Creating the West Virginia Flood Resilience Framework for comprehensive disaster response and long-term community recovery

Report of Research Findings

Rainelle, West Virginia on June 24, 2016

Image courtesy of Elevated Media

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Building Trails To A Bright Future

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Executive Summary

West Virginia communities are at high risk for flooding. The state is ranked nationally at or near the top of nearly every risk category, including flooding's potential impact on utilities, roads, fire and police stations, commercial properties, and schools. These risks are compounded by aging infrastructure and high levels of socioeconomic vulnerability. On June 23, 2016, one storm delivered nearly 10 inches of rain across West Virginia, or 25% of the state's mean annual rainfall, in less than 24 hours. The resulting flood killed 23 people, destroyed or damaged thousands of homes and businesses, and caused $1 billion in damage.

The objective of this research project was to document lessons learned from the 2016 flood in Greenbrier County to determine *gaps in organizational capacity, cross-organization coordination, and flood risk knowledge that need to be filled for more comprehensive flood response and long-term flood recovery in West Virginia*. The project was funded by a Stage 1 grant from the National Science Foundation Civic Innovation Challenge (CIVIC) program and was a collaboration between civic actors and researchers from West Virginia University (WVU). Activities included a county-wide survey (1,168 respondents), seven focus groups (42 participants), and participatory GIS (PGIS) methods to understand flood risk. If awarded a Stage 2 grant, the project will expand statewide to create the West Virginia Flood Resilience Framework (WVFRF), an online resource containing materials to support residents, local leaders, non-profits, and state officials in efforts to increase flood resilience for West Virginia.

County-level findings show:
(1) Greenbrier County residents are significantly impacted by floods, have struggled to fully recover from past floods, and are not adequately prepared for future floods;
(2) There is a lack of accessible resources to support pre-disaster organizational coordination of disaster response;
(3) There is a need for increased capacity building and training related to floodplain management, the National Flood Insurance Program (NFIP), and the Community Rating System (CRS) at community, county, and state levels; and,
(4) Residents, leaders, and organizations responsible for flood response and recovery require increased knowledge about community flood risk.

The project also had specific findings for Rainelle and White Sulphur Springs, which are detailed in the final section of the report. Both towns are highly vulnerable to riverine flooding, but they had different socioeconomic contexts before the 2016 flood. Rainelle has experienced decades of socioeconomic decline while the economy of White Sulphur Springs has been buoyed by The Greenbrier Resort and strong developer investment. As a result, White Sulphur Springs is further along in recovery than Rainelle.

The remainder of this report details findings from each of the research activities and offers recommendations based on those findings (Table 1, Page 3). The full set of results can be found in the appendix, available online at the link provided on the back page of this report.

Project Recommendations

Table 1: Project recommendations for building flood resilience in Greenbrier County

Recommendation	Level of Focus	Key Stakeholders
Educate individuals and communities on their flood risk, including training for realtors & high impact area residents	Household/ Community	Floodplain Managers, Emergency Management, City/County Government
Educate individuals and communities on updated FEMA floodplain maps, their vulnerabilities, the National Flood Insurance Program (NFIP) and participation in Community Rating System (CRS)	Household/ Community/ County	Floodplain Managers, Emergency Management, City/County/State Government
Confirm shelters are safely out of the floodplain and relocate if needed	Community	Floodplain Managers, Emergency Management, City/County Governments
Create plan for long-term relocation of key facilities (e.g., police and fire stations, schools, town halls) out of floodplain	Community	Region 4 Planning and Development Council, Floodplain Managers, Emergency Management, City Government
Engage in long-term planning for Open Space Preservation (OSP) for flood mitigation	Community	Floodplain Managers, City Government
Create plans for disaster response management, including communications, community asset mapping, volunteer coordination, and provision of mental health care	Community/ County	Community Leadership, Floodplain Managers, Emergency Management, City/County Government
Create early warning systems for disaster events	Community/ County	Floodplain Managers, Emergency Management, City Government
Increase proactive floodplain mitigation, management, and permitting with integration of efforts from local to state levels	Community/ County/ State	Community Members, Floodplain Managers, Emergency Management, City/County/State Government
Increase training and funding for disaster recovery case managers at local and state levels	Community/ State	WV VOAD, WV Ready, State Government
Train substantial damage assessment and recovery teams so they are disaster ready	Community/ State	WV VOAD, Americorps, Emergency Management, City Governments, WV Emergency Management
Increase funding for mitigation (including nature-based solutions)	State	WV Emergency Management, State Government

Survey Findings

Over six years after the 2016 flood, a survey of Greenbrier County residents on flood impacts and preparation was conducted in December 2022 - January 2023, with 1,168 responses.

- The age range of participants was 18-82, with an average age of 27.5.
- Annual household income ranged from less than $20,000 (5%) to over $100,000 (16%).
- A total of 56% identified as female and 43% as male, with 80% identifying as white, 11% as Black or African American, and 6% as Asian.
- The average number of adults in households was 2.73, with .84 children.
- Approximately 75% were employed full time and 15% were employed part time.
- Nearly 70% had education after high school, from trade school to advanced degrees.

