Greenbrier County Flood Risk Assessment

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Greenbrier County / Greenbrier County Unincorporated Area

For overall cumulative riverine flood risk using 25 flood factors, **Greenbrier County** ranks **11th** of 55 counties in the state with a Cumulative Flood Risk Score of **81.4%** (VERY HIGH RISK).

Since **Greenbrier County** is the second largest county in the state, both the **county** and **unincorporated area** have expansive floodplain areas. The extensive floodplain acreage and mileage to manage development at the county jurisdictional level ranks in the top 10% of all counties in the state. Consequently, **Greenbrier County,** must be vigilant in monitoring and permitting new development in its expansive unincorporated area in accordance with its floodplain management ordinance.

Floodprone Incorporated Places of Greenbrier County

CUMULATIVE FLOOD RISK. Of the 229 municipalities in the state evaluated using 25 risk factors, the **top two** places of VERY HIGH RISK are **Alderson and Rainelle**, followed by **White Sulphur Springs** of RELATIVELY HIGH RISK, then the MODERATE RISK communities of **Rupert** and **Ronceverte**. The split community of **Alderson** that spans Greenbrier and Monroe counties has the third highest cumulative risk index of municipalities in the state, followed by Rainelle (19th), White Sulphur Springs (82nd), Rupert (98th), and Ronceverte (130th).

TOP 10% RISK FACTORS. The incorporated places of Greenbrier County below are evaluated on specific flood risk factors that are in the top 10% of all 229 incorporated places in the state.

- **Rainelle** ranks in the top 10% for the following seven risk factors: Buildings in SFHA, structures in floodway, floodplain building ratio, Pre-FIRM buildings, roads inundated, damage claims, and people displaced.
- **Alderson** ranks in the top 10% for the following five risk factors: Pre-FIRM buildings, critical infrastructure, community assets, and disaster claims.
- **White Sulphur Springs** ranks in the top 10% for two risk factors: Buildings in SFHA and structures in the floodway.
- **Ronceverte** ranks in the top 10% for two risk factors: community assets and repetitive loss structures.
- **Rupert** ranks in the top 10% for the building characteristic risk factor: one-story buildings.

- BUILDING EXPOSURE. **Rainelle** and **White Sulphur Springs** have the highest building counts in the SFHA with more than 300 structures. The higher number of buildings in the floodplain indicates higher physical and human exposure to riverine flooding. Additionally, a **third** of the buildings in **Rainelle** are in the high-risk flood area, which signifies greater exposure of this community to flooding. **White Sulphur Springs** has the highest number of buildings in the floodway, the most hazardous areas of the floodplain with the greatest flood depths, velocities and debris. Additionally, higher velocity floodwaters are found in floodways along steeper-gradient streams such as White Sulphur Springs.
- BUILDING CHARACTERISTICS. **Alderson** and **Rainelle** have a high percentage of Pre-Flood Insurance Rate Map (FIRM) buildings built before the effective date of the initial flood maps for the communities, or buildings built when no FIRM was in effect (e.g., Rainelle). Pre-FIRM structures are more vulnerable to flooding because they were constructed before the initial Flood Insurance Rate Map (FIRM) date and thus were not built according to the regulations and building codes for floodplain development. The community of **Rupert** has a high percentage of one-story buildings in the high-risk floodplains. During extreme flooding, occupants of one-story buildings cannot seek higher floors and thus are at more risk to flood fatalities.
- CRITICAL INFRASTRUCTURE: ROADS. Nearly 40% of the roads for **Alderson** and **Rainelle** will be inundated by waters of one foot or more by a major 1% annual chance (100-yr) flood event. A foot of water can float many vehicles and make roads impassable. Communities should compare historical flooding events with flood estimation models for major transportation routes and plan for alternative evacuation or rescue routes.
- COMMUNITY ASSETS. **Alderson** has a high number of historical and non-historical community assets, while **Ronceverte** has a high number of historical assets. Historical assets often have significant cultural value, so it is crucial to know how many historical assets are in floodprone areas to aid in allocating resources for flood resilience and emergency response. Non-historical community assets such as churches often serve as emergency shelters during floods. Flooding can disrupt critical community lifelines, including safety, water, shelter, health, and energy. The inundation of government buildings can cause service disruptions and damage important documents and records.

