

# Virginia Community Flood Preparedness Fund Grant Application

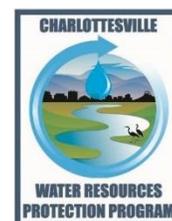
2-Dimensional Stormwater Management Model  
for Moores Creek Watershed



*Sunset Avenue Bridge flooding, after peak flow*

## **CITY OF CHARLOTTESVILLE**

Department of Public Works  
305 4<sup>th</sup> Street NW • Charlottesville, Virginia 22903  
Telephone 434-970-3631





## Overview

The City of Charlottesville, Virginia's corporate limits of 10.2 square miles and population of just under 46,786 people are located within the 750 square mile Rivanna River watershed, one of the largest watersheds in Virginia and a major tributary to the Chesapeake Bay.

As stewards of the watershed, the City of Charlottesville manages many components of a stormwater infrastructure system, both grey and green, including the following:

- ❖ 35 miles of open waterways
- ❖ 130 miles of storm drain
- ❖ 8,250 stormwater structures (inlets, manholes, junction boxes, etc.)
- ❖ 460 outfalls
- ❖ 294 BMPs
- ❖ 445 acres of Zone AE floodplain

In 2008, the City of Charlottesville, in partnership with the Army Corp of Engineers (USACE), hired URS to develop a comprehensive stormwater model representing the majority of the City's stormwater management inventory. This model was designed to do the following:

1. Produce an updated technical basis for the City's stormwater management program that could be used to make good management decisions,
2. Create computer models that could be modified in the future as additional field data was collected and future developments were considered, and
3. Identify major flooding points within the City's stormwater and drainage systems for both existing and future land cover conditions.

The existing model represents the input data and best methodology available in 2008. The purpose of this grant application is to update a portion of the existing SWMM model for use as initially intended, as well as expanding the model beyond its originally identified applications.

## Area of Interest

The grant application will focus on the portion of the Moore's Creek watershed within City limits, approximately 3.8 square miles. The watershed makes up approximately 37% of the City's acreage and forms its southern border. The area of the watershed within City limits is highly urbanized and includes over 65% of the City's high social vulnerability geography.

Because of the increased complexity of the updated model, it will be phased through several grant applications including the development of separate models for the Moores Creek, Meadow Creek, and Rivanna River watersheds within City limits. A phasing strategy is partially due to the cost of development but also so that City stakeholders can assess the benefit of a more complex analysis before committing to a larger project.



## SWMM Inventory

PCSWMM Version 5.0.11 was originally used by URS in 2008. The model delineated approximately 360 subbasins in order to distribute point sources for inflow throughout the entire area. The entire SWMM model has over 750 nodes and over 800 links, making it an extremely large and complex model for this locality.

The focus of model updates will include the following general categories:

### Increased Functionality

The existing model will be imported to the most current version of PCSWMM, running on an EPA SWMM 5.1.015 engine. This will enable the City to take advantage of increased functionality in the model, especially a combined 1D-2D approach to system analysis. While 1D SWMM can connect drainage networks and convey capacity percentages, it does not route stormwater once it leaves the system. This can lead to false assumptions that storm networks are appropriately sized when water bypasses an upstream node and does not reenter the system. The 1D model cannot identify flood at-risk areas due to a lack of infrastructure. Additionally, it cannot support an impact analysis of undersized or non-existent systems. Identifying areas of vulnerability, including roads, residences, and critical facilities, will be important when prioritizing improvement projects and can be accomplished with 2D modeling.

Additionally, future areas of vulnerability will be identified based on climate change- influenced storm events. The City will use SWMM-CAT, a climate adjustment tool function of EPA SWMM, to incorporate future climate change projections into the updated model. The SWMM-CAT tool provides a set of location-specific adjustments derived from World Climate Research Programme global climate change models. These adjustments, along with IDF curves developed specifically for the Chesapeake Bay watersheds, will be important inputs for developing a sensitivity analysis to determine the future conveyance and treatment needs of City drainage infrastructure.

The current version of SWMM allows users to simulate green infrastructure components, such as rain barrels, porous pavement, and infiltration trenches – practices that the City of Charlottesville encourages. Online BMPs can benefit from continuous flow simulations, especially in determining treatment volumes and designing bypass components.

### Updated Data

Perhaps the most impactful changes to the model will be the incorporation of new input data, including updated existing and future impervious cover data. The City updates its impervious cover layer annually in GIS as part of the stormwater utility fee billing process.

Since 2008, the City has also been actively updating the GIS layer for storm drain pipe, structures, and open channels. This GIS layer will be compared against the network in the existing SWMM model to identify discrepancies and the model will be updated accordingly. Some field investigation may be required in select areas to determine the authenticity of data in the City's GIS layer. When the original model was developed, a consultant was hired to survey utilities in a small portion of the storm drain network. This information will be retained in the updated model and additional survey will be added, specifically in areas with known flooding issues.



The City implemented a stormwater utility fee in 2013 and has been implementing a vigorous storm sewer system rehabilitation program. The updated model will incorporate increased conveyance and alignment changes associated with work done under this program in the last 8 years. Updates from other projects, including private developments and transportation improvements, will also be incorporated into the new

## Manageable Output

In this iteration of the model buildout, careful consideration will be given to how output data is organized and communicated. While the SWMM model will be run and managed by engineers within the City, the data should be useful to parties beyond experienced SWMM users. Nomenclature in the model should mirror that used by the City's utility inventory. GIS output should include not only location but useful information for future design and analysis of the system, including inverts, size, material, depth of cover, and percent capture for design storms.

Aggregated sub-basin delineations should match larger delineations for minor and major tributaries, allowing for an infrastructure inventory and flood assessment per receiving water body. This will be especially useful as the City considers simplifying its 38 named drainage areas to less than a dozen drainage areas associated with named tributaries. Comprehensive stormwater management plans can be developed and communicated to the public per City "watershed" to promote a sense of ownership among residents.

## Future Uses

### Master Planning

The primary function of the SWMM model is to analyze the watershed by using configurations to quantify flooding associated with both existing and future watershed conditions. Potential drainage improvement projects can be geospatially mapped in relation to predicted future flooding, so City staff can make assessments about the value of individual projects. The advantage of this approach is that the entire drainage system can be evaluated on a consistent, system-wide basis.

Consistent and transparent methods of analysis when determining how and where to spend taxpayer money are essential for prioritizing improvements in an equitable manner. Although additional consideration factors, including other master plan objectives, location-specific funding opportunities, a history of underinvestment, etc., can also be incorporated into a system of project selection, the foundation of project prioritization should be the quantification of potential impacts from existing and future flooding events. An objective analysis using industry standard methodology applied over the entire City is a key element to achieving this goal.



*2D Flood Modeling allows terrain and bathymetry data to be used to predict flow path, water depth, average velocity, and flood extents.*

Images Courtesy of: Montalto, Franco, PE, PhD.(2021), "H&H Modeling 101" from Overwhelmed? Reevaluating Stormwater Modeling in Changing Climate webinar series, Power Point Presentation

## Flood Mitigation Projects

The SWMM model can also be used to design improvement projects based on impact analyses and the subsequent development of a prioritization system. The benefit of having larger projects designed within a SWMM model is that the effects of the individual projects on the performance of the entire drainage system can be evaluated holistically, rather than in piecemeal fashion. This approach ensures that monies are well spent, and that each project is truly needed as part of an overall master drainage plan. The model should also be useful for obtaining starting hydraulic grade line elevations for design purposes on smaller development projects, and for designing stormwater management BMPs on specific sites. Once a level of confidence is achieved for the model, it can be shared with consultants and private developers to support community-led efforts to improve flood mitigation and water quality.



