

SUBJECT

Summary of Eastwick Flood Mitigation
Measures for FEMA BRIC/FMA Scoping Application

TO

Korin Tangtrakul, City of Philadelphia

DATE

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Overview

Arcadis U.S. (Arcadis) was engaged by the City of Philadelphia Office of Sustainability (OOS) to develop a Federal Emergency Management Agency (FEMA) Building Resilient Communities and Infrastructure (BRIC) and/or Flood Mitigation Assistance (FMA) grant application for the Fiscal Year 2022 funding round. In consultation with Arcadis, OOS decided to apply for Capability and Capacity Building (C&CB), hereafter referred to as “scoping” funds, under both the BRIC and FMA programs to advance flood mitigation and community resiliency measures for the Eastwick neighborhood in southwest Philadelphia, a community with recurrent flooding issues (see Figure 1). The BRIC Scoping Grant application draws on a range of recent and ongoing planning efforts led by local community leaders, academic institutions, and Federal agencies (U.S. Army Corps of Engineers (USACE), Environmental Protection Agency (USEPA), and U.S. Fish and Wildlife Service (USFWS)). The scope of work for the grant is intended to provide a dedicated planning and technical assessment process to address critical questions and knowledge gaps related to previous and ongoing planning efforts, assess multiple flood risk mitigation alternatives, and develop community-supported, technically feasible, and eligible flood mitigation project(s) for future federal funding applications (including but not limited to the BRIC program).

This memo serves as a baseline inventory of previous and ongoing flood risk mitigation planning efforts in Eastwick and summary of the high-level technical, feasibility, and community engagement considerations pertaining to these efforts. The goal is twofold: 1) to document these measures and identify the key open questions and data needs and 2) to outline a recommended scope of work for the BRIC/FMA Scoping Application that can help address these open questions and needs resulting in a preferred integrated flood resiliency strategy for the Eastwick neighborhood and individual flood mitigation projects that are eligible for future BRIC/FMA project funding.

The memo is broken into three sections as summarized below:

- **Overview and Summary of Flood Risk in Eastwick:** Introduces the memo and summarizes the primary flood hazards experienced in Eastwick
- **Resiliency Measures Studied:** Summarizes the 12 measures studied or discussed by stakeholders and partners and identifies the key open questions and data needs
- **Recommendations for Project Scoping:** Outlines recommendations for necessary project scoping activities that may be funded through a BRIC/FMA Scoping Grant, including analysis/steps necessary to refine, determine, and substantiate a preferred integrated resiliency strategy for Eastwick

Summary of Eastwick Flood Mitigation Measures



Figure 1 - Map of Eastwick and surrounding region

Summary of Flood Risk in Eastwick



| Flood Hazard | COASTAL FLOODING DURING SEVERE STORMS: Coastal storms create flooding due to surge—a rise in water levels due to storm pressure and waves—which can also lead to coastal erosion. | TIDAL FLOODING DURING FREQUENT HIGH TIDES: Low-lying coastal areas flood when water levels rise above ground elevation due to high tides. | RIVERINE FLOODING FROM HEAVY RAINFALL AND TERRESTRIAL RUNOFF: Rainfall upstream of Eastwick results in flood waters overtopping the banks of Cobbs Creek. | STORMWATER FLOODING FROM HEAVY RAINFALL: Lower lying areas, both along waterways and inland, can flood due to heavy rain events overwhelming drainage infrastructure. Also called "Infrastructure Flooding" |
|----------------|--|--|--|--|
| Climate Driver | Sea Level Rise More Severe Storms | Sea Level Rise | Increased Precipitation | Increased Precipitation Sea Level Rise |
| Timing | Current and Future Threat | Future Threat | Current and Future Threat | Current and Future Threat |

Figure 2 – Summary of primary flood hazards facing Eastwick today and in the future

Eastwick is among the most flood vulnerable neighborhoods in Philadelphia. There are four distinct sources of flooding in the neighborhood:

1. **Riverine Flooding:** Overflow from the convergence of the Cobbs and Darby Creeks caused by upstream terrestrial runoff from the north, which can bring high velocity floodwaters. Flooding of this type has occurred historically in Eastwick, most notably and recently during Tropical Storm Isaias in August 2020, and is anticipated to be an ongoing and growing risk to the community.
2. **Coastal Flooding:** Coastal storm surge due to Nor’easters and extratropical cyclones that cause a rise in water levels in the tidal Delaware and Schuylkill Rivers, which overtops surrounding banks via Darby Creek and flows overland into Eastwick. While coastal storm surge has not been experienced in recent memory in Eastwick, flood modeling demonstrates the community is nevertheless at both current and future risk of coastal flooding.
3. **Tidal Flooding:** Chronic tidal flooding is likely to impact Eastwick in the future due to sea level rise. Tidal flooding will enter the neighborhood from the Darby Creek estuary in the John Heinz National Wildlife Refuge (Heinz Refuge) and via Mingo Creek. Based on preliminary analysis conducted as part of the Consortium for Climate Risk in the Urban Northeast (CCRUN) Eastwick Compound Flood Modeling and Adaptation Study, with four feet of sea level rise (projected as soon as the 2080s) chronic tidal flooding in the area could be as widespread as today’s extreme rainfall events. Projected sea level rise also may result in a rising ground water table, which can impact sub-surface infrastructure and potentially lead to chronic groundwater emergence above ground.
4. **Stormwater Flooding:** Also called “Infrastructure Flooding,” runoff from precipitation falling within Eastwick collects in low-lying portions of the neighborhood and can generate flooding due to a high

Summary of Eastwick Flood Mitigation Measures

concentration of impervious and paved surfaces and drainage infrastructure that may not be designed to manage future precipitation increases.

Eastwick is vulnerable to combined flooding from any or all of these sources, as shown in Figures 2 and 3. The multi-pronged nature of flooding in this area, combined with its low-lying topography, makes mitigating flood risk particularly complex. Currently, a network of storm sewers and a minimal amount of groundwater recharge helps mitigate smaller floods. However, these measures are limited in their capacity to address the scale of the problem in Eastwick, as witnessed during recent flood events including Tropical Storm Isaias. As sea levels rise and heavy rainfall events increase in frequency and severity due to climate change, these risks are projected to increase.

Eastwick is also a neighborhood with a history of environmental injustice and forced displacement, given historic government programs such as redlining and urban renewal that have led to a high concentration of low income and minority households and the location of hazardous industrial and waste management facilities in proximity to the neighborhood. With limited access to resources to prepare for, respond to, and recover from flooding, the consequences of flooding for the community are likely to be more severe than for other households. Further, given the chronic nature of some of the flood sources affecting Eastwick, flood risk in the neighborhood negatively affects overall quality of life and increasingly threatens to disrupt critical everyday services.

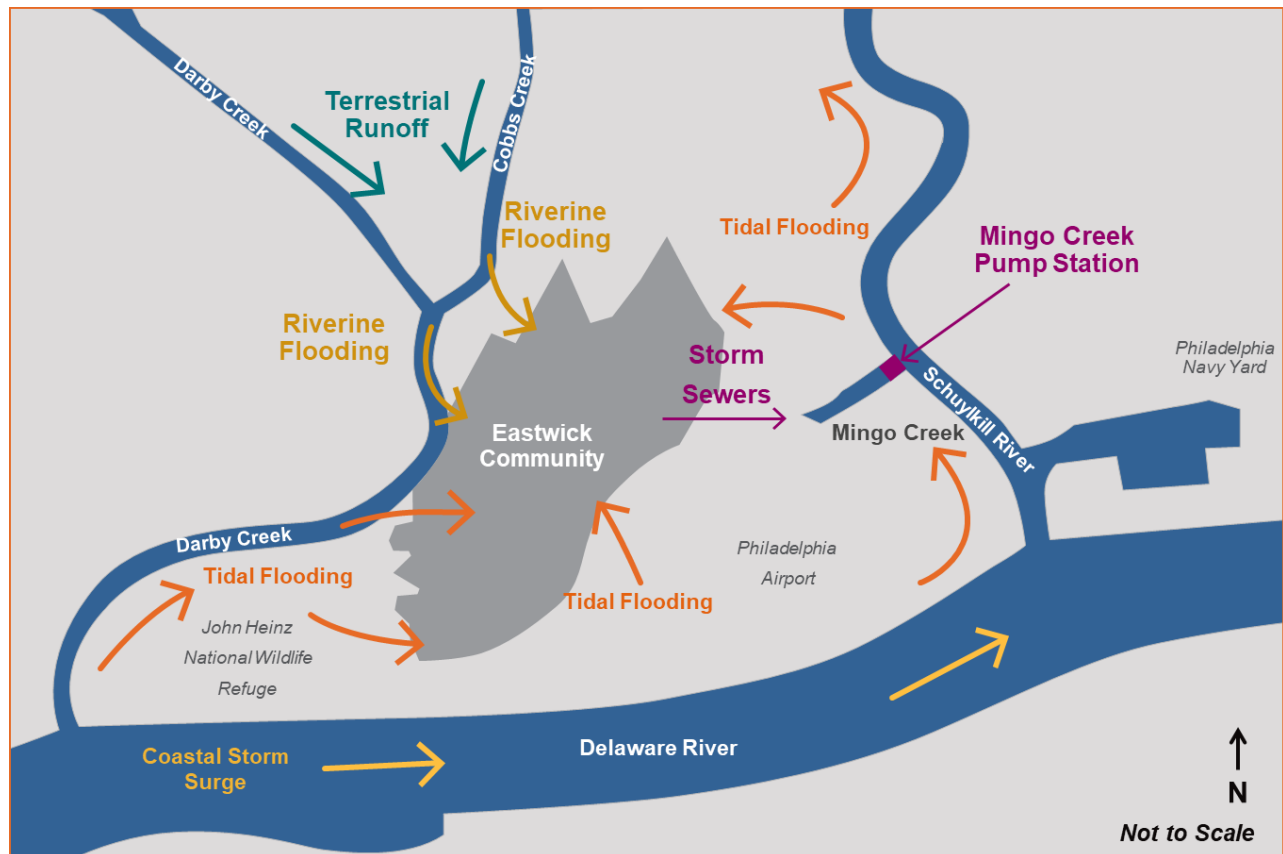


Figure 3 – Conceptual map of flood sources affecting Eastwick today and in the future

Overview of Studies and Work Conducted to Date

Although a truly comprehensive evaluation of potential flood risk mitigation and resiliency measures has not been formulated to date, certain aspects of flooding in Eastwick have been extensively studied in the past, and several efforts to understand flood risk and to evaluate restoration measures are ongoing. A summary of the major recent and ongoing studies is provided below. These studies establish the foundation for future scoping activities recommended in this memo.