Table 1. Greenbrier County risk assessment by various geographic scales: county, community (unincorporated area, incorporated place), region, watershed, and stream/river.

SCALE	CUMULATIVE RISK / # BLDGS. in SFHA	HIGH RISK FACTORS	REPORT LINKS
County	A Cumulative Flood Risk Index of 25 flood factors reveals that **Greenbrier County** ranks **11th** of 55 counties in the state with a Cumulative Flood Risk Score of **81.4%** (VERY HIGH RISK). The county ranks **6th** in the **Floodplain Characteristics** category. Greenbrier County is the second largest county in the state at 1,010 square miles. 1,879 building in SFHA	TOP 10% • FLOODPLAIN CHARACTERISTICS ○ Total High-Risk Floodplain Area (21,615 acres) ○ Total High-Risk Floodplain Length (588 miles) • 1,072 of Damage Claims TOP 20% • 269 Floodway Structures • 45 Historical Buildings	All Risk Indicators Top 20% Risk Comparison Floodplain Characteristics Category Rank
Community – **Unincorporated Area**	**Greenbrier Unincorporated** ranks **17th** of 55 unincorporated areas in the state with a Cumulative Risk Score of **70.3%** (RELATIVELY HIGH RISK). Greenbrier Unincorporated ranks **5th** in the **Floodplain Characteristics** Category at **92.5%.** 997 building in SFHA	TOP 10% • FLOODPLAIN CHARACTERISTICS ○ Total Floodplain Area (20,700 acres) ○ Total Floodplain Length (579 miles)	All Risk Indicators Top 20% Floodplain Characteristics Category Rank County-Community Report
Community – **Incorporated Place**	Of the 229 municipalities in the state evaluated using 25 risk factors, the **top 2** places of VERY HIGH RISK are **Alderson and Rainelle**, followed by **White Sulphur Springs** of RELATIVELY HIGH RISK, then MODERATE RISK communities of **Rupert** and **Ronceverte**. • **Alderson*** ranks **3rd** for cumulative risk index (CRI) in the state with a score of **99.1%** (5 Top 10% factors, VERY HIGH RISK) ○ 205 Buildings in SFHA but only 6 buildings in floodway ○ Pre-FIRM buildings ranks **10th** in the state.	TOP 10% (ALDERSON) • BUILDING CHARACTERISTICS ○ 96% Pre-FIRM Buildings • CRITICAL INFRASTRUCTURE ○ 40% of Roads Inundated during major flood event (14th rank in state) • COMMUNITY ASSETS ○ 30 Historical Assets ○ 9 Non-Historical Assets • 201 Disaster Claims TOP 10% (RAINELLE) • BUILDING EXPOSURE ○ 336 Buildings in SFHA ○ 47 Floodway Structures	All Risk Alderson All Risk Rainelle Al Risk WSS All Risk Rupert All Ronceverte Top 20% Alderson Top 20% Rainelle Top 20% WSS Alderson Highlight Rainell Highlight WSS Highlight Rainelle Building Exposure Rank

