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1 INTRODUCTION

1.1 PURPOSE OF STUDY

The City of Annapolis, Maryland, located at the confluence of the Severn River and Chesapeake Bay, has flooded in the past and continues to be at risk of flooding. Therefore, the City requested the assistance of the U.S. Army Corps of Engineers (USACE), Baltimore District, to provide technical services to investigate and develop viable nonstructural mitigation solutions to reduce the risk of flood damage in their historic district. As a part of this study, three tasks were performed between June and September 2014: 1) building elevation surveys, 2) cultural/historical surveys, and 3) a flood proofing evaluation. The purpose of this technical memorandum is to document the tasks and present the findings of this effort. As a result of this study, the City will know the locations and elevations of the most vulnerable historic structures. This information could assist with planning efforts and evacuation plans. The flood proofing evaluation conducted as a part of this effort provides various recommendations for the City and property owners to consider as ways to reduce their flood risk.

1.2 STUDY AREA

The study area is the portion of the City of Annapolis’ Historic District with an elevation below 10 feet North American Vertical Datum of 1988 (NAVD88) in Annapolis, Maryland (See Figure 1-1).

**Figure 1-1 Map of Study Area**
1.3 BACKGROUND

The City of Annapolis in Anne Arundel County, Maryland is both flood-prone and rich in historical/cultural resources. It is located at the mouth of the Severn River, where it meets the Chesapeake Bay. There are four sizeable creeks that run through the city: Weems Creek, College Creek, Spa Creek and Back Creek. The city is prone to both river flooding and storm surge. Annapolis was once our Nation’s capital and three signers of the Declaration of Independence had homes in Annapolis that are still available to visit today.

The City identified 147 buildings of historical significance situated below 10 feet NAVD88 and asked USACE to provide building elevation surveys, historical surveys, and flood proofing mitigation guidance. USACE executed this work as part of the Floodplain Management Services Program (FPMS). The FPMS program is designed to provide planning-level assistance to communities for floodplain related issues.

1.4 COORDINATION

USACE’s role in this project is only a part of the larger and ongoing historic preservation and hazard mitigation effort shared by many other agencies. Federal, state, and city governments; preservation organizations; emergency management agencies and other local agencies involved include:

Preservation Maryland, a statewide advocacy preservation organization gave a Heritage Grant to support survey and research needs.

National Trust for Historic Preservation, a national preservation organization that deals with advocacy and policy issues gave a grant to support the project and designated Annapolis as a National Treasure in their program.

Maryland Historical Trust is a state government agency that deals with statewide preservation issues. They provided a grant for to support the City’s historic building preservation efforts.

Mainstreets Annapolis Partnership is a locally based non-profit who advocates for economic development through historic preservation efforts. They work with the business community to ensure their voice is heard through the public notification process.

Maryland Department of Natural Resources gave a “Coastal Communities” grant for the creation of design guidelines and prototype mitigation strategies.

Maryland Humanities Council, a new partner and state government agency is assisting with public outreach and community engagement.

FEMA provided guidance for which the planning process for the development of an integrated cultural resources management plan for hazard mitigation is based.

Maryland Emergency Management Agency and Annapolis Office of Emergency Preparedness were consulted in the planning of this project and representatives have participated in the steering committee meetings.

Annapolis Planning and Zoning (P and Z), Office of Neighborhood and Environmental Programs (DNEP), Public Works (DPW), and Information Technology (MIT) and a member of the City Council have representatives on the steering committee to provide technical guidance and support.
US Naval Academy is engaged in the planning effort, as neighbors who are dealing with the same issues on the yard and are bringing in expertise through the architect of the USNA and through public works, Facilities Management Division.

National Park Service is providing guidance from the national perspective about how to integrate GIS as a management tool, and survey and mitigation options.

Historic Annapolis (HA) a local preservation advocacy organization is supporting the mission as a member of the steering committee.

Historic Preservation Commission (HPC) a volunteer branch of city government that helps manage change to the exterior of properties in the historic district, and will be heavily involved in the creation of design guidelines.
2 BUILDING ELEVATION SURVEYS

The City of Annapolis provided a list of 147 residential and commercial structures of historical significance, situated below 10 feet NAVD88, which were surveyed in July 2014. An elevation was taken at the Lowest Adjacent Grade (LAG) to identify the water surface elevation at which the start of damages to the structure could occur. Measurements were also taken at the lowest opening to identify the elevation at which flood waters could enter the structure and cause damage to the contents within the structure. Elevation measurements were also taken at the first floor, which is the first enclosed level of the structure representing livable space subject to property damage/loss. Figure 2-1 illustrates these three points.

The surveyed elevations were referenced to NAVD88. Elevations were determined using a Trimble™ Real Time Kinematic (RTK) GPS hardware device, with vertical elevations to accurate to approximately 20 millimeters (Trimble, 2012a). Standard differential leveling and/or other surveying techniques were utilized where RTK technology was obstructed by tree/building cover. A Trimble™ Yuma GPS tablet collected latitude and longitude points for each structure surveyed. The Yuma tablet GPS function is accurate to approximately 2-5 meters (Trimble, 2012b).

A Microsoft Office Access database was developed to inventory each structure and its associated data (Microsoft, 2006). The data collected for each structure included the following: date inventoried, staff, latitude/longitude, street address, parcel identification, primary structure use (e.g., commercial, residential, or other), commercial activity (e.g., commercial, industrial, residential), structure type (e.g., detached, duplex, townhouse), structure condition (e.g., good, fair, poor), basement (e.g., yes/no and type (e.g., no access, below grade, walkout)), crawlspace or slab on grade, year built, square feet, number of floors, lowest adjacent grade (LAG) elevation, low opening type (e.g., door, window, vent, other), low opening elevation, first floor elevation, digital pictures, and comments.

Elevation surveys were completed for 147 structures within the study area. Figure 2-2 is a map showing the location of each structure where elevation surveys were conducted, and Table 2-1 lists the addresses. Data collected in the field were entered into a Microsoft Office Access database, exported into shape file format, and included as enclosures to this technical memorandum. Table 2-2 presents a screenshot of the Microsoft Office Access database deliverable.
**Lowest adjacent grade** in this example is the front left corner, the lowest point closest to where the water is coming from. **Low opening** in this example is the basement window, where water would first enter the building during flooding. **First floor opening** here is the front door, where the most damage would typically occur if flood waters reached this elevation.
FIGURE 2-2 MAP OF SURVEYED PROPERTIES
### Table 2-1 Address List of Surveyed Properties

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3 CULTURAL/HISTORICAL SURVEY

The USACE Baltimore District cultural resources team assisted the City of Annapolis in completing Maryland Inventory of Historic Properties (MIHP) forms for buildings that are at risk of flooding. The City provided a list of historically significant properties within the study area that needed new or updated MIHP forms and identified which portions of the forms USACE was to complete. From that list, USACE downloaded and digitized existing MIHP forms into an editable format, conducted online research, performed field surveys, and photographed structures to complete several portions of the forms. This information will assist the City when evaluating flood mitigation measures.

The USACE Cultural Resources team completed the property name, location description, property owner, location of legal description, location of additional data, classification of structure, condition description, architectural descriptions, cultural significance of the property, and bibliography portion of the MIHP forms for 70 properties. Figure 3-1 shows an example architectural description written for the MIHP forms. These forms are included in the database. In addition to the completed forms, photos and old forms converted to an editable format for the City to update are included in the CD.

**FIGURE 3-1 MHIP PROPERTY DESCRIPTION FOR ANNAPOLIS SUMMER GARDEN THEATER**
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4 EVALUATION OF FLOOD PROOFING MEASURES

The City of Annapolis identified 16 prototypical structures of historical value, consisting of residential and commercial buildings, which are at risk of flood damage to be assessed by USACE’s National Flood Proofing Committee (NFPC) for identification of potential flood risk adaptive measures (FRAM). The overall purpose of a nonstructural FRAM is to reduce flood risk, decrease flood damages, and to potentially eliminate life-loss. FRAM measures reduce flood risk by modifying the characteristics of the buildings and structures that are subject to flooding or modifying the behavior of people living in or near floodplains. In general, nonstructural FRAM measures do not modify the characteristics of floods (stage, velocity) nor do they induce development in a floodplain that is inconsistent with reducing flood risk. These measures do aim to provide effective, socially acceptable, environmentally suitable, and mindful modifications of the existing neighborhood and community social and economic systems.

The project team determined the design flood elevation (8.2’ NAVD88) by adding the Intergovernmental Panel for Climate Change’s best projection for Maryland’s sea level rise in the next 100 years (3.7’ NAVD88) to Federal Emergency Management Agency’s 2013 Flood Insurance Study 100-year flood elevation (4.5’ NAVD88).

Some of the basic considerations used to develop nonstructural FRAM measures are as follows:

- Relocate buildings from the floodplain to a flood-free location.
- Acquire the floodplain land on which the relocated buildings previously existed and enforce deed restrictions so the land will not be developed for uses that are subject to flood risk in the future.
- Acquire floodplain land that is in existing open space use to prevent future development that could be at flood risk.
- “Acquire” buildings within the floodplain, destroy them, and enforce deed restrictions to prevent future development that could be at flood risk.
- Elevate buildings above a particular flood elevation.
- Dry flood proof buildings (traditional building waterproofing).
- Wet flood proof buildings (retrofitting existing buildings below a design flood elevation with water resistant materials and allowing flood water to easily flow into and out of the building).
- Install flood warning systems.
- Develop and implement emergency flood preparedness plans.
- Employ communication and educational outreach programs aimed at no flood risk.

Floodproofing Results

Two members of the USACE National Nonstructural Flood Proofing Committee (NFPC) conducted this reconnaissance level assessment of prototypical structures during the week of August 4-8, 2014. See Table 4-1 for a description and list of addresses for the buildings assessed.

Many of the NFPC’s recommendations for the prototypical structures in the historic district include measures such as dry flood proofing, repairing foundations, and elevating critical equipment. Please see Appendix A for the complete Nonstructural Assessment Sampling Report prepared by the USACE NFPC.
<table>
<thead>
<tr>
<th>Structure ID</th>
<th>Structure Name / Description</th>
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<tbody>
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<td>Residence</td>
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</table>
5 REFERENCES


Nonstructural Mitigation Assessment for the City of Annapolis Historic District

APPENDIX A

Nonstructural Assessment Sampling Report
Annapolis, Maryland Historic District
Nonstructural Assessment Sampling

November 2014

Prepared by:
Randall Behm & Stephen O’Leary
USACE National Nonstructural Flood Proofing Committee
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<tr>
<td>Table 1</td>
<td>Description of Assessed Structures</td>
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1.0 Introduction
This nonstructural assessment has been conducted in support of the U.S. Army Corps of Engineers (USACE), Baltimore District (NAB), to assess a sampling of 16 historic structures, consisting of residential and commercial buildings, to identify potential flood risk adaptive measures (FRAM), generally referred to as nonstructural mitigation measures within the historic downtown Annapolis, Maryland area (see Figure 1). Information regarding the 16 sample structures assessed is provided in Table 1. This reconnaissance level assessment was conducted by two members of the USACE National Nonstructural Flood Proofing Committee (NFPC), Randall Behm, Omaha District and Stephen O’Leary, Huntington District.

The data collected for this assessment is being provided to NAB for inclusion in their ongoing activities with the City of Annapolis for consideration in mitigating the current flood risk and addressing potential future flood risks associated with these structures.

The entire assessment area contains numerous structures, most of which are privately owned, but designated as historic properties. Many of the structures are culturally significant due to their construction techniques, construction materials, and age of the properties to the establishment and evolution of this area, as well as to the region and the nation.

If flood risks to these structures and others within the vicinity of the assessment area increase as predicted by the conclusion of a multitude of comprehensive climate and sea level studies, then this area will be pressed to implement nonstructural FRAM measures, consider the construction of significant seawalls along the entire coastline, or face losing these historically significant buildings.

This assessment focuses on at-risk structures and contains the detailed technical assessment used for investigating the incorporation of nonstructural FRAM measures within the assessment area. It is conclusive that without the incorporation of nonstructural flood risk adaptive measures or other measures such as levees, seawalls and floodwalls, a significant number of historically significant structures would continue to be damaged under existing conditions by extensive flooding along the Chesapeake Bay.

While nonstructural FRAM measures are specific to the structure being investigated, when considered for the mitigation of flood damages, the cumulative effect is to determine a strategy for incorporating a full range of nonstructural FRAM measures which are economically feasible and will reduce the cumulative risk of flooding. Each individual structure assessed may require a different nonstructural technique. While this assessment relies heavily upon an inventory of data collected in the field for implementation, each structure would be required to be inspected by a team consisting of a floodplain engineer, architect or structural engineer, cost engineer, civil engineer, and real estate specialist in order to determine the mitigation details relative to each type of nonstructural FRAM measure employed. Because of the limited nature of this level of investigation, this assessment was conducted as reconnaissance level detail.

Nonstructural FRAM measures require different implementation methods than structural measures. Since each structure is owned and typically occupied, nonstructural implementation agreements must be entered into with each individual owner.
Nonstructural FRAM measures are proven methods and techniques specifically directed at reducing flood risk and flood damages in floodplains. Numerous structures across the nation are subject to reduced risk and damage or no risk and damage due to implementation of nonstructural measures. Nonstructural mitigation measures are very effective for both short and long term flood risk and flood damage reduction and can be very cost effective when compared to structural measures.

