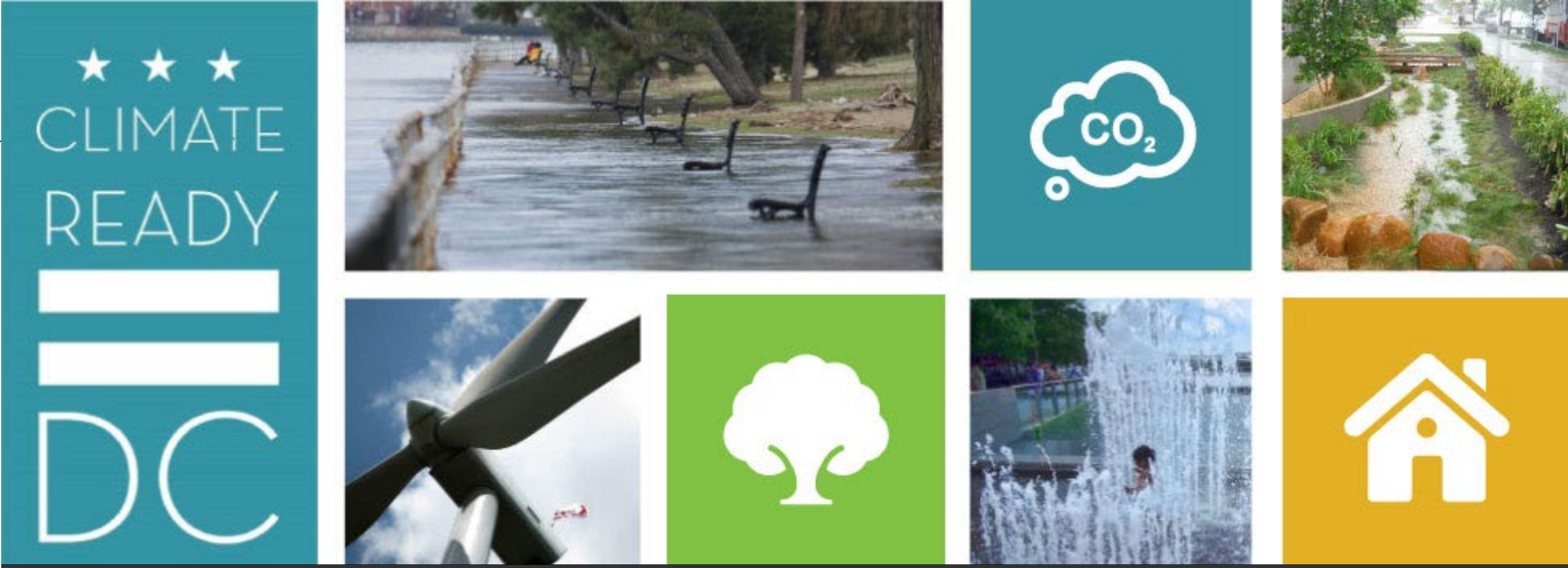


FloodSmart Homes Research

Executive Summary

Prepared for DC Department of Energy and Environment

November 22, 2019

DEPARTMENT OF ENERGY & ENVIRONMENT

CADMUS

Contents

Introduction | Goals

Cadmus is assisting DOEE in investigating the potential of a Flood Smart Homes program, which would be targeted towards homes in the floodplain and fund retrofit improvements. This research is part of a larger project focused on implementing Climate Ready DC.

To date, Cadmus has:

» Conducted desk research and a GIS analysis to understand DC's housing stock, conditions, and common interventions for flood mitigation.

» Completed desk research and interviews with DC agencies and program managers from other local government retrofit programs across the country.

» Collected cost estimates for ten priority retrofit measures.

More detailed information on these tasks is available in two supporting memos and an Excel spreadsheet contained in the FloodSmart Homes Sharepoint folder alongside this Executive Summary of the research.

Contents

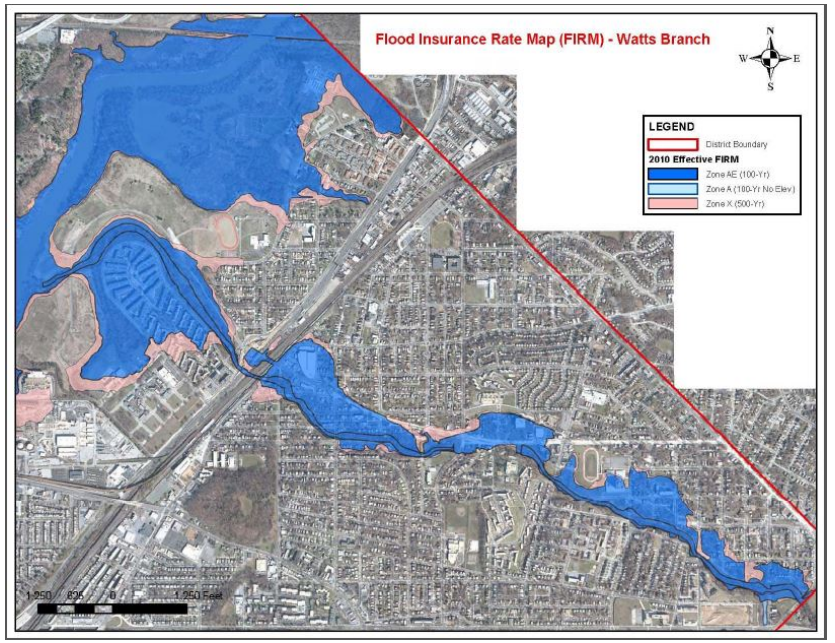
Interviews: Overview

- **Internal DC Agencies**
  - **Vermecia Alsop:** Mitigation Planner, HSEMA
  - **Casey Studhalter:** Program Analyst, DOEE Urban Sustainability Administration
  - **Marco Ciarla and Stacey Underwood:** Program Manager, Silver Jackets Coordinator (respectively) U.S. Army Corps of Engineers (USACE)
    - Referred by Marco Ciarla
      - **Lea Adams:** Chief, Water Resources Division, U.S. Army Corps of Engineers.

Interviews: Key Takeaways

» Flood Experience in DC

- The **most common flooding-related issue District residents are facing is interior flooding**, particularly in basements.
- **Near Watts Branch**, one of the most flood-vulnerable sections of the District, **residents have not experienced more than nuisance flooding** in recent memory, despite significant riverine flood risk.
- Based on outreach to Advisory Neighborhood Commissions (ANCs), **flooding due to aging infrastructure** is a more commonly expressed concern.
- The team also asked about **data availability and suggestions for use of GIS layers,** particularly regarding basements, but **no ideal source was identified.** The USACE is doing physical surveys for basement data in Watts Branch.



