

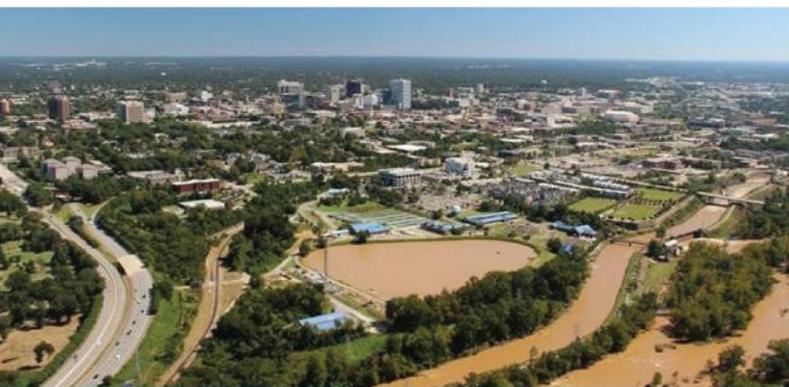
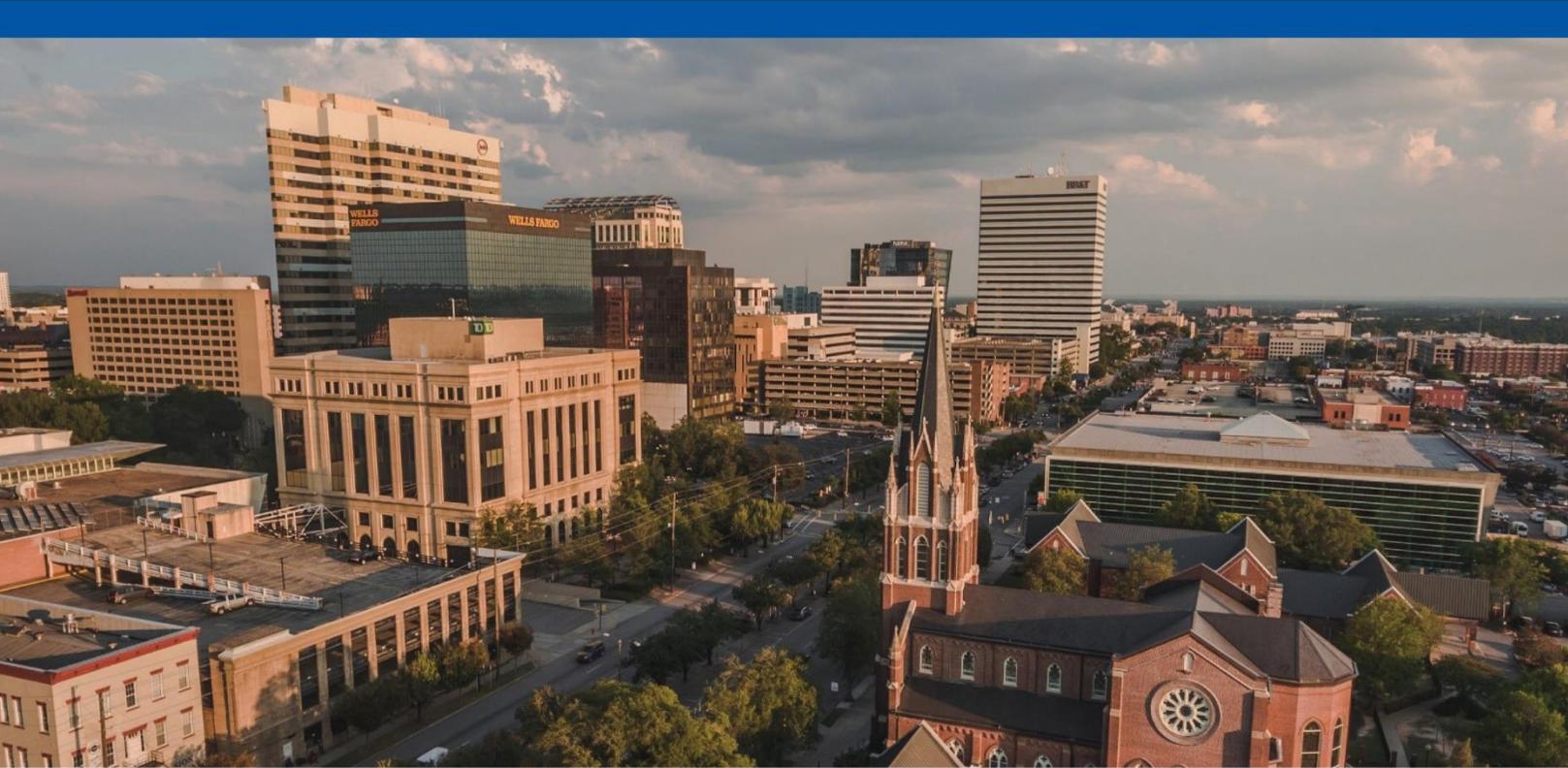


We Are Columbia

# ACTION PLAN

## CITY OF COLUMBIA

COMMUNITY DEVELOPMENT BLOCK GRANT MITIGATION  
(CDBG-MIT)



March 16, 2020

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Citizens are encouraged to provide comments on the City of Columbia's Community Development Block Grant Mitigation Action Plan. Comments can be submitted:

On the Website: <https://mit.columbiasc.gov>

By Email: [CityMitigation@columbiasc.gov](mailto:CityMitigation@columbiasc.gov)

In person: Public Hearing - April 6, 2020  
6:00 – 8:00 pm  
Busby Street Community Center  
1735 Busby Street  
Columbia, SC 29203

Public comments will be accepted from March 16, 2020, 5:00 pm until April 30, 2020, 5:00 pm.

Reasonable modifications and equal access to communications will be provided upon request. **For assistance please call 803-545-3373 or dial 7-1-1 TDD, or email at [CommunityDevelopment@ColumbiaSC.gov](mailto:CommunityDevelopment@ColumbiaSC.gov).**



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## 1.0 Executive Summary

In October 2015, the City of Columbia experienced unprecedented and historical rainfall and flooding resulting from an upper atmospheric low-pressure system that funneled tropical moisture from Hurricane Joaquin. This heavy and extended rainfall exceeded a once in a thousand-year flood event with more than 2 feet of rainfall in less than 48 hours. The rain and flooding caused extensive damage to many dams, bridges, roads, homes, and businesses in the state's capital. As a result, approximately 400 homes and 60 businesses received rain and/or flood damage at an estimated value of \$65 million. In addition, the City sustained more than \$75 million in infrastructure losses.

The flooding also impacted the City's utilities, wastewater treatment systems, and drinking water treatment and collection systems. Ground surfaces were saturated from rainfall in September, resulting in runoff that caused multiple dam failures in the City and a massive breach in the Columbia Canal. Flooding caused a 60-foot section of the Columbia Canal to wash away and the water level to drop below the level necessary for the City to pump water into its water treatment facility through normal operations. Waste water stations were completely submerged, and multiple sewer and water lines were ruptured or broken. The canal breach combined with numerous line breaks throughout the water system, and led to a 10-day disruption of clean drinking water for more than 375,000 residents who received boil water notices. The flooding and disruption of drinking water severely impacted the operations of local hospitals, universities, military installations, and city and state government.

In February 2018, Congress, recognizing that it was not sufficient to fund only repair of damage caused by the disasters, passed historic legislation that enabled storm-impacted jurisdictions to become more proactive in addressing the impacts of these disasters on their communities. The Further Additional Supplemental Appropriations for Disaster Relief Requirements Act, 2018 (P.L. 115-123) made funding available to enable communities to carry out strategic, high-impact activities that increase resilience to disasters and reduce or eliminate the long-term risk of loss of life and property, and the suffering it causes by lessening the impact of future disasters.

The City of Columbia conducted a Mitigation Needs Assessment and determined that the primary risks facing the community continue to be flooding, tornadoes, thunderstorms, lightning, hurricanes, and tropical storms.

In 2017, the City launched a program to be more progressive in addressing the stormwater hazards and flooding problems in Columbia, issuing bonds using the Stormwater Utility Fund. This resulted in the implementation of a comprehensive

Stormwater Management Capital Improvement Program. The City now intends to utilize the CDBG-MIT funding to take additional actions to make Columbia more resilient.

The City acknowledges the high probability that these extreme weather conditions will continue to affect Columbia’s residents and city services, and may become more severe or more frequent in occurrence.

The impact of these types of events was taken into consideration as the City made critical decisions around project selection and how each project will affect the City’s ability to deliver critical services to its residents.

The City has identified two projects that will have a significant and long-term impact on the welfare of Columbia’s residents – replacement of the Columbia Canal Head Gates and replacement of the Olympia Fire Station.

These two projects demonstrate the City’s commitment to addressing the continuing impact on residents of damage to critical infrastructure that occurred during the 2015 flooding and has yet to be addressed, and to increasing the City’s ability to respond to future disaster events in a manner that improves its ability to protect lives and property.

| Category                            | Project Name                                   | Allocation Level | Estimated LMI Benefit* |
|-------------------------------------|--|------------------|------------------------|
| Infrastructure                      | Columbia Canal Head Gates and Lock Gate Repair | \$8,000,000      | 100%                   |
|                                     | Olympia Fire Station Replacement               | \$7,000,000      | 100%                   |
| Planning, Oversight, and Monitoring | Planning Activities                            | \$2,655,750      |                        |
|                                     | Administration                                 | \$929,250        |                        |
| TOTAL                               |  | \$18,585,000     | 100%                   |

In addition, the City will supplement currently limited planning resources in a manner that will allow continual improvement in overall resilience through land use, building code, emergency management, and hazard mitigation planning.

## 2.0 Mitigation Needs Assessment

To align with the requirements in the Federal Register Notice (84 FR 45840), the City of Columbia’s Office of Community Development has developed this risk-based Mitigation Needs Assessment to identify and analyze all significant current and future risks impacting the City. This assessment serves to provide a substantive basis for the mitigation activities proposed in Section 3.0 CDBG-MIT Program Design.

This assessment:

1. Provides an overview of the City of Columbia’s geographic landscape within the State of South Carolina;
2. Summarizes climate trends and analyzes projections that may contribute to current and future risks;
3. Analyzes vulnerable populations and low and moderate income;
4. Discusses historic damage patterns that have impacted the City of Columbia;
5. Identifies all considered resources, including South Carolina’s FEMA-approved State Hazard Mitigation Plan and the Central Midlands’ Hazard Mitigation Plan;
6. Assesses current and future risk to the City’s critical service areas or community lifelines; and
7. Addresses unmet mitigation needs in response to identified current and future risks.

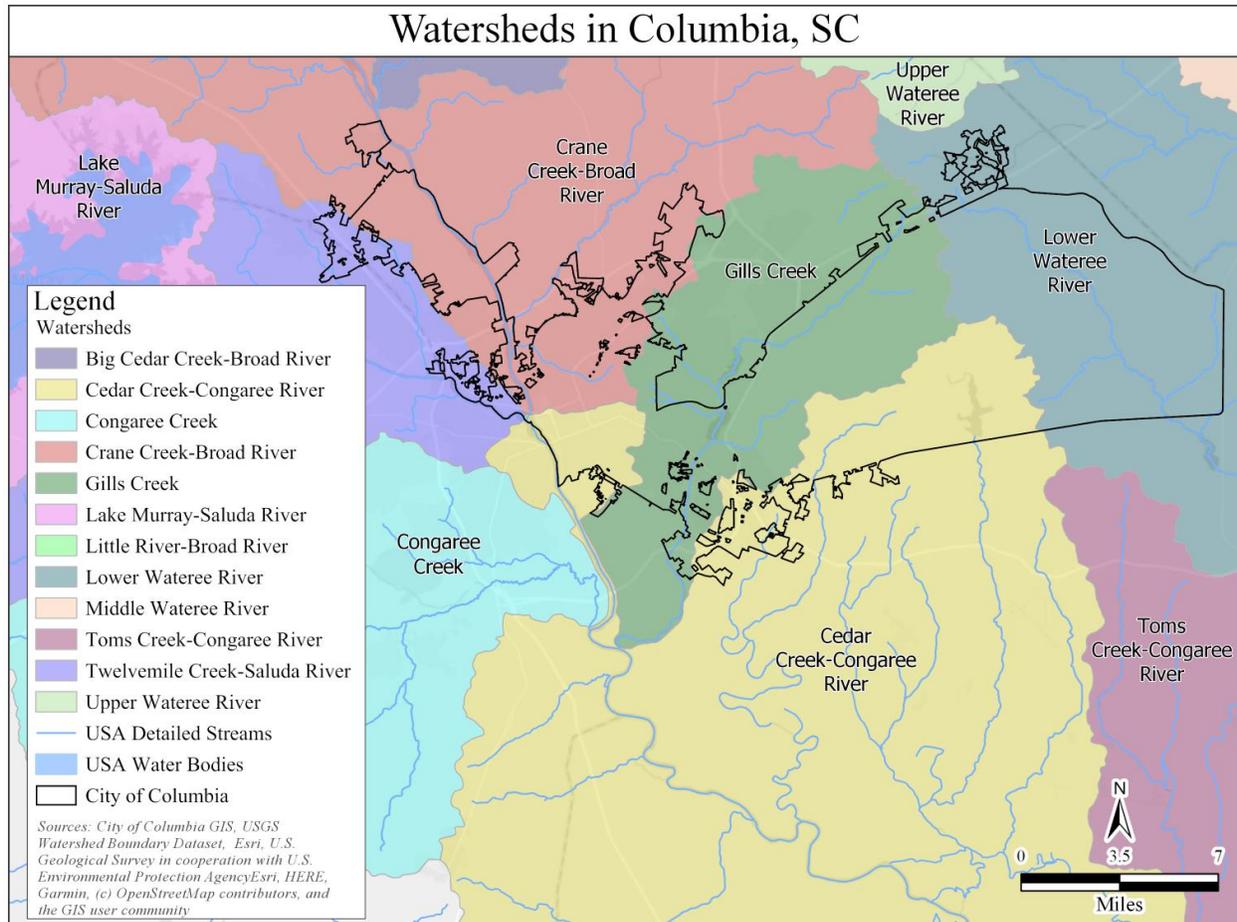
In order to ensure a comprehensive risk-based Mitigation Needs Assessment, Community Development coordinated with other City departments as pertinent to ensure that full understanding of all risks was known. These included Columbia Water, Planning and Development Services, General Services, Columbia Police Department, Columbia Fire Department, and IT. In addition, the Department of Community Development consulted with the South Carolina Emergency Management Division, the Central Midlands Planning group, and other governmental agencies to collect data and review state and local plans for consideration. This collaboration and analysis of various data sources and planning initiatives were key in ensuring a comprehensive review of the hazards discussed here and subsequent mitigation measures to be implemented.

### 2.1 Overview of City Landscape and Climate Conditions

The City of Columbia is located approximately 13 miles northwest of the geographic center of South Carolina and is the primary city of the Midlands region of the state. It lies at the confluence of the Saluda River and the Broad River, which merge at

Columbia to form the Congaree River (Figure 1). Historically, Columbia’s rivers have been important resources for the City’s growth, supporting both the development of the local economy and establishing Columbia as the final inland point of navigation from the coast. But the City’s location in the center of multiple watersheds has also created vulnerabilities, as demonstrated by Columbia’s history of flooding and related extreme events.

Figure 1. Water Sheds and Water Bodies in Columbia, SC



Climate in the Central Midlands is humid and subtropical, with long, hot summers and short, mild winters. On average, temperatures range in Columbia from 32°F to 55°F degrees in January and from 70°F to 92°F in July.<sup>1</sup> The state receives, on average, 49 inches of precipitation annually (Figure 2).

<sup>1</sup> Central Midlands Hazard Mitigation Plan, 2016, p. 10. Accessed on 2/19/2020 at <http://www.centralmidlands.org/pdf/CMHMP%202016%20-%20Final.pdf>

While average annual precipitation levels have remained relatively steady over the past century, extreme rainfall events have taken their toll on the City. The 2015 flood events resulted from extreme precipitation rates combined with an extended duration of rainfall throughout much of the state. As shown in Figure 3, that 4-day rainfall event in Columbia totaled 12.4 inches, exceeding the 500-year rainfall level and coming within less than an inch of a thousand-year rainfall event.

Figure 2. Cumulative Annual Precipitation, University of South Carolina, Columbia, SC, 1895–2010

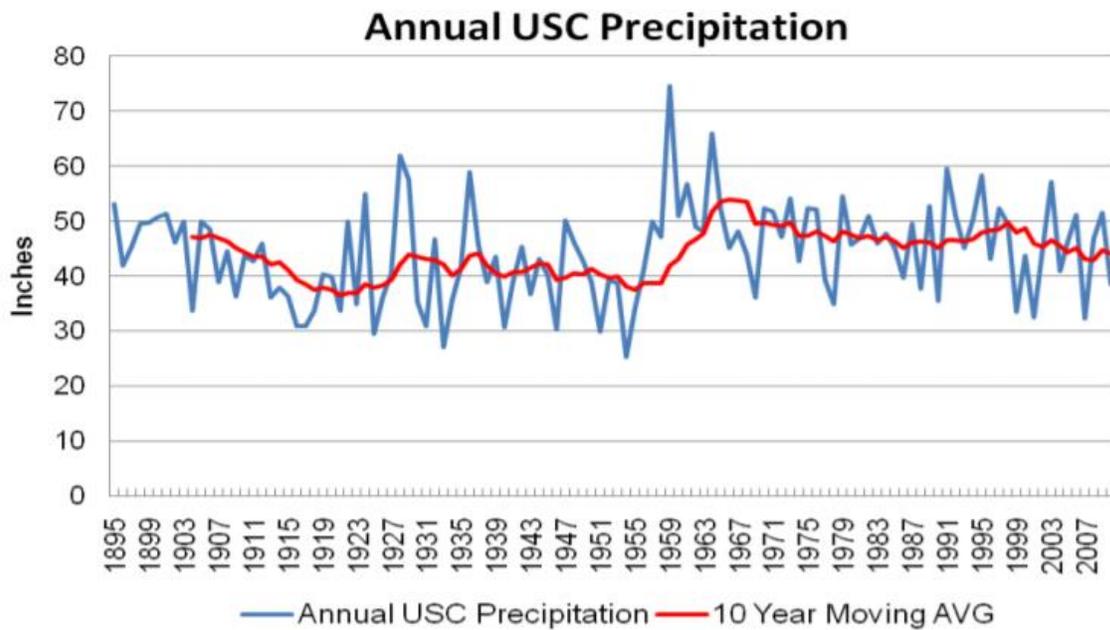
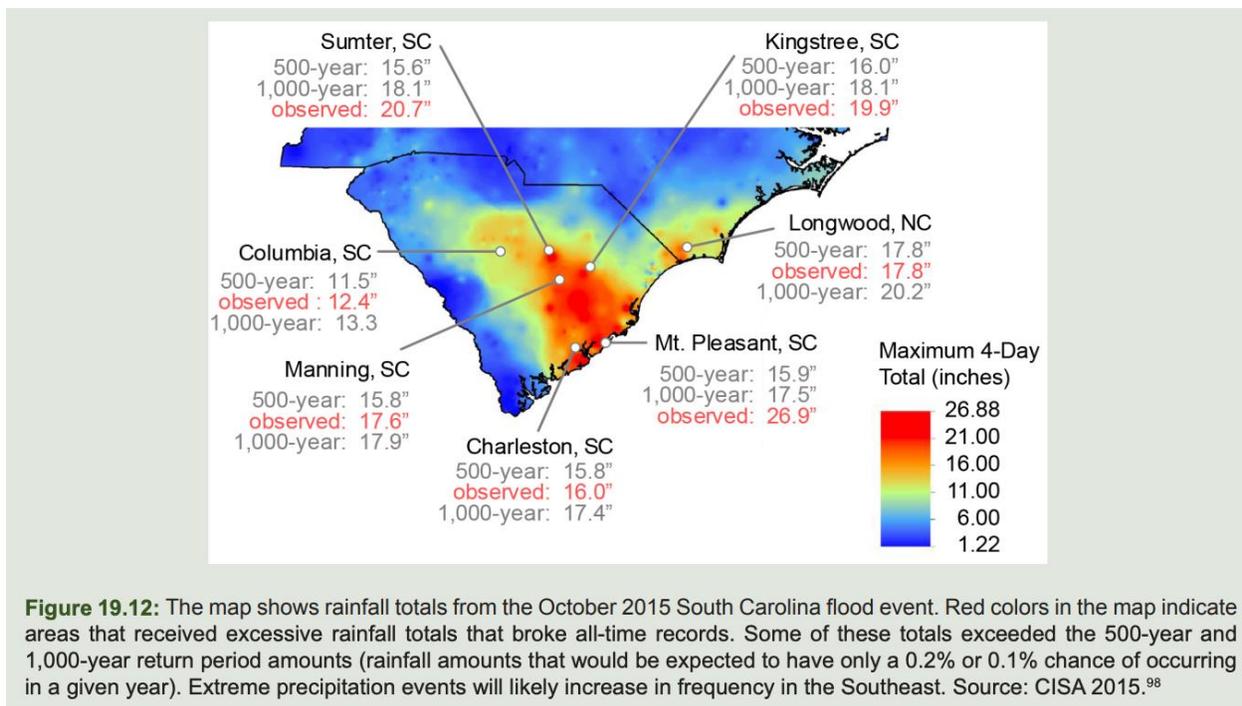


Figure from the South Carolina Department of Natural Resources, Climate Change Impacts to Natural Resources in South Carolina. Retrieved from <http://www.dnr.sc.gov/pubs/CCINatResReport.pdf>

**Figure 3. October 2015 Extreme Rainfall Event.** In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II, Chapter 19, Southeast, 2018.*<sup>2</sup>



### Projected Climate Conditions

Looking forward, climate conditions in Columbia can be expected to mirror climate changes in much of the interior Southeast. According to the Fourth National Climate Assessment, “The number of extreme rainfall events is increasing. Climate model simulations of future conditions [in the Southeast] project increases in both temperature and extreme precipitation.”<sup>3</sup> According to a technical study by the U.S. EPA, “Climate change is projected to increase the frequency of inland flooding in most watersheds of the U.S.,” with the Southeast region experiencing higher inland flooding than some other parts of the country.<sup>4</sup>

<sup>2</sup> Carter, L., A. Terando, K. Dow, K. Hiers, K.E. Kunkel, A. Lascurain, D. Marcy, M. Osland, and P. Schramm. 2018. Southeast. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, pp. 743–808. doi: 10.7930/NCA4.2018.CH19. <https://nca2018.globalchange.gov/chapter/southeast>

<sup>3</sup> Ibid.

<sup>4</sup> U.S. EPA. 2017. Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment. EPA 430-R-17-001. [https://indecon.com/wp-content/uploads/CIRA2.0\\_TechnicalReportforNCA4.pdf](https://indecon.com/wp-content/uploads/CIRA2.0_TechnicalReportforNCA4.pdf)

An analysis focused on downscaled projections for future temperature and precipitation patterns for the City of Columbia under the RCP 8.5 high emissions scenario<sup>5</sup> is consistent with these regional projections, as discussed below.

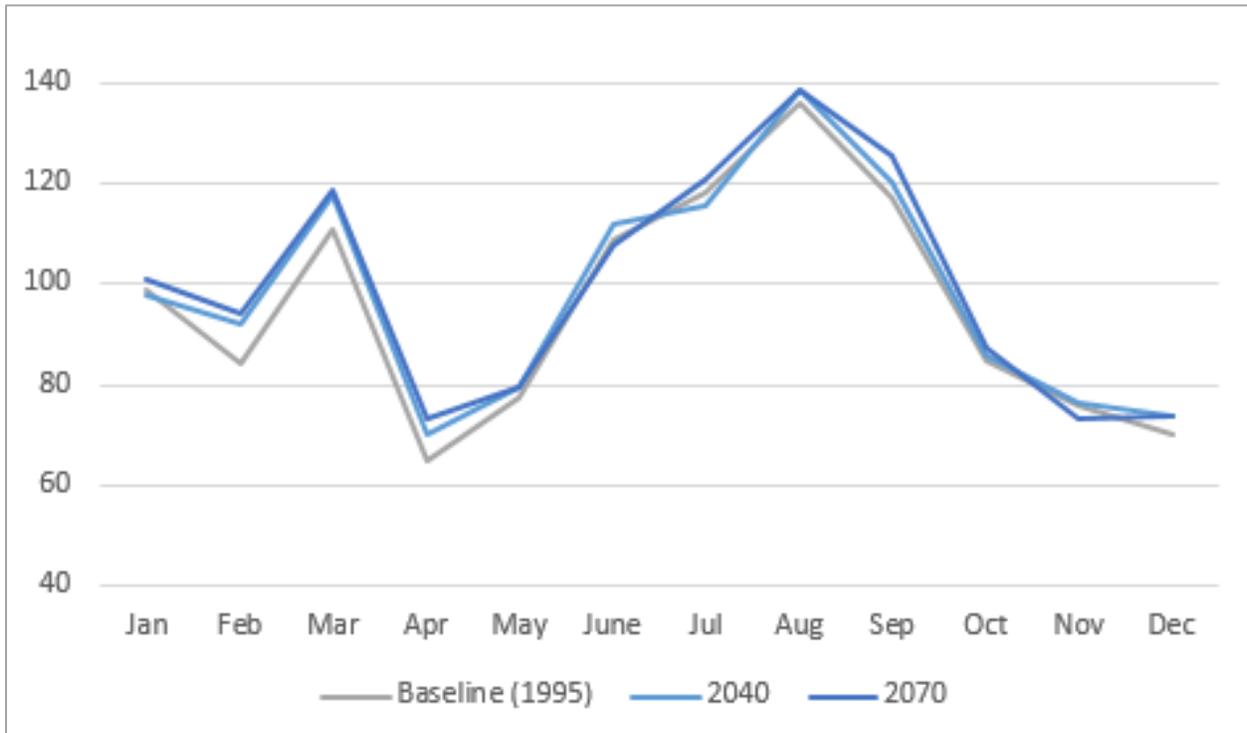
### **Precipitation**

Analysis of a range of climate models for future precipitation levels indicates that over the next 50 years, the City of Columbia will experience seasonal rainfall patterns similar to those it has experienced in the past, with most rainfall occurring in the summer months and dryer conditions during the fall and winter (Figure 4). However, these models also project an increase in the frequency and severity of extreme rainfall events (Figure 5). In 20 years (2040), projections indicate that the average annual number of days of heavy rainfall in Columbia will be between 4.2 and 5.2 days; in 50 years, this will increase to an average of 4.7 to 5.7 days per year. Given the topography of Columbia and its location on three rivers, the likelihood of more and heavier rainfall events increases the risk of flood events.

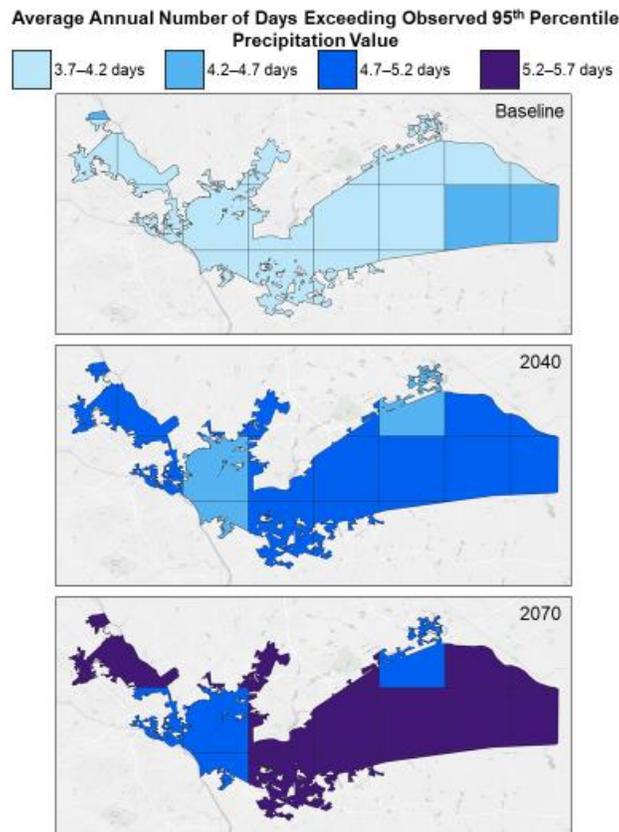
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<sup>5</sup> A Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory adopted by the Intergovernmental Panel on Climate Change. Different RCPs assume different levels of greenhouse gas concentrations and are used to project future climate conditions using climate models. The RCP 8.5 scenario assumes continued increases in greenhouse gas emissions.

Figure 4. Average Monthly Rainfall in Columbia, SC. Historical observed values are shown for the baseline (1986–2005). Projected values are shown for 2040 (2031–2050) and 2070 (2061–2080) for RCP 8.5.



**Figure 5. Average Annual Number of Days Experiencing Very Heavy Precipitation.** Average annual number of days exceeding the observed 95th percentile precipitation value for Columbia, SC. Historical observed values are shown for the baseline (1986–2005). Projected values are shown for 2040 (2031–2050) and 2070 (2061–2080) for RCP 8.5. Values represent the average annual number of days exceeding the observed (1986–2005) 95th percentile precipitation value.

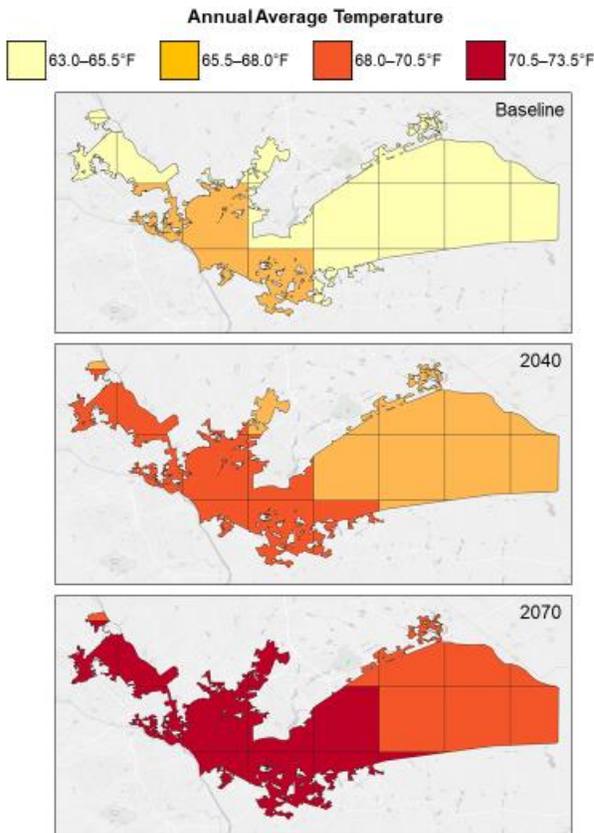


## Temperature

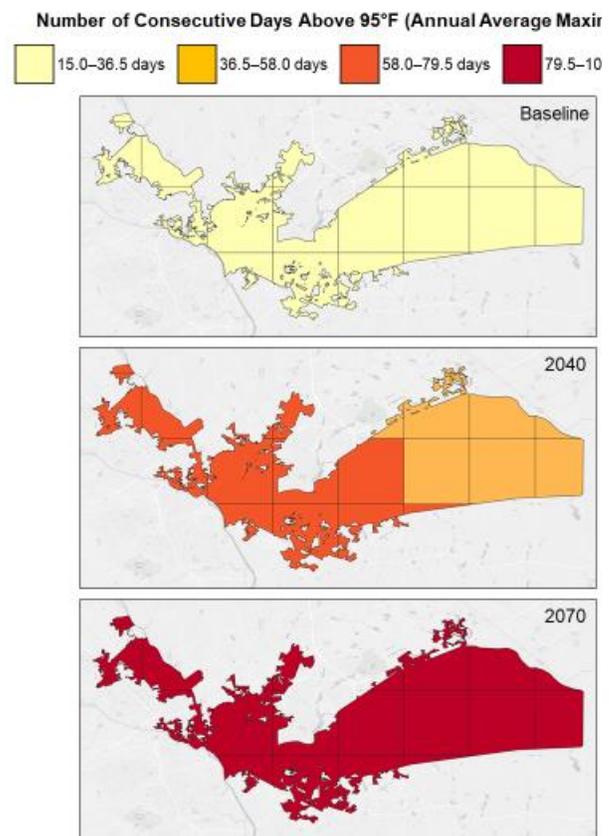
The City also assessed the projected change in average temperatures, and the frequency of very hot days due to climate change over the next 20 and 50 years. Under the high emissions scenario (RCP 8.5), climate models project that average annual temperatures in Columbia will increase from a baseline of 63.0°F to 68.0°F to 65.5°F to 70.5° by 2040, and 68.0°F to 73.5°F by 2070 (Figure 6). Even more significant is the projected increase in the frequency of days with extreme heat during the same timeframe. Climate model projects indicate an increase in the number of high heat days per year (over 95°F) from current levels of 15.0 to 36.5 days to 36.5 to 70.5 days in 2040, and 79.5 to 101.0 days by 2070 (Figure 7). These increases in temperature have implications for public health in terms of changing disease patterns and increased incidence of heat stress. Higher temperatures also trigger changes in vegetation and agriculture, increasing the demand for air conditioning, and greater

stress on water resources. Each of these impacts place greater demands on city services and infrastructure.