The ability of nonstructural FRAM measures to be implemented in very small increments, each increment producing flood risk reduction benefits, and the ability to initiate and close a nonstructural program with relatively minimal costs are important characteristics of this form of flood risk reduction. Also important is the ability to implement measures over intermediate and
long periods such that layering of measures, each one providing a higher degree of risk reduction, is possible and given both Federal and non Federal funding constraints may be probable.

1.1 Nonstructural Flood Risk Adaptive Measures (FRAM)
The overall purpose of a nonstructural flood risk adaptive measure (FRAM) is to reduce flood risk, decrease flood damages, and to potentially eliminate life-loss. FRAM measures reduce flood risk by modifying the characteristics of the buildings and structures that are subject to flooding or modifying the behavior of people living in or near floodplains. In general, nonstructural FRAM measures do not modify the characteristics of floods (stage, velocity) nor do they induce development in a floodplain that is inconsistent with reducing flood risk. Some nonstructural FRAM measures that can be formulated include removing buildings from the floodplain by relocation or acquisition; flood proofing buildings; placing small levees, berms or walls around buildings; implementing flood warning and preparedness activities; and implementing floodplain regulation. The National Flood Insurance Program (NFIP) is also considered among nonstructural flood risk adaptive measures since it contains programs to provide minimum standards for floodplain regulation, to provide flood insurance, and to provide flood hazard mitigation. In contrast, structural alternatives reduce flood risk by modifying the characteristics of the flood. Structural measures do not modify the characteristics of existing development in the floodplain. Structural alternatives, although they decrease the frequency of flooding, can actually increase flood risk if the consequences of flooding are allowed to increase. This occurs when new development is placed in the floodplain that is inconsistent with reducing flood risk, such as extensive levee and floodwall systems.

Some of the basic considerations used to develop nonstructural FRAM measures are as follows:

- Relocate buildings from the floodplain to a flood-free location.
- Acquire the floodplain land on which the relocated buildings previously existed and enforce deed restrictions so the land will never be developed in the future for uses that are subject to flood risk.
- Acquire floodplain land that is in existing open space use to prevent future development that could be at flood risk.
- ”Acquire” buildings within the floodplain, destroy them, and enforce deed restrictions to prevent future development that could be at flood risk.
- Elevate buildings above a particular flood elevation.
- Dry flood proof buildings (traditional building waterproofing)
- Wet flood proof buildings (retrofitting existing buildings below a design flood elevation with water resistant materials and allowing flood water to easily flow into and out of the building).
- Install small ring levees, berms, and walls around one building or a few buildings that are in close proximity to one another. Such levees, berms, and walls are not to be accredited for the National Flood Insurance Program.
- Install flood warning systems.
- Develop and implement emergency flood preparedness plans.
- Employ communication and educational outreach programs aimed at no flood risk.
Each of these general categories of nonstructural FRAM measures can be applied as a single measure or can be applied in combination with one another or with structural measures to reduce or eliminate flood risk. The range of benefits, costs, and residual damages associated with application of each measure is broad. The extent and severity of social and economic impacts associated with the various measures can be likewise broad and must be identified for any plan. Depending upon the nonstructural measures selected for application and the relative percentage of each applied, the future land use pattern of the area could look considerably different in specific areas.

The consequences associated with locating damageable property and people within floodplain areas can be extreme to property owners and floodplain occupants. Within the context of this assessment, an objective is to identify strategies and measures that can be used in tandem to reduce flood risk. Some strategies and measures may be more appropriate for Federal action while others will be more attuned to local regulatory action and administration. In either case, these measures must be effective, socially acceptable, environmentally suitable, and mindful of the existing neighborhood and community social and economic systems within which they would be implemented. It is the intent of this assessment to identify such nonstructural FRAM measures.

1.2 Floodplain and Flood Risk Characteristics
The source of the most major historic floods is hurricane related rainfall events and tidal processes causing flood problems. Because of the characteristics of the Chesapeake Bay, flood warning is generally quite ample to enable human intervention to reduce flood damages. Because of the coastal characteristics, actual flood duration can last from several days up to over a week.

The floodplain within the historic downtown area of Annapolis consists of the entire spectrum of development - residential, commercial, and governmental. Basements and crawl spaces exist in some of the buildings. Age of development is from very old to relatively new.

1.3 Executive Order 11988; Floodplain Management (EO11988)
This Executive Order (EO11988) was issued by President Carter on 24 May 1977. In issuing EO11988 the President stated “in order to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative, it is hereby ordered that each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities…”. The nonstructural FRAM measures contained herein was conducted in complete compliance with EO11988 meaning that any nonstructural FRAM measures that are incorporated into alternatives recommended for implementation support the vision of EO11988.

1.4 Critical Facilities
Structures/facilities which become inoperable during a flood event and result in additional adverse impacts or hardship on the effected population are critical facilities. They are essential
during a flood to provide human safety, health, and welfare. Critical facilities are generally those services required during the flood such as police and fire protection, emergency operations, people evacuation sites, and medical care. Facilities that house the elderly or disabled and people requiring medical assistance or extensive evacuation time would be considered critical. Facilities that could, if flooded, add to the severity of the disaster such as power stations, waste water treatment plants, and toxic material storage sites are considered critical. Each critical facility within the guidelines of EO11988 should be located at a flood free site. If this is not possible or practicable, the facility should be located external to the 500-year floodplain. If this is not possible or practicable, the facility must be, at a minimum, protected to the extent that it can function as intended during all floods up to and equal to a 500-year event.

1.5 Common Nonstructural Flood Risk Adaptive Measures (FRAM)
The following nonstructural FRAM measures are commonly utilized for reducing flood risk within urban and rural areas across the nation. Each measure must meet specific criteria that would make it acceptable to the flood characteristics and site conditions. While many nonstructural FRAM measures are described in detail, not all measures were found to be acceptable for implementation within the Annapolis study area.

1.5.1 Acquisition and Demolition of the Structure. This measure consists of buying the structure and the land as part of the project. The structure is either demolished or the structure is sold to others and relocated to a location external to the floodplain. Development sites, if needed, can be part of a project in order to have locations where displaced people can build new homes or businesses. This measure is applicable anywhere in the within the study area.

1.5.2 Elevation of Structures. This measure requires lifting the entire structure or the habitable area to be above a particular flood event (see Figure 2). If a basement exists and had been fully developed prior to elevation and could not be developed post-elevation, compensation of the basement space would be in order to the owner. This measure is applicable anywhere within the study area unless the required elevation is greater than a maximum of 12 feet above the adjacent grade. Velocity and hydrodynamic forces on the structure would also have to be considered.

![Figure 2](Structure Elevation (Diagrammatic Section))
1.5.3 Removal of Basement. This measure consists of filling in the existing damageable basement without elevating the remainder of the structure. This would occur if the structures’ first floor was located above the BFE or above the design elevation or whichever is higher. With this measure, placing an addition onto the side of the structure as part of the project could occur to compensate for the lost basement space to the owner. If the addition could not be developed because of limited space within the property parcel or because the owner did not want it, compensation for the lost basement space would be in order to the owner. Hydrodynamic forces on the structure would also be a consideration.

1.5.4 Relocation of Structures. This measure requires physically moving the at-risk structure and buying the land upon which the structure is located. This measure achieves a high level of flood risk reduction when structures can be relocated from a high flood hazard area to an area that is located completely out of the floodplain. Development of relocation sites where structures could be moved to achieve the planning objectives and retain such aspects as community tax base, neighborhood cohesion, or cultural and historic significance can be part of any relocation project. This measure should be applicable anywhere within the study area.

1.5.5 Dry Flood Proofing. This measure basically consists of waterproofing the structure (see Figure 3). This can be done to residential homes as well as all other types of structures. This measure achieves flood risk reduction benefits but it is not recognized by the NFIP for any flood insurance premium rate reduction if applied to residential structures. Based upon testing, a “conventional” built structure can generally be dry flood proofed up to 3 feet on the walls. A structural analysis of the wall strength would be required if it was desired to achieve higher protection. A sump pump and perhaps French drain system may be required as part of the project. Closure panels are required for all openings. This concept does not work with basements nor does it work with crawl spaces due to the possible long duration of flood. This measure will work if design flood depths are generally less than three feet and on an appropriate structure as discussed. Hydrodynamic forces would also be a consideration. For buildings with basements and/or crawlspaces, the only way that dry flood proofing could be considered to work is for the first floor to be made impermeable to the passage of floodwater.

![Dry Flood Proofing Diagram](image-url)
1.5.6 Wet Flood Proofing. This measure is applicable as either a stand-alone measure or as a measure combined with other measures such as elevation (see Figure 4). As a stand-alone measure, all construction materials and finishing materials are required to be water resistant. All utilities must be elevated above the design flood elevation. Because of these requirements, wet flood proofing of finished residential structures is generally not recommended. Wet flood proofing is quite applicable to commercial and industrial structures and should consider being combined with a flood warning, flood preparedness, and flood response plan. This measure is generally not applicable to large flood depths and high velocity flows.

![Figure 4](image)

Figure 4

Wet Flood Proofing (Diagrammatic Detail/Section)

1.5.7 Berms, Levees, and Floodwalls. This measure is applicable to several locations within the study area. As nonstructural measures, berms, levees, and walls should be constructed to no higher than 5 feet above grade and are not certifiable for the NFIP, meaning that flood insurance and floodplain management requirements of the NFIP are still applicable within the protected area (see Figure 5). These nonstructural measures are intended to reduce the frequency of flooding but not eliminate floodplain management and flood insurance requirements. These measures can be used for all types of structures located within the study area. They can be placed around a single structure or a small group of structures. With application of these measures to be nonstructural, they cannot adversely impact the water surface elevation of the 100-year flood by any more than 0.00 feet.

![Figure 5](image)

Figure 5
1.5.8 Flood Warning, Preparedness, Evacuation Plans and Pertinent Equipment Installation. These measures are applicable to the entire study area. Any nonstructural plan should consider the development and implementation of flood warning systems and emergency preparedness planning. The development of such plans and the installation of pertinent equipment such as data gathering devices (rain gages, stream gages) and data processing equipment can become an integral feature of a project.

1.5.9 Land Acquisition. Land acquisition can be in either the form of fee title or permanent easement with fee title. Land use after acquisition is open space use via deed restriction that prohibits any type of development that can sustain flood damages or restrict flood flows. Land acquired as part of a nonstructural project can be converted to a new use such as ecosystem restoration and/or recreation that is open space based such as trails, shoreline access, and interpretive markers. Conversion of previously developed land to open space means that infrastructure no longer needed such as utilities, streets, and sidewalks can be removed as part of the project. The conversion to new use (ecosystem restoration and/or recreation) can also be part of a nonstructural project. By incorporating “new uses of the permanently evacuated floodplains” into the nonstructural flood risk reduction project, economic feasibility of the buyout or relocation projects is enhanced due to transfer of some flood risk reduction costs to ecosystem restoration and by adding benefits and costs of recreation.

1.5.10 Floodplain Regulation and Floodplain Management. Floodplain regulation and floodplain management have proven to be very effective in reducing flood risk and flood damage. The basics principles of these tools are based nationally in the NFIP which requires minimum standards of floodplain management and floodplain regulation for those communities that participate in the NFIP. While the minimum standards have not resulted in substantial flood risk reduction, incorporation of more stringent building codes and zoning ordinances may meet community objectives of no flood risk.

1.5.11 National Flood Insurance Program (NFIP). The NFIP contains 3 basic parts; flood insurance, flood mitigation, and floodplain regulation. In terms of reducing flood risk, only flood mitigation and floodplain regulation have a direct impact in theory. In regard to the flood insurance part of the NFIP, flood insurance simply allows spreading the flood risk across multiple properties as does any insurance program. It does not reduce flood risk. It shares flood risk. In terms of the NFIP as a nonstructural measure to truly reduce flood risk, the flood mitigation and floodplain regulation parts of the NFIP are those measures. Five mitigation programs exist within the NFIP. They are the hazard mitigation grant program, pre disaster mitigation grant program, flood mitigation public assistance program, repetitive loss program, and severe repetitive loss program. Within the floodplain regulation part of the NFIP, this serves as a nonstructural mitigation measure indirectly through adoption of minimum floodplain management standards by communities participating in the NFIP.

2.0 Nonstructural Assessment Objectives
The assessment area contains multiple structures and these structures are generally classified as residential, commercial, and public (government). For a nonstructural assessment, each structure
must be examined for purposes of what type of nonstructural measure is most appropriate for that particular structure given what it is, where it is located within the floodplain, what the flood characteristics are (velocities and stages), and other site conditions. The 1% exceedance (100-year) flood event alone (4.5’ NAVD88) and the 1% exceedance flood event plus projected sea level rise determined the design flood elevation (+/- 8.20’ NAVD88). Both were considered as the benchmarks for implementation of FRAM measures to mitigate the structures.

This assessment conducted an investigation of 16 historic properties, which are detailed later in this report. While economic considerations of estimated annual damages and benefits were not a requirement of this assessment, detailed information was collected in the field, combined with additional information provided by NAB, and used to develop nonstructural recommendations.

