Repetitive Loss Area Analysis

The City of Alexandria, Virginia Department of Transportation and Environmental Services

Attachment 1

Delivering a better world

Prepared for:

The City of Alexandria, Virginia
Department of Transportation and Environmental Services

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Acronyms and Abbreviations

CID	Community Identification
CRS	Community Rating System
DCR	Virginia Department of Conservation and Recreation
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMP	Floodplain Management Plan
HVAC	Heating, Ventilation, and Air Conditioning
NFIP	National Flood Insurance Program
RLA	Repetitive Loss Area
RLAA	Repetitive Loss Area Analysis
SFHA	Special Flood Hazard Area
SWU	The City of Alexandria Stormwater Utility
T&ES	The City of Alexandria Department of Transportation and Environmental Services
The City	The City of Alexandria, VA

1 Background

Flooding is the most common natural hazard in the United States. In addition to large floods resulting from hurricanes or overflow of a major body of water, smaller floods are also considered natural hazards and are leading causes of property damage and financial losses experienced by both public institutions and private residents. These smaller flooding events, also known as “nuisance flooding,” occur more frequently and can be a result of controllable factors such as inadequate drainage or localized stormwater problems. Damages from nuisance flooding account for most flood insurance claims, especially for properties located in low-risk flood zones. To help communities deal with flooding, the Federal Emergency Management Agency (FEMA) established the National Flood Insurance Program (NFIP) to provide federally backed flood insurance to property owners.

To be covered by the NFIP’s flood insurance policy, a property must be in a community that participates in the NFIP. This participation aids in improving a community’s floodplain management program. The three basic components of the NFIP are floodplain mapping, flood insurance, and floodplain management regulations. Floodplain mapping is provided by FEMA through a series of maps called Flood Insurance Rate Maps (FIRMs). Participation in the NFIP is voluntary and results in federally backed flood insurance and potential federal aid for damage to insurable buildings in a floodplain. Additionally, floodplain management regulations help mitigate flood losses by requiring substantially damaged and improved buildings to be retrofitted to the same flood protection level as a new building under a community’s floodplain management ordinance.

A separate voluntary incentive program developed by FEMA to support the NFIP is the Community Rating System (CRS). This program rewards communities for going above and beyond the NFIP’s minimum standards to reduce flood damages by providing discounted flood insurance premiums that reflect the community’s floodplain management program. Activities that communities can undertake to receive these rewards include reducing damage to existing buildings, managing development in areas inside and outside of floodplain zones, assisting insurance agents in obtaining flood data, and helping property owners learn how to obtain flood insurance.

The NFIP may consider a property a “Repetitive Loss” if it has an insurable building with at least two or more claims of more than $1,000 paid by the NFIP within any 10-year rolling period (since 1978). FEMA keeps track of these properties on a designated “Repetitive Loss List” for each community; even if ownership of a building changes, the designation of Repetitive Loss remains with the property. That list is continually updated to ensure that all repetitive loss problems of unmitigated properties within a community are addressed. The Repetitive Loss properties are considered part of a Repetitive Loss Area (RLA), which includes the surrounding properties that may experience the same or similar flooding conditions whether or not they have also been damaged by flooding.

To maintain participation in the CRS, a community with 50 or more repetitive loss properties is required to perform a Repetitive Loss Area Analysis (RLAA). This analysis focuses on mitigation planning for RLAs and provides specific guidance on how to reduce damage from repetitive flooding and on how to reduce damage from repetitive flooding beyond the local hazard mitigation plan. The RLAA involves reviewing the FEMA-identified Repetitive Loss properties/areas to better understand

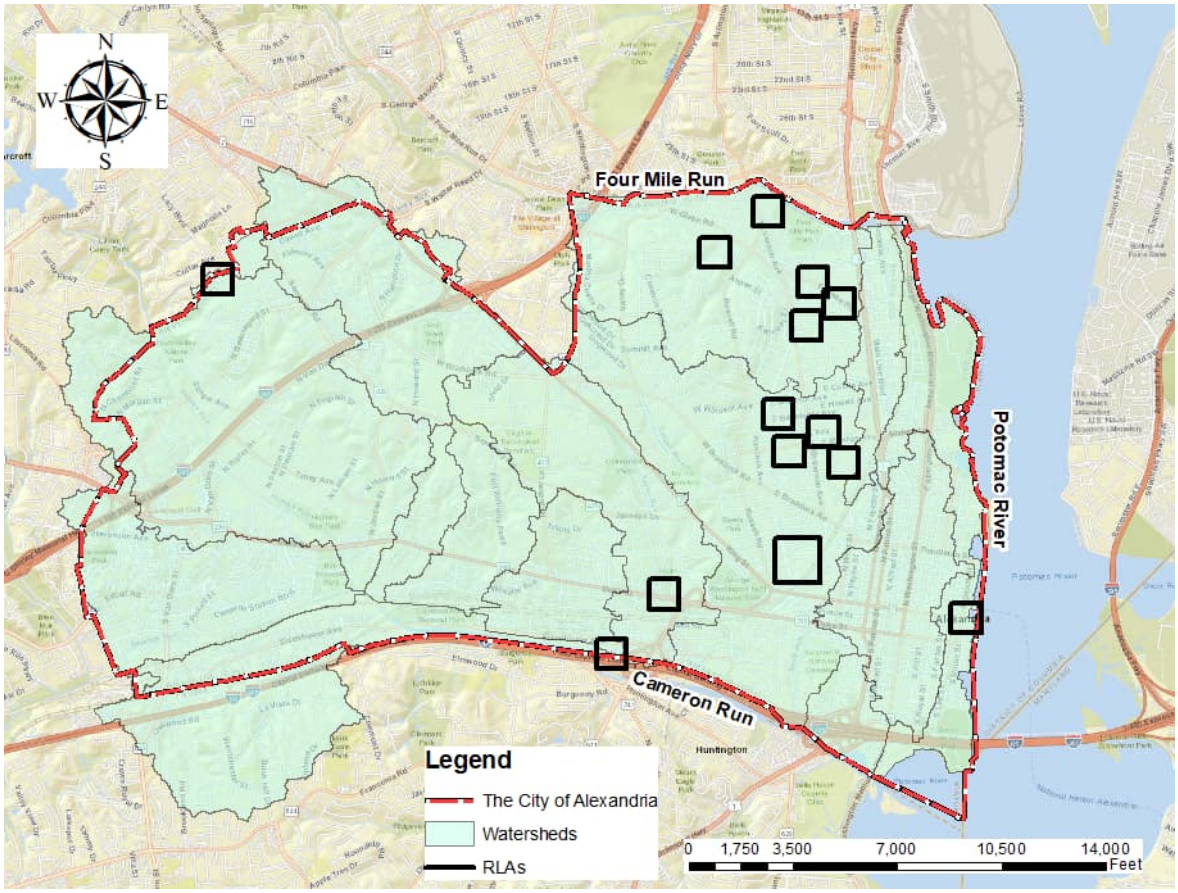
the sources of flooding. By maintaining accurate information through FEMA's Repetitive Loss list, communities can identify problems and generate meaningful mitigation solutions for the property owners in those areas. Participating in the CRS and completing the RLAA can increase mitigation opportunities, leading to reduced future damages.

1.1 Purpose

Participating in the CRS allows a community to earn credit points towards premium reductions of flood insurance for policy holders dependent on their location within a Special Flood Hazard Area (SFHA). Completion of this RLAA is an activity that earns a community credit points towards their current CRS rating class for corresponding discounts established in the *CRS Coordinator's Manual*. The following Section 2 describes The City of Alexandria's (the City) participation in the CRS.

2 City of Alexandria

The City is an independent city in the Commonwealth of Virginia. According to the 2020 U.S. Census, its population stands at 159,467 residents. Situated on the western bank of the Potomac River, the City is approximately 6 miles south of Washington, DC. Notably, there are 15 local watersheds, as seen in Figure 1, that directly discharge into Four Mile Run, Cameron Run, or the Potomac River, which is ultimately part of the Chesapeake Bay watershed.



Source: ESRI

Figure 1: The City's Watershed Map

The City has participated in FEMA's NFIP since May 8, 1970 and has participated in FEMA's CRS program since October 1, 1992 which is identified by community ID (CID) 515519. As part of the CRS, the repetitive loss data must be maintained and re-certified annually to ensure continued participation. Since many NFIP losses result from repetitively flooded properties, addressing these properties is a priority. Specific community responsibilities depend on the severity of the repetitive loss problems and are grouped into three types:

- Category A: A community that has no Repetitive Loss properties or whose Repetitive Loss properties all have been mitigated. These communities have no special requirements except to submit information to update their Repetitive Loss list as needed.

- Category B: A community with at least one, but fewer than 50, Repetitive Loss properties that have not been mitigated. At each verification visit, a Category B community must:
  - Prepare a map of the RLA(s),
  - Review and describe its repetitive loss problem,
  - Prepare a list of the addresses of all properties with insurable buildings in those area, and
  - Undertake an annual outreach project to those addresses. A copy of the outreach project is submitted with each year's recertification.
- Category C: A community with 50 or more Repetitive Loss properties that have not been mitigated. A Category C community must:
  - Complete all Category B community requirements, and
  - Prepare and adopt an RLAA for all RLAs or prepare and adopt a floodplain management plan.

In November of 2023, FEMA NFIP identified 40 Repetitive Loss properties in CID 515519. On July 12, 2024, the City requested that five properties be removed from its Repetitive Loss Properties list, but only two were approved, resulting in a total of 38 Repetitive Loss properties; cosmetic change to an address was also requested. Although the list of Repetitive Loss properties that are unmitigated has decreased in this community, it will remain as Category B, which determines the community's additional requirements to remain in compliance with the CRS.

As required for a Category B community, the City is required to prepare maps of RLAs. While the FEMA NFIP list only tracks Repetitive Loss properties, adjacent properties that have similar conditions and could be exposed to flooding events are considered part of the RLA. These areas are mapped to gain a better understanding of flooding causes and potential mitigation measures and to provide awareness to owners of neighboring properties that may experience repetitive flooding.

Dates of reported claims from the Repetitive Loss properties that correspond with anecdotal information from citizens of the community help delineate the adjacent properties to be included within a RLA. Topographic maps and site visits also aid in identifying properties within a similar or lower elevation to analyze where flooding is focused. As seen in Figure 1 the Repetitive Loss properties have been delineated into 14 RLAs within the City's boundary and local watersheds. In accordance with the Privacy Act of 1974, detailed flood insurance and repetitive loss data are protected, so information in this report is discussed in general terms. Table 1 summarizes the number of repetitive losses within this community.

Table 1: Summary of Repetitive Losses

Watershed	# of Repetitive Loss Properties	Flood Zone	Repetitive Losses	Earliest Loss	Latest Loss
Holmes Run	1	No	2	July 2019	August 2021
Four Mile Run (east)	11	Yes (AE and X)	29	December 1977	August 2021
Hooffs Run	17	Yes (AE and X)	43	June 2006	August 2021
Taylor & Cameron Run	3	Yes (AE)	9	June 1982	August 2021
Potomac River	4	Yes (AE)	12	November 1985	September 2003
*Fairfax County	2	Yes (AH and X)	5	March 1978	July 2021

*RLPs were not analyzed during this verification cycle.

In addition to the CRS-required activities, the City updated its floodplain regulations in 2024 to the most recent (2017) Virginia Department of Conservation and Recreation (DCR) model floodplain management ordinance to comply with NFIP requirements; this update coincides with FEMA's issuance of a new Flood Insurance Study (FIS) and new Flood Insurance Rate Maps (FIRMs) with an effective date of January 11, 2024. When a community completes required and voluntary activities, it earns points toward the rating system, which are factored into the community rewards such as flood insurance premium discounts. The City has a current CRS rating of Class 6, which is associated with a 20% premium reduction for residents and businesses within a Special Flood Hazard Area (SFHA) and 10% for those outside of a SFHA; preferred risk policies are not eligible for CRS premium discounts because they have minimal risk to flood damage. With respect to the City, the SFHA are areas within flood zone AE while flood zone X is considered outside a SFHA.

