5.5 Flood

2023 SHMP Update Changes

- The flood hazard is now divided into several separate flood-related hazards. This profile explains the event-based flooding hazard in the State of West Virginia (the State).
- The hazard profile was reorganized and significantly enhanced to include detailed descriptions of the following: hazard definition, location, extent, previous occurrences, and probability of future occurrences (including how future conditions may impact the hazard).
- Flood events that occurred in the State from January 1, 2018, through December 31, 2022, were researched for this 2023 State Hazard Mitigation Plan (SHMP) update.
- New and updated figures from federal and state agencies are incorporated.
- The 1 percent annual chance flood or special flood hazard area (SFHA) served as the basis for the exposure analysis for state assets, critical facilities, population, general building stock, and environmental resources.
- Hazus was used to generate estimated potential losses for state buildings, critical facilities, and general building stock located in the SFHA.

5.5.1 Hazard Profile

A flood is an overflow of water from oceans, rivers, groundwater, or rainfall that submerges areas that are usually dry. This natural phenomenon can be exacerbated by features of the built environment.

Summary of Key Terms

Special Flood Hazard Area (SFHA)

The 1 percent annual chance flood as depicted on the FEMA Flood Insurance Rate Maps. The hazard area is called the ***Special Flood Hazard Area*** *(SFHA).*

Source: FEMA 2020

Flood is a natural hazard that can occur during any season. Flooding typically occurs during prolonged rainfalls over several days or due to intense rainfalls over a short period of time. The most common cause of flooding is due to rain or snowmelt that accumulates faster than soils can absorb it, or rivers can carry it away. Flooding can also result from the failure of a water control structure (NWS 2019). For information on dam failure or levee failure in West Virginia, refer to Section 5.1 and Section 5.8, respectively.

Floods are one of the most frequent and costly natural hazards in the State in terms of human hardship, environmental impacts, and economic loss, particularly to communities that lie within flood-prone areas or floodplains of a major water source. Flooding is a general and temporary condition of partial or complete inundation on normally dry land from the following:

- Riverine overbank flooding
- Flash floods
- Alluvial fan floods
- Mudflows or debris floods

- Dam- and levee-break floods
- Local draining or high groundwater levels
- Fluctuating lake levels
- Ice jams (NWS 2019)

Flooding from snowmelt and ice jams are identified by the National Weather Service as being one of the major flood concerns for West Virginia. Snowmelt flooding occurs when the major source of water involved in a flood is caused by melting snow. The mountainous areas of West Virginia are particularly susceptible to snowmelt flooding. Snowpack can store the water for an extended amount of time until temperatures rise above freezing and the snow melts; this delays the arrival of water to the soil for days, weeks, or even months. Once the snow begins to melt and reaches the soil, water from snowmelt behaves much as it would if it had come from rain instead of snow by either infiltrating into the soil, running off, or both. Ice jams are common during the winter and spring along rivers, streams, and creeks in the mountainous regions of West Virginia but can occur statewide. As ice or debris moves downstream, it may get caught on any sort of obstruction to the water flow. When this occurs, water can be held back, causing upstream flooding. When the jam finally breaks, flash flooding can occur downstream (NWS 2019).

For the purpose of this SHMP and as deemed appropriate by the West Virginia State Planning Team, excessive localized rainfall, flash, riverine, and stormwater flooding are the main flood types of concern for the county. These types of flooding are further discussed below.

Hazard Description

Historically, flooding has affected each of the 32 major watersheds and 55 counties within the state. Federally declared flood disasters are far too common in the Mountain State. Many communities across West Virginia suffered from the effects of the June 2016 flood, and those impacts were exacerbated by lingering impacts from floods earlier that year. Repeated flood damage to city infrastructures has been exasperated by decreased tax revenues that resulted in negative effects from postponed maintenance and flood-associated repairs. Repeated damage from flooding has affected the infrastructure of several communities, resulting in systems that are now in need of major repairs and upgrades that require relocation of major components of the systems (State of West Virginia 2018).

Flooding has historically been the most damaging hazard to infrastructure and residents in the State.

Four types of flooding frequently occur in West Virginia. They can occur separately or simultaneously.

Excessive Localized Rainfall is also referred to as “heavy precipitation”. Excessive localized rainfall refers to instances during which the amount of rain experienced in a location substantially exceeds what is normal. What constitutes a period of excessive localized rainfall varies according to location and season (U.S. EPA 2022).