2.1 Description of Nonstructural Structure Dataset

For the nonstructural FRAM assessment, structure information was collected within the historic downtown area for 16 structures. In addition to the dataset provided by NAB, field data was collected for each structure. A list of the structures assessed is summarized in Table 1.

<table>
<thead>
<tr>
<th>Structure ID</th>
<th>Structure Name / Description</th>
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<tbody>
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<tr>
<td>16</td>
<td>Residence</td>
<td>67 Conduit street</td>
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The location of specific structures is illustrated on Figure 6. The assessed structures are located in the heart of a vibrant town center, where tourism intermixes with day to day activities.
3.0 Description of Structure Assessment

A detailed field investigation and desktop assessment was conducted on behalf of Baltimore District for each of the 16 historic structures. Details regarding structure characteristics, site conditions, site elevations and flood elevation data was prepared for each structure and is presented in report section 4.0 below. Observations of structure characteristics were noted and compared to the hydrologic conditions to determine potential flood risk, from which nonstructural FRAM measures, or those measures which adapt to the characteristics of the floodplain, could be identified and recommended. Each recommendation for a given structure includes pros and cons as well as a cost magnitude too give an associated relative cost. Cost magnitudes of the following values were used: Very Low (< $5K); Low ($5 - $10K); Medium ($10 - $50K); High ($50 - $100K); Very High (> $100K).

Each of the 16 historic structures is assessed using a similar format for each. The recommendations include measures described in section 1.5 of this report, and are described as individual measures or in combination with other measures to provide the most effective level of flood risk reduction. All elevation data in this report are referenced to the North American Vertical Datum of 1988 (NAVD88).
Structure Information / Data

Name/Description: Sands’ House
Location: 130 Prince George Street
Occupancy type: Single-Family Dwelling (Residential)
No of Stories: 2 ½

Building Construction:
- Exterior Walls: Wood frame
- Floor Construction (1st Flr): Wood Frame
- Foundation Wall: Masonry w/crawlspace (+/- 4.33 ft.)
- Grade/Crawlspace/Basement: Crawlspace

Structure/Flood Elevations Table

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<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
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<tr>
<td>5.54’</td>
<td>*6.62’</td>
<td>7.29’</td>
<td>1.5’</td>
<td>4.50’</td>
<td>8.20’</td>
<td>-2.79’</td>
<td>0.91’</td>
<td>-1.04’</td>
<td>2.66’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

*See Site Visit and Analysis sections.

Structure Photographs

South Elevation (Front)  Front Entrance  Crawl Space

Site Visit (Observations/Field Notes)

The structure was observed from the exterior and the interior of crawl space of the original building. The property owner was present for information or comment. Per property owner - Water infiltrated through the crawlspace perimeter foundation walls in the past flood. The structure has been elevated estimated 18 inches in the past.

The structure is wood framed construction on masonry foundation walls (unreinforced brick/stone), with a crawlspace. The masonry foundation is in poor condition, requiring repair/ rehab/renovation. The structure and site have been modified over time with upgrades/renovations/additions and fill.

*The first floor is the lowest habitable space. Field measurements taken show the first floor to be approximately 1’- 6” above the finish grade at low ground on the front elevation (right side of the front porch).

The crawlspace is the lowest level and is partially below exterior finish grade. The crawlspace (of the original structure) was accessed and observed via a floor hatch at front entrance hall. The crawlspace floor is
dirt/unfinished. Field measurements show the crawlspace floor to be approximately 4’- 4” below the first floor at the access hatch. The estimated crawlspace finish grade/floor elevation is 2.96’NAVD88.

Grade around structure is level perpendicular to structure; drainage away from the structure is basically neutral. The sidewalk in front of building is composed of brick pavers of unknown substrate, in poor/fair condition. The siding at several locations around the structure is close to or at the finish grade (i.e. close to top of foundation wall and wood floor/wall construction). Downspouts discharge to grade close to structure. No flood louvers were visible in the foundation walls. *A small foundation wall vent was observed at the rear of the original structure, just below siding. No sump pump or drainage systems were observed in the crawlspace.

Existence of foundation drainage and its condition is unknown.

FEMA’s National Flood Insurance Program (NFIP) does not recognize dry floodproofing as a means of mitigation for of residential structures and will not impact insurance rates.

**Analysis**

The first floor (the lowest habitable space) of this structure is above the 1% exceedance flood (100 yr) elevation and below the design flood elevation. The 1% exceedance flood (100 yr) elevation approximately 2’- 9” below the first floor. The DFE is approximately 11” above the first floor elevation.

* The low opening (LO) provided has been adjusted base on field observations – 6.62’ NAVD88.

The crawlspace grade/ floor is below both the 1% exceedance flood (100 yr) elevation and the design flood elevation. The 1% exceedance flood (100 yr) elevation is estimated to be approximately 1’- 6” above the crawlspace finish grade/floor. The crawlspace is fully inundated by the DFE.

Though the structure is not in the 1% floodplain, ground water does enter during high water events (per the owner).

Surface water/ storm runoff may be entering the structure through the foundation walls, due to their condition and height relative to finish grade (at certain locations).

This structure could be mitigated, to reduce ground water infiltration, using some basic / minimal actions. Further investigation and analysis may allow dry floodproofing to the top of the masonry foundation wall and higher elevation. [OR]. This structure could be mitigated, to reduce flood risk, by elevation. Elevation is probably not feasible due to strict historical preservation requirements.

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.
1. Basic / Minimal action(s):
   - Maintenance/Repair/rehab/renovate masonry foundation.
   - Inspect and verify sidewalk integrity. Rehab sidewalk to be more impervious with positive drainage if/as necessary. Re-grade around the structure (where feasible) to improve drainage away from structure.
   - Improve ventilation to crawlspace.
   - Install sump pump in crawlspace.
   - Pros/Cons/Relative Cost
     - Pros: Least expensive; Addresses nuisance flooding / ground water infiltration; Passive system.
     - Cons: Minimal flood risk reduction; No insurance rate reduction.
     - Cost Magnitude: Very Low to Low (dependant on actions taken).

2. Dry floodproof to top of masonry foundation wall/low opening (using existing exterior foundation wall as barrier):
   - In addition to Item #1.
   - Investigate and analyze the structural integrity of the foundation wall.
   - Provide crawlspace drainage system and sump pump with emergency power.
   - Pros/Cons/Relative Cost
     - Pros: Minimal expensive; addresses 1% flood event/ nuisance flooding; Passive system.
     - Cons: Minimal flood risk reduction; No insurance rate reduction.
     - Cost Magnitude: Low to Medium (dependant on actions taken).

3. Dry floodproof via temporary barrier to increase reliability:
   - In addition to Item #1 & 2.
   - Use temporary removable barrier (especially at lower areas in the front of the structure).
   - Pros/Cons/Relative Cost.
     - Pros: relatively inexpensive (dependent on barrier type and extent); increased reliability of item #2; Active system (installation/setup required prior to event).
     - Cons: Minimal flood risk reduction; No flood insurance rate reduction.
     - Cost Magnitude: Low to Medium (dependent on barrier type and extent).

4. Elevate (considered, but probably not feasible):
   - Elevate the 1st floor of all or portions of structure above DFE.
   - Pros/Cons/Relative Cost
     - Pros: Maximum flood risk reduction; Might reduce flood insurance rates; Passive system.
     - Cons: Most costly; Impacts structure aesthetics /historic traits.
     - Cost Magnitude: High to very high (dependant on actions taken).
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Structure Information / Data

Name/Description: Gibsons Lodgings
Location: 110 Prince George Street
Use/Occupancy: Residential (Hotel)
No of Stories: 2 ½

Building Construction:
- Exterior Walls: Masonry
- Floor Construction (1st Flr): Wood Frame
- Foundation Wall: Masonry
- Grade/Crawlspace/Basement: Basement (+/- 7.1 ft.)

Structure/Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
<th>Δ DFE-FF</th>
<th>Δ 1%-FG</th>
<th>Δ DFE-FG</th>
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</thead>
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<tr>
<td>4.84’</td>
<td>4.84’</td>
<td>7.34’</td>
<td>2.50’</td>
<td>4.50’</td>
<td>8.20’</td>
<td>-2.84’</td>
<td>0.86’</td>
<td>-0.34’</td>
<td>3.36’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs

South Elevation
Front Entrance
Basement Entrance

Site Visit (Observations/Field Notes)

The structure was viewed / inspected from the exterior and the interior of basement (of the original structure). The property owner was not present for information or comment.

The structure is a masonry (brick) structure on masonry foundation walls (unreinforced brick/stone), with a basement. The masonry foundation is in fair to good condition, requiring some repair/rehab/renovation. The structure and site have been modified over time with upgrades/renovations/additions and fill. Extensive additions have been made at rear of structure.

The first floor is the lowest habitable space.

The basement, below the original structure, is the lowest level and is partially below finish grade. The basement was accessed and observed via exterior stairs at the rear of the structure. The basement floor is a concrete slab. The basement houses the water heater, HVAC and electrical equipment, communications equipment, appliances, utility meters and is also used as a storage space. Field measurements showed the basement floor to be approximately 7’-2” to the underside of the first floor joists. The estimated basement finish floor elevation is approximately 0.65’ NAVD88.
Grade around structure is level perpendicular to structure, drainage away from structure basically neutral. Sidewalk in front of building – brick pavers; poor/fair condition; substrate unknown.

No flood louvers or vents were visible in the foundation walls. Two +/- 2ft x 2ft openings (two) at front of building (coal chutes?) w/ cast iron door/frame, sealed w/sealant. The basement does have several sump pumps.

A high masonry wall (7 – 8 ft.) abuts the structure on right side.

**Analysis**

The first floor (the lowest habitable space) of this structure is above the 1% exceedance flood (100 yr) elevation and below the design flood elevation. The 1% exceedance flood (100 yr) elevation approximately 2’- 10” below the first floor. The DFE is approximately 10” above the first floor elevation.

The basement floor and the basement contents are below both the 1% exceedance flood (100 yr) elevation and the design flood elevation. The 1% exceedance flood (100 yr) elevation is estimated to be approximately 3’- 10” above the basement floor.

Though the structure is not in the 1% floodplain, ground water does enter during high water events.

Surface water/ storm runoff may be entering the structure through the foundation walls, due to their condition and height relative to finish grade (at certain locations).

FEMA’s National Flood Insurance Program (NFIP) does not recognize dry floodproofing as a means of mitigation for of residential structures and will not impact insurance rates.

This structure could be mitigated, to reduce ground water infiltration, using some basic / minimal actions. Further investigation and analysis may allow dry floodproofing of the masonry foundation wall to finish grade. [OR] This structure could be mitigated, to reduce flood risk, using wet floodproofing measures to the underside of the first floor.

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. Basic/ Minimal action(s):
   - Remove and/or relocate some or all contents of basement and above 1% exceedance flood (100 yr) elevation or higher utilizing elevated platforms and space in the first floor (or above).
   - Maintain/Repair/Rehab/Renovate masonry foundation.
   - Investigate and rehab sidewalk and surrounding yard to be more impervious with positive drainage (if needed).
   - Investigate/verify adequacy of basement interior drainage systems(s).
   - Pros/Cons/Relative Cost
     - Pros: Least expensive; Addresses nuisance flooding / ground water infiltration. No impact on contents and use of interior space (basement; Passive system.
2. Dry floodproof the basement to finish grade [or higher if possible] (using existing exterior foundation wall as barrier). The exterior foundation walls could be utilized as a water barrier to dry floodproof the basement to 3 to 4 feet approximately above the basement floor.
   - In addition to Item #1.
   - Investigate and analyze the structural integrity of the foundation wall. Repair/modify as required.
   - Provide with emergency power sump pump (drainage system).
   - Check valve/backflow preventer in building sewer line.
   - Rehab sidewalk and surrounding yard to be more impervious with positive drainage.
   - Break-away panels / flood louvers and vents may be required in exterior foundation walls to prevent structural damage from flood events of high elevations.
   - Pros/Cons/Relative Cost
     - Pros: moderate expensive; Flood risk reduction to 1% flood event/nuisance flooding; little / minimal impact on contents and use of interior space (basement); Passive system.
     - Cons: Minimal flood risk reduction; No insurance rate reduction. May be difficult to implement (many variables/unknowns).
     - Cost Magnitude: Low to Medium (dependant on actions taken).

3. Wet floodproof the basement to the just below first floor joist/construction.
   - Relocate basement contents above DFE, add flood louvers and vents to foundation walls allow basement to flood.
   - Partially fill basement.
   - Pros/Cons/Relative Cost
     - Pros: Most reliable measure; highest level of risk reduction; Passive; Possible flood insurance rate reduction.
     - Cons: Most expensive; Loss of space.
     - Cost Magnitude: Medium (dependant on actions taken).
Structure Information / Data
Name/Description: Middleton Tavern
Location: 2 Market Space
Occupancy type: Restaurant (Assembly)
No of Stories: 2 ½
Building Construction:
  Exterior Walls: Masonry
  Floor Construction (1st Flr): Wood Frame
  Foundation Wall: Masonry
  Grade/Crawlspace/Basement: Crawlspace (*+/- 3 ft.)

Structure Photographs
South Elevation  East Elevation  North Elevation

Structure/Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
<th>Δ DFE-FF</th>
<th>Δ 1%-FG</th>
<th>Δ DFE-FG</th>
</tr>
</thead>
<tbody>
<tr>
<td>*2.73</td>
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<td>4.27’</td>
<td>1.54”</td>
<td>4.50’</td>
<td>8.20’</td>
<td>0.23’</td>
<td>3.93’</td>
<td>1.77’</td>
<td>5.47’</td>
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</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

*See Site Visit and Analysis sections.