Survey results indicate that the 2016 flood had widespread impacts on communities and households in Greenbrier County.

- Nearly all survey respondents (98%) reported that their community was impacted by the 2016 flood, with 76% of these reporting that their primary residence was either damaged (55%) or destroyed (44%).
- Of these, 87% reported being able to stay in their home despite damage, while some left their home for a short period of time (9%) and a few left permanently (3%).
- When people were forced to leave their home, they found a wide range of temporary housing alternatives, ranging from staying in hotels (31%) to shelters (30%) to staying with friends and family (35%) to combinations of these or other alternatives.

Results show that Greenbrier County residents were not fully prepared for the 2016 flood.

- Of those whose homes were impacted, 36% did not think they were vulnerable to flooding prior to the 2016 event, 35% thought they were somewhat vulnerable, and 27% thought they were very vulnerable.
- However, 83% knew if their home was located in the floodplain (defined as any land area which is at risk of experiencing flooding).

The survey reveals that recovery from the 2016 flood remains incomplete.

- When asked about the recovery level of their community as a whole, only 19% of respondents felt there had been a full recovery, while 74% reported partial recovery.
- A full 92% of respondents received some kind of assistance for flood recovery, ranging from assistance with cleaning to fully rebuilt homes, but only 52% of respondents reported being fully recovered, with another 47% reporting partial recovery.
- Respondents received help from a combination of sources, including: FEMA, the West Virginia National Guard, Red Cross, WV VOAD, Greater Greenbrier Long Term Recovery, Faith Based Organizations, and other groups.
- When asked how satisfied they were with the recovery process, 27% were very satisfied, 34% were somewhat satisfied, 34% were neither satisfied nor dissatisfied, and 4% were somewhat or very dissatisfied.

The survey also shows that the flood had widespread impacts on people's level of employment in the aftermath of the flood, including the need to take time off to repair damaged homes. In some cases, such as for those involved in social work, employment demands increased after the flood.

- When asked how the flood impacted employment, only 9% reported no impact, while 43% reported working longer hours and 42% reported working fewer hours.
- When asked if their place of employment was damaged by the flood, 28% reported no damage, 40% reported some extent of damage, and 31% reported damage severe enough to necessitate either moving to a new location to perform duties (16%) or stopping work entirely for a period of time (15%).
- As a result of these disruptions, 30% of respondents whose jobs were impacted by the flood experienced a reduction in income for one month or less, while 32% reported a reduction in income for more than one month.

The flood also took an emotional toll on Greenbrier County residents.

- When asked if the experience of the 2016 flood caused emotional or mental health impacts (diagnosed by a medical professional or not), only 27% reported no impact.
- The remaining 73% reported a combination of impacts, including new or increased levels of anxiety, depression, and fear of large storms resulting in another flood.
- Over half (54%) of people received support for these impacts, including from family and friends (27%) or mental health professionals (23%). An additional 23% reported wanting but not receiving mental health care.

Survey responses indicate a wide range of perceptions on how prepared individuals and communities are for future flooding events.

- When asked if their home is currently in a floodplain, nearly half (48%) reported no, a quarter (26%) reported yes, and another quarter (26%) were unsure.
- When asked if they were concerned that their primary residence will experience a major flood in the next ten years, 32% reported that they were a little concerned, with similar numbers reporting that they are somewhat concerned (31%) or very concerned (30%). Only 8% reported no concern at all. Responses were similar when asked about their level of concern about a major flood in the next 30 years.
- When asked how prepared they are for a future flood, 30% reported being a little prepared, 35% reported being somewhat prepared, 23% reported being very prepared, with 12% reporting no preparation at all.
- When asked how prepared their community is for a future flood, 34% reported they are a little prepared, 37% reported they are somewhat prepared, and 24% reported they are very prepared, with 6% reporting no preparation at all.
- When asked if they have flood insurance for their homes, 47% reported having no flood insurance, 21% reported having mandated flood insurance, 26% reported voluntarily purchasing flood insurance, and 6% were unsure if they had it.

The final three questions of the survey were open-ended and asked respondents what would help their households and communities better prepare for a future flood, and what the barriers are to those preparations. Around 200 people submitted responses to these questions which were then coded into categories. Full results are included in the appendix.

To the question, "Briefly describe anything that you think would help your household be more prepared for a future flood," there were a variety of responses which were coded into 17 categories.

- The most responses were in the categories of *individual property/home mitigation* and *individual/household emergency preparation kit/materials* with 41 responses each.
- *Generator and emergency tools/sump pumps* and *community mitigation* were the next most used categories with 20 and 19 responses respectively.
- Finally, 14 responses were tied to *emergency/evacuation plans in case of flood including escape routes*, with *community warning and alarm systems,* and *moving out of the floodplain*, with ten responses each.