To earn additional credit from the CRS, the City developed this nonmandatory RLAA (required by Category C communities), akin to a Floodplain Management Plan (FMP), focusing on detailing the outcomes of the RLAA Five-Step Plan.

3 Repetitive Loss Area Analysis Process

The RLAA Five-Step Plan follows the guidelines outlined in Section 510 of the *CRS Coordinator's Manual*, supplemented by resources such as "Developing a Repetitive Loss Area Analysis" (FEMA 2017b) Communities can earn credit by preparing both an FMP and RLAA. The City completed an FMP in the form of the "Northern Virginia Hazard Mitigation Plan" in November of 2022; adopted by the City Council on June 13, 2023. While the RLAA primarily focuses on Repetitive Loss properties, data must be collected on all similarly constructed buildings and flooding characteristics within the RLAs. The RLAA Process involves the following five planning steps:

- Step 1 – Advise all the property owners in the RLAs that this analysis will be conducted and request their input regarding investigating flood damage and mitigation solutions.
- Step 2 – Perform supplemental research by contacting agencies and organizations that may have plans or studies regarding the potential causes or impacts of the flooding.
- Step 3 – Visit each building within the RLAs and collect data.
- Step 4 – Review alternative approaches and consider any property protection measures or drainage improvements.
- Step 5 – Document all findings in this RLAA.

3.1 Step 1. Contact Property Owners

Before proceeding with any other step in the RLAA process, property owners within the RLAs must be notified. The City reached out to property owners and current residents through the mail about the RLAA process and encouraged their participation in analyzing the hazards and recommended solutions.

On May 10, 2024, the City mailed out a letter (Figure 2) notifying residents of the commencement of the RLAA and the required site visits. The letter included a QR code linking to a questionnaire (Figure 3a, Figure 3b, and Figure 3c) where the property owner and/or resident could provide valuable information about their experience with flooding; questionnaire responses in Appendix A are subject to the Privacy Act of 1974 and therefore will not be shared in the public version of this report. Alongside the letter, a Fact Sheet (Figure 4) was included to explain the purpose of the RLAA. On June 14, 2024, the City also mailed reminder postcards (Figure 5) to remind the property owners and/or residents about the earlier mailed letter and request them to complete the questionnaire. The contributed information from the questionnaires ultimately helped to better understand the causes of flooding and with developing ideas of mitigation measures. The following steps of the RLAA process could then be carried out in any order or consecutively.

RLAA Outreach Letter

Department of Transportation and Environmental Services
Stormwater Management Division
2900B Business Center Drive
Alexandria, VA 22313

May 6, 2024

Dear City of Alexandria Resident,

As part of The City of Alexandria's (The City) participation in the National Flood Insurance Program's (NFIP) Community Rating System (CRS), The City's Department of Transportation and Environmental Services (T&ES), Stormwater Management Division is preparing a Repetitive Loss Area Analysis (RLAA) report (please refer to the included RLAA handout). This entails evaluating, with your consent and support, properties and areas that have experienced repetitive flood damage. This analysis involves reviewing flood history data and performing field investigations from a street view. We are concerned about the repetitive flooding in your area and would like your input and support in performing this analysis which may involve the review and collection of information such as:

- Building Permit Records
- Building foundation type and first floor elevation information (elevation certificate if available)
- Historical flood event information (when events occurred, damage to property, etc.)
- Flood mitigation practices implemented
- Building Property Value on record

Results from this analysis will not include personal property information in accordance with the Privacy Act of 1974. As part of this RLAA, The City and its contractor (AECOM) will visit the neighborhoods to survey and document/photograph potential flood risks. AECOM will not be entering private property without your written permission. All the field survey will be conducted from city Right-of-Way. The City encourages Property Owners to be part of this process by providing any relevant flooding information, hazards, and recommended actions. To help facilitate this analysis, a questionnaire can be completed online via the QR code below. Please try to complete the survey as thoroughly as possible by June 30, 2024.

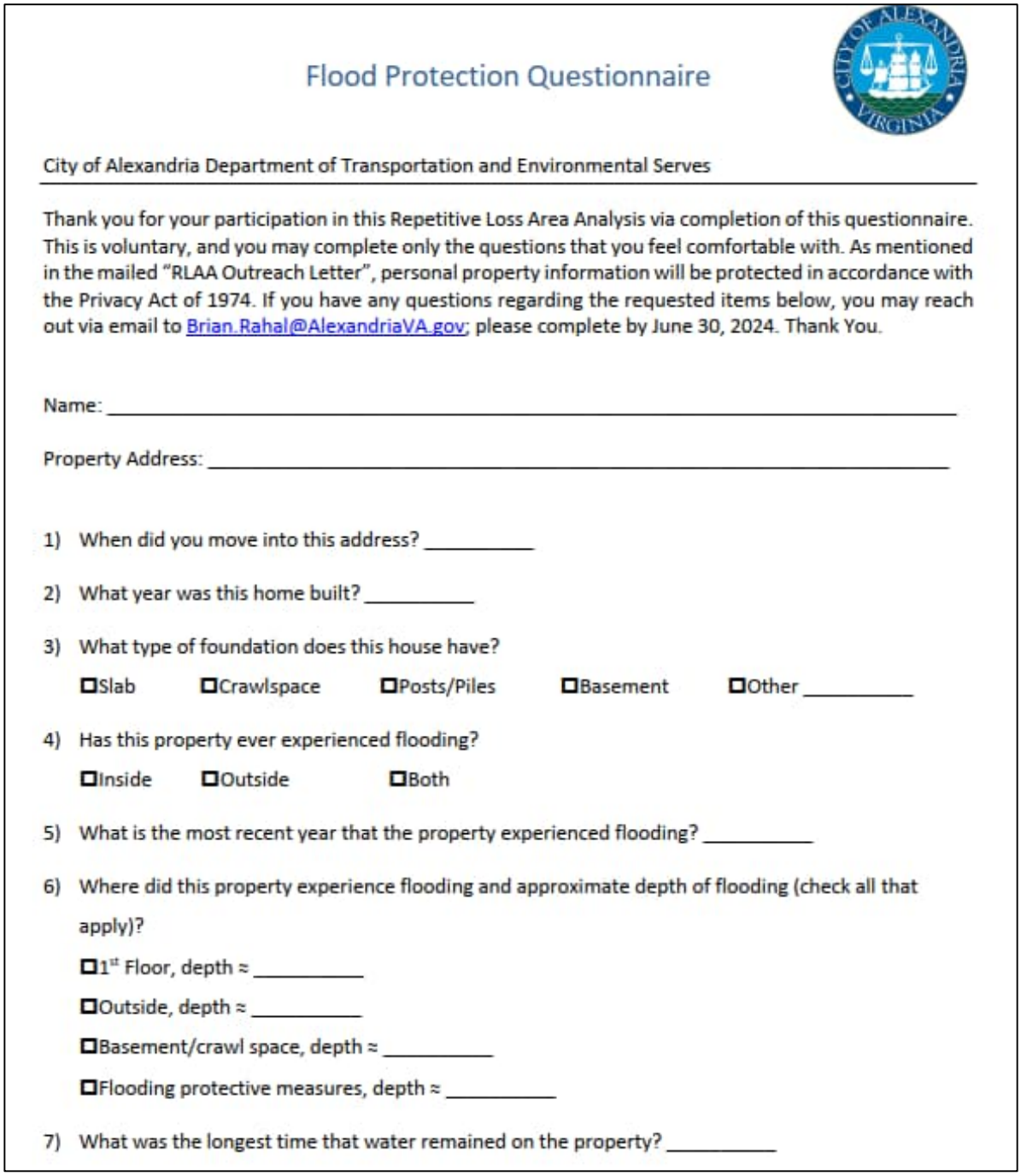
Completion of the RLAA will result in a report to be submitted to FEMA. Prior to this submission, a draft of the report will be made available for your review and feedback by visiting https://www.alexandriava.gov/flood-action/community-rating-system-crs-and-national-flood-insurance-program.

Thank you very much for your cooperation. The City looks forward to working with you all on completing this RLAA. If you have any questions or concerns, please contact me via email at Brian.Rahal@AlexandriaVA.gov.

Sincerely,

Brian Rahal, P.E., CFM
Civil Engineer IV / Section Lead
Stormwater Management Division
Department of T&ES Stormwater Management
City of Alexandria, Virginia

Figure 2: Step 1: Letter



Flood Protection Questionnaire

City of Alexandria Department of Transportation and Environmental Serves

Thank you for your participation in this Repetitive Loss Area Analysis via completion of this questionnaire. This is voluntary, and you may complete only the questions that you feel comfortable with. As mentioned in the mailed "RLAA Outreach Letter", personal property information will be protected in accordance with the Privacy Act of 1974. If you have any questions regarding the requested items below, you may reach out via email to Brian.Rahal@AlexandriaVA.gov; please complete by June 30, 2024. Thank You.

Name: _____

Property Address: _____

1) When did you move into this address? _____

2) What year was this home built? _____

3) What type of foundation does this house have?

☐Slab ☐Crawlspace ☐Posts/Piles ☐Basement ☐Other _____

4) Has this property ever experienced flooding?

☐Inside ☐Outside ☐Both

5) What is the most recent year that the property experienced flooding? _____

6) Where did this property experience flooding and approximate depth of flooding (check all that apply)?

☐1st Floor, depth ≈ _____

☐Outside, depth ≈ _____

☐Basement/crawl space, depth ≈ _____

☐Flooding protective measures, depth ≈ _____

7) What was the longest time that water remained on the property? _____

Figure 3a: Step 1: Questionnaire

Flood Protection Questionnaire

City of Alexandria Department of Transportation and Environmental Serves

8) What do you believe was the cause of the flooding (check all that apply)?

- ☐Storm sewer backup
- ☐Sanitary sewer backup
- ☐Ponded rainwater
- ☐Drainage/runoff from nearby properties
- ☐Saturated ground/leaks in basement walls
- ☐Flooding from body of water (stream, pond, lake, etc.): _____
- ☐Other: _____

9) Have you installed or implemented any flood protection measures on the property (check all that apply)?

- ☐Sump pump
- ☐Waterproofed the outside walls
- ☐Floodwalls
- ☐Re-grading of land to promote drainage away from building
- ☐Backup power system/generator
- ☐Sandbags
- ☐Moved items and/or equipment to higher elevation
- ☐Drain pipes to improve drainage away from property
- ☐Other: _____

10) Please identify and rate the effectiveness of any of the selected items from question 9 (1 through 5) with 1 being least effective and 5 being most effective. If possible, may you describe how any of the flood protection measures performed?

_____

_____

_____

_____

11) Do you, or this property owner, have FEMA Flood Insurance?

☐Yes ☐No ☐Unsure

Figure 3b: Step 1: Questionnaire

Flood Protection Questionnaire

City of Alexandria Department of Transportation and Environmental Serves

12) Do you want information on protecting your property from flooding? If so, please provide an appropriate email address and/or phone number: _____

13) Please include any additional information and comments that you may have about flooding on this property or the surrounding areas: _____

_____

_____

_____

Thank You very much for taking the time to complete this questionnaire and your support with this Repetitive Loss Area Analysis.

Sincerely,

Brian Rahal, P.E., CFM
Civil Engineer IV / Section Lead
Stormwater Management Division
Department of T&ES Stormwater Management
City of Alexandria, Virginia

Figure 3c: Step 1: Questionnaire

Repetitive Loss Area Analysis

RLAA: A mitigation plan for areas that have or are expected to experience repeated losses from flooding; flooding not only from large events but including smaller "nuisance flooding" as well.