Site Visit (Observations/Field Notes)
The structure was observed from the exterior of the building. The property tenant was present for information or comment. Per the property tenant - There is a 3’- 0” crawlspace below first floor. The crawlspace was not accessible and could not be observed.

The structure is a masonry (brick) structure on masonry foundation walls, with a crawlspace. The exterior of the masonry foundations/walls are in poor condition, requiring repair/rehab/renovation. The exterior masonry walls have multiple layers of paint/coating which is in poor to fair condition. Assumption - The structure consist of multiple tenets with party walls separating the adjacent spaces.

The first floor is the lowest habitable space. *The first floor to be approximately 18” to 24” above the finish grade/low ground at the front elevation.

The crawl space was not accessible. The crawlspace is the lowest level and is partially below exterior finish grade. Condition of foundation walls (interior/below grade) is unknown. Assumption -The estimated crawlspace finish grade/floor elevation is approximately 0.44’ NAVD88.
Structure abuts an adjacent structure on one side and open on other side at the rear.

**Analysis**

The first floor (the lowest habitable space) of this structure is below both the 1% exceedance flood (100 yr) elevation and the design flood elevation. The 1% exceedance flood (100 yr) elevation is about 3” above the first floor. The DFE is about 3’-11” above the first floor elevation.

The crawlspace floor is below both the 1% exceedance flood (100 yr) elevation and the design flood elevation. The crawlspace is fully inundated in both cases.

The structure abuts other structures. Coordination and cooperation with the property owners may be required to mitigate structure successfully.

FEMA’s National Flood Insurance Program (NFIP) does recognize dry floodproofing as a means of mitigation for of non-residential structures and may impact insurance rates.

This structure could be mitigated, to reduce ground water infiltration, using some basic / minimal actions. Further investigation and analysis may allow dry floodproofing to the top of the masonry foundation wall, the low opening, and the 1% or higher.

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. **Basic/ Minimal action(s):**
   - Maintenance/Repair/rehab/renovate masonry foundation and exterior wall up to lowest opening (probably first floor door).
   - Investigate and rehab sidewalk and surrounding yard to be more impervious with positive drainage (if needed).
   - Provide crawl space access, drainage with emergency power.
   - Improve ventilation to crawlspace.
   - Elevate HVAC/electrical equipment and storage (interior and exterior) as high as feasibly/reasonably possible.
   - Pros/Cons/Relative Cost
     - Pros: Least expensive; Addresses nuisance flooding; Passive system.
     - Cons: Minimal flood risk reduction; No insurance rate reduction.
     - Cost Magnitude: Very Low to Low (dependant on actions taken).

2. **Dry floodproof to top of masonry foundation wall/low opening (using existing exterior foundation wall as barrier):**
   - In addition to Item #1.
   - Investigate and analyze the structural integrity of the foundation wall. Modify and required.
   - Elevate kitchen equipment, HVAC equipment and electrical panels, storage (interior and exterior) above floor/low opening elevation (and higher if possible)
   - Provide crawlspace drainage system and sump pump with emergency power.
• Provide check valve/backflow preventer on building sewer line (if required).
• Pros/Cons/Relative Cost
  o Pros: Minimal expensive; addresses nuisance flooding to low opening; Passive system.
  o Cons: Minimal flood risk reduction; No insurance rate reduction; May be difficult to implement (many variables/unknowns).
  o Cost Magnitude: Low to Medium (dependant on actions taken).

3. Dry floodproof to 1% (or higher) - In addition to Dry Floodproof to low opening:
• Investigate and analyze the structural integrity of the foundation wall. Modify and required.
• Maintenance/Repair/rehab/renovate masonry foundation and exterior wall up to 1% elevation.
• Provide closures/shields at door openings.
• Pros/Cons/Relative Cost
  o Pros: Flood risk reduction to 1% flood event/nuisance flooding; possible flood insurance rate reduction.
  o Cons: Active system, May be difficult to implement (many variables/unknowns).
  o Cost Magnitude: Medium to High (dependant on actions taken).
4.0 STRUCTURE DATA/ASSESSMENT SHEETS
STRUCTURE #3 - 2 MARKET SPACE (CONTINUED)
Structure Information / Data

Name/Description:  Mills Fine Wines and Spirits
Location:  87 Main Street
Occupancy type:  Retail Store (Mercantile)
No of Stories:  2
Building Construction:
  Exterior Walls:  Masonry
  Floor Construction (1st Flr):  Concrete
  Foundation Wall:  Masonry
  Grade/Crawlspace/Basement:  Grade

Structure/Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
<th>Δ DFE-FF</th>
<th>Δ 1%-FG</th>
<th>Δ DFE-FG</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.50’</td>
<td>3.50’</td>
<td>3.50’</td>
<td>0.00’</td>
<td>4.50’</td>
<td>8.20’</td>
<td>1.00’</td>
<td>4.70’</td>
<td>1.00’</td>
<td>4.70’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs

Front - Looking West
North Elevation
Storefront

Site Visit (Observations/Field Notes)

The structure was observed from the exterior. The property owner/tenant was not present for information or comment.

The structure is a masonry (brick) structure on masonry foundation walls, with a concrete slab on grade first floor. The masonry foundation is below grade and was not visible for observation. The exterior walls are masonry construction and in fair condition, requiring maintenance/repair/rehab/renovation. First floor level fenestration includes aluminum entrance door and aluminum storefront construction on low masonry walls.

The first floor is the lowest habitable space and is level with the exterior grade at the front of the structure.

Structure abuts adjacent structures on both sides and open at rear. The grade at the rear of the building is higher than the front.

Sidewalk in front/sides of building – brick pavers; poor/fair condition; substrate unknown. Grade around structure is level perpendicular to structure, drainage away from structure basically neutral.
Analysis
The first floor (the lowest habitable space) of this structure is below both the 1% exceedance flood (100 yr) elevation and the design flood elevation. The 1% exceedance flood (100 yr) elevation is about 1'-0” above the first floor. The DFE is about 4’-8” above the first floor elevation.

Dry floodproofing up to 3 feet (without structural modifications) may be feasible.

The structure abuts other structures. Coordination and cooperation with the property owners may be required to mitigate structure successfully.

FEMA’s National Flood Insurance Program (NFIP) does recognize dry floodproofing as a means of mitigation for of non-residential structures and may impact insurance rates.

This structure could be mitigated, to reduce flood risk, using dry flood proofing measures to the 1% flood and possibility higher (up to 3’-0” above the finished floor) on the masonry wall, but below the DFE. Further investigation and analysis may allow dry floodproofing to a higher elevation (above the 1% flood).

Recommendations
The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. Basic/ Minimum Action(s):
   - Elevate HVAC equipment and electrical panels, retail items and inventory (and other?) as necessary above floor elevation as high as feasibly possible.
   - Dry floodproof individual interior areas/rooms.
   - Pros/Cons/Relative Cost
     o Pros: Least expensive; addresses nuisance flooding; Passive system.
     o Cons: Minimal flood risk reduction; No insurance rate reduction.
     o Cost Magnitude: Very Low to Low (dependant on actions taken).

2. Dry floodproof to 1% :
   - Investigate and analyze the structural integrity of the foundation wall. Modify and required.
   - Maintenance/repair/rehab/renovate masonry foundation and exterior wall up to 1% elevation. Repair/modify as required.
   - Inspect and verify sidewalk integrity. Rehab sidewalk to be more impervious with positive drainage if/as necessary.
   - Provide interior drainage and sump pump with emergency power.
   - Provide check valve/backflow preventer on building sewer line.
   - Provide closures/shields at door openings.
   - Pros/Cons/Relative Cost
     o Pros: Flood risk reduction to 1% flood event/ nuisance flooding; possible flood insurance rate reduction.
     o Cons: Active system, May be difficult to implement (many variables/unknowns).
     o Cost Magnitude: Low to Medium to High (dependant on actions taken).
3. Dry floodproof to 3’ above finished grade/floor:
   - In addition to item #2.
   - Investigate and analyze the structural integrity of the foundation wall. Modify and required.
   - Maintenance/repair/rehab/renovate masonry foundation and exterior wall up to 3’ above finished grade/floor.
   - Modify storefront construction/windows openings to include structural glassing or shields/closures.
   - Provide closures/shields at door
     - Pros: Highest level of flood risk reduction; possible flood insurance rate reduction.
     - Cons: Active system, May be difficult to implement (many variables/unknowns).
     - Cost Magnitude: Medium to High (dependant on actions taken).
Structure Information / Data

Name/Description: Donner Office Building
Location: 91 Main Street
Occupancy type: Office Building (Business)
No of Stories: 4
Building Construction:
- Exterior Walls: Masonry
- First Floor: Concrete
- Foundation Wall: Masonry
- Grade/Crawlspace/Basement: Grade

Structure/Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
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<td>8.20’</td>
<td>0.58’</td>
<td>4.28’</td>
<td>0.58’</td>
<td>4.28’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs

Front - Looking West  North Elevation  Storefront  Alley

Site Visit (Observations/Field Notes)

The structure was observed from the exterior. The property owner/tenant was not present for information or comment.

The structure is a masonry (brick) structure on masonry foundation walls, with a concrete slab on grade first floor. The masonry foundation is below grade and was not visible for observation. The exterior walls are masonry construction and in fair condition, requiring maintenance/repair/rehab/renovation. First floor level fenestration includes aluminum entrance door and aluminum storefront construction on low masonry walls.

The first floor is the lowest habitable space and is level with the exterior grade at the front of the structure.

Structure abuts adjacent structure one sides and opens at other side and rear. The grade at the rear of the building in high than the front.

Sidewalk in front/sides of building – brick pavers; poor/fair condition; substrate unknown. Grade around structure is level perpendicular to structure, drainage away from structure basically neutral.
Analysis
The first floor (the lowest habitable space) of this structure is below both the 1% exceedance flood (100 yr) elevation and the design flood elevation. The 1% exceedance flood (100 yr) elevation is about 7” above the first floor. The DFE is about 4’-3” above the first floor elevation.

Dry floodproofing up to 3 feet (without structural modifications) may be feasible.

Structure abuts adjacent structures on both sides and open at rear. The grade at the rear of the building is higher than the front.

FEMA’s National Flood Insurance Program (NFIP) does recognize dry floodproofing as a means of mitigation for non-residential structures and may impact insurance rates.

This structure could be mitigated, to reduce flood risk, using dry floodproofing measures to the 1% flood and possibility higher (up to 3’-0” above the finished floor) on the masonry wall, but below the DFE. Further investigation and analysis may allow dry floodproofing to a higher elevation (above the 1% flood).

Recommendations
The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be taken to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. Basic/ Minimum Action(s):
   • Elevate HVAC equipment and electrical panels and first floor contents as necessary above floor elevation as high as feasibly possible.
   • Dry floodproof individual interior areas/rooms.
   • Pros/Cons/Relative Cost
     o Pros: Least expensive; Addresses nuisance flooding; Passive system.
     o Cons: Minimal flood risk reduction; No insurance rate reduction.
     o Cost Magnitude: Very Low to Low (dependant on actions taken).

2. Dry floodproof to 1% :
   • Investigate and analyze the structural integrity of the foundation wall. Modify and required.
   • Maintenance/repair/rehab/renovate masonry foundation and exterior wall up to 1% elevation. Repair/modify as required.
   • Inspect and verify sidewalk integrity. Rehab sidewalk to be more impervious with positive drainage if/as necessary.
   • Provide interior drainage and sump pump with emergency power.
   • Provide check valve/backflow preventer on building sewer line.
   • Provide closures/shields at door openings.
   • Pros/Cons/Relative Cost
     o Pros: Flood risk reduction to 1% flood event/ nuisance flooding; possible flood insurance rate reduction.
     o Cons: Active system, May be difficult to implement (many variables/unknowns).
     o Cost Magnitude: Low to Medium to High (dependant on actions taken).
3. Dry floodproof to 3’ above finished grade/floor:
   - In addition to item #2.
   - Investigate and analyze the structural integrity of the foundation wall. Modify and required.
   - Maintenance/repair/rehab/renovate masonry foundation and exterior wall up to 3’ above finished grade/floor.
   - Modify storefront construction/windows openings to include structural glassing or shields/closures.
   - Provide closures/shields at door
     - Pros: Highest level of flood risk reduction; possible flood insurance rate reduction.
     - Cons: Active system, May be difficult to implement (many variables/unknowns).
     - Cost Magnitude: Medium to High (dependant on actions taken).
Structure Information / Data

Name/Description: Storm Brothers
Location: 130 Dock Street
Occupancy type: Restaurant (Assembly)
No of Stories: 1
Building Construction:
  Foundation Wall: Masonry
  Exterior Walls: Masonry
  Floor Construction (1st Flr): Concrete
  Grade/Crawlspace/Basement: Grade

Structure/Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
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<td>2.44’</td>
<td>6.14’</td>
<td>2.44’</td>
<td>6.14’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs

Site Visit (Observations/Field Notes)

The structure was observed from the exterior. The property owner/tenant was not present for information or comment.