To the question, "Briefly describe any barriers to implementing additional preparations for a future flood," there were 143 responses which were coded into 28 separate categories. A large majority of responses to this question (62) were related to *cost/funding/money,* with the next two most popular responses (8 each) being *community mitigation* and *infrastructure*.

To the question, "Briefly describe anything that you think would help your community be more prepared for a future flood," responses were coded into 22 categories.

- Most responses (75) were coded as *community mitigation*, followed by *community warning and alarm systems* (23), and *community flood plan* (21).
- Other categories included *funding* (7), *shelters with adequate supplies* (11), *individual/family flood planning, preparation, and awareness* (12), *community/property owner education* (11), *and individual property/home mitigation* (6).

Responses to the open-ended survey questions indicate that respondents feel that the most critical factors to building resilience against future flooding at the individual and community levels are funding, mitigation and emergency planning.

Taking all survey responses into consideration, three broad conclusions stand out. First, the response rate of this survey was high, with 1,168 valid responses out of a county population of about 32,000 (or, about 4% of the county population). This indicates a great deal of community interest in the ongoing impact of the floods of 2016. Second, many residents and communities were not fully prepared for the flood, and there were varying levels of disruption to living situations, physical and emotional health, and employment, as well as varying levels of recovery support from actors at local, state, and federal levels. As a result, respondents report varying and uneven levels of recovery. Tellingly, 92% of respondents report receiving some kind of assistance but only 52% report full recovery, over six years after the flood.

Focus Group Findings

Figure 1: Focus group meeting in Rainelle, WV, discussing lessons learned from 2016 flood and priorities for building resilience.

Three in-person community focus groups were held in Rainelle and White Sulphur Springs in November 20022 (26 participants) and four virtual focus groups were held in January 2023 with key informants from across the region (16 participants). Community focus group participants included floodplain managers, former and current mayors, city council members, emergency first responders, healthcare professionals, VOAD case workers, and impacted residents. Virtual focus group participants included representatives from FEMA, Legal Aid of WV, WV and Greenbrier County office of Homeland Security and Emergency Management, WV Pets in Disaster Task Force, AmeriCorps, Volunteer West Virginia's Disaster Services, Appalachia Service Project, Catholic Charities, Southern Baptist Disaster Relief, and Presbyterian Disaster Assistance. Community and virtual focus group discussions were the first cross-organizational documentation of lessons learned from the 2016 flood response and recovery efforts, with a focus on how lessons learned shaped participants' priorities for building community resilience to future floods. At each focus group, participants were also asked for feedback on the flood visualization tools being created by the WV GIS Tech Center.

Figure 2: Focus group meeting in Rainelle, WV, where the public provided feedback on a community mitigation map.

Two primary themes arose during the focus groups: 1) The need for pre-disaster preparation (e.g., coordinating with FEMA and other organizations, community asset mapping, establishing clear communication channels and leadership roles, and volunteer coordination) and 2) The need for additional pre-disaster capacity building (e.g., hiring and training floodplain managers, providing accurate flood insurance information to residents, and creating improved flood risk assessment tools). In addition, virtual focus group participants discussed issues of equitable access to assistance, including for disabled residents, those with low literacy rates, and the ability of low-income households to access flood insurance. Focus group findings are summarized in Table 2, alongside representative quotes from participants.

Table 2: Summary of Focus Group Findings

Lesson learned from 2016 flood	**Representative quote from focus group participant**
Engage in pre-disaster community preparation	*The thing that I would say is that number one, preparedness actually pays off.*
Learn to navigate FEMA and other organizations before disaster	*I would say the biggest thing that I could pass on to anyone else… is to learn in advance as much as you can about dealing with FEMA and the other organizations.*
Engage in pre-disaster community capacity and asset mapping	*Understanding where in your community that capacity is …. folks with resources, that's the kind of thing I think that really helps build resilience.*
Establish clear communication channels & leadership roles	*We were building relationships pretty much from scratch, which is definitely not the way to do it… partnerships didn't exist, networks didn't exist, playbooks didn't exist*
Conduct pre-disaster volunteer coordination and training	*You're going to have people coming out of the woodwork and without a clear coordination plan… you're going to have growing pains*.
Hire and train floodplain managers	*Today's the first time I've heard the word floodplain manager.*
Provide flood insurance information to residents and realtors	*So that should be a lesson learned- always push flood insurance… that solves a whole world of issues.*