**Figure 6. Annual Average Projected Temperature for Columbia, SC (degrees Fahrenheit).** Historical observed values are shown for the baseline (1986–2005). Projected values are shown for 2040 (2031–2050) and 2070 (2061–2080) for RCP 8.5. Values are calculated using the average of the daily maximum and minimum temperatures.



**Figure 7. Very Hot Days in Columbia, SC (degrees Fahrenheit).** Historical observed values are shown for the baseline (1986–2005). Projected values are shown for 2040 (2031–2050) and 2070 (2061–2080) for RCP 8.5. Values represent the 95th percentile maximum temperature.



### Population and Demographics

While the frequency and severity of physical hazards vary by location, individuals will not all be affected equally when a disaster occurs. Many factors impact increased vulnerability to disasters, including age, poverty status, disability status, educational attainment, housing, and access to transportation. The population and demographics of the City of Columbia and the state are presented below.

| <b>Total Population</b>   | <b>Columbia</b> | <b>South Carolina</b> |
|---|-----------------|-----------------------|
| Population Estimate (American Community Survey, 2017)               | 132,236         | 4,893,444             |
| <b>Age</b>  |                 |                       |
| Persons under age 5   | 5.1%            | 5.9%                  |
| Persons under age 18  | 16.2%           | 22.3%                 |
| Persons age 65 and older  | 9.7%            | 16.3%                 |
| <b>Race and Ethnicity</b>   |                 |                       |
| White   | 52.3%           | 67.3%                 |
| Black or African American   | 40.9%           | 27.2%                 |
| American Indian and Alaskan Native                                  | 0.1%            | 0.3%                  |
| Asian   | 2.6%            | 1.5%                  |
| Native Hawaiian or other Pacific Islander                           | 0.2%            | 0.1%                  |
| Other race  | 1.2%            | 1.5%                  |
| Two or more races   | 2.6%            | 2.1%                  |
| Hispanic or Latino  | 5.8%            | 5.5%                  |
| <b>Education</b>  |                 |                       |
| High school graduate or higher                                      | 88.2%           | 85.6%                 |
| Bachelor's degree or higher   | 42.3%           | 26.6%                 |
| <b>Disability Status</b>  |                 |                       |
| With a disability   | 11.7%           | 10.4%                 |
| <b>Language spoken at home</b>                                      |                 |                       |
| English   | 91.6%           | 93.1%                 |
| Other than English  | 8.4%            | 6.9%                  |
| <b>Economy</b>  |                 |                       |
| In labor force (population age 16 and over)                         | 64.7%           | 60.7%                 |
| Unemployment  | 8.4%            | 7.2%                  |
| Median Household Income   | \$43,650        | \$48,781              |
| Persons with no health insurance coverage                           | 10.5%           | 12.1%                 |
| Families and people with income below poverty level                 | 15.2%           | 12.3%                 |
| Families with children under age 18 with income below poverty level | 24.1%           | 20.5%                 |
| <b>Housing</b>  |                 |                       |
| Vacancy rate  | 13.6%           | 16.1%                 |
| Renter-occupied   | 54.7%           | 31.4%                 |
| No vehicle available  | 11.4%           | 6.5%                  |
| Gross Rent as a Percentage of Household Income > 35%                | 45.0%           | 21.1%                 |

Source: U.S. Census Bureau, 2013–2017 American Community Survey 5-Year Estimates

As shown above, Columbia has a high proportion of minority residents, renters, and families below the poverty level. Renters in Columbia are also very cost burdened, with more than 40% spending more than 35% of gross income on rent. Eleven percent of residents also do not have access to a vehicle.

### Social Vulnerability Index

While the frequency and severity of physical hazards vary by location, communities in that location will not all be affected equally when a disaster occurs. Social vulnerability is a measure of the socioeconomic and demographic characteristics that affect the resilience of communities using four components: (1) socioeconomic status, (2) household composition and disability, (3) minority status and language, and (4) housing and transportation. When disaster strikes, the socially vulnerable are more likely to be impacted and have more difficulty recovering over the long term.<sup>6</sup>

Furthermore, research shows that vulnerable populations face a disproportionate impact from stresses driven by climate change. As noted in the Fourth National Climate Assessment, “Climate change tends to compound existing vulnerabilities and exacerbate existing inequities. Already poor regions, including those found in the Southeast, are expected to continue incurring greater losses than elsewhere in the United States.”<sup>7</sup>

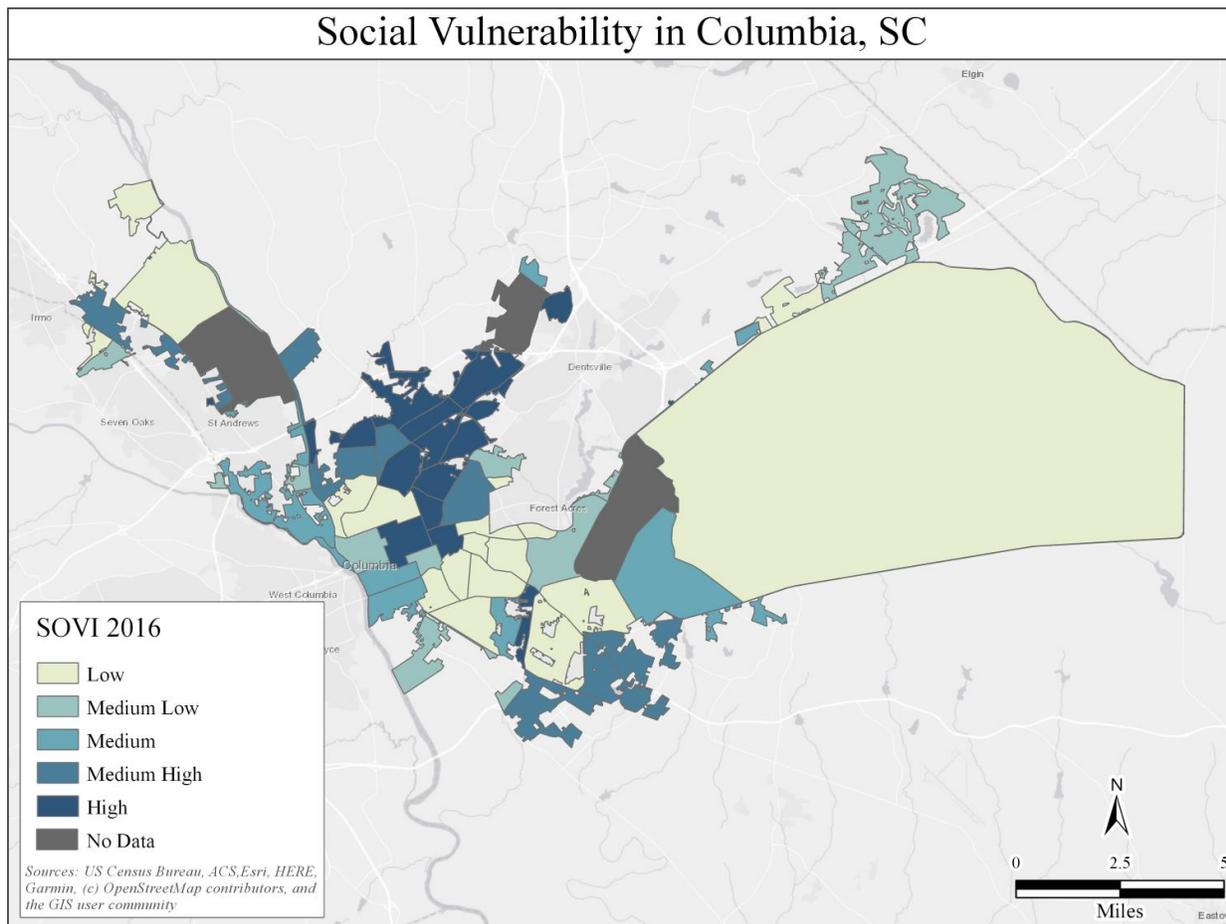
The map below displays social vulnerability by census tract in the City of Columbia in 2016. Census tracts in the northern part of the City have the highest levels of social vulnerability.

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<sup>6</sup> Flanagan, B.E., E.W. Gregory, E.J. Hallisey, J.L. Heitgerd, and B. Lewis, 2011. A Social Vulnerability Index for Disaster Management, *Journal of Homeland Security and Emergency Management*, 8(1), Article 3.

<sup>7</sup> Carter, L., A. Terando, K. Dow, K. Hiers, K.E. Kunkel, A. Lascurain, D. Marcy, M. Osland, and P. Schramm. 2018. Southeast. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, pp. 743–808. doi: 10.7930/NCA4.2018.CH19.  
<https://nca2018.globalchange.gov/chapter/southeast>

Figure 8. Social Vulnerability in the City of Columbia

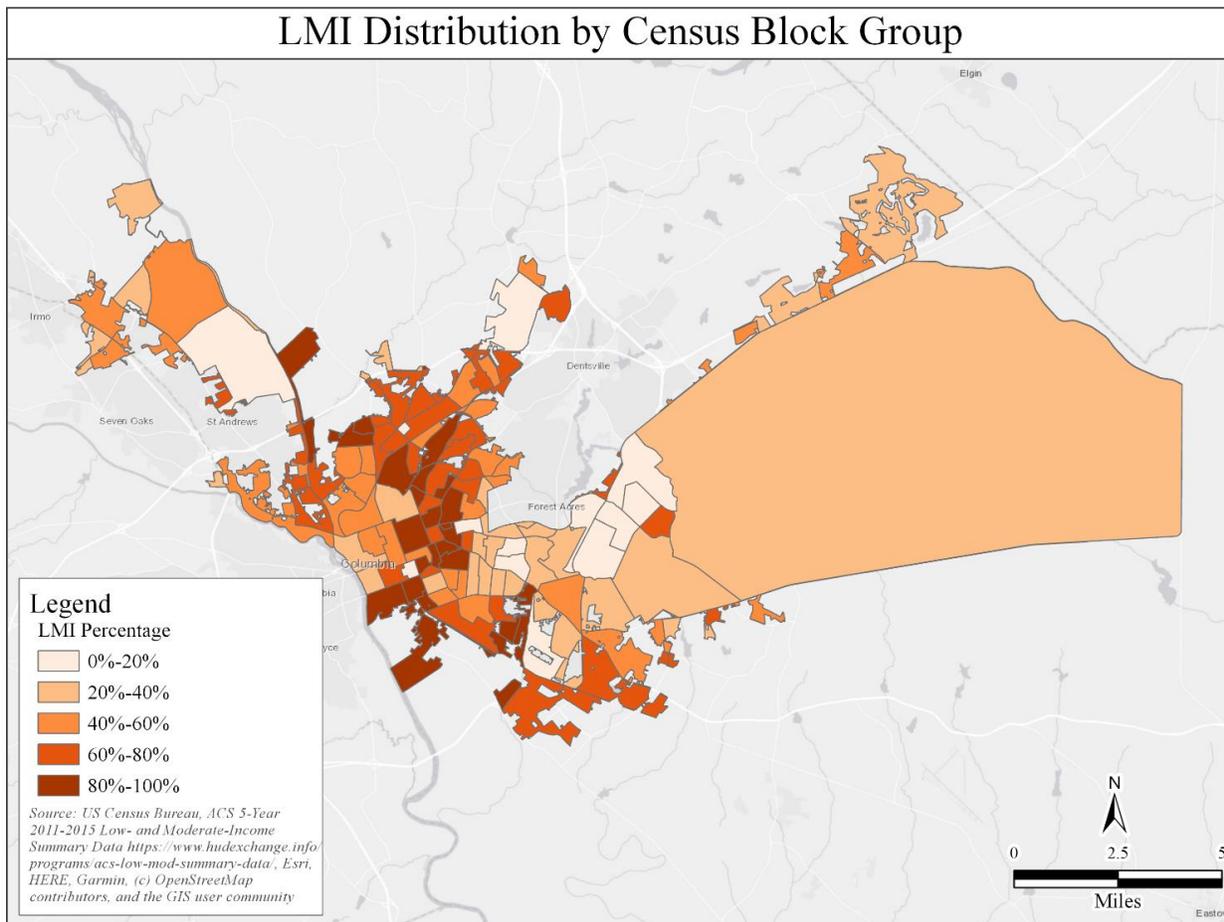


### Low and Moderate Income (LMI)

As discussed above, income is a component of social vulnerability. All programs funded by CDBG grants must meet one of the program’s three National Objectives: (1) benefiting LMI, (2) aiding in the prevention of slum and blight, or (3) meeting a particularly urgent need.

LMI households are defined as households that do not exceed 80% of the median income for their area, as defined by U.S. HUD. For CDBG-MIT programs, 50% of the funding must benefit LMI persons. The map below (Figure 9) shows LMI percentages by block group, with darker shades indicating higher concentrations of LMI individuals. In conjunction with the risk assessment below, these data were used by the City to select areas for CDBG-MIT project implementation.

Figure 9. LMI Distribution by Census Block Group, Columbia, SC



## 2.2 Historic Damage

The State of South Carolina has experienced many declared flood- and hurricane-related disasters or emergencies. Every county in the state has been impacted by one or more of these events. Of these declared disasters, Table 1 shows those that were declared statewide, or specifically for Richland County and subsequently the City of Columbia.

Table 1. Major Disasters Declared for Richland County, 1950–2019

| Disaster No. | Year | County    | Declaration Date | Incident Type    | Title                                       |
|--------------|------|-----------|------------------|------------------|---|
| 4346         | 2017 | Statewide | 10/16/2017       | Hurricane        | HURRICANE IRMA                              |
| 3378         | 2016 | Richland  | 10/06/2016       | Hurricane        | HURRICANE MATTHEW                           |
| 4286         | 2016 | Richland  | 10/11/2016       | Hurricane        | HURRICANE MATTHEW                           |
| 3373         | 2015 | Richland  | 10/03/2015       | Severe Storm     | SEVERE STORMS AND FLOODING                  |
| 4241         | 2015 | Richland  | 10/05/2015       | Flood            | SEVERE STORMS AND FLOODING                  |
| 3369         | 2014 | Richland  | 2/12/2014        | Severe Ice Storm | SEVERE WINTER STORM                         |
| 3233         | 2005 | Richland  | 9/10/2005        | Hurricane        | HURRICANE KATRINA EVACUATION                |
| 1509         | 2004 | Richland  | 2/13/2004        | Severe Ice Storm | SEVERE ICE STORM                            |
| 1566         | 2004 | Richland  | 10/07/2004       | Hurricane        | TROPICAL STORM FRANCES                      |
| 1313         | 2000 | Richland  | 1/31/2000        | Severe Storm     | SEVERE WINTER STORM                         |
| 1299         | 1999 | Richland  | 9/21/1999        | Hurricane        | HURRICANE FLOYD MAJOR DISASTER DECLARATIONS |
| 3145         | 1999 | Richland  | 9/15/1999        | Hurricane        | HURRICANE FLOYD EMERGENCY DECLARATIONS      |
| 843          | 1989 | Richland  | 9/22/1989        | Hurricane        | HURRICANE HUGO                              |
| 3047         | 1977 | Richland  | 8/04/1977        | Drought          | DROUGHT                                     |
| 44           | 1955 | Statewide | 8/20/1955        | Hurricane        | HURRICANES                                  |
| 29           | 1954 | Statewide | 10/17/1954       | Hurricane        | HURRICANE                                   |

### 2.3 Data Sources and Documents Utilized to Conduct Mitigation Needs Assessment

The City of Columbia Office of Community Development certifies that, in responding to this action plan requirement and presenting the required information, the City has reviewed and considered all applicable sources, including, but not limited to, the following:

1. FEMA Hazard Mitigation Planning Resources

<https://www.fema.gov/hazard-mitigation-planning-resources>

2. FEMA State Mitigation Planning Resources

website: <https://www.fema.gov/state-mitigation-planning-resources>

3. FEMA State Mitigation Planning Key Topics Bulletins  
<https://www.fema.gov/media-library/assets/documents/115780>
4. FEMA Local Mitigation Planning Resources  
<https://www.fema.gov/local-mitigation-planning-resources>
5. U.S. Forest Service Wildland Fire Resources  
<https://www.fs.fed.us/managing-land/fire>
6. National Interagency Coordination Center  
<https://www.nifc.gov/nicc/>
7. HUD CPD Mapping Tool  
<https://egis.hud.gov/cpdmaps/>
8. DHS Office of Infrastructure Protection  
<https://www.dhs.gov/topic/critical-infrastructure-security>
9. FEMA Community Lifelines Implementation Toolkit  
<https://www.fema.gov/media-library/assets/documents/177222>

In addition, the state has reviewed and coordinated with the following plans/data sources in the sections below.

### 2.3.1 State of South Carolina Hazard Mitigation Plan – 2018 Update

The State of South Carolina’s 2018 Hazard Mitigation Plan is the state’s most recent risk assessment completed through FEMA’s Hazard Mitigation Plan process. This plan serves as the foundation for the City of Columbia’s Risk-Based Mitigation Needs Assessment in this action plan. The FEMA-approved State Hazard Mitigation Plan was completed by South Carolina’s State Emergency Management Division. The state’s Hazard Mitigation Plan is the result of a systematic evaluation of the nature and extent of vulnerability to the impacts of natural hazards present in the State of South Carolina.<sup>8</sup> The plan also includes the actions necessary to minimize future vulnerability to those hazards. The City of Columbia has, at a minimum, addressed the risks included in the state’s Hazard Mitigation Plan in this Risk-Based Mitigation Needs Assessment. The City of Columbia has also used the state’s most recent risk assessment completed through the FEMA Hazard Mitigation Plan process as one of the resources to inform the use of CDBG-MIT funds.

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<sup>8</sup> 2018 South Carolina Hazard Mitigation Plan, p. 5.

<https://www.scecmd.org/media/1391/sc-hazard-mitigation-plan-2018-update.pdf>

### 2.3.2 Central Midlands Hazard Mitigation Plan – 2016 (Currently undergoing update)

The Central Midlands Hazard Mitigation Plan provides a vulnerability and risk assessment, as well as a mitigation plan for all natural hazards impacting the Central Midlands region of South Carolina where the City of Columbia is located. This plan is developed in coordination with the Central Midlands Council of Governments and the Hazards and Vulnerability Research Institute at the University of South Carolina. The plan is for use by the municipalities and jurisdictions of Fairfield, Lexington, Newberry, and Richland counties. Within the context of this plan, the City of Columbia is captured within Richland County. This Hazard Mitigation Plan represents the lowest jurisdictional level available at the time of this action plan’s development. At the time of this action plan’s development, the City coordinated with the Central Midlands Hazard Mitigation planning group to confirm that they had not begun compiling data for the 2021 update. The data on risks impacting Richland County have been utilized here as the most recent available for alignment in the Mitigation Needs Assessment of this document.

### 2.3.3 South Carolina Emergency Operations Plan

The South Carolina Emergency Operations Plan (SCEOP) is an all-hazards plan developed for use by state government departments and agencies to ensure a coordinated and effective response to natural, technological, or human-caused disasters that may occur in South Carolina.<sup>9</sup> The plan is organized to correspond to the four phases of emergency management: mitigation, preparedness, response, and recovery. For the Mitigation Needs Assessment in this action plan, the City of Columbia has, in particular, reviewed and referenced findings in SCEOP’s Attachment F, Hazards and Vulnerabilities Analysis and Annex 1, Hazards and Vulnerabilities Consequence Analysis Chart.

### 2.3.4 City of Columbia Disaster Impact Data

The City of Columbia’s GIS Division provides the city government with access to comprehensive and accurate geospatial data. The data are used to accurately map city assets at extremely high detail, such as fire hydrants, water meters, manholes, and so forth. This type of spatial and attribute information is the foundation of the City’s operations. In addition, the Division maintains data on impacts from disasters, such as properties impacted during the 2015 event, areas of known flooding, repetitive-loss properties, and so forth. The City utilized the data as part of this Mitigation Needs Assessment for this action plan.

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<sup>9</sup> Accessed on 2/17/2020 at <https://www.scmd.org/em-professionals/plans/emergency-operations-plan/>

## 2.4 Analysis of Current and Future Disaster Risks

The City of Columbia is located in the Central Midlands region of the state, which faces a multitude of natural hazards, mostly meteorological and hydrological.<sup>10</sup> These include the following:

1. Flooding
2. Tornadoes
3. Severe thunderstorms
4. Lightning
5. Hurricanes and tropical storms
6. Wind
7. Hail
8. Fog
9. Winter weather and ice storms
10. Temperature extremes
11. Wildfires
12. Droughts
13. Earthquakes

### 2.4.1 Assets at Risk

The table below reflects the assets at risk to the hazards noted above. The values are provided by Richland County and are capped based on the maximum taxable amount according to the county tax code.<sup>11</sup>

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<sup>10</sup> Central Midlands Hazard Mitigation Plan, 2016, p. 26. Accessed on 2/19/2020 at <http://www.centralmidlands.org/pdf/CMHMP%202016%20-%20Final.pdf>

<sup>11</sup> Ibid, p. 394. Accessed on 2/19/2020.

**Table 2. City of Columbia Appraised and Assessed Values of Buildings Only as of March 28, 2016**

| <b>Town / Type of Use</b> | <b>Number of Buildings</b> | <b>Assessed Value</b> | <b>Appraised Value</b> |
|---------------------------|----------------------------|-----------------------|------------------------|
| Single Family             | 28,059                     | \$193,801,772         | \$3,440,506,500        |
| Mobile Homes              | 33                         | \$6,780               | \$130,000              |
| Multi-Family              | 6,507                      | \$69,854,998          | \$1,156,408,800        |
| Commercial                | 2,020                      | \$96,453,632          | \$2,766,037,100        |
| Industrial                | 395                        | \$12,265,870          | \$201,585,900          |
| Institutional             | 45                         | \$2,528,520           | \$169,961,100          |
| <b>TOTAL</b>              | <b>37,059</b>              | <b>\$374,911,572</b>  | <b>\$7,734,629,400</b> |

Data from Central Midlands Hazard Mitigation Plan, 2016, p. 394.

The City of Columbia contains most of the critical infrastructure for Richland County and the surrounding areas. These include emergency operations centers, 911 communications center, major hospitals, airports, several wastewater treatment plants, and administrative buildings, as well as numerous law enforcement, fire/EMS, and school facilities.<sup>12</sup> The distribution of critical facilities in the City of Columbia and the surrounding areas of Richland County are shown in Figure 10.

<sup>12</sup> Central Midlands Hazard Mitigation Plan, 2016, p. 396. Accessed on 2/19/2020 at <http://www.centralmidlands.org/pdf/CMHMP%202016%20-%20Final.pdf>

Figure 10. Critical Facilities in Columbia, SC, and Surrounding Areas

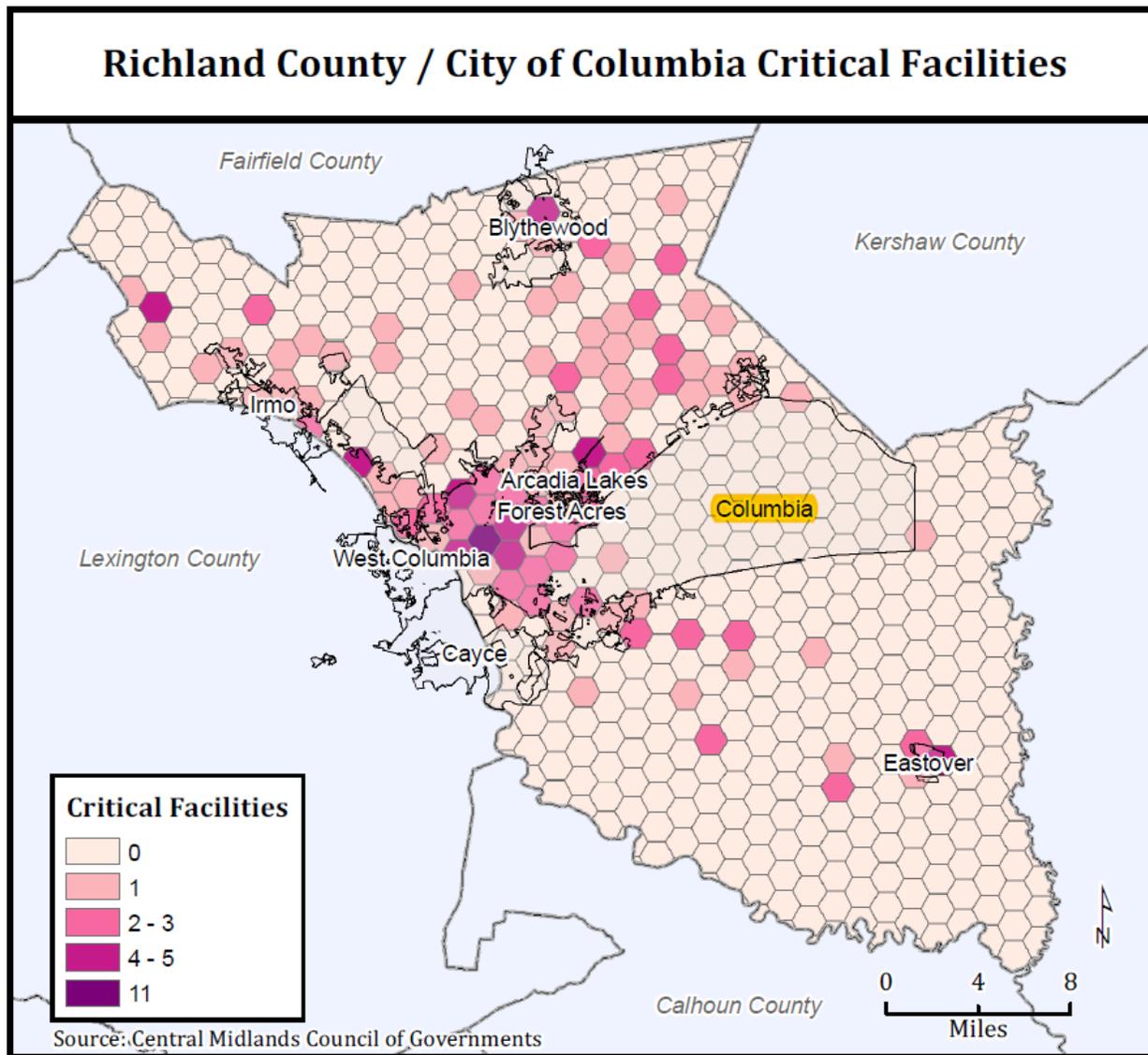


Figure from Central Midlands Hazard Mitigation Plan, 2016.

Prior to the 2015 flood disaster (DR-4241), hurricanes were thought to pose the highest risk to the area. Table 3, below, from the Central Midlands Hazard Mitigation Plan, contains the summary of Natural Hazards and Their Impact on Richland County, and subsequently the City of Columbia.

Table 3. Summary of Natural Hazards and Their Impact on Richland County/City of Columbia

|   | Direct Losses<br>(Property and<br>Crop) | Direct<br>Injuries<br>and<br>Fatalities | No. of Loss-<br>Causing<br>Events<br>(No. of<br>Events) | Frequency      | Recurrence<br>Interval<br>(in years) | Future<br>Changes |
|---|---|---|---|----------------|--------------------------------------|-------------------|
| Flooding  | \$3,611,182*                            | 3*                                      | 89 (103)*   | 191%*          | 0.5*                                 | ▲                 |
| Hurricane   | \$96,540,101                            | 31                                      | 8 (12)  | 22%            | 4.6                                  | ▲                 |
| Tornadoes   | \$25,402,320                            | 21                                      | 15 (34)   | 62%            | 1.6                                  | ▲                 |
| Thunderstorm                                      | \$1,685,500                             | 9                                       | 48 (62)   | 113%           | 0.9                                  | ▲                 |
| Lightning   | \$6,400,734                             | 62                                      | 64 (278,105)  | 1030019%<br>** | Several<br>times per<br>day          | ▲                 |
| Wind  | \$12,909,454                            | 8                                       | 181 (469)   | 853%           | 0.12                                 | ▲                 |
| Hail  | \$1,576,679                             | 7                                       | 64 (242)  | 440%           | 0.2                                  | ▲                 |
| Fog   | Not available                           | Not<br>available                        | not/available   | > 8%**         | > 12.6 days                          | ◀▶                |
| Winter Storm                                      | \$10,093,420***                         | 1                                       | 28 (45)   | 53%            | 1.9                                  | ▼                 |
| Cold  | \$16,925,275                            | 4                                       | 31 (31)   | 56%            | 1.7                                  | ▼                 |
| Heat  | \$21,263,066                            | 6                                       | 13 (13)   | 24%            | 4.2                                  | ▲                 |
| Drought   | \$24,345,640                            | 0                                       | 17 (17)   | 31%            | 3.2                                  | ▲                 |
| Wildfire  | \$366,633                               | 0                                       | 3 (1,996)   | 23%**          | 4.4 days                             | ▲                 |
| Earthquake  | 0                                       | 0                                       | 0 (3)   | 3%             | 39                                   | ◀▶                |
| TOTAL   | \$\$219,543,325                         | 152                                     |   |                |                                      |                   |
| Hazards of Major Concern for the City of Columbia |   |   |   |                |                                      |                   |

\* Excludes 2015 flood losses

\*\* Daily frequency/recurrence calculations instead of years

\*\*\* Excludes 2004 ice storm losses

▲ indicates that future increase in occurrence and/or impacts is likely.

▼ indicates that future decrease in occurrence and/or impacts is likely.

◀▶ indicates that either no change in future occurrence or impacts is expected or that a determination of future changes cannot be made.

Data from Central Midlands Hazard Mitigation Plan, 2016, p. 343.

Based on the above, flash flooding, thunderstorms (which for the purposes of this Mitigation Needs Assessment includes lightning, wind, and hail), and tornadoes are the most frequent occurrences. While heat and drought also pose serious threats to the City, they are difficult to quantify in loss figures or maps due to their impacts being underreported or a lack of data.<sup>13</sup>

#### 2.4.2 Overall Vulnerability

The 2016 Central Midlands Hazard Mitigation Plan includes a vulnerability assessment for each individual hazard above that identifies assets at risk (e.g., people, critical infrastructure) and estimates potential losses from the hazards identified. Overall vulnerability was quantified into low, medium, and high categories and overlaid with information on social vulnerability, critical infrastructure, population, and building stock.<sup>14</sup> The 2016 Central Midlands Hazard Mitigation Plan discusses hazard-specific vulnerabilities for each hazard. For the purposes of this Mitigation Needs Assessment, the City of Columbia defers to that 2016 Central Midlands Hazard Mitigation Plan for individual, hazard-specific vulnerability assessments, but presents the summary findings when vulnerability information was combined across all hazard types in Figure 11.

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<sup>13</sup> Central Midlands Hazard Mitigation Plan, 2016, p. 343. Accessed on 2/18/2020 at <http://www.centralmidlands.org/pdf/CMHMP%202016%20-%20Final.pdf>

<sup>14</sup> Ibid, p. 392. Accessed on 2/19/2020.