*Backyard inundated during August 2021 rain event (Image courtesy of 500B Moseley Avenue homeowner).*

## BMP/Green Infrastructure Performance Assessments

Increased functionality in SWMM will allow for assessment of various green infrastructure techniques with continuous simulation modeling. Existing BMPs can be evaluated for performance over a range of storm events and retrofits can be designed within SWMM to protect treatment volumes from intense, destructive rainfalls.

New BMPs can be designed as stand-alone treatment systems or as part of a distributed system meant to provide both water quality and flood volume reductions, alleviating performance needs for grey infrastructure systems. This type of distributed green infrastructure is aligned with the goals of the City's Green Streets plan and has a co-benefit of being a public amenity. It can also be a cost-effective alternative to upsizing an existing or installing a new storm drain system.

## Climate Resilient Stormwater Management

In order to incorporate climate change impacts into stormwater management design standards, a wide range of potential extreme rainfall events must be analyzed. The suite of rainfall events will be derived from multiple methodologies to determine future IDF (intensity-duration-frequency) curve values that best fit Charlottesville's location and geography. These rainfall events will be routed through SWMM to determine confidence intervals around the predictive performance of stormwater management infrastructure. Based on the SWMM results, both storm drain conveyance goals and maintenance routines may be updated to reflect future needs.

Backwater effects from climate change – influenced floodplains can also be modeled in SWMM to determine impacts on stormwater infrastructure performance.



## Future Maintenance

Moving forward, the updated PCSWMM model will be an active tool in the City's stormwater management practices. As such, the model will be continuously updated by existing in-house staff. The City's Water Resource Protection (WRP) Administrator is a professional engineer with almost two decades of hydrologic and hydraulic modeling experience. As more data, better methodologies, and updated SWMM versions become available, the Administrator will revise the City's working model. As the confidence in the SWMM model's accuracy increases, the Administrator will also be responsible for sharing model results with other design professionals in the community so that everyone works from a shared point of knowledge.

As-built plans, for both private development and public improvement projects, will be submitted to the City's Stormwater Technician and WRP Administrator so that storm drain infrastructure and BMPs can be added to both the GIS inventory and SWMM model. Additionally, this team will take on the responsibility of utility mapping beyond the scope of survey included in this grant application to identify discrepancies and provide accurate data in areas of the City's storm drain inventory that are less susceptible to flooding.

The grant application also includes SWMM training for up to three professional engineers or engineers in training in the City of Charlottesville to provide overlap in technical skill sets and distributed responsibility of model use and management.

## Stakeholders

### Model Update

A consulting firm with significant hydrologic and 2D hydraulic modeling experience will be hired with funds from the grant to update the model, incorporate new data, expand analyses to include minor tributaries and select portions of the storm drain network, and introduce future climate change adjustments. It will be important to select a firm with the man-hour capacity to complete the update in a timely manner, so that the model results can be used as soon as possible for master planning.

A technical advisor from the University of Virginia's Link Lab, Dr. Jon Goodall, will be involved during the development of the model to identify potential future uses of the data and provide relevant input for climate change adjustments. The Link Lab has experience in Norfolk, VA creating data driven management strategies for stormwater that can provide insight into the City of Charlottesville's modeling efforts and resilience plan development. Dr. Goodall recently co-chaired a study on the impacts of climate change in Virginia and presented the results to Virginia's Joint Commission on Science and Technology with several recommendations for infrastructure management at the state level.

The WRP Administrator will serve as the project manager and City's technical advisor for the model update. The WRP Stormwater Tech will be tasked with data collection, including gathering as-builts, conducting field investigations, and providing pertinent GIS layers.



## Future Use

The SWMM model will be used internally for master planning, identification of under-capacity systems, and project design. Public Works Engineering staff will be offered opportunities for training to become proficient in SWMM modeling techniques.

The model will be maintained by the WRP Administrator and used to build a master plan, to be incorporated into the City's resilience plan, and develop annual budgets. The WRP Administrator will communicate the results of modeling efforts and how they will be used in project prioritization efforts to the City's Water Resource Protection Program (WRPP) Advisory Committee. This committee is made up of City residents with a variety of professional experiences that ensure the stormwater utility fee is managed appropriately.

The 1D portion of the model will be available to design professionals in the community and the City will undertake outreach efforts to encourage its use when conducting drainage analyses for site development.



*Azalea Park Flood Damage, May 2018*

## Implementation Plan

Once grant funding is awarded, select stakeholders for the model buildout will meet to develop a detailed scope of work and identify areas that need additional survey data. Procurement for professional services will be initiated no later than two months after award.

Efforts to upgrade model methodology and inputs, collect survey data (including select utilities, roadways, and open channels), and conduct field investigations for problematic areas in the terrain data will happen concurrently to build out a draft model within a year of the RFP selection. Once the draft model is finalized and a level of confidence is achieved using standard design storms, stakeholders will conduct a detailed review and identify where additional survey data will be necessary to quantify impacts of flooding. A portion of the funding allocated to survey efforts will be reserved for the final model update.



As the model is upgraded, the technical advisor and stakeholders will determine the appropriate suite of climate-informed storm events to include in an analysis of future flood vulnerability and best methods for communicating the results of climate-informed stormwater management analysis. In the third year of the project, a report, graphics, and suggestions for a future web-based dashboard will be developed specifically for climate resilience modeling and results.

The Moore's Creek 2D model will be used to communicate the potential effects of climate-influenced storm events on existing infrastructure and the importance of 2D models across the entire City and for regional floodplain studies to support internal efforts for future grant applications.

## Performance Metrics

Once the model is finalized, it will be used in conjunction with visual assessments of stream degradation to identify and prioritize projects, funded in part with the City's stormwater utility fee, in the following categories: flood mitigation, outfall protection, and BMP development. The model will also be used to develop scopes of work for each project identified in these categories that provides a comprehensive solution to overall stormwater management in the City. For example, an outfall protection project should be designed based on future predicted storm events and necessary conveyance upgrades to the outfall. Flood mitigation projects should evaluate the cost effectiveness and co-benefits of volume reduction techniques such as distributed green infrastructure. These are all design scenarios that can be built and analyzed within SWMM.

Immediate success metrics will include the development of a master plan with a prioritized project list that includes a comprehensive review of vulnerabilities to flooding throughout the Moores Creek watershed and a transparent pathway to equity-based funding strategies. Maps will be developed for each drainage area contributing to minor and major tributaries, conveying flood vulnerability assessments for both design storms and climate change – informed storm events.

A scope and budget for annual maintenance of grey infrastructure will be developed using the SWMM model as the basis for selection. Model results will be compared against recently identified (within the last 5-years) drainage issues to determine areas prone to flooding as a result of infrastructure clogging.

## Budget

The total budget for this grant application is **\$307,000**, broken down into the following general categories:

- **\$150,000**: 1D model methodology updates, 2D mesh and model development, incorporation of stormwater infrastructure information from as-built drawings and prior field investigations conducted by the City of Charlottesville and survey and utility mapping conducted during this study. Technical methodology report included.
- **\$60,000**: Survey and utility mapping in flood-prone areas identified by the 2008 SWMM model and a history of drainage issues.
- **\$30,000**: Survey and utility mapping for areas within the preliminary 2D model that have unidentified drainage patterns



- \$15,000: Model revisions based on the 2<sup>nd</sup> round of survey and utility mapping efforts.
- \$30,000: Model analyses, technical report, and maps for climate-influenced storm events.
- \$17,000: PCSWMM license for 4 users within the City of Charlottesville for 3 years.
- \$5,000: PCSWMM training for 4 City of Charlottesville staff.