Participatory Geographic Information Science (GIS) Findings

Flood Risk

Flood Hazard

In White Sulphur Springs, the effective 1%-annual-chance flood zone area also known as Special Flood Hazard Area (SFHA) is 266 acres, which is 21.9% of the community area, while in Rainelle it is 223 acres which represents 31.1% of the community area. These percentages are higher than the median ratio for all incorporated areas in the state (10.2%). Rainelle is potentially more exposed to higher flood depths, while in White Sulphur Springs, the primary concern lies in the considerable threat posed by flood velocity. The community area of Rainelle is more vulnerable to frequent smaller floods, such as 10%-annual chance (10-year) events, as well as less frequent but larger floods like the 2016 flood. That event was between a 1%-annual chance (100-yr) and 0.2% chance (500-yr) flood event. The 2016 flood high-water marks in Rainelle show an elevation of 2,396 feet while the new 2023 flood profiles of a FEMA restudy indicate a base flood elevation (BFE) for a 100-year event is 2,393 feet in a large part of the town; this increases significantly to 2,399 feet for a 500-year event. It can be inferred that the 2016 flood in Rainelle surpassed the severity of a 100-year (1%) event but fell short of the magnitude associated with a 500-year flood (0.2%) and was not a 1000-year flood (0.1%) as erroneously publicized in the news media. In White Sulphur Springs, the new FEMA flood study reveals that the major 2016 flood exhibited similarities to a 500-year event.

New FEMA maps become effective on July 5, 2023, and reveal that both communities will have a significant amount of structures mapped into the SFHA to include the floodway or main stream channel where the highest flood depths and velocities occur. Of all the 213 flood-prone incorporated places in the state, White Sulphur Springs (n=105) and Rainelle (n=47) are ranked 6th and 18th, respectively, for buildings in the floodway. Structures located in the floodway are subject to stricter engineering development standards and should be a priority for mitigation efforts. Moreover, the town of Rainelle will have a significant SFHA increase due to the inaccurate effective floodplain maps currently in use, which date back to 2012 and depict a much narrower floodplain than the updated maps.

Exposure

Physical Exposure: As mentioned previously, the new FEMA flood maps show that both Rainelle and White Sulphur Springs have a high level of physical exposure of primary structures in the high-risk floodplains. The ratio of buildings in the floodplain to the total structures within the community is significantly higher for both areas compared to the state ratio. The median building replacement cost in the floodplain of White Sulphur Springs is higher than the statewide value, while it is lower in Rainelle. The majority of buildings in high-risk floodplains are residential; however, in Rainelle, the ratio of non-residential structures is higher than the statewide ratio indicating higher risk of business interruption by flooding. In both communities, more than 75% of the flood-prone structures were constructed before the initial FEMA Flood Insurance Rate Map (FIRM) and local floodplain development standards

were established; consequently, these older buildings are likely more susceptible to damage and should be targeted for mitigation.

Two essential facilities were identified in the high-risk (100-year) floodplain of White Sulphur Springs, the White Sulphur Elementary School and the White Sulphur Springs Police Department. However, the school will no longer be within the floodplain when the new Flood Insurance Rate Map (FIRM) becomes effective. In Rainelle, there are two essential facilities located in the high- and moderate- risk flood zones. These structures are the Rainelle Volunteer Fire Department in the 100-year floodplain and the co-located Town Hall and Rainelle Police Department in the 500-year flood zone. The location of these structures within the floodplains can lead to significant operational challenges during flooding events as well as the loss of critical governmental records and services.

In White Sulphur Springs, eight non-historical community assets were identified within the high-risk floodplain, including four churches, the city hall, the municipal court, a United States Postal Service (USPS) office, and the White Sulphur Springs National Fish Hatchery which was appraised at $425K. In Rainelle, there are six community assets in the high-risk flood zone including four churches, the Rainelle Public Library, and the Municipal Water Department. Among these, the Church of God has the highest dollar value of $435K.

Findings also reveal that a considerable portion of the road network including U.S. 60 in both towns are at risk of inundation at flood depth of 1 foot or higher. Three bridges within White Sulphur Springs and two in Rainelle are identified as being subject to inundation by flooding events. The bridges can obstruct flow and increase the risk of flooding by causing backwater flooding. In addition, an engineering flood study for Rainelle reveals that during large floods the built-up environment of the town is affected by backwater flooding where the Sewell Creek enters the larger Meadow River, which can increase the water surface flood elevation by up to six feet upstream of the confluence of these two water bodies.

Human Exposure: A significant portion of the population resides in the floodplains with a 1%-annual-chance of flooding in both communities. In White Sulphur Springs, 1026 individuals are estimated to live in the high-risk area representing 39% of the city's total population. In Rainelle, the estimated population residing in the floodplain is 582 accounting for 43% of the total population. This percentage is significantly higher than the statewide percentage of 10% for all incorporated areas.

