7	9.7 9.6 - 9.7	11.1 10.1 - 11.1	14.6 14.4 - 14.6

Figure 4: Transect Data from FEMA Preliminary Flood Insurance Study (FIS)

While discussed in later sections, it is worth noting that, while the starting stillwater elevations have little variation, the starting wave conditions for the 1% annual chance event vary significantly across the transect locations.

Compliance with Local Law (LL) 96

Local Law 96 of 2013 requires that the New York City Building Code, and therefore the coastal flood protection projects built in compliance with it, use the more restrictive of either FEMA's Effective Flood maps that date to 2007 or any Preliminary Flood maps released since then (2013, or, more recently, 2015). In compliance with that requirement, all resiliency projects within LMCR and across the city, are designed in accordance with this practice.

In 2015, the City appealed the PFIRMS on the basis that FEMA's modeling contained technical errors. In October 2016, FEMA agreed to work with the City to revise the 2015 PFIRMs to better reflect current and future flood risk by creating two separate maps: one for flood insurance purposes, and the other for building and planning purposes. However, until the new flood maps are issued, flood insurance rates in New York City will continue to be based on the 2007 effective FIRMs while provisions of the Building Code and Zoning Resolution will continue to be based on the 2007 FIRMs and the 2015 PFIRMs (whichever is more conservative).[12]

Sea Level Rise

For all LMCR projects, the City of New York advises using sea level rise data provided by the New York City Panel on Climate Change (NPCC). The NPCC is a 20-member independent advisory body that synthesizes scientific information on climate change and advises policymakers on local resiliency and adaptation strategies to protect against rising temperatures, increased flooding, and other hazards.[13] Each project in the LMCR portfolio is using the NPCC's 90th percentile projections for future sea level rise projections – in the 2050s, this is 30 inches (2.5 feet), and by 2100, this is 75 inches (6.25 feet). Sea level rise projections from 2020s to 2100 and low to high estimates is shown in Figure 5**.**

With the Stillwater Elevation in hand, the Project Team can then adjust for projected sea level rise (SLR) in the 2050s and 2100. As shown in Figure 6, as the selected sea level rise projection becomes further into the future (i.e., 2100 versus 2050s), the design flood elevation becomes higher to respond to the projected rising sea levels.

[12] Zoning Districts & - DCP (nyc.gov)
[13] https://www1.nyc.gov/site/sustainability/reports-and-data/new-york-city-panel-on-climate-change.page

Table 3.1. New York City sea level rise projections[a] for the 2020s, 2050s, and 2100, relative to 2000–2004, (NPCC, 2015)

Sea level rise baseline (2000–2004)	Low estimate (10th percentile)	Middle range (25th–75th percentile)	High estimate (90th percentile)
2020s	+2 in.	+4–8 in.	+10 in.
2050s	+8 in.	+11–21 in.	+30 in.
2080s	+13 in.	+18–39 in.	+58 in.
2100	+15 in.	+22–50 in.	+75 in.

[a]Based on 24 GCMs and two representative concentration pathways, RCP 4.5 and 8.5. Shown are the low-estimate (10th percentile), middle range (25th–75th percentile), and high-estimate (90th percentile).