FEMA

NATIONAL FLOOD INSURANCE PROGRAM

NFIP: Program developed by FEMA to provide federally backed flood insurance to property owners. To be covered by this flood insurance policy, a property must be in a community that participates in the NFIP which aids in improving a community's floodplain management program.

Community Rating System (CRS): Voluntary incentive program developed by FEMA to support the NFIP, that rewards communities for going above the NFIP's standards. Participation in this program results in discounted flood insurance premiums to reflect the community's floodplain management program.

City of Alexandria's Department of Transportation & Environmental Services: Brian.Rahal@AlexandriaVA.gov serves as the City's representative between the agencies and the community.

This analysis reviews FEMA identified repetitive loss areas to better understand the sources of flooding and to aid in generating meaningful mitigation solutions for the property owners in those areas.

- FEMA helps increase mitigation opportunities through additional funding for those mitigation opportunities to result in reduced future damages.
- Mitigation is achieved through a combined effort between local, state, and federal agencies, especially if FEMA grant funding is used.

To receive that additional FEMA funding, The City must participate in the NFIP's CRS. This analysis is one step in maintaining compliance with this program.

The draft of this year's 2024 Repetitive Loss Area Analysis report will be available later this summer for community feedback via https://www.alexandriava.gov/flood-action/community-rating-system-crs-and-national-flood-insurance-program.

Figure 4: Step 1: Fact Sheet

Figure 5: Step 1: Postcard Reminder

3.2 Step 2. Contact Other Agencies

To aid in understanding flooding sources, impacts of flooding, and identifying mitigation measures for property owners, the City collaborated with the following agencies to review related plans or studies:

- Virginia NFIP State Coordinating Office
- Northern Virginia Regional Commission
- Virginia Department of Conservation and Recreation
- U.S. Army Corps of Engineers

Supplemental resources that were also reviewed included flood and drainage studies, watershed master plans, capital improvement plans, and history of flooding data. The data collected from this review helped to identify potential solutions and mitigation measures.

3.2.1 Summary of Reports and Studies

- FEMA issued revised FIRMs and a corresponding FIS with an effective date of January 11, 2024; the previous FIRMs and FIS have an effective date of June 16, 2011. The purpose of the revised FIS was to update flood hazard information to establish flood insurance rates. The FIS analyzed various flooding sources in the floodways, which included a re-study of Four Mile Run in July of 2020 by FEMA. Additionally, new studies of Cameron Run and South Lucky Run were performed by Strategic Alliance for Risk Reduction II in December of 2021 and January of 2017, respectively. The principal flood problems and historical flooding elevations are also discussed in this study. The revised FIRMs include changes to the boundaries of the 1- and 0.2-percent-annual-chance floodplains. Feedback from multiple community meetings between FEMA, various county agencies, and community officials was incorporated into this FIS.
- IEM Inc., funded by FEMA through the Virginia Department of Emergency Management and administered by the Prince William County Office of Emergency Management, prepared the 2022 Northern Virginia Hazard Mitigation Plan that aimed to reduce the long-term vulnerability of the region; this entailed a comprehensive review and revision of its 2017 plan. The plan increased public awareness of local hazards and risks, as well as their impacts and consequences. Floods and Severe Storms were identified as some of typical high hazards that the City experiences; between 2001 and 2021 the City experienced 11 of those events. The City also experienced 40 floods/flash floods, 14 high wind and severe storms, and 31 winter storm events between 1950 and June 30, 2021.
- Radar and rain gauge data of four historical events in the City was processed by Vieux & Associates Inc. in the “Radar Rainfall Analysis Report” in October of 2021. The four historical events that were processed and analyzed are July 8, 2019; July 23, 2020; September 10, 2020; and August 15, 2021. Data from 28 rain gauges were used in the analysis; 9 of the gauges are in the City, 13 are in Fairfax County, 4 are owned by DC Water, 1 is from the United States Geological Survey, and 1 is owned by the National Weather Service Automated Surface Observing System.

3.2.2 Summary of Reviewed Data

In addition to reviewing reports and summaries, data from the rain gauge at Ronald Reagan Washington National Airport Station was reviewed for all dates of reported insurance claims. This data was compared with anecdotal reports of flooding and the reports, as well as with other studies, to better understand the behavior of the flooding. Information from the City's interactive website about its Capital Improvement projects was also reviewed to compare with dates of flooding events and to help with developing mitigation recommendations. The list of completed, active, and future projects can be found on the City's Flood Action Alexandria dashboard (https://www.alexandriava.gov/FloodAction).

Flood insurance claims data was also reviewed. The Privacy Act of 1974 (5 U.S.C. 5222a) restricts the release of flood insurance policy and claims data to the public. This information can only be released to state and local governments for floodplain management-related activities. Therefore, all repetitive loss claims data in this report are only discussed in general terms.

3.3 Step 3. Data Collection

Site visits for the RLAs were completed on May 14 and 16 of 2024. Data was collected to aid in identifying potential causes of repetitive flooding and appropriate mitigation measures.

Although the National Flood Mitigation Data Collection Tool was not utilized in this effort, a site investigation worksheet (Figure 6a and Figure 6b) was created to document flooding-related factors—drainage patterns, locations of HVAC units, nearby storm drain systems, and building appurtenances—from an in-person street view within the right-of-way. Some property owners and/or residents permitted the field survey members to observe their property more closely. Without being inside a building, determining the exact foundation type of a building is challenging. The diagrams in Figure 7a and Figure 7b were used to identify foundations to the extent possible; this information was cross-checked with the questionnaire results from Step 1 and research of the building records as necessary. Data collected from these site visits are detailed in Appendix B, which is subject to the Privacy Act of 1974 and therefore will not be included in the public version of this report.

Site Investigation Worksheet

Repetitive Loss Area: _____

Street Name: _____

Address Numbers: _____

Inspection Date: _____ Inspector: _____

Neighborhood/Building Type: _____

No. of Stories: _____

1) Foundation Type:

☐Slab ☐Crawlspace ☐Posts/Piles ☐Basement ☐Other _____

☐Elevated _____ feet ☐Unable to determine

Notes: _____

_____

2) Building Construction Type:

☐Masonry ☐Wood Frame ☐Concrete ☐Steel ☐Other _____

Notes: _____

_____

3) HVAC Unit Location:

☐Outside: Ground ☐Outside: Elevated ☐Inside

Notes: _____

_____

4) Stormwater Drainage:

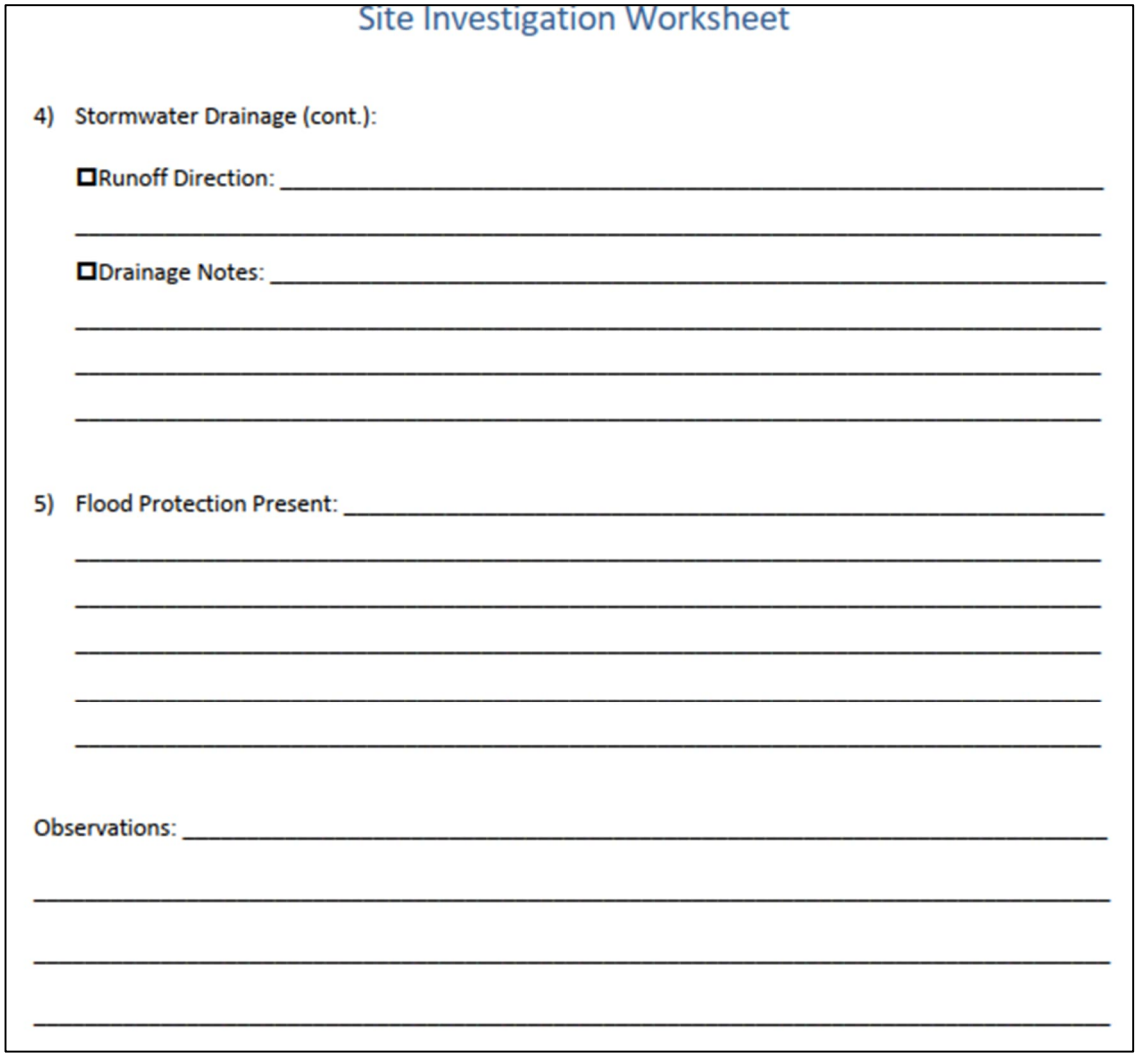
☐Roof Drains: _____

_____

☐Curb Drains: _____

_____

Figure 6a: Step 3: Site Investigation Worksheet



Site Investigation Worksheet

4) Stormwater Drainage (cont.):