Table 3: Building and parcel-level exposure in White Sulphur Springs (WSS) and Rainelle

Physical Exposure Indicators	WSS	Rainelle	Statistics in All WV Incorporated Areas [1]
Total Primary Building Count in Floodplain	425 (Rank [2]: 12th)	338 (Rank: 18th)	59 (Median)
Building Ratio b/w Floodplain & Community Total	26%	34%	9%
Building Count in Floodway [3] (High Velocity & Depth)	105 (Rank: 6th)	47 (Rank: 18th)	12 (Average)
Percent of SFHA Buildings in Floodway	25%	14%	8%
Total Primary Building Value in Floodplain	$41.02M (Rank: 16th)	$16.89M	$6.42M (Median)
Median Building Value in Floodplain	$49K	$38K	$42K
Percent Count Residential Building in Floodplain	88%	74%	81%
Percent Count Non-Residential Bldgs. in Floodplain	12%	26%	19%
% Pre-FIRM Structures (includes "unknown")	88% Before 1978	77% Before 1987	77%
New Maps: Bldgs. "Mapped In" SFHA	75 (Rank: 11th)	325 (Rank: 3rd)	19 (Average)
New Maps: Bldgs. "Mapped In" Floodway	14	38	97
Number of Essential Facilities in the Moderate Risk 0.2%-Annual-Chance Floodplain	2	2	2 (Average)
Number of Community Assets (Non-Historical) in the High-Risk 1%-Annual-Chance Floodplain	8	7	3
Transportation: Road Inundation of 1 ft or higher (% of Total Road Network Mileage)	23%	36%	N/A
Transportation: Inundated Bridges	3	2	N/A

[1] For numbers, used median, or average where the median was too low, of the state's 213 incorporated areas.
[2] Ranks based on the BLRA data of April 2022 where the community is in he top 20 incorporated areas in WV.
[3] Based on the new floodway maps of 2023.
The red numbers show a large difference, to the risk side, from the state ratios.

Vulnerability

Social and Institutional Vulnerability: The Community Rating System (CRS) is a voluntary program designed to recognize and promote community floodplain management practices that go beyond the minimum standards required for the National Flood Insurance Program (NFIP). Since Rainelle and White Sulphur Springs are not yet part of the CRS, they may face higher institutional vulnerability compared to communities that participate in this program. This study identified several social vulnerability indicators for the two communities, as summarized in Table 2. Note that both communities have a higher average of renter-occupied properties in which the structures and residents are more susceptible to flood loss.

Table 4: Community analysis of social vulnerability in White Sulphur Springs (WSS) and Rainelle based on the Census Bureau's 2019 American Community Survey (ACS) 5-year Estimates

Social Vulnerability Indicators	WSS	Rainelle	State Ratio	National Ratio
Poverty Rate	14.4%	37.0%	17.3%	12.9%
Unemployment Rate	21.4%	33.6%	23.8%	14.7%
Vulnerable Ages Ratio	41.7%	39.8%	30.8%	28.3%
Disability Ratio	17.8%	26.9%	18.7%	13.0%
Population Growth Ratio	-9.1%	-20.9%	-3.2%	7.4%
Renter-Occupied Ratio	42.8%	43.0%	26.8%	36.0%
Housing Values Less than $50K Housing Median Value	3.9% $125,700	37.5% $59,400	16.9% $119,600	6.6% $229,800

Physical Vulnerability: Primary structures located in flood zones that have subgrade basements are more vulnerable to flooding. In comparison to the statewide ratio for all incorporated areas, both communities have a lower percentage of these structures. However, White Sulphur Springs has a much higher ratio than Rainelle. One-story buildings are more vulnerable to flooding compared to multi-story structures because if the flood water exceeds the first floor, the percentage of building damage will be higher and trapped occupants cannot escape to a higher floor level. The ratio of one-story residential buildings is higher than the statewide percentage. Rainelle has a much higher ratio of red tag structures (dilapidated, vacant, or low-value buildings with appraised values equal to or less than $10,000) in the floodplain, which means this town may be more vulnerable in terms of building quality and the cost effectiveness of mitigation low-valued buildings.

Table 5: Highlights from physical vulnerability analysis in White Sulphur Springs and Rainelle

Physical Vulnerability Indicators	White Sulphur Springs	Rainelle	Statistics in All WV Incorporated Areas
Primary Buildings with Basements in Floodplain	93	27	37%
Percent Count Buildings with Basements in Floodplain	22%	8%	
One-Story Residential Buildings in Floodplain	336	292	69%
Percent Count One-Story Residential Buildings in Floodplain	79%	86%	
Low Valued (Red Tag) Structures [1]	20	56	6 (Median)
Percent Low Valued (Red Tag) Structures	5%	17%	4% (Median) [2]

[1] Structures with the appraised values of equal to or less than $10K
[2] For this ratio, the incorporated communities with more than 50 buildings in the high-risk flood zones were considered.
The red numbers show a large difference, to the risk side, from the state ratios.

Flood Loss Estimates

Physical Loss: Field surveys of the 2016 flood and building-level loss models show that a significant number of structures will be substantially damaged at greater than 50% for larger floods where flooding exceeds the 100-year base flood elevations. Field damage assessments led by FEMA Region 3 after the 2016 flood between August 1 and August 9 identified 87 designated structures in White Sulphur Springs as substantially damaged. However, FEMA's Hazus flood loss models estimate fewer substantial damaged structures for a similar flood size, which does not factor in the higher flow velocities in and near the flood source, overestimated first-floor heights, and underestimated building replacement values.