Interviews: Key Takeaways

- **Current landscape of flood retrofits**
  - Though little concrete data is available, most DC stakeholders have **not seen significant uptake of residential flooding retrofits**. Of the few retrofit strategies observed, the **installation of backflow preventers** and **covering of window wells are among the most frequent**, as a treatment for nuisance water intrusion.
  - Some **elevation and dry floodproofing** measures were noted for non-residential buildings, as well as **cognizance of the BFE when constructing new homes**.
  - **Sand bagging** was also frequently observed, though not favorable given that flooding risk must be known in advance.

Contents

Quantitative Analysis: Introduction

- The quantitative analysis was designed to:
  - Define **rough order of magnitude of estimated level of needs for single-family homes** based on current and projected flooding conditions
  - Understand the **current Housing Stock and its condition by conducting buildings counts** within the floodplain and examining the type of construction
- Data sources were chosen to characterize resident building assets and flood exposure.
- The analysis categorized the buildings and determined geospatial proximality to flooding areas to give estimates of the counts of vulnerable and retrofit-eligible buildings.

Quantitative Analysis: Introduction

- Data layers for this analysis were refined through iteration and feedback with DOEE and conversations with other D.C. agencies.
- This analysis presents **building counts by a variety of factors, which could impact vulnerability including construction type and housing typology.**
- These counts can help DOEE think about different ways to target and structure a future program and how costs and the ease of retrofitting may differ across the housing stock.

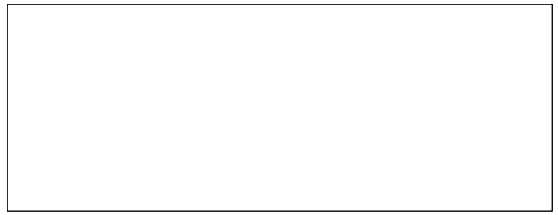
Data Sources: Residential Building Assets

- Building footprints
  - Data source name: “Historic_Data_on_DC_Buildings”
  - Includes year built, and construction material, and detatched type
  - Used buildings with property type “dwelling” to limit to residential
- Parcel and building assessor's data
  - Data source name: “DC Real Property Lots/ Common Ownership Lots”
  - Includes building square footage
  - Assessor data filtered to single-family residential parcels

Data Sources: Flood Exposure

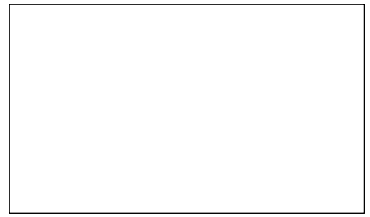
- FEMA floodplains
  - Data source name: “Floodplains_from_2016”
  - Areas within the 100-year and 500-year floodplains

- SLOSH flood risk
  - Data source name: “Storm_Surge_Risk_Areas”
  - Areas with a risk of storm tide flooding from hurricanes, based on potential storm tide heights and classified by hurricane categories 1 through 5



Counts of Residential Buildings for FloodSmart Program

- Residential buildings were overlaid with flood exposure zones to generate overall counts and counts by building categorization
- A number of characteristics of residential buildings (available from the Historic_Data_on_DC_Buildings data source) were chosen that would help indicate either a) vulnerability or b) suitability for retrofit measures
- In order to develop counts of buildings to prioritize for the FloodSmart program, categorizations were developed for the residential building assets
- Categories were developed based on input from the DOEE and interviews with subject matter experts



Residential Building Categorization: Construction Material

- Based on subject matter expert interviews, the following categories for construction material were chosen:
  - Frame
  - Frame Mixed
  - Masonry
  - Masonry Mixed
  - Other or Not Specified
- It was noted that frame houses would be best suited to measures such as elevation whereas masonry would be best suited to measures such as dry floodproofing.
- The building records indicated numerous residential buildings of mixed construction types. Mixed types that included frame or wood were categorized as “Frame Mixed”. Mixed types that included masonry but no indication of frame or wood were categorized as “Masonry Mixed”

Building Counts: FEMA Floodplain and Building Material

Floodplain	Building Material	Count
500-year floodplain	Frame	15
100-year floodplain	Frame	92
Outside 500-year floodplain	Frame	10,537
100-year floodplain	Frame Mixed	7
Outside 500-year floodplain	Frame Mixed	4,978
500-year floodplain	Masonry	39
100-year floodplain	Masonry	64
Outside 500-year floodplain	Masonry	57,114
100-year floodplain	Masonry Mixed	1
Outside 500-year floodplain	Masonry Mixed	6,049
500-year floodplain	NA	25
100-year floodplain	NA	28
Outside 500-year floodplain	NA	16,475

Residential Building Categorization: Detached Type

- Based on subject matter expert interviews and desk research, Cadmus determined that detached building type is an important factor in choosing appropriate retrofit measures. The following categories were chosen:
  - Detached
  - Semi-Detached
  - Row House

Building Counts: FEMA Floodplain and Detached Type

Floodplain	Detached Type	Count
500-year floodplain	Detached	14
100-year floodplain	Detached	102
Outside 500-year floodplain	Detached	26,132
500-year floodplain	Semi-Detached	37
100-year floodplain	Semi-Detached	54
Outside 500-year floodplain	Semi-Detached	17,307
500-year floodplain	Row House	14
100-year floodplain	Row House	32
Outside 500-year floodplain	Row House	41,101
500-year floodplain	Not Specified	14
100-year floodplain	Not Specified	4
Outside 500-year floodplain	Not Specified	10,613

Residential Building Categorization: Year Built

- In order to develop counts characterizing the age of buildings, the following discrete categories were chosen:
  - 1980 to present
  - 1920-1979
  - 1890-1919
  - Before 1890
- The date ranges were chosen based on discussion with DOEE and agency staff.
- In subject matter expert interviews, Cadmus received feedback that older buildings were more vulnerable, but that they had not found distinguishing times before or after which buildings were more vulnerable.