☐Runoff Direction: _____

_____

☐Drainage Notes: _____

_____

_____

_____

5) Flood Protection Present: _____

_____

_____

_____

_____

_____

Observations: _____

_____

_____

_____

Figure 6b: Step 3: Site Investigation Worksheet

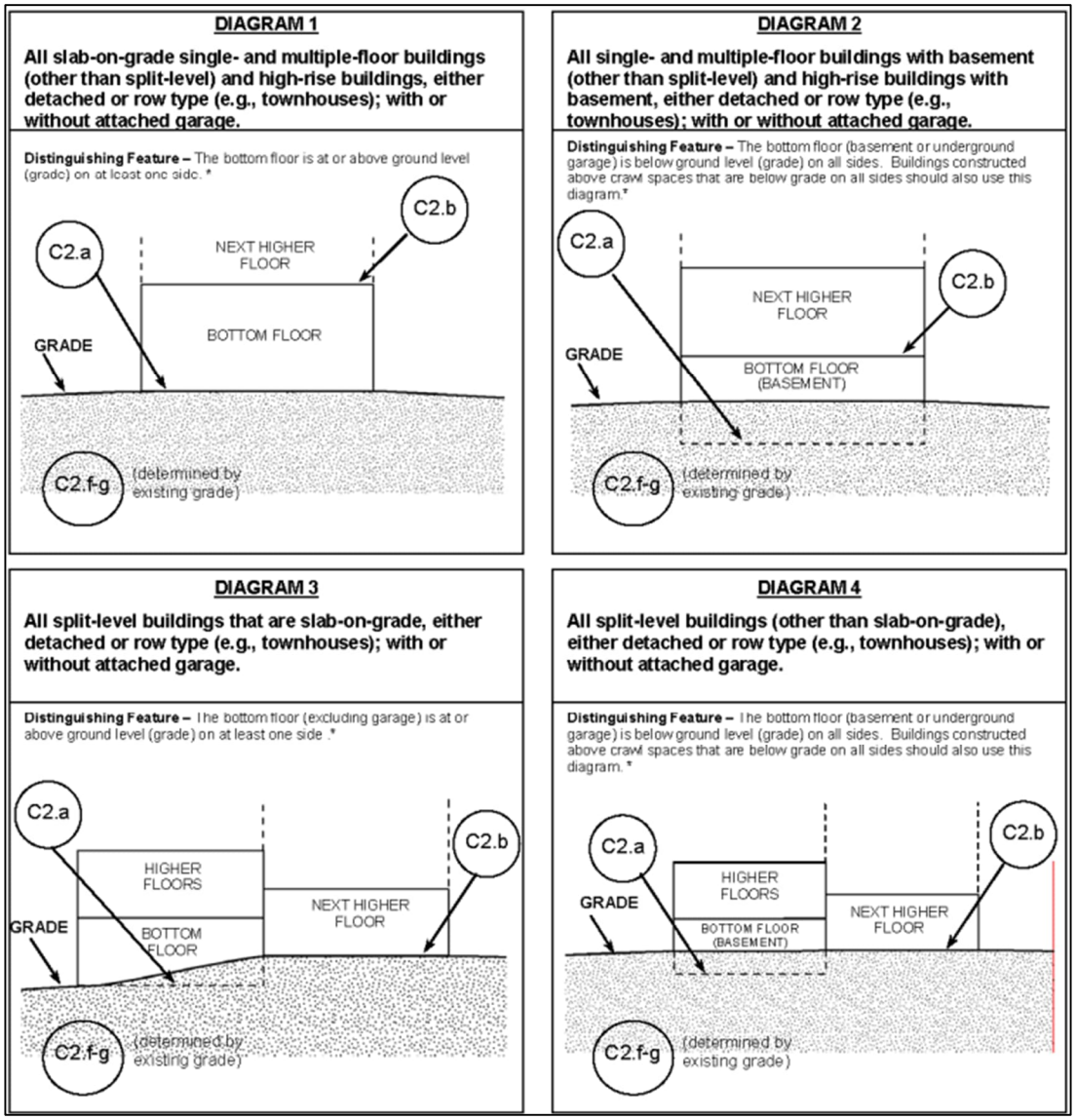


Figure 7a: Step 3: Foundation Diagram

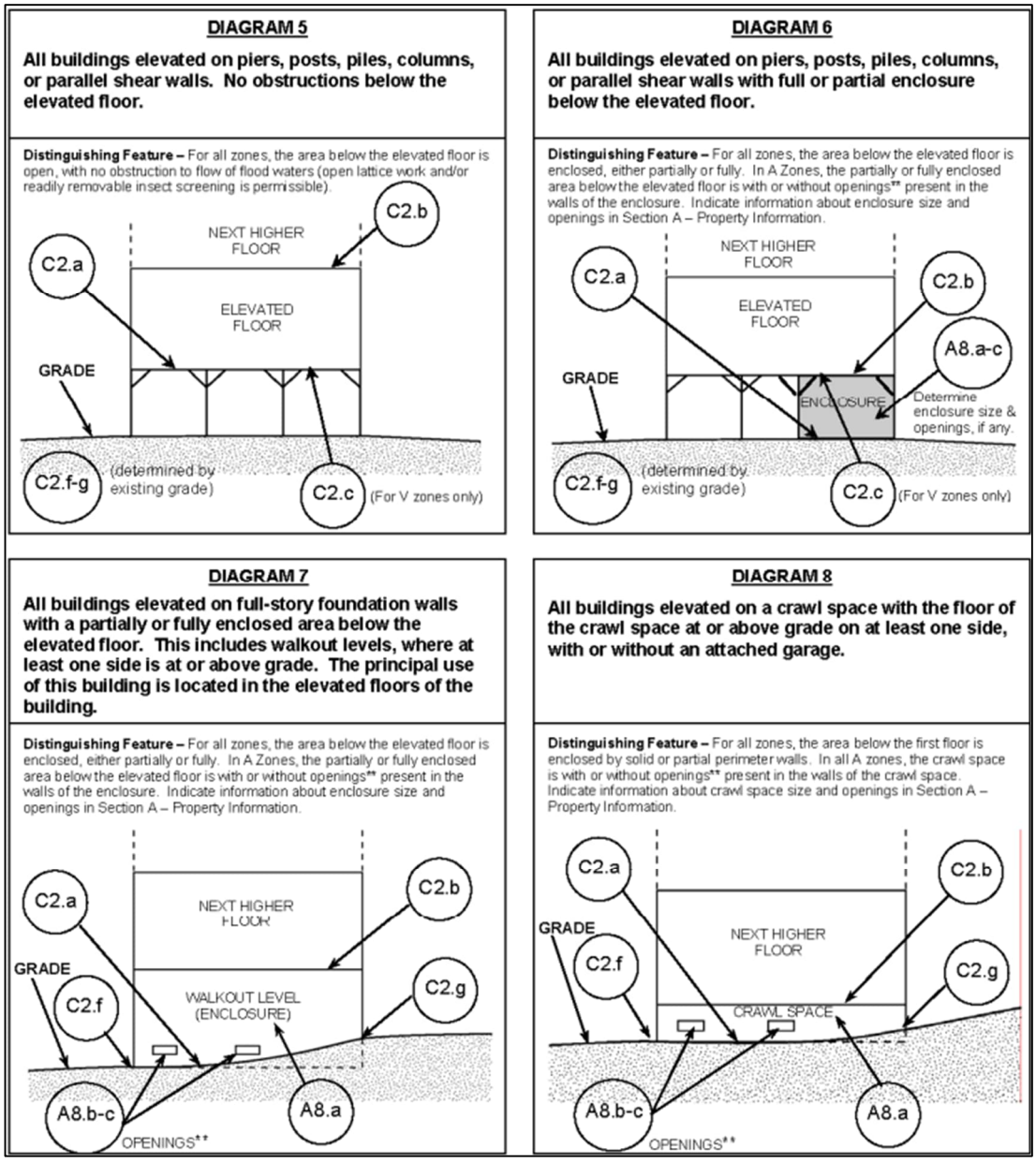
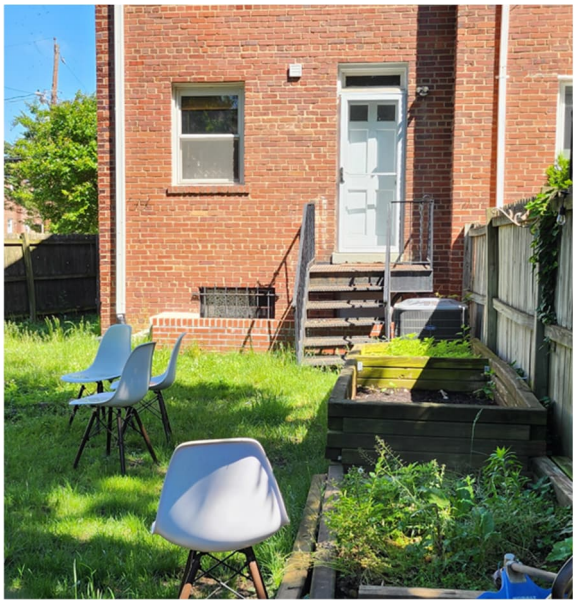
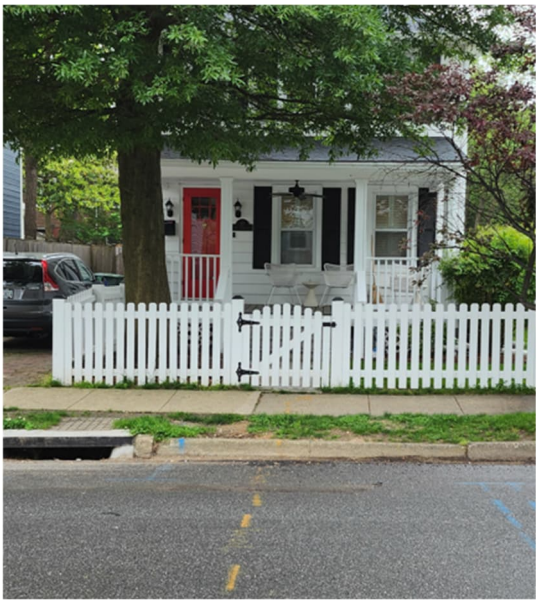


Figure 7b: Step 3: Foundation Diagram

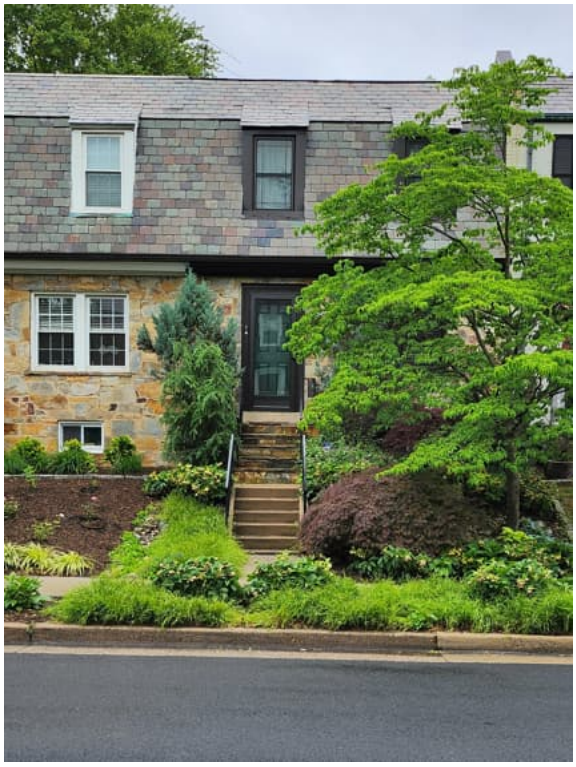
As part of the data collection, pictures were taken of the structures/buildings on the properties as well as of various drainage features, if evident from a street view; some property owners and/or residents permitted the field survey members to take closer pictures. Completion of this step allowed the City to compare the information gathered from Steps 1 and 2 with this field data to create a more comprehensive outlook on the flooding, for which mitigation alternatives can be developed in Step 4.



Brick wall/steps installed around basement entrance to block surface runoff.



Storm drain inlet adjacent to structure entrance.



First floor and basement windows of building elevated above ground surface.

Basement entrance and HVAC unit susceptible to flooding.

3.4 Step 4. Mitigation Alternatives

The information gathered from the previous steps was used to evaluate the causes of flooding for each RLA. Potential flooding sources were cascaded into six categories:

- *Surface Drainage* – Surface runoff flowing toward and encroaching upon structures.
- *Storm Drain System* – Stormwater escaping the system resulting in ponding.
- *Significant Hazard Events* – Natural hazard events with a FEMA Hazard Ranking of "High" from the *Northern Virginia Hazard Mitigation Plan*.
- *Large Rainfall Events* – Storm events that do not coincide with a Significant Hazard Event.
- *Floodplain* – Structure/property located within a floodplain.
- *Waterway* – Flooding resulting from overflow of a natural body of water.