Figure 11. Vulnerability to Natural Hazards in the City of Columbia/Richland County

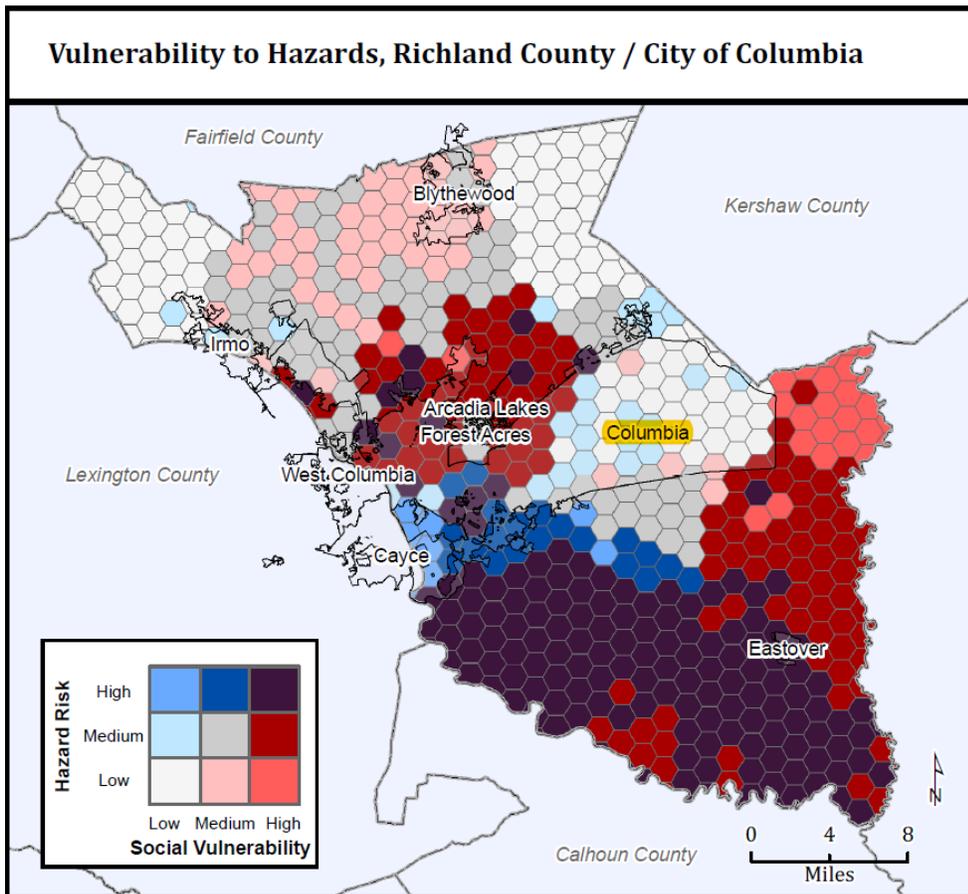


Figure from Central Midlands Hazard Mitigation Plan, 2016, p. 392.

### 2.4.3 Hazards of Major Concern

Per the Federal Register (84 FR 45838), the City of Columbia addresses all risks included in the most recent Central Midlands Hazard Mitigation Plan (2016) in the section above, but has chosen to present an in-depth analysis of current and future disaster risk for those hazards of major concern that are most frequent, and most threaten property and loss of life.

## Flooding

### Overview of Hazard

Flooding is defined as the partial or complete inundation of land areas that are normally dry as a result of the overflow of inland or tidal water and surface water runoff from any source. Floods are one of the most common natural disasters in the United States and one of the greatest risks facing the City of Columbia, as evident from the impacts of DR-4241. Floods result from excessive precipitation over a span

of days, intense rain in a short period of time, river overflow from an ice or debris jam, or failure of a water structures (e.g., dams, levees).

The South Carolina 2018 State Hazard Mitigation Plan defines five distinctive types of flooding in the state:

1. **Flash flooding:** Rapid flooding occurs from short, heavy rainfall accumulating in areas faster than the ground can absorb it. Urban flooding occurs because of impervious surfaces (e.g., streets, roads, parking lots).
2. **Riverine flooding:** Occurs when an increase in water volume within a river channel causes an overflow onto the surrounding floodplain.
3. **Coastal flooding:** Occurs when water is pushed inland as a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, nor'easters, and other coastal storms.
4. **Local drainage problems:** Occurs in the City where the ground is flat, where the drainage pattern has been disrupted, or where channels or culverts have not been maintained.
5. **Dam/levee failure:** Sudden release of impounded water, flooding the land downstream.

Of these flood types, the City of Columbia is most susceptible to flash flooding, riverine flooding, and local drainage problems.

#### Historical Impact

The City of Columbia has historically experienced flooding that often impacts residential properties, roadways, and infrastructure. Flooding impacts as total annualized losses and repetitive-loss properties are highlighted in the tables 4 and 5, and Figure 12 below.

Table 4. Historical and Recent Flood Events and Losses

| Hazard Occurrence | Historical Impact (1960–2015) |        |          | Recent Impacts (2012–2015) |        |          |
|-------------------|-------------------------------|--------|----------|----------------------------|--------|----------|
|                   | Annualized Losses             | Deaths | Injuries | Annualized Losses          | Deaths | Injuries |
| RICHLAND*         | \$578,395                     | 9      | 31       | \$7,437,650                | 9      | 30       |

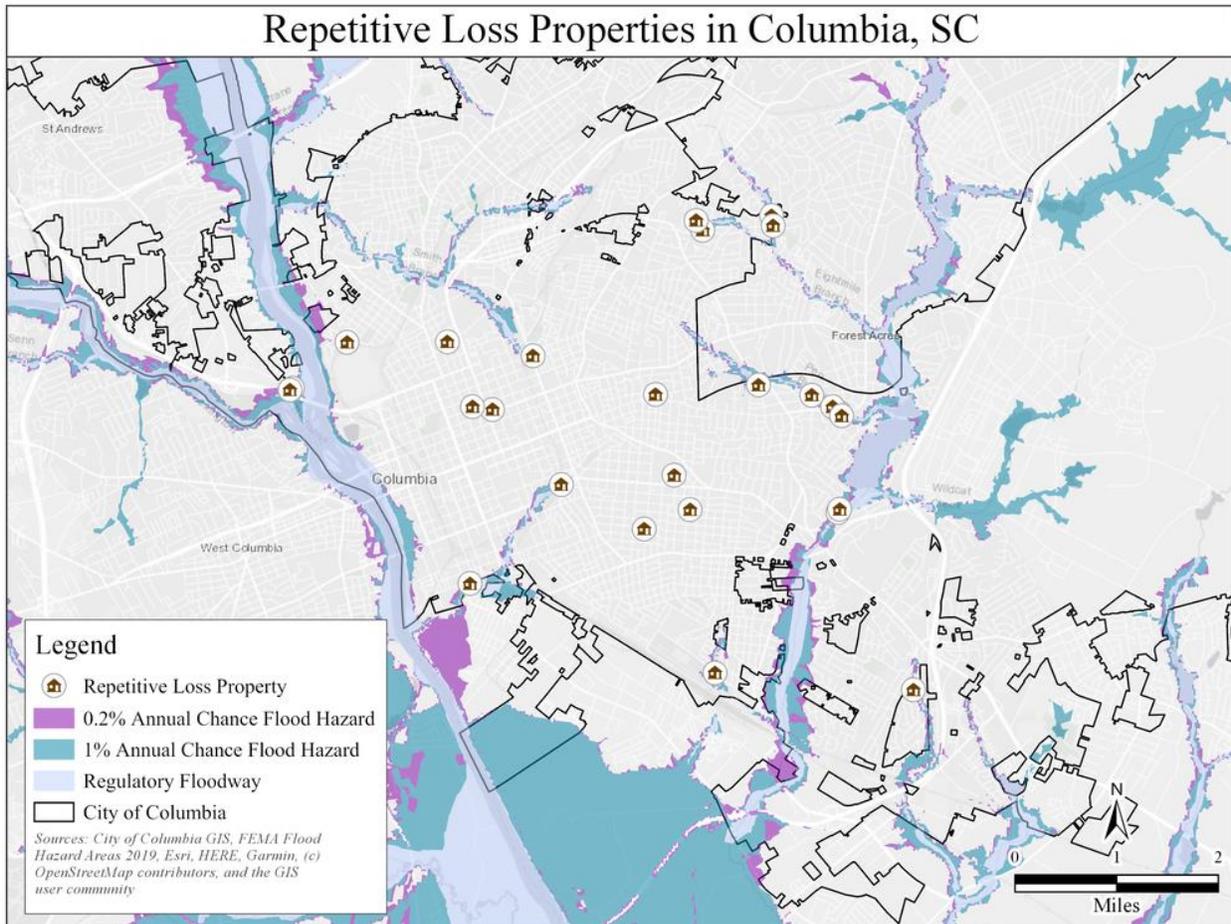
\* The City of Columbia is within Richland County.

Table 5. Repetitive-Loss Properties, City of Columbia

| Community Name   | Content Payments | Total Payments | Average Payment | Losses | Properties |
|------------------|------------------|----------------|-----------------|--------|------------|
| City of Columbia | \$368,684        | \$1,690,348    | \$19,655        | 86     | 31         |

Table from the South Carolina State Hazard Mitigation Plan, 2018.

Figure 12. Repetitive-Loss Properties in Columbia, SC



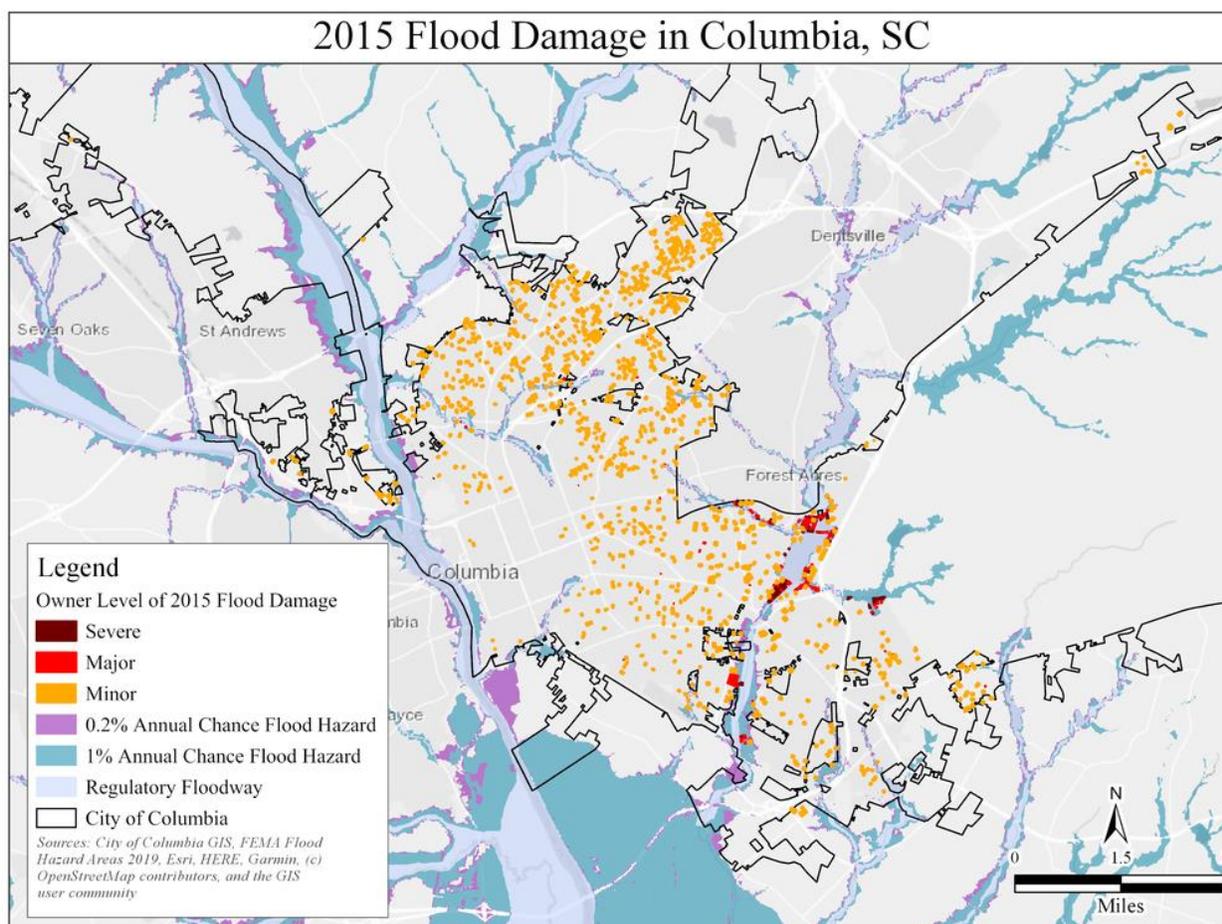
**DR-4241**

In October 2015, the City of Columbia experienced unprecedented rainfall and flooding resulting from an upper atmospheric low-pressure system that funneled tropical moisture from Hurricane Joaquin. The rain exceeded a once in a thousand-year flood event with more than 2 feet of rainfall in less than 48 hours. The rain and flooding caused extensive damage to many dams, bridges, roads, homes, and

businesses in the state’s capital. The City sustained more than \$75 million in infrastructure losses.<sup>15</sup>

Most of the major damage to housing occurred along the banks of Lake Katherine, Central and Lower Gills Creek, Wildcat Creek, and the Penn Branch areas of the City. Numerous city residents had to abandon their homes, and many houses were isolated as more than 100 streets were closed, blocked, or impassable. Residential properties that were damaged as a result are shown in Figure 13.

Figure 13. 2015 Flood Damage in Columbia, SC



In addition to the damage to private residences and businesses, the flooding also caused dam breaches and failures, impacted wastewater treatment systems, and drinking water treatment and collection systems with backwater flooding due to

<sup>15</sup> City of Columbia, CDBG-DR Action Plan, December 21, 2016. Accessed on 2/23/2020 at <https://dr.columbiasc.gov/wp-content/uploads/2016/08/20161221-COC-Final-Action-Plan-Revisions.pdf>

emergency water release from the Lake Murray Dam. As a result, the City was under a systemwide boil water notice, which was the first ever in the City's history. Broken water lines were submerged in flooded areas and were inaccessible until the water receded. While the water source/supply was in jeopardy due to the breach in the canal, the City was able to sustain operations through a combination of measures until such time that emergency repairs in the canal were completed. Those measures included pushing water from the Lake Murray Water Treatment Plant to portions of the system typically served by the Columbia Canal Water Treatment Plant. Conservation measures, as well as installation of pipes and pumps that allowed water to be withdrawn directly from the river until such time that the canal was stabilized, were also utilized.

A detailed analysis of the impacts on the City's water supply as a result of the flood is discussed in Section 2.5.2, Food, Water, and Shelter.

The City of Columbia's CDBG-DR Action Plan, published in December 2016, also notes that the flooding and subsequent disruption of drinking water severely impacted operations of the following, highlighting the critical need for further flood mitigation measures:

- City Capitol Complex
- Governor's residential compound
- State agencies
- City Government agencies
- 5 Colleges and 1 major university (40,000 students and 2,000 faculty)
- 5 Hospitals with 2,436 beds (including a Level 1 Trauma Center)
- U.S. military installation – Fort Jackson (3,500 active duty members and 12,000 family members)
- All public, private, and parochial school districts
- Nursing homes and assisted care facilities
- Numerous banking institutions, restaurants, hotels, tourist destinations, and hundreds of other businesses and organizations

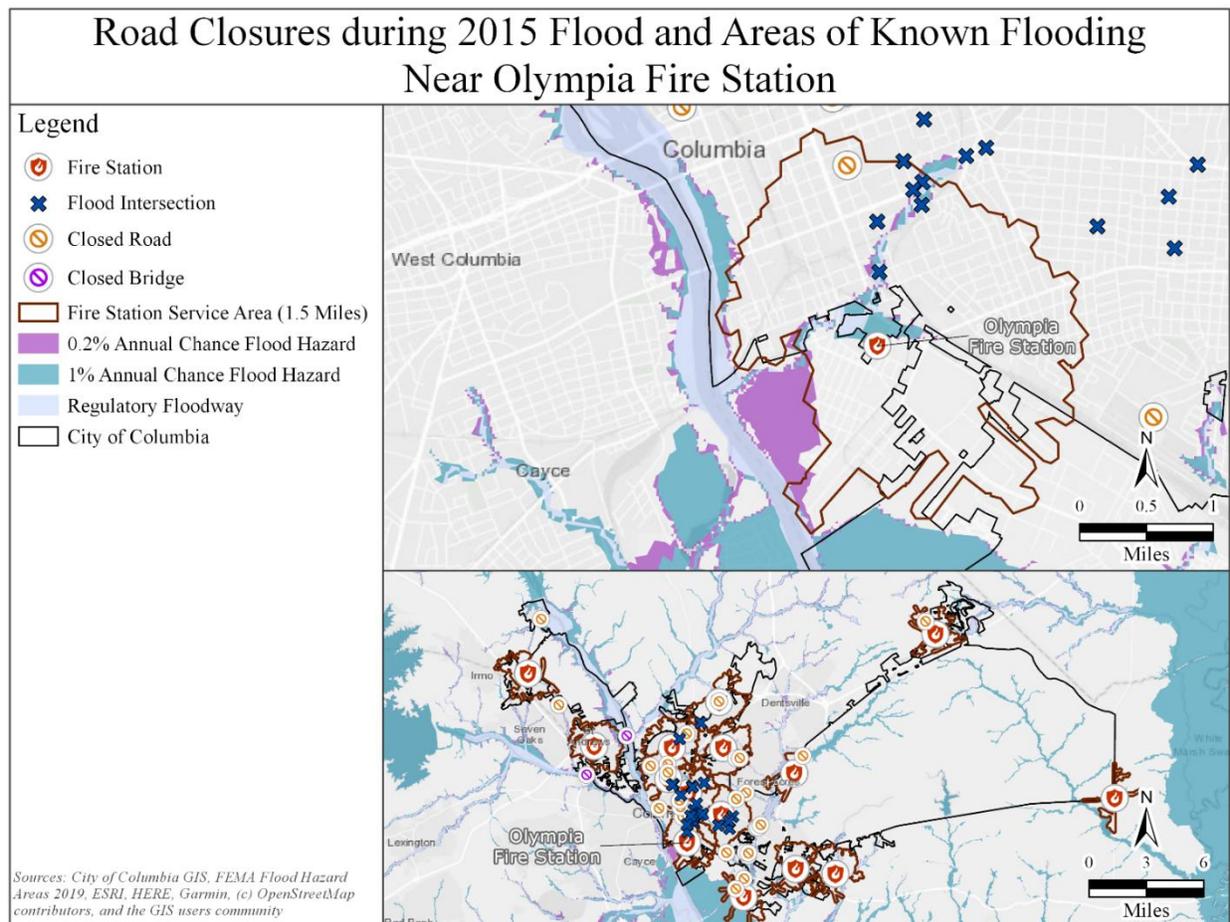
In addition to damage to property and the impact on the water supply, debris removal and emergency response costs as a result of the 2015 floods in the State of South Carolina were in excess of \$58 million statewide.<sup>16</sup> Responders and fire officials in the City of Columbia's Olympia Fire Station faced extreme difficulties when responding to the flood events of 2015, both due to the capacity of the station and the poor

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<sup>16</sup> South Carolina Emergency Operations Plan, Annex 1 – Hazards and Vulnerabilities Consequence Analysis Chart. Accessed on 2/18/2020 at <https://www.scemd.org/media/1453/annex-1-hazard-identification-and-consequence-analysis-chart.pdf>

location with respect to the areas of flooding. Historically, flash floods often require swiftwater rescues for residents who find themselves suddenly trapped in flooded areas. Columbia’s GIS Division maps intersections of known flooding historically, and the state’s Emergency Management Division maintained a list of road and bridge closures during the 2015 floods that created emergency response difficulties for the Olympia Fire Station. Both of these are depicted in Figure 14 to highlight the difficulty that response operations faced, and may continue to face, during periods of heavy rain and flooding due to the fire station’s current location and capacity.

Figure 14. Road Closures during 2015 Flood and Intersections of Known Flooding in Columbia, SC



### Future Risk

The City of Columbia, like many areas of the Southeast, is projected to experience increasing frequency of extreme precipitation events, as depicted in Figure 5 in Section 2.1 above. Absent mitigation measures, these changes in rainfall patterns will contribute to more frequent flooding and subsequent impacts. Likewise, the projections of increased intensity and duration of hurricanes will contribute to greater

flooding, combined with wind damage. The prospect of increased flooding has serious implications across all sectors.

## Tornadoes

### Overview of Hazard

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes may form at any time of the year, but in the United States, peak occurrence is in the spring and early summer months of March through June. Tornadoes are most often generated by thunderstorm activity or any situation of severe weather (sometimes spawned from hurricanes and other coastal storms) when cool, dry air intersects and overrides a layer of warm, moist air, forcing the warm air to rise rapidly.

### Historical Impact

Common consequences of tornadoes in Columbia are damage to homes and businesses, interruption of utility services, and devastation of the local economy at the state level.<sup>17</sup> However, the Central Midlands region, where the City of Columbia is located, experiences mostly weak tornadoes, although EF3s and EF4s have occurred in the past in the counties neighboring the City of Columbia.<sup>18</sup> While tornadoes do not cause as widespread damage as flooding or hurricanes, they can cause devastating localized damage to areas where they impact. In addition, the rapid formation of tornadoes often leaves little time for advanced warning, highlighting the need for proper emergency alert and response measures, as well as measures to protect against loss of life (e.g., community safe rooms).

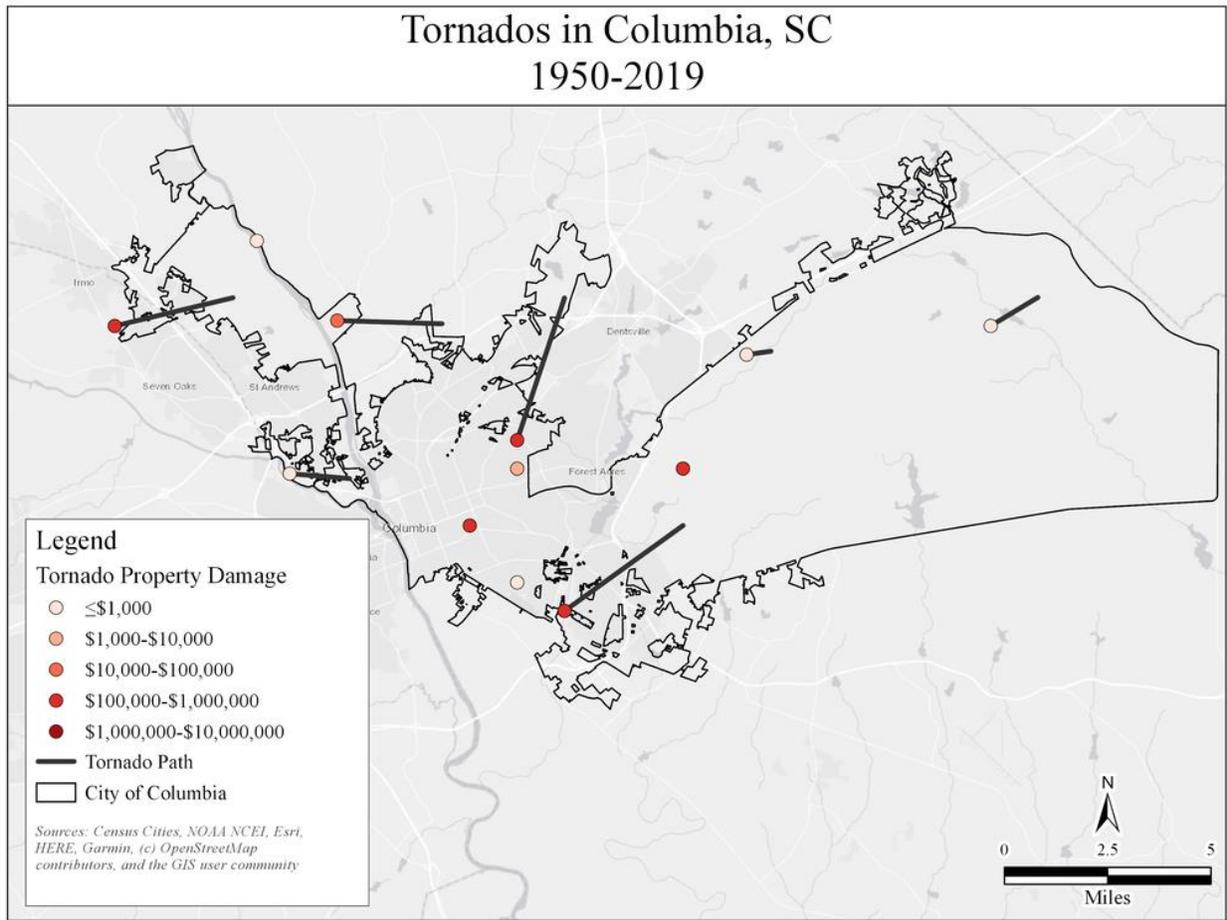
Property damage from tornadoes in the City are shown in Figure 15.

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<sup>17</sup> South Carolina Emergency Operations Plan, Annex 1 – Hazards and Vulnerabilities Consequence Analysis Chart. Accessed on 2/18/2020 at <https://www.scemd.org/media/1453/annex-1-hazard-identification-and-consequence-analysis-chart.pdf>

<sup>18</sup> Central Midlands Hazard Mitigation Plan, 2016, p. 34. Accessed on 2/18/2020 at <http://www.centralmidlands.org/pdf/CMHMP%202016%20-%20Final.pdf>

Figure 15. Tornado Property Damage, 1950–2019



The historical impact of tornados with respect to injuries, fatalities, and property damage (including crop damage) is shown in Table 6.

Table 6. Historical Loss-Causing Tornado Events in Columbia, SC, Since 1960

| Start Date | End Date   | Inj | Fat | Property Damage | Crop Damage | Mag. | Location     |
|------------|------------|-----|-----|-----------------|-------------|------|--------------|
| 7/03/1964  | 7/03/1964  | 0   | 0   | \$190,916       | \$0         | F2   |              |
| 8/29/1964  | 8/29/1964  | 0   | 0   | \$1,909,161     | \$0         | F2   |              |
| 5/29/1967  | 5/29/1967  | 3   | 0   | \$177,198       | \$0         | F2   |              |
| 11/24/1967 | 11/24/1967 | 0   | 0   | \$1,771,976     | \$0         | F1   |              |
| 1/10/1972  | 1/10/1972  | 1   | 0   | \$1,415,885     | \$0         | F1   |              |
| 11/12/1975 | 11/12/1975 | 7   | 0   | \$1,100,074     | \$0         | F2   |              |
| 5/15/1976  | 5/15/1976  | 3   | 1   | \$1,040,141     | \$0         | F2   |              |
| 6/19/1977  | 6/19/1977  | 0   | 0   | \$97,663        | \$0         | F1   |              |
| 5/20/1980  | 5/20/1980  | 0   | 0   | \$718,252       | \$0         | F1   |              |
| 2/11/1981  | 2/11/1981  | 0   | 0   | \$65,109        | \$0         | F1   |              |
| 8/31/1987  | 8/31/1987  | 2   | 0   | \$520,986       | \$0         | F2   |              |
| 7/23/1997  | 7/23/1997  | 1   | 0   | \$302,373       | \$0         | F1   | Columbia     |
| 9/07/2004  | 9/07/2004  | 0   | 0   | \$375,970       | \$0         | F1   | Fort Jackson |
| TOTAL      | 13         | 17  | 1   | \$9,685,704     | \$0         |      |              |

From the Central Midlands Hazard Mitigation Plan, 2016, p. 358.

### Future Risk

The occurrence of tornadoes is variable and the relationship between climate change and tornadoes is not fully understood; changes in tornado activity cannot be projected as a direct result of climate change. However, national trends indicate that tornado activity in the United States has become more variable, particularly over the 2000s, with a decrease in the number of days per year with tornadoes and an increase in the number of tornadoes on these days – known as “tornado outbreaks” – and an extended season during which tornadoes occur.<sup>19</sup> For Columbia, the increased risk of damage from tornado activity is likely to be a function of the value of increased development and assets exposed to tornadoes in future years.

<sup>19</sup> Kossin, J.P., T. Hall, T. Knutson, K.E. Kunkel, R.J. Trapp, D.E. Waliser, and M.F. Wehner. 2017. Extreme storms. In *Climate Science Special Report: Fourth National Climate Assessment, Volume I* [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, pp. 257–276, doi: 10.7930/J07S7KXX.

## Severe Thunderstorms and Lightning

### Overview of Hazard

Severe thunderstorms are rain showers in which thunder occurs that are defined as *severe* by the National Weather Service when containing one or more of the following: hail 1 inch or greater, winds gusting in excess of 50 knots (57.5 mph), or a tornado.<sup>20</sup> A thunderstorm is also an event during which thunder is audible due to lightning. Therefore, all thunderstorms have lightning.<sup>21</sup> Lightning is a spark of static electricity in the atmosphere that results from the buildup of electrical energy between positively and negatively charged areas among clouds, the air, and the ground. Tall objects within the City of Columbia, such as trees and skyscrapers, are commonly struck by lightning. While forecasters are able to detect the likelihood of intense lightning activity, it is impossible to forecast individual strikes since lightning is so widespread, frequent, and random.

In the Central Midlands region of South Carolina, where the City is located, thunderstorms and lightning frequently occur during the spring and summer months. On average, the Central Midlands region experiences between 50 and 60 thunderstorm days per year.<sup>22</sup>

### Historical Impact

Historical damage associated with thunderstorms throughout the City is noted in Figure 16.

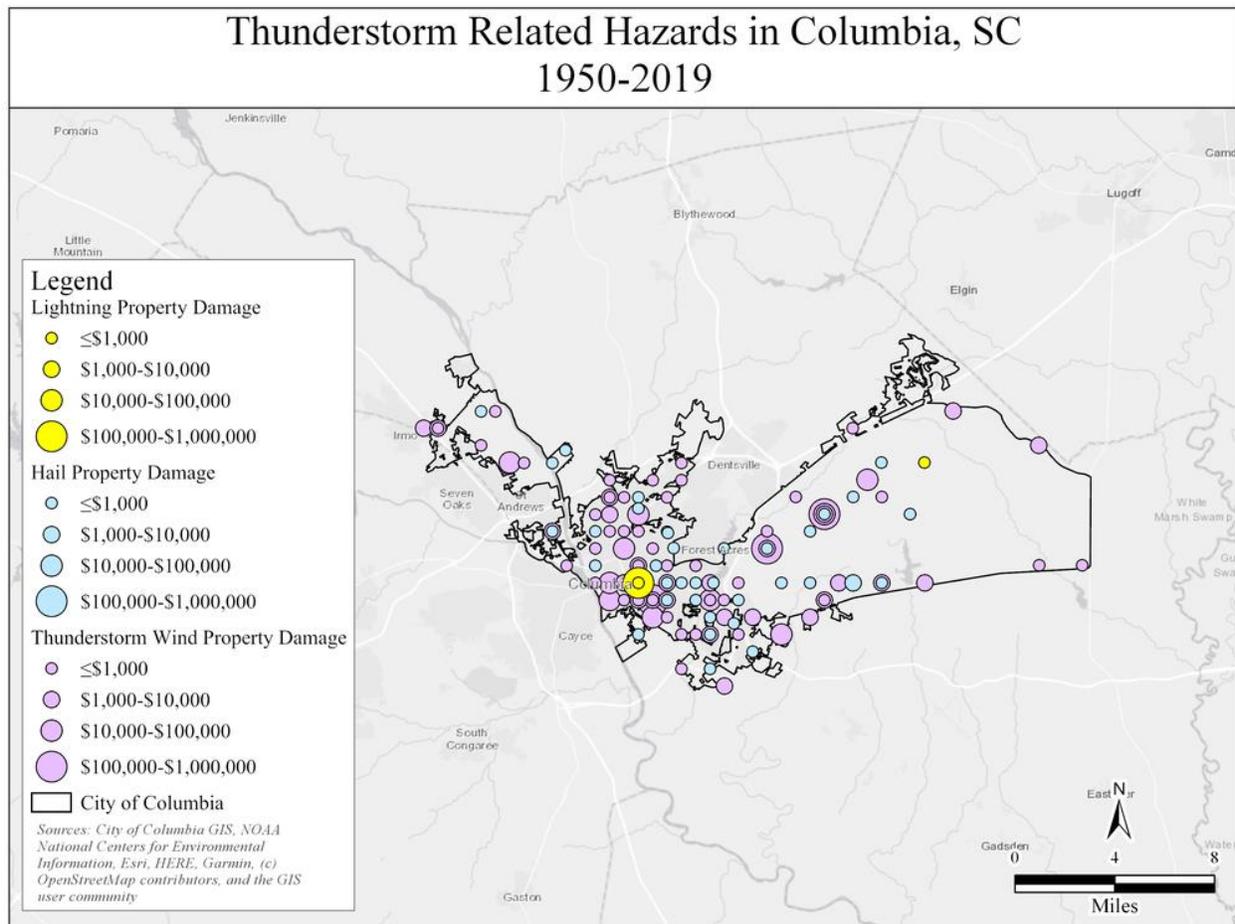
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<sup>20</sup> National Severe Storms Laboratory. Severe Weather 101 – Thunderstorms. Accessed on 2/19/2020 at <https://www.nssl.noaa.gov/education/svrwx101/thunderstorms/>

<sup>21</sup> South Carolina State Hazard Mitigation Plan, 2018, p. 72. Accessed on 2/19/2020 at <https://www.scemd.org/media/1391/sc-hazard-mitigation-plan-2018-update.pdf>

<sup>22</sup> Central Midlands Hazard Mitigation Plan, 2016, p. 28. Accessed on 2/19/2020 at <http://www.centralmidlands.org/pdf/CMHMP%202016%20-%20Final.pdf>

Figure 16. Thunderstorm Wind Hazards, 1950–2019



Both property and people are at risk from lightning in the City of Columbia. Lightning occurs very frequently in Richland County, averaging several strikes per day.<sup>23</sup>

The frequency of lightning strikes in the City of Columbia often results in house fires and personal harm, increasing the demand on immediate fire response resources in the City. The historical impact of loss-causing lightning events in Columbia is captured in Table 7.