This project falls under the funding category of a flood prevention and protection study. As such, the City of Charlottesville is requesting funding in the amount of \$153,500, a cost participation percentage of 50%. These funds will come from previously appropriated budgets for Environmental Sustainability programs and are confirmed in the accompanying letter from the City Manager.



## Attachments

Attachment A: Application Form for Grant Requests

Attachment B: Scoring Criteria for Studies

Attachment C: Checklist for All Categories

Attachment D: City of Charlottesville Local Waterways Map

Attachment E: Moores Creek Watershed Location Map

Attachment F: Charlottesville Social Vulnerability Index Location Map

Attachment G: City of Charlottesville Floodplain Ordinance

Attachment H: Thomas Jefferson Planning District Regional Natural Hazard Mitigation Plan (2018)

Attachment I: City of Charlottesville Comprehensive Plan (2013)

Attachment J: Authorization to Request Funding, Charlottesville City Manager

Attachment K: FIRM Panel 510033269D/510033288D/510033289D



Attachment A

Application Form for Grant Requests



Contact Person (If different from authorized official): Andrea Henry, PE

Mailing Address (1): Department of Public Works

Mailing Address (2): 305 4th Street NW

City: Charlottesville State: VA Zip: 22903

Telephone Number: ( [REDACTED] ) Cell Phone Number: ( [REDACTED] )

Email Address: [REDACTED]

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes \_\_\_ No ✓

**Categories (select applicable project):**

**Project Grants (Check All that Apply)**

- Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development.
- Wetland restoration.
- Floodplain restoration.
- Construction of swales and settling ponds.
- Living shorelines and vegetated buffers.
- Structural floodwalls, levees, berms, flood gates, structural conveyances.
- Storm water system upgrades.
- Medium and large scale Low Impact Development (LID) in urban areas.
- Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool.
- Dam restoration or removal.
- Stream bank restoration or stabilization.
- Restoration of floodplains to natural and beneficial function.
- Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.

**Study Grants (Check All that Apply)**

- Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks or freeboard, or correcting issues identified in a Corrective Action Plan.
- Revising other land use ordinances to incorporate flood protection and mitigation goals, standards and practices.
- Conducting hydrologic and hydraulic studies of floodplains. Applicants who create new maps must apply for a Letter of Map Revision or a Physical Map Revision through the Federal Emergency Management Agency (FEMA). For example, a local government might conduct a hydrologic and hydraulic study for an area that had not been studied because the watershed is less than one square mile. Modeling the floodplain in an area that has numerous letters of map change that suggest the current map might not be fully accurate or doing a detailed flood study for an A Zone is another example.
- Studies and Data Collection of Statewide and Regional Significance.
- Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- Other relevant flood prevention and protection project or study.

**Capacity Building and Planning Grants**

- Floodplain Staff Capacity.
- Resilience Plan Development
  - Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
  - Resource assessments, planning, strategies and development.
    - Policy management and/or development.
    - Stakeholder engagement and strategies.

Location of Project (Include Maps): Moones Creeke Watershed (Attachment E)

NFIP Community Identification Number (CID#):(See appendix

F 510033

Is Project Located in an NFIP Participating Community?  Yes  No

Is Project Located in a Special Flood Hazard Area?  Yes\*  No \*partially

Flood Zone(s) (If Applicable): Includes, not limited to, zone AE

Flood Insurance Rate Map Number(s) (If Applicable): 510033-269D/288D/289D

Total Cost of Project: \$307,000

Total Amount Requested \$153,500



Attachment B

Scoring Criteria for Studies

## Appendix C: Scoring Criteria for Studies *C12510033 - Charlottesville*

Virginia Department of Conservation and Recreation  
Virginia Community Flood Preparedness Fund Grant Program

<b>Applicant Name:</b>		
<b>Eligibility Information</b>		
Criterion	Description	Check One
<b>1. Is the applicant a local government (including counties, cities, towns, municipal corporations, authorities, districts, commissions, or political subdivisions created by the General Assembly or pursuant to the Constitution or laws of the Commonwealth, or any combination of these)?</b>		
Yes	Eligible for consideration	<input checked="" type="checkbox"/>
No	Not eligible for consideration	<input type="checkbox"/>
<b>2. Does the local government have an approved resilience plan and has provided a copy or link to the plan with this application?</b>		
Yes	Eligible for consideration under all categories	<input type="checkbox"/>
No	Eligible for consideration for studies, capacity building, and planning only	<input checked="" type="checkbox"/>
<b>3. If the applicant is <u>not</u> a town, city, or county, are letters of support from all affected local governments included in this application?</b>		
Yes	Eligible for consideration	<input type="checkbox"/>
No	Not eligible for consideration	<input type="checkbox"/>
<b>4. Has this or any portion of this project been included in any application or program previously funded by the Department?</b>		
Yes	Not eligible for consideration	<input type="checkbox"/>
No	Eligible for consideration	<input checked="" type="checkbox"/>
<b>5. Has the applicant provided evidence of an ability to provide the required matching funds?</b>		
Yes	Eligible for consideration	<input checked="" type="checkbox"/>
No	Not eligible for consideration	<input type="checkbox"/>
N/A	Match not required	<input type="checkbox"/>

Studies Eligible for Consideration		<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Applicant Name:	CID510033 - charlottesville		
Scoring Information			
Criterion	Point Value	Points Awarded	
<b>6. Eligible Studies (Select all that apply)</b>			
Revising floodplain ordinances to maintain compliance with the NFIP or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks or freeboard, or correcting issues identified in a Corrective Action Plan.	30		
Creating <u>tools</u> or applications to identify, aggregate, or display information on flood risk or creating a crowd-sourced mapping platform that gathers data points about real-time flooding. This could include a locally or regionally based web-based mapping product that allows local residents to better understand their flood risk.	15	15	
Conducting hydrologic and hydraulic studies of floodplains. Applicants who create new maps must apply for a Letter of Map Revision or a Physical Map Revision through the Federal Emergency Management Agency (FEMA).	35		
Studies and Data Collection of Statewide and Regional Significance. Funding of studies of statewide and regional significance and proposals will be considered for the following types of studies:			
<input checked="" type="checkbox"/> Updating precipitation data and IDF information (rain intensity, duration, frequency estimates) including such data at a sub-state or regional scale on a periodic basis.	45	45	
<input type="checkbox"/> Regional relative sea level rise projections for use in determining future impacts.	45		
<input checked="" type="checkbox"/> Vulnerability analysis either statewide or regionally to state <u>transportation</u> , water supply, water treatment, impounding structures, or other significant and vital infrastructure from flooding.	45	45	
<input type="checkbox"/> Flash flood studies and modeling in riverine regions of the state.	45		
<input type="checkbox"/> Statewide or regional stream gauge monitoring to include expansion of existing gauge networks.	45		