Just as there are many diverse causes of flooding, there are also many different types of potential flood mitigation measures. FEMA established the following six mitigation categories (FEMA 2017a):

- "*Preventive* – activities that keep flood problems from getting worse. The use and development of flood-prone areas is limited through planning, land acquisition, or regulation. They are usually administered by building, zoning, planning, and/or code enforcement offices.
- *Property Protection* – activities that are usually undertaken by property owners on a building-by-building or parcel basis.
- *Natural Resource Protection* – activities that preserve or restore natural areas or the natural functions of floodplain and watershed areas. They are implemented by a variety of agencies, primarily parks, recreation, or conservation agencies or organizations.
- *Emergency Services* – measures [that] are taken during an emergency to minimize its impact. These measures are usually the responsibility of city or county emergency management staff and the owners or operators of major or critical facilities.
- *Structural Projects* – keep flood waters away from an area with a levee, reservoir, or other flood control measure. They are usually designed by engineers and managed or maintained by public works staff.
- *Public Information* – activities that advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards, and the natural and beneficial functions of local floodplains. They are usually implemented by a public information office."

With an understanding of the potential causes of flooding for each respective RLA and property, a combination of mitigation measures can be recommended to lessen the impacts of flooding. The objective is to evaluate realistic and feasible mitigation measures to reduce damage from recurring floods; grants and other forms of financial assistance may be available to some residents.

3.4.1 Mitigation Funding

Some mitigation measures may qualify for one or more grant programs or loans from various agencies and organizations such as local governments or FEMA. Depending on the type of structure, severity of flooding and proximity to additional structures with similar flooding conditions, certain mitigation measures taken by the property owner may be eligible for the aforementioned grants and loans. Table 2 lists various Federal programs versus the different types of projects that they are eligible for the property owner can implement.

Table 2: Mitigation Funding Programs

Types of Projects Funded	Hazard Mitigation Grant Program[1] & 2	Flood Mitigation Assistance[1]	Pre-Disaster Mitigation[1]	Repetitive Flood Claims	Severe Repetitive Loss[1]	Increased Cost of Compliance[3]	Small Business Administration[2] & 4
Acquisition of the entire property by a government agency	✓	✓	✓	✓	✓		
Relocation of the building to a flood free site	✓	✓	✓	✓	✓	✓	✓
Demolition of the structure	✓	✓	✓	✓	✓	✓	✓
Elevation of the structure above flood levels	✓	✓	✓		✓	✓	✓
Replacing the old building with a new elevated one	✓				✓	✓	✓
Local drainage and small flood control projects	✓				✓		
Dry floodproofing (non-residential buildings only)		✓	✓		✓	✓	✓
Percent paid by program	75%	75%	75%	100%	75%	100%	0%

1. Requires a grant application from your local government
2. Only available after a Federal disaster declaration
3. Requires the building to have a flood insurance policy and to have been flooded to such an extent that the local government declares it to be substantially damaged. Pays 100% up to $30,000.
4. This is a low interest rate loan that must be paid back.

In addition to those FEMA mitigation funding opportunities, the City has established their own Flood Mitigation Program (www.alexandriava.gov/flood-action/flood-mitigation-grant-program) that allows all property owners in the City to apply for funding for projects up to 50% of the mitigation measure's total cost.

3.5 Step 5. Findings

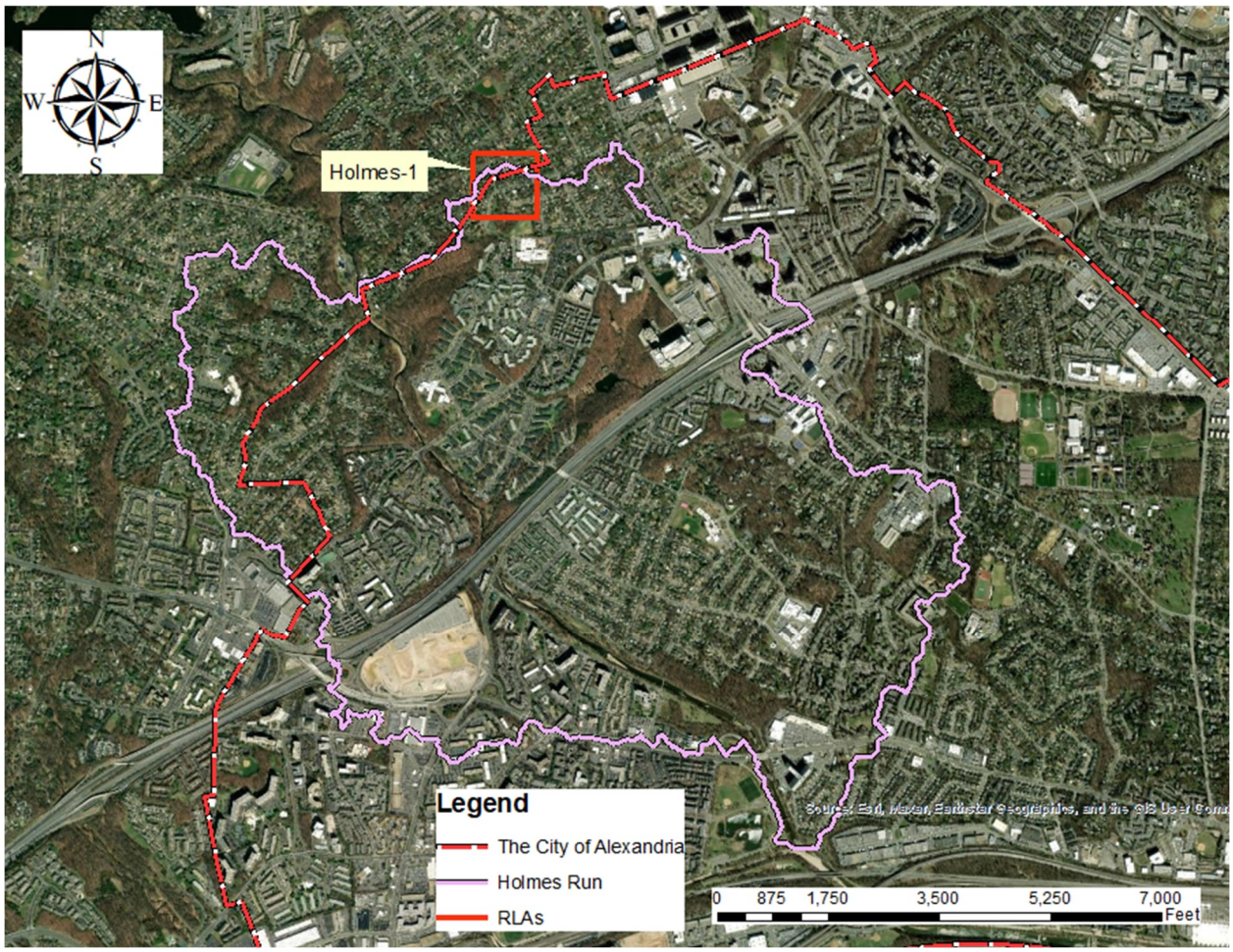
This RLAA report presents findings and mitigation measures for each RLA within the six different watersheds in Alexandria: Holmes Run, Four Mile Run, Hooffs Run, Taylor Run, Cameron Run, and the Potomac River. Individual RLA maps are in Appendix C but are subject to the Privacy Act of 1974 and therefore will not be shared in the public version of this report.

4 Repetitive Loss Areas

4.1 Holmes Run

4.1.1 Problem Statement

Within the Holmes Run watershed, there is one RLA (Holmes-1), as seen in Figure 8, that contains one Repetitive Loss property and four properties/structures with similar flooding characteristics. Those properties each experience surface runoff flowing to the back of their structures and are adjacent to the storm drain inlet. The flooding sources for this area are *Surface Drainage* and *Significant Hazard Events*.



Source: ESRI

Figure 8: Holmes Run RLAs

Based on results from steps 1, 2, and 3 of the RLAA process, the buildings are all single-family houses that have a single floor with basements that are split-levels; all appear to be in good condition. The building construction type in this area varies between brick, vinyl, and stone, which all appear in good condition. No mitigation measures were observed along the front of the properties.

One-level structure with elevated first floor and split-level basement.

Storm drain inlet blocked with leaves and debris.

4.1.2 Mitigation Alternatives – Holmes-1

Grading/Drainage Improvement: A *Property Protection* mitigation measure to combat surface runoff that may be encroaching the back of the structures is to construct a structural barrier or berm to convey that runoff away from the structure and toward the roadway. Although the responsibility for this mitigation falls upon the property owner, there is local government funding for local drainage and small flood control projects through the City's Floodproofing Grant Program.

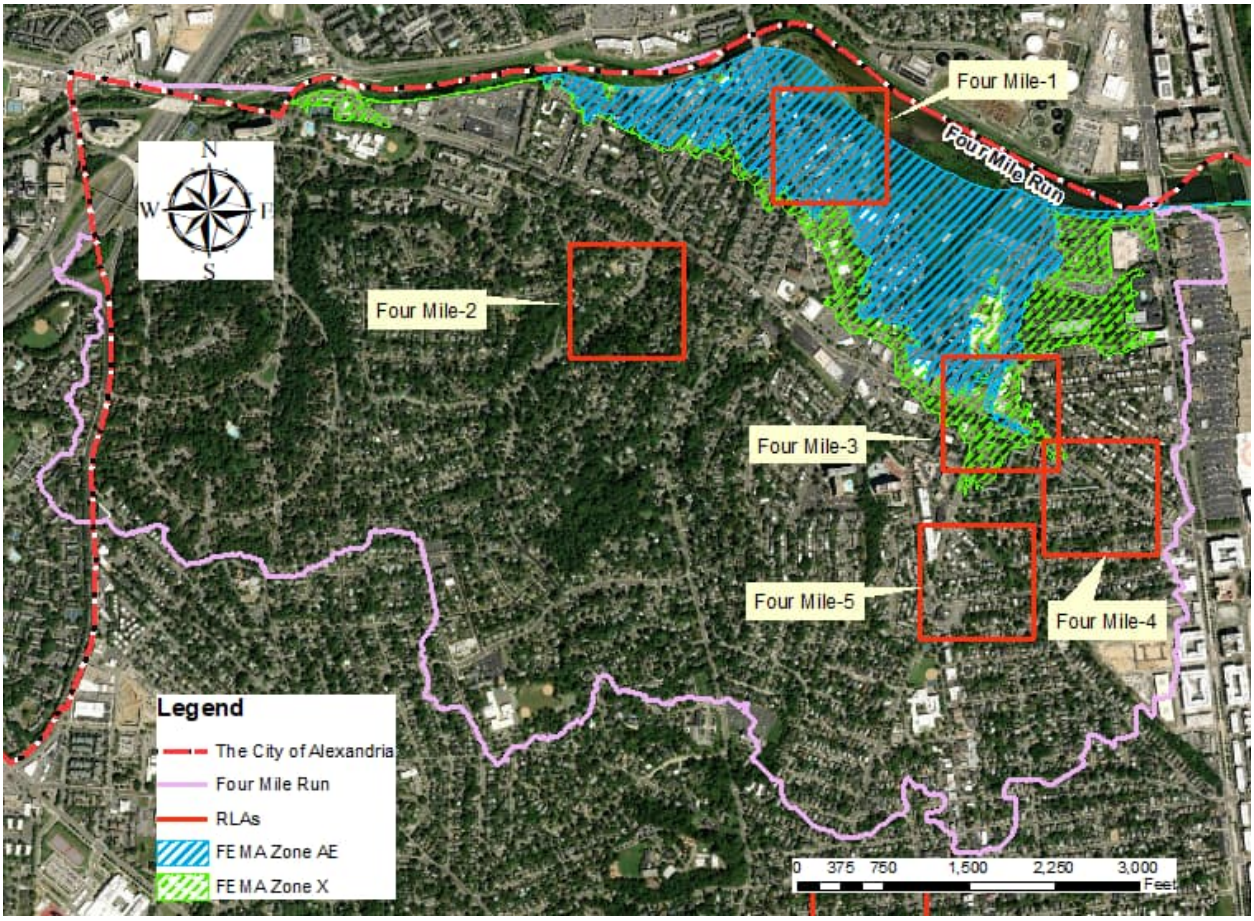
Maintain Storm Inlet Capacity: A *Structural Project* that the City's Transportation and Environmental Services (T&ES) can implement is to increase the frequency of storm drain inlet maintenance to improve conveyance of surface runoff into the storm drain system.