<sup>23</sup> Central Midlands Hazard Mitigation Plan, 2016, p. 362. Accessed on 2/19/2020 at <http://www.centralmidlands.org/pdf/CMHMP%202016%20-%20Final.pdf>

Table 7. Historical Loss-Causing Lightning Events in Columbia, SC, Since 1960

| Start Date | End Date  | Inj. | Fat. | Property Damage | Crop Damage | Location   | Description                          |
|------------|-----------|------|------|-----------------|-------------|--|--------------------------------------|
| 9/05/1961  | 9/05/1961 | 0    | 0    | \$1,885         | \$0         | Eastern and Central South Carolina                     | High winds and excessive lightning   |
| 7/24/1964  | 7/24/1964 | 28   | 0    | \$0             | \$0         | Fort Jackson   | Electrical                           |
| 4/12/1965  | 4/12/1965 | 0    | 0    | \$37,577        | \$0         | Columbia   | Lightning                            |
| 5/28/1965  | 5/28/1965 | 3    | 0    | \$0             | \$0         | Fort Jackson   | Lightning                            |
| 6/30/1965  | 6/30/1965 | 0    | 0    | \$37,577        | \$0         | Columbia   | Lightning                            |
| 7/12/1965  | 7/12/1965 | 8    | 0    | \$0             | \$0         | Fort Jackson   | Lightning                            |
| 8/10/1965  | 8/10/1965 | 0    | 0    | \$18,788        | \$0         | Richland and Lee Counties                              | Lightning and wind                   |
| 8/18/1965  | 8/18/1965 | 0    | 0    | \$18,788        | \$0         | Columbia and Vicinity, Richland and Lexington Counties | Heavy thundershower and lightning    |
| 8/27/1965  | 8/27/1965 | 0    | 0    | \$816           | \$0         | Statewide  | Severe lightning                     |
| 7/15/1966  | 7/15/1966 | 0    | 0    | \$18,266        | \$0         | Columbia, Richland and Lexington Counties              | Wind and electrical                  |
| 7/09/1973  | 7/09/1973 | 0    | 0    | \$26,659        | \$0         | Columbia   | Wind and lightning                   |
| 8/04/1973  | 8/04/1973 | 0    | 0    | \$148           | \$14        | Midlands and Southern SC                               | Rain, wind, and electrical           |
| 8/29/1973  | 8/29/1973 | 0    | 0    | \$133           | \$13        | Northwest and Midlands                                 | Wind, rain, and electrical           |
| 3/21/1974  | 3/21/1974 | 0    | 0    | \$5,219         | \$521       | Statewide  | High winds and electrical            |
| 4/08/1974  | 4/08/1974 | 0    | 0    | \$96            | \$0         | Central SC   | Wind and electrical                  |
| 4/08/1974  | 4/08/1974 | 0    | 0    | \$6,669         | \$6         | Central, Western, and Northern SC                      | Wind and electrical                  |
| 5/12/1974  | 5/12/1974 | 0    | 0    | \$12,636        | \$12,636    | Central, Southern, and Eastern SC                      | Lightning, heavy rain, and high wind |

| Start Date | End Date   | Inj. | Fat. | Property Damage | Crop Damage | Location  | Description                             |
|------------|------------|------|------|-----------------|-------------|---|---|
| 6/07/1974  | 6/07/1974  | 0    | 0    | \$2,400         | \$0         | Columbia  | Heavy rain and lightning                |
| 8/13/1974  | 8/13/1974  | 0    | 0    | \$1,091         | \$109       | Central   | Wind and lightning                      |
| 5/15/1975  | 5/15/1975  | 0    | 0    | \$4,782         | \$47        | Statewide   | Wind and lightning                      |
| 7/24/1975  | 7/24/1975  | 0    | 0    | \$628           | \$0         | Western, Central, and Northern SC                     | Lightning                               |
| 8/27/1975  | 8/27/1975  | 0    | 0    | \$5,789         | \$57        | North, Northeast, and Central                         | Lightning, high wind, and thunderstorms |
| 10/09/1976 | 10/09/1976 | 0    | 0    | \$5,778         | \$57        | Central and Eastern                                   | Wind and lightning                      |
| 7/14/1977  | 7/14/1977  | 0    | 0    | \$4,246         | \$42        | Statewide   | Wind and lightning                      |
| 7/16/1981  | 7/16/1981  | 0    | 0    | \$32,554        | \$0         | Greenwood, Newberry, Lexington, and Richland Counties | Lightning, wind, and rain               |
| 6/03/1982  | 6/03/1982  | 0    | 0    | \$122,661       | \$12,266    | Columbia  | Lightning, rain, and wind               |
| 7/03/1983  | 7/03/1983  | 2    | 0    | \$1,188         | \$0         | Columbia  | Lightning                               |
| 7/25/1983  | 7/25/1983  | 0    | 0    | \$2,583         | \$25        | Statewide   | Wind and lightning                      |
| 8/23/1983  | 8/23/1983  | 0    | 0    | \$3,395         | \$0         | North and Central SC                                  | Wind and lightning                      |
| 7/12/1984  | 7/12/1984  | 2    | 0    | \$1,139         | \$0         | Columbia  | Lightning                               |
| 7/13/1984  | 7/13/1984  | 0    | 0    | \$5,696         | \$0         | Columbia, West Columbia, and Cayce                    | Lightning                               |
| 8/21/1985  | 8/21/1985  | 0    | 0    | \$11,000        | \$0         | Columbia  | Lightning                               |
| 5/28/1986  | 5/28/1986  | 0    | 0    | \$5,400         | \$0         | Lexington and Richland Counties                       | Lightning                               |
| 7/16/1986  | 7/16/1986  | 0    | 0    | \$108,000       | \$0         | Columbia  | Lightning                               |
| 7/27/1986  | 7/27/1986  | 0    | 0    | \$1,080         | \$0         | Eastern Columbia                                      | Lightning                               |
| 10/08/1986 | 10/08/1986 | 0    | 0    | \$1,080         | \$0         | Columbia  | Lightning                               |
| 6/01/1987  | 6/01/1987  | 1    | 0    | \$1,041         | \$0         | Countywide  | Lightning                               |
| 6/04/1987  | 6/04/1987  | 0    | 0    | \$1,041         | \$0         | Countywide  | Lightning                               |
| 7/28/1987  | 7/28/1987  | 0    | 0    | \$1,041         | \$0         | Columbia  | Lightning                               |

| Start Date | End Date  | Inj. | Fat. | Property Damage | Crop Damage | Location     | Description   |
|------------|-----------|------|------|-----------------|-------------|--------------|---|
| 4/23/1988  | 4/23/1988 | 0    | 0    | \$10,005        | \$0         | Countywide   | Lightning   |
| 5/16/1988  | 5/16/1988 | 0    | 0    | \$10,005        | \$0         | Eastover     | Lightning   |
| 8/20/1989  | 8/20/1989 | 0    | 1    | \$0             | \$0         | Columbia     | Lightning   |
| 5/16/1991  | 5/16/1991 | 0    | 0    | \$7,821         | \$0         | Columbia     | Lightning   |
| 7/04/1991  | 7/04/1991 | 0    | 0    | \$608,352       | \$0         | Columbia     | Lightning   |
| 7/18/1994  | 7/18/1994 | 0    | 0    | \$7,987         | \$0         | Columbia     | Lightning   |
| 7/06/1995  | 7/06/1995 | 4    | 1    | \$0             | \$0         | Fort Jackson | Lightning   |
| 4/27/1999  | 4/27/1999 | 3    | 0    | \$0             | \$0         | Columbia     | Three people were hit by lightning at River Banks Zoo. The victims were taken to nearby hospitals and released the next day.      |
| 2/22/2003  | 2/22/2003 | 0    | 0    | \$90,062        |             | Columbia     | A home was struck by lightning that caused a fire.  |
| 6/11/2003  | 6/11/2003 | 0    | 0    | \$70,763        | \$0         | Columbia     | Lightning struck a home, starting a fire.   |
| 7/21/2003  | 7/21/2003 | 0    | 0    | \$225,156       |             | Columbia     | Lightning struck a home in Spring Valley at 411 Bridgecrest Drive.  |
| 8/14/2005  | 8/14/2005 | 0    | 0    | \$363,650       | \$0         | Columbia     | Lightning caused a home fire at 204 Upland Trail.   |
| 6/12/2006  | 6/12/2006 | 0    | 0    | \$2,348,571     | \$0         | Columbia     | Lightning struck a tree and ran through the ground into the home, starting a fire in the home in the Woodcreek Farms subdivision. |
| 6/11/2009  | 6/11/2009 | 0    | 0    | \$242,764       | \$0         | Columbia     | Lightning struck a home and ignited a fire that destroyed it. The home was located at 150 Rivendale Drive.                        |

| Start Date   | End Date  | Inj. | Fat. | Property Damage | Crop Damage | Location | Description  |
|--------------|-----------|------|------|-----------------|-------------|----------|--|
| 6/11/2009    | 6/11/2009 | 0    | 0    | \$551,737       | \$0         | Columbia | Lightning struck a home at 38 Shoreline Drive and ignited a fire that destroyed it.  |
| 6/28/2011    | 6/28/2011 | 5    | 0    | \$0             | \$0         | Columbia | A mid-afternoon thunderstorm produced lightning that struck an oak tree at Allen Benedict Court on Harden Street where five landscape and maintenance workers were sitting. One worker was taken to the hospital with non-life-threatening injuries. |
| <b>TOTAL</b> | 55        | 56   | 2    | \$5,045,799     | \$25,787    |          |  |

Data from Central Midlands Hazard Mitigation Plan, 2016, p. 363.

Due to the sporadic nature and unpredictability of lightning, responders in the City face difficulties when responding to thunderstorm events. Storm debris blocking critical roadways and access points create transportation issues, while power lines may also create fire hazards. This emphasizes the need for implementation of mitigation measures that ensure an adequate response to the impacts from lightning.

#### **Future Risk**

Climate models indicate a range of environmental changes that may contribute to increased thunderstorm activity, but the science in this area is still emergent and projections are difficult to make, particularly at the local scale.<sup>24</sup> Mitigation measures to reduce the risk of thunderstorms in Columbia will be similar to those undertaken to reduce exposure and increase resilience to hurricanes and extreme precipitation events.

<sup>24</sup> Kossin, J.P., T. Hall, T. Knutson, K.E. Kunkel, R.J. Trapp, D.E. Waliser, and M.F. Wehner. 2017. Extreme storms. In *Climate Science Special Report: Fourth National Climate Assessment, Volume I* [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, pp. 257–276, doi: 10.7930/J07S7KXX.

## Hurricanes and Tropical Storms

### Overview of Hazard

Hurricanes and tropical storms are low-pressure systems that originate over warm ocean waters and bring damaging forces from high winds, storm surge, heavy precipitation, and tornadoes. These storms are capable of causing immense destruction and loss of life, and have historically done so across the United States. The primary damaging forces related to hurricanes and tropical storms in the City are high winds, heavy precipitation, and tornadoes.

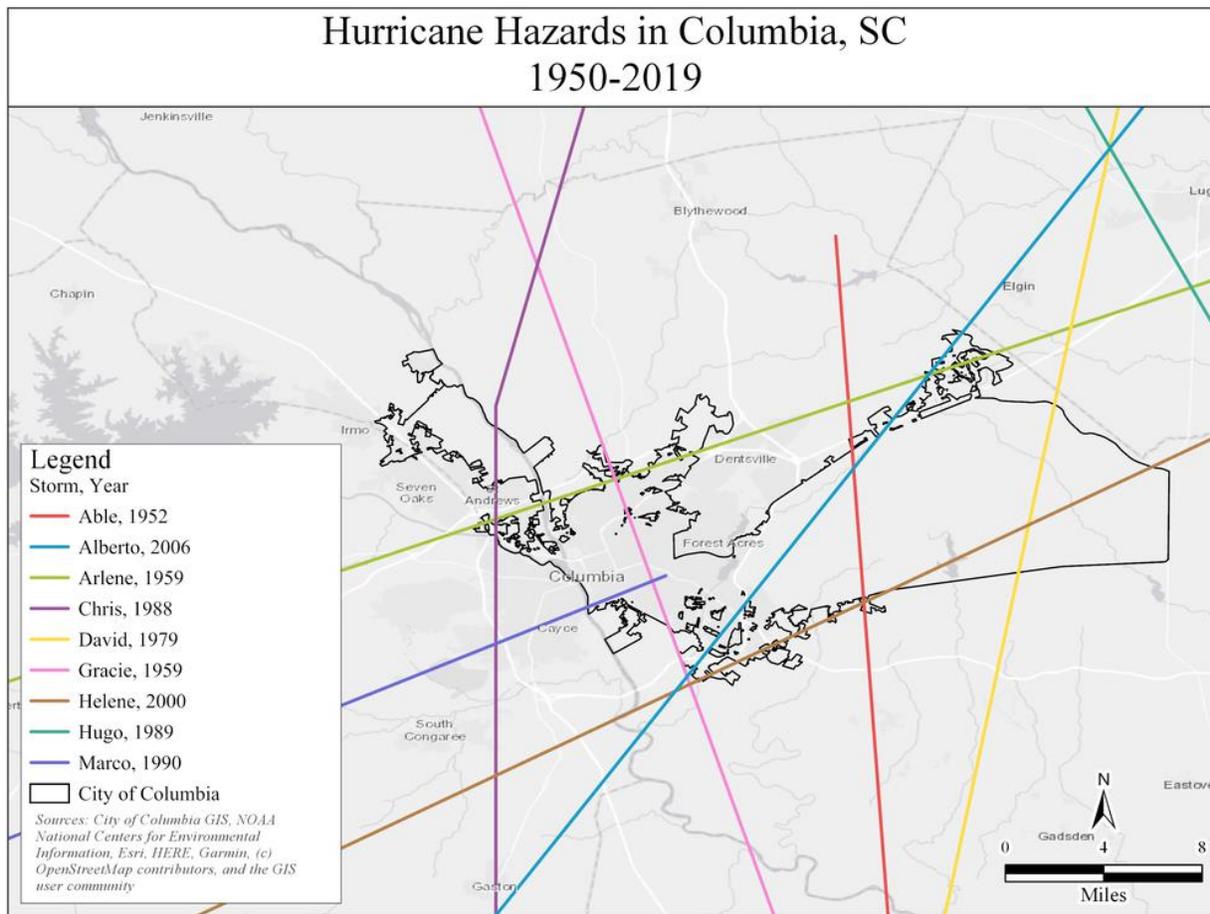
### Historical Impact

Since 1851, more than 90 tropical cyclones have affected South Carolina, of which more than 30 have impacted the Central Midlands region where the City of Columbia is located.<sup>25</sup> Those that have impacted the City directly are shown in Figure 17.

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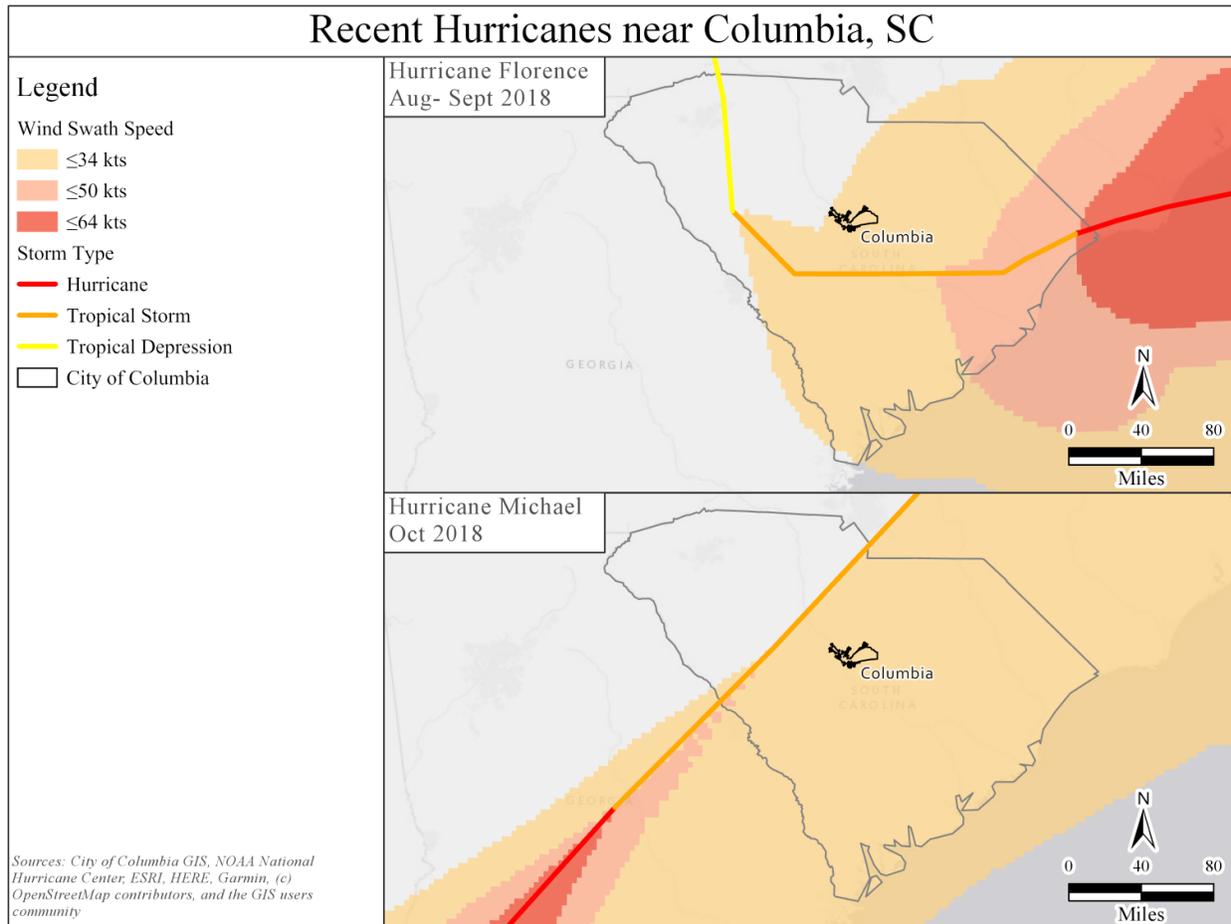
<sup>25</sup> Central Midlands Hazard Mitigation Plan, 2016, p. 33. Accessed on 2/19/2020 at <http://www.centralmidlands.org/pdf/CMHMP%202016%20-%20Final.pdf>

Figure 17. Hurricane Hazards in Columbia, SC



Due to its inland location, the City of Columbia does not experience coastal storm surge, but has still historically been at risk from hurricane-force winds, heavy rainfall, flash flooding, and tornadoes that result from hurricanes and tropical storms. Many of the same impacts and risks noted in the Flooding section of this Mitigation Needs Assessment are present with the effects of hurricanes and tropical storms due to heavy rainfall associated with the outer bands of hurricanes. Figure 18 highlights two recent examples – Hurricane Michael and Hurricane Florence – where the City felt impacts from these storms.

Figure 18. Hurricane Michael and Hurricane Florence Wind Speed for Columbia, SC



While the windspeeds highlighted above are not those that may typically impact the City, property and infrastructure damage due to falling trees, as well as power outages, are highly likely to occur from the strong winds of which the City is at risk from in stronger storm scenarios.

#### Future Risk

The Fourth National Climate Assessment reports that climate models and theory point to an increase in the Atlantic region in the intensity of tropical cyclones (i.e., hurricanes) and an increase in the number of very intense cyclones. Increases are projected in precipitation rates (high confidence) and intensity (medium confidence).<sup>26</sup> While the science is mixed regarding the number of hurricanes that

<sup>26</sup> Kossin, J.P., T. Hall, T. Knutson, K.E. Kunkel, R.J. Trapp, D.E. Waliser, and M.F. Wehner. 2017. Extreme storms. In Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, pp. 257–276, doi: 10.7930/J07S7KXX.

will make landfall, recent experience has dramatically demonstrated that even off-shore hurricanes can have grave consequences for inland communities. The prospect of stronger severe events underscores the urgent need for mitigation.

## 2.5 Quantitative and Qualitative Assessment of Hazard Risks and Hazard Impacts on Community Lifelines



Community lifelines are defined by FEMA’s National Response Framework as services that enable a continuous operation of critical government and business functions and are essential to ensuring human health, safety, and economic security.<sup>27</sup> This is especially critical in the wake of disasters. Lifelines are the integrated network of infrastructure, services, assets, and capabilities<sup>28</sup> that support the recurring needs of the City of Columbia.

The seven community lifelines are as follows:

1. Safety and Security
2. Food, Water, and Shelter
3. Health and Medical
4. Energy (Power and Fuel)
5. Communications
6. Transportation
7. Hazardous Materials

For the City of Columbia, CDBG-MIT mitigation activities will ensure that these critical areas are more resilient and can reliably continue operations during future disasters, and will reduce the risk of loss of life, injury, and property damage and accelerate recovery following a disaster.<sup>29</sup>

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<sup>27</sup> FEMA. National Response Framework, Fourth Edition, October 28, 2019, p. ii. Retrieved from [https://www.fema.gov/media-library-data/1572366339630-0e9278a0ede9ee129025182b4d0f818e/National\\_Response\\_Framework\\_4th\\_20191028.pdf](https://www.fema.gov/media-library-data/1572366339630-0e9278a0ede9ee129025182b4d0f818e/National_Response_Framework_4th_20191028.pdf)

<sup>28</sup> FEMA Community Lifelines Implementation Toolkit, Version 2.0, November 2019. Retrieved from <https://www.fema.gov/media-library-data/1576770152678-87196e4c3d091f0319da967cf47ffd9c/CommunityLifelinesToolkit2.0v2.pdf>

<sup>29</sup> 45838 Federal Register, Vol. 84, No. 169, Friday, August 30, 2019, Notices.

### 2.5.1 Safety and Security

The 2015 floods that impacted the City of Columbia created an unforeseen demand for rescue missions and emergency response. Dumping more than a foot of rain on the first night of the storm, local officials responded to several hundred water rescues that included motorists and homeowners trapped by high water.<sup>30</sup> By the following mid-morning, the fire chief reported challenges in keeping a record of all requests.<sup>31</sup> On October 4, the Columbia-Richland County 911 processed 6,415 phone calls in the first 24 hours, a 114% increase from the average. The agency dispatches total per day reached more than 2,600, a 70% increase. More than 100 streets in the City were deemed closed, blocked, or impassable.<sup>32</sup>

The heavy rains and floods did not spare Columbia's public service stations, which are critical for securing safety across the City. Water infiltrated two police facilities, a police car, and submersed ammunition; roof leaks affected most fire stations; and one fire station and training facility were inundated and recorded as lost.<sup>33</sup>

Separately, as state environment officials recommended staff evacuate and shut down the City of Columbia Metro Wastewater Treatment Plant, due to the condition of a nearby dike, four employees stayed behind to keep the plant running. The volume of water the plant processed tripled its 60-million gallon per day limit, making it the most significant amount in the plant's history – these brave heroes mitigated raw sewage pouring into the Columbia River, surrounding neighborhoods and city streets.<sup>34</sup>

The resiliency of government functions – such as the capacity and security of police, fire responders, and city employees – is critical for ensuring that response times do not suffer, and communities can remain the focus in times of need. Resilient building investment and construction ensure that facilities can withstand the impacts of hazards and reduce their susceptibility to future damages. Resilient, storm-resistant

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<sup>30</sup> U.S. Department of Commerce. The Historic South Carolina Floods of October 1–5, 2015 Service Assessment. Retrieved from [https://www.weather.gov/media/publications/assessments/SCFlooding\\_072216\\_Signed\\_Final.pdf](https://www.weather.gov/media/publications/assessments/SCFlooding_072216_Signed_Final.pdf)

<sup>31</sup> Times Free Press. Historic South Carolina Floods: Heavy Rains, Hundreds Rescued. Retrieved from <https://www.timesfreepress.com/news/breakingnews/story/2015/oct/04/historic-south-carolina-floods-heavy-rain-hundreds-rescued/328719/>

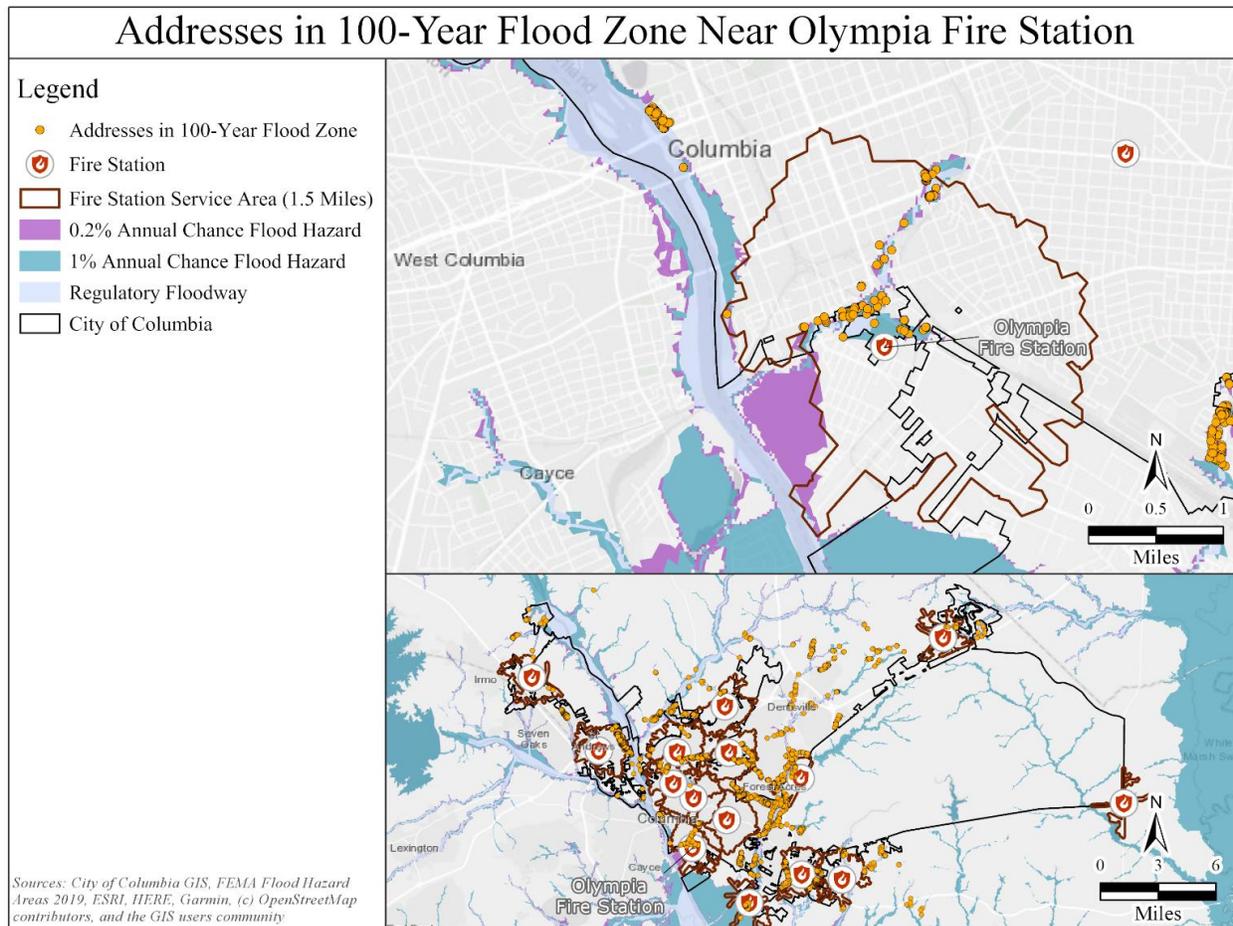
<sup>32</sup> Road to Recovery Annual Report: Status of Recovery One Year After the Historic Flood Event in October 2015, pp. 8–9. Retrieved from <https://columbiasc.gov/depts/flood/final-road-to-recovery-annual-report-print.pdf>

<sup>33</sup> Ibid, p. 13.

<sup>34</sup> Municipal Association of South Carolina. October 2016. One year later, cities take steps, lessons from flood. Retrieved from [https://www.masc.sc/Pages/newsroom/uptown/October%202016/One\\_year\\_later\\_lessons\\_from\\_flood.aspx](https://www.masc.sc/Pages/newsroom/uptown/October%202016/One_year_later_lessons_from_flood.aspx)

designs can also consider additional amenities that can serve the community through training spaces for volunteers to increase capacity or storm shelters to increase the availability of safe spaces. Mitigating the potential for losses of government services will be crucial for Columbia’s Safety and security lifeline. To highlight this future risk, Figure 19 shows addresses in 100-year flood zones with respect to the Olympia Fire Station’s service area.

Figure 19. Addresses in 100-Year Flood Zone Near Olympia Fire Station



### 2.5.2 Food, Water, and Shelter

The Food, Water, and Shelter Lifeline focus on the fundamental operations for daily life. It considers the impact on supply chains, commercial facilities, residential areas, and citywide distribution systems. Disasters can quickly put a significant strain on the ability to maintain the supply chain of food, potable water, and shelter to residents. Without proper mitigation measures, this strain will increase as projected flood risk increases with the prospect of climate change.

In 2015, Columbia experienced a significant test to its Water Lifeline. Columbia Water operates and maintains the drinking water treatment, distribution, and storage system that serves City customers. Between the Columbia Canal and Lake Murray Water Treatment Plants, they have a distribution system that has more than 2,400 miles of water lines, pump stations, storage tanks, and pressure-reducing valves that distribute water across nine major pressure zones.<sup>35</sup> Floods on October 4, 2015, ripped a 60-foot section of the Columbia Canal, destroying the head gates, impacting the water levels that affected water pressure, and ultimately threatening the potable water distribution system.<sup>36</sup> The canal breach, combined with numerous line breaks throughout the water system, resulted in a 10-day disruption of clean drinking water for more than 375,000 residents who received boil water notices.<sup>37</sup> Figure 20 shows the location of the canal breach and subsequent area of impacted water supply.