Eastwick Stream Modeling and Technical Evaluation, 2014 - Ongoing

U.S. Army Corps of Engineers

In 2014, US Army Corps of Engineers published a “Federal Interest Determination” to determine the potential feasibility and constraints of building a levee to prevent overland riverine flooding of the Cobbs and Darby Creeks into Eastwick. The modeled levee was assumed to have a 10-foot top width, 3:1 side slopes, and a length of approximately 1,300 feet. The work included hydraulic modeling using a 1-D HEC-RAS model¹, evaluation of real estate requirements and the development of a Draft Real Estate Plan, a review of existing geotechnical information and collection of preliminary boring data, and an environmental review focusing on potential impacts of the levee on the Clearview Landfill, located near the confluence of Cobbs and Darby Creeks. The study concluded that a levee would be feasible and effective based on the initial review and provided several recommended additional studies including additional modeling and benefit cost analysis. The study did not include an analysis of downstream impacts and did not account for the effects of climate change. The study did not evaluate the impacts of compound flooding resulting from riverine and coastal flooding.

Following the 2014 study, USACE continued investigating the levee as an alternative in a flood risk mitigation feasibility study. As of Fall 2022, USACE is conducting ongoing analysis and development of options for mitigating flood risk via a cost sharing agreement with Philadelphia Water Department. According to the USACE, several options for mitigating flood risk are being or have been reviewed from the lens of funding under USACE authorization. These include:

- Structure elevation (elevating homes)
- Floodwall (similar type of protection to a levee but made of concrete, rather than earthen material)
- Floodproofing (making changes to an individual home to block water from entering)
- Levee
- Acquisition

USACE anticipates identifying a tentatively selected plan in early 2023.

Lower Darby Creek Hydrologic and Hydraulic Analysis Report, 2017

Keystone Conservation Trust, model developed by Princeton Hydro

This study involved the development of an unsteady 2-D HEC-RAS model to evaluate a range of scenarios to mitigate flood impacts in Eastwick, focusing on riverine flooding along the Darby/Cobbs upstream of 84th Street. The 2-D model was based on a 1-D model for the area that was developed through the 2014 USACE effort. The primary flood event studied was based on hydrographs from Tropical Storm Lee (2011). The model used a fixed

¹ HEC-RAS is a modeling software for performing one-dimensional steady flow, one and two-dimensional unsteady flow calculations, sediment transport/mobile bed computations, and water temperature/water quality modeling.

elevation for the downstream tidal boundary condition of 2.61 feet NAVD88. Mitigation alternatives evaluated include removing the 84th St. Bridge, removing Clearview Landfill, adding a levee with crest elevation of 20 feet NAVD88, creating floodplain storage, and combinations thereof. The study concluded that 1) removal of the Clearview Landfill would prevent flooding upstream of the Darby/Cobbs Creek confluence but would increase flooding elsewhere in Eastwick, 2) Modest reductions in the landfill area, removal of the 84th Street Bridge, and floodplain storage options produced minimal reductions in flooding, and 3) The proposed levee prevented flooding from a storm like Tropical Storm Lee and did not increase flood risks for apartment buildings at Tribet Place on the west bank of Cobbs Creek.

Eastwick Hydrologic & Hydraulic Study Report, 2022

Philadelphia Housing and Development Corporation (Philadelphia Redevelopment Authority), model development by AKRF

The objective of this study was to evaluate the flooding impacts of beneficial reuse and redevelopment scenarios associated with publicly owned lands in Eastwick held by the Philadelphia Housing and Development Corporation (PHDC, formerly Philadelphia Redevelopment Authority - PRA). The redevelopment scenarios evaluated corresponded with development proposals outlined in the Lower Eastwick Public Land Strategy, as well as an ecological restoration option involving the creation of a large wetland. The study involved the development of a 2-D unsteady HEC-RAS model for Eastwick. Unlike the USACE and Keystone Conservation Trust modeling efforts previously mentioned, the PHDC model directly simulated both tidal and riverine flooding, accounted for the effects of climate change on sea level rise and increased precipitation, and modeled a range of events that involved varying combinations of tidal and riverine flooding. Tidal boundary conditions were evaluated using a larger 1-D HEC-RAS model of the tidal Delaware River. The study results indicate that the implementation of beneficial reuse concepts (e.g., redevelopment) evaluated would not increase flooding in Eastwick for most events, except for the most extreme event studied. The model results for the wetland creation scenario indicated that the benefits of this approach depend on the type and magnitude of flooding studied. Most of the flood reductions occurred in the vicinity of 84th St. Southeast of Lindbergh Avenue, well east of the area most vulnerable to riverine flooding.

Eastwick Compound Flood Modeling and Adaptation Study, Ongoing, anticipated completion August 2023

Stevens Institute of Technology, Drexel University, Hunter College, Water Center of Pennsylvania, Philadelphia Water Department, OLIN.

The study combines grant funding from a variety of National Oceanic and Atmospheric Administration (NOAA) grant sources to develop and refine modeling tools for predicting flooding in Eastwick. The study incorporates several improvements from prior modeling efforts including incorporating a PC-SWMM² model of the Darby-Cobbs Creek system with a 2D HEC-RAS model of Eastwick and using enhanced rainfall radar data from the Philadelphia Water Department. The effort looks at the effects of a range of compound event types in combination with various levels of climate induced precipitation changes and sea level rise. As part of the effort, the team has also developed a mitigation approach that contemplates removal of residential communities within the most severely flooded portions of Eastwick as part of a so-called “land-swap” concept in which displaced residents

² PC-SWMM is a tool used to model stormwater runoff, combined and sanitary sewers, and other drainage systems, aiding in the understanding of these systems and design of new drainage infrastructure.

Summary of Eastwick Flood Mitigation Measures

would be relocated *en masse* to proposed housing that would be constructed south of 84th St. Other aspects of the proposed flood risk mitigation measures include a long berm extending along the eastern edge of the Clearview Landfill toward 84th St. and cloudburst street conveyance for flows overtopping the proposed berm. The concept also envisions wetland storage in the publicly owned lands north and south of 84th St. Recommendations to support legal and financial aspects of the “land swap” concept are being developed as part of the study, including a recently conducted two-day panel workshop facilitated by the Urban Land Institute. The study also incorporates an assessment of the potential benefits of incorporating upstream watershed storage.

John Heinz National Wildlife Refuge Restoration and Resilience Concepts, Ongoing

John Heinz National Wildlife Refuge

The Heinz Refuge, managed by the U.S. Fish and Wildlife Service (USFWS), has developed several potential concepts for improving the management of flow within the Refuge. These include breaching flow control berms within the refuge, adding pumping controls, expanding the refuge to include portions of the City-owned properties south of 84th St., and incorporating wetland storage and natural channel features to convey and manage tidal and riverine flooding within Eastwick. USFWS is in the process of implementing the first phase of this effort within the impoundment area south of Eastwick and east of Darby Creek, which is managed as an emergent wetland, with water levels controlled via pumping to maximize ecological value. This project includes installation of two new pumps and a new water control structure that will help convey water from the wetland to Darby Creek. Lower water levels in the impoundment help provide suitable foraging areas for birds and other wildlife. The project is slated for construction in fall 2022. In addition, in partnership with The Nature Conservancy, the Refuge recently submitted a grant to the National Oceanic and Atmospheric Administration (NOAA) under the Habitat Protection and Restoration Infrastructure Investment and Jobs Act (IIJA) Competition. The goal of this project is to identify and evaluate nature-based strategies for flood risk reduction and ecological (habitat) restoration within the Refuge and upstream portions of Darby and Cobbs Creeks. This project focuses on the Lower Darby Critical Area and its potential to mitigate flood risk through restoration of a networked drainage pattern that maximizes the potential for flood water storage and absorption in the tidal freshwater wetland complex. The project is slated to begin in January 2023 and conclude with a final report in November 2024.

FEMA Floodplain Mapping, Ongoing

Federal Emergency Management Agency (FEMA), US Army Corps of Engineers (USACE)

FEMA is updating a portion of Eastwick's flood mapping that is in Zone A to establish Base Flood Elevations (BFE). USACE is performing the modeling and analysis to establish the BFEs using an existing model developed for the flood risk management feasibility study. As a result, several hundred homes in Eastwick that were already in the 1% annual chance floodplain will soon have effective BFEs (upgrading from Zone A to Zone AE). This project is nearing completion and BFEs are expected to take effect around fall 2023 following public comment period.

Enhanced Flood Alert and Early Warning System, Summer 2023

Philadelphia Office of Emergency Management

The Philadelphia Office of Emergency Management (OEM) is piloting a community-based enhanced flood alert and warning system in Eastwick. This system will provide more locally specific flood alerts to residents, including

community-specific information for Eastwick. Information and messaging will be tailored to Eastwick based on community engagement to collect input on effective messaging strategies. OEM plans to expand this pilot program city-wide and is implementing measures to provide flood alert messaging in the top 10 languages spoken in the city to improve language access.

Eastwick Ambassadors for Restorative Justice, Ongoing

Eastwick United and OOS

Eastwick United is working the OOS to promote engagement and transparency between Eastwick residents and other stakeholders, including City government. The goal is to build the capacity of community organizations by engaging residents that previously had not been involved in community organizations to partner with local government to advance community-led projects that align with the Justice40 Initiative. The program kicked off during summer 2022, funded by a grant to Eastwick United through Bloomberg Philanthropies American Cities Climate Challenge Justice 40 Capacity Building Fund.³ The program included 15 residents onboarded as an inaugural “Eastwick Ambassadors” cohort. Residents participating in the program received stipends to attend workshops on environmental justice, climate change, and flood resiliency opportunities in Eastwick. OOS and Eastwick United aim to continue this program through encouraging more residents to participate in civic engagement, and maintain participation by including the Eastwick Ambassadors in a community advisory group.

Urban Land Institute Technical Assistance Panel, Fall 2022

Urban Land Institute, Eastwick United and OOS

Eastwick United CDC with the support of OOS applied and were selected to sponsor a Technical Assistance Panel (TAP) through the Urban Land Institute (ULI) Resilience Land Use Cohort. A TAP brings together a panel of local experts in land use, real estate, planning, development, and related fields to offer a fresh perspective and act as an “honest broker” on a challenge identified by the sponsor. Through a 2-day intensive session, panelists tour the site, interview key stakeholders, and develop preliminary recommendations to present to the sponsor and the public. Panelists were asked to explore the feasibility of the Land Swap concept developed by Eastwick United and recommend a feasible pathway to achieving a resilient and equitable housing solution. The panelists presented their preliminary recommendations in early November 2022, and ULI will be sharing a final report detailing the recommendations in early 2023.

Resiliency Measures Studied

While work to date has advanced the understanding of flood risk in Eastwick and has evaluated various potential resiliency measures, prior studies have not comprehensively evaluated the full range of possible resiliency measures in Eastwick and how these measures may work together as part of an integrated flood resiliency strategy. The list of measures provided herein incorporates measures that have been identified in previous or other ongoing work and adds several measures that have not been previously identified or studied. The measures summarized in this section establish a baseline for additional scoping and project implementation steps that may be funded through a variety of sources, including but not limited to FEMA BRIC and FMA funding programs. **It is not expected that all measures determined to be feasible and necessary to reduce flood risks in Eastwick**

³ For more information on the Justice40 Capacity Building Fund, visit: www.kapwaconsulting.com/j40fund

would be funded under the BRIC and FMA programs. Rather, the objective is to develop a comprehensive strategy that effectively combines multiple resiliency measures and, from this strategy, select one or more projects that meet the following criteria for FEMA funding:

- high priority
- eligible for funding under FEMA programs
- not duplicating activities being undertaken by other entities
- can be completed within the current BRIC and FMA Period of Performance (POP) of 36 months.