4.2 Four Mile Run

4.2.1 Problem Statement

Within the Four Mile Run watershed, there are five separate RLAs, as seen in Figure 9, that contain 113 properties/structures with similar flooding characteristics; there are 11 Repetitive Loss properties in these areas.

- Being located within a *Floodplain* (Zones AE and X) is a flooding source in Four Mile-1 and -3; the floodplains from the FIRMs with an effective date of January 11, 2024, were used in this analysis.
- *Surface Drainage* is a flooding source for areas Four Mile-1, -2, and -4. Capacity and conveyance are issues of the *Storm Drain System* within areas Four Mile-3, -4, and -5.
- Flooding because of *Significant Hazard Events* affected areas Four Mile-2, -3, -4, and -5.
- *Large Rainfall Events* outside of the Significant Hazard Events resulted in flooding within areas Four Mile-1, -3, -4, and -5.
- The Four Mile-1 area also experienced flooding due to being located near a *Waterway* (Four Mile Run).



Source: ESRI

Figure 9: Four Mile Run RLAs

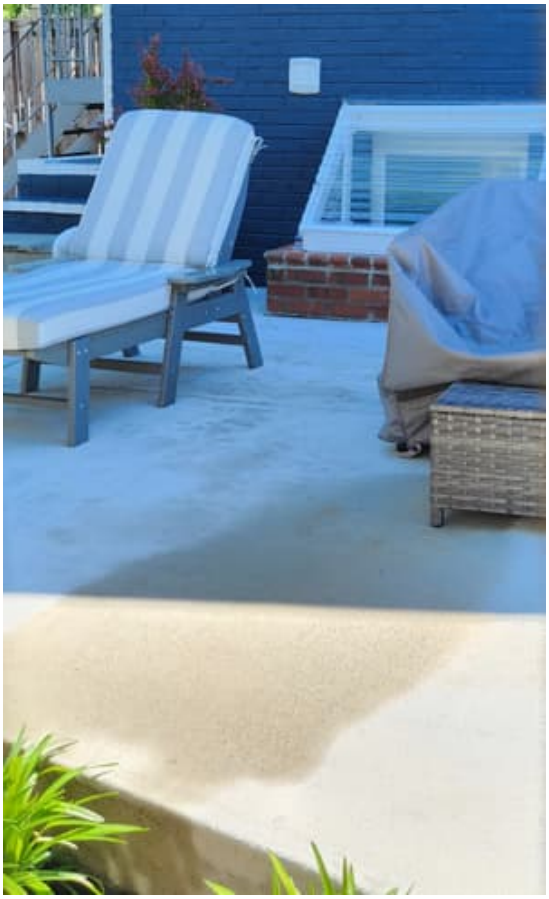
Based on results from Steps 1, 2, and 3 of the RLAA process, buildings in these RLAs consist of townhouses, single-family houses, condos/apartments, and businesses. The foundations of those structures are a mix of slab-on-grade, crawlspaces, and basements. Brick masonry is the predominant building construction type with some vinyl siding, which all appear in good condition. Mitigation measures were observed during the site visits, and results from the questionnaires revealed that mitigation measures such as sump pumps, floodwalls, re-grading of land, and sandbags have been installed/implemented.

Standing water near property boundary.

Re-graded driveway with barrier.

Standing water along curb & gutter.

Dry floodproofing, floodwall at garage entrance.



Dry floodproofing, protection around basement window.

Storm drain and sanitary structures adjacent to houses.

4.2.2 Mitigation Alternatives – Four Mile-1

"Notabene Dr. and Old Dominion Blvd.": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. Although this project is not located within the RLA, it will explore opportunities to improve the conveyance and storage of stormwater immediately upstream of the waterway that does have an impact on this area. This project will be funded by the City's Stormwater Utility (SWU).

Stormwater Mitigation for Future Development: Since this RLA is located within a floodplain, a *Preventive* mitigation measure is to regulate future development to prioritize flood and stormwater mitigation for both new development and re-development projects. This can be implemented by the City's T&ES through its updated floodplain ordinance that went into effect in January 2024.

Maintain Four Mile Run: A *Natural Resource Protection* mitigation measure is to improve the conveyance of water within the un-named tributary discharging into Four Mile Run to reduce the area of inundation encroaching onto the properties. This can be addressed by removing any accumulated sediment along the stream. This mitigation measure was performed on this stream in the past with positive results, so it is recommended to increase the frequency of this maintenance

measure. This mitigation measure will be addressed by the City's T&ES through its Four Mile Run Channel Maintenance program.

4.2.3 Mitigation Alternatives – Four Mile-2

Grading/Drainage Improvement: A *Property Protection* mitigation measure to combat surface runoff that may be encroaching on the back of the structures in this RLA is to construct a structural barrier or berm to convey that runoff away from the homes and toward the roadway. Although the responsibility for this mitigation falls upon the property owner, there is local government funding for local drainage and small flood control projects through the City's Floodproofing Grant Program.

Re-grade Driveways: This *Property Protection* mitigation measure entails the re-grading of driveways to promote surface runoff toward the roadway. This mitigation measure was observed throughout this RLA with positive results. Although the responsibility for this mitigation falls upon the property owner, there is local government funding for local drainage and small flood control projects through the City's Floodproofing Grant Program.

4.2.4 Mitigation Alternatives – Four Mile-3

"Commonwealth, Ashby, Glebe Flood Mitigation Project": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. This project will explore opportunities to improve the conveyance capacity and provide additional stormwater storage within the storm drain system. Green infrastructure will also be a part of this project to provide water quality treatment of the surface runoff. This project will be funded by the City's SWU and Virginia Community Flood Preparedness Fund. This project will also benefit the Four Mile-4 and -5 RLAs.

4.2.5 Mitigation Alternatives – Four Mile-4

Grading/Drainage Improvement: A *Property Protection* mitigation measure to combat surface runoff that may be encroaching on the back of the structures in this RLA is to construct a structural barrier or berm to convey that runoff away from the homes and toward the roadway. Even though the responsibility for this mitigation falls upon the property owner, there is local government funding for local drainage and small flood control projects through the City's Floodproofing Grant Program.

4.2.6 Mitigation Alternatives – Four Mile-5

"Clifford, Fulton, and Manning Storm Sewer Improvements": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. This project entails the installation of green infrastructure to infiltrate surface runoff, which will help lessen the burden on the conveyance system; an added benefit is the water quality treatment of surface runoff within the Fulton St. alleyway. A conveyance channel through the alley will aid in moving water through the neighborhood and help prevent the ingress of surface drainage onto private properties. This project will be funded by the U.S. Representative for Virginia, D. Beyer.

Upgrade Storm Drain System between Manning St. and Glebe Rd.: To accompany other planned projects by the City ("Clifford, Fulton, and Manning Storm Sewer Improvements" and

"Commonwealth, Ashby, Glebe Flood Mitigation Project"), this *Structural Project* is to improve the storm drain system between Manning Street and East Glebe Road. This project will be the responsibility of the City, as the storm drain system is located within the right-of-way.

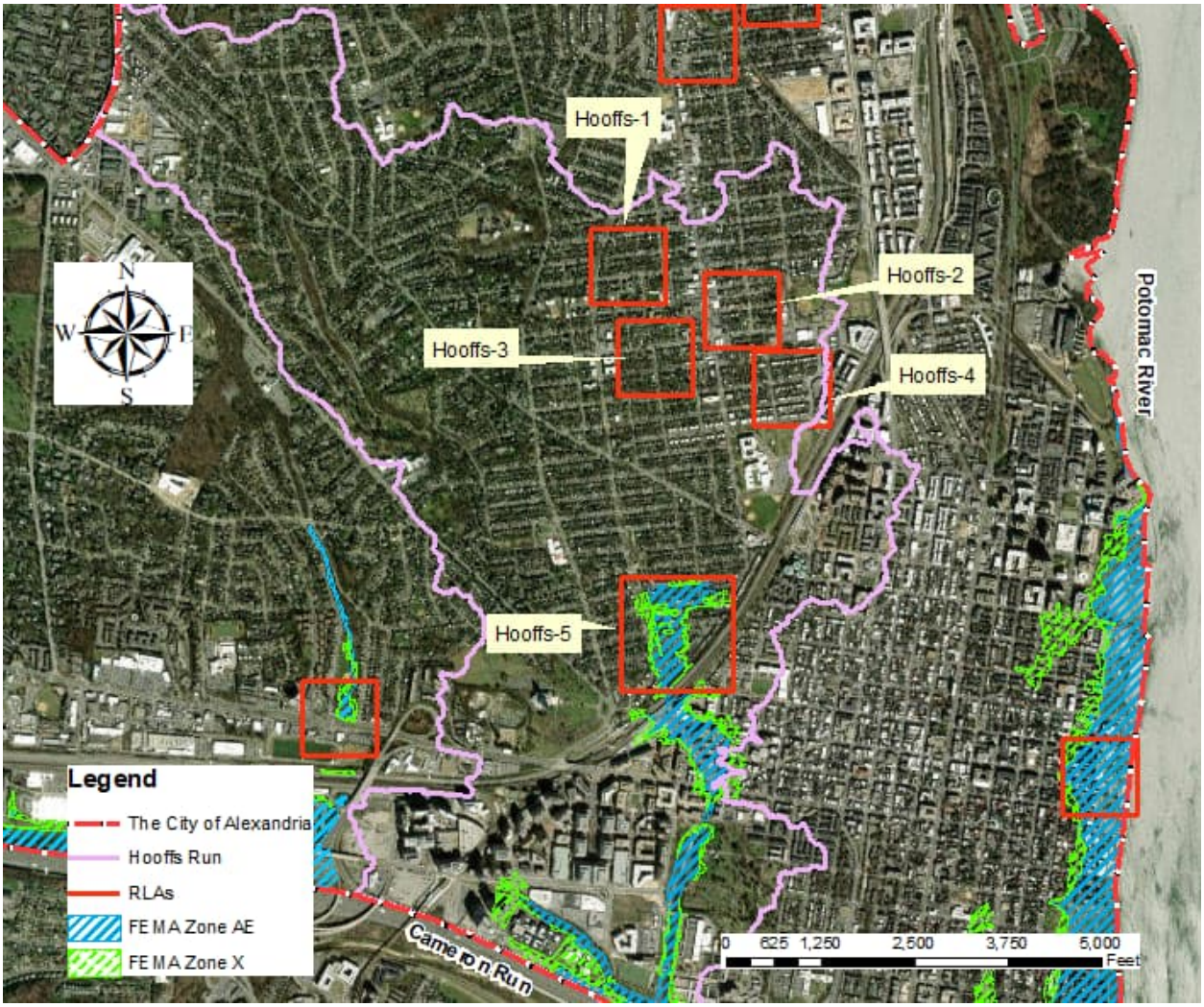
"Clifford Ave. & Manning St. Curb Inlet": This is a *Structural Project* that the City's T&ES implemented as part of its comprehensive initiative to address flooding issues. This project added additional storm drain inlets as well as increased the size of the existing storm drain inlets to improve the conveyance of surface runoff into the storm drain system, resulting in a reduction of stormwater spread on the roadway. This project was completed in January 2023 and funded by the City's SWU, and has had positive results.

4.3 Hooffs Run

4.3.1 Problem Statement

Within the Hooffs Run watershed, there are five separate RLAs, as seen in Figure 10, that contain 237 properties/structures with similar flooding characteristics; there are 17 Repetitive Loss properties in these areas.

