

## Section 11.04 *Severe Storms and Precipitation*

### Overview

Storms bringing rain, snow, and wind are expected to increase in frequency and severity in the Piedmont Region of North Carolina as climate change accelerates.<sup>1</sup> Warmer air in the atmosphere holds more water, leading to more rain, wind, snow, or hail.<sup>2</sup> Large amounts of rain over a short period of time can lead to flooding, an increase in disease-carrying mosquitoes, water contamination, and mental health issues due to stress.<sup>3</sup> High winds topple trees and powerlines disrupting energy and transportation systems, leading to cascading impacts on the health and medical, energy, and transportation sectors.<sup>4</sup>

The NC Climate Science Report defines extreme precipitation events as days on which three inches or more precipitation falls over an area.<sup>5</sup> Rainfall can have a few separate extreme values including duration and intensity that are also significant. For example, flash floods can be dangerous even though the duration of the rainstorm is relatively short. At times, lower amounts of rainfall can fall on a smaller area in very short durations and create an extreme event. At other times, rain can fall continuously over an area for a long period of time. Both can accumulate water at the surface at a rate higher than what the ground can absorb. Vulnerability to these events is determined by several factors including the severity of weather events themselves, the built environment, and social and economic determinants of health such as income level, health insurance, and access to reliable transportation. Durham County is experiencing extreme precipitation events more frequently than historical averages and that trend is projected to increase in the next 30 to 80 years.<sup>6</sup>

Flooding causes the most adverse public health outcomes stemming from all extreme precipitation events that Durham might experience, which include fast, heavy downpours or prolonged periods of sustained rain. Human factors influence the severity of flooding including damage to or structural failures of dams and levees, altered drainage, and land-use patterns. Urban areas have a lot of impervious surfaces, which are surfaces that do not allow rainwater to soak into the ground, such as roads, pavement, parking lots, and buildings. This increases stormwater runoff and sometimes overflows storm drains. Infrastructure issues including clogged culverts, improperly graded asphalt, blocked drainage, and inadequate capacity of stormwater pipe systems also contribute to flooding.<sup>7</sup>

Flooding is currently ranked as the second most deadly weather-related hazard in the United States.<sup>8</sup> One hundred and eighty-one people died in North Carolina due to floods between 1959 and 2019, making it the state with the twelfth most flooding fatalities in the US.<sup>9</sup> Fifteen percent of those fatalities occurred between 2005-2019. The major hazards posed by flooding are the immediate threats to persons through fast-moving water and the debris carried in it. Flooding, especially flash flooding, can create emergency situations with very little warning. These events are especially dangerous to people in low-lying areas or areas with a large percentage of impervious surface.<sup>10</sup>

There are lingering health hazards posed by flooding that can be felt for hours, days, or weeks after the event. Flooded roadways present dangers for drivers who can misjudge the depth of the water or be swept into deeper water, leading to the vehicle being submerged, causing injuries and drowning deaths.<sup>11</sup> Water flooding or seeping into households, basements, and crawl spaces causes fungal or mold growth, which can make existing respiratory health problems worse. Additional issues include long-lasting power, infrastructure, and communications outages which can lead to

people having a lack of access to edible food and potable water or access to emergency services and relief. Excess standing water can provide more habitat for the water-dwelling larvae of insects like mosquitoes that can be disease vectors for serious illness including Zika, malaria, and West Nile fever, especially as warmer temperatures extend the range for those diseases.<sup>12</sup> The release of pesticides, animal waste, and hazardous chemicals into water sources can harm people and wildlife.

Flooding also impacts mental health. People who live in floodplains and fear the dangers presented by flooding or who have witnessed death or destruction during a prior flooding event can suffer from mental anguish, trauma, anxiety, and depression.<sup>13</sup> Mental health is an important component of health and the effects of living through, witnessing, or fearing a potentially life-threatening hazard because of where one lives can impact other determinants of health.

In addition to extreme precipitation, severe storms may lead to trees falling and power outages. Two people were killed by falling trees due to high winds in Durham between 2013-2023.<sup>14</sup> Extended power outages can have several public health impacts for sensitive groups including people dependent on electrically powered medical equipment or temperature-sensitive pharmaceuticals, those more sensitive to extreme heat or extreme cold, people susceptible to foodborne illness due loss of refrigeration for temperature-sensitive foods, and people who use combustion appliances in unventilated areas where carbon monoxide can concentrate.<sup>15</sup>

## Secondary Data

Durham is experiencing more extreme storms and precipitation events, including a 129% increase in heavy precipitation events in the period from 2005-2014 compared to 1950-1959.<sup>16</sup> Durham is the 36<sup>th</sup> highest ranking city in the U.S. for extreme precipitation events overall, and the city with the 12<sup>th</sup> largest increase in these events over that time.<sup>17</sup>