All measures will require additional study and evaluation prior to implementation and most measures will involve multiple years of planning, design, permitting, and construction before providing flood risk reduction and other benefits to the community. For the purposes of a future BRIC and FMA funding application, a project will need to be identified that can either be designed, permitted, and constructed within the current POP or that has advance through pre-construction phases using funding from other sources and can be constructed within the current POP. Attention should be paid throughout future project scoping activities to ensure activities targeted for FEMA support are not duplicating activities already being undertaken by other entities, including federal agencies.

Possible resiliency measures for Eastwick have been grouped into the following categories for the purposes of this memo:

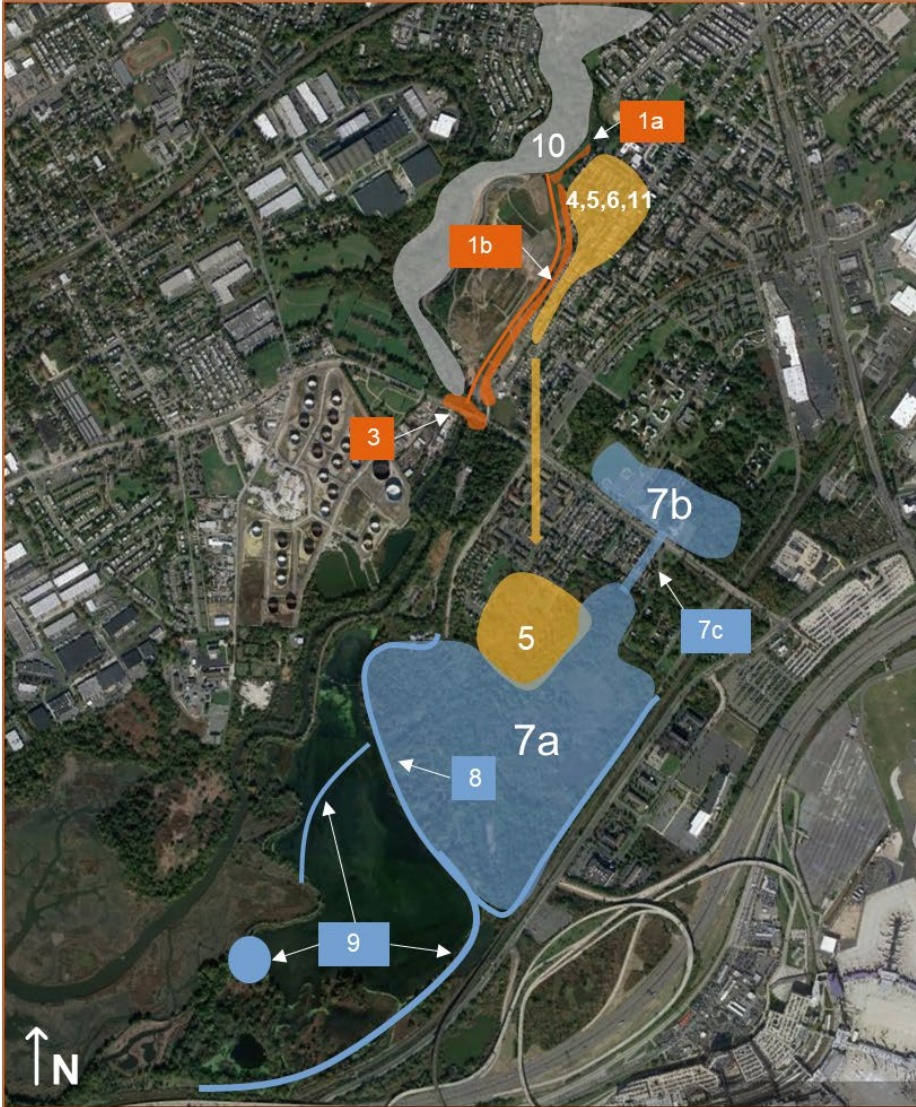
- **Upstream Resiliency Measures**– Upstream measures restrict and control the rate of flow entering Eastwick from the Darby and Cobbs Creeks
- **Property-level Resiliency Measures** – Property-level measures involve the modification or removal and relocation of existing housing and associated infrastructure to reduce flood risk
- **Downstream Resiliency Measures** – Downstream controls focus on reducing the risk flooding due to storm surge and tidal flooding with sea level rise

Other resiliency measures are also summarized. These include large-scale natural channel and floodplain improvements in Darby and Cobbs Creek and interim flood risk mitigation measures, intended to reduce the current impacts of flooding on Eastwick residents. They also include long term preventative measures needed to provide flood risk mitigation for areas of Eastwick that may not be currently impacted by flooding, but that would be affected by flooding under future climate change scenarios, such as areas surrounding the former Pepper Middle School that are vulnerable to future inundation due to sea level rise.

The conceptual locations of these measures are shown schematically in Figure 4.

Finally, implementation of a comprehensive solution to flooding in Eastwick may require the development of new conveyance systems or enhancement of existing conveyance systems to transport overflow from a levee or berm through Eastwick and to the former Pepper Middle School site. These options could include solutions such as cloudburst streets, open channels or swales, or piped conveyance systems. These options have not been depicted graphically or discussed in detail as the type, extent, and alignment of these measures has not been discussed with the community or key stakeholders. It is anticipated that the future scoping steps outlined in this memo would assess the need for additional conveyance and provide the opportunity for engagement with the community around appropriate and acceptable conveyance approaches.

Summary of Eastwick Flood Mitigation Measures



UPSTREAM RESILIENCY MEASURES

- **Measure 1:** Cobbs Creek Levee/Berm
 - 1a: Smaller Extent
 - 1b: Larger Extent w/ and w/o Auxiliary Channel
- **Measure 2:** Regional Watershed-Based Storage (*not shown on map*)
- **Measure 3:** Enhanced Conveyance at 84th Street Bridge

PROPERTY-LEVEL RESILIENCY MEASURES

- **Measure 4:** Voluntary Buyouts
- **Measure 5:** Land Swap/Relocation
 - 5a: No Elevation
 - 5b: Elevation of Receiving Site
 - 5c: Elevation of Receiving Site and Surrounding Streets
- **Measure 6:** Reconstruction Mitigation

DOWNSTREAM RESILIENCY MEASURES

- **Measure 7:** Wetland Restoration/Detention Basin
 - 7a: City-owned Land South of 84th Street
 - 7b: City-owned Land North of 84th Street (Pepper Bowl Site)
 - 7c: Conveyance Under 84th St.
- **Measure 8:** Structural or Nature-Based Flood Mitigation for Tidal/Coastal Flooding and Interior Pumping
- **Measure 9:** Heinz Wildlife Refuge Berm and Breach

OTHER RESILIENCY MEASURES

- **Measure 10:** Darby/Cobbs Creek Natural Channel and Floodplain Design
- **Measure 11:** Interim Flood Risk Mitigation
- **Measure 12:** Preventative Measures (*not shown on map*)

Figure 4 – Summary map of primary resiliency measures being studied for Eastwick (based on available information). Note map is not to scale and the representation of all measures is conceptual.

Upstream Controls

Measure 1: Cobbs Creek Levee/Berm

The Cobbs Creek Levee/Berm measure consists of the placement of a flood barrier, likely an earthen berm or levee, to prevent floodwaters from Cobbs Creek from entering Eastwick. Additional design features would typically include outlets and pumping for interior drainage. A range of locations, heights, and extents for the flood barrier are possible and have been explored through multiple studies discussed above. Broadly, there are two options that have been proposed through previous and ongoing efforts: 1) a shorter berm located near the banks of the Cobbs Creek, upstream of the Clearview Landfill, which is the focus of USACE feasibility assessments, and 2) a larger extent berm that would extend southeast of the Clearview Landfill to 84th St., which has been conceptually studied by CCRUN. Once the feasibility study has been completed, USACE has congressional authority to move into construction, but this would require the sign-off of the non-federal sponsor, namely the City of Philadelphia. The outcome of the USACE study is expected in early 2023 and these findings would be an input into the BRIC/FMA-funded scoping work led by OOS. The objective of these scoping activities is to identify feasible and community supported projects and funding pathways based on further evaluation that meaningfully advances the remaining feasibility issues that are anticipated at the conclusion of the current USACE study.

The creation of a levee along Cobbs Creek provides a potentially potent reduction in riverine flood risk through Eastwick. This has been the most acute form of flooding experienced by the Eastwick community historically and the levee/berm option is perhaps the most straightforward way to alleviate this risk without relocation.

The levee measure has significant potential interactions with several other alternatives:

- The implementation of Measure 3, which would increase conveyance through 84th St., is compatible with the berm and may lessen the size and extent of the berm needed, as would upstream regional storage and floodplain measures.
- Levee construction is generally compatible with downstream resiliency measures 7-9. The combination of the levee with these measures may provide enhanced levels of protection for riverine and coastal flooding as well as compound flooding.
- The interaction of the levee with the property-level resilience measures is significant and complex. Implementation of mass buyouts or land swaps could substantially lessen the financial risk of flooding, reducing both the need for the levee and the potential financial benefit of the levee. A benefit cost analysis (BCA) would be helpful in further understanding these interactions.
 - Elevating/floodproofing homes in place could provide a means to further extend the benefits of a levee or reduce the height of the levee needed to provide a particular level of protection
 - Measures that envision a longer berm alignment in conjunction with the land swap concept have been put forth by the CCRUN team. These measures view the levee as a means to protect less flood prone areas in the interior of Eastwick, while relocating those that are more flood prone

Option 1a: Smaller Extent

Option1a consists of a shorter levee that would extend along the primary area of overtopping along Cobbs Creek, tying into the Clearview Landfill to the south and tying into an elevated forested hillside along the north end. This option is currently under evaluation by USACE. Within this option, a variety of berm alignments, elevations, footprints, and widths could be explored.

Option 1b: Larger Extent with and without Auxiliary Channel

Option 1b consists of a longer berm that would extend to the southeast along the Clearview Landfill and tie into existing grade in the vicinity of the 84th St. bridge. While some proposed alignments for this berm would necessitate the removal of existing homes and relocation of residents, it is not clear that the longer berm extent would necessarily require relocation if its footprint were located on the Clearview Landfill site that is currently the focus of remediation efforts by the USEPA.

The CCRUN Team has envisioned a design that combines the larger extent levee with an auxiliary natural channel running between the levee and the landfill. This channel would be designed to provide additional flow capacity during high flow events and channel flood waters more quickly downstream.