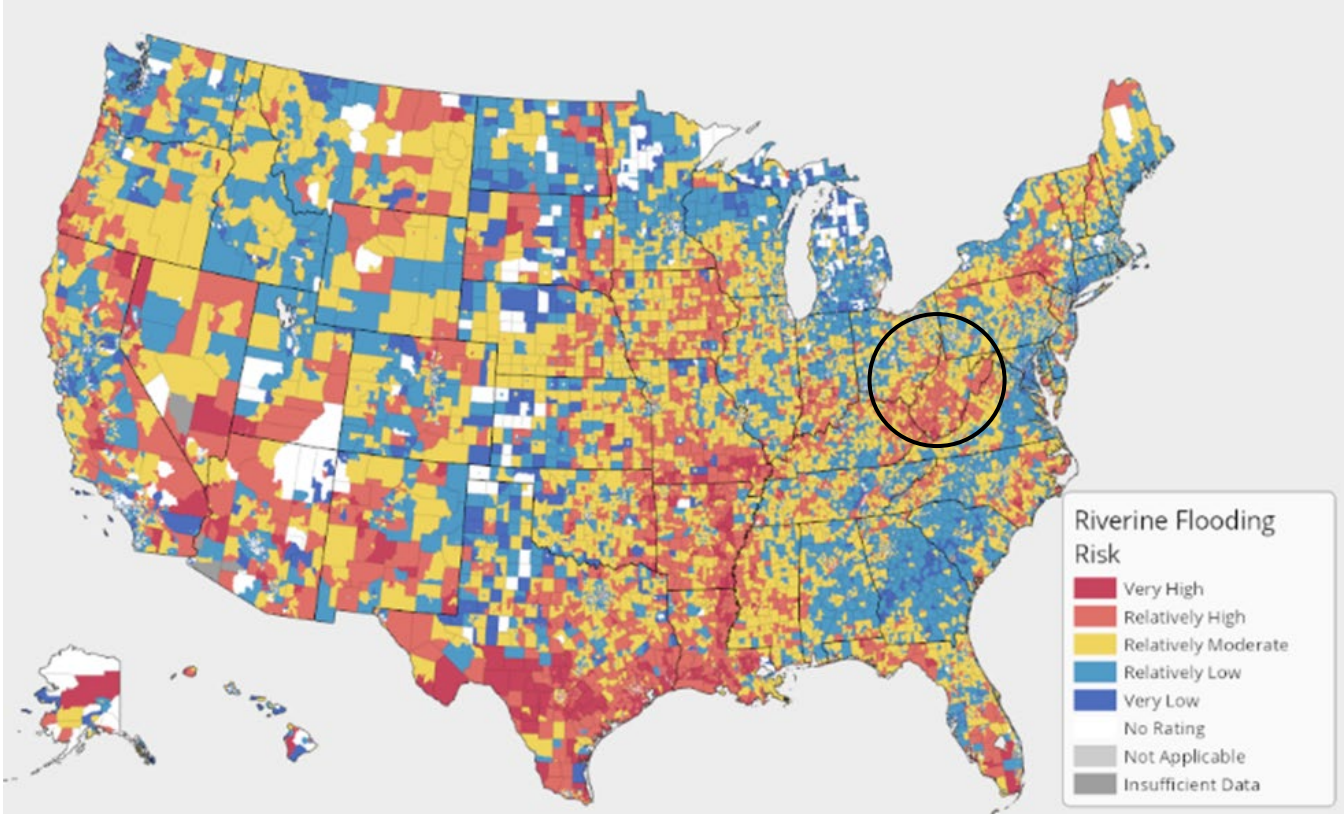
Flash Flood is a rapid inundation of low-lying areas caused by heavy rain associated with severe thunderstorms, tropical systems, or melting water from ice or snow. Flash flooding also occurs far away from water bodies when a large volume of water cannot be absorbed by the soil or storm water systems and travels overland unimpeded. The intensity of the rainfall, the location and distribution of the rainfall, the land use and topography, vegetation types and growth/density, soil type, and soil water-content all determine how quickly the flash flooding may occur

and influence where it may occur (NWS 2019). Flash floods can also occur due to dam or levee breaks and/or mudslides (debris flow) (NWS 2009).