- All the RLAs have experienced flooding due to *Significant Hazard Events*.
- *Surface Drainage* is a flooding source for areas Hooffs-1, -2, and -3.
- Capacity and conveyance issues of the *Storm Drain System* within areas Hooffs-1, -2, and -4 is another flooding source.
- Being located near a *Waterway* (Hooffs Run) and within a *Floodplain* (Zones AE and X) are additional flooding sources for area Hooffs-5; the floodplains from the FIRMs with an effective date of January 11, 2024, were used in this analysis.



Source: ESRI

Figure 10: Hooffs Run RLAs

Based on results from Steps 1, 2, and 3 of the RLAA process, buildings are predominantly townhouses with single-family houses. The foundations of those structures are predominantly basements with some slab-on-grade. Brick masonry is the predominant building construction type with some stone and vinyl, which all appear in good condition. Mitigation measures were observed during the site visits, and results from the questionnaires revealed that mitigation measures such as sump pumps, floodwalls, re-grading of land, and sandbags have been installed/implemented.

Elevated front entrance and lower basement entrance protected with wall/steps.

Lower basement entrance protected with wall/steps adjacent to storm drain inlet.

Front of structure susceptible to flooding since sidewalk is higher than structure's walkway.

Elevated HVAC unit.

Opening of Hooffs Run Culvert adjacent to backyard of a structure.

4.3.2 Mitigation Alternatives – Hooffs-1

Grading/Drainage Improvement: A *Property Protection* mitigation measure to combat surface runoff that may be encroaching the front and back of the structures is to re-grade the surface around the home to promote drainage of stormwater away from the homes and toward the roadways and alleyways. Although the responsibility for this mitigation falls upon the property owner, there is local government funding for local drainage and small flood control projects through the City's Floodproofing Grant Program.

"Bellefonte Ave. Storm Drain Improvements": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. Based on review of the drainage patterns, site visits, and questionnaire results, rainwater ponds on the streets and in the alleyways. Providing additional storm drain catch basins along the roadways and the alleyways, while increasing the capacity of the adjacent system's pipes, will mitigate the impacts of flooding in the fronts and backs of the structures. This project will be funded by the City's SWU through its Storm Sewer System Spot Improvements project.

4.3.3 Mitigation Alternatives – Hooffs-2

"E. Mason Ave. Curb Inlets": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. Based on review of the drainage patterns, site visits, and questionnaire results, a factor of the flooding is water not being conveyed in a timely manner from the road into the storm drain system. This project will increase the size of the existing storm drain inlets to increase the capture of surface runoff. This project will be funded by the City's SWU through its Inlet Capacity Program.

"E. Mason Ave. & E. Duncan Ave. Storm Drain Connection": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. To improve the capacity and collection of the surface runoff in the alleyway between East Mason and

East Duncan Avenues, this project will connect the two separate storm drain systems. This project will be funded by the City's SWU through its Storm Sewer Capacity Projects.

"E. Mason Ave. Storm Drain Extension": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. To discourage ponding in the roadway, this project will install an additional storm drain system branch to provide additional capacity to capture surface storage. This project will be funded by the City's SWU.

"E. Mason Ave. Storage": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. To improve capacity within the overall storm drain system, the opportunity to provide temporary storage during large storm events is being explored. This will provide relief of the storm drain system upstream in this RLA. This project will be funded by the City's SWU.

4.3.4 Mitigation Alternatives – Hooffs-3

Grading/Drainage Improvement: A *Property Protection* mitigation measure to combat surface runoff that may be encroaching on the back of the structures in this RLA is to construct a structural barrier or berm to convey that runoff away from the homes and toward the roadway. Although the responsibility for this mitigation falls upon the property owner, there is local government funding for local drainage and small flood control projects through the City's Floodproofing Grant Program.

"E. Monroe Ave. & Newton St. Curb Inlets": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. To reduce the area of spread resulting from the existing storm drain inlets that are too small, this project will replace them with larger curb inlets to increase the surface runoff captured. This project will be funded by the City's SWU through its Storm Sewer Capacity Projects.

"E. Monroe and Wayne St. Conveyance": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. To mitigate the flooding resulting from surface drainage issues, this project will explore opportunities to increase the storm drain system's conveyance capacity. This project will be funded by the City's SWU through its Storm Sewer System Spot Improvements Projects.

4.3.5 Mitigation Alternatives – Hooffs-4

"E. Alexandria Ave. & Luray Ave. Curb Inlets": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. To reduce the area of spread resulting from the existing storm drain inlets that are too small, this project will replace them with larger curb inlets to increase the surface runoff captured. This project will be funded by the City's SWU.

"500 E. Alexandria Ave. Alleyway Storm Drain Extension": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. To increase the amount of surface runoff captured by the inadequate storm drain systems in the alleyways, trench

drains will be installed. This project will be funded by the City's SWU through its Storm Sewer Capacity Projects.

"DeWitt Ave. Storage and Conveyance": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. To mitigate the flooding resulting from storm drain system capacity issues, this project will explore opportunities to increase the storm drain system's conveyance capacity and provide temporary storage during large rain events. This project will be funded by the City's SWU.

"Mt. Vernon, E. Glendale, E. Luray, E. Alexandria": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. To mitigate the flooding resulting from storm drain system capacity issues, this project will explore opportunities to increase the storm drain system's conveyance and storage capacity. This project will be funded by the City's SWU through its Storm Sewer Capacity Projects.

Install Check Valves in Alleyway Storm Drain Systems: A *Structural Project* that can be implemented prior to and/or in conjunction with the "500 E. Alexandria Ave. Alleway Storm Drain Extension" project is to install check valves in the storm drain system branches that have inlet openings adjacent to buildings. This will discourage collected downstream stormwater from backing up and escaping through the upstream storm drain inlets. Even though segments of the storm drain system traverse private property, the responsibility of this project will fall upon the City's T&ES.

4.3.6 Mitigation Alternatives – Hooffs-5

"Mt. Vernon Cul-de-Sac Inlets and Alley": A *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues, this project entails re-grading of the alleyway to promote positive drainage away from the houses and toward an improved storm drain system. A check valve will also be installed in the sanitary system to prevent backflow in the collection system. This project will be funded by the American Rescue Plan Act.

Stormwater Mitigation for Future Development: As this RLA is located within a floodplain, a *Preventive* mitigation measure is to regulate future development to prioritize flood and stormwater mitigation for both new development and re-development projects. This can be implemented by the City's T&ES through its updated floodplain ordinance that went into effect in January 2024.

Maintain Hooffs Run: A *Natural Resource Protection* mitigation measure is to improve the conveyance of water within the open and closed/underground portions of this channel to reduce the area of inundation encroaching onto the properties. This can be addressed by removing any accumulated sediment along the stream and within the underground box culvert. This mitigation measure was performed on this stream in the past with positive results, so it is recommended to increase the frequency of this maintenance measure. This mitigation measure will be addressed by the City's T&ES Hooffs Run Culvert Maintenance program.

4.3.7 Mitigation Alternatives – Hooffs Run Watershed

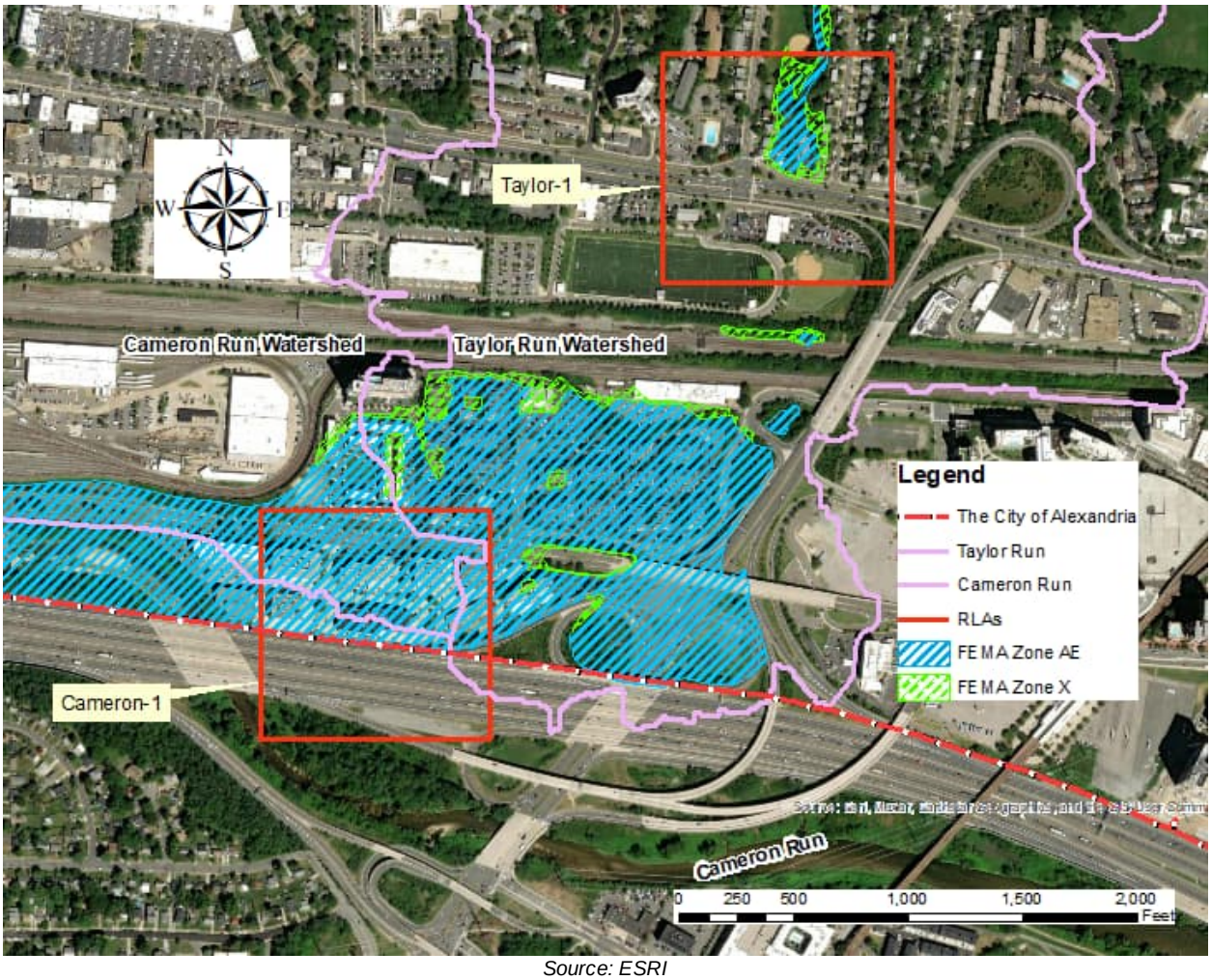
"Hooffs Run Culvert Bypass": This is a *Structural Project* that the City's T&ES has planned as part of its comprehensive initiative to address flooding issues. This project entails the construction of a new storm drain system to convey stormwater from Timber Branch away from Hooffs Run to reduce the volume of water in the existing storm drain system. The capacity of Hooffs Run will not increase, but the typical volume of stormwater in the system will decrease resulting in a decreased area of inundation in this RLA. This can also be considered a *Natural Resource Protection* project, as it will improve the conveyance of Hooffs Run. This project will be funded by the City's SWU.

4.4 Taylor & Cameron Runs

4.4.1 Problem Statement

Within the Taylor and Cameron Run watersheds, there are two separate RLAs, Taylor-1 and Cameron-1, as seen in Figure 11, which includes 18 and 10 properties/structures, respectively, with similar flooding characteristics; there are two and one Repetitive Loss properties in Taylor-1 and Cameron-1 areas respectively.

- Both Taylor-1 and Cameron-1 areas experience flooding due to being in a *Floodplain* (Zones AE and X) and being adjacent to *Waterways*; the floodplains from the FIRMs with an effective date of January 11, 2024, were used in this analysis.
- The Taylor-1 area also experiences flooding due to *Significant Hazard Events*.
- Both Taylor-1 and Cameron-1 areas also experience flooding due to *Large Rainfall Events*.