Effectiveness and Co-Benefits

- The effectiveness of the levee/berm option in lessening the severity and frequency of riverine flooding into Eastwick is likely to be high, increasing with the height (and footprint) of the berm.
- The levee/berm would likely have minimal effect on mitigating coastal flooding or the effects of sea level rise, except to the extent that riverine flooding is exacerbated by downstream tidal conditions and sea level rise.
- Levee/Berm construction itself could be combined with other design elements to provide co-benefits such as natural areas and multi-use trails. The extent of benefits would largely depend on the addition of these supplemental project elements and the alignment of the levee/berm. One already proposed element that could be potentially linked to the long berm concept is a proposed connector trail that is planned to extend around the southeast side of the Clearview Landfill.

Technical and Feasibility Considerations

All measures require further investigation to assess technical feasibility and specifications (e.g., site survey, geotechnical, H&H modeling, etc.). The creation of a berm/levee has some significant technical feasibility considerations, among them:

- The levee would increase the conveyance of flows downstream toward 84th St creating the possibility of induced flooding. Increases in flows could cause flooding of structures downstream of 84th St. on the Delaware County side of Darby Creek, as well as potential increases in velocity at the 84th St. Bridge, which could lead to increased rates of scour. Preventing/reducing induced flooding could increase the required height of the levee. These factors are being quantified further through modeling studies by the USACE but may need additional study if this measure is combined with other upstream or downstream measures.
- The presence of forested wetlands at the northern tie-in location for the short levee option could pose permitting challenges.
- The levee/berm could also pose an increased risk of downstream bank erosion and failure, as well as risk to the side slopes and retaining wall along the Clearview Landfill.
- The levee/berm could change the dynamics of sediment transport within Cobbs and downstream reaches of Darby Creek. This could include increased transport of fines to sensitive wetlands downstream.
- The physical tie-in of the short levee with the Clearview Landfill on the downstream side could pose feasibility issues relating to ensuring the integrity of the landfill cap and avoiding any risk of release or

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exposure of hazardous materials. The landfill is also located in Delaware County, creating land acquisition, interjurisdictional coordination, and governance challenges.

- With respect to the longer berm alignment, feasibility could be impacted by whether the berm can be located on property owned by the landfill, or whether the levee would require relocation of adjacent residents, land acquisition, etc. Preliminary coordination with the USEPA suggests a larger alignment located on the eastern side of the landfill could be feasible but may be hampered by USACE policies regarding impacts to contaminated sites.
- The addition of an auxiliary channel running between the longer levee alignment and the Clearview Landfill could create additional risks of levee failure. Sedimentation within this channel would also be a concern.
- Levee/berm creation could pose permitting challenges in terms of fill in the floodplain and adjacent to natural channels, which are regulated both federally and by the Commonwealth of Pennsylvania.

Community Considerations

- Levee/berm measures provide potentially effective relief for flooding from riverine sources to those most impacted by flooding. For community members in highly impacted areas that want to remain in place, the levee is likely to be among the more attractive options.
- A lengthy USACE-led process in combination with feasibility issues relating to land acquisition could extend the timeline for implementation to 8 or more years.

Open Questions and Data Needs

- Evaluating of the levee/berm measures will require H&H modeling evaluations to understand the interplay between the levee and related measures, the level of protection provided by various levee alternatives, as well as to understand the potential for downstream impacts to infrastructure and ecological resources stemming from the increase in flow, velocity, and sediment transport.
- Evaluation is needed to analyze the cost effectiveness of this measure when combined with other potential measures
- The USACE has noted that the levee may be presented as the tentatively selected plan for mitigating riverine flood risk through a USACE authorization. However, that measure, if selected, will not address residual risk from rainfall and coastal flooding. Additional planning and study will be necessary to develop measures that reduce residual flood risks in the area, address induced flooding, and provide for interior drainage.
- Additional coordination with Delaware County, Darby Township, USEPA, and the City of Philadelphia is needed regarding real estate and governance issues
- Continued coordination with USEPA is needed regarding contamination issues relative to the Clearview Landfill tie-in
- Continued coordination is needed between the City, USEPA, and USACE regarding applicable rules and restrictions that may affect the ability to fund and construct levee tie-in to Clearview Landfill, particularly as related to the larger extent

Measure 2: Regional Watershed-Based Storage

Regional watershed-based storage measures include the creation of floodplain storage, stormwater basins, green infrastructure, and other types of stormwater storage facilities upstream of Eastwick within the Cobbs and Darby Creek watersheds. Regional watershed-based storage would have limited interaction with downstream control measures and would incrementally lessen the flow required to be managed via other upstream control measures, most notably the levee. It is important to note that the majority of the watershed draining to Cobbs and Darby Creeks is outside of the City of Philadelphia's jurisdiction. Consequently, the effective implementation of any regional watershed-based approach would be dependent on significant collaboration and coordination between the City and neighboring municipalities and counties.

Effectiveness and Co-Benefits

Given the level of investment required to provide significant storage for extreme events responsible for severe riverine flooding in Eastwick, the effectiveness of this strategy, at least in the near term, seems modest. Nevertheless, almost all of the upstream communities are regulated as Municipal Separate Storm Sewer System communities and are required to implement stormwater management and/or stream restoration projects to meet pollutant reduction targets. These required investments provide a good opportunity to incorporate additional storage that could provide local flood control and incrementally increase regional storage. Conceptually, these investments could offset performance losses of downstream resiliency measures due to climate change. Preliminary modeling undertaken by the CCRUN team indicates that implementation of all Green Stormwater Infrastructure (GSI) included in pollution reduction plans developed by localities in the watershed could decrease peak flows during a Tropical Storm Isaias-like event by 10%.

Technical and Feasibility Considerations

Implementation of watershed storage throughout the Darby-Cobbs watershed has a number of challenges, principally relating to scaling the deployment of distributed storage in a large watershed with numerous political jurisdictions. Specific challenges include:

- Identifying a streamlined mechanism for funding and deploying projects at scale. This could include the development of a watershed wide funding and project delivery entity like models currently being used to facilitate the implementation of water quality projects to meet MS4 requirements at a County-wide level.
- Financial or other incentives for upstream municipalities to invest in solving downstream flooding issues.
- Availability of storage sites sufficient to meaningfully reduce flood risk

Community Considerations

- Implementing watershed storage on the scale necessary to reduce flood risk downstream may require significant time and political will to realize. For community members already experiencing flooding, this timeline may not be acceptable.

Open Questions and Data Needs

- The volume and cost of watershed storage needed to meaningfully reduce flooding in Eastwick has not been studied comprehensively. Currently, Drexel University, the Water Center at Penn, and Hunter College are working with a team of partners under a NOAA funded grant to evaluate this question in detail utilizing an existing PCSWMM model and developing a new Vensim model paired with watershed outreach. Further refinement of this work is necessary to determine the ultimate feasibility and effectiveness of these measures to meaningfully reduce risk in Eastwick.
- Evaluation is needed to analyze the cost effectiveness of this measure when combined with other potential measures

Measure 3: Enhanced Conveyance at 84th Street Bridge

Enhancing conveyance at the 84th Street Bridge would involve physical modifications to the bridge that would increase the rate of flow during large events. These could include modifications to the entrance conditions and reconstruction of the bridge or modification of the bridge abutments.

This measure could interact with the levee measure by lessening the amount of flow that would need to be handled. Enhanced conveyance measures for 84th Street Bridge could also be combined with the elevation of 84th Street as needed to accommodate the “land swap” measure.

Effectiveness and Co-Benefits

The effectiveness of this strategy has been evaluated in a study completed by Keystone Conservation Trust in 2017. This study found only a modest reduction in flood elevations for an event like Tropical Storm Lee if the bridge was fully removed. Based on this study, expectations regarding the benefits of this strategy for upstream flood mitigation are modest. Co-benefits of implementing this strategy would include extension of the lifespan of the bridge and the potential for transportation related co-funding.

Technical and Feasibility Considerations

All measures require further investigation to assess technical feasibility and specifications (e.g., site survey, geotechnical, H&H modeling, etc.). Technical and feasibility considerations for this measure include:

- The feasibility and benefits of specific bridge modification measures have not been well studied.
- The existing bridge was constructed in 1974 and reconstruction is not planned by the City in the near-term.
- Benefits are likely to be modest based on prior studies, although the prior study only evaluated the impacts on a single storm event and did not take into account the potential effects of climate change.
- Modifications to the bridge could be challenging given the potential disruption to traffic on 84th St, particularly if upgrades or replacement of the structure is not otherwise planned.
- Planning and deployment of major reconstruction would take a considerable amount of time (5-10 years) to implement.
- Expansion of the bridge opening could result in an increase in flow velocity upstream, which could increase bed scour, bank erosion, and sediment transport.

- The upstream channel approach to the bridge is highly sinuous, suggesting that modifications to the channel may be necessary.

Community Considerations

- Construction activities on the bridge may disrupt traffic and otherwise impact quality of life for a period of time

Open Questions and Data Needs

- Evaluation is needed to analyze the cost effectiveness of this measure when combined with other potential measures.
- Coordination among City departments is necessary to determine if modifications to the bridge could be accelerated prior to the existing timeline for bridge reconstruction if those modifications provide meaningful flood risk reduction benefits.
- Prior evaluation of this measure only explored the impact of bridge modification for a single flood event. Analyzing the impact of various bridge modifications on flood risk under a range of flood events would create a more complete understanding of the flood risk reduction potential of this measure.

Property-level Resiliency Measures

Property-level resiliency measures involve actions that minimize individual households' exposure to flood risk—whether by elevation above expected current and future flood elevations or by relocating to lower-risk areas entirely. While some of these measures have the benefit of nearly eliminating some types of direct flood risk to the affected households, they could introduce a series of other issues, including community disruption and failure to address indirect impacts of flooding to the surrounding neighborhood, including streets and critical facilities. While some of these measures will not comprehensively address flood risks for every at-risk property, especially those measures that rely on implementation by individual property owners, a significant advantage is that they can provide risk reduction benefits to residents more quickly than other measures, such as the levee options. As such, property-level resiliency can provide near-term interim or redundant flood risk reduction as other measures are implemented over time.

Measure 4: Voluntary Buyouts

This measure would involve state and/or local government acquisition of residential development from private property owners. Bought-out land would be converted to natural floodplains and open space uses in perpetuity. USACE has included acquisition as a potential alternative in their flood risk management feasibility study, however, it so far is found to be less cost-effective than the levee alternative according to USACE's criteria. Further, the Commonwealth would require the entire residential block to voluntarily participate in order to move forward. As a result, this measure would be mutually exclusive with Measures 5 and 6 for any given residential block. This measure could significantly reduce overall quantifiable benefits for other mitigation measures (e.g., a levee/berm) that would provide flood risk mitigation for any residential blocks not participating in a voluntary buyout.

Effectiveness and Co-Benefits

- This measure has the potential to eliminate existing riverine, stormwater, tidal and coastal flood risk if residents relocate to areas outside of the current and future floodplain
- Acquired land can be converted to passive uses for stormwater storage, storm buffers, public recreational areas, and/or habitat restoration areas, depending on funding source, which could offer flood risk reduction benefits to other portions of Eastwick.
- This measure could be implemented in conjunction with a program that OOS is currently exploring to offer residents a suite of household-level flood risk mitigation options, including voluntary buyout and/or relocation. This would mean that voluntary buyouts and relocation strategies could be implemented in tandem over time.