Riverine Flooding is when streams and rivers exceed the capacity of their natural or constructed channels to accommodate water flow and water overflows the banks, spilling out into adjacent low-lying, dry land. This occurs when the flow of a river exceeds the bank sides and causes damage or obstruction to a nearby floodplain. Riverine flooding can turn into a flash flood if the river is at or above its flood stage and if the soil is saturated (FEMA 2019). The National Risk Index indicates that the State has a relatively moderate to very high likelihood of riverine flooding (FEMA 2019). Figure 5.5-1 below shows the risk of riverine flooding in the United States. The State is identified by a black circle.

Stormwater Flooding occurs when flooding results from poorly designed or blocked drainage systems. Local (urban) drainage systems collect groundwater from heavy rainfall in developed areas. Water that does not evaporate or become absorbed by the ground is carried by conduits to waterways such as creeks and rivers. These systems have two purposes: (1) to control storm water runoff during periods of heavy rainfall, and (2) to minimize disruption of activity from more frequently occurring, less significant storms. Flooding occurs when runoff exceeds system capacity or because systems are blocked from lack of maintenance (NOAA 2022).

Figure 5.5-1. Riverine Flooding Risk in the United States



Source: FEMA 2019
Note: The State is identified by a black circle

LOCATION

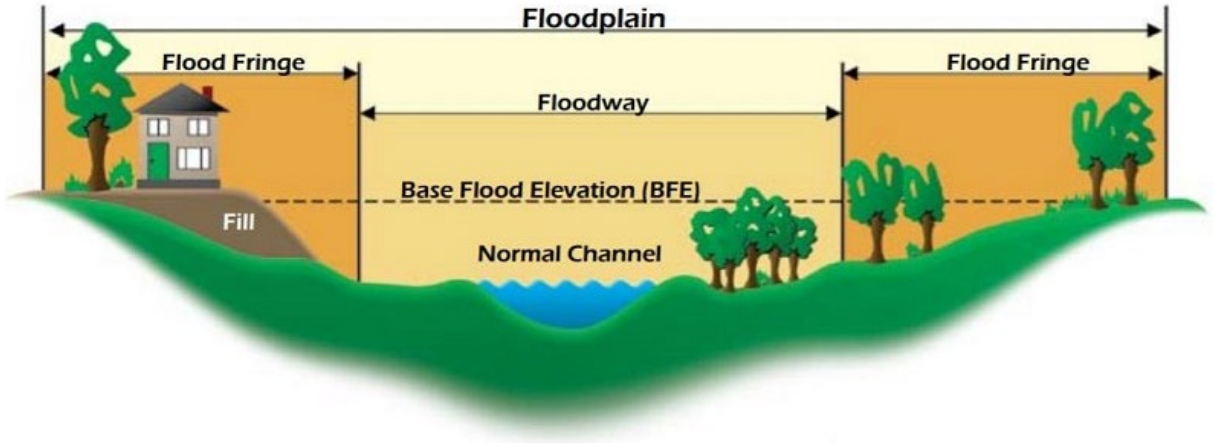
West Virginia's topographic, climatological, and meteorological features create an environment conducive to year-round flooding. The mountainous topography of West Virginia contributes greatly to the hazards threatening the state. A review of its early history shows that development in West Virginia occurred primarily along rivers. Steep inclines and rocky terrain discouraged development on the mountainsides and resulted in the establishment of cities and towns in the valleys. Heavy rains, which commonly occur in West Virginia, often result in flooding in those same valleys. Warm weather flooding is caused by severe thunderstorms bringing heavy rainfall that leads to flash floods and riverine flooding. Bank erosion and sediment deposits exacerbate flooding by blocking and re-directing the natural flow of waterways. While West Virginia is not affected by storm surge from hurricanes or tropical storms, severe rainfall associated with these systems can result in flooding.

In West Virginia, floodplains line the rivers and streams of the state. The boundaries of the floodplains are altered as a result of changes in land use, the amount of impervious surface, placement of obstructing structures in floodways, changes in precipitation and runoff patterns, improvements in technology for measuring topographic features, and utilization of different hydrologic modeling techniques.

Floodplain

A floodplain is land adjacent to a river, creek, or stream that is subject to periodic inundation. The floodplain describes the area inundated by the "100-year" flood or a flood that has a 1 percent chance in any given year of being equaled or exceeded (National Geographic 2022).