The structure is a masonry (brick) structure on masonry foundation walls, with a concrete slab on grade first floor. The masonry foundation is below grade and was not visible for observation. The exterior walls are masonry construction and in good condition, requiring minor maintenance. Building fenestration includes wood entrance door and windows.

The first floor is the lowest habitable space and is level with the exterior grade at the front of the structure.

Structure abuts adjacent structure both sides and open at other side and rear. The rear of the structure was not accessible for observation. Assumption – Grade at rear of structure is at similar elevation as front.

Sidewalk in front/sides of building – brick pavers; poor/fair condition; substrate unknown. Grade around structure is level perpendicular to structure, drainage away from structure basically neutral.
Analysis
The first floor is the lowest level and the lowest habitable space. The first floor elevation is below the 1% exceedance flood (100 yr) and the design flood elevation.

The 1% exceedance flood (100 yr) elevation is about 2’-5” above the first floor. The DFE is about 6’-2” above the first floor.

Dry floodproofing up to 3 feet (without structural modifications) may be feasible.

The structure abuts other structures. Coordination and cooperation with the property owners may be required to mitigate structure successfully.

FEMA’s National Flood Insurance Program (NFIP) does recognize dry floodproofing as a means of mitigation for of non-residential structures and may impact insurance rates.

This structure could be mitigated, to reduce flood risk, using dry flood proofing measures to the 1% flood and possibility higher (up to 3’-0” above the finished floor) on the masonry wall, but below the DFE. Further investigation and analysis may allow dry floodproofing to a higher elevation (above the 1% flood).

Recommendations
The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommended mitigation measures may reduce flood insurance rates.

1. Basic/ Minimum Action(s):
   • Elevate HVAC equipment and electrical panels and first floor contents as necessary above floor elevation as high as feasibly possible.
   • Dry floodproof individual interior areas/rooms.
   • Pros/Cons/Relative Cost
     o Pros: Least expensive; addresses nuisance flooding; Passive system.
     o Cons: Minimal flood risk reduction; No insurance rate reduction.
     o Cost Magnitude: Very Low to Low (dependant on actions taken).

2. Dry floodproof to 1% :
   • Investigate and analyze the structural integrity of the foundation wall. Modify and required.
   • Maintenance/repair/rehab/renovate masonry foundation and exterior wall up to 1% elevation. Repair/modify as required.
   • Inspect and verify sidewalk integrity. Rehab sidewalk to be more impervious with positive drainage if/as necessary.
   • Provide interior drainage and sump pump with emergency power.
   • Provide check valve/backflow preventer on building sewer line.
   • Provide closures/shields at door openings.
   • Pros/Cons/Relative Cost
     o Pros: Flood risk reduction to 1% flood event/ nuisance flooding; possible flood insurance rate reduction.
3. Dry floodproof to 3’ above finished grade/floor:
   • In addition to item #2.
   • Investigate and analyze the structural integrity of the foundation wall. Modify and required.
   • Maintenance/repair/rehab/renovate masonry foundation and exterior wall up to 3’ above finished grade/floor.
   • Modify storefront construction/windows openings to include structural glassing or shields/closures.
   • Provide closures/shields at door
     o Pros: Highest level of flood risk reduction – including 1% flood event/nuisance flooding; possible flood insurance rate reduction.
     o Cons: Active system, May be difficult to implement (many variables/unknowns).
     o Cost Magnitude: Medium to High (dependant on actions taken).
Structure Information / Data
Name/Description: Fleet Street Row House
Location: 12 Fleet Street
Occupancy type: Residential (Two-Family Dwelling)
No of Stories: 2
Building Construction:
  Exterior Walls: Wood Frame
  Floor Construction (1st Flr): Wood Frame
  Foundation: Masonry
  Grade/Crawlspace/Basement: Crawlspace (*+/− 3 ft.)

Structure/Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
<th>Δ DFE-FF</th>
<th>Δ 1%-FG</th>
<th>Δ DFE-FG</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.19’</td>
<td>9.61’</td>
<td>9.61’</td>
<td>2.42’</td>
<td>4.50’</td>
<td>8.20’</td>
<td>-5.11’</td>
<td>-1.41’</td>
<td>-2.69’</td>
<td>1.01’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs

Front - Looking East
South Elevation
South Elevation – Close-up

Site Visit (Observations/Field Notes)
The structure was observed from the exterior of the building. The property owner was not present for information or comment.

The structure is a wood framed structure on masonry foundation walls, with a crawlspace. Masonry foundation is in good condition.

The first floor is the lowest habitable space.

Crawl space was not accessible. The crawlspace is the lowest level and is partially below exterior finish grade. The height of the crawlspace and condition of foundation walls (interior/below grade) is unknown.

Grade around structure is drained away from the structure. Sidewalk in front of building – brick pavers; good condition; substrate unknown.

No flood louvers or vents were visible in the foundation walls.
The rear of the structure was not accessible for observation.

**Analysis**

The first floor (the lowest habitable space) of this structure is above both the 1% exceedance flood (100 yr) elevation and the design flood elevation. The 1% exceedance flood (100 yr) elevation is 5’- 1” below the first floor. The DFE is 1’- 5” below the first floor elevation.

FEMA’s National Flood Insurance Program (NFIP) does not recognize dry floodproofing as a means of mitigation for of residential structures and will not impact insurance rates.

Because this is a duplex with adjoins structure and party wall, successful mitigation may require both duplex property owners to coordinate/cooperate mitigation together.

This structure could be mitigated, to reduce flood risk, using wet floodproofing measures to the DFE.

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. **Basic/ Minimum Action(s):**
   - Elevate exterior HVAC equipment above DFE.
   - Wet floodproof crawlspace - Flood louvers/vents in foundation wall.
   - Pros/Cons/Relative Cost
     - Pros: Minimal Expense; Passive system.
     - Cons: No insurance rate reduction.
     - Cost Magnitude: Very Low (dependant on actions taken).
Structure Information / Data
Name/Description: Historic Annapolis Museum
Location: 99 Main Street
Occupancy type: Retail Store (Mercantile)
No of Stories: 3 ½
Building Construction:
  - Exterior Walls: Masonry
  - First Floor: Concrete
  - Foundation Wall: Masonry
  - Grade/Crawlspace/Basement: Grade

Structure/Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
<th>Δ DFE-FF</th>
<th>Δ 1%-FG</th>
<th>Δ DFE-FG</th>
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<tr>
<td>4.28’</td>
<td>5.11’</td>
<td>5.11’</td>
<td>0.83’</td>
<td>4.50’</td>
<td>8.20’</td>
<td>-0.61’</td>
<td>3.09’</td>
<td>0.22’</td>
<td>3.92’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs

North Elevation  Front - Looking East  Alley  Detail

Site Visit (Observations/Field Notes)
The structure was observed from the exterior and interior. The property tenant was present for information or comment.

The structure is a masonry (brick) structure on masonry foundation walls, with a concrete slab on grade first floor. The masonry foundation is below grade and was only partially visible for observation from the exterior. The exterior walls are masonry construction and in fair condition, requiring minor maintenance/repair/rehab/renovation. Lower level fenestration includes wood entrance doors and windows.

The first floor is about 10” above exterior grade at the front of the structure. The grade rises toward the rear of the structure.

Structure is freestanding on the front and sides and partially abuts another structure at the rear. The grade at the rear of the building is higher than the front.

Sidewalk in front and at sides of building – brick pavers; poor/fair condition; substrate unknown.
Analysis

The first floor is the lowest level and the lowest habitable space. The first floor elevation is above the 1% exceedance flood (100 yr) and below the design flood elevation.

The 1% exceedance flood (100 yr) elevation is about 7” below the first floor. The DFE is about 3’-0” above the first floor.

Dry floodproofing up to 3 feet (without structural modifications) may be feasible.

The structure/property abuts other structures. Coordination and cooperation with the property owners may be required to mitigate structure successfully.

FEMA’s National Flood Insurance Program (NFIP) does recognize dry floodproofing as a means of mitigation for non-residential structures and may impact insurance rates.

This structure may be able to be mitigated, to reduce flood risk, using dry flood proofing measures up to 3’-0” (the DFE) above the finished floor on the masonry exterior walls. Further investigation and analysis will be required.

Recommendations

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. Basic/ Minimum Action(s):
   - Elevate HVAC equipment and electrical panels, retail items and inventory (and other?) as necessary above floor elevation as high as feasibly possible.
   - Dry floodproof individual interior areas/rooms.
   - Pros/Cons/Relative Cost
     - Pros: Least expensive; Addresses nuisance flooding; Passive system.
     - Cons: Minimal flood risk reduction; No insurance rate reduction.
     - Cost Magnitude: Very Low to Low (dependant on actions taken).

2. Dry floodproof to 3’ above finished grade/floor:
   - Maintenance/repair/rehab/renovate masonry foundation and exterior wall up to 3’ above finished grade/floor. Repair/modify as required.
   - Modify storefront construction/windows openings to include shields/closures.
   - Install closure/shield in alley (connecting to Donner Office building). Or elevate HVAC equipment and electrical panels, retail items and inventory (and other?) as necessary above DFE.
   - Provide closures/shields at doors.
     - Pros: Highest level of flood risk reduction.
     - Cons: Active system, May be difficult to implement (many variables/unknowns).
     - Cost Magnitude: Medium to High (dependant on actions taken).
Structure Information / Data
Name/Description: Shipwright Street Pumping Station
Location: Shipwright Street and Spa Creek
Occupancy type: Pumping Station (Industrial)
No of Stories: 1
Building Construction:
Exterior/Interior Walls: Masonry
Floor Construction (1st Flr): Concrete (elevated structural slab)
Foundation: Concrete
Grade/Crawlspace/Basement: Basement (Estimated +/- 8 ft.)

Structure/Flood Elevations Table
<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
<th>Δ DFE-FF</th>
<th>Δ 1%-FG</th>
<th>Δ DFE-FG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.47’</td>
<td>2.72’</td>
<td>6.02’</td>
<td>3.55’</td>
<td>4.50’</td>
<td>8.20’</td>
<td>-1.52’</td>
<td>2.18’</td>
<td>2.03’</td>
<td>5.73’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs
North & East Elevations
East & South Elevations
South Entrance Close-up

Site Visit (Observations/Field Notes)
The structure was observed from the exterior. The property owner was not present for information or comment.

The structure is a masonry (brick) structure on concrete foundation walls, with a concrete basement and first floors. The concrete foundation wall was in good condition. The exterior walls are masonry construction and in poor condition. The structure fenestrations include wood doors and metal windows.

The first floor is about 3’-6” above exterior grade around the entire structure. The basement floor is estimated 8’- 0” below the first floor. The basement houses pumping station equipment.

The structure is free standing.

The structure is a state of disrepair. Masonry walls are cracked / failing.

Sidewalk in front and side of structure –concrete and asphalt paving – good condition; substrate unknown.
Grade around structure is level perpendicular to structure, drainage away from structure basically neutral.

**Analysis**

The basement floor is the lowest level and the lowest habitable space. The basement floor elevation is below the 1% exceedance flood (100 yr) and below the design flood elevation.

The 1% exceedance flood (100 yr) elevation is about 1’- 6” below the first floor and an estimated 6’-6” above the basement floor. The DFE is about 2’- 2” above the first floor (basement fully inundated).

Dry floodproofing up to 3 feet (without structural modifications) may be feasible. Structure may have been designed for to reduce flood risk to the top of the concrete foundation wall. Additional design and structural analysis will be required to determine max dry floodproofing height allowed on this structure.

FEMA’s National Flood Insurance Program (NFIP) does recognize dry floodproofing as a means of mitigation for of non-residential structures and may impact insurance rates.

This structure may be able to be mitigated, to reduce flood risk, using dry floodproofing measures to the 1% flood and possibility higher on the masonry wall, to the DFE. Further investigation and analysis will be required.

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. **Basic/ Minimum Action(s):**
   - Elevate equipment and electrical panels (and other?) as necessary above floor elevation as high as feasibly possible. Provide access platform.
   - **Pros/Cons/Relative Cost**
     - Pros: Minimal Expense; Passive system.
     - Cons: No insurance rate reduction.
     - Cost Magnitude: Low to Medium (dependant on actions taken).

2. **Dry floodproof to 1%  (In addition to Item #1):**
   - In addition to Item #1
   - Investigate and analyze the structural integrity of the foundation wall.
   - Maintenance/repair/rehab/renovate concrete foundation/exterior wall up to 1% elevation.
   - Check structure buoyancy.
   - Provide interior drainage and sump pump with emergency power.
     - Pros: Flood risk reduction to 1% flood event/ nuisance flooding; possible flood insurance rate reduction. Passive system.
     - Cons: May be difficult to implement (many variables/unknowns).
     - Cost Magnitude: Low to Medium to High (dependant on actions taken).

