Quincy Flood Mitigation Case Study

Municipality: City of Quincy
Project Title: *Coastal Flood Mitigation Storm Drainage Improvements – Phase 1: Engineering & Public Outreach*
Grant Award: $164,046
Match: $58,954

Community Overview:
The City of Quincy is a vibrant and diverse coastal community, located immediately south of Boston in Norfolk county. The City occupies 16.7 square miles and has 27 miles of coastline. Quincy is the eighth largest city in Massachusetts - with an ethnically diverse population estimate in July 2017 of 94,166 people, according to the U.S. Census.

Quincy has a bustling economy dominated by jobs in finance, education and health services, professional and business services and transportation and utilities. The Fore River Shipyard located in South Quincy has been designated as a maritime industrial working port of regional significance, protected by the State as part of the Weymouth (Fore River) Designated Port Area. This area has the potential for additional growth as one of the last remaining large marine-related sites in the state.

The City of Quincy is charged with operating and maintaining the water, sewer and stormwater system to provide efficient and consistent water and sewer service and effective flood prevention to protect public health and property and preserve water quality for recreation and wildlife habitat, as well as complying with regulatory requirements. The City maintains 230 miles of water distribution mains, 205 miles of sanitary sewers mains and 3000+ manholes and 150 miles of drain pipes and 9,329 catch basins as well as other drainage features.

The City's coastal protection system is comprised of coastal beaches, salt marshes and wetlands, tide gates, seawalls, and stone revetment. The City maintains tide gates to prevent coastal storm surge from backflowing to upland areas. The City has approximately 12 miles of seawall structures; 5.6 miles of which are owned by the City.

In addition to the extensive shoreline, the City of Quincy contains other bodies of water, including Furnace Brook, Town Brook, Town River, and Blacks Creek. Quincy's coastline and multiple inland water bodies provide an abundance of natural resources in the area and opportunities for economic development, including fisheries, shipbuilding, and marine transportation. Quincy's coastline and inland water bodies, however, also increase the City's vulnerability to natural hazards. FEMA's Flood Hazard Zones mapping indicates flood hazards for parts of Quincy, including along its coastline, rivers, and estuarine wetlands. As documented in the City's recently updated Hazard Mitigation Plan and MVP Planning Process the areas with the greatest risk of flooding include Marina Bay in North Quincy, Merrymount Park near Blacks Creek and Quincy Bay, the beginning of Houghs Neck, and areas near Town River.

Description of Climate Impact:
The City of Quincy is already feeling the impacts of climate change, particularly related to coastal flooding due to storm surge and sea level rise and extreme temperatures. Quincy has close to the highest number of repetitive loss claims in the Commonwealth due to flood damage from coastal storms and extreme precipitation. Due to the extensive coastline, and three isolated dense residential peninsulas, Quincy is particularly vulnerable to sea level rise and storm surge. Inland, the City is vulnerable as stormwater conveyed by numerous waterways frequently overtops during large precipitation events, which results in localized flooding of adjacent neighborhoods and businesses. The winter of 2018 included weeks of below zero temperatures and record-breaking high tides in January, temperatures 30 degrees above normal in February, and three back-to-back Nor'easters in March resulting in some of the worst flooding that Quincy has seen, raising awareness of the community's vulnerability. With climate change, the City anticipates more severe and commonly occurring storms will increase coastal impacts and inland flooding.

The Adams Shore coastline, including the Houghs Neck neighborhood, is highly susceptible to coastal flooding, storm surge, and flooding due to inadequate drainage of surface runoff. Flooding is common and parts of the community can be become isolated for hours and even days, depending on the severity of the storm. The vast majority of repetitive loss properties are located in the Adams Shore and Houghs Neck neighborhoods. Nearly one-third of all residential and commercial properties in these neighborhoods are located within the 100-year flood hazard area with a combined building value over $338 million. Damages to property and infrastructure, lost wages, and resulting insurance claims are frequent in this neighborhood following severe weather. The Quincy DPW reported over $30 million just from damages to seawalls and roadways in these neighborhoods from a single storm event. This figure does not include residential damages. Sea Street is the evacuation route for the western part of Houghs Neck. Sea Street becomes impassible near Post Island Road during the high tide when there is extreme rainfall and storm surge, cutting off critical emergency services for 1,000's of homes until flood waters recede. Without drainage improvements, flooding will continue to be a danger to residents in this area and a source of repeated damages to personal property and public infrastructure, including sewer infiltration, nearly every year.