Figure 5.5-2. Characteristics of a Floodplain



Source: FEMA 2022

Floodplains serve multiple functions. They moderate flooding, maintain water quality, recharge groundwater, reduce erosion, redistribute sand and sediment, and support fish and wildlife habitat. Areas subject to flooding include the following:

- Locations that experience greater than the 1 percent annual chance flood, often referred to as the 100-year flood

- Sites that experience shallow flooding, storm water flooding, or drainage problems that do not meet the National Flood Insurance Program (NFIP) mapping criteria
- Places affected by flood-related hazards such as riverine erosion (National Geographic 2023)

Table 5.5-1 lists the area of each county in West Virginia located within the 1 percent and 0.2 percent annual chance flood event. See Figure 5.5-3. through Figure 5.5-14. on the following pages which visualize the FEMA-designated SFHA for the State.

Table 5.5-1. Area Located in the SFHA by County

County	Total Area	Total Acres of Land Area (Excluding Waterbodies) Located in the Flood Hazard Areas			
		Total Acres Located in the 1 percent Annual Chance Flood Event	Percent of Total	Total Acres Located in the 0.2 percent Annual Chance Flood Event	Percent of Total
Barbour	218,598	6,708	3.1%	6,790	3.1%
Berkeley	205,141	10,440	5.1%	10,928	5.3%
Boone	321,687	8,057	2.5%	8,057	2.5%
Braxton	328,023	9,843	3.0%	9,843	3.0%
Brooke	59,321	4,136	7.0%	4,554	7.7%
Cabell	184,109	15,166	8.2%	16,438	8.9%
Calhoun	179,487	6,487	3.6%	6,487	3.6%
Clay	219,951	5,796	2.6%	5,828	2.6%
Doddridge	205,051	5,672	2.8%	5,672	2.8%
Fayette	427,276	7,456	1.7%	8,126	1.9%
Gilmer	217,274	7,119	3.3%	8,007	3.7%
Grant	305,479	7,902	2.6%	7,911	2.6%
Greenbrier	654,360	22,362	3.4%	22,676	3.5%
Hampshire	412,248	26,568	6.4%	27,364	6.6%
Hancock	56,222	4,621	8.2%	4,869	8.7%
Hardy	373,689	17,429	4.7%	17,435	4.7%
Harrison	266,023	9,363	3.5%	11,726	4.4%
Jackson	300,968	19,105	6.3%	19,599	6.5%
Jefferson	134,920	9,157	6.8%	9,336	6.9%
Kanawha	582,312	25,784	4.4%	35,235	6.1%
Lewis	246,359	7,410	3.0%	7,678	3.1%
Lincoln	280,594	11,307	4.0%	11,746	4.2%
Logan	291,325	5,517	1.9%	6,156	2.1%
Marion	199,006	6,125	3.1%	6,941	3.5%
Marshall	199,304	9,730	4.9%	10,140	5.1%
Mason	284,059	31,514	11.1%	35,215	12.4%
McDowell	342,174	4,371	1.3%	4,856	1.4%
Mercer	268,828	7,667	2.9%	8,149	3.0%
Mineral	210,134	9,169	4.4%	9,734	4.6%
Mingo	270,756	6,071	2.2%	7,651	2.8%
Monongalia	232,200	6,735	2.9%	7,174	3.1%
Monroe	302,704	7,783	2.6%	7,803	2.6%
Morgan	146,880	8,447	5.8%	8,554	5.8%

County	Total Area	Total Acres of Land Area (Excluding Waterbodies) Located in the Flood Hazard Areas			
		Total Acres Located in the 1 percent Annual Chance Flood Event	Percent of Total	Total Acres Located in the 0.2 percent Annual Chance Flood Event	Percent of Total
Nicholas	415,482	11,807	2.8%	12,015	2.9%
Ohio	69,666	4,316	6.2%	4,611	6.6%
Pendleton	446,485	14,422	3.2%	14,422	3.2%
Pleasants	85,837	6,625	7.7%	6,734	7.8%
Pocahontas	601,520	14,450	2.4%	14,874	2.5%
Preston	415,612	10,346	2.5%	10,381	2.5%
Putnam	223,706	13,078	5.8%	17,953	8.0%
Raleigh	388,484	10,416	2.7%	10,892	2.8%
Randolph	664,970	26,563	4.0%	26,600	4.0%
Ritchie	290,396	8,123	2.8%	8,123	2.8%
Roane	309,410	7,087	2.3%	7,105	2.3%
Summers	233,898	4,931	2.1%	5,535	2.4%
Taylor	110,892	3,412	3.1%	3,440	3.1%
Tucker	265,897	10,568	4.0%	10,842	4.1%
Tyler	166,857	10,464	6.3%	10,563	6.3%
Upshur	226,613	6,773	3.0%	6,950	3.1%
Wayne	325,702	15,322	4.7%	17,692	5.4%
Webster	355,637	22,215	6.2%	22,877	6.4%
Wetzel	231,289	8,830	3.8%	8,888	3.8%
Wirt	150,356	8,268	5.5%	8,278	5.5%
Wood	241,020	25,122	10.4%	26,872	11.1%
Wyoming	320,602	5,383	1.7%	5,635	1.8%
Total	**15,466,796**	**599,538**	**3.9%**	**639,960**	**4.1%**