Building Counts: FEMA Floodplain and Year Built

Floodplain	Year Built	Count
500-year floodplain	1980 to present	4
100-year floodplain	1980 to present	3
Outside 500-year floodplain	1980 to present	3,030
500-year floodplain	1920-1979	51
100-year floodplain	1920-1979	148
Outside 500-year floodplain	1920-1979	57,320
500-year floodplain	1890-1919	11
100-year floodplain	1890-1919	40
Outside 500-year floodplain	1890-1919	27,829
500-year floodplain	Before 1890	13
100-year floodplain	Before 1890	1
Outside 500-year floodplain	Before 1890	6,974

Additional Residential Building Characteristics

- As was noted in the interview summary memo, the interviewees indicated that additional key building characteristics were **basement type and building condition.**
- Unfortunately, that **information was not contained in available data sources** and was not included in this analysis.
- At a site-specific level, those characteristics will be important to determine eligibility of specific buildings for retrofit measures.

Contents

Existing Programs: Interviews

- **Existing retrofit programs**
  - Though fairly uncommon, some governments and organizations are leading the nation in flood retrofit programs. Some notable examples from the desk research were: t**he RetroFIT program in the greater Charlotte, NC area; FloodHelp NY in New York City; and the Residential Resiliency Grant program in greater Chicago.**
- The Cadmus team conducted one-hour interviews with the following staff managers:
  - **Tim Trautman:** Program Manager, Mecklenburg County Storm Water Engineering & Flood Mitigation
  - **Caroline Nagy, Aaron Sterm, and Sara Melomedov:** FloodHelp NY
  - Multiple attempts were made to contact Cook County, but efforts were not successful

Contents

RetroFIT: Introduction

Charlotte-Mecklenburg retroFIT
Floodproofing • Improvements • Together

- **Overview**
  - **WHO:** Charlotte-Mecklenburg County
  - **WHAT:** RetroFIT offers **technical assistance** and **financial aid** to **property owners within the floodplain.**
  - **WHEN:** Launched August, 2015 and ongoing
  - **WHERE:** Charlotte-Mecklenburg County
  - **WHY: A preventative program** to help residents and businesses fortify their homes against flood damage, principally those noncompliant with floodplain regulations.
  - **HOW:** Grants are **available to cover 75-95% of costs for qualifying floodproofing projects.** County provides a home assessment service at the property to discuss options available, cost-benefit, and regulations. Homeowners manage their retrofit job, and the County reimburses costs. The program is **funded by a portion of the County's stormwater fees.**

Flooding from severe storms in Mecklenburg, June 9, 2019

RetroFIT: Process

Charlotte-Mecklenburg retroFIT
Floodproofing • Improvements • Together

Application Phase:

The Charlotte-Mecklenburg Storm Water Services (CMSWS) **conducts outreach** to property owners located within the floodplain.

and/or

Homeowners **complete the online application** and select flood proofing strategies. CMSWS may **provide guidance to property owners in determining appropriate retrofits.**

Review & Assistance Phase:

CMSWS **evaluates the application for project viability** (namely: is the project feasible and cost-effective? Will the improvements made bring the property into compliance with floodplain regulations?)

May conduct **in-home assessment** to determine **site's needs and income determination**.

Property owner submits a **Grant Application**.
(Average 45-120 days)

Approval Phase:

If selected, project is **approved for funding** by the Storm Water Advisory Committee,

A **contract is written** between the County and property owner regarding the terms and project requirements.

Project Implementation Phase:

Property owners **hire contractors** to complete the work and manages the project.

The County does not provide a list of recommended contractors or provide support during retrofit project development, so the **property owner is responsible for the hiring process**.

Reimbursement Phase:

The County **reimburses** the property owner either **at the completion** of the project **or at verifiable milestones**.

Property owners' **cost share ranges from 5%-25%** of final grant amount.

DEPARTMENT OF ENERGY & ENVIRONMENT
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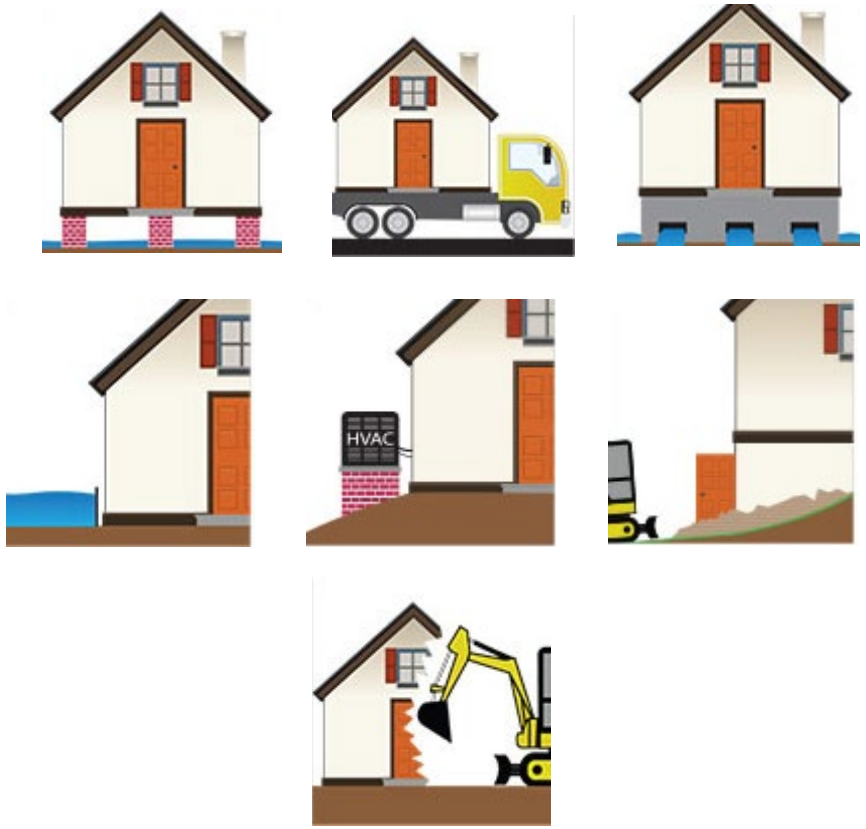
RetroFIT: Components

- **Types of Projects Funded:**
  - **Structure Elevation**
  - **Structure Relocation**
    - Homeowner bears cost of acquiring a new parcel; grant covers relocation costs
  - **Wet Floodproofing**
    - Defined as ventilating crawl spaces, replacing unsuitable materials with flood resistant ones
  - **Dry Floodproofing**
    - Ensuring structure is watertight, *not acceptable for residential structures*
  - **Equipment Elevation**
    - Elevating, relocating, or protecting utilities
  - **Abandon basement**
  - **Demolition**
    - Grant will fund demolition and removal of debris



RetroFIT: Components cont.