Technical and Feasibility Considerations

Technical and feasibility considerations for this measure include:

- This measure would introduce challenges and questions related to the long-term plan for existing public infrastructure in buyout areas. For example, public streets and other utilities will likely need to be maintained by the City if some residents remain in the buyout areas due to partial participation in the voluntary buyout program, increasing the per home cost of delivering these services. Similarly, in areas with 100% participation in the voluntary buyout program, the City and other utility providers would need to develop a plan to remove or abandon infrastructure, including public streets and buried utilities such as electric lines, fiber optic cables, and sewers.
- While there has been remediation of contamination from the Superfund site in residential backyards, there is likely still underground contamination in the areas around the landfill. Any earth disturbance in that area (for example to create a wetland or forested wetland) will need to consider possibility of soil contamination, which could increase costs and pose public health risks.
- This measure could result in a loss of tax base for the City of Philadelphia unless the program includes provisions or incentives for resident relocation within city boundaries

Community Considerations

- At present, there is not consensus around this measure, with some residents expressing interest in buyouts and others opposed depending on multiple factors, including tenure in the neighborhood, property location, and specific risk conditions.
- A previous attempt at a voluntary buyout (following Hurricane Floyd in 1999) was unsuccessful but explanations as to why are varied. Some feel that because property owners were not offered fair market value or were required to participate as full residential blocks support was not as great as it may have been otherwise.
- Many residents continue to express a desire to stay in Eastwick and there are many elderly residents in Eastwick that have lived in their homes for decades and may not be interested in moving.
- Buyouts funded by FEMA/PEMA would require the entire residential block to participate to move forward, requiring significant buy-in from the community. This is a critical requirement because the most vulnerable homes in Eastwick are attached structures, limiting the ability to acquire single homes. Locally funded

buyouts are not bound by the same restrictions and may be able to adopt an approach for acquiring single properties.

- While most properties are owner-occupied, there are some renter-occupied homes. Buyouts have the potential to displace renters from their homes which raises equity concerns.
- The history of forced eviction through the failed Urban Renewal program and other poorly executed relocation initiatives evokes strong emotional responses to a government-sponsored buyout program among some residents.

Open Questions and Data Needs

- H&H modeling to assess effectiveness of and need for this measure if/when other measures are implemented, including residual risk and the minimum threshold of full residential blocks that would be needed to make this a viable/cost-effective measure (including in concert with other measures)
- Evaluation is needed to analyze the cost effectiveness of this measure when combined with other potential measures, as well as the impact of this measure on the cost effectiveness of other measures, including the levee
- There is a need for a granular, property-level understanding of resident preferences regarding options for reconstruction mitigation, relocation, and/or buyouts, which will inform the preferred approach for each property and the community overall
- There is a need to engage residents in discussion regarding buyout program specifics, including a range of options with respect to level of compensation, level of relocation assistance, etc.
- Engagement with the community and City staff is necessary to better understand what kind of relocation assistance would be needed and whether existing staff capacity and capability is sufficient to support this with the delicacy and attention required
- Community engagement and technical analysis is needed to define how the newly created open space would be used most beneficially

Measure 5: Land Swap/Relocation

This measure is based on a concept developed by Eastwick United, supported by CCRUN, to relocate residents from the highly vulnerable "Planet Streets" near the convergence of the Darby and Cobbs Creeks, to an identified site of vacant land owned by the Philadelphia Housing and Development Corporation. The previously occupied homes could be demolished and turned into natural floodplains and open space. The Urban Land Institute further explored this concept in a recently conducted 2022 technical assistance panel. The receiving site identified, which is located in Eastwick south of 84 St., is less floodprone than the existing neighborhood but is still within the present day 500-year floodplain (with some surrounding areas/streets still within the 100-year floodplain). Similar to Measure 4, PEMA/FEMA would require the entire residential block to voluntarily participate in order to move forward. As a result, this measure would be mutually exclusive with Measures 4 and 6 for any given residential block if PEMA/FEMA funding is used. This measure could significantly reduce overall quantifiable benefits for other mitigation measures (e.g., a levee/berm) for any residential blocks not participating in the land swap.

Option 5a: No Elevation of Receiving Site

This option would involve the land swap/relocation without any major alterations to the receiving site, thereby mitigating some risk but leaving some residual risk unaddressed.

Option 5b: Elevation of Receiving Site

This option would involve elevating the receiving site above the current 500-year flood elevation to minimize risk.

Option 5c: Elevation of Receiving Site and Surrounding Streets

This option would involve elevating the receiving site and surrounding streets above the current 500-year flood elevation to further minimize risk with respect to ingress and egress during and after flooding events and to promote maximum quality of life into the future.

Effectiveness and Co-Benefits

- This measure would substantially reduce riverine and stormwater risk, with the potential to mitigate coastal flood risk. However, residents could still face flood risk due to a 500-year flood—including direct flooding under Option 3a and indirect impacts (e.g., loss of critical services and transportation) under Option 3b—or even the indirect impacts of a 100-year flood affecting neighboring streets, depending on the sub-option selected
- Residents would be able to stay in Eastwick, which is a priority for many community members
- Any acquired land can be converted for passive use as stormwater storage, storm buffers, public recreational areas, and/or habitat restoration areas depending on funding source, which could offer flood risk reduction benefits to other portions of Eastwick.

Technical and Feasibility Considerations

Technical and feasibility considerations for this measure include:

- All measures require further investigation to assess technical feasibility (e.g., site survey, geotechnical, H&H modeling, etc.)
- Due to a lack of precedents for land swaps of this scale and complexity, many feasibility questions remain regarding property title swaps
- There are significant coordination needs and feasibility concerns related to the practicality of the land swap from a real estate development perspective. Coordination between property owners, community champions, and the Philadelphia Land Bank and PHDC would be necessary to advance the idea beyond conceptual levels. There are concerns related to the number of properties that could practically be developed on the receiving site and how these new properties would be valued as compared to the existing properties slated for buy-out (e.g., would there be an implicit City subsidy provided in trading higher value new properties for lower value properties in areas of significant flood risk). Furthermore, the concept would be contingent on the ability to secure financing for the project, which may be challenging given the flood risk concerns in the area, including at the receiving site.
- Funding a land swap or relocation program would likely require combining multiple sources of funding. While FEMA has traditionally funded acquisitions, they have not funded rebuilding of homes elsewhere, so some components of this measure may be ineligible for FEMA funds. The use of combined public and private funds could present administrative and eligibility complexities to the process.
- To be feasible, all property owners/residents in the area subject to relocation would need to agree to participate in the land swap program. Designing the program flexibly to allow some property owners to opt for a buyout rather than relocation through the land swap could help to mitigate this concern.

Summary of Eastwick Flood Mitigation Measures

- Preliminary results from the ULI technical workshop indicated the land swap could take up to 20 years to implement, primarily due to complexities related to funding and financing the plan. This timeline would exceed other potential resiliency measures that are being considered.
- Philadelphia Land Bank does not have the legal authority to undertake a land swap and would need to convey properties through another City entity, likely within PHDC. Any land transfers would require City Council approval.

Community Considerations

- This measure would likely take a long time to ensure an equitable approach is undertaken with full support from, and for, the community affected
- There are many elderly residents in Eastwick that have lived in their homes for decades. For some, the thought of moving, even if within Eastwick, is worrisome.
- To successfully implement this measure would require entire residential blocks to participate, thus necessitating significant buy-in from the community before moving forward
- The estimated lengthy timeline for implementation could lead to lower overall support for the plan, compared to options that protect existing residences in place and could be implemented sooner
- An advantage of this measure, however, is that it would be a community-led initiative, and is the most preferred measure of Eastwick United, a community partner

Open Questions and Data Needs

- H&H modeling is needed to assess effectiveness of and need for this measure when other measures are implemented, including residual risk (and whether this would be a tolerable level of risk to the community) and the minimum threshold of full residential blocks that would be needed to make this a viable/cost-effective measure (including in concert with other measures)
- Evaluation is needed to analyze the cost effectiveness of this measure when combined with other potential measures, as well as the impact of this measure on the cost effectiveness of other measures, including the levee
- Community engagement and technical analysis is needed to define how the newly created open space would be used most beneficially
- There is a need for a granular, property-level understanding of resident preferences regarding options for reconstruction mitigation, relocation, and/or buyouts, which will inform the preferred approach for each property and the community overall
- There is a need to define the design flood elevation (DFE)/design storm that would be used for elevation of the receiving site (Options 3b and 3c)
- There is a need to understand any potential negative consequences of elevating the receiving site and whether any compensatory floodwater storage would be required to mitigate these impacts
- There is currently a gap in understanding the legal and financial framework required to implement a relocation program
- Analysis is needed to understand adequacy of receiving site for providing commensurate housing options for all displaced residents, as well as engineering feasibility issues relating to infrastructure tie ins, subsidence, grading, etc.

- There is a need to quantify the loss of tax base for city/value of property value loss if land swap is not financially equitable from the city's perspective
- A private developer with interest and experience to lead the program, procure financing, develop a detailed proforma for development, and build receiving properties will need to be identified to carry out the plan

Measure 6: Reconstruction Mitigation

This measure would involve the construction of improved, elevated buildings on the same site as existing at-risk buildings. The existing buildings and/or foundations for participating properties would be partially or completely demolished. There have not been any assessments or discussion to date to determine which properties would be recommended for this measure. Preliminarily, the homes in Zone AE that experience the highest flood depths would most likely be recommended. Similar to Measures 4 and 5, this measure would require the entire residential block to voluntarily participate in order to move forward if using PEMA or FEMA funding. As a result, this measure would likely be mutually exclusive with Measures 4 and 5 for any given residential block. Further, this measure would limit any open space, habitat, or flood storage co-benefits that might variously be achieved through Measure 4 and 5, if variably implemented on different blocks. Were this measure to be implemented, other measures would almost certainly be necessary to mitigate flood risk to any properties not reconstructed at a higher elevation.

Effectiveness and Co-Benefits

- This measure would reduce riverine and stormwater risk, with the potential to mitigate coastal and tidal flood risk
- The effectiveness of this measure would depend on the design flood elevation (DFE) and the number of buildings that participate. Depending on DFE, this measure may not reduce risk from extreme floods or higher future flooding level as a result of sea level rise or increased precipitation
- This measure would leave any residential blocks not participating at risk
- Further, protected residents would still be at risk of systemic impacts resulting from poor access to critical services during and after flooding events, limiting the overall effectiveness of this measure
- Nevertheless, with this measure residents would be able to stay in Eastwick and on their properties

Technical and Feasibility Considerations

Technical and feasibility considerations for this measure include:

- All measures require further investigation to assess technical feasibility (e.g., site survey, geotechnical, H&H modeling, etc.)
- It would likely be necessary to provide temporary housing for residents during the reconstruction period
- If funded through FEMA, mitigation reconstruction has a \$150,000 per structure cap for the federal share of the reconstruction cost
- Neighborhood ingress and egress needs would need to be studied and determined

Community Considerations

- This measure would likely require an entire residential block to participate as a group to move forward, requiring significant buy-in from the community. This is a critical requirement because the most vulnerable homes in Eastwick are attached structures, limiting the ability to reconstruct single homes.
- While residents would be able to stay on their properties, the newly rebuilt homes would likely be substantially different from their original homes due to changes in building material and design standards over the decades. This effectively may feel like moving into a new home, which may be challenging for residents that have lived in the same home for decades.