### Days with 1+ inch rain in 24-Hours in Durham County, NC 1950-2100

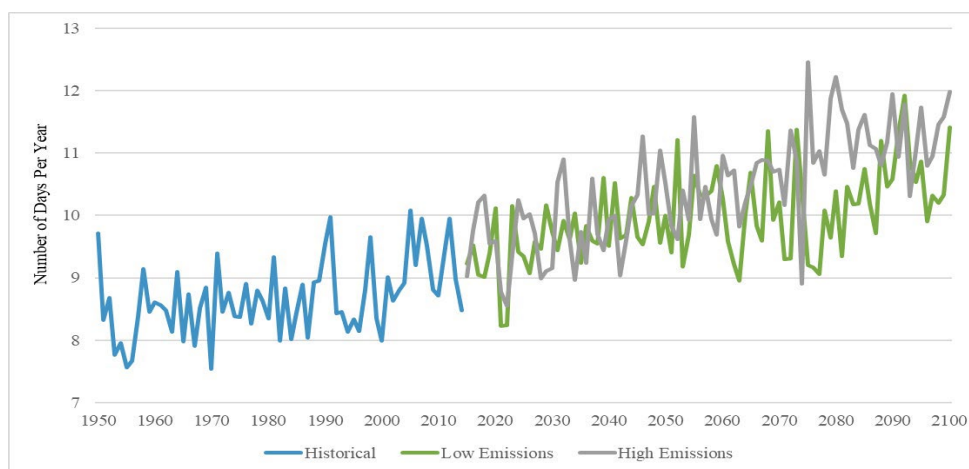


Figure 11.02(a) The number of days per year with 1" of precipitation or more over a 24-hour period for Durham County from 1950-2100.<sup>18,19</sup> The green and gray line show future projections based on scenarios in which humans reduce rates of greenhouse gas emission or continue to emit high levels of emissions, respectively.

Much of Durham County lies within floodplains or floodways and most census block groups are

ranked as “medium” or “high” risk for loss of access due to roads being either flooded or damaged during a high precipitation event.<sup>20</sup> The most affected areas were Braggtown, Southeast Durham, East Durham, Northeast Durham, and Southwestern Durham County. This affects public health by potentially making it harder for emergency responders to access the property and for residents to leave their homes to get food, supplies, and health care.

There are 112 dams in Durham County, of which 36 are listed as “High Hazard Dams” because a potential failure would likely cause loss of life and/or serious damage to structures and infrastructure.<sup>21</sup> Dam failures can cause flooding that is catastrophic and extremely hazardous downstream with fast-moving walls of water that can carry debris. The probability and severity of dam failure will increase with climate change.<sup>22</sup> Along with creating an immediate threat to human life, dam failures can also rapidly reduce or contaminate the potable drinking water supply in Durham County, creating a possible public health problem.<sup>23</sup>

### Interpretations: Disparities, Gaps, and Emerging Issues

Impacts of extreme storm events are not evenly distributed throughout Durham County geographically or demographically. Rainfall varies across the County and local differences in topography, impervious surface coverage and the condition of stormwater infrastructure affect the impact of rain. Typically, areas with more pervious surfaces such as farms, parks, or other areas with unpaved soil or vegetation can absorb water that might otherwise cause a flooding event.

Approximately two percent (7,282 people) of Durham County residents live within a FEMA-designated flood hazard area.<sup>24</sup> Elderly people and children are more at-risk during flooding due to mobility issues and not understanding the risk associated with flooding. People living in poverty have fewer resources to mitigate flood risk and recover from flood damage or pay for health care associated with flood impacts.

Historical systematic racism has resulted in higher vulnerability to extreme precipitation events for certain populations in Durham. Eight historically redlined neighborhoods, clustered in the areas directly South, Southeast, and East of Downtown Durham have more risk of extreme precipitation events with lower than average tree coverage and higher than average impervious surface than the rest of Durham.<sup>25</sup> As in many Southern cities, formerly enslaved people were forced to settle in low-lying lands that frequently flooded and where mosquitoes were present because it was less expensive and considered undesirable by white landowners.<sup>26</sup> These neighborhoods, still predominantly lived in by people of color also have among the highest levels of poverty in the County. The average of 40.91% for people living in poverty in the eight census tracts is about 22% higher than Durham County’s total average poverty level.<sup>27</sup> Along with being the most vulnerable to climate risk, the people living in these areas have the fewest resources available with which to combat the hazards from flooding or to recover after an event.

### Recommended Strategies

- Conduct regional mapping assessment of stormwater conveyances and assess capacity.
- Create and implement green stormwater infrastructure programs and fee credit programs for stormwater retention.
- Expand education efforts to include citizen/community science efforts around local flooding such as NOAA Community Collaborative Rain, Hail, and Snow Network <sup>28</sup>
- Maintain and preserve upstream and urban forestry canopy and vegetation amounts in

areas where this has been neglected, including and especially formerly redlined neighborhoods.

- Establish Resilience Hubs in areas with high percentages of vulnerable populations to build physical and social resilience to extreme precipitation and storms.
- Develop and set standards for canopy percentage per neighborhood and for urban forestry levels.

## Current Initiatives & Activities

### ***City of Durham Stormwater Services***

Provides services and public education to reduce the impacts of stormwater on people and the environment. <https://durhamnc.gov/692/Stormwater-GIS-Services>

### ***Flood Inundation Mapping and Alert Network***

Provides rain and stage gage data and flood alerts in real-time to support risk-based decisions. <https://fiman.nc.gov/>

### ***Durham County Stormwater and Erosion Control Division***

Provides services, enforces stormwater ordinances, and conducts public education on stormwater issues in the unincorporated areas of Durham County. <https://www.dconc.gov/county-departments/departments-a-e/engineering-and-environmental-services/stormwater-and-erosion-control-division>

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