3. **Dry floodproof to 3’ above finished floor (first floor):**
   - In addition to Items #1 & 2.
   - Investigate and analyze the structural integrity of the masonry wall.
• Maintenance/repair/rehab/renovate exterior masonry wall.
• Check structure buoyancy.
• Provide closures/shields at doors.
  o Pros: Highest level of flood risk reduction;
  o Cons: Active system, May be difficult to implement (many variables/unknowns).
  o Cost Magnitude: Medium to High to Very High (dependant on actions taken).
Structure Information / Data
Name/Description: Annapolis Recreation Center
Location: 9 St. Mary’s Street
Occupancy type: Business (Recreation)
No of Stories: 2
Building Construction:
   Exterior Walls: Masonry
   Floor Construction (1st Flr): Concrete
   Foundation: Concrete
   Grade/Crawlspace/Basement: Grade

Structure/Flood Elevations Table
<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
<th>Δ DFE-FF</th>
<th>Δ 1%-FG</th>
<th>Δ DFE-FG</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.03’</td>
<td>7.66’</td>
<td>7.66’</td>
<td>3.63’</td>
<td>4.50’</td>
<td>8.20’</td>
<td>-3.16’</td>
<td>0.54’</td>
<td>0.47’</td>
<td>4.17’</td>
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</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs

Site Visit (Observations/Field Notes)
The structure was observed from the exterior. The property tenant was not present for information or comment.

The structure is a masonry (brick) structure on concrete foundation walls, with a concrete slab on grade first floor. The concrete foundation wall was in good condition. The exterior walls are masonry construction and in good condition. Lower level fenestration includes wood entrance doors and windows.

The structure is free standing.

Sidewalk in front and rear of structure – concrete/ asphalt paving – good condition; substrate unknown. Grade around structure is level perpendicular to structure, drainage away from structure basically neutral.

Analysis
The first floor is the lowest level and the lowest habitable space. The first floor elevation is above the 1% exceedance flood (100 yr) and below the design flood elevation.
The 1% exceedance flood (100 yr) elevation is about 3’- 2” below the first floor. The DFE is about 6” above the first floor.

Dry floodproofing up to 3 feet above the first floor elevation (without structural modifications) may be feasible.

FEMA’s National Flood Insurance Program (NFIP) does recognize dry floodproofing as a means of mitigation for of non-residential structures and may impact insurance rates.

This structure could be mitigated, to reduce flood risk, using dry floodproofing measures to the DFE.

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. Basic/ Minimum Action(s):
   - Elevate HVAC equipment and electrical panels and first floor contents as necessary above floor elevation as high as feasibly possible (to the DFE).
   - Dry floodproof individual interior areas/rooms (to the DFE).
   - Pros/Cons/Relative Cost
     - Pros: Passive system.
     - Cons: Minimal flood risk reduction; No insurance rate reduction.
     - Cost Magnitude: Low to Medium (dependant on actions taken).

2. Dry floodproof to 3’ above finished floor :
   - Investigate and analyze the structural integrity of the concrete foundation wall and the exterior masonry wall.
   - Maintenance/repair/rehab/renovate the concrete foundation wall and the exterior masonry wall as required.
   - Inspect and verify sidewalk integrity. Rehab sidewalk to be more impervious with positive drainage if/as necessary.
   - Provide interior drainage and sump pump with emergency power.
   - Provide check valve/backflow preventer on building sewer line.
   - Provide closures/shields at door openings
   - Pros/Cons/Relative Cost
     - Pros: Highest level of flood risk reduction - flood risk reduction to the DFE; Possible flood insurance rate reduction.
     - Cons: Active system, May be difficult to implement (many variables/unknowns).
     - Cost Magnitude: Medium to High (dependant on actions taken).
Structure Information / Data
Name/Description: AL Goodman Building
Location: 100 Main Street
Occupancy type: Retail Store(s) (Mercantile)
No of Stories: 2

Building Construction:
  Exterior Walls: Masonry
  Floor Construction (1st Flr): Concrete
  Foundation: Masonry
  Grade/Crawlspace/Basement: Grade

Structure/Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
<th>Δ DFE-FF</th>
<th>Δ1%-FG</th>
<th>Δ DFE-FG</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.24'</td>
<td>5.74'</td>
<td>5.74'</td>
<td>0.50'</td>
<td>4.50'</td>
<td>8.20'</td>
<td>-1.24'</td>
<td>2.46'</td>
<td>-0.74'</td>
<td>2.96'</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs

South Elevation

East Elevation

Site Visit (Observations/Field Notes)
The structure was observed from the exterior and interior. The property owner/tenant was present for information or comment. Access was provided to the rear of the structure.

The structure is a masonry (brick) structure on masonry foundation walls, with a concrete slab on grade first floor. The masonry foundation is below grade and not visible for observation. The exterior walls are masonry construction and in good condition. Lower level fenestration includes aluminum entrance door and aluminum storefront construction on low masonry walls. The first floor level has a high ceiling.

An electrical room was located at the rear of the structure. The electrical room floor elevation was lower than the first floor. Also observed sump pit at same location.

The first floor is about 6” to 1’ above exterior grade at the two front of the structure. The grade rises from Market Square to Main Street. The grade at the rear of the structure is much higher than the front. There are high ceiling on the first floor level.

Structure abuts adjacent structures on both sides and open at rear.
Sidewalk in front/sides of building – brick pavers; poor/fair condition; substrate unknown.

Multiple tenants occupy the structure.

**Analysis**

The first floor is the lowest level and the lowest habitable space. The first floor elevation is above the 1% exceedance flood (100 yr) and below the design flood elevation.

The 1% exceedance flood (100 yr) elevation is approximately 1’-3” below the first floor. The DFE is approximately 2’-5” above the first floor.

The structure abuts other structures. Coordination and cooperation with the property owners may be required to mitigate structure successfully.

Dry floodproofing up to 3 feet (without structural modifications) may be feasible.

FEMA’s National Flood Insurance Program (NFIP) does recognize dry floodproofing as a means of mitigation for non-residential structures and may impact insurance rates.

This structure may be able to be mitigated, to reduce flood risk, using dry flood proofing measures up to 3’-0” above the finished floor on the masonry exterior walls. Further investigation and analysis will be required.

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be taken to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. **Basic/ Minimum Action(s):**
   - Elevate HVAC equipment and electrical panels, retail items and inventory (and other?) as necessary above floor elevation as high as feasibly possible.
   - Dry floodproof individual interior areas/rooms.
   - Pros/Cons/Relative Cost
     - Pros: Least expensive; Addresses nuisance flooding; Passive system.
     - Cons: Minimal flood risk reduction; No insurance rate reduction.
     - Cost Magnitude: Very Low to Low (dependant on actions taken).

2. **Dry floodproof to DFE (2’- 5”)** above finished floor (first floor):
   - Maintain/repair/rehab/renovate masonry foundation and exterior wall up to 3’ above finished grade/floor. Repair/modify as required.
   - Modify storefront construction/windows openings to include shields/closures.
   - Provide closures/shields at door and modify storefront construction/windows openings to include structural glassing or shields/closures.
     - Pros: Highest level of flood risk reduction.
     - Cons: Active system, May be difficult to implement (many variables/unknowns).
     - Cost Magnitude: Medium to High to very High (dependant on actions taken).
Structure Information / Data

Name/Description: Sophie’s Crepes
Location: 1 Craig Street
Occupancy type: Restaurant (Assembly)
No of Stories: 2 ½

Building Construction:
- Exterior Walls: Wood Frame
- Floor Construction (1st Flr): Wood Frame
- Foundation: Masonry
- Grade/Crawlspace/Basement: Grade

Structure/Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
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</thead>
<tbody>
<tr>
<td>2.99’</td>
<td>2.99’</td>
<td>3.67’</td>
<td>0.68’</td>
<td>4.50’</td>
<td>8.20’</td>
<td>0.83’</td>
<td>4.53’</td>
<td>1.51’</td>
<td>5.21’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ -Delta/Difference

Structure Photographs

North & West Elevations
West & South Elevations
Close-up at Sill

Site Visit (Observations/Field Notes)

The structure was observed from the exterior. The property owner was not present, but a person who’s worked on the structure was present and offered information and comment. Per the person – The building has significant structural issues due to termite damage and rot of wood floor and wall construction. Extensive work has been done to repair and maintain the structure.

The structure is a wood framed structure on masonry foundation walls (brick), with no crawlspace. The first floor is constructed just above grade with a minimal airspace between the floor joist and the grade. The Masonry foundation was not visible for inspection.

The first floor is the lowest level and the lowest habitable space. The first floor elevation is below the 1% exceedance flood (100 yr) and the design flood elevation.

The structure is freestanding, open on all sides. Gravel parking lot on side.

Grade around structure is level perpendicular to structure, drainage away from structure basically neutral. Significant termite/rot damage was observed at the perimeter joist. Siding was in poor condition.
Analysis
The first floor is the lowest level and the lowest habitable space. The first floor elevation is below the 1% exceedance flood (100 yr) and the design flood elevation.

The 1% exceedance flood (100 yr) elevation is about 10” above the first floor. The DFE is about 4’-6” above the first floor.

The structural integrity of the structure is questionable. Mitigating the structure in its current condition is not feasible. Additionally the soil types/characteristics adjacent to the structure are unknown. If the structure were in sound structural condition and soil type/characteristics are suitable, it could be mitigated, to reduce flood damages using dry floodproofing. Elevation may also physically feasible, but probably not acceptable due to strict historical preservation requirements.

Recommendations
The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

There are no viable measures to mitigate this structure in its current condition, to reduce flood risk. If the structure were repaired and rehabilitated to correct structural integrity issues, measures may feasible to be implemented. Note; if actions are taken to repair/rehab the structure, some of the recommended risk reduction measure may be able to be incorporated in part or in full during the renovation work.

1. Dry floodproof the structure with a temporary barrier (3 feet max above the grade).
   - Investigate adjacent soil type/characteristics. Modified as required.
   - Provide sump pump with emergency power.
   - Pros/Cons/Relative Cost
     - Pros: Flood risk reduction to 1% flood event/ nuisance flooding; possible flood insurance rate reduction.
     - Cons: Active system; probably no flood insurance reduction; May be difficult to implement (many variables/unknowns).
     - Cost Magnitude: Low to Medium to High (dependant on actions taken).

2. Dry floodproof with a permanent barrier (3 feet max above the grade/foundation). This may be incorporated during repair and rehabilitation of the structure.
   - Investigate adjacent soil type/characteristics. Modified as required.
   - Provide sump pump with emergency power.
   - Pros/Cons/Relative Cost
     - Pros: Flood risk reduction to 1% flood event/ nuisance flooding; possible flood insurance rate reduction.
     - Cons: Expensive, Active system; May impact structure aesthetics/historic traits. May be difficult to implement (many Variables/unknowns); Possible flood insurance reduction.
     - Cost Magnitude: High (dependant on actions taken).
3. Elevate (considered, but probably not feasible because of historic preservation restrictions and impact to the historic building traits):
   - Elevate all or portions of structure above DFE.
   - Pros/Cons/Relative Cost
     - Pros: Maximum flood risk reduction; Might reduce flood insurance rates; Passive system.
     - Cons: Very expensive; Impacts structure aesthetics/historic traits.
     - Cost Magnitude: High to very high (dependant on actions taken)
ANNAPOLIS, MARYLAND - HISTORIC DISTRICT – NONSTRUCTURAL ASSESSMENT SAMPLING

4.0 STRUCTURE DATA/ASSESSMENT SHEETS  
STRUCTURE #13 - 141-143 COMPROMISE STREET

Structure Information / Data
Name/Description:  Annapolis Summer Garden Theatre  
Location:  141-143 Compromise Street  
Occupancy type:  Theater (Assembly)  
No of Stories:  2 ½  
Building Construction:  
Exterior Walls:  Masonry…………………………….
Floor Construction (1st Flr): Concrete…………………………....
Foundation:  Masonry…………………………….
Grade/Crawlspace/Basement: Grade…………………………….

Structure/Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
<th>Δ DFE-FF</th>
<th>Δ 1%-FG</th>
<th>Δ DFE-FG</th>
</tr>
</thead>
<tbody>
<tr>
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<td>3.83’</td>
<td>0.91’</td>
<td>4.50’</td>
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<td>0.67’</td>
<td>4.37’</td>
<td>1.58’</td>
<td>5.28’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs

Site Visit (Observations/Field Notes)
The structure was observed from the exterior and interior. The property tenant was present for information or comment.

The property is composed of a structure, a partially walled courtyard at the front and a high walled theater area at the rear. The structure is a masonry (brick) structure on masonry foundation walls, with a concrete slab on grade first floor, with a wood framed addition on masonry foundation walls (brick), with no crawlspace. The addition first floor is constructed just above grade with a minimal airspace between the floor joist and the grade. The Masonry foundation was not visible for inspection. The masonry foundation is below grade and was only partially visible for observation from the exterior. The exterior walls are in good condition. Lower level fenestration includes wood entrance doors and windows.

The courtyard is walled by masonry in the front and concrete retaining wall on the right side (ownership unknown).

The theater is walled by masonry retaining walls at the right side and rear and a freestanding masonry wall on the left side.
The property and structure and site have been modified over time with upgrades/renovations/additions.

The first floor is about 11” above exterior grade at the front of the structure.

Structure is freestanding. The grade at the right side and rear of the property in higher than the front.

Sidewalk in front/sides of building – Concrete and brick pavers; good condition; substrate unknown. Grade around structure is level perpendicular to structure, drainage away from structure basically neutral.

**Analysis**

The first floor is the lowest level and the lowest habitable space. The first floor elevation is below the 1% exceedance flood (100 yr) and below the design flood elevation.

The 1% exceedance flood (100 yr) elevation is about 8” above the first floor. The DFE is about 4’-4” above the first floor.

The existing retaining walls abut other properties. Coordination and cooperation with the property owners may be required to mitigate structure successfully.