<input type="checkbox"/> New or updated delineations of areas of recurrent flooding, stormwater flooding, and storm surge vulnerability in coastal areas that include projections for future conditions based on sea level rise, more intense rainfall events, or other relevant flood risk factors.	45	
<input checked="" type="checkbox"/> Regional flood studies in riverine communities that may include <u>watershed-scale evaluation</u> , updated estimates of rainfall intensity, or other information.	50	50
<input type="checkbox"/> Regional hydrologic and hydraulic studies of floodplains.	45	
<input type="checkbox"/> Studies of potential land use strategies that could be implemented by a local government to reduce or mitigate damage from coastal or riverine flooding.	40	
<input checked="" type="checkbox"/> Other proposals that will significantly improve protection from flooding on a statewide or regional basis	35	35
<b>7. Is the study area socially vulnerable? (Based on <a href="#">ADAPT VA's Social Vulnerability Index Score.</a>)</b>		
Very High Social Vulnerability (More than 1.5)	15	
High Social Vulnerability (1.0 to 1.5) <i>24% of area</i>	12	3
Moderate Social Vulnerability (0.0 to 1.0) <i>9% of area</i>	8	1
Low Social Vulnerability (-1.0 to 0.0)	0	
Very Low Social Vulnerability (Less than -1.0)	0	
<b>8. Is the proposed study part of an effort to join or remedy the community's probation or suspension from the NFIP?</b>		
Yes	10	
No	0	
<b>9. Is the proposed study in a low-income geographic area as defined in this manual?</b>		
Yes	10	
No	0	
<b>10. Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?</b>		
Yes	5	
No	0	
<b>Total Points</b>		<b>194</b>



Attachment C

Checklist for All Categories

## Appendix D: Checklist All Categories

Virginia Department of Conservation and Recreation

Community Flood Preparedness Fund Grant Program

C1D510033 - Charlottesville

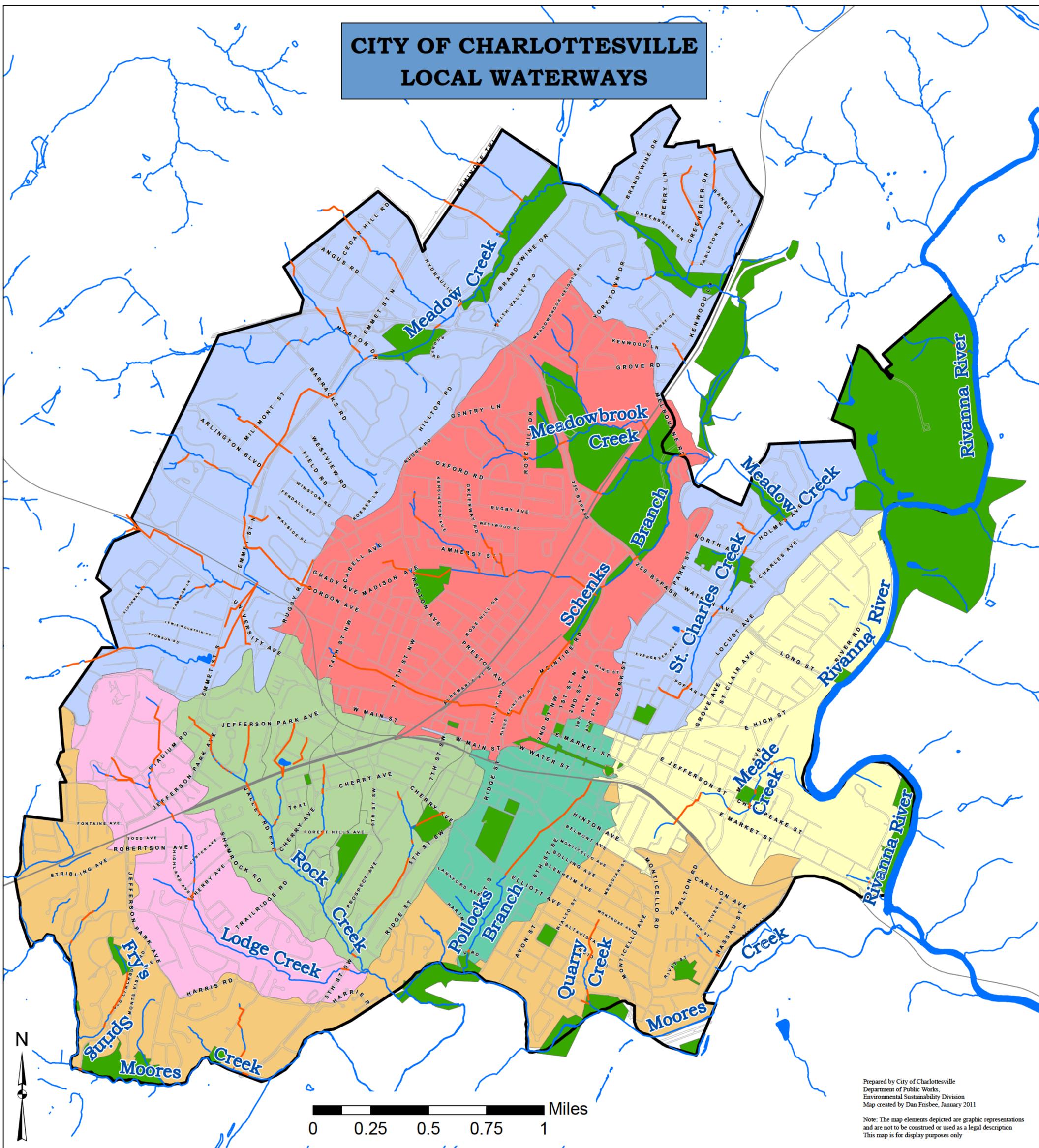
Scope of Work Narrative	
Supporting Documentation	Included
Detailed map of the project area(s) (Projects/Studies)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
FIRMette of the project area(s) (Projects/Studies) (3)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Historic flood damage data and/or images (Projects/Studies)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
A link to or a copy of the current floodplain ordinance	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Non-Fund financed maintenance and management plan for project extending a minimum of 5 years from project close	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
A link to or a copy of the current hazard mitigation plan	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
A link to or a copy of the current comprehensive plan	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Social vulnerability index score(s) for the project area from <a href="#">ADAPT VA's Virginia Vulnerability Viewer</a>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
If applicant is not a town, city, or county, letters of support from affected communities	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
Completed Scoring Criteria Sheet in Appendix B, C, or D	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Budget Narrative	
Supporting Documentation	Included
Authorization to request funding from the Fund from governing body or chief executive of the local government	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Signed pledge agreement from each contributing organization	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A



Attachment D

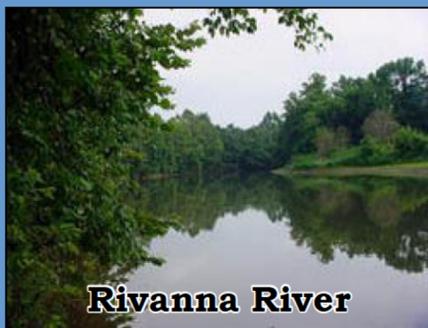
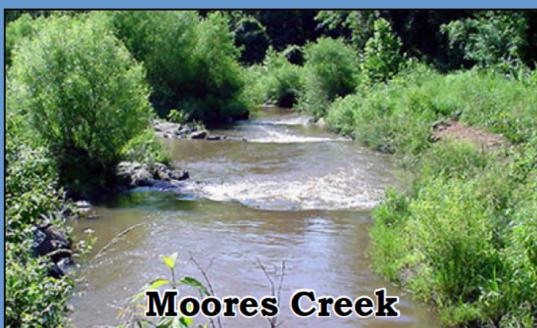
City of Charlottesville Local Waterways Map