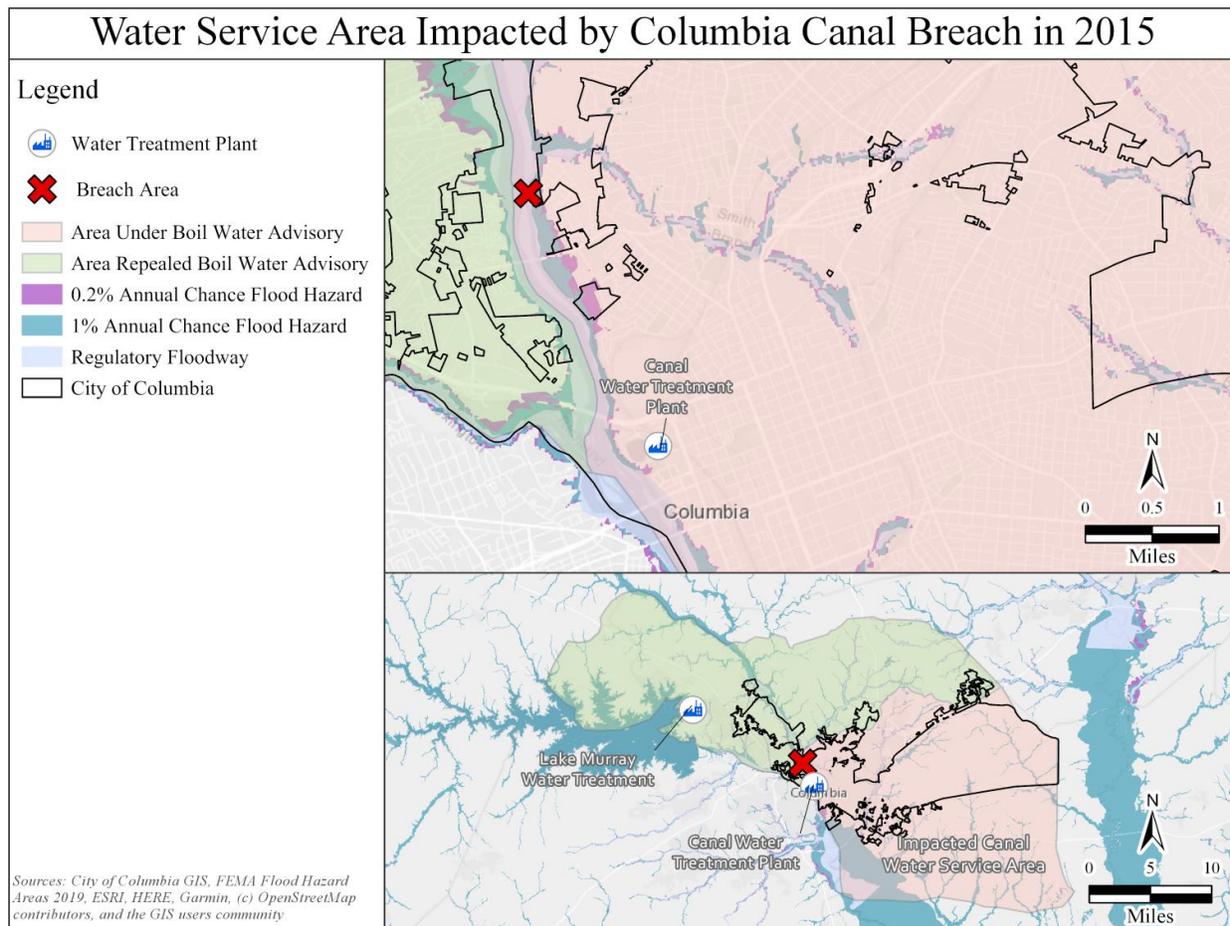
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<sup>35</sup> City of Columbia Drinking Water website. Accessed on 2/20/2020 at <https://www.columbiasc.net/drinking-water>

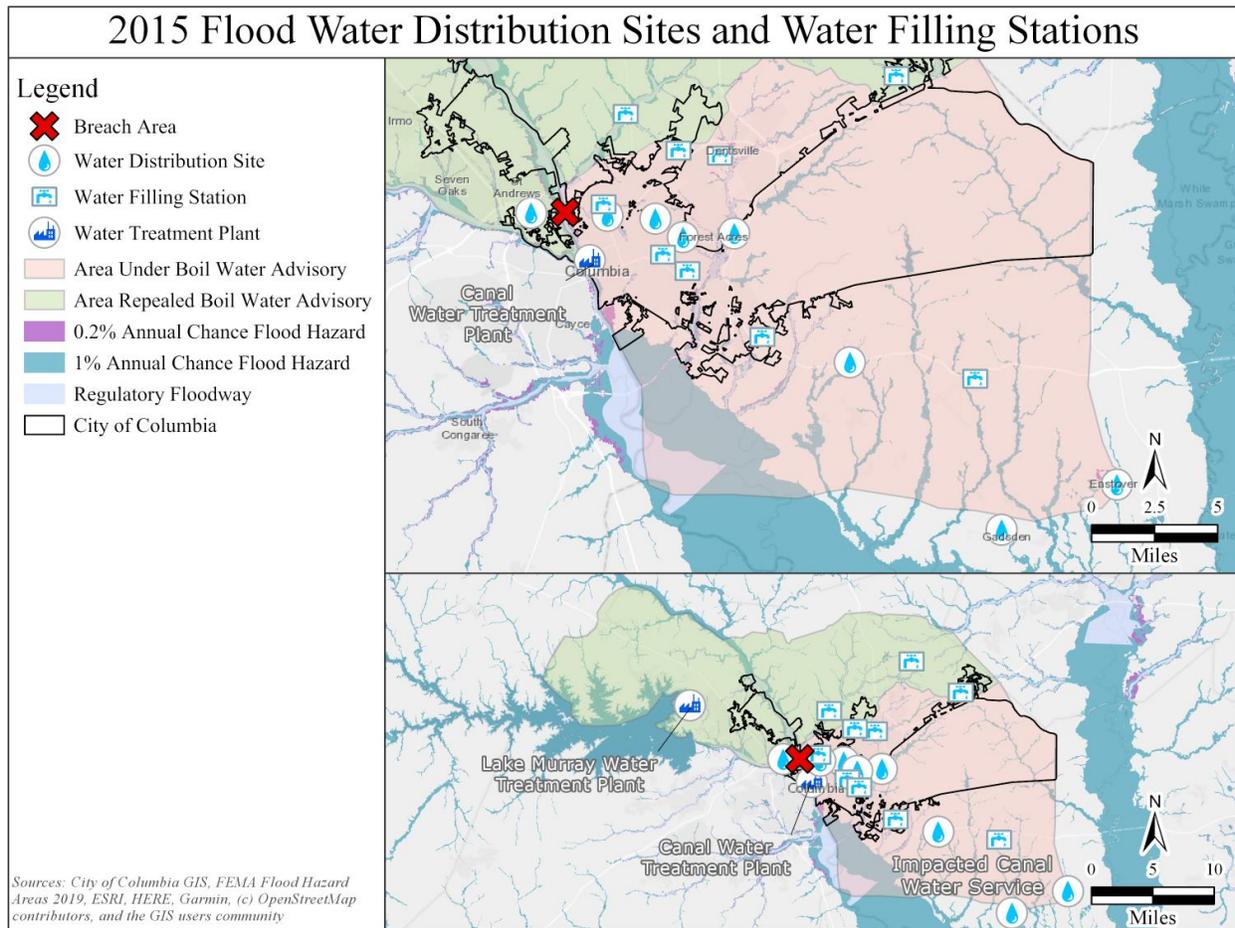
<sup>36</sup> Road to Recovery Annual Report: Status of Recovery One Year After the Historic Flood Event in October 2015, pp. 8–9. Retrieved from <https://columbiasc.gov/depts/flood/final-road-to-recovery-annual-report-print.pdf>

<sup>37</sup> City of Columbia. CDBG-DR Action Plan, December 21, 2016. Accessed on 2/23/2020 at <https://dr.columbiasc.gov/wp-content/uploads/2016/08/20161221-COC-Final-Action-Plan-Revisions.pdf>

Figure 20. Water Service Area Impacted by Columbia Canal Breach in 2015



Within just 2 hours of canal water rushing into the Congaree River, the water treatment plant lost the amount of water that would usually supply the City for 5 days. Subsequently, the City had to act swiftly to ensure that water levels reached a sufficient level to allow adequate water intake at the water treatment plant. At the same time, water main breaks and dam failures inundated streets and neighborhoods across the City, further impacting water supply and residential areas. In response, the City opened eight water distribution sites and 10 water filling stations across the City, which are shown in Figure 21.

Figure 21. 2015 Flood Water Distribution Sites and Water Filling Stations<sup>38</sup>

The flooding was unprecedented, affecting the City’s capacity to support hundreds of residents who sought refuge from the rains to come – and later, by the floods that became more detrimental as dams failed.<sup>39</sup> The City had to open an additional emergency facility that would not usually start operations until November to assist people with enduring cold temperatures. It also requested a local partner, on short notice, to open their winter shelter; by Saturday, it hosted more than 300 people. Supplemental, temporary shelters were added at local schools and community spaces across the City. Yet, as Columbia Water wrestled with water pressure, shelters faced

<sup>38</sup> City of Columbia Incident Brief October 8 – November 6, 2015, pp. 19–20. Retrieved from [https://www.columbiasc.net/depts/pr/incident\\_response\\_brief\\_oct\\_8\\_-\\_nov\\_6\\_2015.pdf](https://www.columbiasc.net/depts/pr/incident_response_brief_oct_8_-_nov_6_2015.pdf)

<sup>39</sup> LA Times. 2015, October 7. South Carolina residents rush to higher ground as 14 dams fail. Retrieved from: <https://www.latimes.com/nation/la-na-south-carolina-floods-dams-20151007-story.html>

no water for drinking, bathing, or toilets.<sup>40</sup> The connections in the Food, Water, and Shelter Lifeline remain critical for ensuring the survival of residents as they endure a storm. The inclusion of shelter in emergency management, in conjunction with dam safety inspections and investment in mitigating future impacts on water systems, is critical for reducing vulnerability during future disasters.<sup>41</sup>

## Future Risks

Future risks to essential services are expected to increase due to a combination of factors. Urban growth itself – increasing population, more businesses, and denser communities – puts more stress on vital public services, requiring the City to plan for and manage expanding water and sanitation, local transport, and electricity services with Columbia Water and other utilities and regional partners. Climate changes, such as worsening heatwaves,<sup>42</sup> will add further stress on these services. Infrastructure related to drinking water and wastewater treatment has the potential to be compromised more frequently by extreme weather events, and investments should ensure their safety.<sup>43</sup> Gaps in the availability of potable water, and the resulting health impacts that this generates, can have cascading impacts on health and medical services as demand for health care – particularly for vulnerable populations – increases.

### 2.5.3 Health and Medical

The Health and Medical Lifeline includes medical care, patient movement, fatality management, public health, and the medical supply chain. In the City of Columbia, these critical systems have been affected by disasters in the past.

As a result of the canal breach and water supply impacts from DR-4241, there was no potable water source for several days for Palmetto Health Baptist, a 400-bed

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<sup>40</sup> Al Jazeera. 2015, October 6. Homeless scramble for shelter in flood-ravaged South Carolina. Retrieved from <http://america.aljazeera.com/articles/2015/10/6/south-carolina-shelters-homeless.html>

<sup>41</sup> LA Times. 2015, October 7. South Carolina residents rush to higher ground as 14 dams fail. Retrieved from <https://www.latimes.com/nation/la-na-south-carolina-floods-dams-20151007-story.html>

<sup>42</sup> Habeeb, D., J. Vargo, and B. Stone, 2015. Rising heat wave trends in large US cities. *Natural Hazards*, 76(3), 1651–1665. <http://dx.doi.org/10.1007/s11069-014-1563-z>

<sup>43</sup> Carter, L., A. Terando, K. Dow, K. Hiers, K.E. Kunkel, A. Lascurain, D. Marcy, M. Osland, and P. Schramm. 2018. Southeast. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, pp. 743–808. doi: 10.7930/NCA4.2018.CH19. Available at <https://nca2018.globalchange.gov/chapter/southeast>

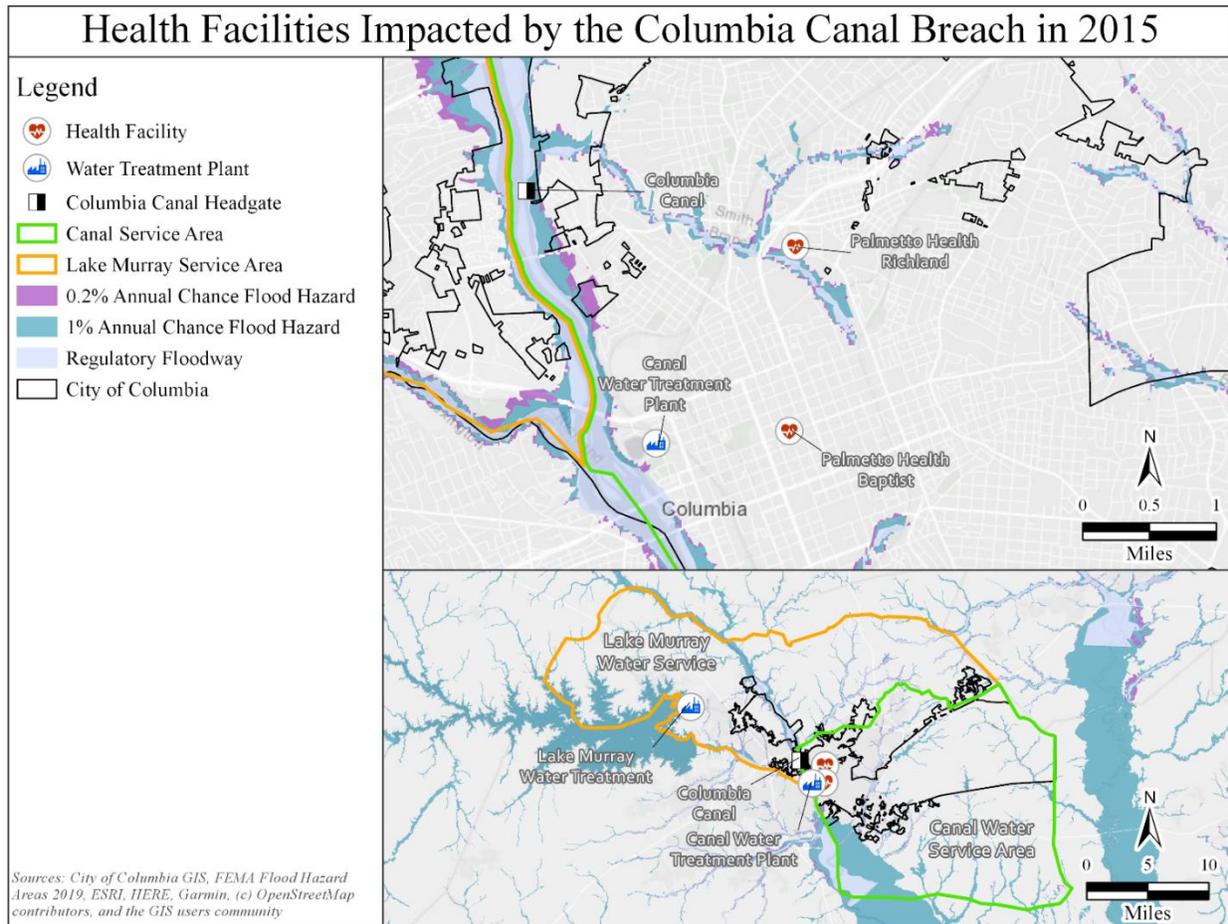
community hospital, or Palmetto Health Richland, a major 649-bed academic trauma hospital. Staff had to use bottled or sterile water for drinking and washing their hands, and non-potable water for operating chillers and boilers, and even for operating MRIs or CT scanners.<sup>44</sup> Figure 22 shows the two hospitals with respect to the water service area that was impacted due to the canal breach as a result of the flooding. To meet this need, the Fire Department committed 18 straight hours to ensure that water allowed for continual hospital operations, requiring more than 500,000 gallons of water be transported to both hospitals. However, fire trucks can only transport 1,500 gallons of water at a time, making this solution only temporary. Once the City was able to restore water pressure, the challenge was transitioned to operationalizing the hospitals under a boil water advisory. The National Guard arrived to assist the City for the days that followed, until they were able to assist the hospitals.<sup>45</sup>

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<sup>44</sup> South Carolina Public Radio. A Story from the Columbia Canal: Hospitals and Water. Retrieved from <https://www.southcarolinapublicradio.org/post/story-columbia-canal-hospitals-and-water>

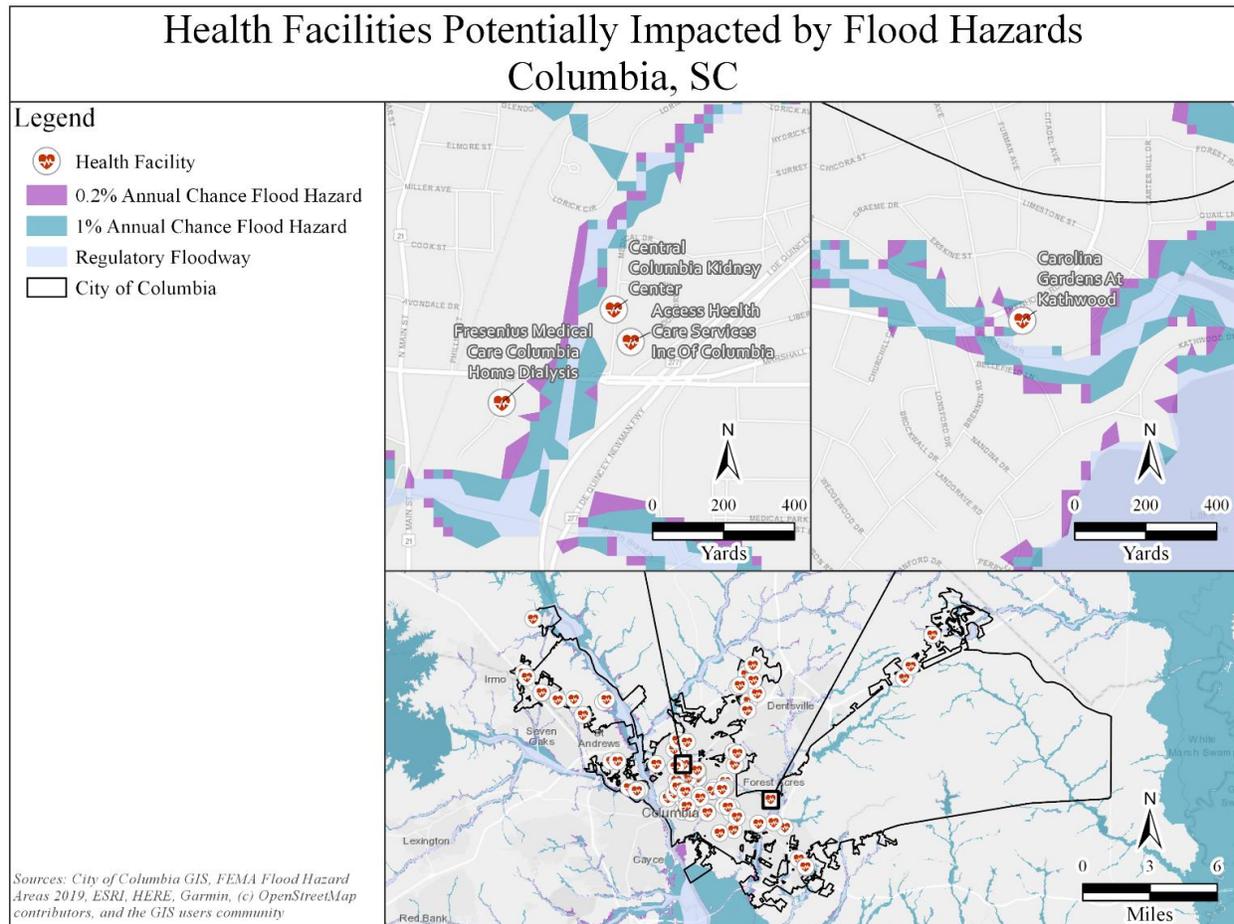
<sup>45</sup> Ibid.

Table 8. Health and Medical Facilities With Water Supply Impacted



In addition to the impacts on continuity of operations as a result of compromised water supply, several hospitals in the City of Columbia are located within 100 yards of FEMA’s 1% or 0.2% annual chance flood hazard areas as shown in Figure 22. This has the potential to impact staff and patient accessibility in the event of a storm, and may require an increase in emergency response ability to ensure alternative patient transportation. When the water supply was compromised at the hospitals noted above, the Fire Department worked around the clock to deliver water for continued operations.

Figure 22. Hospitals Within 100 Yards of Flood Hazard Areas



## Future Risks

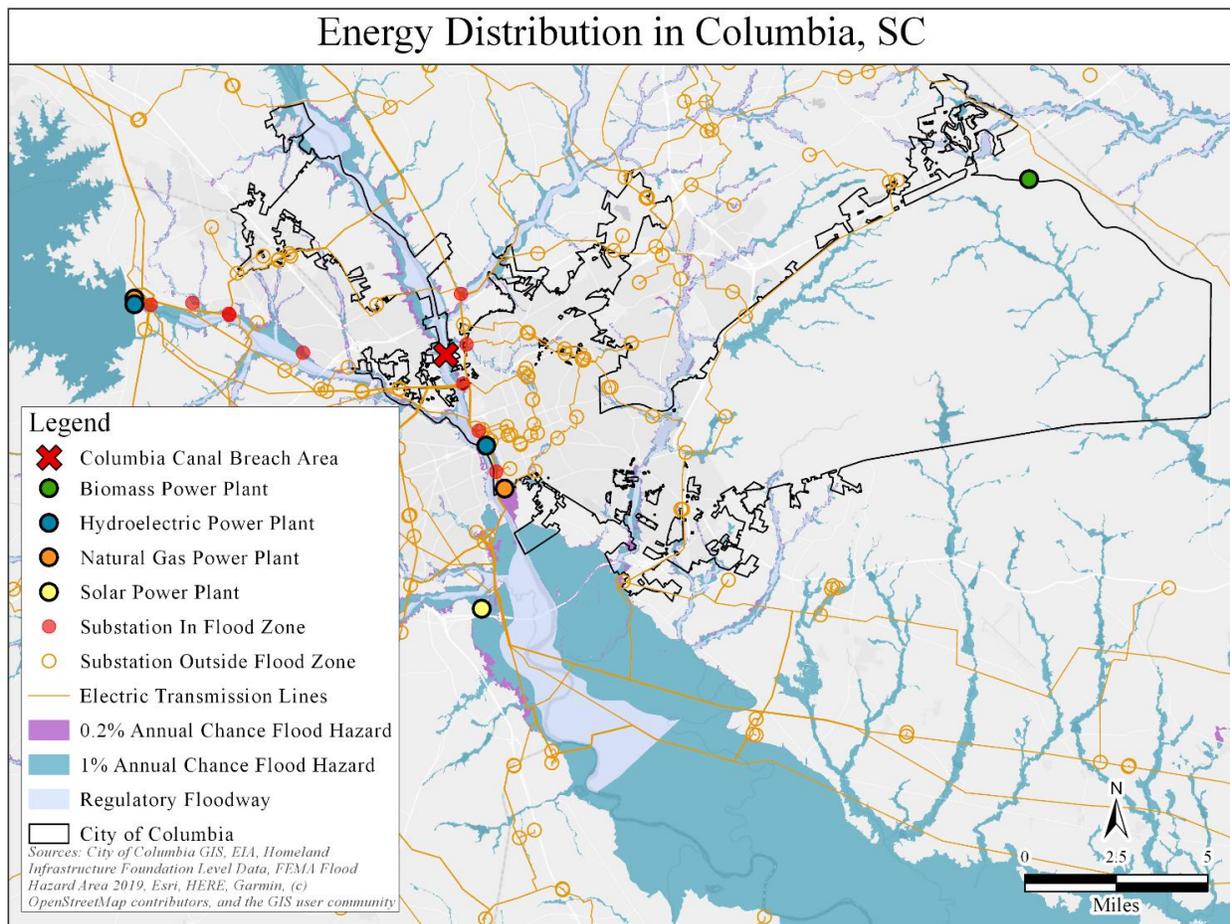
Increased frequency in extreme precipitation events, severe storms, and extreme heat as a result of climate change may exacerbate the risk of hazard impacts, such as these, to the Health and Medical Lifeline of the City. Mitigation measures, such as those that reduce future potential for disruption to clean water supply and increase flood emergency response measures, will ensure a reduced threat to loss of life.

### 2.5.4 Energy (Power and Fuel)

The Energy Lifeline includes the power grid and its critical facilities, including fuel supply lines that ensure continuous power supply to the City (Figure 23). The Energy Lifeline in the City of Columbia is one of the most critical given that the City contains many of the critical facilities that support both the City and the surrounding areas. It is, however, one of the areas that is most often impacted during storms due to downed power lines resulting in power outages. The restoration process often includes assessing and repairing damage to large transmission towers, power lines,

and substations, clearing obstructions and repairing primary distribution poles and power lines.<sup>46</sup> Figure 23 shows the transmission system in the City and highlights substations that may be impacted during flood events. In addition, as a result of the flooding in 2015, the Columbia Canal breach resulted in a shutdown of water supply to the hydroelectric plant downstream. This hydroelectric plant was originally able to generate 10 megawatts of power and was operational up until the 2015 flood, but has yet to resume functionality due to the impacts on the canal.<sup>47</sup>

Figure 23. Energy Distribution in Columbia, SC



### Future Risks to Energy

Increasing temperatures and increased incidence of extreme events – including heavy precipitation, as well as hurricanes – will increase the risks to energy systems

<sup>46</sup> <https://columbiabusinessreport.com/news/government/75148/>

<sup>47</sup> <https://www.southcarolinapublicradio.org/post/columbia-canal-rebuild-could-be-years-away>

in Columbia. These risks include both direct damage to generation and transmission infrastructure, as well as pressure on energy utilities due to increasing demand.<sup>48</sup>

The risk of direct damage to energy infrastructure due to flooding and extreme storm events will increase as the frequency, duration, and intensity of precipitation and hurricane events increase. These growing risks point to the need for further mitigation actions to reduce flooding, and to site, design, and construct new or replacement infrastructure to reduce exposure and increase resilience to future impacts.

As discussed in Section 2.1, the number of days of extreme heat is projected to increase due to climate change. A hotter city – the result of hotter days and less cool nights, as well as the urban heat island effect created by an increase in buildings and pavement – increases demand for air conditioning and puts more strain on power systems. Increasing temperatures increase energy demand, and the Southeast is projected to experience the highest regional costs due to increased demand.<sup>49, 50</sup> Increases in the cost of energy have impacts across the economy, affecting both local businesses and households, and can increase the level of “energy poverty” among vulnerable populations.<sup>51</sup> Surges in demand can increase the risk of disruption to electricity supply; loss of power can disrupt the full range of essential public services, including medical support, water and sanitation services, communications, and emergency response. Ensuring that energy and power availability is resilient is vital to ensuring the continuity of critical operations, such as emergency response and communications during disaster. This may include the development of back-up generation and transmission systems to ensure uninterrupted electricity service.

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<sup>48</sup> U.S. Department of Energy. October 2015. Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions. Retrieved from [https://www.energy.gov/sites/prod/files/2015/10/f27/Regional\\_Climate\\_Vulnerabilities\\_and\\_Resilience\\_Solutions\\_0.pdf](https://www.energy.gov/sites/prod/files/2015/10/f27/Regional_Climate_Vulnerabilities_and_Resilience_Solutions_0.pdf)

<sup>49</sup> U.S. EPA. 2017. Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment, EPA 430-R-17-001. Retrieved from [https://indecon.com/wp-content/uploads/CIRA2.0\\_TechnicalReportforNCA4.pdf](https://indecon.com/wp-content/uploads/CIRA2.0_TechnicalReportforNCA4.pdf)

<sup>50</sup> Carter, L., A. Terando, K. Dow, K. Hiers, K.E. Kunkel, A. Lascurain, D. Marcy, M. Osland, and P. Schramm. 2018. Southeast. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, pp. 743–808. doi: 10.7930/NCA4.2018.CH19. Retrieved from <https://nca2018.globalchange.gov/chapter/southeast>

<sup>51</sup> U.S. Department of Energy. October 2015. Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions. Retrieved from [https://www.energy.gov/sites/prod/files/2015/10/f27/Regional\\_Climate\\_Vulnerabilities\\_and\\_Resilience\\_Solutions\\_0.pdf](https://www.energy.gov/sites/prod/files/2015/10/f27/Regional_Climate_Vulnerabilities_and_Resilience_Solutions_0.pdf)

### 2.5.5 Communications

The Communications Lifeline includes the necessary information channels critical during disaster tracking, response, and recovery. The channels include responder communications, local alerts, warnings and messages, 911 and dispatch, infrastructure streams (i.e., internet, broadcast, and satellite), and finance (i.e., banking services and electronic payments). These channels of information keep residents, businesses, and local services aware of disaster developments, including storm updates, safety information, possible hazards, and city coordination for response and recovery needs.

The 2015 floods impacted most of the State of South Carolina, making federal, state, and local coordination necessary for alerting the public about storm updates and safety messages.<sup>52</sup> Social media proved to be a significant vehicle for effectively sharing information during the flood event with government agencies, community members, media outlets, and nonprofit partners. Storm alerts, updates, and messages were able to reach a diverse audience of stakeholders and ensured that the public was connected and engaged. These communication channels provided weather conditions, safety tips, where to access resources such as water, volunteer opportunities, and appreciation for fellow community members.<sup>53</sup>

As for the Columbia-Richland County (CRC) 911, they processed 6,415 phone calls on October 4, 2015, alone, a 114% increase from the average. For the days that followed, CRC 911 saw an average of 2,500–3,000 calls per day, a considerable steady flow as dam failures continued throughout the City. The agency dispatches total for October 4 reached more than 2,600, a 70% increase, with the rest of the week dropping to an average of 1,400–1,600 dispatches.<sup>54</sup> Aligned with the urgency, the Columbia Water Customer Care Center also saw a hike of more than 6,500 calls, as the City coped with a boil water advisory.<sup>55</sup> Communication throughout the City

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<sup>52</sup> U.S. Department of Commerce. The Historic South Carolina Floods of October 1–5, 2015 Service Assessment. Retrieved from [https://www.weather.gov/media/publications/assessments/SCFlooding\\_072216\\_Signed\\_Final.pdf](https://www.weather.gov/media/publications/assessments/SCFlooding_072216_Signed_Final.pdf)

<sup>53</sup> University of South Carolina Office of Research. SC Floods Project Summaries: Examining the Role of Twitter as a Response and Recovery Strategy During the #SCFlood in October 2015, p. 8. Retrieved from [https://www.sc.edu/about/offices\\_and\\_divisions/research/docs/sc\\_floods\\_project\\_summary\\_booklet.pdf](https://www.sc.edu/about/offices_and_divisions/research/docs/sc_floods_project_summary_booklet.pdf)

<sup>54</sup> Road to Recovery Annual Report: Status of Recovery One Year After the Historic Flood Event in October 2015, pp. 8–9. Retrieved from <https://columbiasc.gov/depts/flood/final-road-to-recovery-annual-report-print.pdf>

<sup>55</sup> City of Columbia Incident Brief October 8 – November 6, 2015, p. 7. Retrieved from [https://www.columbiasc.net/depts/pr/incident\\_response\\_brief\\_oct\\_8\\_-\\_nov\\_6\\_2015.pdf](https://www.columbiasc.net/depts/pr/incident_response_brief_oct_8_-_nov_6_2015.pdf)

was overloaded, causing a backlog on rescue missions, threatening response times in what could have been life-threatening situations. At the peak of October 4, the Police Department noted 200 pending calls for rescues.<sup>56</sup> In addition, due to the depth of the water, roads were blocked and emergency call boxes were lost. Winds and saturated soils also led to downed trees and power line poles across Columbia, leading to communication and power disconnections.<sup>57</sup>

The City was also able to leverage the Columbia Richland Alerts – launched in 2013 – for time-sensitive critical information alerts and advisories via email, phone, and text message. City messaging to the public included an overnight curfew requesting that people stay off of the roads as the rain persisted, and a boil water advisory was shared due to water main breaks and capacity concerns about the water treatment plant. Local broadcasters, education partners, and nonprofits were also able to provide supplemental support providing Spanish-language messaging when government agencies only alerted residents in English.<sup>58</sup>

Coordination across government agencies and local partners, such as local broadcasters and nonprofits, indeed showcase the importance of a robust Communications Lifeline during disaster events. Power outages, equipment damage, and overloaded communication systems are examples of disruptions to communication channels. Resilient infrastructure, connections, and alternative methods must ensure a variety of distribution channels, languages, and partners to reach the City’s diverse population and landscape in times of shock.