Dry floodproofing up to 3 feet (without structural modifications) may be feasible.

FEMA’s National Flood Insurance Program (NFIP) does recognize dry floodproofing as a means of mitigation for of non-residential structures and may impact insurance rates.

This structure could be mitigated, to reduce flood risk, using a combination dry flood proofing measures with floodwalls to the 1% flood and possibility higher (3’-0” above the finished floor) on the masonry wall, but below the DFE. Further investigation and analysis may allow dry floodproofing to a higher elevation (above the 1% flood).

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. **Basic/ Minimum Action(s):**
   - Elevate HVAC equipment and electrical panels, building contents (and other?) as necessary above floor elevation as high as feasibly possible.
   - Dry floodproof individual interior areas/rooms.
   - Pros/Cons/Relative Cost
     - Pros: Least expensive; Addresses nuisance flooding; Passive system.
     - Cons: Minimal flood risk reduction; No insurance rate reduction.
     - Cost Magnitude: Very Low to Low (dependant on actions taken).

2. **Dry floodproof to 1%:**
   - Maintenance/repair/rehab/renovate masonry foundation and exterior wall up to 1% elevation.
   - Investigate and analyze the structural integrity of the foundation wall. Repair/modify as required.
4.0 STRUCTURE DATA/ASSESSMENT SHEETS
STRUCTURE #13 - 141-143 COMPROMISE STREET (CONTINUED)

- Inspect and verify sidewalk integrity. Rehab sidewalk to be more impervious with positive drainage if/as necessary.
- Provide interior drainage system and sump pump with emergency power.
- Provide check valve/backflow preventer on building sewer line.
- Provide closures/shields at door openings in the structure and openings the masonry wall at the courtyard.
- Pros/Cons/Relative Cost
  - Pros: Flood risk reduction to 1% flood event/ nuisance flooding; possible flood insurance rate reduction.
  - Cons: Active system, May be difficult to implement (many variables/unknowns).
  - Cost Magnitude: Low to Medium to High (dependant on actions taken).

3. Dry floodproof to 3’ above finished floor (first floor):
- In addition to Item #2.
- Pros/Cons/Relative Cost
  - Pros: Highest level of flood risk reduction; possible flood insurance rate reduction.
  - Cons: Active system, May be difficult to implement (many variables/unknowns).
  - Cost Magnitude: Medium to High (dependant on actions taken).

4. Dry floodproof wood framed portion of structure with temporary barrier (3 feet max above the grade). Pros/Cons/Relative Cost
- Pros: Addresses entire structure; possible flood insurance rate reduction.
  - Cons: Active system, May be difficult to implement (many variables/unknowns).
  - Cost Magnitude: Medium to High (dependant on actions taken).
Structure Information / Data
Name/Description: Conduit Street Duplex/Residence
Location: 63 Conduit Street
Occupancy type: Residential (Two-Family Dwelling)
No of Stories: 2 ½
Building Construction:
  Exterior Walls: Wood Frame
  Floor Construction (1st Flr): Wood Frame
  Foundation: Masonry
  Grade/Crawlspace/Basement: Basement* (Estimated +/- 7 ft.)

Structure/Flood Elevations Table
<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
<th>Δ DFE-FF</th>
<th>Δ 1%-FG</th>
<th>Δ DFE-FG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2'</td>
<td>2.49'</td>
<td>8.52'</td>
<td>5.75'</td>
<td>4.50'</td>
<td>8.20'</td>
<td>-4.02'</td>
<td>-0.32'</td>
<td>2.30'</td>
<td>6.00'</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

Structure Photographs

Site Visit (Observations/Field Notes)
The structure was observed from exterior only (at a distance). Assumptions were made based on inspection of similar adjacent structures (65 Conduit St.) and discussion with property owner of same. The property owner was not present / available for information or comment. Basement floor elevation not provide/available.

The structure is a wood framed structure on masonry foundation walls (unreinforced brick), with a basement. The structure is a duplex w/ party wall separating adjoining property. The structure and site have been modified over time with upgrades/renovations/additions and fill. The structure appears to be structurally sound.

The basement is the lowest level and is partially below finish grade. Assumption - The basement houses the water heater, HVAC and electrical equipment, appliances and is also use as a storage space (similar to 65 Conduit St.). The rear exterior access door to the basement is estimated to be approximately 1’-6” below finish grade. The estimated basement finish floor elevation is approximately 0.70’ NAVD88.

The basement is the lowest level, is partially below finish grade. Assumption - The basement houses the
water heater, HVAC and electrical equipment, appliances and is also use as a storage space (similar to 65 Conduit St.).

The first floor is the lowest habitable space.

No flood louvers or vents were visible in the foundation walls.

Exterior HVAC equipment is below the first floor elevation, the 1% Flood and the DFE.

**Analysis**

The first floor (the lowest habitable space) of this structure is above both the 1% exceedance flood (100 yr) elevation and the design flood elevation.

The basement and its contents are below both the 1% exceedance flood (100 yr) elevation and the design flood elevation. The 1% exceedance flood (100 yr) elevation is approximately 3 to 4 feet above the basement floor.

FEMA’s National Flood Insurance Program (NFIP) does not recognize dry floodproofing as a means of mitigation for of residential structures and will not impact insurance rates.

Because this is a duplex with adjoins structure and party wall, successful mitigation may require both duplex property owners to coordinate/cooperate mitigation together.

This structure could be mitigated, to reduce flood risk, using dry flood proofing measures to the 1% flood and possibility higher on the masonry foundation wall, but below the DFE. Further investigation and analysis may allow dry floodproofing to a higher elevation (above the 1% flood). [OR] This structure could be mitigated, to reduce flood risk, using wet floodproofing measures to the underside of the first floor (which is below the DFE).

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. **Basic/Minimum Action:**
   - Remove and/or relocate some or all contents of basement and exterior HVAC equipment above 1% exceedance flood (100 yr) elevation utilizing elevated platforms and space in the first floor (or above).
   - Pros/Cons/Relative Cost
     - **Pros:** Least expensive; May reduce Flood Insurance rate; address nuance flooding.
     - **Cons:** Minimal risk reduction.
     - **Cost Magnitude:** Very Low to Low to Medium (dependant on actions taken).

2. **Dry floodproof the basement to the 1% exceedance flood (100 yr) elevation.**
   - The exterior foundation walls could be utilized as a water barrier to dry floodproof the basement to the 1% flood.
• Provide interior drainage w/ pump and emergency power. Install break-away panels / flood louvers and vents may be required in exterior foundation walls to prevent structural damage from flood events of higher elevations.

• Pros/Cons/Relative Cost
  o Pros: Risk reduction to 1%; least impact on contents and use of space.
  o Cons: Risk reduction to only 1%, No flood insurance rate reduction; May be difficult to implement (many variables/unknowns).
  o Cost Magnitude: Low to Medium.

3. Wet floodproof the basement to the DFE.
   • Relocate basement contents above DFE, add flood louvers and vents to foundation walls allow basement to flood.
   • Pros/Cons/Relative Cost
     o Pros: Passive, Highest level of risk reduction; Probable flood insurance rate reduction.
     o Cons: Most expensive.
     o Cost Magnitude: Low to Medium (dependant on actions taken).
ANNAPOLIS, MARYLAND - HISTORIC DISTRICT – NONSTRUCTURAL ASSESSMENT SAMPLING

4.0 STRUCTURE DATA/ASSESSMENT SHEETS
STRUCTURE #15 - 65 CONDUIT STREET

Structure Information/Data

Name/Description: Conduit Street Duplex/Residence
Location: 65 Conduit Street
Occupancy type: Residential (Two-Family Dwelling)
No of Stories: 2 ½
Building Construction:
  Foundation: Masonry
  Exterior: Wood Frame
  Floor Construction (1st Flr): Wood Frame
  Grade/Crawlspace/Basement: Basement (Estimated +/- 7 ft.)

Structure Flood Elevations Table

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
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<tbody>
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<td>-0.32’</td>
<td>0.72’</td>
<td>4.42’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

*See Site Visit and Analysis sections.

Structure Photographs

North Elevation (Front)  North & West Elevations  South Elevation (Rear)

Site Visit (Observations/Field Notes)

The Structure was observed from the exterior and the interior of the basement. The property owner was present for information or comment.

The structure is a wood framed structure on masonry foundation walls (unreinforced brick), with a basement. The structure and site has been modified over time with upgrades/renovations/additions and fill.

The basement is the lowest level and is partially below finish grade. The basement was accessed and observed via exterior stairs at the right side of the structure. The basement floor is a concrete slab. The basement houses the water heater, HVAC and electrical equipment, communications equipment, appliances, utility meters and is also used as a storage space. The basement floor is estimated (no measurement taken) to be approximately 7’-0” to the underside of the first floor joists. The estimated basement finish floor elevation is approximately 0.36.

The basement is the lowest level, is partially below finish grade. The basement houses the water heater,
HVAC and electrical equipment, appliances and is also use as a storage space.

The first floor is the lowest habitable space. *The first floor elevation is same as adjacent attached structure.

*Low opening is at or near finish grade. No flood louvers or vents were visible in the foundation walls.

Exterior HVAC equipment is below the first floor elevation, and appears to be above the 1% exceedance flood (100 yr) elevation and below the DFE.

**Analysis**

The first floor (the lowest habitable space) of this structure is above both the 1% exceedance flood (100 yr) elevation and the design flood elevation (DFE).

The basement and its contents are below both the 1% exceedance flood (100 yr) elevation and the design flood elevation. The 1% exceedance flood (100 yr) elevation is approximately 3 to 4 feet above the basement floor.

*The first floor elevation has been adjusted to be same adjacent attached structure – 8.52’ NVAD88.

*The low opening provided has been adjusted base on field observation – 3.78’ NVAD88.

FEMA’s National Flood Insurance Program (NFIP) does not recognize dry floodproofing as a means of mitigation for residential structures and will not impact insurance rates.

Because this is a duplex with adjoins structure and party wall, successful mitigation may require both duplex property owners to coordinate/cooperate mitigation together.

This structure could be mitigated, to reduce flood risk, using dry floodproofing measures to the 1% flood and possibility higher on the masonry foundation wall, but below the DFE. Further investigation and analysis may allow dry floodproofing to a higher elevation (above the 1% flood). [OR] This structure could be mitigated, to reduce flood risk, using wet floodproofing measures to the underside of the first floor (which is below the DFE).

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be take to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommend mitigation measures may reduce flood insurance rates.

1. Basic/Minimum Action:
   - Remove and/or relocate some or all contents of basement and exterior HVAC equipment above 1% exceedance flood (100 yr) elevation utilizing elevated platforms and space in the first floor (or above).
   - Pros/Cons/Relative Cost
     - Pros: Least expensive; May reduce Flood Insurance rate; address nuance flooding.
     - Cons: Minimal risk reduction.
     - Cost Magnitude: Very Low to Low to Medium (dependant on actions taken).
2. Dry floodproof the basement to the 1% exceedance flood (100 yr) elevation.
   • The exterior foundation walls could be utilized as a water barrier to dry floodproof the basement to the 1% flood.
   • Provide interior drainage w/ pump and emergency power.
   • Provide Break-away panels / flood louvers and vents may be required in exterior foundation walls to prevent structural damage from flood events of higher elevations.
   • Pros/Cons/Relative Cost
     o Pros: Risk reduction to 1%; least impact on contents and use of space.
     o Cons: Risk reduction to only 1%, No flood insurance rate reduction; May be difficult to implement (many variables/unknowns).
     o Cost Magnitude: Low to Medium.

3. Wet floodproof the basement to the DFE. Relocate basement contents above DFE, add flood louvers and vents to foundation walls allow basement to flood.
   • Pros/Cons/Relative Cost
     o Pros: Passive; Highest level of risk reduction; Probable flood insurance rate reduction.
     o Cons: Most expensive.
     o Cost Magnitude: Low to Medium (dependant on actions taken).
**Structure Information / Data**

Name/Description: Conduit Street Duplex/Residence  
Location: 67 Conduit Street  
Occupancy type: Residential (Two-Family Dwelling)  
No of Stories: 2 ½  
Building Construction:  
   Exterior Walls: Wood Frame  
   Floor Construction (1st Flr): Wood Frame  
   Foundation: Masonry  
Grade/Crawlspace/Basement: Basement (Estimated +/- 7 ft.)

**Structure/Flood Elevations Table**

<table>
<thead>
<tr>
<th>FG</th>
<th>LO</th>
<th>FF</th>
<th>Δ FF-FG</th>
<th>1%</th>
<th>DFE</th>
<th>Δ 1%-FF</th>
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<th>Δ 1%-FG</th>
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<tr>
<td>7.05’</td>
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<td>-5.01’</td>
<td>-2.55’</td>
<td>1.15’</td>
</tr>
</tbody>
</table>

Abbreviations: FG – Finish Grade [low point]; LO – Low Opening; FF – First Floor; 1% - One Percent Exceedance Flood [100 yr]; DFE - Design Flood Elevation; Δ-Delta/Difference

**Site Visit (Observations/Field Notes)**

The structure was observed from exterior only (at a distance). Assumptions were made based on inspection of similar adjacent structures and discussion with property owner of same. The property owner was not present/available for information or comment.

Structure is a wood framed structure on masonry foundation walls (unreinforced brick), with a basement. Structure and site may have been modified over time with upgrades/renovations/additions and fill.