SCALE	CUMULATIVE RISK / # BLDGS. in SFHA	HIGH RISK FACTORS	REPORT LINKS
	○ Critical Infrastructure Category ranks **4th** or 98.6% in the state ○ Community Assets category ranks **10th** in community assets • **Rainelle** ranks **19th** for cumulative risk index (CRI) in the state with a score of **92.1%** (**7 Top 10% factors,** VERY HIGH RISK) ○ 336 buildings in SFHA (**1st** municipality rank in county; **14th** state rank) ○ 47 floodway structures ○ Building Exposure category ranks **3rd** or **99.1%** in state • **White Sulphur Springs** ranks **82nd** (CRI 64.4%; 2 Top 10% factors, RELATIVELY HIGH RISK) ○ 302 buildings in SFHA (**2nd** highest place in county; **21st** state rank) ○ 105 floodway structures ranks **7th** in the state at **97.3%** ○ Building Exposure ranks **21st** or **91.2%** in state • **Rupert** ranks **98th** (CRI 57.4%, 1 Top 10% factor, MODERATE RISK) ○ 56 structures in SFHA ○ Ranks **4th** in state for ratio of one story floors at **96.1%** • **Ronceverte** ranks **130th** (CRI 43.4%; 2 Top 10% factors, MODERATE RISK) ○ 47 structures in SFHA; 1 floodway structure ○ Ranks 15th in state for historical community assets at 80.2% *Alderson spans Greenbrier & Monroe Counties.	○ 34% of floodplain buildings to total buildings • BUILDING CHARACTERISTICS ○ Pre-FIRM: 99% of floodplain buildings are Pre-FIRM or built with no FIRM in effect • CRITICAL INFRASTRUCTURE ○ 39% of Roads Inundated during major flood event (16th rank in state) • PEOPLE/SOCIAL ○ 38% of Population Displaced during major (100-yr) flood event. • 154 Prior Damage Claims TOP 10% (WHITE SULPHUR SPRINGS) • 302 Buildings in SFHA • 105 Floodway Structures TOP 10% (RUPERT) • 96% of floodplain buildings have only one story (80% median value statewide) TOP 10% (RONCEVERTE) • 27 Historical Community Assets • 50 Repetitive Loss Structures (structures may have been removed since only 47 structures in SFHA)	WSS Building Exposure rank (sort on Building Floodway) 5 city comparison County-Community Report
Region	A Cumulative Flood Risk Index of 24 flood factors reveals that **PDC Region 4** ranks **6th** of 11 regions in the state	TOP 20% (PDC Region 4) • Total Floodplain Length (miles) • % of Pre-FIRM buildings	Top 20% PDC 4

SCALE	CUMULATIVE RISK / # BLDGS. in SFHA	HIGH RISK FACTORS	REPORT LINKS
	with a Cumulative Flood Risk Score of **50%**.	• Social Vulnerability Index	PDC4 to All Regions Comparison
Watershed	A Cumulative Flood Risk Index of 9 flood factors reveals that the **Greenbrier Watershed** ranks **8th** of 33 watersheds in the state with a Cumulative Flood Risk Score of **78.1%.** The Gauley Watershed ranks **22nd** in the state with a cumulative risk score of **34.3%**	TOP 20% (GREENBRIER Watershed) • 2.4 ft. Flood Depth Median (statewide median value 0.8 ft.) • 701 Building Floodway Count • 361 Bldg. Substantial Damage • 12.7% Bldg. Substantial Damage Ratio	All Indicators Greenbrier Watershed Top 20% Greenbrier Watershed Top 20% Gauley 2 Watershed Comparison
Rivers / Streams	A comparison of rivers/streams that intersect Greenbrier County analyzed using 8 flood factors. These waterways have more than 100 structures in the Special Flood Hazard Area (SFHA). **Greenbrier River** ranks **3rd** of 156 river/stream floodplains in the state with a Cumulative Flood Risk Score of **98.7%**.	STATE STREAM RANKING • 3rd - Greenbrier River (Pocahontas, Greenbrier, Monroe, Summers counties) • 54th - Meadow River (Greenbrier, Raliegh, Fayette counties) • 59th - Sewell Creek (Fayette, Greenbrier) • 65th - Howard Creek (Greenbrier) • 112th - Anthony Creek (Greenbrier)	Top 20% Greenbrier River 5 River/Stream Comparison

Table 2. Rationales and recommendations of specific flood risk factors affecting floodprone communities of Greenbrier County.

RISK FACTOR	RATIONALE	RECOMMENDATION
Floodplain Area (Acres) and Floodplain Length (miles) **Greenbrier Unincorporated Area**	For unincorporated areas and at the county level, it may be more challenging for communities larger in geographic size to enforce their floodplain management ordinance. Often larger jurisdictions have more acres and miles of floodplain extent than compared to smaller communities.	Larger jurisdictions must be vigilant in monitoring and permitting new development for an expansive geographic area that includes a large amount floodplain area and miles. Additionally, in rural areas, thick foliage and private drives may result in floodplain structures being harder to view or access.
Building Floodplain Count (#) **Rainelle** **White Sulphur Springs**	All primary insurable structures in the effective 100-year floodplain or Special Flood Hazard Area (SFHA). The higher number of buildings in the floodplain indicates higher physical and human exposure to riverine flooding. More structures also correlate to higher debris totals and displaced people from a major storm. Mandatory Flood Insurance Requirement. If a building owner has a mortgage from a federally regulated lender and the property is in the Special Flood Hazard Area, then the building owner is required by Federal law to carry flood insurance.	Communities with a high floodplain building count should actively engage property owners about flood insurance and minimizing flood losses of property owners. See Floodsmart.gov for more information. Communities can become more resilient to flooding by exceeding the minimum NFIP requirements. Higher building standards adopted by local communities may include increasing the freeboard of the base flood elevation. Floodplain managers and emergency planners should pre-load at-risk structures into substantial damage estimator software. Local officials should review early warning systems as well as short-term shelters located outside the floodplain and away from inundated roads.
Building Floodway Count (#) **White Sulphur Springs** **Rainelle**	The floodway is the most hazardous area of the floodplain with the greatest floodwater depths, velocities, and debris. Additionally, higher velocity floodwaters are found in floodways along steeper-gradient streams. High flood velocities and deep flood depths increase the likelihood of physical damage and loss of life.	Community floodplain management ordinances often recommend not constructing closed foundations or solid perimeter walls where flood velocities exceed 5 feet per second. Nonstructural mitigation measures are not recommended either where high flood velocities exceed 6 feet per second or where debris impacts may occur. Source USACE. FEMA