# CITY OF CHARLOTTESVILLE LOCAL WATERWAYS



Prepared by City of Charlottesville  
Department of Public Works,  
Environmental Sustainability Division  
Map created by Dan Frisbee, January 2011

Note: The map elements depicted are graphic representations  
and are not to be construed or used as a legal description  
This map is for display purposes only

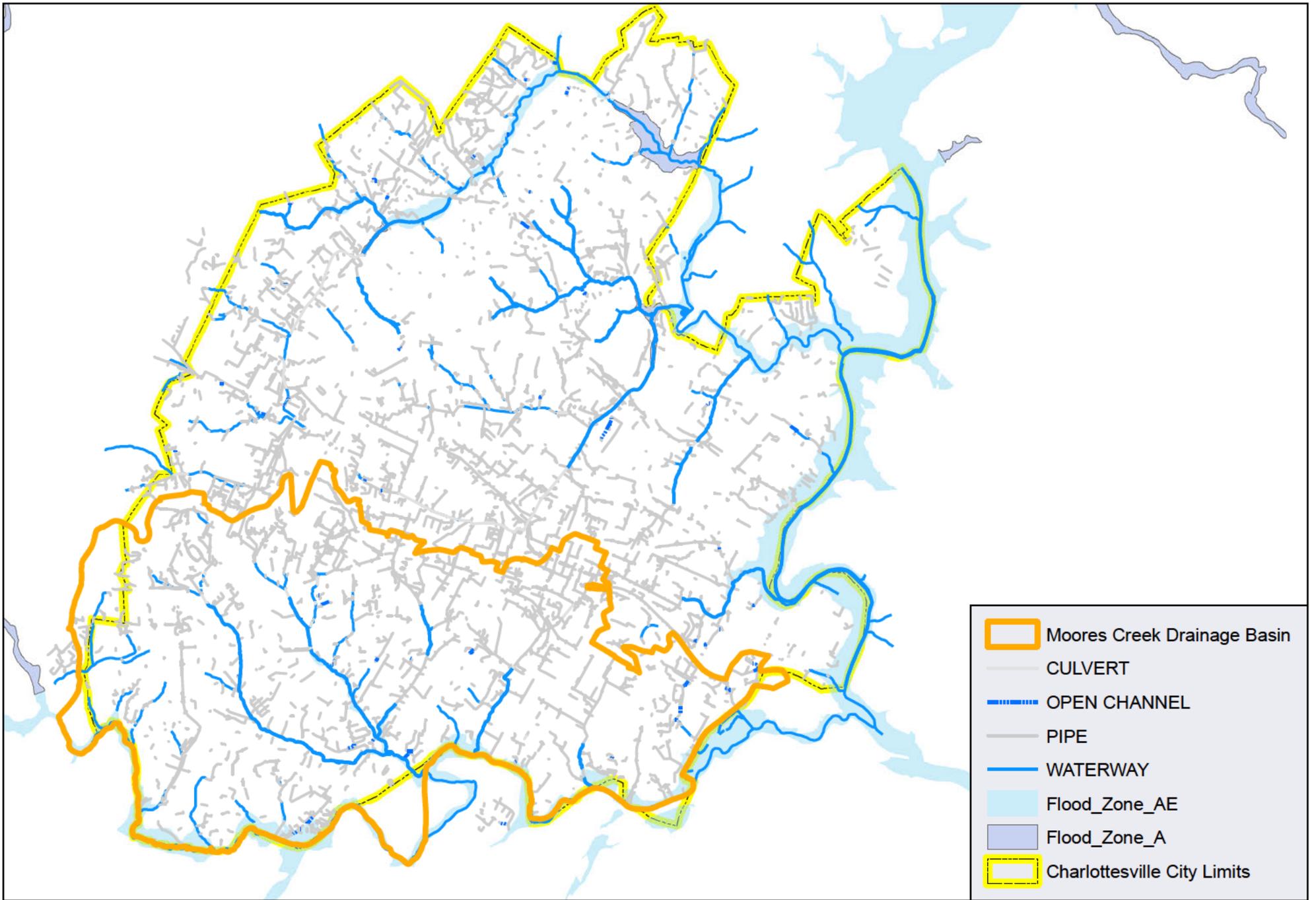


Legend	
	Waterways
	City Limits
	Roads
	Parks
	Railroads
	Waterways in Pipes
	Drains to Moors Creek
	Drains to Meadow Creek
	Drains to Rivanna River
	Drains to Schenks Branch
	Drains to Lodge Creek
	Drains to Rock Creek
	Drains to Pollocks Branch