Figure 5: NYC Sea Level Rise Projections, provided by NPCC

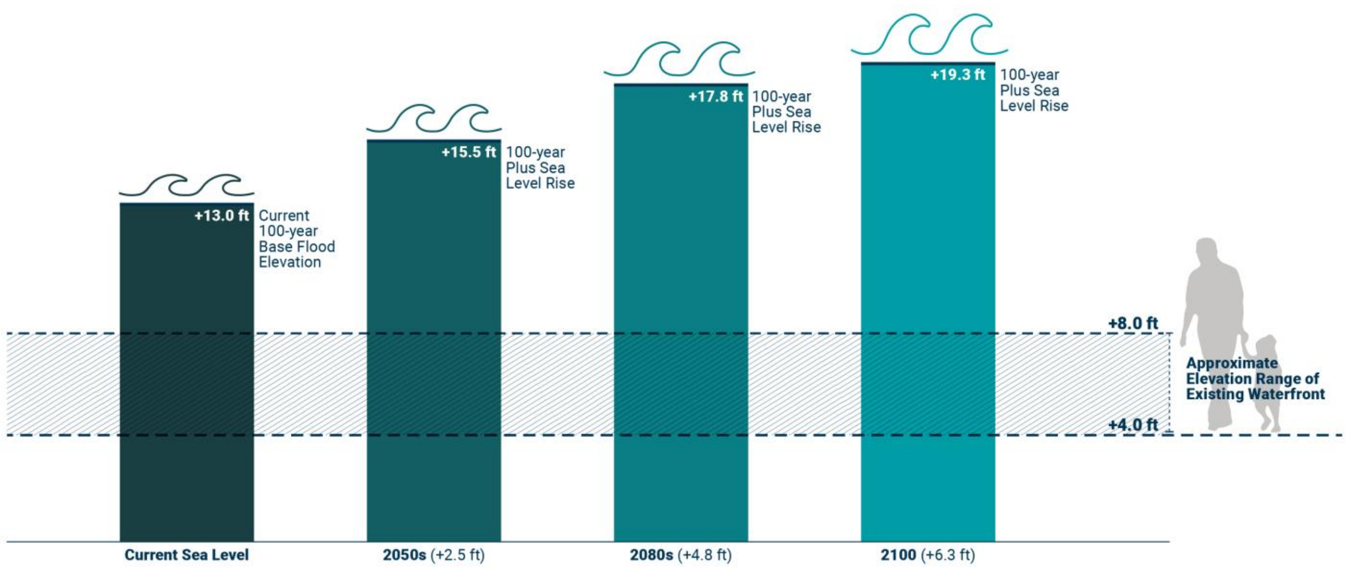

Figure 6: Graphical Representation of Impact of Sea Level Rise on Design Flood Elevation over Time

Waves

Arguably the most variable factor in determining the design flood elevation is the effect of waves. Wave impacts refers to how the wave interacts with the shoreline and the flood defense structure.

The effect of waves varies across the study area due to a specific site's relative location in the New York Harbor. Waves within the study area are locally generated from wind blowing across the water. Where there is substantial "fetch," or open water for waves to gain energy before reaching land, larger waves are generated (Figure 7).

Figure 7: Graphical representation of wave heights, based on FEMA Preliminary FIS

After the waves reach the shoreline, the waves may break and will also interact with topography and structures. The height of the wave reaching a flood defense structure can vary greatly depending based on the topography, vegetation and other structures located between the water and the flood defense system. The shape of the structure and whether it is a vertical wall (like a floodwall) or if it is sloped (like a levee or berm) also influences how the wave interacts with the flood defense system. Wave impacts include both structural (wave forces) and flooding potential. If a project is seeking FEMA accreditation, like BMCR or the Battery Park City Resiliency Projects, FEMA specifies wave effect criteria for the flood protection system's certification.

Wave overtopping is the final component for determining the top of wall elevation. Wave overtopping occurs when a wave "runs up" the flood defense structure and exceeds the top of wall elevation, allowing water to enter the dry side of the flood defense system. While a goal of no overtopping is often preferred, practical considerations may necessitate some overtopping with extreme storm conditions and future sea level rise. When overtopping is considered in the flood defense design, the volume of water from wave overtopping is based upon the capacity of the interior drainage system, public safety, and structural considerations.

How and why do Design Flood Elevations vary throughout the LMCR Portfolio?

The following describes the design criteria and design flood elevations for each project in the LMCR Portfolio.

Projects to Address 100-year Storm Surge and Tidal Flooding

BMCR, South BPCR, and North/West BPCR are capital projects designed to address both storm surge and tidal flooding in Lower Manhattan. Once implemented (construction is currently unfunded), the Financial District and Seaport Master Plan, will complete the missing link in providing comprehensive flood protection from both storm surge and tidal flooding in Lower Manhattan. Figure 8 illustrates the projects, with the South and North/West BPCR Projects illustrated as "Battery Park City Coastal Resilience" Projects.