Open Questions and Data Needs

- H&H modeling is needed to assess effectiveness of and need for this measure when other measures are implemented, including any residual risk and the minimum threshold of full residential blocks that would be needed to make this a viable/cost-effective measure (including in concert with other measures)
- Evaluation is needed to analyze the cost effectiveness of this measure when combined with other potential measures, as well as the impact of this measure on the cost effectiveness of other measures, including the levee
- There is a need for a granular, property-level understanding of resident preferences regarding options for reconstruction mitigation, relocation, and/or buyouts, which will inform the preferred approach for each property and the community overall
- Analysis is needed to evaluate the residual risk that would remain with this measure
- The DFE and design storm that would be used to implement this measure will need to be studied and defined

Downstream Controls and Storage

Downstream controls and storage are measures located primarily south of 84th Street and east of Lindbergh Boulevard intended to manage residual flood risks not addressed by other upstream control measures. These measures work either together to reduce flood risk from Cobbs Creek overflow, stormwater/rainfall within the project area, or from tidal flooding and coastal storm surge originating from the Delaware River and the Darby Creek estuary. USFW John Heinz Wildlife Refuge submitted a grant to the National Oceanic and Atmospheric Administration (NOAA) under the Habitat Protection and Restoration Infrastructure Investment and Jobs Act (IIJA) Competition. The scope of work for the grant includes assessment of the range of Nature-Based Solutions (NBS) discussed below, which are aimed at advancing ecological restoration objectives within the Refuge and portions of Darby and Cobbs Creeks downstream of 84th Street while providing additional flood risk mitigation co-benefits to Eastwick. The outcomes of this study would complement and provide inputs for the scoping work managed by OOS.

Measure 7: Wetland Restoration/Detention Basins

These measures would be implemented together to manage, detain, and convey stormwater and overflow flooding from Cobbs Creek in constructed low-lying detention basins with eventual discharge to Darby Creek. The objective is to create additional local storage capacity for residual risk from riverine and stormwater flooding that is

Summary of Eastwick Flood Mitigation Measures

not addressed by berms, relocation, and other flood risk mitigation measures discussed above. These measures may also have some limited benefit in mitigating tidal flooding as well, though would not fully address projected future tidal flooding alone. This group of measures does not fully address the flood risk in the area and these measures are best implemented in combination with other measures, particularly measures 1,3, and potentially 5.

Option 7a: City-owned Land South of 84th Street

Restoration of publicly owned parcels or portions of them (land owned by the Philadelphia Housing and Development Corporation) as constructed wetland. John Heinz Wildlife Refuge has expressed interest in acquiring/stewarding this land. Construction of wetland would likely require excavation and connection with the Pepper Bowl (see Option 9b below) in order for the new wetland to serve as a natural storage for drainage from upland areas. This option could conflict with the land swap proposal (Measure 5), which would limit the volume of water that could be stored in/moved through this area. However, this is a sizable parcel of land and, depending on the final design of the concept, there could be room for both wetland restoration and construction of homes described in Measure 5. John Heinz's concept (Measure 9) would also involve pump installation and water control replacement at the existing refuge site, as well as installation of new berms/dikes in the refuge to direct water with a breach between the detention basin and tidal marsh.

Option 7b: City-owned Land North of 84th Street (Pepper Bowl Site)

This concept proposes a detention basin in the low-lying "Pepper Bowl" area, near/around the site of the former (vacant) Pepper Middle School. This option can be implemented to complement most other measures including upstream controls such as the Cobbs Creek levee/berm. Under some alternatives, this option would be complemented by a cloudburst street that would divert excess flows from Cobbs Creek toward the Pepper Bowl site or by a channel conveying stormwater from the "Planet Streets." This concept has been discussed as part of the CCRUN Eastwick Compound Flood Modeling and Adaptation Study and was evaluated at a high level by AKRF for PHDC in the Eastwick Hydrologic and Hydraulic Study Report.

Option 7c: Conveyance Under 84th Street

This concept would link the detention basins Options 7a and 7b through a large culvert under 84th Street, conveying water from the Pepper Bowl site to the Redevelopment Authority site, with eventual discharge to the John Heinz Wildlife Refuge/Darby Creek. This is not a standalone option but rather would be implemented as an improvement to the combined implementation of Options 7a and 7b. This concept was evaluated at a high level by AKRF for PHDC in the Eastwick Hydrologic and Hydraulic Study Report.

Effectiveness and Co-Benefits

- These measures do not substantially mitigate riverine flooding in the most vulnerable section of Eastwick but could provide stormwater flood risk reduction to address residual risk if combined with other measures
- Measures have the potential to provide some protection from tidal events but would not fully address tidal flooding as standalone measures
- Co-benefits of these measures include use of a nature-based approach with potential for ecosystem benefits, water quality improvements, habitat restoration, and recreational/educational opportunities

Technical and Feasibility Considerations

Technical and feasibility considerations for these measures include:

Summary of Eastwick Flood Mitigation Measures

- They would require conversion of large area of existing land to wetland/detention basin
- Combined measures including 7c are likely to have substantial costs relative to flood risk reduction benefits (affecting benefit-cost analysis), but funding may be available from other sources to advance non-flood-risk-related goals, such as habitat restoration through the National Fish and Wildlife Foundation's America the Beautiful Challenge and the National Oceanic and Atmospheric Administration funding programs
- The Philadelphia Land Bank owns the majority of land and would need to agree to the approach; however, they are preliminarily supportive if the approach is supported by community consensus. Any land transfers would require City Council approval.

Community Considerations

- Community members are likely to be supportive based on feedback collected thus far if this measure is combined with other options that effectively address flood risk from Cobbs Creek and other flood sources, such as the Delaware River
- Community support will be maximized if the measure is combined with features that provide educational, economic, and recreational value to local residents
- Community members have expressed a desire to convert vacant Pepper Middle School to workforce training center and “resilience hub”, though have acknowledged that safety from flooding is a priority.

Open Questions and Data Needs

- Further technical assessment is necessary to determine the optimal combination of measures, including these options, to maximize flood risk reduction benefits for study area
- Refinement of H&H modeling is needed to assess effectiveness of and need for these options when other measures are implemented. For example, how would the implementation of a Cobbs Creek Levee/Berm affect the storage capacity necessary for mitigation of various coastal and compound events?
- Evaluation is needed to analyze the cost effectiveness of this measure when combined with other potential measures
- If these options are determined to be necessary and effective, the next step will be determining the precise sizing and location of basins and conveyance

Measure 8: Structural or Nature-Based Flood Mitigation for Tidal/Coastal Flooding and Interior Pumping

Coastal and tidal flooding are current and long-term threats to the study area that will not be addressed by upstream control measures. Based on preliminary analysis conducted as part of the CCRUN Eastwick Compound Flood Modeling and Adaptation Study, with 4 feet of sea level rise (projected as soon as the 2080s) chronic tidal flooding in the area could be as widespread as today's extreme rainfall events. The primary sources of future tidal flooding in the area appear to be the low-lying rail corridor located along Bartram Avenue that acts as a flood pathway from John Heinz Wildlife Refuge and Mingo Creek. Much of the area is also susceptible to flooding from coastal storm surge. As discussed preliminarily through the Eastwick Hydrologic & Hydraulic Study Report (2022), a conceptual approach to address this long-term risk is to construct a structural flood mitigation approach (flood

Summary of Eastwick Flood Mitigation Measures

wall, berm, elevated streets, etc.) to a DFE that prevents chronic tidal flooding from entering the neighborhood. The location, extent, DFE, and performance criteria for this measure are not yet determined and will require further planning and analysis. Potential structural and nature-based approaches that should be evaluated to mitigate risk from coastal and tidal flooding include flood walls, earthen berms, and levees, including the potential for a “horizontal” or “living” levee, a hybrid structural and nature-based approach that combines flood protection with gradual vegetated slopes that provide ecological value.⁴

While these measures could be implemented in isolation to address long-term tidal flooding, they would be best implemented as part of a multi-phased, multi-pronged approach that combines other upstream and downstream control measures, such as the Cobbs Creek levee/berm (Measure 1) and Wetland Restoration/Detention Basins (Measure 7). Depending on the other measures implemented and analysis of the stormwater management system, this measure may also necessitate the need for new pumping capacity to convey water from the landside of the wall to receiving waters.

Effectiveness and Co-Benefits

- This measure has potential to reduce risk of chronic tidal flooding or episodic coastal storm surge to the designated DFE (to be determined)
- This measure may not reduce risk from severe coastal floods (e.g., flooding from the present-day or future 1% annual chance storm) depending on selected DFE
- Groundwater flooding due to sea level rise may require elevation of land/infrastructure or substantial pumping capacity
- This measure will not fully address flood risk in the study area and will need to be implemented in conjunction with other upstream and downstream controls measures
- Co-benefits of the measure include potential for structural flood defense approach to include public access, artwork, and educational programming

Technical and Feasibility Considerations

Technical and feasibility considerations for this option include:

- This measure require further significant investigation to assess technical feasibility (e.g., site survey, geotechnical, H&H modeling, etc.)
- Technical and feasibility considerations will help determine appropriate structural flood control approaches for each area (e.g., flood wall, berm, living levee, elevated roadways, etc.)
- There is a potential for structural flood defense to affect service on rail corridors, local roadways, and other infrastructure if the measures must cross roadways or the rail
- Design of the measure will include technical investigation of potential conflicts with subgrade utilities, including the drainage system
- The cost of this measure could be high, especially in combination with the cost of other necessary upstream and downstream control measures

⁴ “A Horizontal Levee is a re-imagining of how a levee looks and what it can do. Instead of a vertical wall to protect against storm surges, a horizontal levee uses vegetation on a slope to break waves. The ecosystems that live on horizontal levees can thrive while helping to further treat runoff.” See Oro Loma Sanitary District’s [Horizontal Levee Project](#) website for more information.

Community Considerations

- This measure has not been discussed in detail with community stakeholders as of November 2022
- Community support is likely to be dependent on combination of this measure with other upstream and downstream control measures that address flooding from Cobbs/Darby Creek

Open Questions and Data Needs

- Substantial planning, analysis, and community/stakeholder engagement is necessary to further develop details on this measure, including the optimal DFE
- Cost-benefit analysis will be needed to determine cost effectiveness as a standalone measure and when implemented in combination with other upstream and downstream control measures
- Further study will be needed to develop appropriate sequencing and timing of implementation based on the timing and degree of coastal flood risks over time

Measure 9: Heinz Wildlife Refuge Berm and Breach

USFWS is studying an approach that uses a combination of berms and breaches to enhance the storage function and hydrologic connectivity of the impoundment area south of Eastwick and east of Darby Creek to the adjacent tidal wetlands. The project is at the conceptual level of development and has not been studied in detail. As currently conceived, the objective of the project is to enable tidal exchange between Darby Creek and a portion of the impoundment area (approximately 2/3 of the current impoundment area) by creating a breach in the existing berm separating the impoundment from the creek. The addition of several additional berms within the impoundment would be used to direct flows from upland drainage areas in Eastwick southward to Darby Creek, helping to reduce the potential for flooding to back up into the neighborhood. This measure is intended to be combined with other downstream control measures discussed above, most notably Measure 7 Wetland Restoration/Detention Basins. If combined, the berm and breach approach would direct flows discharging from the Pepper Bowl and Redevelopment Authority Sites to outlets in the tidal wetlands surrounding Darby Creek.