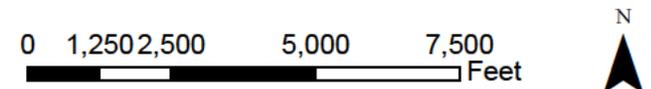
Attachment E

Moore's Creek Watershed Location Map



Date: 9/2/2021

## Moores Creek Watershed in Charlottesville City Limits

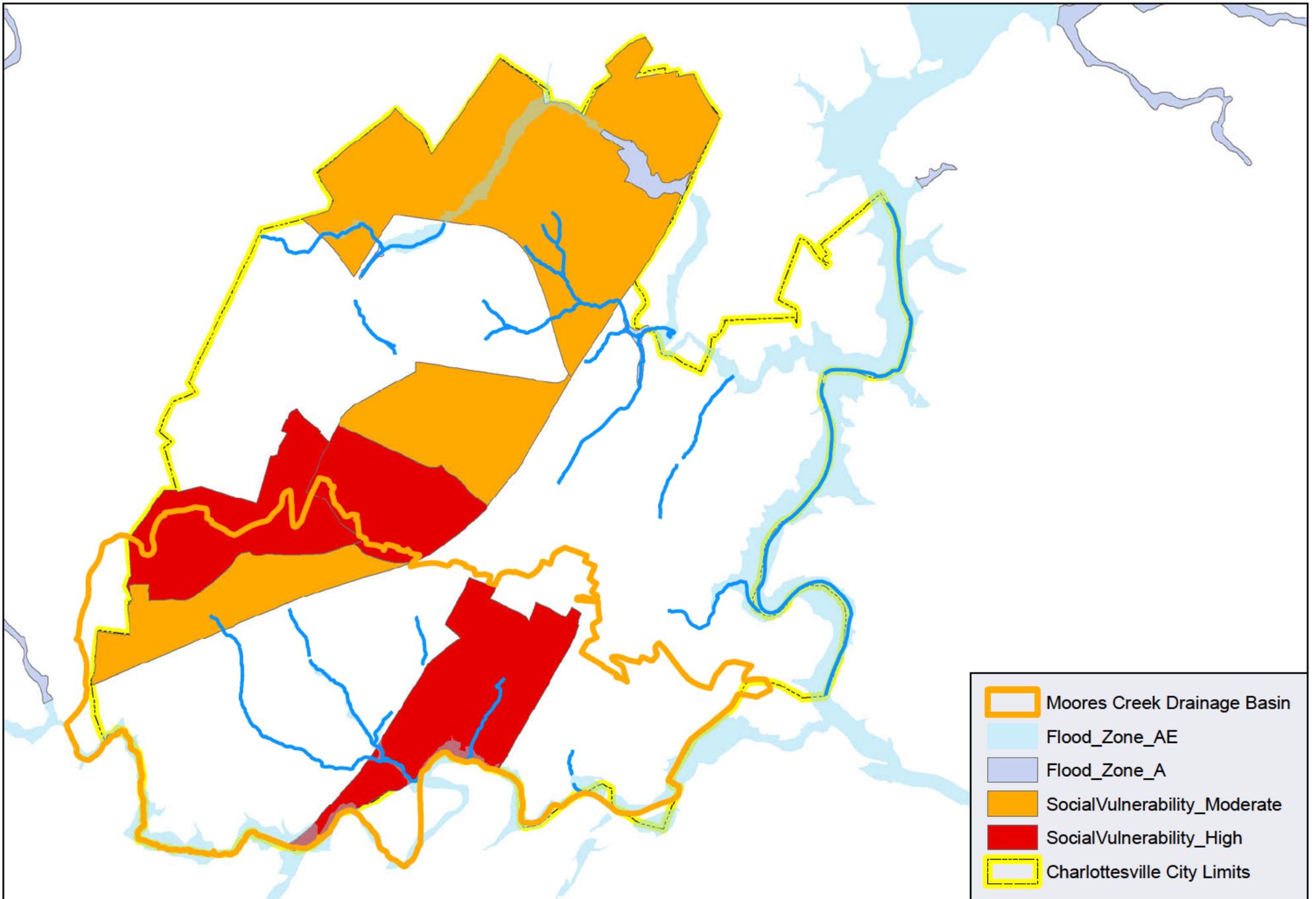


The geographic data layers produced by the City of Charlottesville are provided as a public resource. The City makes no warranties, expressed or implied, concerning the accuracy, completeness or suitability of this data, and it should not be construed or used as a legal description. The information displayed is a compilation of records, information, and data obtained from various sources, and the City is not responsible for its accuracy or how current it may be. Every reasonable effort is made to ensure the accuracy and completeness of the data. Pursuant to Section 54.1-402 of the Code of any determination of topography or contours, or any depiction of physical improvements, property lines or boundaries is for general information only and shall not be used for the design, modification or construction of improvements to real property or for flood plain determination.



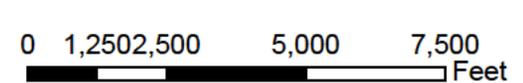
Attachment F

Charlottesville Social Vulnerability Index Location Map



Date: 9/2/2021

## Charlottesville Social Vulnerability Index



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## Attachment G

[City of Charlottesville Floodplain Ordinance](#)

<https://www.charlottesville.gov/DocumentCenter/View/1380/City-Ordinance-34-240-PDF>

## Attachment H

[Thomas Jefferson Planning District Regional Natural Hazard Mitigation Plan \(2018\)](#)

<https://tjpd.org/wp-content/uploads/pdf/Environment/Hazard-Mitigation/Hazard-Mitigation-Plan-2018.pdf>

## Attachment I

[City of Charlottesville Comprehensive Plan \(2013\)](#)

<https://www.charlottesville.gov/DocumentCenter/View/477/2013-Comprehensive-Plan-PDF?bidId=>



Attachment J

Authorization to Request Funding, Charlottesville City Manager

# CITY OF CHARLOTTESVILLE

*"To be One Community Filled with Opportunity"*

Office of the City Manager

P.O. Box 911 • Charlottesville, Virginia 22902

Telephone 434-970-3101

Fax 434-970-3890

[www.charlottesville.gov](http://www.charlottesville.gov)



August 30, 2021

Virginia Department of Conservation and Recreation  
Attention: Virginia Community Flood Preparedness Fund  
Division of Dam Safety and Floodplain Management  
600 East Main Street, 24<sup>th</sup> Floor  
Richmond, Virginia 23219

To Whom it May Concern,

The City of Charlottesville is excited for the opportunity to submit this application for the inaugural round of the Community Flood Preparedness Fund grant awards. We have been strong proponents of the Commonwealth of Virginia joining the Regional Greenhouse Gas Initiative and are pleased that funds are now being made available to support our efforts to mitigate and protect against flooding in neighborhoods across our entire community.

The enclosed grant application is to assist the City with the development of a 2-Dimensional Stormwater Management Model for the Moores Creek Watershed. The total estimated project budget is \$307,000. Per the grant application process, I hereby confirm that the City has identified the necessary funds for the required match of \$153,500. Upon Notice of Award of the grant, a resolution will be presented to City Council of Charlottesville for appropriation of the grant funds and the identified matching funds.

We look forward to the VA Department of Conservation and Recreation's support in building our local flood resilience plan and in furthering our climate resilience efforts to serve and protect our community in a strategic, equitable, and proactive manner.

Sincerely,

A handwritten signature in blue ink that reads 'C. P. Boyles, II' with a stylized flourish at the end.

Charles P. Boyles, II  
City Manager  
City of Charlottesville, VA



Attachment K

FIRM Panel 510033269D/510033288D/510033289D

**NOTES TO USERS**

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**Coastal Base Flood Elevations** shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

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The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 17. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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National Geodetic Survey, NOAA  
Silver Spring Metro Center  
1315 East-West Highway  
Silver Spring, Maryland 20910  
(301) 713-3191

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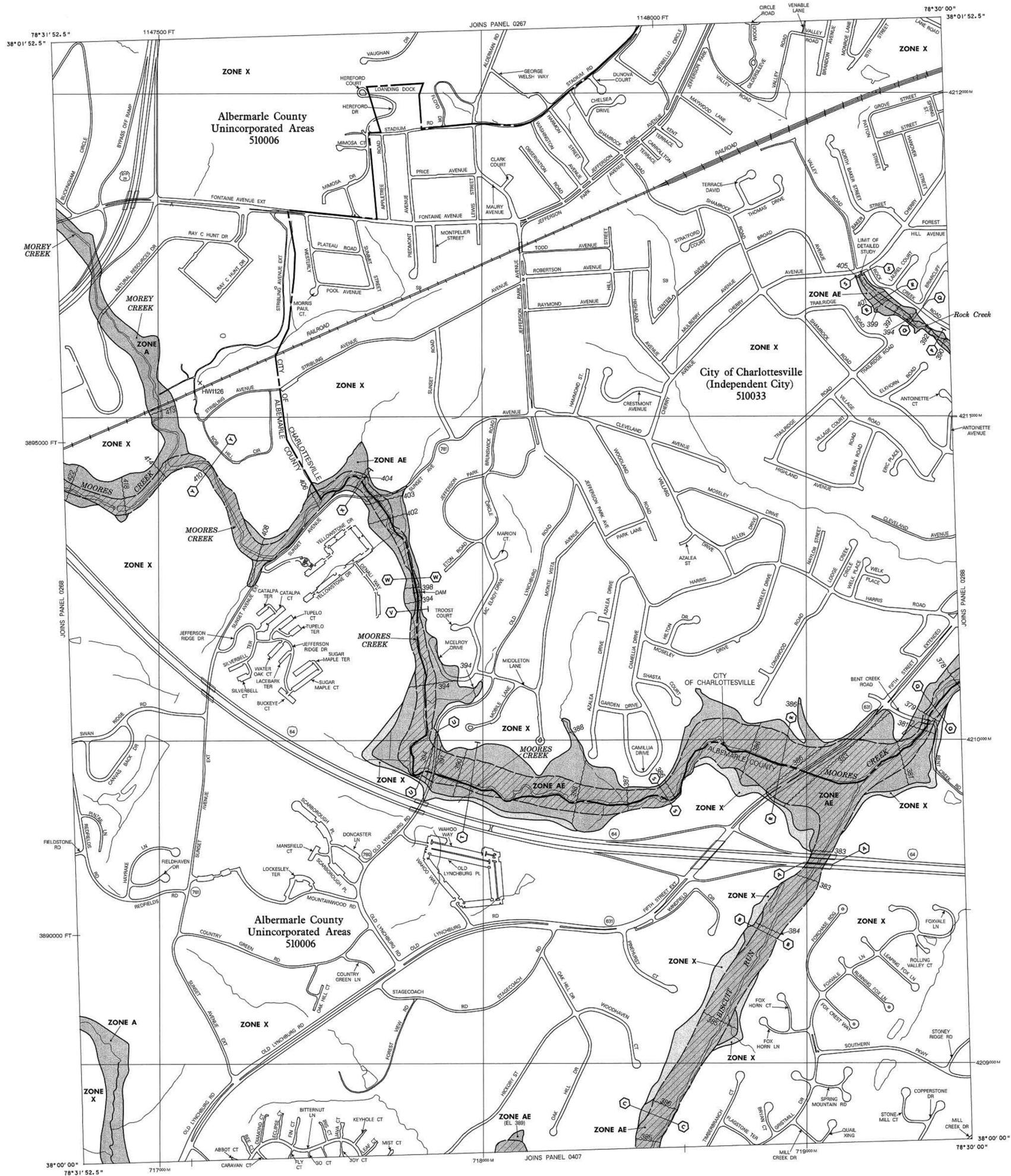
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**LEGEND**