A high priority mitigation action from the Hazard Mitigation Planning and MVP Planning Process is to address flooding by developing a hydraulic model and updating drainage system operations for the areas that discharge via tide gates and/or check valves at Norton Beach, Post Island Road, and Bayswater Road. This recognizes that integrated watershed modeling is essential to make sure that multiple projects within a watershed area are compatible and effective. The grant funds were needed take the first step with the engineering assessment and public outreach to develop the alternatives that will best address use of both man-made and natural wetlands, with a design that will benefit natural resource areas and have minimal impacts to residential properties while best protecting them from flood damages now and in the future.

Project Goals:
The goal of this project is the take the first step in helping the City improve resilience to Houghs Neck and along Adams Shore by lessening the frequency, duration, and severity of flooding impact to help prevent future damages to municipal property and infrastructure.

Specific objectives include:

- Preparing a calibrated, validated model for future use
- Providing modeling runs to confirm value of ongoing seawall improvements
- Providing modeling runs to assess benefits of projects to improve flood protection for over 150 low-lying residential structures and protect critical public infrastructure and transportation/evacuation routes and determining costs associated with these projects
- Assessing opportunities for nature-based solutions, including solutions to improve salt marsh habitat
- Continuing to engage the public in the City's efforts to make Quincy more climate resilient

Approach and Result:
This project consisted of four major tasks as further discussed below:

<u>Task 1: Data gathering and coordination</u>

This effort consisted of gathering and organizing data needed for Task 2, Watershed Modeling. Primarily, the focus was on improving and updating the City's stormwater GIS database with information from recent survey to support seawall improvements and with survey of drainage in approximately 420 acres, including over 500 catch basins and drainage manholes to obtain inverts, material, diameter, and improve connectivity mapping. All work was coordinated with City's ongoing efforts to improve utility mapping consistency and organization. Other data gathered and organized included elevations, soils, land cover and land use, building information, seawall geometry for existing and future conditions, historical and future precipitation data including more extreme precipitation, and historical and future coastal and tide data including sea level rise.

<u>Task 2: Watershed modeling</u>

This extensive scope item included building the model, completing a calibration and validation of the model, and running a variety of precipitation and coastal conditions on existing conditions, future conditions (i.e., seawall being raised by 2 feet currently under construction), and potential drainage improvements and pumping stations, as well as additional seawall elevation increases.

Information collected in Task 1 was used to develop a model of the Adams Shore/Hough's Neck area using the Innovyze® InfoWorks Integrated Catchment Modelling (ICM) software. Infoworks ICM allows modeling of complex hydraulic and hydrologic networks for both above ground and below ground systems and includes both 1-dimensional (1D) and 2-dimensional

(2D) model components. The software was used to establish a robust model of the study area system that integrates coastal and inland natural systems and built infrastructure.

Three observed/historical storm events (1991 "Perfect Storm", May 1995 flooding event, and March 2018 "Storm Riley") were modeled to calibrate/validate the existing conditions model. Information from the City and FEMA regarding areas with known flooding during these historical storm events was considered and used to confirm the modeling results.

The model established rainfall depths from 24-hour design storm events based on the Northeast Regional Climate Center (NRCC) precipitation information. Modelling efforts included the 1, 2-, 5-, 10-, 25-, 50-, 100-, and 500-year frequency storm events occurring during mean higher high tide conditions. Joint coastal and inland flooding occurring during 1-year, and 10-year coastal storm surge events occurring simultaneously with 2-, 10-, and 50-year frequency rainfall storm events was also evaluated. A moderate rainfall event (1-inch over 24 hour) occurring during a 100-year storm surge was also evaluated. Each of the above three model scenarios were also run to evaluate "sea level rise" conditions at the 100-year frequency rainfall event occurring during mean higher high tide.

Drainage system alternatives were identified and evaluated for both the future and potential future scenarios.

Full results are documented in the report and associated attachments. The following provides a brief overview of findings:

- The calibration/validation storm event results show that the InfoWorks ICM model appears to provide a reasonable and acceptable representation of previously observed flooding based on available FEMA repetitive loss data and locations with previously observed flooding.
- The study area is impacted by coastal flooding more than by inland flooding. Flooding is anticipated to be greater during extreme tidal events that coincide with small precipitation events, versus larger precipitation events coinciding with more typical tidal conditions because the storm drain system cannot drain during high tides.
- Model results show that the Adams Shore/Hough Neck Seawall Repair & Improvements project is anticipated to measurably reduce the likelihood of flooding in the study area during extreme tidal events.
- Localized improvements to the storm drain system are not anticipated to improve flooding that occurs during high tide when the system cannot drain, but will improve localized flooding, and at times during low tide.
- Pump stations may reduce the frequency and duration of flooding, particularly during extreme tidal events when drainage via gravity is not possible. Model results show that a pump station at Norton Beach marsh would prevent flooding during a 100-year rainfall event with 2070 SLR and reduce both the duration of flooding and the number impacted

residences for three additional model scenarios. Results also show that flooding adjacent to the Post Island Road marsh would prevent flooding during a 100-year precipitation event coinciding with a 100-year tide level. More work to finalize pump station sizing given desired level of protection and costs/benefits is needed.