Effectiveness and Co-Benefits

- This measure may not substantially mitigate riverine flooding from impacting the most vulnerable section of Eastwick, but could improve the function of other measures that provide stormwater flood risk reduction to address residual risk
- The effectiveness of the measure is dependent on other detention and conveyance measures being implemented upstream of the refuge
- Any breach of existing berms in the Refuge could exacerbate long-term tidal flood risk
- The effectiveness of this measure may be limited over time by sea level rise as the emergent wetland area becomes permanently inundated
- Co-benefits of this measure include use of a nature-based approach with the potential for ecosystem benefits, water quality improvements, habitat restoration, and recreational/educational opportunities

Technical and Feasibility Considerations

Technical and feasibility considerations for this option include:

- This measure is at a conceptual stage of development and requires further investigation to assess technical feasibility (e.g., site survey, geotechnical, H&H modeling, etc.)
- The measure will require significant intervention in existing wetland area, which may create a complex permitting process
- This measure is likely to have substantial costs relative to flood risk reduction benefits (affecting benefit-cost analysis), but funding may be available from other sources to advance non-flood-risk-related goals, such as habitat restoration through the National Fish and Wildlife Foundation's America the Beautiful Challenge and the National Oceanic and Atmospheric Administration funding programs.

Community Considerations

- Community members are likely to be supportive based on feedback collected thus far if this measure is combined with other measures that effectively address flood risk from Cobbs Creek and other flood sources such as the Delaware River
- Community support will be maximized if the measure is combined with features that provide educational, economic, and recreational value to residents

Open Questions and Data Needs

- Substantial planning, analysis, and community/stakeholder engagement is necessary to further develop details on this measure
- Further information/collaboration between USFWS, City of Philadelphia, and other stakeholders is necessary to evaluate the need for and support for this measure
- Further modeling will be needed to evaluate necessity and effectiveness of this measure if other measures, such as the Cobbs Creek levee/berm, are implemented
- Further modeling and evaluation are needed to assess degree to which this measure reduces upstream flooding by increasing storage capacity of the refuge area, both today and in the future with projected sea level rise.
- Further modeling is also needed to evaluate whether this measure could be designed to reduce risk of coastal and tidal flooding in the study area
- Further study will be needed to develop appropriate sequencing and timing of implementation based on the timing and degree of coastal flood risks over time

Other Measures

Measure 10: Darby/Cobbs Creek Natural Channel and Floodplain Design

The redesign of the Darby/Cobbs Creek channel and floodplain would involve modification of the channel and floodplain from the railroad crossing across Cobbs Creek downstream to the 84th Street bridge. Several redesign options are possible, ranging from regrading of floodplain areas to increase conveyance and reduce roughness, the addition of constructed flood storage areas along the creek channel, and localized steepening of the channel and floodplain gradient in the vicinity where flood flows are introduced into Eastwick.

This option could reduce the height of the levee required to provide a particular level of flood control, should this option be pursued. This option is generally compatible with relocation and reconstruction options as well as downstream controls.

Effectiveness and Co-Benefits

The potential effectiveness of a natural channel and floodplain strategy is not well understood. Generally, given low gradient of the system and relatively limited land area available to increase floodplain storage, in combination with the high flow rates associated with flooding events, this option should be viewed as a supporting option that could reduce but not eliminate the need for a levee/berm. Co-benefits associated with this option include enhancement of riparian and in-stream habitat and reduction of bank erosion (which could be used to support City of Philadelphia NPDES permitting requirements).

Technical and Feasibility Considerations

Technical and feasibility considerations for this option include:

- The removal of riparian trees will have environmental impacts that need to be studied and mitigated
- Determination of the effectiveness of this measure in terms of increasing conveyance/reducing water surface elevations
- There are likely to be significant permitting requirements associated with large scale channel and floodplain redesign
- Evaluation of the potential for channel incision and sediment transport, as well as the associated need for channel armoring
- Evaluation of the potential for floodplain scour or channel avulsion during large flood events

Open Questions and Data Needs

- Modeling of various floodplain and channel reconfiguration options is needed to understand the potential effectiveness of this scenario, as well as to understand the potential for channel migration, incision, and floodplain scour.

Measure 11: Interim Flood Risk Mitigation

Given the chronic flooding the Eastwick community has faced, actions are necessary in the near-term to reduce risk to property and public safety. These near-term measures can be considered interim measures intended to reduce current flood risks while long-term measures are studied, designed, and implemented. To-date, interim measures have not been studied in detail but may include approaches such as building/property-scale flood resilient retrofits, structural elevation, relocation of first floor living space to an addition on top of the existing structure, or deployable flood barriers at key flood entry points. Interim flood risk mitigation measures can provide a degree of risk reduction in the near-term and can serve as key redundancy after other upstream and downstream control measures are in place.

Effectiveness and Co-Benefits

- Effectiveness will depend on the approach undertaken and scale of implementation. For example, building/property-scale flood resilient retrofits only reduce risk for affected properties/buildings and would not prevent flooding from impacted non-retrofitted buildings.
- For the most part, interim measures do not alter the course of water flows and so would not prevent flooding from impacting unmitigated buildings and infrastructures, such as streets and parks
- Interim measures should not be considered standalone measures but rather should be implemented in conjunction with upstream and downstream control measures

Technical and Feasibility Considerations

Technical and feasibility considerations for interim measures will be highly dependent on the interim measures selected for implementation. For building/property-scale retrofits, for example, the number of properties under private ownership in the floodplain could complicate implementation, as could the structures themselves. Considerations such as structure type (attached vs detached, single-family vs multi-family), structural soundness, construction material, access requirements, and zoning and land use regulations would need to be further studied to better understand the feasibility of building/property scale retrofits.

Open Questions and Data Needs

- Evaluation is needed to determine and select feasible and effective options for interim flood risk mitigation
- Selection of interim measures will depend in part on the determination of an optimal DFE and specific area(s) where interim flood risk mitigation would be implemented
- Evaluation is needed to analyze the cost effectiveness of this measure when combined with other potential measures. Securing federal funding for interim measures will be challenge, so local or philanthropic sources could be prioritized. Cost effectiveness will be limited since these measures are not long term. If longer term measures are being pursued at the same time, this could also cause issues with duplication of benefits and cost-effectiveness of longer term solutions. Some of these activities may also be ineligible for HMA funding and require funding from a different source.
- Further community engagement is needed to assess stakeholder support/input on acceptable interim flood risk mitigation

- It is possible that the implementation of Interim measures may influence residents' desire and support for other measures, so community engagement and education will be needed to communicate the need for multiple measures implemented over time

Measure 12: Preventative Measures

Preventative measures are intended to proactively mitigate future risks created or heightened by climate change driven effects including sea level rise and increased frequency and intensity of precipitation. These measures are described separately from other property level measures since they would be focused on areas exposed to flood risks in the future rather than today. These measures can be implemented in the near- to mid-term and should work in conjunction with other measures intended to mitigate present-day flood risks. To-date preventative measures have not been studied in detail but may include approaches such as relocation or retrofitting of properties threatened by projected future riverine, coastal, or tidal flooding, strategic acquisition of properties, or changes to zoning regulations to limit new development and reduce density (for example, limiting new development to single-family detached structures) in areas subject to long-term risks.

Effectiveness and Co-Benefits

- Effectiveness of the preventative measures will depend on the timing of implementation, approach undertaken, and scale of implementation
- Preventative measures should not be considered standalone measures but rather should be implemented in conjunction with upstream and downstream control measures
- Preventative measures that reduce density or new development potential should be complemented by increases in density or allowable development in lower risk areas of the city and region

Technical and Feasibility Considerations

Technical and feasibility considerations for preventative measures will be highly dependent on the measures selected for implementation. Decisions regarding which measures to implement and where should be based on further study and community engagement, as well as best available climate change projections. Changes to zoning and land use regulations are subject to the public review and approvals process led by the City of Philadelphia and may necessitate updates to master planning documents such as the Lower Southwest District Plan.

Open Questions and Data Needs

- Evaluation is needed to determine feasible and effective options for preventative flood risk mitigation measures, as well as where preventative measures should be implemented, either in lieu of or in conjunction with other resiliency measures
- Further community engagement is needed to assess stakeholder support/input on acceptable preventative flood risk mitigation
- A key question is how preventative measures affect the feasibility and desire for other measures, especially the land swap/relocation measure or Cobbs Creek berm

Preliminary Recommendations for Project Scoping

Comprehensive Integrated Flood Resilience Strategy

As discussed in the previous section, multiple resiliency measures have been studied or are being studied to reduce flood risks in Eastwick. A key observation about the planning and analyses conducted to-date is that they show there is no individual measure that will alleviate flooding from all current and future flood sources. This reflects the complexity of the hydrologic system in Eastwick and the area’s high degree of exposure to riverine, stormwater, and coastal/tidal flooding. Consequently, multiple measures implemented as part of an integrated strategy will be necessary to effectively and equitably reduce flood risk in the neighborhood.

Work to date has significantly advanced technical feasibility evaluations for a number of individual measures. However, a number of significant feasibility and effectiveness questions will remain even after the completion of the work that is currently funded. Given the lack of a cohesive decision-making and governance structure through which to select and ultimately decide on a preferred strategy, and the low level of understanding of how costs and benefits vary when disparate resiliency measures are combined, the implementation of a BRIC or FMA Scoping process is critically needed. We recommend that the fiscal year 2022 FEMA BRIC or FMA Scoping Grant application support implementing a focused community-based planning and analysis process, building on prior and current efforts, to assess potential integrated flood resiliency strategies in collaboration with the community (see Figure 5 for a summary of how ongoing efforts can be integrated into future scoping and grant funding applications). An integrated flood resiliency strategy is a comprehensive combination of potential measures (those summarized in this memo with others added, as appropriate) that has the potential to reduce current and future flood risks in Eastwick. The outcome of this alternatives assessment and planning process would be a preferred integrated strategy and implementation roadmap that is supported by the community, from which constituent resiliency projects can be expedited to the next steps of implementation (funding, design, permitting, or other steps depending on the selected strategy).