**SPECIAL FLOOD HAZARD AREAS (SFHA) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**

The 1% annual chance flood (100-year flood) also known as the base flood is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, AP9, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE AP9** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

**FLOODWAY AREAS IN ZONE AE**

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

**OTHER FLOOD AREAS**

**ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

**OTHER AREAS**

**ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.

**ZONE D** Areas in which flood hazards are undetermined, but possible.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Base Flood Elevation line and value; elevation in feet\*
- Base Flood Elevation value where uniform within zone; elevation in feet\*
- \*Referenced to the North American Vertical Datum of 1988

- Cross section line
  - Transect line
- 91°07'30", 32°22'30"
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 4278900 M  
600000 FT  
DX5510 X
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5  
River Mile

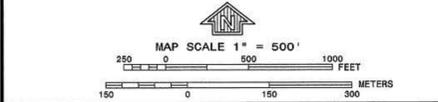
**MAP REPOSITORY**  
Refer to listing of Map Repositories on Map Index

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**  
February 4, 2005

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**

For community map revision history prior to countywide mapping refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0269D**

**FIRM FLOOD INSURANCE RATE MAP**

**ALBEMARLE COUNTY, VIRGINIA AND INCORPORATED AREAS AND THE INDEPENDENT CITY OF CHARLOTTESVILLE**

**PANEL 269 OF 575**

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
ALBEMARLE COUNTY	510006	0269	D
CHARLOTTESVILLE CITY OF (INDEPENDENT CITY)	510033	0269	D

Note to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

**MAP NUMBER 51003C0269D**

**EFFECTIVE DATE FEBRUARY 4, 2005**

Federal Emergency Management Agency

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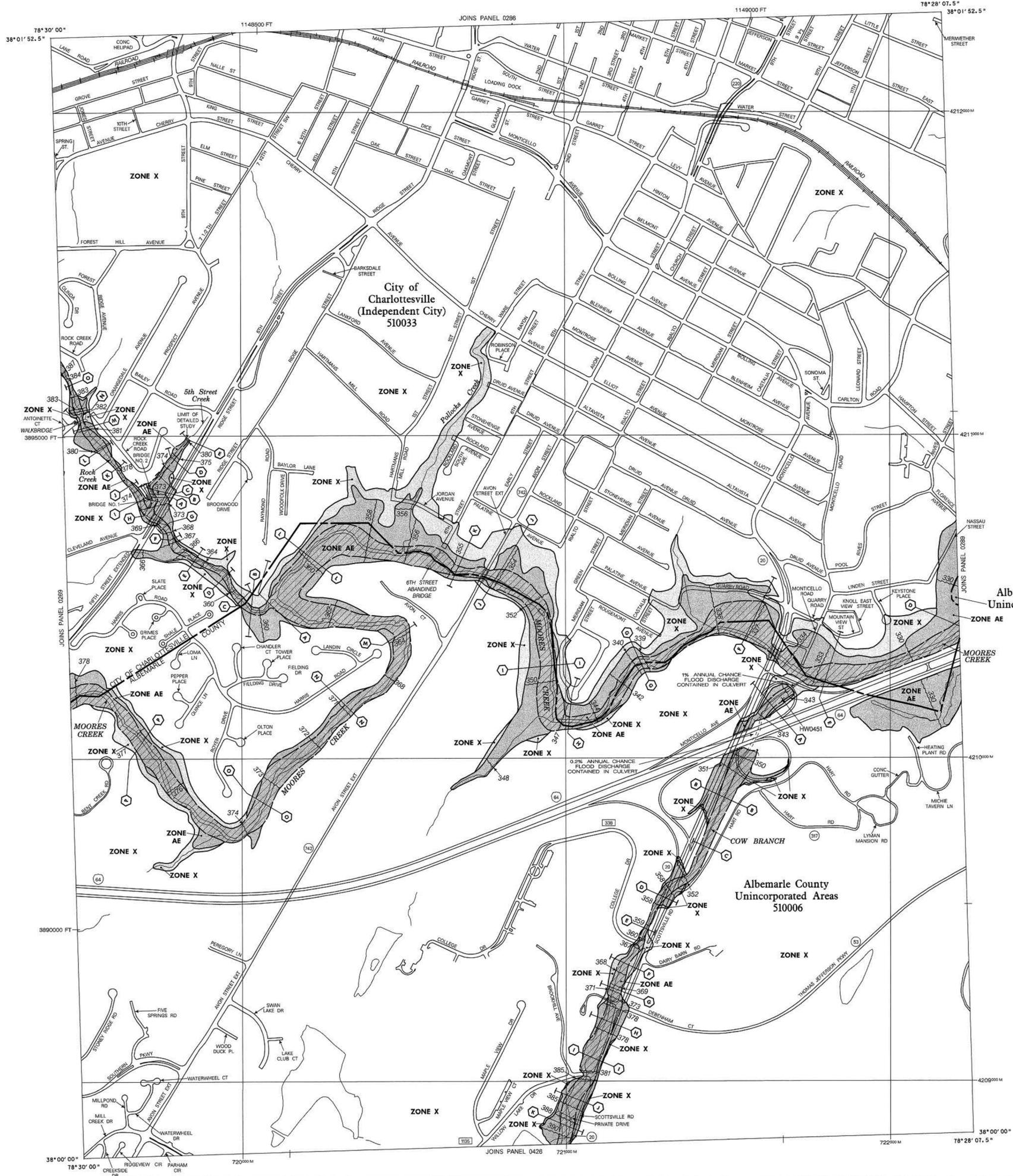
**LEGEND**

- SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**
- The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
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- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
- FLOODWAY AREAS IN ZONE AE**
- The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
- OTHER FLOOD AREAS**
- ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- OTHER AREAS**
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- 4276000 M
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- DMS15 X
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- River Mile