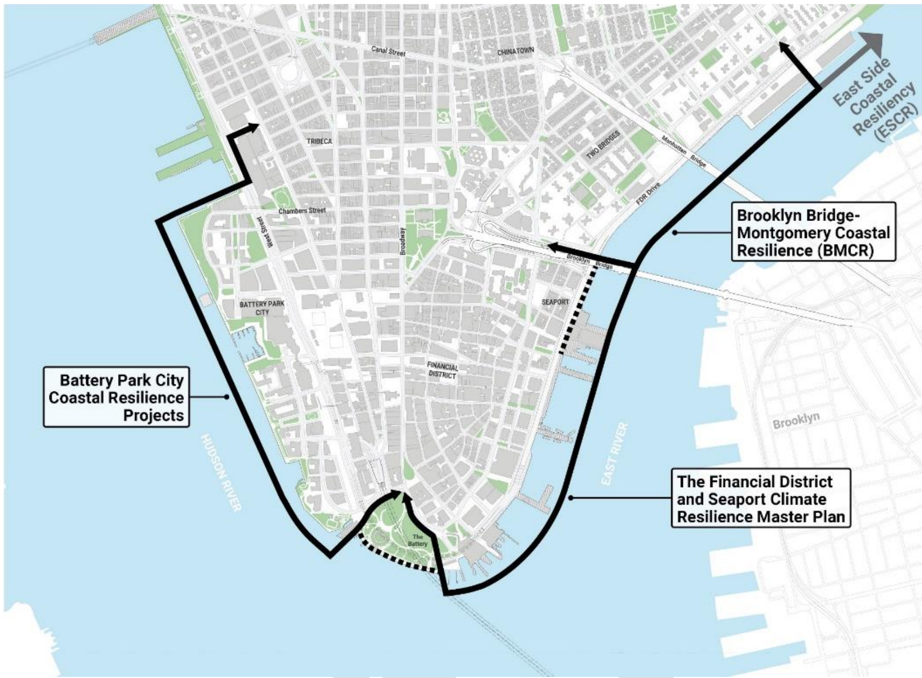

Figure 8: Projects to Address both Storm Surge and Tidal Flooding

Brooklyn Bridge-Montgomery Coastal Resilience (BMCR)

The BMCR project is a 0.80-mile capital project from Montgomery Street to the Brooklyn Bridge. The project is designed to address both tidal flooding and coastal storms. It has a passive, or constant, level of protection from 2050s high tide, and is designed to protect from the 2050s 100-year storm.

The project is funded through a combination of HUD CDBG-DR funds and City Capital. The HUD CDBG-DR funds were awarded to the City via the National Disaster Resilience Competition (NDRC) in 2016. NDRC was a two-phased process that ultimately awarded over $1 billion in HUD Disaster Recovery funds, including $176 million to New York City for the BMCR project.[14]

As a result of the NDRC award, the project needs to be designed and implemented such that it could be accredited by FEMA and constructable with the allowable timeframe set forth by HUD. To be accredited by FEMA means that BMCR needs to comply with design, data, and documentation requirements put forth by FEMA in 44 CFR 65.10.[15] To construct the project within the timeframe set forth by HUD, BMCR aims to avoid/minimize potential right-of-way (ROW) conflicts, avoid significant utility obstructions/conflicts, avoid known major environmental impacts, and avoid lengthy or complex permitting considerations.

Battery Park City Coastal Resilience Projects

Battery Park City Authority (BPCA) has assumed responsibility for two distinct but interrelated resiliency projects, South BPCR and North/West BPCR – comprising a combined flood barrier length of approximately 1.8 miles -- as

[14] https://www.hud.gov/sites/documents/NDRCFACTSHEETFINAL.PDF
[15] https://www.fema.gov/sites/default/files/documents/fema_meeting-criteria-accrediting.pdf

part of LMCR to protect Battery Park City and other parts of Lower Manhattan from the threats of storm surge and sea level rise.[16] South BPCR will create an integrated coastal flood risk management system from the Museum of Jewish Heritage, through Wagner Park, across Pier A Plaza, and along the northern border of the Historic Battery. Construction is scheduled to begin in Fall of 2022. North/West BPCR contemplates the creation of an integrated coastal flood risk barrier system extending from First Place, north along the Battery Park City Esplanade, across to the east side of West Street/Route 9A, terminating at a high point on Greenwich Street. Both Battery Park City Coastal Resiliency Projects are designed to protect from the 2050s 100-year storm.