Source: ESRI

Figure 11: Taylor and Cameron Run RLAs

Based on results from Steps 1, 2, and 3 of the RLAA process, the buildings in the two areas have a mix of different types of foundations: slab, elevated, posts/piles, or split-level basements. No mitigation measures were observed along the front of the properties. Taylor Run and Cameron Run are the two waterways that both Taylor-1 and Cameron-1 areas are adjacent to, respectively. Although mitigation measures were not observed during the site visits, the results from the questionnaires revealed that mitigation measures such as sump pumps and waterproofing of walls were implemented.

Parking areas adjacent to stream.

Elevated entrance to building.

Elevated utility unit.

4.4.2 Mitigation Alternatives – Taylor-1

Maintain Taylor Run: A *Natural Resource Protection* mitigation measure is to improve the conveyance of water within the stream to reduce the area of inundation encroaching onto the properties. This can be addressed by removing any accumulated sediment along the stream. A *Structural Project* that can coincide with this mitigation measure is to perform a capacity and condition assessment of the culverts/structures that may constrict the stream. This mitigation measure will be addressed by the City's T&ES Stream & Channel Maintenance program.

4.4.3 Mitigation Alternatives – Cameron-1

Maintain Cameron Run: A *Natural Resource Protection* mitigation measure is to improve the conveyance of water within the stream to reduce the area of inundation encroaching onto the properties. This can be addressed by removing any accumulated sediment along the stream. This mitigation measure was performed on this stream in the past with positive results, so it is recommended to increase the frequency of this maintenance measure. This mitigation measure will be addressed by the City's T&ES Stream & Channel Maintenance program.

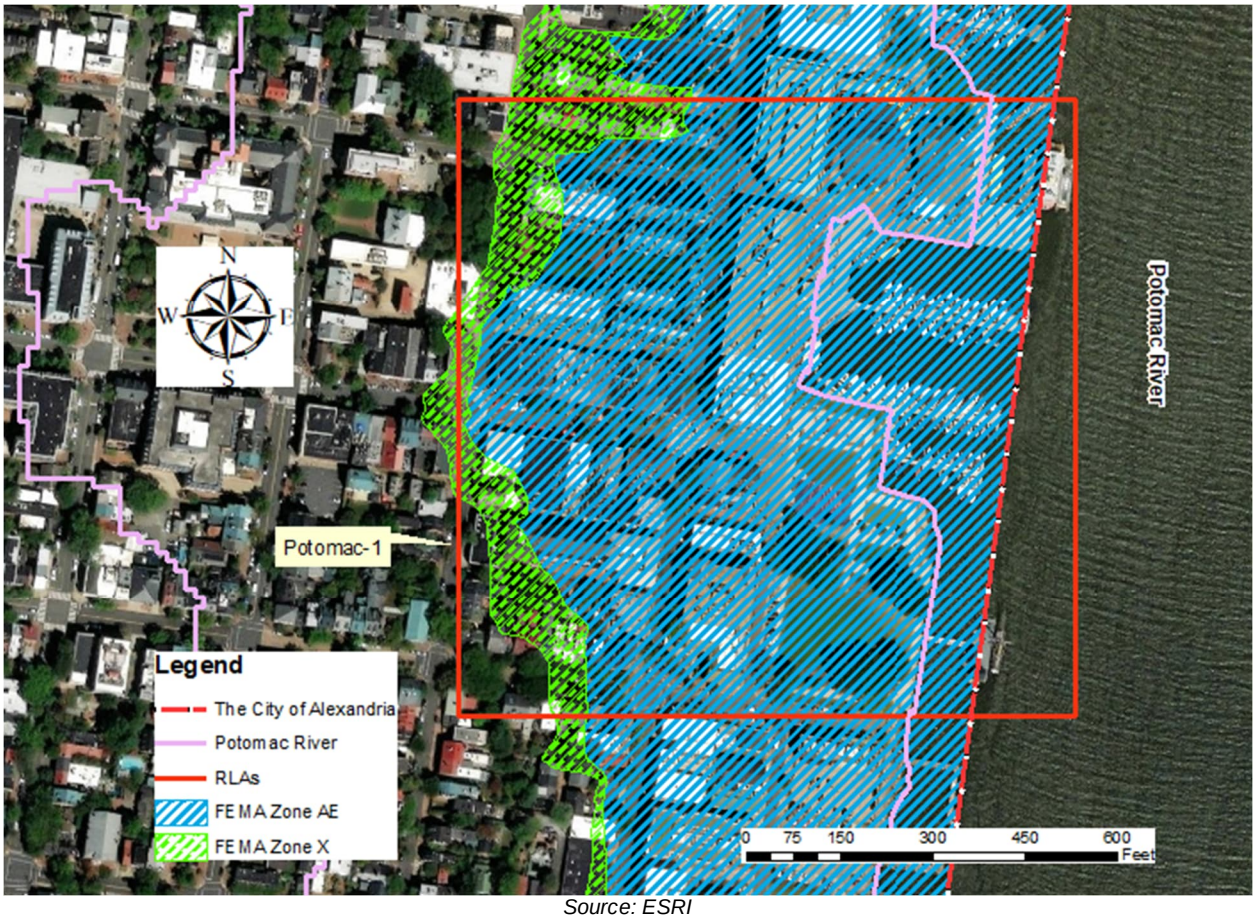
4.4.4 Mitigation Alternatives – Taylor & Cameron Run Watersheds

Stormwater Mitigation for Future Development: Since both RLAs are located within a floodplain, a *Preventive* mitigation measure is to regulate future development to prioritize flood and stormwater mitigation for both new development and re-development projects. This can be implemented by the City's T&ES through its updated floodplain ordinance that went into effect in January 2024.

4.5 Potomac River

4.5.1 Problem Statement

Within the Potomac River watershed, there is one RLA (Potomac-1), as seen in Figure 12, which encompasses 40 properties/structures of which four are Repetitive Loss properties. The primary flooding source within this RLA is being located within a *Floodplain* (Zones AE and X); the floodplains from the FIRMs with an effective date of January 11, 2024, were used in this analysis. In addition to being located within a floodplain, this area is also located near the Potomac River *Waterway* in which flooding is a result of tidal events in conjunction with storm surge. This RLA has also experienced flooding due to *Significant Hazard Events* and *Large Rainfall Events*. Even though surface drainage patterns and storm drain capacity could be improved, the inefficiencies are a result of the aforementioned flooding sources.



Source: ESRI

Figure 12: Potomac River RLAs

Based on results from Steps 1, 2, and 3 of the RLAA process, buildings in these RLAs consist of condos/apartments and businesses. The foundations of those structures are a mix of slab-on-grade and posts/piles. Brick masonry is the predominant building construction type, and all appear in good condition. No mitigation measures were observed during the site visits.

Elevated first floor entrance.

Ponded water at storm drain inlet.

Leakage of roof drain.

4.5.2 Mitigation Alternatives – Potomac-1

Stormwater Mitigation for Future Development: As the RLA is located within a floodplain, a *Preventive* mitigation measure is to regulate future development to prioritize flood and stormwater mitigation for both new development and re-development projects. This can be implemented by the City's T&ES through its updated floodplain ordinance that went into effect in January 2024.

Re-grade Strand Street: This *Structural Project* entails the re-grading of Strand Street to promote positive drainage away from the buildings and toward the Potomac River. In conjunction with this re-grading, the storm drain system corresponding with the storm drain inlets in Strand Street should have check valves installed to prevent backflow from the Potomac River. Even though segments of

the storm drain system traverse private property, the responsibility of this project will fall upon the City's T&ES.

Self-Deploying Barriers at Parking Lots: Wet-floodproofing as a *Property Protection* mitigation measure in the form of self-deploying barriers will protect the parking garages from encroaching floodwater. Even though the responsibility for this mitigation falls upon the property owner, there is local government funding for local drainage and small flood control projects.

Maintain Roof Drains: A *Property Protection* mitigation measure is to maintain all roof drains to ensure that they convey stormwater safely to their corresponding storm drain system and/or curb and gutters. Some roof drains were observed to have debris at their outfalls, don't discharge safely to a curb and gutter, and/or are leaking. Even though the responsibility for this mitigation falls upon the property owner, there is local government funding for local drainage and small flood control projects.

5 Conclusion and Recommendations

The City will encourage property owners to implement floodproofing measures and to take advantage of its Sandbag Program in which sandbags are provided to any resident affected by flooding. The City will also work with property owners, the state, and other regional and federal agencies to devise other capital improvement projects to mitigate flooding impacts; the City launched their Flood Mitigation Grant Program in August of 2021 as part of their Flood Action Alexandria initiative. Property owners should obtain and keep a flood insurance policy on their structures. In addition to the RLA-specific mitigation measures, there are general recommendations that apply to all properties subject to repetitive flooding such as the following:

Improve Communication and Engagement: A *Public Information* mitigation measure that the City's T&ES can implement to combat damage from forecasted significant hazard events is to continue improving its public education programs on local flood hazards. The City's T&ES can perform this by updating its websites, posting signs throughout the community, discussing flood protection measures during Stormwater Utility and Flood Mitigation Advisory committee meetings, and/or local neighborhood association meetings.

Elevate Structures: A *Property Protection* mitigation measure that is recommended for all RLAs within this watershed is to elevate damage-prone structures such as HVAC units and furnaces above a previously experienced flood elevation level to avoid encroachment from flood waters. Although the responsibility for this mitigation falls upon the property owner, there is local government funding for local drainage and small flood control projects.

Dry Floodproofing: This *Property Protection* mitigation measure entails installing watertight shields over building openings such as windows and doors that require human intervention in a timely manner prior to a heavy rainfall event. Even though the responsibility for this mitigation falls upon the property owner, there is local government funding for local drainage and small flood control projects.

Funding for the aforementioned planned projects has been allocated through fiscal year 2034; Table 3 lists the corresponding funding for the City planned projects.

Table 3: City of Alexandria Stormwater Management Capital Improvement Program

The City Capital Improvement Program	Expenditure Budget through FY 2034
Floodproofing Grant Program	$11,212,500
Four Mile Run Channel Maintenance	$10,363,181
Hooffs Run Culvert Maintenance	$9,490,192
Inlet Capacity Program	$1,584,100
Commonwealth Ave, E. Glebe Rd, & Ashby St	$47,534,073
Hooffs Run Culvert Bypass	$59,315,250
Stormwater Maintenance Projects	$9,920,300
Mt. Vernon Cul-de-Sac and Alley	$1,232,784
Storm Sewer Capacity Projects	$89,224,307

The City Capital Improvement Program	Expenditure Budget through FY 2034
Storm Sewer System Spot Improvements	$60,163,717
Stream and Channel Maintenance	$19,309,294

In addition to establishing programs to provide protection and funding for flood protection, FEMA regularly issues manuals and publications to inform businesses and residents about the dangers and causes of flooding and methods to deal with their impacts. The following is a list of some of those publications that provide guidance on protection of properties:

- FEMA P-85, Protecting Manufactured Homes from Floods and Other Hazards
- FEMA P-259, Engineering Principles and Practices of Retrofitting Floodprone Residential Structures, 3rd Edition
- FEMA P-312, Homeowner's Guide to Retrofitting, 3rd Edition
- FEMA 347, Above the Flood: Elevating Your Floodprone House
- FEMA P-348, Protect Your Property from Flooding: Protecting Building Utility Systems from Flood Damage
- FEMA 511, Reducing Damage from Localized Flooding
- FEMA 551, Selecting Appropriate Mitigation Measures for Floodprone Structures
- FEMA P-936, Floodproofing Non-Residential Buildings

6 References

Federal Emergency Management Agency, Flood Insurance Study, City of Alexandria, VA, January 11, 2024.

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