- **Uptake**
  - Since inception: **100+ applicants and assessments, 20 completed projects,** all projects residential
  - To date**, assessments have been provided by County staff**
  - **Most common retrofit**: **flood vents** and **equipment elevation projects**, approximately 6 demolitions
  - **No structure elevations** conducted as of October, 2019

Not a high-volume program likely due to **cost-share** nature and need for property owners to **independently hire contractors**.

Though a majority of the applications have not pursued retrofits to date, RetroFIT program managers still find value in the ability to **educate homeowners about the flood mitigation risk and strategies** during an on-site assessment.

RetroFIT: Lessons Learned

- **Challenges** in moving homeowners **from assessments to retrofits**
  - **Cost:** homeowners are hesitant to act due to the **prohibitory costs** associated with **elaborate retrofit strategies.** Property owners typically seek to understand their ROI, but obtaining a hypothetical flood insurance rate for the program participants is a cumbersome process.
    - A better mechanism for rate quotes under different scenarios would likely improve participation.
  - **Knowledge of home improvement:** a degree of **sophistication** is **needed to find and manage contractors**. Grant recipients typically have above average experience with home improvement.
  - **Outreach:** To their and our knowledge, Mecklenburg is the only flood retrofit program that began as a **preventative program (as opposed to disaster recovery).** This means outreach and generating interest in the program can be more challenging. They see spikes in interest after flood events.

- **Value in education and awareness**
  - The assessment phase is seen as **equally valuable** because it allows program staff to help property owner's **understand their risks and strategies to mitigate** them

Contents

FloodHelp NY: Introduction

FloodHelpNY

» Overview

- **WHO:** Serviced by the Center for NYC Neighborhoods; Funded by New York Governor's Office of Storm Recovery as part of the NY Rising Community Reconstruction Program
- **WHAT:** A Home Resiliency Audit Program providing **no-cost resiliency audits** and **Elevation Certificates**. Income-qualified homeowners can receive additional no-cost services, like a backwater valve installation.
- **WHEN:** Launched September, 2016 and ongoing
- **WHERE:** New York City
- **WHY:** Connect eligible homeowners and neighborhoods impacted by Superstorm Sandy with resources (audit, counseling, etc.), and **bring greater awareness to resiliency measures and strategies to lower flood insurance rates.**
- **HOW:** A **credentialed engineer inspects the home and conducts a flood risk assessment**; the homeowner receives a detailed technical report with a flood insurance quote and/or an elevation certificate. In addition to the audit, the program also offers counseling to homeowners to walk through the report and discuss appropriate retrofit measures, such as backflow preventers to reduce future flood insurance. Funds for the program were provided via Sandy recovery money.

Flooding from Superstorm Sandy, 2012

FloodHelp NY: Process

FloodHelpNY

Phase 1
2016 - 2018

Phase 2
1/2019 - present

Outreach:

Homeowners learn about the program through **outreach events, direct mail, or through the website portal.**

- The Center's Outreach Team, consisting of field counselors, hold workshops and presentations on flood insurance and safety
- All homeowners within the floodplain received a letter directing them to the online platform

Assessment:

A **credentialed engineering** firm will conduct 1-2 hour site assessment and present a **customized Resiliency Report** with the home's flood risks and mitigation strategies

At least 1 engineer and 1 land surveyor present at each audit

Counseling:

A **resiliency counselor** will walk the home owner through the resiliency report and discuss feasible and cost-effective options, as well as **strategies to reduce flood insurance rates.** Counselors also review available contractors.

The homeowner receives a no-cost **Elevation Certificate**

Handoff:

Following advice from the resiliency counselor and the audit report, the homeowner may take appropriate measures to fortify their homes.

Resources on loans and incentives available on the FloodHelp NY platform.

Retrofit:

For low income homeowners, depending on the home's plumbing fixtures and location (i.e. floodplain located within), homeowners may also qualify for a **no-cost backwater valve installation.**

This phase is currently still accepting applicants and installations have not yet commenced.

FloodHelp NY: Components

FloodHelpNY

Home Resiliency Audit

Resiliency Report & Counseling

FloodHelpNY

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HOME RESILIENCY REPORT | TECHNICAL ASSESSMENT PAGE 1 OF 7

For definitions of the technical terms below, see the GLOSSARY on page 8.

ADDRESS: 123-45 66th St, New York NY

OWNER: John Doe

PROPERTY CHARACTERISTICS

Age YEARS	98	Number of Stories	2
Additional Building Uses	There are no additional building uses.	Residential Units	1
Building Width FEET	18.00	Building Length FEET	37.00
Ground Floor Area SQUARE FEET	670.00	Total Building Area SQUARE FEET	1,332.00
Attachment Comments		Attachment Type	Detached

The structure is a two-story dwelling with a subgrade crawlspace. The homeowner stated that the residence is used as a single-family but is deeded as a two-family.

ELEVATION CERTIFICATE INFORMATION

Current Flood Risk Zone*	AE	Estimated Future Flood Risk Zone*	AE
Current Base Flood Elevation (BFE) FEET	8.00	Estimated Future BFE* FEET	11.00
Datum	NGVD '29	Lowest Ground Level (c2.f) FEET	5.80
Lowest Floor Elevation (c2.a) FEET	5.60	Next Floor Elevation (c2.b) FEET	8.30

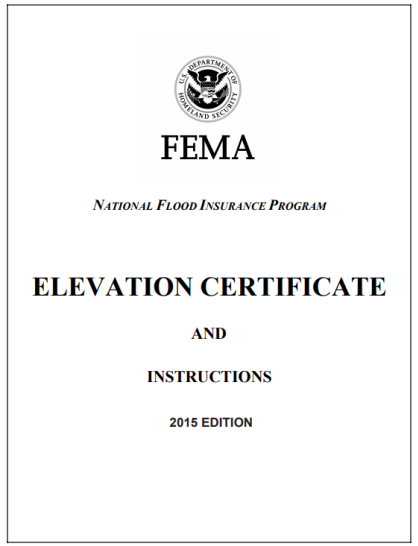
All measurements are in feet to sea level. For example, 5 means five feet above sea level.

*This is the Flood Risk Zone and Base Flood Elevation for your property under FEMA's advisory New York City Flood Insurance Rate Map, which was issued in 2015. The advisory map should only be used as a guide for future rates. A final map is under development.

(c) This code corresponds to the line item under Section C2 of your Elevation Certificate.