#### 2.5.6 Transportation

The City of Columbia’s Transportation Lifeline includes the highways, roads, bridges, and other transportation infrastructure that are utilized for the transit of people and goods. This includes mass transit, railway, aviation, and maritime. Transportation systems in the City are essential for regular operations, but also are critical during times of disaster. Many of the other community lifelines are inherently dependent upon transportation. Response and recovery operations rely on accessible transportation routes in order to ensure the provision of food or medical supplies to

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<sup>56</sup> Flooding Cripples South Carolina Where Some Areas See Over a Foot of Rain. Retrieved from <https://www.nytimes.com/2015/10/05/us/south-carolina-residents-told-to-stay-home-as-rain-continues-to-pound-region.html>

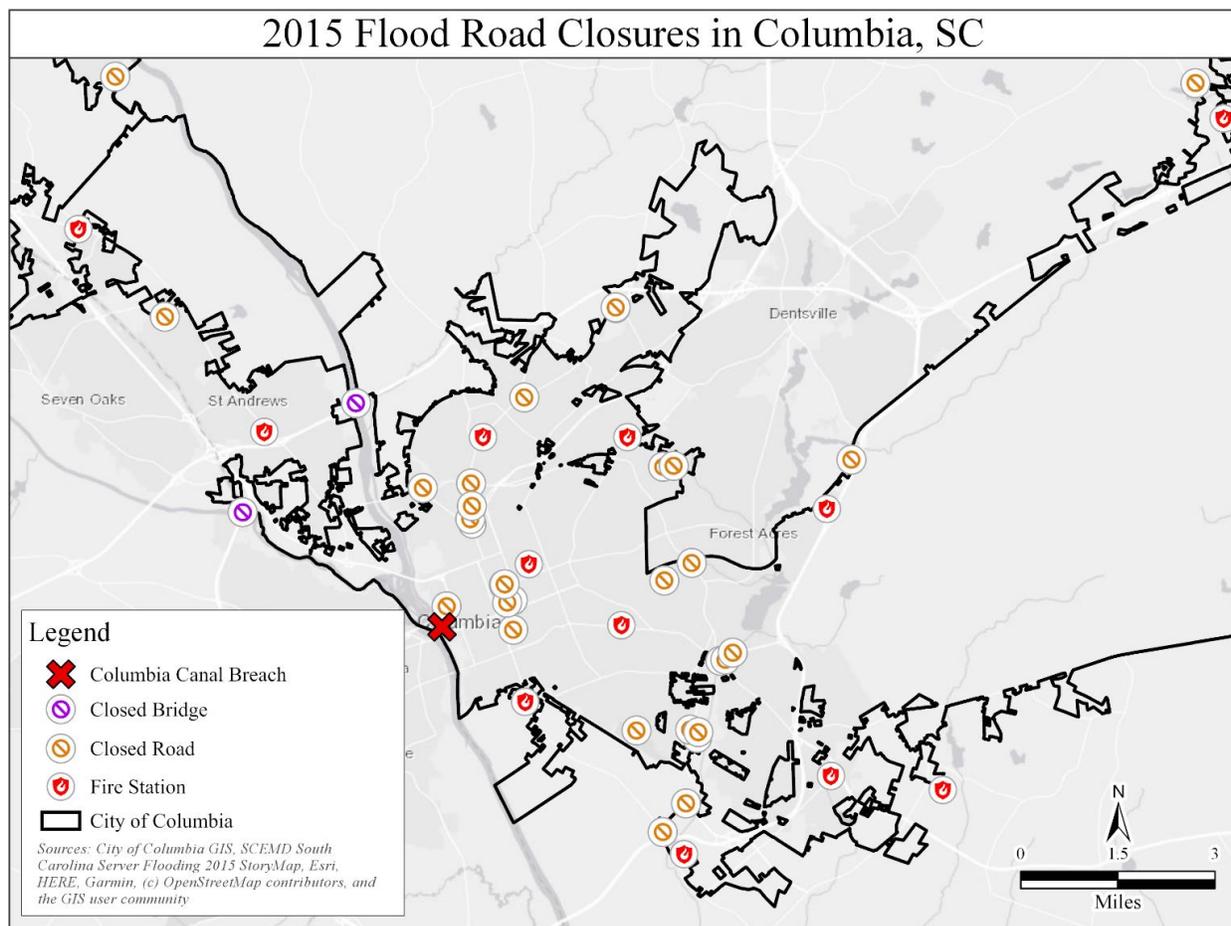
<sup>57</sup> U.S. Department of Commerce. The Historic South Carolina Floods of October 1–5, 2015 Service Assessment. Retrieved from [https://www.weather.gov/media/publications/assessments/SCFlooding\\_072216\\_Signed\\_Final.pdf](https://www.weather.gov/media/publications/assessments/SCFlooding_072216_Signed_Final.pdf)

<sup>58</sup> University of South Carolina Office of Research. SC Floods Project Summaries: Experiences of Latinos Affected by the Floods in Columbia, SC, p. 15. Retrieved from [https://www.sc.edu/about/offices\\_and\\_divisions/research/docs/sc\\_floods\\_project\\_summary\\_booklet.pdf](https://www.sc.edu/about/offices_and_divisions/research/docs/sc_floods_project_summary_booklet.pdf)

those in need. Damaged or flooded transportation networks such as roads and bridges can impede access to essential services such as hospitals, and stifle support from fire departments and police.

The critical importance of a reliable transportation infrastructure was demonstrated during the 2015 floods, when multiple intersections were affected, disrupting efficient emergency response and services. The City’s Emergency Management Division actively published roadway intersections that were closed due to flooding during DR-4241. Figure 24 depicts these locations in relation to critical service areas, highlighting the role of reliable transportation networks at the local, street-by-street level during flood events.

Figure 24. Road Closures Due to DR-4241 Flooding and Critical Facilities in Columbia



During the floods of 2015, major portions of I-95 and three other interstates (I-20, I-26, and I-77), including a 70-mile section of I-95 from I-26 to I-20 in the Columbia/Lexington area at the Saluda River, were also closed in South Carolina.

Floods rendered many roadways impassable and, in some instances, officials were concerned about bridges that may have been rendered unsafe as well.<sup>59</sup>

### Future Risks to Transportation

As the population of Columbia continues to grow and economic activity increases, reliable transportation will be an essential component in building a sustainable and vital city. The most recently adopted Unified Work Program for transportation (2015–2017) highlights a future multi-modal transportation network that meets expanding passenger and freight needs, addresses congestion, and meets both environmental and social goals.<sup>60</sup> To ensure the reliability and robustness of its transportation infrastructure and services, Columbia needs to take action to reduce future risks to the system.

The primary future risk to transportation networks and subsequent emergency response efforts in Columbia will continue to be flooding. Given the increasing frequency of severe rainfall events, as discussed in Section 2.1, the potential flood risk to Columbia’s roads and bridges can be expected to increase over time. This can become an important consideration when determining strategic locations for critical facilities such as fire stations and police departments. According to an EPA technical study for the Fourth National Climate Assessment, the Southeast region has already experienced the most damage to roads and bridges of any U.S. region, and these losses to transportation infrastructure are expected to grow unless mitigation measures are implemented. The EPA report states: “Under both RCPs, the Southeast is projected to have the highest number of vulnerable bridges in 2050 and the second highest in 2090 of all the regions, making up roughly one third of the national total of vulnerable bridges. Cumulative costs to rail by the end of the century are also highest in the Southeast region under both RCPs. Adaptation costs for urban drainage are second highest (behind Southern Plains) under RCP 8.5 (based on 50-year storm estimates).”<sup>61</sup>

The increased disruption of roads and bridges due to flooding has cascading impacts across all lifelines, as transportation is a critical element of each essential service component. Furthermore, it is worth noting that future climate change stressors also have longer range impacts on transportation infrastructure that increase the costs of operations and maintenance. These impacts include more rapid deterioration of

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<sup>59</sup> [https://www.umcsc.org/PDF/disasterresponse/DISASTER\\_RESOURCES\\_SC\\_10%205%2015.pdf](https://www.umcsc.org/PDF/disasterresponse/DISASTER_RESOURCES_SC_10%205%2015.pdf)

<sup>60</sup> Unified Planning Work Program FY 2015–2017, Columbia Area Transportation Study (COATS), Central Midland Council of Governments, adopted June 25, 2015. Retrieved from <https://centralmidlands.org/wp-content/uploads/UPWP%202015-2017%20FINAL%20DOCUMENT%20APPROVED%206-25-15.pdf>

<sup>61</sup> U.S. EPA. 2017. Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment, EPA 430-R-17-001.

pavements as a result of high heat and inundation, damage to lighting and signage during severe storms, and increased erosion rates. These more gradual impacts on infrastructure resilience should be considered as the City budgets for repairs and reconstruction.

### 2.5.7 Hazardous Materials

The Hazardous Materials Lifeline refers to HAZMAT facilities, hazardous materials, pollutants, or contaminants. Often hazardous materials are utilized or transported as part of daily operations, but become a danger when exposed to the public as a result of an accidental release.

The state’s industrial capacity and network of interstate highways and railways that run throughout the City of Columbia result in vulnerabilities to hazardous material releases from both stationary sites and transportation sources. Facilities that use or store hazardous materials are located throughout the state in both rural and densely populated areas. Damage to either the extensive network of interstate highways and railways or a singular transportation source that supplies industries with chemical and petroleum products could also result in a moderate to large accidental release of hazardous materials.<sup>62</sup>

To ensure that these hazards are sufficiently mitigated, South Carolina’s Department of Health and Environmental Control (DHEC) publish radiation and nuclear safety information on their website at <https://www.scdhec.gov/disaster-preparedness>. In addition, DHEC publishes guidance and requirements for Risk Management Plans and preventing accidental releases to ensure compliance with the Risk Management Program Rule under Section 112(r) of the Clean Air Act Amendment of 1990.

## 2.6 Unmet Mitigation Needs Problem Statements

### Unmet Mitigation Need 1. Operational Resilience

Facilities that ensure the health and safety of the public, especially fire stations, are essential for emergency response officials to efficiently coordinate and execute response and recovery efforts across the City of Columbia. As the City expands in size and function, these facilities need the capacity and strategic location to be able to respond to the impacts of flooding and other disasters. Input and feedback from stakeholders across the City highlight that the current capacity and location of fire stations may be inadequate to respond to the growing demands of public safety. It is essential to ensure that emergency response facilities are well equipped to be able

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<sup>62</sup> South Carolina Emergency Management Division (SCEMD). Hazardous Materials. Retrieved from <https://www.scemd.org/prepare/types-of-disasters/hazardous-materials/>

to respond with enough capacity to mitigate the loss of life and property that result from the hazards discussed in this Mitigation Needs Assessment.

#### Unmet Mitigation Need 2. Flood-Resilient Infrastructure

The impacts that DR-4241 had on the City’s infrastructure highlight the need for implementation of infrastructure mitigation projects that will restore resiliency to future hazard impacts. Along the Broad River and Columbia Canal, mitigation projects have gone unimplemented due to a lack of funding necessary to complete them. Infrastructure associated with the Columbia Head Gates was impacted due to flooding and caused widespread failures and impacts citywide. While this critical situation could have evolved into a larger crisis, the City’s strong response minimized both shorter and longer term impacts on residents. However, the infrastructure of the Head Gates is still compromised and is not resilient to future flooding. As the widespread impacts of this failure have been well documented, it is crucial that funding is used to ensure that a repeat scenario does not occur.

### 3.0 Approach to Addressing Mitigation Needs

#### 3.1 Introduction – Connection Between Mitigation Needs and the Distribution of Funds

In the Federal Register Notice (FR-6109-N-01), HUD defines mitigation as “those activities that increase resilience to disasters and reduce or eliminate the long-term risk of loss of life, injury, damage to or loss of property, and suffering and hardship, by lessening the impact of future disasters.”

The Mitigation Needs Assessment demonstrated that the greatest risks to the City would persist in the form of flooding, tornadoes, thunderstorms, lightning, hurricanes, and tropical storms.

Since the 2015 storms, the City adopted a more aggressive approach to provide the necessary funding to implement its Stormwater Management Capital Improvement Program (CIP) in order to address citywide stormwater and flooding issues. To aid in the delivery of the Stormwater Management CIP and manage the cost to rate payers, the City used a financial plan, utilizing the issuance of stormwater revenue bonds. This approach would allow the City to invest in the system at a higher level than can currently be sustained via cash financing that spreads the financing costs across both current and future rate payers.

The City now intends to utilize CDBG-MIT funding to take additional action to make Columbia more resilient.

The City acknowledges the high probability that these extreme weather conditions will continue to affect Columbia’s residents and city services, and may become more severe or more frequent in occurrence.

The impact of these types of events was taken into consideration as the City made critical decisions around project selection and how each project will impact community lifelines. The Method of Distribution and the project descriptions that follow, demonstrate the City’s commitment to addressing:

- The continuing impact on residents of damage to critical infrastructure that occurred during the 2015 flooding and has yet to be addressed;
- The City’s ability to respond to future disaster events in a manner that improves its ability to protect lives and property;

- The City’s interest in addressing some of the unfunded projects specific to Columbia identified in the Central Midlands Hazard Mitigation Plan (2016)<sup>63</sup> and the State of South Carolina’s Hazard Mitigation Plan (2018)<sup>64</sup>;
- The City’s awareness of the need to supplement currently limited planning resources in a manner that will allow continual improvement in overall resilience through land use, building code, and emergency management and hazard mitigation planning; and
- The importance of engaging in more collaborative planning with the Central Midlands Council of Governments, and Lexington and Richland counties.

The City’s Department of Community Development administrator of all other CDBG programs will administer the CDBG-MIT program.

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<sup>63</sup> <http://www.centralmidlands.org/pdf/CMHMP%202016%20-%20Final.pdf>

<sup>64</sup> <https://www.scemd.org/media/1391/sc-hazard-mitigation-plan-2018-update.pdf>

### 3.2 Method of Distribution

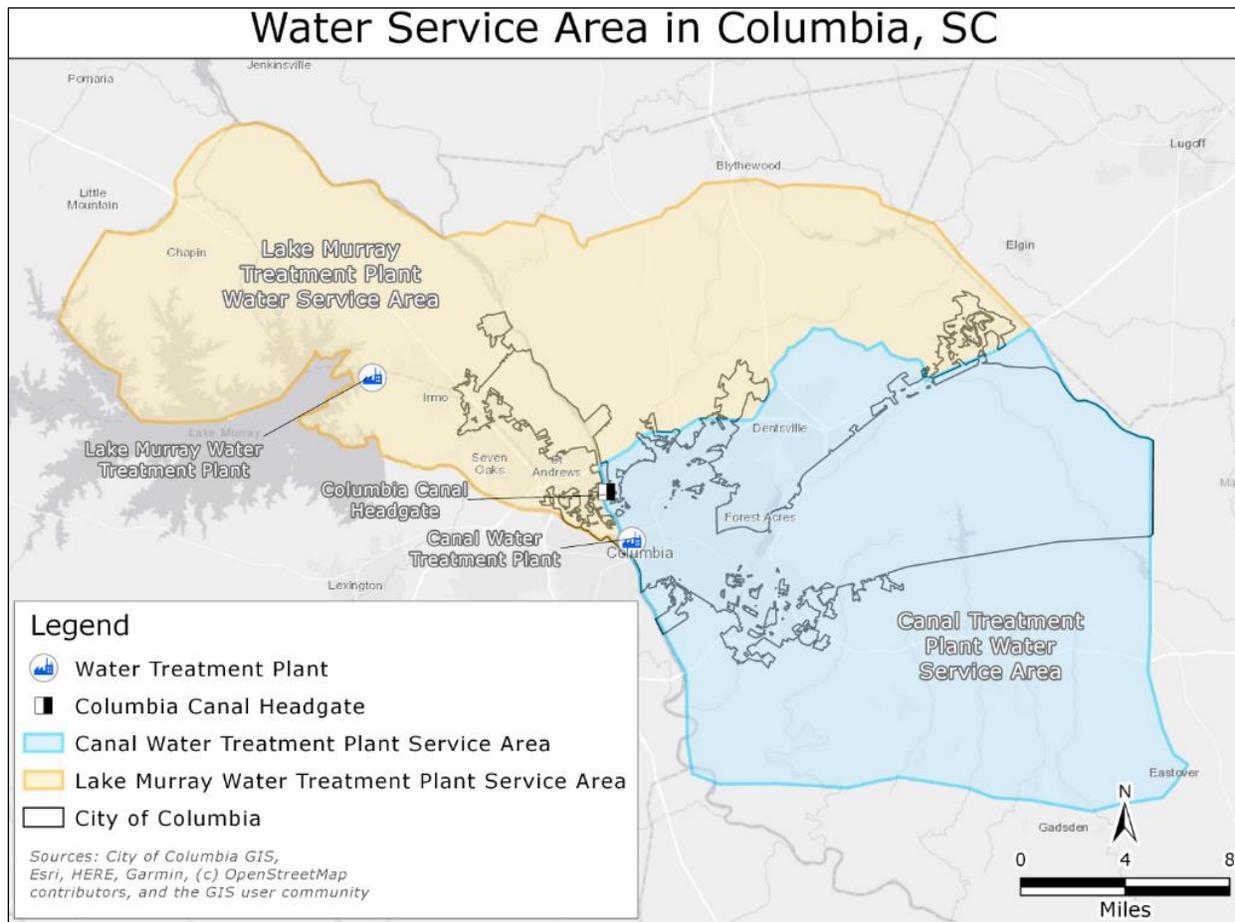
| Category                            | Project Name (Action Plan Section No.)               | Allocation Level | Estimated LMI Benefit* |
|-------------------------------------|--|------------------|------------------------|
| Infrastructure                      | Columbia Canal Head Gates and Lock Gate Repair (3.3) | \$8,000,000      | 100%                   |
|                                     | Olympia Fire Station Replacement (3.4)               | \$7,000,000      | 100%                   |
| Planning, Oversight, and Monitoring | Planning Activities (3.5)                            | \$2,655,750      |                        |
|                                     | Administration (3.6)                                 | \$929,250        |                        |
| TOTAL                               |  | \$18,585,000     | 100%                   |

### 3.3 Columbia Head Gates and Lock Gate Repair

**Project Description:** This project consists of the design, engineering, and replacement of 12 water control gates and one lock control gate. These gates are used to regulate the raw water supply diverted from the Broad River to the Columbia Canal, which supplies raw water to the Columbia Canal Water Treatment Plant and the Columbia Hydroelectric Facility. These facilities serve more than half of the City’s water customers, including the majority of the city limits and much of Richland County, with portions being located within Lexington County as well. The area within the city limits served by the proposed project (shaded in blue on the map below) is 53% low and moderate income. Combining this with the additional service area outside the city limits, the total Canal Water Service Area is 51% low and moderate income<sup>65</sup> (see Section 8.3, Project Service Area Census Tracts). MIT funding will be used to ensure continuous operation of these critical facilities during and after extreme weather events.

<sup>65</sup> ACS 5-Year 2011–2015 Low- and Moderate-Income Summary Data. <https://www.hudexchange.info/programs/acs-low-mod-summary-data/>

Figure 25. Water Service Areas in Columbia



Currently, the City is controlling water flow into the Columbia Canal through a fixed-dimension opening in a bulkhead that was placed in front of the #1 gate during emergency operations, arising from the flood event of 2015. Under this emergency stopgap measure, the City has almost no control over the amount of water entering the canal. This continues to jeopardize the potable water supply for approximately 50% of the City’s customers. This status also does not allow for the functioning of the Columbia Hydroelectric Facility. When fully functioning, this facility produces 10 megawatts of green energy, which is supplied to the City’s power grid.

Figure 26. Two Views of Head Gates



The Head Gates and Lock Gate repair project will be complemented by a separate project that involves repairs to the Columbia Canal. FEMA is funding the canal repair, along with additional funding from the City and state. FEMA denied the City's request to fund the Head Gates and Lock Gate repairs (see letter in Section 8.5). Design and engineering for the Head Gates and Lock Gate repair project are funded by the City's CDBG-DR grant. The City has initiated the National Environmental Policy Act (NEPA) process for all project elements, ensuring that the projects can be completed within the prescribed timeline. The Head Gates and Lock Gate repair project will be the first project to begin once environmental clearance and authorization to use grant funds are received.

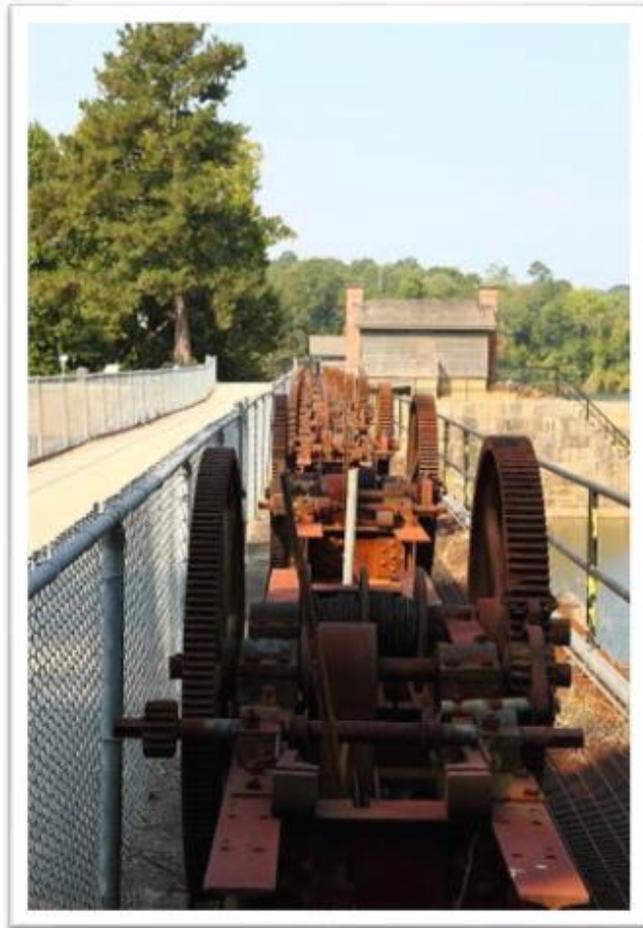
The Head Gates' function is to control and regulate the amount of raw water introduced into the Columbia Canal. The current Head Gates were unable to perform their intended function during the flood event in October 2015. The proposed project will allow the existing gates to be replaced with gates that will be more resilient and able to function under flood and other adverse conditions. This reduces the risk to the City's potable water and energy supply during future events.

A maintenance and operating agreement by the City to operate the project for its useful life can be found in Section 8.4.

**Project Impact on Community Lifelines:**

- **Safety and security:** This project is critical for the City, ensuring a continuing, adequate supply of water used for fire protection.
- **Food, water, and shelter:** This project is critical for the City's ability to ensure a continuing supply of safe drinking water.
- **Health and medical:** This project is critical for ensuring an adequate supply of safe drinking water to five hospitals, including the region's only Level 1 Trauma Center, six major universities and colleges, Fort Jackson (Army's largest basic training site), McEntire Joint National Guard Base, the State Capitol, and other federal facilities. It also ensures an adequate supply of water used for fire protection for those same institutions.
- **Energy (power and fuel):** This project is a key component in supplying 10 megawatts of green energy.

**Figure 27. Head Gates Mechanism**



**Allocation for the Activity:** \$8,000,000

**Eligibility for CDBG-MIT:** Housing and Community Development Act Section 105(a)(2)

**National Objective:** Low and Moderate Income Area Benefit (LMA)

**Administering Agency:** Columbia Water, Columbia Department of Community Development

### 3.4 Olympia Fire Station Replacement

**Project Description:** The existing Olympia Fire Station, which serves an area that is 65.35% low and moderate income,<sup>66</sup> is a repurposed greenhouse. The facility is both inadequate to support modern fire response demands and poses a health hazard to fire safety personnel, due to its poor ventilation system and lack of suitable support quarters for firefighters (see Section 8.3, Project Service Area Census Tracts). The new fire station will reduce the risk of loss of life and injury, and damage to and loss of property.

This station is located in one of the fastest growing areas of the City, and in close proximity to the University of South Carolina campus. With an influx of people and new construction, the City of Columbia must provide additional fire and emergency resources to the station's service area to maintain the level of response capacity necessary to protect lives and property.

Figure 28. Current Olympia Fire Station



The station's current location does not leave room for expansion, and during weather events, the critical access roads needed for engines to reach residential areas are often flooded or blocked with storm debris, slowing response times. In addition, with the rapid expansion in the area, new multi-story residential buildings are being constructed. The station needs to add an aerial or ladder truck to meet the challenges presented by these newer multi-story structures. As can be seen from the picture of the current Olympia Station #2 above, it cannot accommodate a fire truck with multi-story response capacity.

The current station and new facility will provide backup emergency response to the University of South Carolina campus. The new station house will be designed with sufficient space to ensure that additional equipment and resources can be staged at the station when large-scale events occur on the nearby campus, or in the event of potential severe weather. In addition, the new station will add a bay that will accommodate a ladder truck and an additional bay for future use. A training room

<sup>66</sup> ACS 5-Year 2011–2015 Low- and Moderate-Income Summary Data. <https://www.hudexchange.info/programs/acs-low-mod-summary-data/>

will provide space for CPR and emergency response training for first responders and for the surrounding community. The station will also have a full-building natural gas-powered generator.

The station will be elevated or flood-proofed as required, pursuant to 24 CFR 55.2 (b) (3) or any successor standard, up to at least 3 feet above the 100-year floodplain, and may include using structural or nonstructural methods to reduce or prevent damage. It will be designed to adapt to, withstand, and rapidly recover in the event of a flood.

The City also wishes to secure sufficient land to expand and accommodate Columbia Police Department operations at this site in the future. As the City expands, both through growth and development and through annexations, there will be a need to locate a new police facility in this area of the City. The City intends to co-locate that facility with the Columbia Fire Department, as has been done successfully in other parts of the City. Having sufficient space for this expansion of service is critical for ensuring the welfare of the growing community.

A maintenance and operating agreement by the City to operate the fire station for its useful life can be found in Section 8.4.

#### Project Impact on Community Lifelines:

- **Safety and security:** This project will provide a modern resilient facility that will be able to resist extreme weather events and ensure that critical response services will not be delayed or interrupted. The station will also house a redundant emergency communications system.
- **Food, water, and shelter:** The proposed station will have the capacity to house additional emergency response units during natural disasters and is positioned to assist with mass evacuations. It will also be able to house federal emergency management personnel.
- **Health and medical:** All personnel are Emergency Medical Responder (EMR) certified and some are emergency medical technicians.
- **Energy (power and fuel):** The new station will be equipped with a diesel/gas generator that is able to provide the station with power for an extended period.
- **Transportation:** The new fire station, located in the Olympia area, is critical for ensuring the long-term viability of several major transportation routes in Columbia, including the Assembly Street, Bluff Road, Huger Street, and Blossom Street corridors. The area is also home to several major railway intersections. Quick resolution of accidents and disaster incidents in this area is critical for the City's ability to serve existing residents and businesses, and will have a positive impact on mitigating factors that inhibit long-term growth.

**Allocation for the Activity:** \$7,000,000

**Eligibility for CDBG-MIT:** Housing and Community Development Act Section 105(a)(1), Section 105(a)(2)

**National Objective:** Low and Moderate Income Area Benefit (LMA)

**Administering Agency:** Columbia Water (Engineering, Construction Management, and Real Estate), Columbia Fire Department, Columbia Department of Community Development

### 3.5 Planning Activities

**Project Description:** Rising flood insurance costs threaten city residents as they are “priced out” of their homes where flood insurance coverage is required as a condition of their mortgage. On a broader scale, rising National Flood Insurance Program (NFIP) premiums pose a threat to the local economy and real estate markets, as properties gradually lose their resale value as flood risks become more pronounced. Participation in the Community Rating System (CRS), including the implementation of higher regulatory floodplain standards, is an effective tool to mitigate the impact of rising flood insurance costs. As of August 2019, Columbia ranked 23rd in the state for the number of policies written (1,130).<sup>67</sup>

To lessen this financial burden on residents or buy down the cost of flood risk, the City will leverage land-use planning and/or hazard mitigation planning activities, informed by the Mitigation Needs Assessment, to support the adoption and implementation of international building codes and policies as they are put forward. These activities will help to mitigate the cost of current and future flood risk by accumulating discounts on existing flood insurance policies for its residents, while also lessening the impacts of future disasters on new construction built in accordance with higher standards.

The City may also collaborate with Richland and Lexington counties, as well as the Central Midlands Council of Governments, to participate in planning for regional approaches in addition to specific local solutions to promote sound hazard mitigation practices. This may include providing additional financial support for updating the Central Midlands Hazard Mitigation Plan currently underway. Studies could include, but are not limited to, flood control, drainage improvement, resilient housing solutions, surge protection, economic development, infrastructure improvement, or other efforts to mitigate risks and future damages, and establish plans for comprehensive recovery efforts. Planning funds and projects will be administered by

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<sup>67</sup> [https://crsresources.org/files/100/maps/states/south\\_carolina\\_crs\\_map\\_october\\_2019.pdf](https://crsresources.org/files/100/maps/states/south_carolina_crs_map_october_2019.pdf)

the City’s Department of Community Development. The City will make all final determinations regarding planning studies and coordinate with local universities, other local governments, the Central Midlands Council of Governments, state agencies, federal agencies, and/or vendors to identify the scopes, the parameters of the planning efforts, and the type of data that they will gather.

The City continues to work to gather, understand, and utilize data in ways that will enhance the city’s emergency response and preparedness activities. Data of interest includes, but is not limited to natural hazard risks, including anticipated effect of future extreme weather events and other natural hazards. This will enable the city to improve its disaster information analytics capabilities, and foster communication, collaboration, and information gathering amongst relevant city agencies, nonprofits, and community organizations that have a role in disaster response and recovery. Data gathered will inform possible solutions that plan for and create a more resilient landscape in the City. Updated mapping and modeling techniques will be used to inform land-use plans, master plans, historic preservation plans, comprehensive plans, community recovery plans, resilience plans, updating of building codes, zoning ordinances, and neighborhood plans.

The City will use planning funds to support additional collaborative hazard mitigation planning to understand evolving disaster risks and support additional mitigation activities as they may be identified.

**Allocation for the Activity:** \$2,655,750

**Eligibility for CDBG-MIT:** FR-6109-N-02

**National Objective:** Low and Moderate Income Area Benefit (LMA),  
Urgent Need – MIT (UNM)

**Administering Agency:** Columbia Department of Community Development

### 3.6 Administrative Costs

The City has certified and has in place proficient financial controls and procurement processes, adequate procedures to prevent any duplication of benefits as defined by Section 312 of the Stafford Act, and processes for ensuring timely expenditure of funds. The City also maintains a comprehensive website for all mitigation activities assisted with these funds, as well as processes to detect and prevent waste, fraud, and abuse of funds; perform environmental reviews on every project; and ensure that all projects are compliant with the Uniform Relocation Assistance Act; Davis-Bacon Act and other labor standards; Fair Housing, Section 3, Part 85; and other federal laws. HUD provides monies to the City for the operating costs associated with

day-to-day management of programs. Proper oversight and administration ensure a reduction in concerns or findings from HUD.

The Department of Community Development will oversee all activities and expenditures of the CDBG-MIT funds. Existing city employees will be utilized, and additional personnel and contractors may be hired to aid in the administration and carrying out of mitigation programs. Not only will these personnel remain involved in ensuring that there are layers of financial control, they also will provide technical assistance to the City, and will undertake administrative and monitoring activities to better ensure compliance with applicable requirements, including, but not limited to, meeting the mitigation threshold, eligibility, national objective compliance, fair housing, nondiscrimination, labor standards, environmental regulations, and procurement regulations at 2 CFR Part 200.317 – 200.326. Each activity funded will meet the mitigation definition and one of HUD’s three national objectives, with an emphasis on achieving the primary national objective of benefiting low- and moderate-income persons, and will be an eligible activity. Department of Community Development staff will perform monitoring in accordance with the City’s CDBG-MIT monitoring plan.

The Department of Community Development will maintain a high level of transparency and accountability by using a combination of risk analysis of programs and activities, desk reviews, site visits, and checklists modeled after HUD’s Disaster Recovery Monitoring Checklists (until more specific Mitigation Monitoring Checklists are available) and existing monitoring checklists used in monitoring regular program activities.

The Department of Community Development will determine appropriate monitoring of subgrantees and subrecipients, considering prior CDBG and CDBG-DR grant administration performance and audit findings, as well as factors such as the complexity of the project. The primary purpose of the Department’s monitoring strategy is to ensure that all projects comply with applicable federal regulations and are effectively meeting their stated goals. The frequency and areas monitored will be determined by a risk analysis. All projects will be monitored at least once on-site during the life of the activity. The results of monitoring and audit activities will be reported to the Director of the Department of Community Development. The Department will determine the areas to be monitored, the number of monitoring visits, and their frequency. City departments administering program funds will be provided training and technical assistance if requested, or if the Department determines that in-house or on-site monitoring is needed.