For Rainelle, this is supported by building damage loss models at the major 0.2%-chance (500-yr) flood level like the 2016 flood size that reveal high substantial damage estimates for 126 structures. Both building loss estimates and high-water marks indicate that the building damage percentages are considerable for both communities but are estimated to be more in Rainelle due to the high inundation levels, longer flood duration, and wider flooding extent of the town's structures. Lastly, the large amount of debris generated from major storms like the 2016 flood correlates from the high damage percentage of structures.

Both communities have higher amounts of the paid losses compared to the state mean because of an increase in the number of claims from the 2016 flood disaster. Moreover, Rainelle has a higher number of repetitive loss structures. In contrast, White Sulphur Springs has only two repetitive loss structures. Although the total number and value of structures in the high-risk floodplains of Rainelle is lower than White Sulphur Springs, the estimated debris, number and amount of previous paid losses, and the number of repetitive loss structures is higher in this town and indicative of repeated flooding events.

Table 6: Highlights from physical loss estimates in White Sulphur Springs (WSS) and Rainelle

Physical Loss Indicators	WSS	Rainelle	Statistics in All WV Incorporated Areas
Substantial Damage (>50%) Estimates	0	1	7 (Average)
Percent Substantial Damage Estimates	0%	0%	6% (Average)
Substantial Damage by 2016 Flood	87	N/A	N/A
Moderate Damage (10-50%) Estimates	78	106	47 (Average)
Percent Moderate Damage Estimates	18%	31%	34% (Average)
Moderate Damage by 2016 Flood	98	N/A	N/A
Building Debris Removal Estimates	450 ton	809 ton	165 ton (Median)
Number of Previous Paid Losses	89	152 (Rank: 20th)	63 (Average)
Dollar Amount of Previous Insurance Claims	$2,975K (Rank: 15th)	$3,720K (Rank: 10th)	$845K (Average)
Number of Repetitive Loss Structures	2	23	3 (Median)

Table 7: Modeled human loss indicators in White Sulphur Springs and Rainelle

Human Loss Indicator	White Sulphur Springs	Rainelle	Average in All WV Incorporated Areas
Estimated Displaced Population	462 (Rank: 17th)	487 (Rank: 16th)	173
Percent of Population Displaced	17%	36%	13%
Estimated Population in Need of Short-Term Shelter	104 (Rank: 18th)	123 (Rank: 14th)	37

Human Displacement: In both communities, the ratio of estimated population displaced due to flood inundation of one foot or higher caused by a 1%-annual-chance (100-year) flood event is much higher than the state average for all incorporated areas. Moreover, the estimated number of individuals in need of shelter in case of a 1%-annual-chance flood is also greater than the state average.

Flood Mitigation

Public assistance federal dollars to help communities recover from the 2016 flood and build resilience against future floods include: FEMA's individual assistance (more than $42 million), FEMA's public assistance program (more than $415 million), FEMA's Hazard Mitigation Grant Program (HMGP) project ($32 million), Community Development Block Grants ($256 million), and U.S. Small Business Administration low-interest loans (more than $53 million)[1]. Mitigation is a wise investment; the National Institute of Building Sciences found that natural hazard mitigation saves an average of $6 for every $1 spent on federal mitigation grants[2].

Mitigated measures implemented since the 2016 flood by the community were field verified and evaluated in accordance with the local floodplain management regulations. Field verification of both communities show that for most mitigation reconstruction projects, the new structures were built to the proper design flood elevations. However, field surveys show that substantially damaged residential structures were often repaired but not elevated above the base flood elevation, and thus are in violation of FEMA's 50% Rule, which prohibits improvements to a structure exceeding 50% of its market value unless the entire structure is brought into compliance with current flood regulations.

The percentage of elevated structures in the high-risk floodplain built to the Design Flood Elevation (DFE) set by the local floodplain management ordinance, or a two-foot safety factor above the base flood elevation, is lower in Rainelle (35%) than White Sulphur Springs (59%) since the town of Rainelle is more exposed to higher flood depths. Therefore, for mitigation and flood reduction efforts, 65% of the structures in Rainelle and 41% of the structures in White Sulphur Springs should be elevated above the base flood elevation.

To measure a community's recovery and resiliency to future floods, the net cumulative tax assessment of floodplain building values pre- and post-disaster, along with loss avoidance studies of elevated structures and property buyouts, were calculated. The net cumulative tax assessment reveals that for the cumulative building values in the high-risk floodplain, the total floodplain building value in White Sulphur Springs has fully recovered and exceeded pre-disaster levels, while Rainelle has only partially recovered. Of the cumulative building values in the floodplain between 2015-2022, pre-disaster the values were $13.3 million and

[1] https://www.fema.gov/press-release/20210623/milestones-mark-west-virginias-road-recovery-five-years-after-2016-disaster

[2] https://www.fema.gov/sites/default/files/2020-07/fema_mitsaves-factsheet_2018.pdf

$23 million for Rainelle and White Sulphur Springs, respectively, and 2017 post-flood decreased significantly to $5.0 million for Rainelle and $13.4 million for White Sulphur Springs. After mitigation efforts by 2022 the cumulative building values in the floodplain for Rainelle and White Sulphur Springs increased to $12.3 million and $26.2 million, respectively.