SAMPLE

Elevation Certificate



FEMA

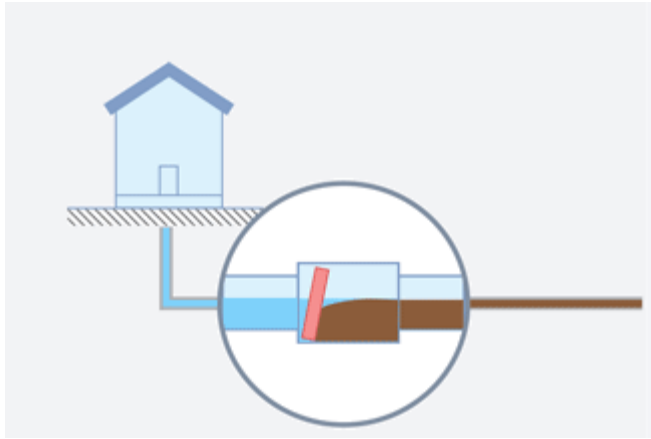
NATIONAL FLOOD INSURANCE PROGRAM

ELEVATION CERTIFICATE

AND

INSTRUCTIONS

2015 EDITION

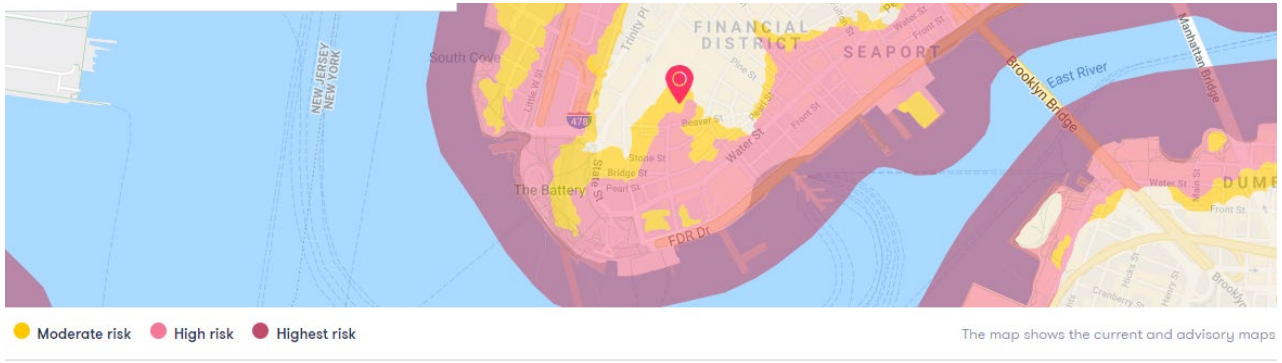


Some homeowners may qualify for a no-cost **backwater valve installation**

FloodHelp NY: Components

FloodHelpNY

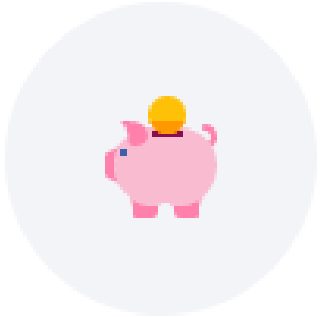
- Additionally, the FloodHelpNY website platforms provides resources on:
  - **Retrofit measures** (e.g. raising utilities, installing flood vents, etc.)**:** how it works, rough cost estimates, how it will affect homeowners flood insurance rate, and level of effort from start to finish).
  - **Mitigation on a budget:** low- to no-cost options for improving home resiliency (e.g. replacing carpet with tiles, floodproofing doors and barriers, etc.)
  - **Programs and benefits:** resources for LMI households, like **low-interest** home improvement **loans** for homeowners within flood zones
- By inputting their home address, owners can **learn about their flood zones** and get a **flood insurance estimate**



FloodHelp NY: Components cont.

FloodHelpNY

- **Uptake**
  - Since inception: 698 homeowners have received a no-cost resiliency audit
    - Over 100,000 users on the FloodHelp NY platform
  - **Post-Audit Survey:** survey administered 6 months after audit.
    - Found ¾ of homeowners were **overpaying for flood insurance**.
    - About **½ of participants submitted the Elevation Certificate**. Of those, about **½ saw their rates lowered**.
    - A majority of homeowners who **have taken actio**n to fortify their homes **have saved money**.
      Anecdotal evidence: one resident previously paying $3,000 was then rated in an X-zone post-audit



FloodHelp NY: Lessons Learned

FloodHelpNY

- **Education and awareness:**
  - The first phase of the program was designed to **educate homeowners** of their flood risks and opportunities for fortifying their home while lowering insurance rates.
  - Program managers identified one of the **greatest values of the program being the conversations between homeowners and resiliency counselors.** Counselors are able to make recommendations for improved resiliency while gauging approximate costs. Most participants were unaware of what an elevation certificate was and the benefit it can provide for insurance premium reductions.
- Transitioning **from audits to retrofits**
  - The current phase of the program is **more construction-oriented.** It will offer qualifying homeowners a **backwater valve installation at no-cost.**

Contents

Residential Resiliency Program: Introduction

Neighborhood Housing Services of Chicago, Inc.

» **Overview**

- **WHO:** The Neighborhood Housing Services of Chicago
- **WHAT:** A flood mitigation grant to provide flood relief to homeowners
- **WHEN:** April, 2017 – April 2019 (construction must be completed by July 2019)
- **WHERE:** Cook County, excluding City of Chicago
- **WHY: Severe storms in April and May of 2013 caused significant damage across the county and was the prime motivator for the development of this program**. Funds are to intended to protect the home from future storms or repair existing damage. The program is only available to homeowners who can prove they were affected by the 2013 storms.
- **HOW:** homeowners may apply for a one-time flood mitigation grant ("Community Development Block Grant – Disaster Recovery") of up to $25,000 per subject property. Grants are only available to eligible low-to-moderate income households.

Residential Resiliency Program: Process

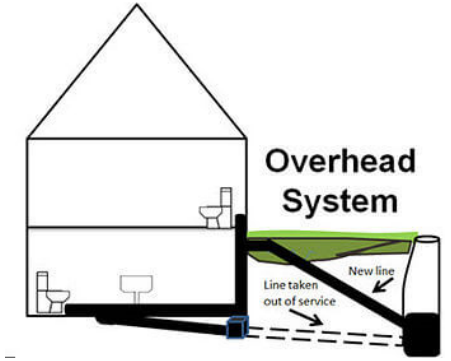
Neighborhood Housing Services of Chicago, Inc.