- MAP REPOSITORY**  
Refer to listing of Map Repositories on Map Index
- EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**  
February 4, 2005
- EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**

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- MAP SCALE 1" = 500'**
- 150 0 150 300 METERS**



**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0288D**

**FIRM FLOOD INSURANCE RATE MAP**

**ALBEMARLE COUNTY, VIRGINIA AND INCORPORATED AREAS AND THE INDEPENDENT CITY OF CHARLOTTESVILLE**

**PANEL 288 OF 575**

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

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CHARLOTTESVILLE, CITY OF (INDEPENDENT CITY)	510033	0288	D

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**MAP NUMBER 51003C0288D**

**EFFECTIVE DATE FEBRUARY 4, 2005**

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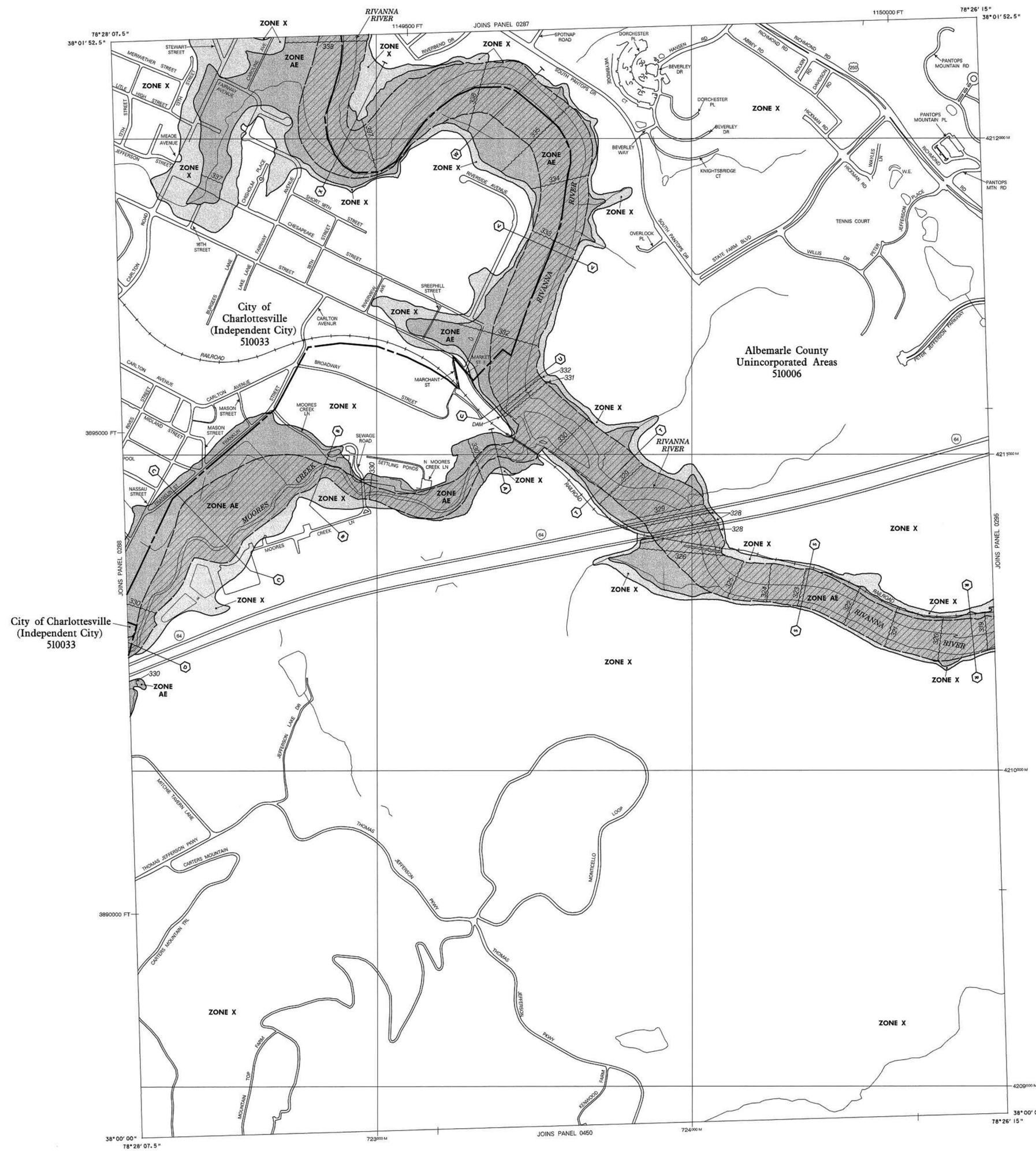
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- COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**
- OTHERWISE PROTECTED AREAS (OPAs)**
- CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Base Flood Elevation line and value; elevation in feet\*
- Base Flood Elevation value where uniform within zone; elevation in feet\*
- \*Referenced to the North American Vertical Datum of 1988

- A ○ A Cross section line
- 23 ○ 23 Transverse line
- 91° 01' 30", 32° 22' 30" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 4270000 M 1000-meter Universal Transverse Mercator grid values, zone 17
- 600000 FT 5000-foot grid ticks; Virginia State Plane coordinate system, south zone (FIPSZONE 4502), Lambert Conformal Conic projection
- DX5510 X Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 River Mile

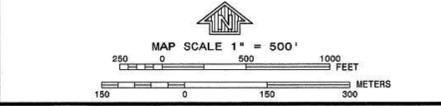
**MAP REPOSITORY**  
Refer to listing of Map Repositories on Map Index.

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**  
February 4, 2005

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0289D**

**FIRM FLOOD INSURANCE RATE MAP**

**ALBEMARLE COUNTY, VIRGINIA AND INCORPORATED AREAS AND THE INDEPENDENT CITY OF CHARLOTTESVILLE**

**PANEL 289 OF 575**

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
ALBEMARLE COUNTY	510006	0289	D
CHARLOTTESVILLE CITY OF (INDEPENDENT CITY)	510033	0289	D

Notes to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

**MAP NUMBER 51003C0289D**

**EFFECTIVE DATE FEBRUARY 4, 2005**

Federal Emergency Management Agency



CFPF, rr <cfpf@dcr.virginia.gov>

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## CFPF Grant Application, City of Charlottesville

2 me age

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Henry, Andrea E <[REDACTED]>

Fri, Sep 3, 2021 at 12:09 PM

To: "CFPF, rr" <cfpf@dcr.virginia.gov>

Cc: "Edward , Tony" [REDACTED]

To Whom It May Concern,

The City of Charlottesville is thrilled to submit our first grant application for the Community Flood Preparedness Fund. This grant is the first in a series aimed at developing a strategic approach to both identifying and prioritizing flood mitigation and protection projects. The City strives to plan projects in an equitable and comprehensive manner, relying on watershed-scale solutions when possible. Development of watershed-scale models is the cornerstone to these future efforts and we are committed to developing stormwater management and resilience plans that reflect the best science and methodology available.

Please let me know if you have any questions or concerns about the application.

Have a wonderful day!

**Andrea Henry, PE**

Water Resource Protection Administrator

Public Work Department

City of Charlottesville

[REDACTED]

[REDACTED]



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 **CID510033\_CharlottesvilleCity\_CFPF.pdf**  
10159K

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**CFPF, rr** <cfpf@dcr.virginia.gov>

To "Henry, Andrea E" [REDACTED]

Fri, Sep 3, 2021 at 4:22 PM

Received

[Quoted text hidden]