Both BPCA projects will be financed with bonds; as such, no City Capital or federal funding is contemplated for the implementation of these projects. The projects will seek FEMA accreditation; therefore, they must comply with design, data, and documentation requirements put forth by FEMA in 44 CFR 65.10.[17]

Financial District and Seaport Climate Resilience Master Plan (FiDi Seaport)

The FiDi Seaport project is a 0.90-mile long-term planning effort to address both storm surge and tidal flooding in Lower Manhattan. Due to unique site conditions in the area, the prior phase of the master plan determined that it was not possible to build the project entirely on-land and that a shoreline extension, or land reclamation, would be required in order to site the coastal defense while maintaining access for all to the maritime assets along the waterfront.

Given the time horizon for implementation, as well as the very low topography within the study area, the project is designed to provide a passive, or constant, level of protection for 2100 sea level rise. The project is also designed to protect the area from the 2100 100-year storm.

Most recent cost estimates suggest the overall project cost between $5-7 billion, with a funding and financing program yet to be realized. As a result, it is not yet certain whether there will be additional design guidance and/or timelines that need to be adhered to as part of the project's implementation. However, to be consistent with other LMCR projects, the Project Team is complying with the design guidance put forth by Local Law 96, NPCC, and FEMA in 44 CFR 65.10.

Given the uncertainty in timeline for implementation, the City is taking swift action to minimize risk in the most vulnerable areas of Lower Manhattan while ensuring compatibility with the overall master plan.

Projects to Address Tidal Flooding & Higher Frequency Coastal Storms.

The Battery Coastal Resilience is a capital project designed to address tidal flooding in Lower Manhattan, and SPCR is a capital project designed to address higher frequency coastal storms, as well as tidal flooding (Figure 99). Both projects protect to 2100 sea level rise and are coordinating with on-going, longer-term efforts, including the Battery Park City Coastal Resilience projects and the Financial District and Seaport Climate Resilience Master Plan.

[16] https://bpca.ny.gov/nature-and-sustainability/resiliency/
[17] https://www.fema.gov/sites/default/files/documents/fema_meeting-criteria-accrediting.pdf

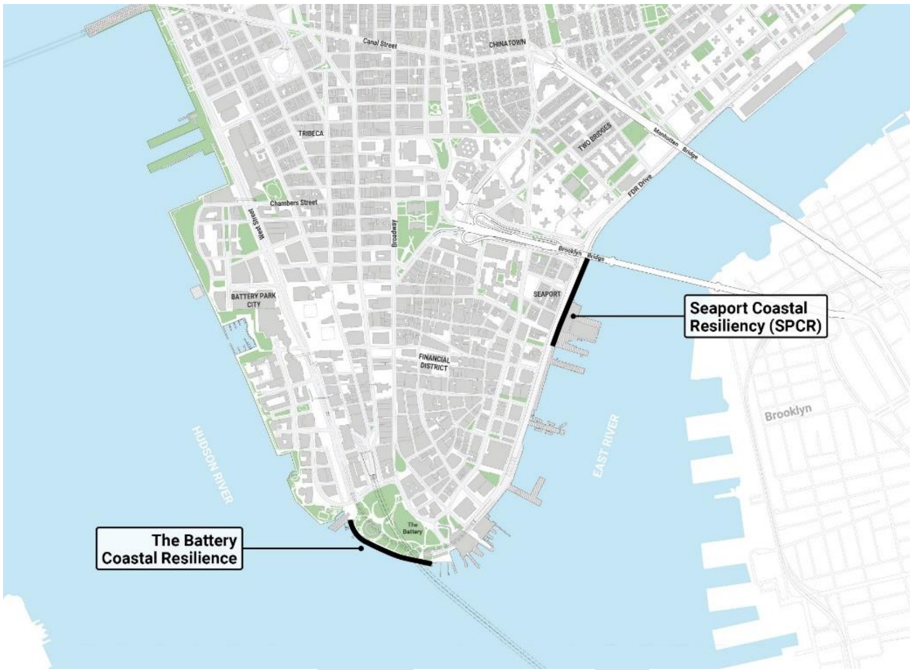

Figure 9: Projects to Address Tidal Flooding

The Battery Coastal Resilience

The Battery Coastal Resilience runs along the waterfront in The Battery and is designed to protect the park from rising seas over the next 80 years (2100 sea level rise). In addition to the project design criteria, Battery Coastal Resiliency will also reconstruct the deteriorating wharf.