- The addition of new tide gates will allow improved ebb and flow to the Bayswater and Norton Beach saltmarshes, thereby improving health of these critical ecosystems. Other nature-based solutions may not provide a reduction in significant flooding, as most of the flooding is strongly influenced by coastal conditions. They will provide mitigation of flooding during smaller precipitation events and will provide co-benefits including reduction in urban heat island effect, creation of habitat, and improved neighborhood aesthetics, while also addressing compliance with federal and state stormwater permit programs.
- Structural improvements should be coupled with changes to City policy and local code related to flood prone areas.

Task 3: Meetings and Public Engagement

The original effort planned for two meetings with the public and/or selected stakeholders to support the work, however, due to the COVID-19 pandemic, the public engagement process had to be revised to be online and virtual. The City created a website with information on the project, continued to promote the previously used GIS-based reporting website, held four public workshops at the end of June 2020, developed a released a PSA from Mayor Koch on the work, sent a mailing to residents in the project area, and posted results of this work online.

A project kickoff meeting was held with City Staff, EEA staff, and the Consultant on February 21, 2020, to review the plan for the work. During the project, the City's Public Works staff met weekly with their Consultant to review project progress. At the end of June 2020, all of the City's consultants involved in modeling met with Public Works staff to review the process and results from various activities with the goal of developing models that cover the entire City.

Task 4: Reporting

Throughout the work, the City provide updates to EEA in the form of monthly progress reports, preparation of a draft and final report, and ongoing conference calls along with a screen share of the modeling.

The City has added content to the Department of Public Works website to document ongoing resilience projects including seawall improvements and the extensive hydraulic modeling: https://www.quincyma.gov/govt/depts/pwd/default.htm

The final report for this work will be posted on EEA's website at: https://www.mass.gov/info-details/municipal-vulnerability-preparedness-program-action-grant-projects

Lessons Learned:

What lessons were learned as a result of the project? Focus on both technical matter of the project and process-oriented lessons learned.

Innovyze® InfoWorks ICM software is a powerful tool to understand both existing and future flooding conditions. However, data input can be incredibly time consuming when multiple sources of data exist (e.g., various sources of the stormwater system). Starting with a well-built drainage map is critical to efficient model development. Pay close attention to the datum used from national, state, and local data sources and convert to a consistent datum. Local data sources with local datums are often less clear than datums used for national and state data sources, and require an additional level of scrutiny, particularly when they are based on site specific tide levels.

The calibration and validation process of developing the model is critical to creating confidence in overall modeling results. Storms that have good information on flooding extent should be selected. In Quincy, repetitive loss data were available from FEMA and information on the recent storm events and extent of impacts were available from residents and City staff, helping vet the calibration and validation results. Displaying model results for recent historical storms is also a valuable communication tool with stakeholders that illustrations what the model is doing in a more concrete way than theoretical storms and provides an opportunity for dialogue comparing observed and modeled flooding.

For a coastal community looking to use InfoWorks ICM ® to model inland flooding coupled with coastal impacts, the unique coastal situation needs to be carefully considered and incorporated into the model. For example, in Quincy, the seawall overtops under certain storm surge events. This was reflected by creating an artificial high wave condition that affected the system at certain points in the storm event.

Changing the public engagement strategy mid-way had its benefits and drawbacks. Due to COVID, the two in-person meetings planned had to be shifted to a multi-modal educational process consisting of online content, mailed brochures, a PSA, and four public engagement virtual presentations. While in-person meetings have their place, the multi-modal approach ultimately reached a broader group than the two meetings would have. Future projects should consider using a similar multi-modal approach with support from the office of the ranking elected or appointed officials.

Partners and Other Support:

We are grateful for the continued support by Mayor Koch and Ward Councilor McCarthy during the project, including their involvement in continued public education and involvement during this project and into the future as the City progresses with improving resiliency to climate change.