Application:	Processing & Verification:	Inspection & Counseling:	Funds Allocation:
Applicants submit an application and proof of damage (insurance claims, photographs, etc.)	Housing agencies (hired by Cook County to aid in program management) process applications Verify proof of damage, income eligibility, taxes and insurance policy, etc.	**Housing agencies conduct site assessment** to inspect damage and **counsel homeowners on contractor selection.**	A Scope-of-Work is arranged and funds are provided.

Residential Resiliency Program: Components

Neighborhood Housing Services of Chicago, Inc.

- **Types of Projects Funded:**
  - **Majority of assistance includes:**
    - Backwater valves
    - Overhead sewer
    - Landscape grading
  - **Other eligible reimbursements include:**
    - Installation or replacement of sump pump and French drains
    - Foundation wall repair
    - Removal of mold, asbestos, or lead-based paint
    - Replacement of gutters and downspouts



Residential Resiliency Program: Lessons Learned

Neighborhood Housing Services of Chicago, Inc.

- **Contractor Selection Support**
  - The Cook County program **chose to provide support to residents with selecting a contractor.** Within the RetroFIT program, Mecklenburg County chose not to expend limited resources on providing concierge services and acknowledged that this may prevent some homeowners less experienced with home improvements from pursuing projects. Cook County's choice could have chosen to provide support because it was targeting lower-resourced homeowners.
- **Low-to-moderate income focus**
  - Cook County targeted the **program exclusively for low-to-moderate income homeowners. The other two programs chose to offer subsidies to low-to-moderate income participants, but kept the program open to anyone within the floodplain.** The qualifying measures for the program were also less expensive than measures provided through RetroFIT with no expectation of cost share in alignment with the target audience.
- **Results To Be Determined**
  - Cadmus was not able to connect with program managers from the Residential Resiliency Program, possibly because program has concluded. Publicly available evaluation results are not yet available but may posted in the future.

Existing Programs: Key Takeaways

- **Education vs Construction**
  - Program managers have **split their resources between educating residents and funding retrofits.** Interviewees from RetroFIT and FloodHelp NY both emphasized the importance of counseling.
    - For instance, in Mecklenburg, even if the site assessment does not render a fundable project, program managers are still pleased by helping homeowners understand their risks and how to mitigate them. Due to limited program funds, Mecklenburg also chose not to provide concierge support to residents to help select contractors.
- **Recommending Contractors**
  - FloodHelp NY's counselors provide guidance on contractors and managing different quotes. Mecklenburg County, on the other hand, is less involved in the contracting phase.
    - There are advantages and disadvantages to both: a preferred provider method could potentially create bottlenecks due to preferred providers' limited capacity or result in poor performance if providers become less incentivized to compete for business. However if contractors are not recommended, homeowners may not be willing or able to navigate the process and rate of implementation may decline.
- **Unified Platform**
  - FloodHelp NY's online platform of consolidated resources, insurance rate calculator, guidance, and more is a driving factor of the program's success. It is essential to have a comprehensive landing page for homeowners to learn more. They **indicated a significant portion of applicant volume comes through the website.**

Contents

Retrofit Measures: Overview

» Based on desk research and review of external programs, Cadmus derived a list of retrofit measures and their applicability in attached vs detached structures. A gray circle indicates an inapplicable measure.

Retrofit Strategies	Single family attached	Single family detached	Mixed use
Wet floodproofing	●	●	●
Dry floodproofing	○	○	●
Deployable flood barriers (flood walls, levees)	●	●	●
Elevation of structure above the BFE/DFE	○	●	●
Resilient elevators	○	●	●
Relocation	●	●	●
Elevation of critical systems above the BFE/DFE	●	●	●

Retrofit Strategies	Single family attached	Single family detached	Mixed use
Secure critical systems and infrastructure	●	●	●
Fill basement/ cellar	●	●	●
Backwater valves	●	●	●
Sump pumps	●	●	●
Back-Up strategies	●	●	●
Emergency Preparedness Kit	●	●	●
Water Alarm	●	●	●

Retrofit Measures: Refined List

» Based on the **feedback from the interviews** on commonly occurring measures, the project team refined the list of proposed measures and **prepared cost estimates** for the 10 measures listed below.

» Cost estimates were obtained based on **desk research and outreach** (emails and phone calls) to **vendors**[1]. Our analysis is limited by the fact that accurate estimates are best obtained by arranging site visits at exact locations or structures. Per protocol, most vendors could not provide an estimate nor range of costs without conducting a site visit. **More detailed cost information is available in the associated spreadsheet.**

- **Wet floodproofing**
- **Deployable flood barriers**
- **Elevation of the structure above the DFE/BFE**
- **Elevation of electrical equipment**
- **Fill basement**
- **Demolition**
- **Sump pumps**
- **Backwater valves**
- **Elevation certificates**
- **Water alarms**

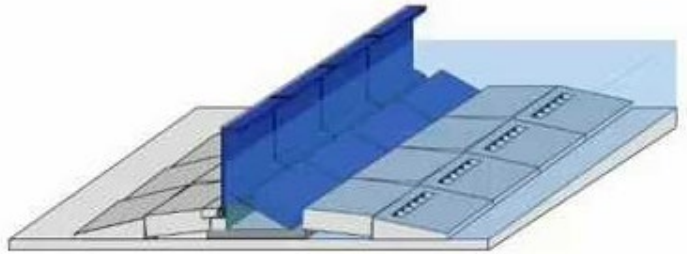
1- Cadmus interviewed Sam Draper, a sales and design consultant at B-Dry Floodproofing. Based on his knowledge and experience in the field, Sam provided rough cost estimates for a number of retrofit measures analyzed. We also discussed pricing with Lea Adams at Army Corps as well as RetroFIT and FloodHelp where they had data. Sam has also offered himself as a reference in further planning and decision making processes. sdraper@bdry.com. Mecklenburg County offered the same: Tim.Trautman@mecklenburgcountync.gov

Cost Analysis

» Wet Floodproofing: FloodVents

- » Price Estimate: $200/unit + $150/unit installation fee
  - › Source: Smart Vent
- » Price Estimate: $2,792 - $6,485
  - › Source: Home Advisor
- » Price Estimate: $4,000 - $8,000
  - › Source: FloodHelpNY

» Deployable Flood Barriers



Passive Deployable Barriers:

- » Price Estimate: $14,000 - $70,000
  - › Source: Floodbreak
- » Price Estimate: $5,000 per sq. m
  - › Source: AquaFragma
- » Price Estimate: $10,200 per sq. m
  - › Source: abettercity.Self Activating Flood Barrier (SAFB)

Active Deployable Barriers:

- » Price Estimate: $325 per ft. (average: $11,000)
  - › Source: Adam Goldberg, AquaFence
- » Price Estimate: $80 - 565 per ft
  - › Source: Joe Haslam, AquaDam
- » Price Estimate: $5,349 per 50’
  - › Source: Global Industrial

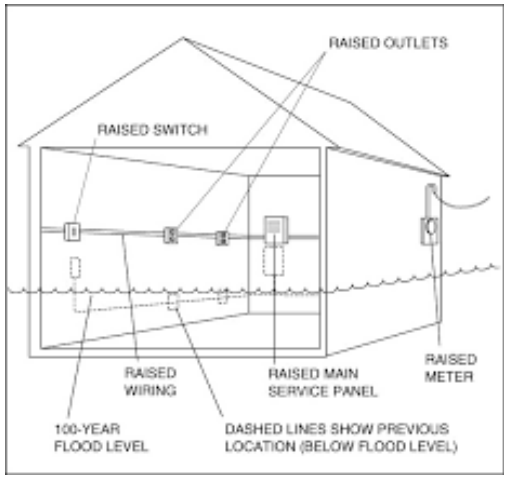
Note: prices will range considerably based on size, conditions, and needs of the home.

Cost Analysis

» Elevation of Structure

- » Price Estimate: $40,000 - $50,000
  - › Source: Sam Draper, B-Dry
- » Price Estimate: $40,000 - $250,000 ($10-$90/sqft)
  - › Source: Dawson Foundation Repair
- » Price Estimate: $100,000
  - › Source: Army Corp of Engineers

» Elevation of Electrical Equipment



- » Price Estimate: $1,500 – $2,000
  - › Source: FEMA
- » Price Estimate: $5,000 - $40,000
  - › Source: FloodHelpNY

Note: prices will range considerably based on size, conditions, and needs of the home.

Cost Analysis

Note: prices will range considerably based on size, conditions, and needs of the home.

» Fill Basement/Cellar

- » Price Estimate: $5,000 - $8,000
  - › Source: Sam Draper, B-Dry
- » Price Estimate: $1,500 - $15,000 (average: $5,500)
  - › Source: HomeAdvisor
- » Price Estimate: $8,000 - $30,000
  - › Source: FloodHelp NY

» Demolition[2]

- » Price Estimate: $4 - $15 per sq. ft.
  - › Source: HomeAdvisor
- » Price Estimate: $5 - $10 per sq. ft.
  - › Source: Hometown Demolition

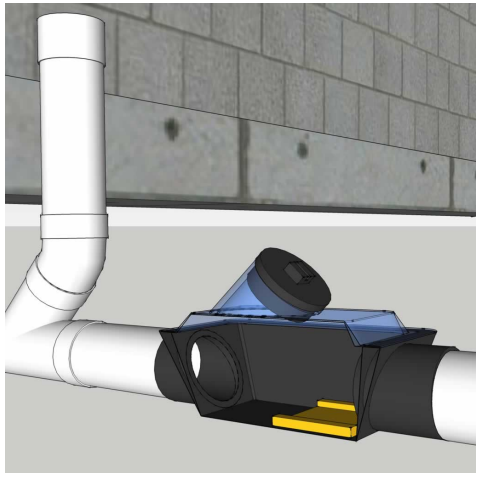
2- This item was added based on DOEE's interest in exploring demolition as a strategy and the practical experience of Mecklenburg County in supporting demolition for tear-down and rebuilds. This is a new addition to the original list.

Cost Analysis

» Sump Pumps

- » Price Estimate: $643 - $1,868
  - › Source: HomeAdvisor
- » Price Estimate: $2,000 - $6,000
  - › Source: Cost Helper Home & Garden
- » Price Estimate: Average $2,000
  - › Source: Sam Draper, B-Dry

» Backwater Valves



- » Price Estimate: Up to $6,000
  - › Source: DC Water
- » Price Estimate: $600 - $5,000
  - › Source: FloodHelpNY

Note: prices will range considerably based on size, conditions, and needs of the home.

Cost Analysis

Note: prices will range considerably based on size, conditions, and needs of the home.

» Elevation Certificates[3]

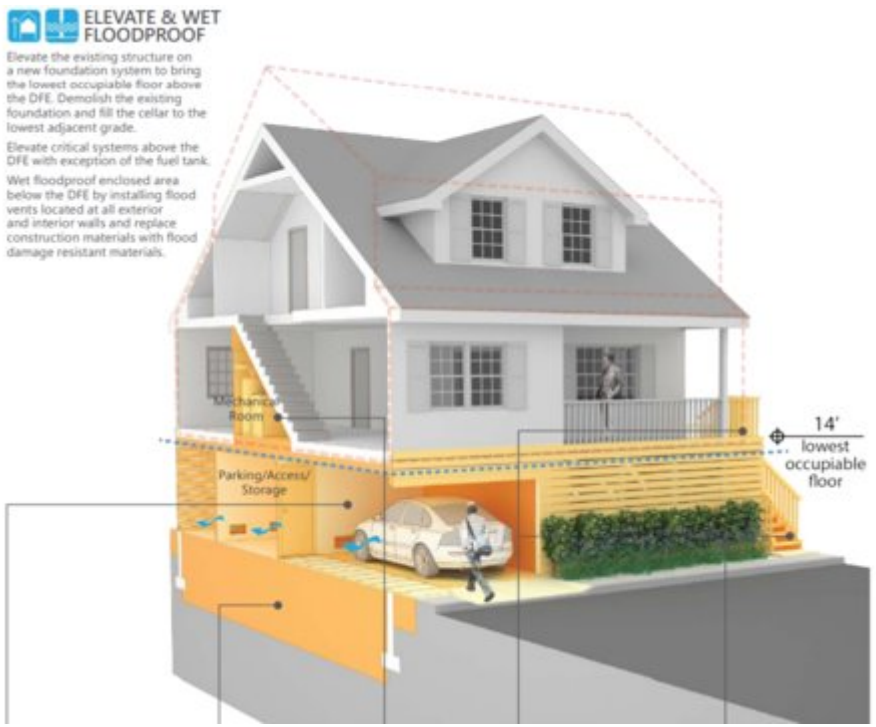
- » Price Estimate: $350
  - › Source: FloodZoneSpecialists.com
- » Price Estimate: $500 - $800
  - › Source: FloodSmartNY

» Water Alarms

- » Price Estimate: $12.48
  - › Source: Lowes
- » Price Estimate: $349.08
  - › Source: Amazon.com
- » Price Estimate: $85 - $1,850
  - › Source: HomeAdvisor

3- This is a new item from the original list based on New York's experience with successfully lowering flood insurance premiums. It also adds an additional lower-cost measure to the suite of potential program offerings.