The basement is the lowest level, is partially below finish grade. Assumption - The basement houses the water heater, HVAC and electrical equipment, appliances and is also use as a storage space (similar to 65 Conduit St.). *The rear exterior access door is the Low opening. The estimated basement finish floor elevation is 5.55’ NAVD88 (same as LO).

The first floor is the lowest habitable space.

No flood louvers or vents were visible in the foundation walls.
Exterior HVAC equipment is below the first floor elevation, and appears to be above the 1% exceedance flood (100 yr) elevation and below the DFE.

**Analysis**

The first floor (the lowest habitable space) of this structure is above both the 1% exceedance flood (100 yr) elevation and the design flood elevation.

The basement floor and the basement contents are above the 1% exceedance flood (100 yr) elevation below the design flood elevation (DFE). The DFE is estimated to be 2’- 6” above the basement floor.

FEMA’s National Flood Insurance Program (NFIP) does not recognize dry floodproofing as a means of mitigation for residential structures and will not impact insurance rates.

Because this is a duplex with adjoins structure and party wall, successful mitigation may require both duplex property owners to coordinate/cooperate mitigation together.

This structure could be mitigated, to reduce flood risk, using dry flood proofing measures to the 1% flood and possibility higher on the masonry foundation wall, but below the DFE. Further investigation and analysis may allow dry floodproofing to a higher elevation (above the 1% flood). [OR] This structure could be mitigated, to reduce flood risk, using wet floodproofing measures to the underside of the first floor (which is above the DFE).

**Recommendations**

The following recommendations are basic/generic descriptions of actions and/or mitigation measures to be taken to mitigate the structure to reduce flood risk. Each recommendation has its limits and reduces risk to a specific flood elevation. As a general rule all structures should be evacuated during a flood event. In all cases purchase of flood insurance is recommend. Some of the recommended mitigation measures may reduce flood insurance rates.

1. **Basic/ Minimum Measures:**
   - Remove and/or relocate some or all contents of basement and exterior HVAC equipment above the DFE utilizing elevated platforms and space in the first floor (or above).
   - **Pros/Cons/Relative Cost**
     - Pros: Least expensive; May reduce Flood Insurance rate; address nuance flooding
     - Cons: Minimal flood risk reduction
     - Cost Magnitude: Very Low to Low to Medium (dependant on actions taken)

2. **Dry floodproof the basement to the DFE.**
   - The exterior foundation walls could be utilized as a water barrier to dry floodproof the basement walls to the DFE.
   - Install break-away panels / flood louvers and vents may be required in exterior foundation walls to prevent structural damage from flood events of higher elevations.
   - **Pros/Cons/Relative Cost**
     - Pros: Flood risk reduction to 1%; least impact on contents and use of space.
     - Cons: Risk reduction to only 1%; No flood insurance rate reduction; May be difficult to implement (many variables/unknowns); requires coordination and cooperation with adjacent attached property.
     - Cost Magnitude: Low to Medium.
3. Wet floodproof the basement to the DFE. Relocate basement contents above DFE, add flood louvers and vents to foundation walls allow basement to flood.
   - Pros/Cons/Relative Cost
     - Pros: Passive; Highest level of flood risk reduction; Probable flood insurance rate reduction.
     - Cons: Most expensive.
     - Cost Magnitude: Low to Medium (dependant on actions taken).
ACE.........................Annual Chance Exceedance
A/E .........................Architect/Engineer
ASFPM ......................Association of State Floodplain Managers
AIA .........................American Institute of Architects
CFM ..........................Certified Floodplain Manager
DFE ..........................Design Flood Elevation
EO .............................Executive Order
FEMA .........................Federal Emergency Management Agency
FF .............................First Flood
FG .............................Finish Grade
FPM .............................Floodplain Management
FPMP ..........................Floodplain Management Plain
FRAM ..........................Flood Risk Adaptive Measure
FRM ............................Flood Risk Management
ft .............................feet
HQUSACE ....................Headquarters, U.S. Army Corps of Engineers
ID# .............................Identification Number
HVAC ........................Heating Ventilation and Air Conditioning
LO .............................Low Opening
NAB .........................United States Army Corps of Engineers, Baltimore District
NFIP ..........................National Flood Insurance Program
NFPC ..........................National Nonstructural Flood Proofing Committee
FRAM ..........................Flood Risk Adaptive Measures
P.E...........................Professional Engineer

FIRM..........................Flood Insurance Rate Map

USACE ......................United States Army Corps of Engineers

w/.............................with

Δ...............................Delta/Difference

1% .............................One Percent Exceedance Flood Event (100 Year Flood Event)
6.0 GLOSSARY

100-year flood – The 1% annual chance exceedance expressed as a return period.

Annual chance exceedance flood – The flood that has a (stated percent - %) chance of being exceeded in any given year, such as the 1% annual chance exceedance (ACE) flood.

Berms, Levees, Floodwalls - Freestanding structure(s) located adjacent to a structure that prevents the encroachment of floodwaters.

Figure 7
Berm/Floodwall Examples

Breakaway Panel – A panel designed and constructed to collapse under water loads without causing collapse, displacement, or other structural damage to a structure’s bearing walls or supporting foundation system.

Closures / Shields - Closures act to close the openings in flood barriers and prevent water from entering. They can be of a variety of shapes, sizes, and materials. In some cases closures are permanently attached using hinges so that they can remain open when there is not flood threat. They may also be portable, normally stored in a convenient location and slipped into place when a flood threatens.

Figure 8
Closures / Shields (Detail)

Community – Any state or area or political subdivision thereof, or any Indian tribe or authorized tribal organization, or Alaska Native village, or authorized native organization that has the authority to adopt and enforce flood plain management regulations for the areas within its jurisdiction.
Consequences (of inundation) - The effect, result, or outcome of inundation/flooding as reflected in the potential loss of life, economic losses, and adverse social - environmental impacts.

**Dry Flood Proofing** involves temporary or permanent sealing building walls with waterproofing compounds, impermeable sheeting, or other materials to prevent the entry of floodwaters into damageable structures. Dry flood proofing is applicable in areas of shallow, low velocity flooding.

**Figure 9**
Dry Flood Proofing (Details)

**Figure 10**
Temporary Dry Flood Proofing (Detail/Example)
**Elevation** involves raising the buildings in place so that the structure sees a reduction in frequency and/or depth of flooding during high-water events. Elevation can be done on fill, foundation walls, piers, piles, posts or columns. Selection of proper elevation method depends on flood characteristics such as flood depth or velocity.

**Figure 11**

**Elevation (Graphic Illustration)**

**Federal Emergency Management Agency (FEMA)** – The agency within the Emergency Preparedness and Response Directorate of the U.S. Department of Homeland Security. FEMA facilitates coordination of Federal dam safety programs and administers the NFIP and several flood mitigation planning and grant programs.

**Fenestration** – The arrangement of windows and doors in a structure.

**FIRM** – Flood Insurance Rate Map

**Flood** - A *flood* is an overflow of water that submerges land or structures which is normally dry.

**Flood Insurance** provides insurance to assist in recovery from a flood event. Typically not include with homeowners insurance policy.

**Flood Louver / Flood Vent** – Flood louvers / flood vents are a permanent opening in a wall designed to allow unobstructed passage of water (automatically) in and out of a structure thereby preventing water pressure buildup (hydrostatic pressure) that can damage or destroy foundations and bearing walls.

**Flood Risk** - The likelihood and consequences that may arise from flood event.

**Flood Risk Management** – Federal and non-Federal policies and programs for managing flood risk. This includes measures that reduce the flood hazard as well as measures that reduce the exposure and vulnerability of persons and property.

**Flood Risk Management Measures** - These measures include implementation of reservoirs, detention storage, channels, diversions, levees, interior drainage systems, flood-proofing, levee
raising, relocation of buildings/communities, and flood warning and emergency preparedness actions. It also includes policies and programs intended to inform and to influence the decisions made by Federal, state, and local government agencies, individuals, businesses and communities in their choice of flood risk reduction measures and to locate assets in flood plain.

**Flood-frequency** – A graph, table, or single tabulation showing the relationship of the flood variable of interest (peak flow, peak stage, 3-hour volume, etc.) to the probability of the variable being exceeded in any given year.

**Foundation Vents** – Foundation vents are permanent openings in foundation walls ventilation and unrestricted passage of air for ventilation of the crawl space. In wet floodproofing applications additional foundation vents may be required to release air pressure changes caused by rising/falling water in confined spaces (crawlspac).

**National Flood Insurance Program (NFIP)** – Federal program under which flood-prone areas are identified and flood insurance is made available to the owners of the property in participating communities.

**Nonstructural Measures** – Historically, this term was used to distinguish flood risk reduction measures constructed to reduce the flood hazard (such as reservoirs and levees) from measures that might be directed to reducing consequences.

**National Nonstructural Flood Proofing Committee (NFPC)** - The National Nonstructural Flood Proofing Committee functions under the general direction of the Chief, Planning Community of Practice, Directorate of Civil Works, and HQUSACE. The objectives of the NFPC are to:

- Promote the development and use of all nonstructural flood risk reduction measures.
- Risk expertise on all aspects of nonstructural flood risk reduction and associated opportunities.
- Disseminate nonstructural flood reduction information
- Partner with Planning Centers of Expertise in all aspects of nonstructural flood risk reduction and associated opportunities.
- Provide leadership in all aspects of floodplain management


**Project (flood risk reduction)** - A flood risk reduction project is made up of one or more flood risk reduction systems which are under the same Congressional or other organizational entity authorization.

**Probability (likelihood)** – Likelihood is a measure of the chance, or degree of belief that a particular outcome or consequence will occur. A probability provides a quantitative description of the likelihood of occurrence of a particular event.
Relocation involves moving the structure to another location away from flood hazards. Relocation is the most dependable method of protection and provides the benefit of use of the evacuated floodplain.

Return period – Alternate term ‘recurrence interval.’ The return period is the average time interval, usually expressed in years, between occurrences of an event of a certain magnitude. The return period is often computed as the reciprocal of the annual chance exceedance.

Risk – Measure of the probability and severity of undesirable consequences.

Risk Communication – Risk communication is the open, two-way exchange of information and opinion about hazards and risks leading to a better understanding of the risks and better risk management decisions.

Silver Jackets (SJ) - The Silver Jackets is an innovative program that provides an opportunity to consistently bring together multiple state, federal, and sometimes tribal and local agencies to learn from one another and apply their knowledge to reduce risk. Website - [http://www.nfrmp.us/state/](http://www.nfrmp.us/state/)

Structural Measures – Historically, this term was used to distinguish flood risk reduction measures constructed to reduce the flood hazard (such as reservoirs and levees) from measures that might be directed to reducing consequences.

Uncertainty – Used to describe any situations without sureness, whether or not described by a probability distribution.

Wet Flood Proofing measures allows floodwater to enter the structure, vulnerable items such as utilities appliances and furnaces are relocated or waterproofed to higher locations. By allowing floodwater to enter the structure hydrostatic forces on the inside and outside of the structure can be equalized reducing the risk of structural damage.
Randall Behm P.E, CFM

Mr. Behm serves as the Chief of the Flood Risk and Floodplain Management Section for the US Army Corps of Engineers, Omaha District, where he leads a team of engineers totally dedicated to identifying and reducing flood risk, formulating nonstructural mitigation measures, and supporting sound floodplain management. Mr. Behm has been in this position since July 2001. He is also Chairman of the Corps’ National Nonstructural Flood Proofing Committee. The committee consists of 10 members and technical advisors who advocate a complete set of nonstructural tools and techniques for reducing flood damages across the country. Mr. Behm is also the Omaha District’s Flood Risk Manager and Silver Jackets Coordinator, providing oversight for six Silver Jacket teams within the District. Prior to these current positions Mr. Behm has served as a Program Manager, a Hydraulic Design Engineer, and a Project Manager. He has been an employee of the Omaha District for 29 years.

Stephen D. O’Leary AIA, CFM

Mr. O’Leary serves as a Planner, Project Manager and Nonstructural Flood Risk Management Subject Matter Expert in the USACE - Huntington District Planning Branch. On a national level, Mr. O’Leary serves as the Project Manager on the Levee Safety Policy and Procedures Team (LSPPT), currently developing the new USACE Levee Safety Program Engineering Circular (EC) and as a member of the USACE Nonstructural Floodproofing Committee (NFPC), promoting, educating and providing support to others in the nonstructural flood risk management arena. Mr. O’Leary joined the Huntington District in 1992. He’s served eleven plus years in the Planning Branch and prior to that, ten years in Engineering Division as the District’s Senior Architect. Much of his work has focused on flood risk management, non-structural floodproofing and the mitigation of flood prone structures. Prior to joining USACE, Mr. O’Leary worked as an architect in the private sector for Architect/Engineering firms and construction contractors in Kentucky, Maryland and New York. Mr. O’Leary received a Bachelor of Architecture Degree from the University of Kentucky in 1982. He is a licensed Professional Architect in the states of Maryland and West Virginia and a nationally Certified Flood Plain Manager (CFM). He’s a member of the American Institute of Architects (AIA) and the Association of State Flood Plain Managers (ASFPM). He serves as a Structures Specialist with the USACE Urban Search and Rescue (US&R) Cadre and a SME with Temporary Housing team.