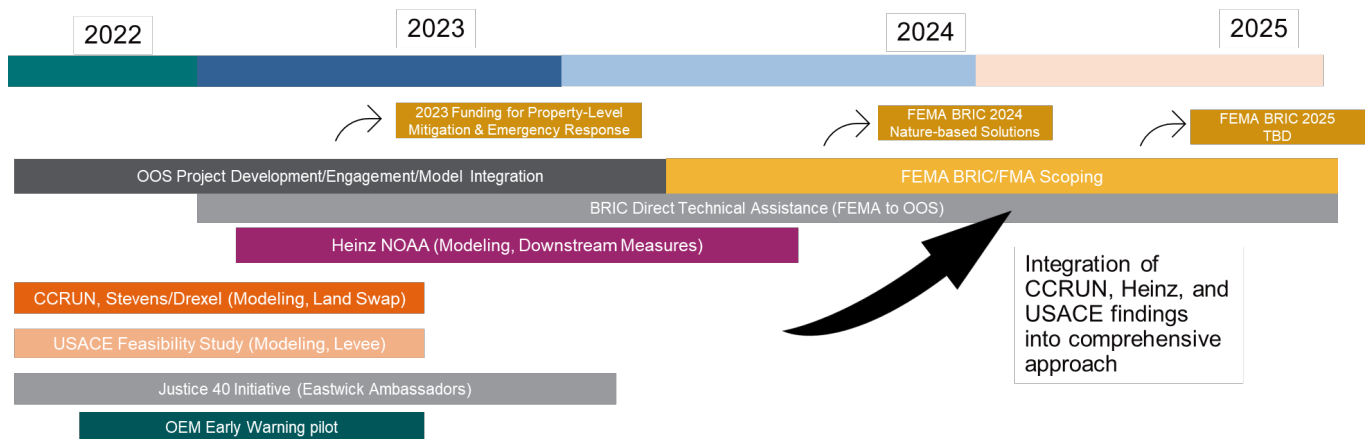


Figure 5 - Timeline of ongoing and planned flood resiliency efforts in Eastwick and how the results of these efforts inform the development an integrated flood resiliency strategy for the community

Summary of Eastwick Flood Mitigation Measures

Prior to commencing this scoping process, we also recommend the City lead pre-planning steps to continue engagement with the community and develop a shared governance and decision-making framework for selecting and advancing preferred resiliency measures. This framework should include clear criteria for community support necessary to reach consensus, resolve technical feasibility issues, decide on land acquisition objectives, facilitate agency approval, pursue permitting, and other critical project needs. The pre-planning process can also include efforts by the various entities leading work in Eastwick to integrate modeling efforts, creating a common comprehensive baseline model from which future evaluation can proceed.

We recognize that flooding is an urgent concern for Eastwick and understand the need to bring solutions to the community as soon as possible. **Undertaking the planning process outlined here should not impede the near-term implementation of property level mitigation and emergency preparedness measures or measures that have been studied and shown to be effective and equitable strategies by partners.** These measures may be fundable through local, state, and federal funding programs while the comprehensive planning process is proceeding and would be complementary to, not duplicative of, measures that might be implemented through subsequent Federal funding applications. This is because even with the near-term implementation of any one measure, there will remain a need to study and plan for how these measures may be optimally integrated with complementary measures over time to address combined and increasing flood risks.

Additional Evaluation and Project Development Recommended for BRIC/FMA Scoping Application

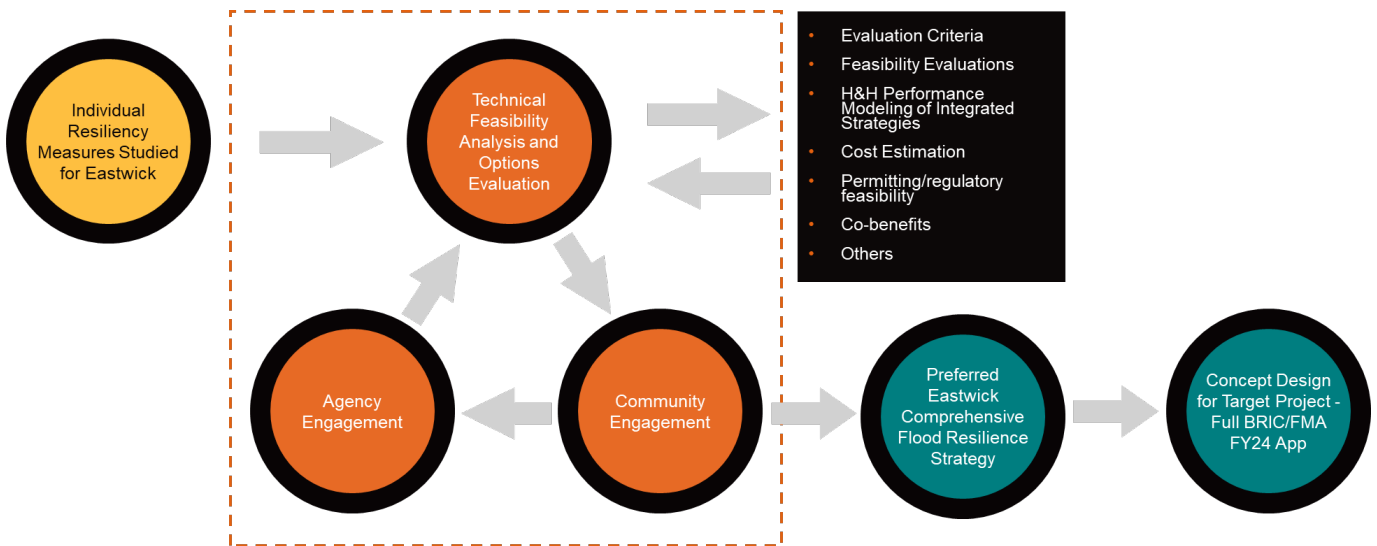


Figure 6 - Concept diagram of process for additional project scoping necessary to develop preferred integrated flood risk mitigation strategy for Eastwick

As discussed above, the project scoping process should identify a set of comprehensive integrated flood resiliency strategies. Then, through additional analysis and discussion with the community and other stakeholders, a preferred integrated strategy should be selected for refinement, design, and implementation. The implementation of the preferred strategy is likely to combine multiple projects that will need to be implemented over time. The selection of a preferred strategy and the projects that comprise that strategy will require evaluation of all alternatives across a number of key questions and analysis steps. The proposed steps described here draw on BRIC scoring criteria and best practices for resiliency planning and design. These steps should be further

Summary of Eastwick Flood Mitigation Measures

developed in collaboration with residents and other stakeholders to provide an equitable decision-making framework for the planning process.

BRIC or FMA Scoping Grant funds can be used to undertake this community engagement process and to complete the data collection and data creation steps necessary to conduct this evaluation and arrive at the optimal strategy for Eastwick. The key questions and analysis steps that can be addressed with scoping funds include:

Long-Term Effectiveness and Adaptability

- Conduct H&H modeling to evaluate the effectiveness of integrated strategy alternatives in reducing combined flood risk in Eastwick. Modeling should include integration of riverine, tidal, and stormwater-driven flood scenarios to identify the primary sources of current and future flooding and appropriate sequencing and necessity of different measures.
- Define DFEs for structural flood risk reduction measures, such as berms and flood walls
- Evaluate sizing and location of any downstream control measures deemed necessary for flood risk reduction purposes, such as detention basins and culverts
- Assess pathways for long-term adaptation to future conditions, building on nearer-term measures

Technical Feasibility

- Review available survey, geotechnical, and other technical information to assess preliminary feasibility of each measure. This effort would build on current feasibility reviews being conducted for certain measures or initiate an initial feasibility review for measures that have not been studied to date.
- Review and resolve outstanding questions pertaining to funding, land acquisition, and long term maintenance
- Review local, state, and federal permitting requirements for strategy implementation scenario and determination of regulatory feasibility
- Develop concept-level cost estimates for the integrated strategy
- Develop a Benefit Cost Analysis (BCA) to evaluate cost-effectiveness for an individual project that contributes to the integrated strategy and the way that individual project selection will impact the cost-effectiveness of each project that contributes to the integrated strategy (i.e., how does acquisition impact cost effectiveness of the levee and vice versa)

Community and Stakeholder Support

- Facilitate continued inclusive community engagement of Eastwick residents to raise awareness, build community capacity, discuss and vet mitigation alternatives, and build consensus around preferred alternatives/measures
- Facilitate continued partnerships with organizations in Eastwick such as Eastwick United and Eastwick Friends and Neighbors Coalition to ensure residents not only have a voice but are leading or co-leading the engagement efforts with their neighbors.
- Undertake granular (e.g., residence scale) surveys within severely affected areas to understand preferences with respect to relocation, reconstruction, levee construction, land swap etc.
- Ensure all community engagement includes a robust educational component so that residents are informed about a range of options and the tradeoffs associated with each

Co-benefits for Ecological Restoration, Environmental Justice, and Community Development

- Assess opportunities for co-benefits associated with each measure, such as ecological restoration, workforce training, public education, community development, and mitigation of other climate-driven hazards such as extreme heat. This process should seek to maximize the number of co-benefits provided through the preferred strategy.

Project Sequencing and Implementation Roadmap

- Evaluate the optimal risk-based timing and sequencing for each measure as part of the integrated strategy. Some measures will need to be implemented as soon as possible and others may not be needed until the future
- Identify a funding strategy for projects including plans for annual funding applications and budget allocations. The BRIC/FMA scoping process recommended here should identify at least one target project that is feasible, supported by the community, and eligible for FEMA funding under the BRIC or FMA programs. Other projects identified through the scoping process may need to be funded through alternative means in keeping with eligibility requirements associated with various funding programs.

Conceptual Design of Target Project(s) and Funding Application Development

- Develop concept-level designs for target projects to provide basic design specifications and performance criteria such as the Design Flood Elevation or flood storage capacity, visuals including detailed section and plan drawings suitable for preliminary permitting review, stakeholder engagement, and BCA development, and delineation of co-benefits.
- Develop and submit one Phased BRIC project application for FY24 to support implementation of the selected target project. The application will include a preliminary BCA and relevant supporting documentation based on the feasibility assessments and engagement steps outlined above.

Conclusion

This memo provides a baseline summary and initial review of the flood risk mitigation measures currently under consideration for Eastwick. As part of this summary, we have provided a preliminary list of open questions and data needs related to each measure. It is expected that this list of questions and data needs will grow as the City and stakeholders learn more about each measure and how individual measures may relate to other proposed measures as part of an integrated strategy. From these questions, we recommend an approach to utilizing BRIC or FMA Scoping funds to develop a preferred comprehensive flood resiliency strategy for Eastwick, a strategy that answers open questions and engages the community in a process of consensus building and decision making.

Based on these steps, the scoping process should identify and develop design concepts and specifications for at least one major project that is eligible for BRIC or FMA implementation funding and that contributes to the comprehensive flood resiliency strategy. Other projects that contribute to the flood resiliency strategy will likely rely on alternative sources of funding, including multiple federal funding programs, local capital funds, private investment, and philanthropic contributions. Ultimately, through cross-departmental and agency collaboration, inclusive engagement of the community, and assembly of funding from multiple partners, including FEMA, this process can lead to long-term flood resiliency for Eastwick.

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