RISK FACTOR	RATIONALE	RECOMMENDATION
	Structures in the floodway require the purchase of mandatory flood insurance for federally backed loans. Restricted development. Before a local permit can be issued for proposed development in the floodway, a "No-Rise/No Impact" certification must be submitted by a professional engineer licensed in West Virginia to ensure a proposed project won't increase flood levels.	recommends open foundations (e.g., piers, posts, columns, pilings) for riverine SFHAs where flow velocities are expected to exceed 10 feet per second. Source FEMA.
Building Floodplain Ratio (%) **Rainelle**	Percentage of floodplain buildings to total buildings. A higher ratio of buildings in the floodplain to total buildings signifies a greater physical and human exposure to flooding	See building count in SFHA recommendations.
Building 1-Story Ratio (%) **Rupert**	Percentage of one-story structures in the high-risk floodplain. Flood Fatality Risk. During extreme flooding, occupants of one-story buildings cannot seek higher floors and thus are at more risk to flood fatalities. Also, they may face challenges during flood evacuation and emergency sheltering, especially for flash floods. Therefore, such structures may potentially cause higher human loss. Flood Damage. Buildings with more floors spread their risk over a higher area. Consequently, the number of stories is a factor in determining a building's unique flood risk and associated premium.	Occupants of one-story buildings should be informed about the increased flood risk associated with their structures to be more vigilant. These buildings should be prioritized in evacuation action plans, with occupants evacuated before inundation begins at their structures and access roads to their places. Providing early warning systems and clear evacuation routes can help ensure the safety of these residents.
Bldg. Year Pre-FIRM Ratio (%) **Alderson** **Rainelle**	Pre-Flood Insurance Rate Map (FIRM) buildings are those built before the effective date of the first Flood Insurance Rate Map (FIRM) for a community, or buildings built when no FIRM was in effect (e.g., Rainelle). Pre-FIRM structures are more vulnerable to flooding because they were constructed when a Flood Insurance Rate Map (FIRM) was not in effect and thus were not built according to the regulations and building codes for floodplain development.	Flood insurance can serve as a mitigation effort for pre-FIRM structures. Such buildings can be insured using "subsidized" rates. These rates are designed to help people afford flood insurance even though their buildings were not built with flood protection in mind. FEMA is continuing to offer premium discounts for pre-FIRM subsidized and newly mapped properties. Source: FEMA.