The proposed design has been planned and designed to ensure that, when completed, the LMCR projects will work together as a compatible, unified system, offering a consistent level of coastal flood risk reduction to Lower Manhattan.[18] Within the Battery, there will be two integrated layers of protection provided under separate projects. The Battery Coastal Resilience project will mitigate risks from sea level rise by elevating the waterfront edge. A future project will provide storm surge protection on higher ground at the back side of the park. Together, the project and adjacent resiliency efforts form a coordinated set of coastal protections that maintain the uses and character of the park today, while providing protections for storm events in the future.

The project is funded entirely through City capital and is another example of where the City is taking action to minimize risk and improve City infrastructure while ensuring compatibility with efforts that can further reduce the risk of flooding from coastal storms in the future.

Seaport Coastal Resilience (SPCR)

The SPCR project runs along the waterfront from the Brooklyn Bridge to John Street. The City plans to develop a Public Request for Proposal (RFP) to procure and select the appropriate and qualified Design Consultant team. This team will coordinate and work with the community on developing an optimal design within the budgeted

[18] The Battery Coastal Resilience (nyc.gov)

funds to address this portion of the LMCR program. The design procurement process will occur Q4/2022-Q1/2023 with the intent of selecting the design team to commence planning based on an iterative community-based design process. As currently envisioned, the project is designed to address 2100 high tide as well as higher frequency, or more frequent, coastal storm events. As compared to other capital projects that are soon to be in construction, SPCR is still at a very early stage of design. As a result, as well as to ensure compatibility with the long-term FiDi Seaport master plan that is discussed below, 2100 sea level rise was selected as the part of the design criteria.

The project is funded through a combination of FEMA BRIC funds and City Capital. The $50 million award of FEMA BRIC funds was announced in August 2022, making SPCR one of three projects nationwide to receive the maximum award amount. As the BRIC program aims to minimize risk prior to a disaster occurring, a project needs to demonstrate that it is cost-effective (i.e., has a benefit-cost ratio greater than 1) and that it can be implemented in a timely manner. To comply with the implementation time horizon, it is anticipated that the project will avoid/minimize potential right-of-way (ROW) conflicts, avoid property acquisition, avoid significant utility obstructions/conflicts, avoid known major environmental impacts, and avoid lengthy or complex permitting considerations.

SPCR is an example of where the City is taking swift action to minimize risk to a vulnerable portion of Lower Manhattan while ensuring compatibility with efforts that can further reduce the risk of flooding from coastal storms in the future.

Summary Table

Table 1 provides a summary of the design criteria for the LMCR projects. Across all projects, the baseline storm return period (i.e., the stillwater elevation) is derived from the FEMA PFIRMs. Similarly, all projects are using NPCC sea level rise data. The variation in the design flood elevation arises from three key factors: (1) what is the project's design criteria (e.g., 100-year storm or a different design standard), what sea level rise projection (i.e., 2050s or 2100, and the local wave conditions.

Table 1: Summary Table of Design Criteria for LMCR Projects

Project Name	Stage of Project	Source of Stillwater Elevation	Design Criteria: Sea Level Rise	Design Criteria: Storm Surge	Design Criteria: Tidal Flooding	Relative Wave Climate in Study Area*
BMCR	Funded, Construction to begin Fall 2022	FEMA PFIRMs	NPCC, 2050s	100-year storm	Constant protection, future high tide	Moderate
Battery Park City Coastal Resilience Projects	Funded, Construction to begin Fall 2022 (South Project)	FEMA PFIRMs	NPCC, 2050s	100-year storm	Constant protection, future high tide	BPCA South = High; BPCA North/West = Low-High
FiDi Seaport	Long-term Planning	FEMA PFIRMs	NPCC, 2100	100-year storm	Constant protection,	Moderate – High

					future high tide	
The Battery Coastal Resilience	Funded, Construction to begin Spring 2023	FEMA PFIRMs	NPCC, 2100	--	Constant protection, future high tide	High
Seaport Coastal Resilience	Funded, Design Development to begin 2023	FEMA PFIRMs	NPCC, 2100	Protect against higher frequency coastal storm events (2% storm)	Constant protection, future high tide	Moderate

*Each project completed a site-specific wave assessment