Table 8: Highlights from the studied mitigation indicators in White Sulphur Springs and Rainelle

Mitigation Indicator	White Sulphur Springs	Rainelle
Elevated Structures to Design Flood Elevation (DFE)	217	87
Percent Residential Structures in 100-year floodplain elevated to Design Flood Elevation (DFE)	59%	35%
Rehabilitated/Repaired Structures	394	278
Unmitigated Low Value Structures	14	47
Area of Open Space Preservation (OSP)	5 Acres	3 Acres
Ratio of Open Space Preservation (OSP to SFHA)	2.6%	4.5%

A Loss Avoidance Study performed by West Virginia University also revealed mitigation measures from elevating buildings above the base flood and buyouts resulted in a damage loss avoidance amount of $2.3 million for Rainelle and $2.6 million for White Sulphur Springs. Loss Avoidance Studies (LAS) quantify the losses avoided (also known as damage prevented or benefits) due to the implementation of the projects. The loss avoidance resulting from the elevation or removal of structures was calculated by determining the difference between loss estimates for buildings with a first-floor height of 1 ft (not elevated) and of a scenario in which those are elevated to Design Flood Elevation (DFE) (2 ft above Base Flood Elevation) or removed entirely. Our Loss Avoidance Study indicates that in addition, the number of unmitigated low valued structures is relatively high in Rainelle; while in White Sulphur Springs, the ratio of open space preservation (OSP) is lower than the average ratio for all incorporated areas statewide (5%), which indicates limited use of this mitigation strategy.

Areas of Mitigation Interest (AoMI) were mapped for both communities into three priority zones. The highest priority zone of mitigation is the floodway where the focus should be on removing structures and converting to open space as well as restoring the floodplain to its natural state. A moderate zone of mitigation is identified by the FEMA 10-year flood depth and 500-year depth that exceed 8-feet and 5-feet flood levels for Rainelle and White Sulphur Springs, respectively. The lower priority mitigation zone is defined by FEMA's 500-yr flood depth and the First Street Foundation's 5-yr climate model for the year 2052. Other factors for

targeting flood reduction measures are 2016 high-water marks greater than 5 feet, substantially damaged structures from 100-yr and 500-yr field and model assessments, repetitive loss areas, and mitigated properties (elevated structures, buyout properties, other preserved open space parcels).

Building Resilience: Flood Insurance, Risk Communication, and Pre-Disaster Planning

One way for building owners to offset the cost of flood damage is to invest in flood insurance, which can help their financial risk and allow homeowners and businesses to protect themselves and recover more quickly after a flood. After the 2016 disaster, households sought financial assistance through flood insurance claims or FEMA's Individual Assistance program. People who filed flood insurance claims received an average of $48,000 per claim. People without flood insurance received only $7,500 in individual assistance for property repairs. While Individual Assistance can help people begin disaster recovery, flood insurance can support families to recover more completely.

The FEMA's Flood Insurance Data and Analytics of 2023 shows 67 policies in force in White Sulphur Springs, which represents about only 16% of the primary structures in the high-risk floodplain[3]. For Rainelle, the data indicate 36 policies in force which is about 11% of the at-risk primary buildings. Communities should promote flood insurance to increase adoption rates to the national average of 30% via outreach activities (e.g., radio broadcasts, social media, mailings, and county fairs). In addition, they can engage the State NFIP and FEMA Region III (insurance specialists) with media requests.

Nobody is exempt from flood risk; where it can rain it can flood. While the purchase of flood insurance is not required for structures outside of the Special Flood Hazard Area (SFHA), it is strongly recommended. According to the FEMA's report of the 2016 flood in West Virginia[4], approximately 23% of the insurance claims related to that event were outside the SFHA. In such cases, owners must apply for FEMA's Individual Assistance (IA) program which provides a small amount of grant funding to disaster survivors who do not have flood insurance.

Risk communication is also key. Although West Virginia lacks flood disclosure laws, flood risk information is disclosed on web applications like the WV Flood Tool (www.mapwv.gov/flood), as well as on national sites like Realtor.com, which discloses information about a home's flood risk and how risk might increase in the future. This is especially important in relation to the new flood maps for Greenbrier County which will become effective July 5, 2023. These maps use more accurate topographic, engineering, and flood modeling data. For both communities, more structures have been mapped into the Regulatory Floodway where high flood depths and velocities occur during a flood event. These areas should be priority mitigation areas and both communities and homeowners should be informed of the changes in flood maps, including through outreach letters and other risk communications.