The Department of Community Development will continue to follow all guidelines that it uses to monitor projects funded under the regular CDBG program. The monitoring will address program compliance with contract provisions, including, but not limited

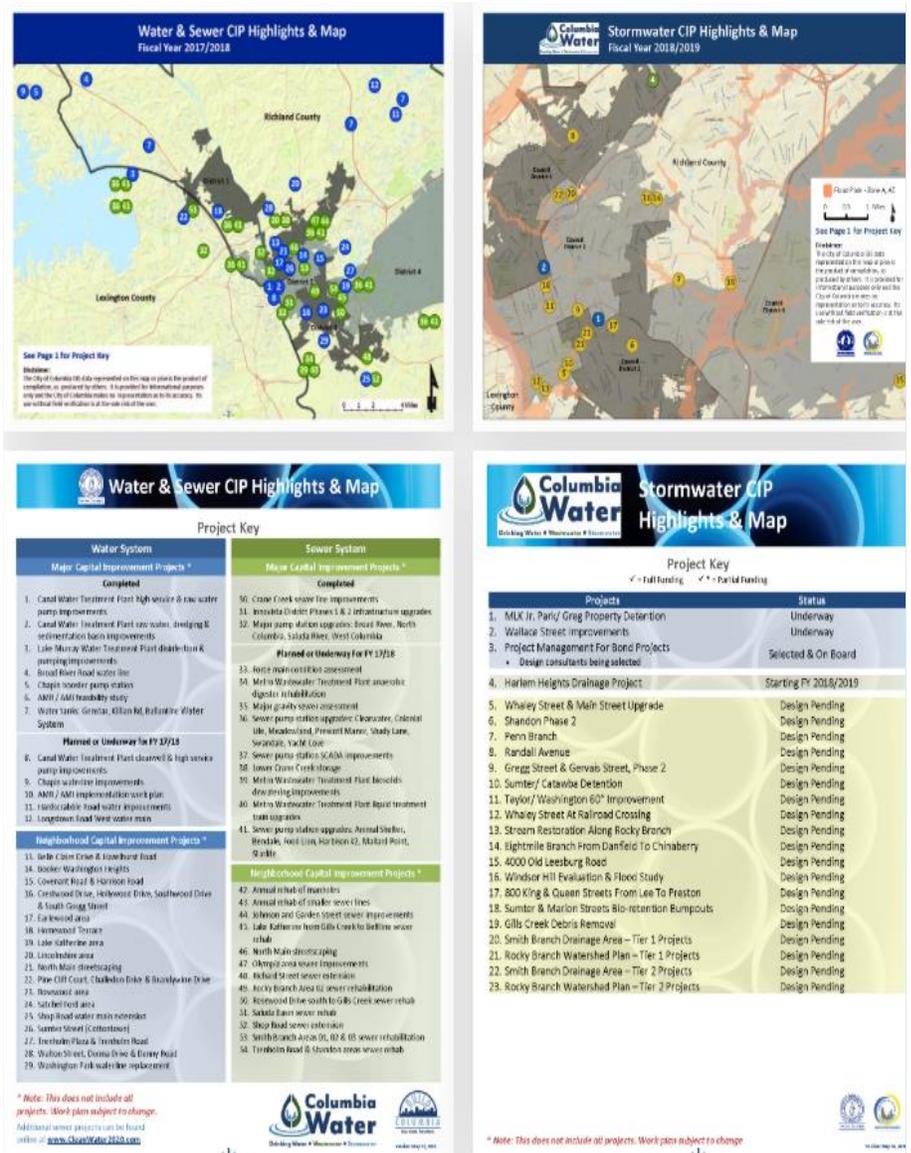
to, environmental reviews, fair housing, Section 3 compliance, compliance with the Davis-Bacon Act and other labor standard provisions, procurement regulations, fair housing and equal opportunity requirements, compliance with 2 CFR Part 200, program income, and other CDBG financial requirements. These policies and procedures are consistent with those used by HUD to monitor entitlement programs. All necessary environmental reviews will be performed on each project prior to funding.

### 3.7 Additional City Actions and Collaborations to Address Mitigation Needs

#### Water and Sewer Projects

Since the flooding in 2015, Columbia Water, the City’s water, sewer, and storm water management department, has moved to develop and fund critical stormwater control projects. The City has had a Stormwater Management Capital Improvement Program (CIP) for decades. Prior to 2001, it was funded via General Funds. On or around 2001, the City implemented a storm-water utility fee that is based on impervious area and is assessed to every parcel within the city limits. While stormwater fees have increased through the years, the projects were funded with a “pay as you go approach” until recently. In 2017, the City increased fees and issued

Figure 29. Capital Improvement Plan Maps & Projects



bonds using the Stormwater Utility Fund to advance the delivery of projects in an effort to be more proactive in addressing stormwater hazards and flooding problems in Columbia. The City was the first to issue Green Bonds.

The City also has a robust Water and Sanitary Sewer CIP. The City budgets \$120 million per year to support improvements to the water and sanitary sewer system. Many of those projects involve enhancing the resiliency of the sanitary sewer and water systems. The improvements made to the sewer system prior to the 2015 flood event proved to be a vital part of mitigating the impact of the flood on the City. Many critical sanitary sewer facilities were elevated above the 100-year flood elevation levels, which allowed those facilities to continue to operate during the flood event, aiding in a quicker recovery throughout the City than otherwise would have been possible.

Through the various CIPs, the City is identifying and funding construction projects to upgrade, increase the capacity, and make more resilient the City's infrastructure for the drinking water treatment and distribution system, the wastewater collection and treatment system, and the stormwater drainage system. Taking an aggressive and proactive approach to mitigation, the City's program is funded through bond sales, with the goal of making the water, wastewater, and stormwater systems more resilient and able to function effectively during severe weather events. These improvements provide benefits within the City, as well as in Richland and Lexington counties.

#### [National Flood Insurance Program Participation](#)

As a part of NFIP, the Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Under CRS, flood insurance premium rates are discounted to reward community actions that meet the three goals of CRS, which are (1) reduce flood damage to insurable property, (2) strengthen and support the insurance aspects of NFIP, and (3) encourage a comprehensive approach to floodplain management.

As a participant in NFIP, the City of Columbia decided to participate in NFIP's CRS Program. As a result of the City's efforts, effective May 1, 2019, the City entered the CRS Program as a Class 9 community. This provides flood insurance policyholders within the City's jurisdiction a **5%** premium discount on their NFIP policies.

Columbia Water has launched an effort to educate residents on the importance of participating in FEMA's NFIP. Columbia Water manages construction and significant improvements in its floodplains as part of its participation in NFIP. Recognizing that the City has a relatively low participation rate (23rd among South Carolina cities),

Columbia Water is deploying educational resources to help property owners learn more about their flood risk and how to manage their flood insurance rates, with the goal of increasing NFIP participation.

#### [Intergovernmental Agreements for Emergency Services](#)

The Columbia Fire Department serves Columbia, the capital of South Carolina, as well as a 772-square mile area of Richland County. The Department is the sole provider of fire services for local, state, and federal government buildings in both the City and county. The City of Columbia and Richland County entered into a contract to provide fire protection to the entire county, and Richland County EMS serves the entire county, including the City of Columbia. The Columbia Fire Department provides fire protection to five local municipalities in addition to unincorporated Richland County. The City has mutual-aid agreements to provide fire protection to McEntire Air National Guard Base and Fort Jackson, in addition to five surrounding counties.

The City of Columbia's Fire Department strives to improve emergency response services to city and county residents. It now utilizes social media to alert residents ahead of severe storms. Not only does it provide real-time weather updates, but it includes pre-storm preparation and safety tips. The Department enhanced its Swiftwater Rescue component with additional boats and pieces of specialty equipment. This equipment, along with advanced training, is credited with saving lives during Columbia's recent flood events.

## 4.0 Coordination and Alignment

The City of Columbia has a long history of collaboration and coordination with its fellow CDBG-MIT grantee neighbors, Richland and Lexington counties. The City provides fire protection and emergency response services to Richland County, and has mutual-aid pacts with five other Richland communities, as well as with Lexington County. Columbia also provides water and sanitary sewer services to Richland County and a portion of Lexington County. In return, Richland County handles EMS for the City and is responsible for shelters and emergency evacuation services. The City of Columbia also owns and operates the Columbia Animal Shelter, which services the city limits and Richland County regarding lost and/or unwanted animals. Disasters such as the 2015 flood result in many stray and homeless animals that need to be reunited with their families or connect with new families. The partnership between the City and county regarding this activity has existed for decades and is beneficial to the entire region.

The Central Midlands Council of Governments (COG) is responsible for the development of the Hazard Mitigation Plan for the four-county Central Midlands area, composed of Richland, Lexington, Newberry, and Fairfield counties. While COG is in the process of updating the 2016 Hazard Mitigation Plan, representatives have been involved in a discussion with city officials around project selection and have provided support for the Mitigation Needs Assessment. Efforts were made to ensure that, to the maximum extent possible, recommendations and goals from the 2016 Hazard Mitigation Plan were incorporated into the projects recommended for funding. For example, the proposed Olympia Fire Station replacement will include both an auxiliary power supply built into the building's electrical system and surge protectors.

The City identified several projects that were included in the State of South Carolina's Hazard Mitigation Plan, last updated in 2018. These projects focused on the development of a comprehensive, interagency flood assessment and mitigation plan to manage floodwater in the Rocky Branch Creek, which originates in the City of Columbia and runs through the University of South Carolina – Columbia campus. Both of these projects have components that are addressed in the City's Stormwater Management CIP.

The three grantees (City of Columbia, Richland County, and Lexington County), along with representatives of the Central Midlands COG, met on February 27, 2020, to share information on the MIT projects that each jurisdiction is proposing and to explore opportunities for additional collaborations to support a regional approach to hazard mitigation and increased community resilience. Both Richland and Lexington counties intend to continue their buyout programs, and both will have at least one infrastructure project as well. Richland County's timetable is similar to that of the

City of Columbia. Lexington County will be submitting their MIT Action Plan in June 2020.

The representatives of the Central Midlands COG provided an update on the planning underway for updating the region’s Hazard Mitigation Plan. A grant application was submitted to FEMA for funding to support development of the plan. Columbia indicated a willingness to allocate some MIT funding as well, should that become necessary.

Staff from the Central Midlands COG discussed an innovative modeling project, developed as a joint venture between the University of South Carolina and the University of North Carolina. The project uses climate data to predict both drought and flood events. COG hopes to be able to introduce the drought modeling to local municipalities and utility providers by early fall.

Joint meetings between the three MIT grantees and COG will continue on a monthly basis going forward.

## **5.0 Citizen Engagement and Participation**

### **5.1 Citizen Participation Plan**

To comply with HUD requirements and community expectations, the City of Columbia has developed a Citizen Participation Plan specifically for its CDBG-MIT programs. The goal of the Citizen Participation Plan is to provide meaningful and inclusive opportunities for citizen involvement.

During the development of this action plan, citizens, residents, and other stakeholders had an opportunity for reasonable and timely access to information and a minimum of 45 days to submit comments related to the allocation of CDBG-MIT funding, program design, and eligible activities. In addition to receiving citizens’ comments on the initial CDBG-MIT Action Plan, the City held one outreach event during the development of the action plan and one additional outreach during the public comment period. These outreach events were held to inform the public of the funding process and solicit input regarding the mitigation and resilience needs of the community. Significant efforts were made to notify the public and generate participation as described in Section 5.3, Public Engagement and Stakeholder Consultation, below. These types of outreach efforts will be continued as mitigation projects evolve, additional mitigation needs are identified, and program activities are modified to respond to these changes.

The City’s initial action plan and subsequent amendments will be posted to the City of Columbia CDBG-MIT website in both English and Spanish in accessible formats. Public notices regarding the action plan and subsequent notices will be posted in *The State* newspaper and will also be placed in a prominent location on the City’s main website along with a hyperlink for the City’s CDBG-MIT website. The CDBG-MIT website will display an announcement on its home page with a hyperlink to the action plan (or amendment). In addition to accepting public comments via more traditional methods (email, mail, and fax), the City’s CDBG-MIT website is also enabled to receive public comments. All comments and city responses will be incorporated into the action plan or action plan amendment for HUD review.

Residents with disabilities or those who need technical assistance or reasonable accommodations are encouraged to contact the City of Columbia Human Resources Employee Relations Officer/ADA Coordinator, Gardner Johnson, for assistance at:

- Phone: 803-545-4625
- Email: [gardner.johnson@columbiasc.gov](mailto:gardner.johnson@columbiasc.gov)
- Mail: 1401 Main Street, 4th Floor, Human Resources, Columbia, SC 29201

Supplemental to the posting of the action plan and subsequent amendments on the City’s CDBG-MIT website, the following items will be posted and updated to promote transparency and provide the latest available information on the City’s mitigation and resilience efforts:

- Program Policies and Documents
- DRGR Quarterly Progress Reports
- Program Performance Reports
- Procurement Policies and Opportunities
- CDBG-MIT Contracts and Status Report

## 5.2 Public Hearings

The City scheduled two public hearings: one while the plan was being developed and the projects identified to solicit community input, and one after the draft action plan was posted to gather additional citizen comments on the projects being proposed. The first notice publicizing the public hearings was posted in *The State* (newspaper of general circulation) on February 19, 2020.

The first public hearing, introducing the community to the Mitigation Grant program and HUD’s goal in providing the funding to Columbia, was held on March 2, 2020 at 6:00 p.m. It took place at the Edisto Discovery Park facility. This site was chosen for

its proximity to the low- and moderate-income community that is currently served by the Olympia Fire Station, and the ease of access for the most heavily impacted community.

The second public hearing, after publication of the Mitigation Action Plan, was held at Busby Street Community Center at April 6, 2020 at 6:00 p.m. This site was selected for its central location and easy access to both public transit and parking.

In addition to the CDBG-MIT specific public hearings, two presentations were made to the City Council: one before final determination of project selection (February 25, 2020) and one following the second public hearing (April 21, 2020). Opportunities for public comment were provided at both City Council meetings. Comments received at both of the City Council meetings have been included in this document (Section 7.0, Public Comments).

### 5.3 Public Engagement and Stakeholder Consultation

As part of the process to develop the City of Columbia CDBG-MIT Action Plan, the City placed a high priority on public engagement. Recognizing the synergies from working in concert with its peers in Lexington and Richland counties, the City has sought to combine efforts where appropriate. This has led to a robust engagement process with multiple opportunities to present to, hear from, and otherwise engage the concerned and impacted residents of the City of Columbia, keeping the two other CDBG-MIT grantees in the area advised of the City's progress.

The Columbia City Council meets regularly, and its meetings are open to the public and are broadcast on the internet. In addition to the members of the Council, the larger public is welcomed to ask questions and voice concerns on matters raised in the meetings. Agendas are publicized in advance of the meetings to provide broad notice to the public of the items to be discussed. Two presentations were made to the City Council and public on the status of progress and the next steps in the development of the CDBG-MIT Action Plan. Those meetings were held in the City Council Chambers on February 25 and April 21, 2020.

The City intends to use its social media channel, as well as its television station to further publicize the mitigation program and the availability of the CDBG-MIT Action Plan for review. The City's Public Information Office will send out press releases and request time on the City's morning television and radio talk shows to reach the broadest possible audience.

In accordance with the Public Comment requirements of the City's CDBG-MIT allocation, the City has also provided the citizens of Columbia with 45 calendar days to review and comment on its Draft CDBG-MIT Action Plan. During this 45-day period,

the City also held its final outreach session on the evening of April 6, 2020 at the Busby Street Community Center, a centrally located public facility. Comments on the plan were accepted in person at public hearings, or by mail, email, fax, or submittal via the City’s CDBG-Mitigation website. Comments and concerns raised in this session and others have been incorporated in the City’s final action plan (Section 7.0, Public Comments).

The action plan made available to the public included an extensive evaluation of unmet mitigation needs based upon best available data; the basis for CDBG-MIT allocations; the budget of the proposed CDBG-MIT programs, including a description of eligible activities; and outlines of the methods by which the City of Columbia will meet all federal requirements. The initial action plan for the City was made accessible via the City’s CDBG-Mitigation website in both English and Spanish. The notice for the availability of the action plan has also been posted in a prominent location on the City’s main website and on the CDBG-Mitigation webpage. In addition, the City has provided contact information on the website for any citizen who may need reasonable accommodation to access the action plan or public outreach events pertaining to the development of the City’s CDBG-MIT Action Plan.

The initial City of Columbia CDBG-MIT Action Plan was posted to the City’s website on March 16, 2020, with a deadline for public comments ending on April 30, 2020. In addition, a public notice regarding the availability of the plan for review was published in *The State* newspaper, the publication with the widest circulation in the City of Columbia, on March 12, 2020. All public comments received on the plan have been incorporated into the final action plan submitted to HUD for review and approval.

#### 5.4 Citizen Complaints and Concerns

During the project implementation process, citizens will be provided with the City’s Grievance Procedures, which contain a point of contact, street address, and telephone number, along with timeframes for filing a complaint or concern. As a part of this process, citizens will be required to sign a receipt that they acknowledge and understand the complaint process. The City (and subrecipients, if applicable) will provide a written response to each inquiry within 15 business days of receiving the complaint, as practicable. All citizen concerns and complaints shall be appropriately logged and filed in a central repository for HUD review and monitoring. In addition, a copy of the complaint or concern and the City’s response will be filed/uploaded to the project file. If the concern or complaint was forwarded to the City by HUD, the City’s (and/or subrecipient’s) response shall be copied to HUD and emailed to HUD’s designated MIT email address.

## 5.5 Receipt of Public Comments

The City provided many opportunities for citizens to comment on the Mitigation Action Plan and its proposed projects. These include the following:

- In person at City Council meetings (February 25 and April 21, 2020)
- At a public hearing:
  - March 2, 2020, 6:00 p.m., Edisto Discovery Park Facility, 1914 Wiley Street
  - April 6, 2020, 6:00 p.m., Busby Street Community Center, 1735 Busby Street
- By email: [CityMitigation@columbiasc.gov](mailto:CityMitigation@columbiasc.gov)
- Through the City’s Mitigation website: <http://mit.columbiasc.gov>

The pre-draft comments were gathered and considered in selecting projects for funding. Once the draft plan was posted for public comment, all comments were collected, logged, and responded to by the appropriate City staff. Comments and staff responses can be found in Section 7.0 of this document (Public Comments).

## 5.6 Amendments to the Mitigation Action Plan

As the mitigation needs of the City of Columbia change over time, the City may elect to update its needs assessment, modify or create new activities, or reprogram CDBG-MIT funds as necessary.

Action plan amendments will be memorialized, approved, and include the following:

- Exactly what content is being added, deleted, or changed
- A chart that clearly identifies where funds are coming from and where they are going to
- Revised budget table that reflects all funds, as amended
- Description of how the amendment is consistent with the Mitigation Needs Assessment

### 5.6.1 Substantial Amendments

The City defines substantial amendments to the action plan as those that propose one or more of the following changes to the initial plan:

- A change in the purpose, scope, location, or beneficiaries of an activity approved in an action plan or subsequent amendment
- The addition of a covered project

- The allocation or re-allocation of more than \$1 million
- The addition or deletion of any allowable activity described in the approved plan

Each amendment will include a single chart or table that illustrates, at the most practical level, how all funds are budgeted (e.g., by program, subrecipient, grantee-administered activity, or other category).

Only those amendments that meet the definition of a substantial amendment are subject to the citizen participation process. Citizens will be provided with at least 30 days to review and comment on all substantial action plan amendments. A summary of all comments received and a response to those comments will be included in the final substantial amendment submitted to HUD for approval.

### 5.6.2 Non-Substantial Amendments

The City will notify HUD of all non-substantial action plan amendments in writing for review and comment at least 5 business days before the amendment becomes effective. If no changes are required, the non-substantial amendment will be posted to the CDBG-MIT website.

### 5.6.3 Submittal of Amendments

A substantial amendment to the action plan will follow the same procedures for publication as the original action plan in accordance with the City's Citizen Participation Plan. All amendments (both substantial and non-substantial) will be numbered sequentially and posted on the City's Mitigation website. The beginning of every amendment will include a section that identifies the content that is being added, deleted, or changed. In addition, this section will include a revised budget allocation table that reflects the entirety of all funds and will clearly illustrate the movement or reallocation of program funding. The City's most recent version of the entire action plan will be accessible for reviewing as a single document at any given time.

## 5.7 City of Columbia Resilience Advisory Committee

Following approval of the action plan, the City will form the Columbia Resilience Advisory Committee. The committee will be composed of city residents, representatives of impacted city departments, experts in the mitigation field, and others as the City reviews its needs. The advisory committee will convene for an open public meeting at least twice annually to provide increased transparency in the implementation of CDBG-MIT funds, solicit and respond to public comment and input regarding the City's mitigation activities and needs, and serve as an ongoing public forum to continuously inform the City's CDBG-MIT projects and programs.

## 5.8 Mitigation Website

The City created a Mitigation website that went live on February 19, 2020. The site provides information on the purpose of the Community Development Block Grant Mitigation allocation and the amount of funding allocated to the City of Columbia. In addition, a section helps residents to understand what mitigation is and how this new resource can help communities lessen the impact of disasters and reduce the long-term risk of death, injury, property loss, property damage, suffering, and hardship.

The website provides an explanation of how data-informed investments can have a positive impact on critical community lifelines, such as public safety; food, water, and shelter; health and medical services; energy; communications; transportation; and hazardous materials handling.

The website will include, but not be limited to, the following information:

- The Mitigation Action Plan (including all amendments)
- All Quarterly Progress Reports
- Procurement policies and procedures
- All public hearing notices and the public comments portal
- All Advisory Committee meeting notices and minutes of the meetings
- All executed contracts that will be paid with CDBG-MIT funds
- The status of services or goods currently being procured (e.g., phase of the procurement, requirements for proposals)

The web address is <http://mit.columbiasc.gov>.

## 6.0 Additional Requirements and Considerations

### 6.1 Pre-Award Cost Reimbursement

The City of Columbia will reimburse itself for pre-award costs associated with the development of the CDBG-MIT Action Plan. Section 24 CFR 570.200(h)(1)(i) will not apply to the extent that it requires pre-agreement activities to be included in a consolidated plan. All pre-agreement costs, such as engineering, planning, administration, and program delivery, are exempt from the environmental process in accordance with 24 CFR 58.34.

## 6.2 Promotion of Housing and Essential Services for Vulnerable Populations

Of the 3,219 applicants who applied for FEMA assistance, 1,725 (53.6%) self-reported their income as low to moderate. Of this number, 1,274 were owner occupants and 451 were renter-occupied households.<sup>68</sup> To address the need for housing repair, six of the eight programs funded by the City of Columbia with their \$19,989,000 CDBG-DR allocation were dedicated to housing repair or reconstruction. This represents 89.5% of the total funding. Of the six programs, four served only low- and moderate-income residents.

The MIT Action Plan plans to use 81% of the total allocation to fund the Olympia Fire Station Replacement (\$7,000,000) and the replacement of 12 Head Gates in the Columbia Canal (\$8,000,000).

The fire station serves an area that is 65.35% low and moderate income.<sup>69</sup> The new fire station site will provide better access to the local service area, particularly during high traffic periods and during times of localized street flooding. In addition, it will be better equipped to respond to fire and other incidents in the new multi-story buildings being constructed in the area, including those on the University of South Carolina campus. The station will also be providing a additional bay for future use.

The service area for the floodgate project covers the entire City of Columbia that is 53% low and moderate income.<sup>70</sup> In addition, the project will provide drinking water and water for residential uses and for fire protection to a portion of Richland County, bringing the total low and moderate income service area to 51%. Currently, stopgap measures are being used to provide water services. The completion of the head gate project will ensure an adequate supply of potable water, critical for resident health and well-being far into the future.

## 6.3 Plans to Minimize Displacement

Currently, there is no plan or expectation of displacement as the result of implementation of any of the CDBG-MIT funded projects.

In the event that relocation is required, the City will minimize displacement of persons or entities as a result of the implementation of CDBG-MIT projects by ensuring that all programs are administered in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act (URA) of 1970, as amended (49 CFR Part

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<sup>68</sup> City of Columbia CDBG-DR Action Plan, p. 40.

<sup>69</sup> ACS 5-Year 2011–2015 Low and Moderate Income Summary Data, [http://www.hudexchange.info/programs/acs-low-mod-summary -data/](http://www.hudexchange.info/programs/acs-low-mod-summary-data/)

<sup>70</sup> Ibid.

24) and Section 104(d) of the Housing and Community Development Act of 1974 and the implementing regulations at 24 CFR Part 570.496(a), subject to any waivers or alternative requirements provided by HUD. In the event displacement does occur, the Department of Community Development will take into consideration the functional needs of the displaced persons in accordance with guidance outlined in Chapter 3 of HUD’s Relocation Handbook.

#### 6.4 Plans to Ensure Open Competition, Reasonable Cost Assessment, and Contractual Requirements

The City follows procurement guidelines outlined in 2 CFR Part 200.317 to 200.326. All procurements will be conducted in a manner to ensure free and open competition, and cost estimates will be provided by the appropriate City department or contracted architecture and engineering firm in advance of any bid postings.

All construction activities that utilize CDBG-MIT funds will be reasonable and consistent with market costs at the time and place of construction. To comply with this requirement, the City will utilize and document independent cost estimates (ICEs) for all of its projects. Specific parameters regarding ICE requirements will be outlined within policies and procedures on a program-by-program basis. No covered projects (infrastructure projects of \$100 million or more with at least \$50 million in CDBG funding) are anticipated at this time.

For all contracts with contractors used to provide discrete services or deliverables, the following contractual provisions will be added:

- The City (or procuring entity) will clearly state the period of performance or date of completion for all contracts.
- The City (or procuring entity) will incorporate performance requirements and liquidated damages or, for administrative and consultant contract, penalties into each procured contract.
- The City (or procuring entity) may contract for administrative support but will not delegate or contract to any other party any inherently governmental responsibilities related to management of the grant.

#### 6.5 Application of Elevation Standards, Natural and Green Infrastructure Standards

The City intends to promote high-quality, durable, sustainable, mold-resistant, and energy-efficient construction methods for all activities funded with CDBG-MIT resources, as applicable. All newly constructed buildings must meet all locally adopted building codes, standards, and ordinances. In the absence of specific locally adopted

and enforced building codes, the requirements of the South Carolina State Uniform Building Code will apply.

As applicable, the City will – at a minimum – adhere to the advanced elevation requirements established in the Federal Register Notice (FR-6109-N-02), subtitled “Elevation standards for new construction, repair of substantial damage, or substantial improvement.” To this effect, future property damage will be minimized by requiring that any rebuilding be done according to the best available science for that area with respect to base flood elevations.

As applicable and within its policies and procedures on a program basis, the City or its subgrantees will document decisions to elevate structures. This documentation will address how projects will be evaluated and how elevation costs will be reasonably determined relative to other alternatives or strategies, such as infrastructure improvements to reduce the risk of loss of life and property.

The City recognizes that natural or green infrastructure methods provide drainage functions to reduce stormwater runoff while offering low-cost and attractive site design options. All commercial or institutional construction or retrofitting funded with CDBG-MIT will utilize one of the following green infrastructure strategies to reduce runoff, retain water, and improve water quality on the subject site:

- Retain or plant native vegetation.
- Remove existing impervious surface area or utilize pervious pavement.
- Install bioswales or other retention areas.
- Collect rainwater for non-potable uses.
- Install green roofs.

The fire station and any subsequent new construction or retrofit of public facilities will, to the maximum extent feasible, adopt one or more of the following programs:

- ENERGYSTAR
- Enterprise Green Communities
- LEED
- ICC-700 National Building Standard
- U.S. EPA Indoor AirPlus
- Any other equivalent comprehensive green building program deemed acceptable to HUD and approved by the City

For construction projects completed, under construction, or under contract prior to the date that assistance is approved for the project, adherence to the applicable standards to the extent feasible will be encouraged, but not required.

## 6.6 Ongoing Operation and Maintenance Agreements

The City is committed to funding the ongoing maintenance and operational costs of CDBG-MIT funded projects.

Copies of the maintenance and operations commitment letters for the Olympia Fire Station and Columbia Canal Head Gates projects can be found in Section 8.4.

## 6.7 Timely Expenditure of Funds

HUD CDBG-MIT requirements state that grantees must expend 50% of their allocation within 6 years and 100% of their allocation in 12 years from the date that the grantees sign the grant agreement with HUD. To meet these requirements, the City will evaluate and report the timeliness of the overall CDBG-MIT expenditure rate, as well as progress toward meeting outcome measures and the comparison of obligations to expenditures.

The City is providing a projection of expenditures and outcomes with the submission of this action plan (Section 8.6, Projections for Expenditures and Performance Outcomes).

Whenever program changes affect projected outcomes, funding levels, or recovery timelines, HUD will be provided with revised projections.

The City will track all requests for payment and will keep records of expenditures. All programs and projects will provide a draw-down summary and balance sheet monthly. Program and project timelines will be submitted to the City's CDBG-MIT project manager, Department of Community Development director, and budget director, along with a detailed plan with measurable benchmarks and critical milestones. In the case of any failure to meet benchmarks, program and project managers will be required to provide an action plan to detail corrective actions that will ensure that the program meets the benchmarks. Technical assistance and monitoring will be provided as needed. In the event that the corrective action is not successful in meeting the stated benchmarks, the program or project may be terminated and the funds re-obligated.

A program or project shall be de-obligated if it fails to correct identified program deficiencies (i.e., Findings) or demonstrate that corrective actions are being implemented to address identified deficiencies within 60 days of receipt of a monitoring letter or other correspondence outlining the deficiencies to be corrected. A "finding" is defined as a deficiency in program performance based on noncompliance with a federal statute or regulation. If there is an unexpended balance

remaining after payment/reimbursement of all eligible, approved program costs upon completion of the project, the remaining funds will be re-obligated.

Once a project has met one or more of the criteria listed above, the reprogramming process shall proceed as follows:

1. Supporting documentation shall be compiled to justify the recommendation for re-obligation of funds. The documentation shall include a summary of technical assistance provided to date and any other documents as may be applicable. The CDBG-MIT project manager and budget director shall review the facts of the case and together make the recommendation regarding re-obligation, as necessary.
2. A first notice letter shall be developed that includes the specific reason(s) that the project is being considered for de-obligation. The letter will provide 30 days from receipt of the letter to implement corrective actions.
3. CDBG-MIT program staff shall take the appropriate measures to ensure that the subrecipient receives the first notice (i.e., the notice shall be sent via first class certified mail with a copy sent via read/receipt email). Within 10 days of issuance of the first notice, CDBG staff shall follow up with the subrecipient to offer technical assistance specific to the deficiencies. The outcome of the initial outreach (as well as any subsequent contacts) will be documented in file notes.
4. If corrective measures have not been implemented by 30 days after the initial letter been received, a Notice of Termination shall be developed and transmitted following the delivery methods described above. The second notice provides a deadline of 15 days from receipt of the letter to demonstrate that corrective actions have been implemented. The letter further advises that at the end of the 15 days, the funds will be de-obligated.
5. Upon expiration of the 15-day termination notice, the request for approval of reprogramming/recommendation for termination shall then be prepared and submitted to the Department of Community Development director through the budget director. Once the director has approved the de-obligation action, the final letter is signed by the director and transmitted via certified mail.

Note: When monies are being de-obligated as the result of completion of a project with an unexpended balance of funds, upon acceptance of the Close-out Report, CDBG-MIT will transmit a letter acknowledging successful close-out of the project and confirming the balance to be re-obligated.

When funds are re-obligated, the City will identify additional eligible recipients or projects, in accordance with the action plan, that require additional funding, or the

City can move forward immediately to expend funds and achieve program goals and comply with all program requirements.

In recognition of the lengthy timeline for major infrastructure projects, the City is funding the architectural and engineering work for the Head Gates project with CDBG-DR funds so that the NEPA review can begin as soon as possible.

## 6.8 Program Income

As an entity that receives CDBG entitlement funding, the City of Columbia understands that when implementing certain activities with CDBG-MIT funds, there is the potential for generating program income. All program income generated by CDBG-MIT funds will be accounted for and expended in accordance with HUD regulations and current program income procedures. Program income will continue to be spent on projects that further recovery in areas impacted by the October 2015 flood event. These funds will continue to be considered Mitigation funds and will be subject to all CDBG-MIT regulations and eligible activities. Any program income generated will be governed by the program income guidance provided in the regulations at 24 CFR 570.489(e) and 24 CFR 85.25 and all applicable waivers.

## 6.9 Duplication of Benefits

The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) requires that “recipients of federal disaster recovery funding make certain that no person, business concern or other entity will receive duplicative assistance.” Because disaster assistance to each person/entity varies widely based on their insurance coverage and eligibility for federal funding, grantees cannot comply with the Stafford Act without first completing a duplication of benefits (DOB) analysis specific to each program and activity.

A DOB occurs when:

- A beneficiary receives assistance, and
- The assistance is from multiple sources, and
- The assistance amount exceeds the need for a particular recovery purpose.

The City of Columbia, in its DOB policy and procedures, will include the following:

- Verification of all sources of assistance received by the applicant, as applicable, prior to the award of CDBG-MIT funds
- Determination of the applicant’s remaining funding need(s) for CDBG-MIT assistance before committing funds or awarding assistance

- The requirement that all beneficiaries, subgrantees, or subrecipients enter into a signed agreement to repay any duplicative assistance if they later receive additional assistance for the same purpose for which the CDBG-MIT award was provided
- Include in all agreements the following language: “Warning: Any person who knowingly makes a false claim or statement to HUD may be subject to civil or criminal penalties under 18 U.S.C. § 287, 1001 and 31 U.S.C. § 3729.”

The City’s policies and procedures governing DOB indicate that, prior to the award of assistance, the grantee will use the best, most recent available data from FEMA; the Small Business Administration; insurers; and any other sources of local, state, and federal sources of funding to prevent DOB. This will include recent HUD guidance published on June 20, 2019, entitled “Updates to Duplication of Benefits Requirements Under the Stafford Act for Community Development Block Grant (CDBG) Disaster Recovery Grantees” 2019 DOB Notice) (84 FR 28836).

As part of the Risk Analysis and Pre-Implementation Plan, the City has developed a plan to implement DOB policies and procedures, as well as conduct compliance and monitoring activities.