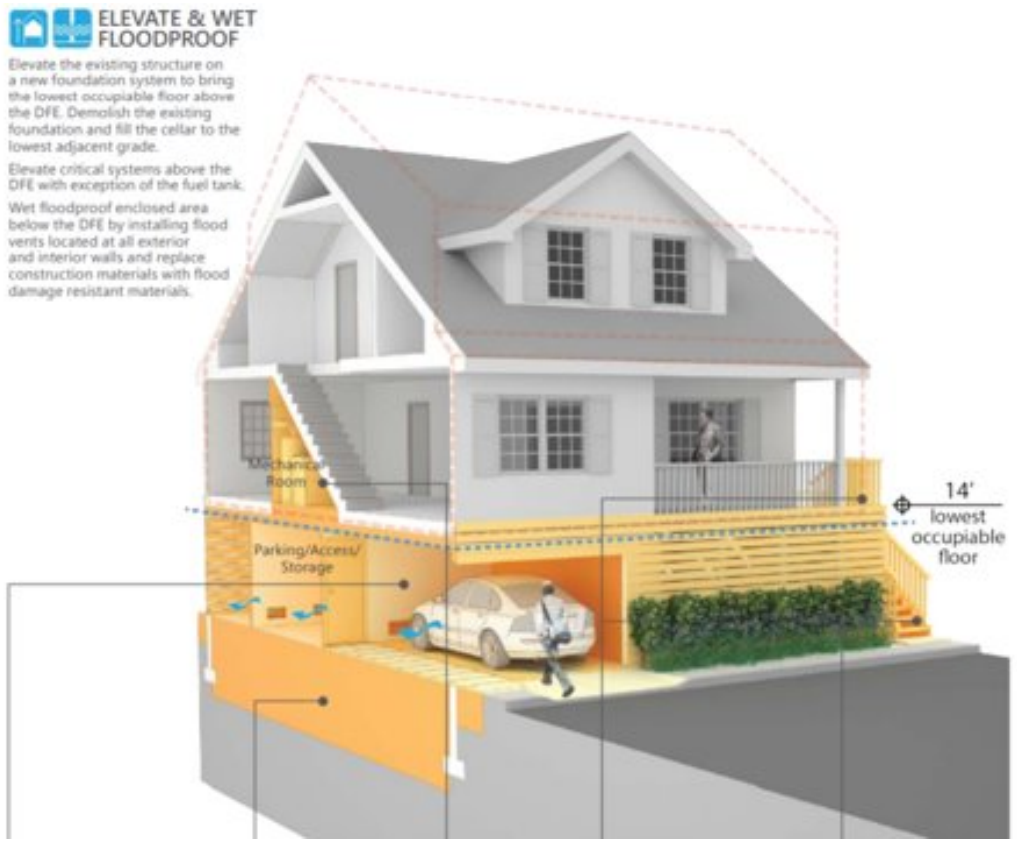
Illustrative Retrofit



Excerpt from Retrofitting Buildings for Floodrisk

» Using an illustrative retrofit strategy for a detached home in the 100-year floodplain from a guidance document entitled, Retrofitting Buildings for Floodrisk by the NYC Office of Planning, the team developed **a rough cost estimate based on the quotes.** Per the building counts, detached homes were the most common type in the 100-year floodplain (118). Quotes are based on the mode of quotes received and/or quotes that seemed most relevant to the illustrative case.

Ilustrative Retrofit



Measure Estimates

Elevate Home

- Approx. $50,000

Elevate Critical Equipment

- Approx. $2,000

Flood vent (Assumes two per the example)

- $8,000

Flood resistant materials

- Approx. $1,020
- Quote based on FEMA guidance assuming ½ of illustrative square footage below DFE

Fill Cellar

- $5,000

Approx. Total (Exclude demolition)

- $66,020

Contents

Key Considerations

At the conclusion of this research study, there were **several core areas that we recommend the District discuss and further research** to inform the design of flood retrofit programs and flood support for homeowners.

- **Program Design**
  - Given the tradeoffs described between an education-oriented program and a construction-oriented program, program managers for FloodSmart Homes must deliberate on the desired program outcomes and focus: **widespread knowledge of flood risks, mitigation strategies and insurance or fewer, yet more protective, enacted retrofits.**
- **Financing**
  - Retrofit programs can be financed very differently: either by reimbursing costs (e.g. Mecklenburg County), providing no-cost services (e.g. no-cost audit and valve installation in NYC), through a grant (e.g. Cook County), or through government issued loans. Flood Smart Homes designers will need to **consider the role of grants and financing** when designing the program. **Even with grant funding, numerous barriers still restrict homeowners from pursuing retrofits.**

Key Considerations

- **Audit Structure**
  - The home assessments for the retrofit program could be conducted by third-party providers or directly by District staff. There are tradeoffs for both methods. Using District staff would require additional time from staff who may already be constrained, but may provide deeper insights into what resident needs and understanding of flood risks and available mitigation options.
- **Qualified Contractors**
  - While none of the programs reviewed had a qualified contractor list, they did provide differing levels of support to homeowners in during contractor selection. **As many residents are not familiar with flood retrofits, the process of comparing quotes will likely be challenging. In the absence of pre-qualifying contractors, which can provide some level of quality control, the District should consider what types of supporting material and educational resources should be available through the program.**
    - One of the common challenges raised with qualified contractors is that there can be a bottleneck. Mecklenburg County noted that when they began RetroFIT there was only one elevation contractor in the area creating a potential bottleneck and no price competition. The District will have **to consider the strength of the current contractor base and possible workforce development based on program volume**. A smaller-scale pilot could help determine the best contracting model and existing capacity.

Key Considerations

- **Additional Data**
  - As mentioned in the quantitative analysis section, **additional information about building condition, elevation, and presence of a basement would be highly valuable at the site-level to provide better visibility on housing types.**
  - During project implementation, additional sources of GIS data were referenced, but due to time and resource limitations could not be pursued. Some of the interviewees referred to additional sources of data through other offices. In addition, USACE models for Watts Branch, not available at the time of this report, may be available at the time of project implementation.

FOR MORE DETAILED INFORMATION, PLEASE REFER TO THE STUDY MEMOS.

DEPARTMENT OF ENERGY & ENVIRONMENT

CADMUS