[3] https://nfipservices.floodsmart.gov/reports-flood-insurance-data

[4] https://www.fema.gov/sites/default/files/documents/Region_III_WV_FloodReport.pdf

In addition to new flood maps, all communities in Greenbrier County are required to approve and adhere to a new floodplain management ordinance to regulate development in the floodplain. Effective floodplain management is an important component of the National Flood Insurance Program (NFIP) in protecting and making more communities resilient to flooding. The towns of Rainelle and White Sulphur Springs should enroll in FEMA's Community Rating System (CRS), a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements of the National Flood Insurance Program (NFIP). Over 1,500 communities participate nationwide including Greenbrier County unincorporated.

Lastly, pre-disaster planning is an important activity for a flood-prone community to be prepared for the physical and human loss of a major flood disaster. Communities should meet annually to review and update their local hazard mitigation and emergency operation plans. Flood mitigation activities and goals should be integrated with the community's comprehensive plan. Communities should ensure development is restricted in high flood risk areas, especially since flood insurance may not be affordable for many residential and non-residential building owners. Essential facilities and other community assets should not be built in a floodplain, or if they exist in the floodplain, these significant structures should be evaluated for flood adaptive measures. Substantial damage estimation teams should be prepared to conduct damage assessments and notify property owners of necessary actions immediately following a flood. In addition, plans should be created or reevaluated for early flood warning systems and evacuating flood victims to shelters outside the floodplain. Proper pre-disaster planning will not only reduce flood damage and save lives but will speed up a community's recovery after a major flood disaster.

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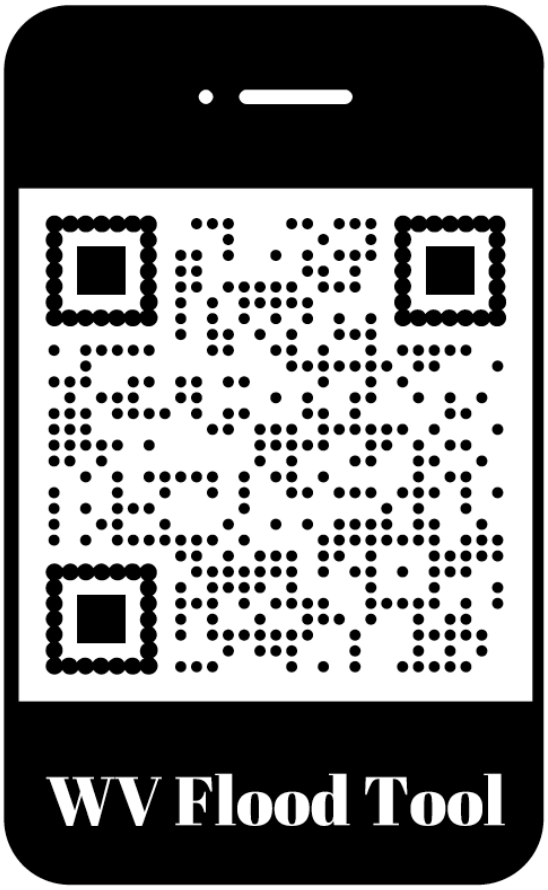
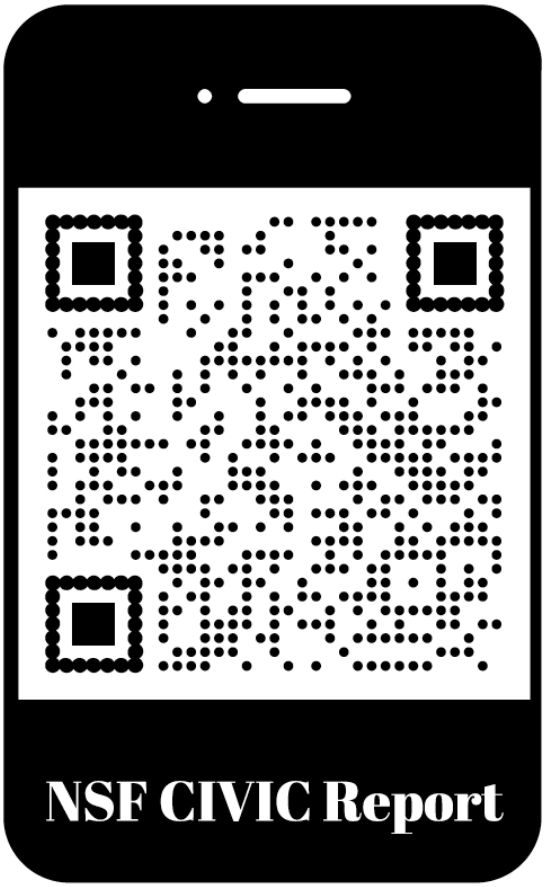


Learn more about your risk for flooding with the WV Flood Tool.

Scan the QR code above or visit https://www.mapwv.gov/flood/



See a digital copy of this report and an appendix of all results.

Scan the QR code above or visit https://www.greenbriercountyhealthalliance.org/civic-report

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