## **7.0 Public Comments**

## 8.0 Appendices

### 8.1 Definitions

**Action plan amendment:** As the grantee continues to finalize its long-term mitigation goals, or as mitigation needs change, the grantee must submit an action plan amendment to HUD that updates its needs assessment, modifies or creates new activities, and/or re-programs funds, as necessary. There are two types of action plan amendments: substantial and non-substantial. See Section 5.6 of this action plan for more detail.

**CDBG-DR:** Community Development Block Grant–Disaster Recovery assistance is the term for the HUD funding stream that is allocated to eligible disaster recovery entities via congressional appropriations. HUD provides flexible CDBG-DR grants to cities, counties, and states to help them recover from presidentially declared disasters, especially in low-income areas. This funding provides crucial seed money to begin the recovery process and rebuild in disaster-affected areas. Since CDBG-DR assistance funds a broad range of recovery activities, such as housing, infrastructure, and economic development, HUD can help communities and neighborhoods that may not otherwise recover because of limited resources.

**CFR:** The Code of Federal Regulations is the annual collection of general and permanent rules and regulations (sometimes called “administrative law”) that were published in the Federal Register by executive departments and agencies of the federal government. The CFR is divided into 50 titles that represent broad areas subject to federal regulation.

**Data collection:** Gathering, extracting, or measuring scattered and widespread data that are used to support hydrologic and hydraulic analysis and flood risk assessment.

**Data management:** Effective management of observational and analytical data related to flood risk assessment and risk mitigation.

**Decision-making support:** The capacity to understand the potential short- and long-term, as well as upstream and downstream, effects of development, maintenance, and project activities on flood risk, equitable benefit, and the natural and beneficial functions of the environment.

**Financial and grant management capabilities:** Tools and capabilities to manage funds, contracts, and grants associated with floodplain management and watershed-based initiatives.

**Flash flooding:** Flash flooding occurs when a locally intense precipitation inundates an area in a short amount of time, resulting in local streamflow and drainage capacity being overwhelmed.

**Flood:** An overflow of water onto lands that are used or usable by persons and not normally covered by water. Floods have two essential characteristics: The inundation of land is temporary, and the land is adjacent to and inundated by overflow from a river, stream, lake, or ocean.<sup>71</sup>

**Flood mapping:** Geographic flood hazard information that supports decision making and provides stakeholders with high-resolution flood risk data, including flood elevation and risk assessment.

**Flood risk assessment:** Estimations of flood losses and damages at a given depth of flooding, which are calculated at the structure level or aggregated at the census block level. Risk assessment will require cross reference with the latest predictions concerning the future change of climatic and physical conditions (e.g., predictions of sea level rise, land loss rates), as well as anthropogenic conditions (e.g., predicted land use and development patterns) over the coming decades.

**Green infrastructure:** Green infrastructure is the interconnected systems of natural areas and open spaces that are protected and managed for the ecological benefits they provide to people and the environment. With green infrastructure, green space is considered a form of infrastructure in the same manner as roads, water lines, and sewers. It includes large metropolitan parks, neighborhood parks, riparian buffers, linear parks and greenways, trees and forests, farms, and residential landscapes and urban gardens. It uses stormwater storage areas, water conveyance areas, and other natural flooded areas as part of the community infrastructure for stormwater management and flood damage reduction, as well as for parks, trails, and other recreation areas.

**HAZUS:** A nationally applicable standardized methodology developed and freely distributed by FEMA that contains models for estimating potential losses from earthquakes, floods, hurricanes, and tsunamis.

**Natural floodplain functions:** The functions associated with the natural or relatively undisturbed floodplain that moderate flooding, maintain water quality, recharge groundwater, reduce erosion, redistribute sand and sediment, and provide fish and wildlife habitat.<sup>72</sup>

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<sup>71</sup> U.S. Geological Survey Water Science Glossary of Terms.

<sup>72</sup> *Ibíd.*

**Nonstructural mitigation measures:** Nonstructural measures offer a flood mitigation alternative to structural measures by accommodating floodwaters and either removing structures from harm’s way or reducing the risk to existing buildings and infrastructure.

**Resilience:** The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions. Such disruptions may include, for example, a flooding event, a precipitous economic change, effects of long-term environmental degradation, or short-term or intermittent failure or underperformance of infrastructure such as the electrical grid. Resilience describes an area’s capacity to prepare for, withstand, and recover from unpredictable shocks, minimizing the impacts on people, infrastructure, environments, and economies. In practice, resilience provides a framework for guiding planning, investment, and actions in order to reduce vulnerabilities.

**Riverine flooding:** Riverine flooding occurs along a river or smaller stream. It is the result of runoff from heavy rainfall or intensive snow or ice melt. The speed with which riverine flood levels rise and fall depends not only on the amount of rainfall, but even more on the capacity of the river itself and the shape and land cover of its drainage basin. The smaller the river, the faster water levels rise and fall.

**V-Zone:** Areas along coasts subject to inundation by the 1% annual chance flood event with additional hazards associated with storm-induced waves. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.<sup>73</sup>

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<sup>73</sup> FEMA. 2019. Zone V. <https://www.fema.gov/zone-v>

## 8.2 CDBG-MIT Action Plan List of Acronyms

|          |   |
|----------|---|
| ABFE     | Advisory Base Flood Elevation                       |
| ACS      | American Community Survey                           |
| ADA      | Americans with Disabilities Act                     |
| AI/AN    | American Indian/Alaskan Native                      |
| AMI      | Area Median Income                                  |
| BFE      | Base Flood Elevation                                |
| CDBG-DR  | Community Development Block Grant–Disaster Recovery |
| CHA      | Columbia Housing Authority                          |
| CPAC     | Climate Protection Action Committee                 |
| DOA      | U.S. Department of Agriculture                      |
| DOB      | Duplication of Benefits                             |
| DRGR     | Disaster Recovery Grant Reporting                   |
| EGCC     | Enterprise Green Community Criteria                 |
| EPA      | U.S. Environmental Protection Agency                |
| FEMA     | Federal Emergency Management Agency                 |
| FEMA IA  | FEMA Individual Assistance                          |
| FEMA IHP | FEMA Individual and Households Program              |
| FEMA PA  | FEMA Public Assistance                              |
| FIRM     | Flood Insurance Rate Map                            |
| HMGP     | Hazard Mitigation Grant Program                     |
| HUD      | U.S. Department of Housing and Urban Development    |
| ICC      | Increased Cost of Compliance                        |
| LEED     | Leadership in Energy and Environmental Design       |
| LID      | Low-Impact Development                              |
| LMI      | Low and Moderate Income                             |
| MFRG     | Midlands Flood Recovery Group                       |
| MGD      | Million Gallons Per Day                             |
| MSA      | Metropolitan Statistical Area                       |

|        |  |
|--------|--|
| NFIP   | National Flood Insurance Program   |
| OIG    | Office of Inspector General  |
| PA     | Programmatic Agreement   |
| PP FVL | Personal Property FEMA Verified Loss                                     |
| QA/QC  | Quality Assurance/Quality Control  |
| QPR    | Quarterly Progress Report  |
| RP FVL | Real Property FEMA Verified Loss   |
| SCDNR  | South Carolina Department of Natural Resources                           |
| SFHA   | Special Flood Hazard Area  |
| URA    | Uniform Relocation Assistance and Real Property Acquisition Policies Act |
| USACE  | U.S. Army Corps of Engineers   |

### 8.3 Project Service Area Census Tracts

#### 8.3.1 Columbia Head Gates and Lock Gate Repair

|                     |     |        |         |
|---------------------|-----|--------|---------|
| City                | 53% | 84,570 | 159,430 |
| Outside City Limits | 41% | 14,796 | 35,765  |
|                     | 51% | 99,366 | 195,195 |

| Geographic Identity             | Block Group Identity | HUD LOW/MOD Percentage | Low Mod | Total | WaterSer_1 | City_YoN |
|---------------------------------|----------------------|------------------------|---------|-------|------------|----------|
| <b>Canal Sewer Service Area</b> |                      |                        |         |       |            |          |
| 1500000US450790001001           | 000100-1             | 68%                    | 1,315   | 1,940 | Canal      | Yes      |
| 1500000US450790001002           | 000100-2             | 0%                     | 0       | 0     | Canal      | Yes      |
| 1500000US450790002001           | 000200-1             | 70%                    | 640     | 910   | Canal      | Yes      |
| 1500000US450790002002           | 000200-2             | 61%                    | 350     | 570   | Canal      | Yes      |
| 1500000US450790003001           | 000300-1             | 85%                    | 780     | 920   | Canal      | Yes      |
| 1500000US450790003002           | 000300-2             | 83%                    | 1,930   | 2,325 | Canal      | Yes      |
| 1500000US450790004001           | 000400-1             | 51%                    | 355     | 690   | Canal      | Yes      |
| 1500000US450790004002           | 000400-2             | 47%                    | 590     | 1,250 | Canal      | Yes      |
| 1500000US450790005001           | 000500-1             | 78%                    | 475     | 610   | Canal      | Yes      |
| 1500000US450790005002           | 000500-2             | 89%                    | 1,370   | 1,540 | Canal      | Yes      |
| 1500000US450790006001           | 000600-1             | 49%                    | 505     | 1,030 | Canal      | Yes      |
| 1500000US450790006002           | 000600-2             | 53%                    | 845     | 1,595 | Canal      | Yes      |
| 1500000US450790007001           | 000700-1             | 39%                    | 245     | 635   | Canal      | Yes      |
| 1500000US450790007002           | 000700-2             | 44%                    | 425     | 965   | Canal      | Yes      |
| 1500000US450790009001           | 000900-1             | 94%                    | 505     | 540   | Canal      | Yes      |
| 1500000US450790009002           | 000900-2             | 76%                    | 1,105   | 1,455 | Canal      | Yes      |
| 1500000US450790009003           | 000900-3             | 95%                    | 460     | 485   | Canal      | Yes      |
| 1500000US450790010001           | 001000-1             | 90%                    | 655     | 725   | Canal      | Yes      |
| 1500000US450790010002           | 001000-2             | 74%                    | 695     | 945   | Canal      | Yes      |
| 1500000US450790010003           | 001000-3             | 100%                   | 20      | 20    | Canal      | Yes      |
| 1500000US450790011001           | 001100-1             | 67%                    | 280     | 420   | Canal      | Yes      |
| 1500000US450790011002           | 001100-2             | 76%                    | 850     | 1,115 | Canal      | Yes      |
| 1500000US450790011003           | 001100-3             | 35%                    | 265     | 755   | Canal      | Yes      |
| 1500000US450790011004           | 001100-4             | 58%                    | 695     | 1,200 | Canal      | Yes      |
| 1500000US450790011005           | 001100-5             | 81%                    | 590     | 730   | Canal      | Yes      |

| Geographic Identity             | Block Group Identity | HUD LOW/MOD Percentage |  | Low Mod | Total |  | WaterSer_1 | City_YoN |
|---------------------------------|----------------------|------------------------|--|---------|-------|--|------------|----------|
| <b>Canal Sewer Service Area</b> |                      |                        |  |         |       |  |            |          |
| 1500000US450790012001           | 001200-1             | 18%                    |  | 175     | 950   |  | Canal      | Yes      |
| 1500000US450790012002           | 001200-2             | 13%                    |  | 95      | 725   |  | Canal      | Yes      |
| 1500000US450790013001           | 001300-1             | 93%                    |  | 450     | 485   |  | Canal      | Yes      |
| 1500000US450790013002           | 001300-2             | 85%                    |  | 545     | 640   |  | Canal      | Yes      |
| 1500000US450790013003           | 001300-3             | 81%                    |  | 530     | 655   |  | Canal      | Yes      |
| 1500000US450790013004           | 001300-4             | 73%                    |  | 225     | 310   |  | Canal      | Yes      |
| 1500000US450790016001           | 001600-1             | 22%                    |  | 90      | 405   |  | Canal      | Yes      |
| 1500000US450790016002           | 001600-2             | 59%                    |  | 565     | 950   |  | Canal      | Yes      |
| 1500000US450790021001           | 002100-1             | 46%                    |  | 485     | 1,050 |  | Canal      | Yes      |
| 1500000US450790021002           | 002100-2             | 41%                    |  | 225     | 620   |  | Canal      | Yes      |
| 1500000US450790021003           | 002100-3             | 81%                    |  | 970     | 1,205 |  | Canal      | Yes      |
| 1500000US450790022001           | 002200-1             | 39%                    |  | 240     | 620   |  | Canal      | Yes      |
| 1500000US450790022002           | 002200-2             | 74%                    |  | 640     | 860   |  | Canal      | Yes      |
| 1500000US450790023001           | 002300-1             | 25%                    |  | 160     | 635   |  | Canal      | Yes      |
| 1500000US450790023002           | 002300-2             | 11%                    |  | 90      | 785   |  | Canal      | Yes      |
| 1500000US450790023003           | 002300-3             | 10%                    |  | 70      | 710   |  | Canal      | Yes      |
| 1500000US450790024001           | 002400-1             | 23%                    |  | 445     | 1,965 |  | Canal      | Yes      |
| 1500000US450790024002           | 002400-2             | 35%                    |  | 460     | 1,300 |  | Canal      | Yes      |
| 1500000US450790024003           | 002400-3             | 13%                    |  | 145     | 1,105 |  | Canal      | Yes      |
| 1500000US450790025001           | 002500-1             | 29%                    |  | 230     | 805   |  | Canal      | Yes      |
| 1500000US450790025002           | 002500-2             | 33%                    |  | 425     | 1,300 |  | Canal      | Yes      |
| 1500000US450790025003           | 002500-3             | 22%                    |  | 190     | 880   |  | Canal      | Yes      |
| 1500000US450790025004           | 002500-4             | 26%                    |  | 165     | 645   |  | Canal      | Yes      |
| 1500000US450790026021           | 002602-1             | 44%                    |  | 835     | 1,910 |  | Canal      | Yes      |
| 1500000US450790026022           | 002602-2             | 67%                    |  | 590     | 880   |  | Canal      | Yes      |
| 1500000US450790026031           | 002603-1             | 66%                    |  | 1,020   | 1,555 |  | Canal      | Yes      |
| 1500000US450790026032           | 002603-2             | 85%                    |  | 1,000   | 1,180 |  | Canal      | Yes      |
| 1500000US450790026033           | 002603-3             | 86%                    |  | 1,775   | 2,070 |  | Canal      | Yes      |
| 1500000US450790026041           | 002604-1             | 83%                    |  | 1,220   | 1,470 |  | Canal      | Yes      |
| 1500000US450790027001           | 002700-1             | 80%                    |  | 380     | 475   |  | Canal      | Yes      |
| 1500000US450790027002           | 002700-2             | 31%                    |  | 305     | 1,000 |  | Canal      | Yes      |
| 1500000US450790027003           | 002700-3             | 46%                    |  | 640     | 1,395 |  | Canal      | Yes      |

| Geographic Identity             | Block Group Identity | HUD LOW/MOD Percentage |  | Low Mod | Total |  | WaterSer_1 | City_YoN |
|---------------------------------|----------------------|------------------------|--|---------|-------|--|------------|----------|
| <b>Canal Sewer Service Area</b> |                      |                        |  |         |       |  |            |          |
| 1500000US450790027004           | 002700-4             | 85%                    |  | 195     | 230   |  | Canal      | Yes      |
| 1500000US450790028001           | 002800-1             | 86%                    |  | 1,960   | 2,270 |  | Canal      | Yes      |
| 1500000US450790028002           | 002800-2             | 84%                    |  | 1,110   | 1,325 |  | Canal      | Yes      |
| 1500000US450790028003           | 002800-3             | 94%                    |  | 420     | 445   |  | Canal      | Yes      |
| 1500000US450790029001           | 002900-1             | 33%                    |  | 65      | 200   |  | Canal      | Yes      |
| 1500000US450790029002           | 002900-2             | 71%                    |  | 470     | 665   |  | Canal      | Yes      |
| 1500000US450790029003           | 002900-3             | 0%                     |  | 0       | 0     |  | Canal      | Yes      |
| 1500000US450790030001           | 003000-1             | 83%                    |  | 220     | 265   |  | Canal      | Yes      |
| 1500000US450790030002           | 003000-2             | 91%                    |  | 640     | 700   |  | Canal      | Yes      |
| 1500000US450790030003           | 003000-3             | 59%                    |  | 460     | 785   |  | Canal      | Yes      |
| 1500000US450790031001           | 003100-1             | 93%                    |  | 285     | 305   |  | Canal      | Yes      |
| 1500000US450790031002           | 003100-2             | 55%                    |  | 190     | 345   |  | Canal      | Yes      |
| 1500000US450790105021           | 010502-1             | 61%                    |  | 335     | 545   |  | Canal      | Yes      |
| 1500000US450790106001           | 010600-1             | 61%                    |  | 615     | 1,005 |  | Canal      | Yes      |
| 1500000US450790106002           | 010600-2             | 75%                    |  | 1,000   | 1,325 |  | Canal      | Yes      |
| 1500000US450790106003           | 010600-3             | 80%                    |  | 1,295   | 1,620 |  | Canal      | Yes      |
| 1500000US450790106004           | 010600-4             | 76%                    |  | 385     | 505   |  | Canal      | Yes      |
| 1500000US450790107031           | 010703-1             | 71%                    |  | 705     | 995   |  | Canal      | Yes      |
| 1500000US450790107032           | 010703-2             | 45%                    |  | 255     | 570   |  | Canal      | Yes      |
| 1500000US450790107033           | 010703-3             | 66%                    |  | 485     | 735   |  | Canal      | Yes      |
| 1500000US450790107034           | 010703-4             | 43%                    |  | 345     | 800   |  | Canal      | Yes      |
| 1500000US450790108032           | 010803-2             | 71%                    |  | 615     | 865   |  | Canal      | Yes      |
| 1500000US450790108041           | 010804-1             | 64%                    |  | 885     | 1,380 |  | Canal      | Yes      |
| 1500000US450790108042           | 010804-2             | 51%                    |  | 495     | 970   |  | Canal      | Yes      |
| 1500000US450790109001           | 010900-1             | 57%                    |  | 355     | 625   |  | Canal      | Yes      |
| 1500000US450790109002           | 010900-2             | 96%                    |  | 2,150   | 2,235 |  | Canal      | Yes      |
| 1500000US450790110001           | 011000-1             | 67%                    |  | 530     | 790   |  | Canal      | Yes      |
| 1500000US450790110002           | 011000-2             | 68%                    |  | 660     | 965   |  | Canal      | Yes      |
| 1500000US450790111011           | 011101-1             | 27%                    |  | 325     | 1,205 |  | Canal      | Yes      |
| 1500000US450790111012           | 011101-2             | 48%                    |  | 385     | 800   |  | Canal      | Yes      |
| 1500000US450790111013           | 011101-3             | 51%                    |  | 700     | 1,360 |  | Canal      | Yes      |
| 1500000US450790112011           | 011201-1             | 27%                    |  | 335     | 1,250 |  | Canal      | Yes      |

| Geographic Identity             | Block Group Identity | HUD LOW/MOD Percentage |  | Low Mod | Total |  | WaterSer_1 | City_YoN |
|---------------------------------|----------------------|------------------------|--|---------|-------|--|------------|----------|
| <b>Canal Sewer Service Area</b> |                      |                        |  |         |       |  |            |          |
| 1500000US450790112012           | 011201-2             | 19%                    |  | 160     | 835   |  | Canal      | Yes      |
| 1500000US450790112021           | 011202-1             | 22%                    |  | 710     | 5,290 |  | Canal      | Yes      |
| 1500000US450790112022           | 011202-2             | 50%                    |  | 950     | 1,910 |  | Canal      | Yes      |
| 1500000US450790113013           | 011301-3             | 59%                    |  | 325     | 555   |  | Canal      | Yes      |
| 1500000US450790113014           | 011301-4             | 17%                    |  | 165     | 945   |  | Canal      | Yes      |
| 1500000US450790113015           | 011301-5             | 66%                    |  | 350     | 530   |  | Canal      | Yes      |
| 1500000US450790113016           | 011301-6             | 70%                    |  | 805     | 1,145 |  | Canal      | Yes      |
| 1500000US450790113017           | 011301-7             | 25%                    |  | 260     | 1,055 |  | Canal      | Yes      |
| 1500000US450790113051           | 011305-1             | 44%                    |  | 380     | 870   |  | Canal      | Yes      |
| 1500000US450790113052           | 011305-2             | 82%                    |  | 1,410   | 1,730 |  | Canal      | Yes      |
| 1500000US450790113053           | 011305-3             | 35%                    |  | 480     | 1,365 |  | Canal      | Yes      |
| 1500000US450790113054           | 011305-4             | 54%                    |  | 680     | 1,255 |  | Canal      | Yes      |
| 1500000US450790114071           | 011407-1             | 26%                    |  | 860     | 3,300 |  | Canal      | Yes      |
| 1500000US450790114121           | 011412-1             | 36%                    |  | 930     | 2,550 |  | Canal      | Yes      |
| 1500000US450790114122           | 011412-2             | 42%                    |  | 550     | 1,300 |  | Canal      | Yes      |
| 1500000US450790114131           | 011413-1             | 33%                    |  | 1,685   | 5,145 |  | Canal      | Yes      |
| 1500000US450790114132           | 011413-2             | 17%                    |  | 555     | 3,190 |  | Canal      | Yes      |
| 1500000US450790115011           | 011501-1             | 0%                     |  | 0       | 0     |  | Canal      | Yes      |
| 1500000US450790115012           | 011501-2             | 0%                     |  | 0       | 0     |  | Canal      | Yes      |
| 1500000US450790115013           | 011501-3             | 0%                     |  | 0       | 0     |  | Canal      | Yes      |
| 1500000US450790115014           | 011501-4             | 0%                     |  | 0       | 0     |  | Canal      | Yes      |
| 1500000US450790115021           | 011502-1             | 36%                    |  | 450     | 1,245 |  | Canal      | Yes      |
| 1500000US450790115022           | 011502-2             | 64%                    |  | 695     | 1,080 |  | Canal      | Yes      |
| 1500000US450790116031           | 011603-1             | 26%                    |  | 1,065   | 4,035 |  | Canal      | Yes      |
| 1500000US450790116032           | 011603-2             | 59%                    |  | 505     | 850   |  | Canal      | Yes      |
| 1500000US450790116041           | 011604-1             | 35%                    |  | 265     | 750   |  | Canal      | Yes      |
| 1500000US450790116042           | 011604-2             | 9%                     |  | 185     | 2,155 |  | Canal      | Yes      |
| 1500000US450790116043           | 011604-3             | 29%                    |  | 195     | 670   |  | Canal      | Yes      |
| 1500000US450790116044           | 011604-4             | 22%                    |  | 325     | 1,490 |  | Canal      | Yes      |
| 1500000US450790116061           | 011606-1             | 76%                    |  | 780     | 1,020 |  | Canal      | Yes      |
| 1500000US450790116062           | 011606-2             | 28%                    |  | 410     | 1,450 |  | Canal      | Yes      |
| 1500000US450790116064           | 011606-4             | 29%                    |  | 455     | 1,550 |  | Canal      | Yes      |

| Geographic Identity             | Block Group Identity | HUD LOW/MOD Percentage |  | Low Mod | Total   |  | WaterSer_1 | City_YoN |
|---------------------------------|----------------------|------------------------|--|---------|---------|--|------------|----------|
| <b>Canal Sewer Service Area</b> |                      |                        |  |         |         |  |            |          |
| 1500000US450790116071           | 011607-1             | 66%                    |  | 2,735   | 4,120   |  | Canal      | Yes      |
| 1500000US450790116081           | 011608-1             | 50%                    |  | 810     | 1,620   |  | Canal      | Yes      |
| 1500000US450790116082           | 011608-2             | 87%                    |  | 950     | 1,095   |  | Canal      | Yes      |
| 1500000US450790116083           | 011608-3             | 47%                    |  | 490     | 1,050   |  | Canal      | Yes      |
| 1500000US450790116084           | 011608-4             | 61%                    |  | 515     | 845     |  | Canal      | Yes      |
| 1500000US450790116085           | 011608-5             | 76%                    |  | 1,460   | 1,925   |  | Canal      | Yes      |
| 1500000US450790116086           | 011608-6             | 38%                    |  | 145     | 385     |  | Canal      | Yes      |
| 1500000US450790117011           | 011701-1             | 95%                    |  | 3,845   | 4,060   |  | Canal      | Yes      |
| 1500000US450790117012           | 011701-2             | 88%                    |  | 1,290   | 1,470   |  | Canal      | Yes      |
| 1500000US450790117021           | 011702-1             | 70%                    |  | 975     | 1,290   |  | Canal      | Yes      |
| 1500000US450790117022           | 011702-2             | 76%                    |  | 975     | 1,290   |  | Canal      | Yes      |
| 1500000US450790119011           | 011901-1             | 54%                    |  | 1,115   | 2,065   |  | Canal      | Yes      |
| 1500000US450790119012           | 011901-2             | 61%                    |  | 1,780   | 2,925   |  | Canal      | Yes      |
| 1500000US450790119021           | 011902-1             | 23%                    |  | 685     | 2,985   |  | Canal      | Yes      |
| 1500000US450799801001           | 980100-1             | 40%                    |  | 20      | 50      |  | Canal      | Yes      |
| City                            |                      | 53%                    |  | 84,570  | 159,430 |  |            |          |
| 1500000US450790108031           | 010803-1             | 58%                    |  | 440     | 760     |  | Canal      | No       |
| 1500000US450790108033           | 010803-3             | 68%                    |  | 585     | 855     |  | Canal      | No       |
| 1500000US450790111021           | 011102-1             | 52%                    |  | 980     | 1,890   |  | Canal      | No       |
| 1500000US450790111022           | 011102-2             | 24%                    |  | 190     | 800     |  | Canal      | No       |
| 1500000US450790111023           | 011102-3             | 15%                    |  | 195     | 1,345   |  | Canal      | No       |
| 1500000US450790113011           | 011301-1             | 24%                    |  | 140     | 580     |  | Canal      | No       |
| 1500000US450790113012           | 011301-2             | 25%                    |  | 195     | 765     |  | Canal      | No       |
| 1500000US450790113032           | 011303-2             | 38%                    |  | 300     | 795     |  | Canal      | No       |
| 1500000US450790113033           | 011303-3             | 69%                    |  | 1,790   | 2,610   |  | Canal      | No       |
| 1500000US450790113041           | 011304-1             | 73%                    |  | 740     | 1,015   |  | Canal      | No       |
| 1500000US450790113042           | 011304-2             | 24%                    |  | 240     | 995     |  | Canal      | No       |
| 1500000US450790113043           | 011304-3             | 48%                    |  | 840     | 1,750   |  | Canal      | No       |
| 1500000US450790113044           | 011304-4             | 63%                    |  | 1,065   | 1,690   |  | Canal      | No       |
| 1500000US450790114042           | 011404-2             | 24%                    |  | 620     | 2,550   |  | Canal      | No       |
| 1500000US450790114043           | 011404-3             | 63%                    |  | 760     | 1,210   |  | Canal      | No       |
| 1500000US450790114044           | 011404-4             | 34%                    |  | 275     | 820     |  | Canal      | No       |

| Geographic Identity             | Block Group Identity | HUD LOW/MOD Percentage |  | Low Mod | Total  |  | WaterSer_1 | City_YoN |
|---------------------------------|----------------------|------------------------|--|---------|--------|--|------------|----------|
| <b>Canal Sewer Service Area</b> |                      |                        |  |         |        |  |            |          |
| 1500000US450790114111           | 011411-1             | 32%                    |  | 670     | 2,075  |  | Canal      | No       |
| 1500000US450790114112           | 011411-2             | 17%                    |  | 100     | 590    |  | Canal      | No       |
| 1500000US450790114113           | 011411-3             | 21%                    |  | 180     | 870    |  | Canal      | No       |
| 1500000US450790114123           | 011412-3             | 31%                    |  | 200     | 650    |  | Canal      | No       |
| 1500000US450790116063           | 011606-3             | 32%                    |  | 360     | 1,120  |  | Canal      | No       |
| 1500000US450790118001           | 011800-1             | 60%                    |  | 1,000   | 1,670  |  | Canal      | No       |
| 1500000US450790118002           | 011800-2             | 43%                    |  | 540     | 1,260  |  | Canal      | No       |
| 1500000US450790118005           | 011800-5             | 69%                    |  | 635     | 915    |  | Canal      | No       |
| 1500000US450790119013           | 011901-3             | 21%                    |  | 320     | 1,495  |  | Canal      | No       |
| 1500000US450790119014           | 011901-4             | 16%                    |  | 360     | 2,190  |  | Canal      | No       |
| 1500000US450790119022           | 011902-2             | 42%                    |  | 315     | 755    |  | Canal      | No       |
| 1500000US450790119023           | 011902-3             | 48%                    |  | 415     | 865    |  | Canal      | No       |
| 1500000US450790120002           | 012000-2             | 39%                    |  | 340     | 880    |  | Canal      | No       |
| Outside City Limits             |                      | 41%                    |  | 14,790  | 35,765 |  |            |          |

## 8.3.2. Olympia Fire Station

| CDBGNAME         | COUNTYNAME       | TRACT  | BLKGRP | LOWMOD        | LOWMODUNIV    | LOWMODPCT     | MOE_LowmodPct | GEOID               |
|------------------|------------------|--------|--------|---------------|---------------|---------------|---------------|---------------------|
| Columbia         | Richland County  | 001600 | 1      | 90            | 405           | 22.22%        | +/-15.80      | 15000US450790016001 |
| Columbia         | Richland County  | 002602 | 1      | 835           | 1,910         | 43.72%        | +/-12.46      | 15000US450790026021 |
| Columbia         | Richland County  | 002602 | 2      | 590           | 880           | 67.05%        | +/-28.75      | 15000US450790026022 |
| Columbia         | Richland County  | 002700 | 1      | 380           | 475           | 80.00%        | +/-29.05      | 15000US450790027001 |
| Columbia         | Richland County  | 002700 | 2      | 305           | 1,000         | 30.50%        | +/-20.50      | 15000US450790027002 |
| Columbia         | Richland County  | 002700 | 3      | 640           | 1,395         | 45.88%        | +/-27.24      | 15000US450790027003 |
| Columbia         | Richland County  | 002700 | 4      | 195           | 230           | 84.78%        | +/-45.65      | 15000US450790027004 |
| Columbia         | Richland County  | 002900 | 1      | 65            | 200           | 32.50%        | +/-18.00      | 15000US450790029001 |
| Columbia         | Richland County  | 002900 | 2      | 470           | 665           | 70.68%        | +/-16.09      | 15000US450790029002 |
| Columbia         | Richland County  | 002900 | 3      | 0             | 0             | 0.00%         |               | 15000US450790029003 |
| Columbia         | Richland County  | 003000 | 2      | 640           | 700           | 91.43%        | +/-38.29      | 15000US450790030002 |
| Columbia         | Richland County  | 003000 | 3      | 460           | 785           | 58.60%        | +/-21.66      | 15000US450790030003 |
| Columbia         | Richland County  | 003100 | 2      | 190           | 345           | 55.07%        | +/-17.10      | 15000US450790031002 |
| Columbia         | Richland County  | 011701 | 2      | 1,290         | 1,470         | 87.76%        | +/-27.96      | 15000US450790117012 |
| Lexington County | Lexington County | 020100 | 2      | 285           | 330           | 86.36%        | +/-45.45      | 15000US450630201002 |
| Lexington County | Lexington County | 020201 | 1      | 1,010         | 1,410         | 71.63%        | +/-17.16      | 15000US450630202011 |
| Lexington County | Lexington County | 020300 | 1      | 1,065         | 1,665         | 63.96%        | +/-17.72      | 15000US450630203001 |
| Lexington County | Lexington County | 020509 | 2      | 355           | 1,000         | 35.50%        | +/-13.00      | 15000US450630205092 |
| Richland County  | Richland County  | 002800 | 1      | 1,960         | 2,270         | 86.34%        | +/-18.28      | 15000US450790028001 |
| Richland County  | Richland County  | 002800 | 2      | 1,110         | 1,325         | 83.77%        | +/-28.75      | 15000US450790028002 |
| Richland County  | Richland County  | 002800 | 3      | 420           | 445           | 94.38%        | +/-33.26      | 15000US450790028003 |
| <b>TOTAL</b>     |                  |        |        | <b>12,355</b> | <b>18,905</b> | <b>65.35%</b> |               |                     |

## 8.4 Maintenance and Operating Agreements

## 8.5 FEMA Letter Regarding Columbia Canal Head Gates and Lock Gate Repair

## 8.6 Projections for Expenditures and Performance Outcomes

## 8.7 CDBG-MIT Certifications

## 8.8 CDBG-MIT Action Plan Checklist

8.9 SF-424