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Infrastructure: Roads Inundated Ratio (%) **Alderson** **Rainelle**	Percentage of roads inundated by flood waters of 1 foot or more by a major 1% annual chance (100-yr) flood event. A foot of water can float many vehicles and make roads impassable. Analyzing inundation at this level is essential, as it can block regular access to properties and services. Approximately three feet of water is near the limit for using high-profile vehicles for high-water rescues. At depths of about six feet or higher, boats and helicopters are required for rescues.	Communities should compare historical flooding events with flood estimation models for major transportation routes and plan for alternative evacuation or rescue routes. Community planners and transportation officials could consider increasing roadway elevation to mitigate the flood risk.
Community Assets Historical (#) **Alderson** **Ronceverte**	Number of historical community assets listed on the National Register of Historic Places, the official list of the Nation's historic places worthy of preservation, and includes buildings identified within National Register Areas constructed before 1930. Historical assets often have significant cultural value, so it is crucial to know how many historical assets are in floodprone areas to aid in allocating resources for flood resilience and emergency response. Additionally, it may affect insurance premiums for these assets and eligibility for government funding for flood mitigation. A designated historic structure can obtain the benefit of subsidized flood insurance through the NFIP even if it has been substantially improved or substantially damaged so long as the building maintains its historic designation.	Adaptive flood mitigation options should always be selected to minimize impacts on the historical character and appearance of a historical building or district. These options can range from temporary protective measures, such as temporary barriers, systems, or equipment, to structural and landscape adaptations. **HISTORICAL RESOURCES** Mitigation Historic Resources: FEMA R3 Presentation | MD Guide FEMA Tech. Bulletin: Floodplain Management of Historic Structures Map Resources: WV Flood Tool's Risk MAP View | WV SHPO GIS National Register Listing: WV State Historic Preservation Office
Community Assets Non-Historical (#) **Alderson**	Number of non-historical community assets including utilities (water, sewage, gas, electric, or phone), post-secondary educational facilities, emergency medical services (EMS), government buildings providing public services, and facilities hosting religious services. Buildings such as churches often serve as emergency shelters during floods. Flooding can disrupt critical community lifelines,	It is crucial for floodplain managers and risk planners to perform hazard vulnerability analyses of community assets to devise appropriate mitigation strategies. They should also create plans for the long-term relocation of key community assets (e.g., utilities, town halls, churches, etc.) out of the floodplain.

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	including safety, water, shelter, health, and energy. The inundation of government buildings can cause service disruptions and damage important documents and records.	Examples of mitigation measures for utilities are emergency response plans, barriers around key assets, elevated electrical equipment, emergency generators, and bolted down chemical tanks. Source: EPA.
Bldg. Previous Damage Claims (#) **Alderson** **Rainelle**	Bldg. Previous Damage Claims (#) Number of previous flood-related insurance claims for a geographic unit since 1978. A high number of claims in a community indicates that flooding is occurring, and community members are making claims against their policies. The frequency of flooding and claim history are factors in determining a building's unique flood risk and associated premium.	Communities with a high number of previous flood claims should be prioritized for mitigation planning and funding. Establishing or enhancing floodplain management policies, including stricter building codes and land use regulations, can help mitigate future flood damage and reduce the number of claims.
Bldg. Repetitive Loss Structures (#) **Ronceverte**	Number of NFIP-insured structures that have had at least 2 paid flood losses of more than $1,000 each in any 10-year period since 1978. A preponderance of repetitive loss structures indicates that the community is at a higher risk for future losses. Repetitive loss structures can cause direct cost of the continued need for emergency services as well as the indirect cost related to lost economic activity and sales tax revenue from businesses that are off-line during recovery efforts in addition to lost property taxes for abandoned properties. Source: FEMA Region 3.	Repetitive loss structures may be eligible for the Flood Mitigation Assistance (FMA) grant program by FEMA up to a 90% cost share for mitigation efforts such as property acquisition, structure demolition or relocation, building elevation, and dry flood proofing of non-residential structures. Source: FEMA. Communities with high numbers of repetitive loss structures should consider such grants to mitigate the risk. They should also consider comprehensive plans and economic development plans to identify sites for relocation from flood-prone areas in order to avoid future risk. Source: FEMA Region 3.
People Displaced Ratio (%) **Rainelle**	Estimated percentage of population displaced by a major flood of a 1% annual chance (100-yr) probability, causing inundation of equal to or greater than 1 foot. Short-term displacement may occur when inundation damages residential units or blocks access to them. Evacuees plan to return to their communities after the	Communities should use population displacement estimates to enhance emergency response, particularly for evacuation during high-risk floods. They should use these estimates to identify evacuation routes and improve planning for transportation, shelters, and supplies.

RISK FACTOR	RATIONALE	RECOMMENDATION
	inundation ends and the damaged residential units are restored. Until then, they may stay with relatives or friends in safer areas, go to hotels, or use short-term shelters. Population displacement estimates can aid in pre-disaster emergency management and evacuation planning.	Emergency plans should include mobile pet shelter resources (e.g., trailers, plastic crates, pens, etc.) for companion dogs and cats as well as other animals.