Source: FEMA 2022; USGS 2022; West Virginia University Geographic Information Systems (GIS) Technical Center (WVU GISTC) 2022
Notes: The acreage in this table excludes waterbody area

Figure 5.5-3. SFHA in Region 1 of the State of West Virginia

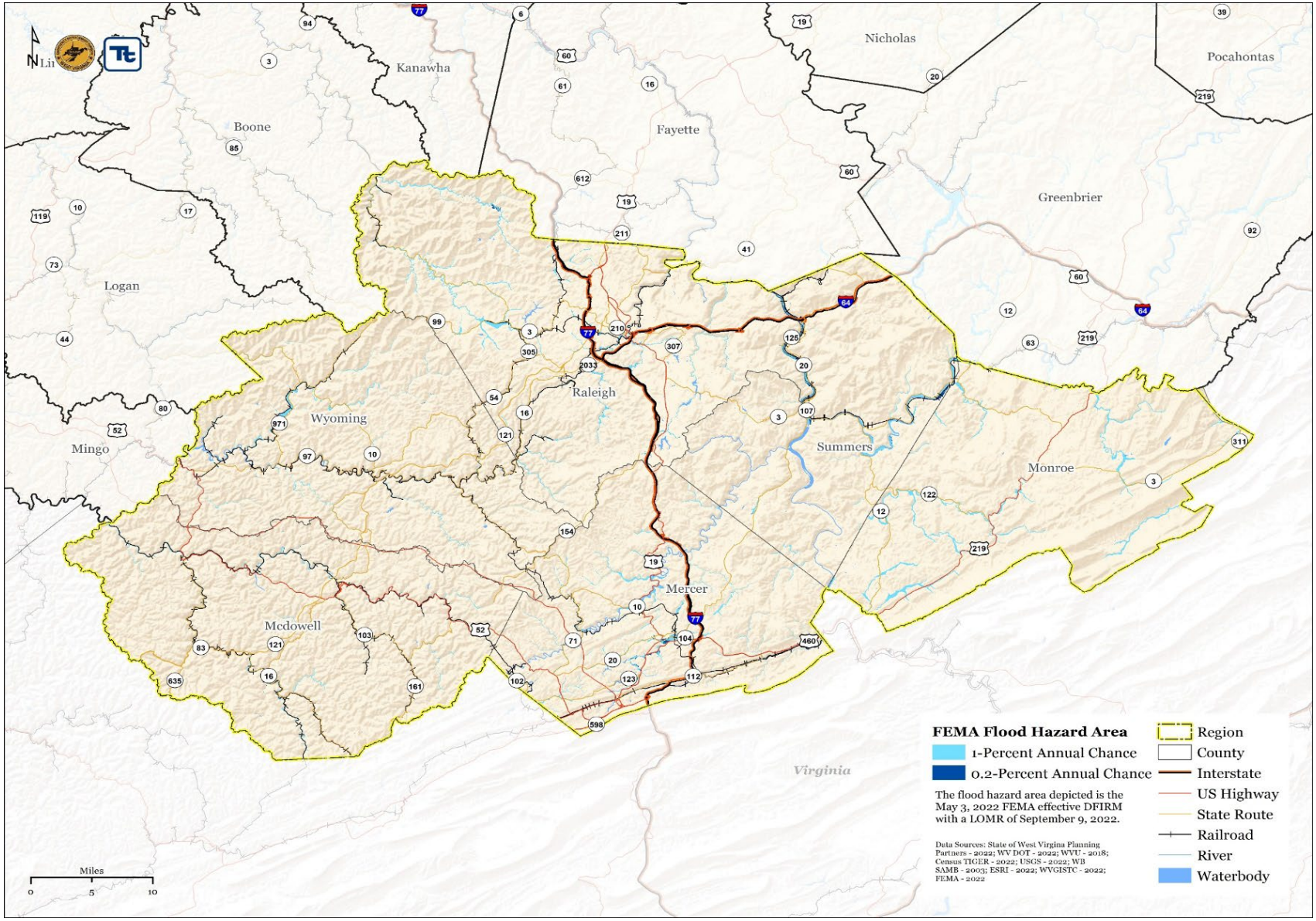


Figure 5.5-4. SFHA in Region 2 of the State of West Virginia

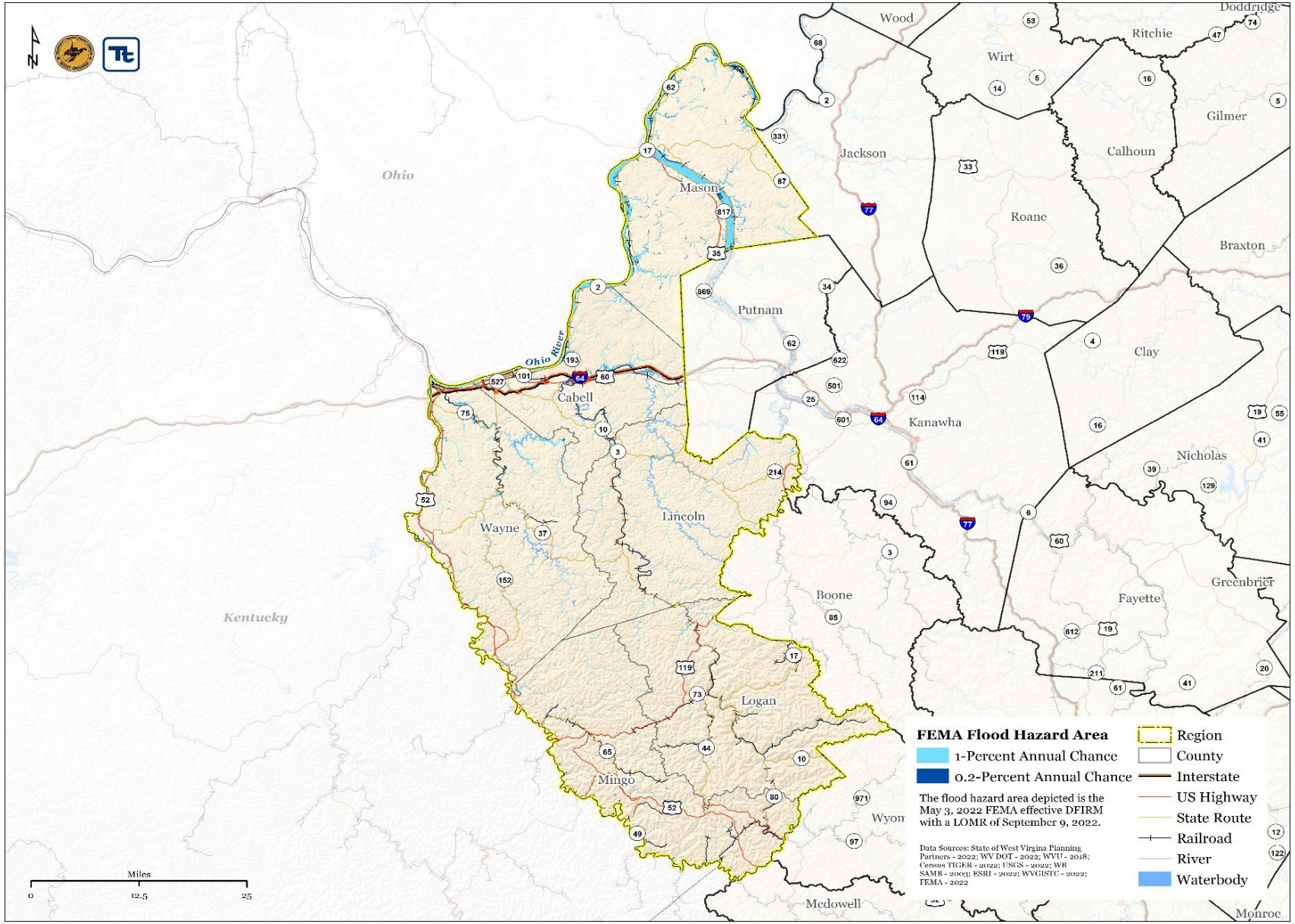


Figure 5.5-5. SFHA in Region 3 of the State of West Virginia

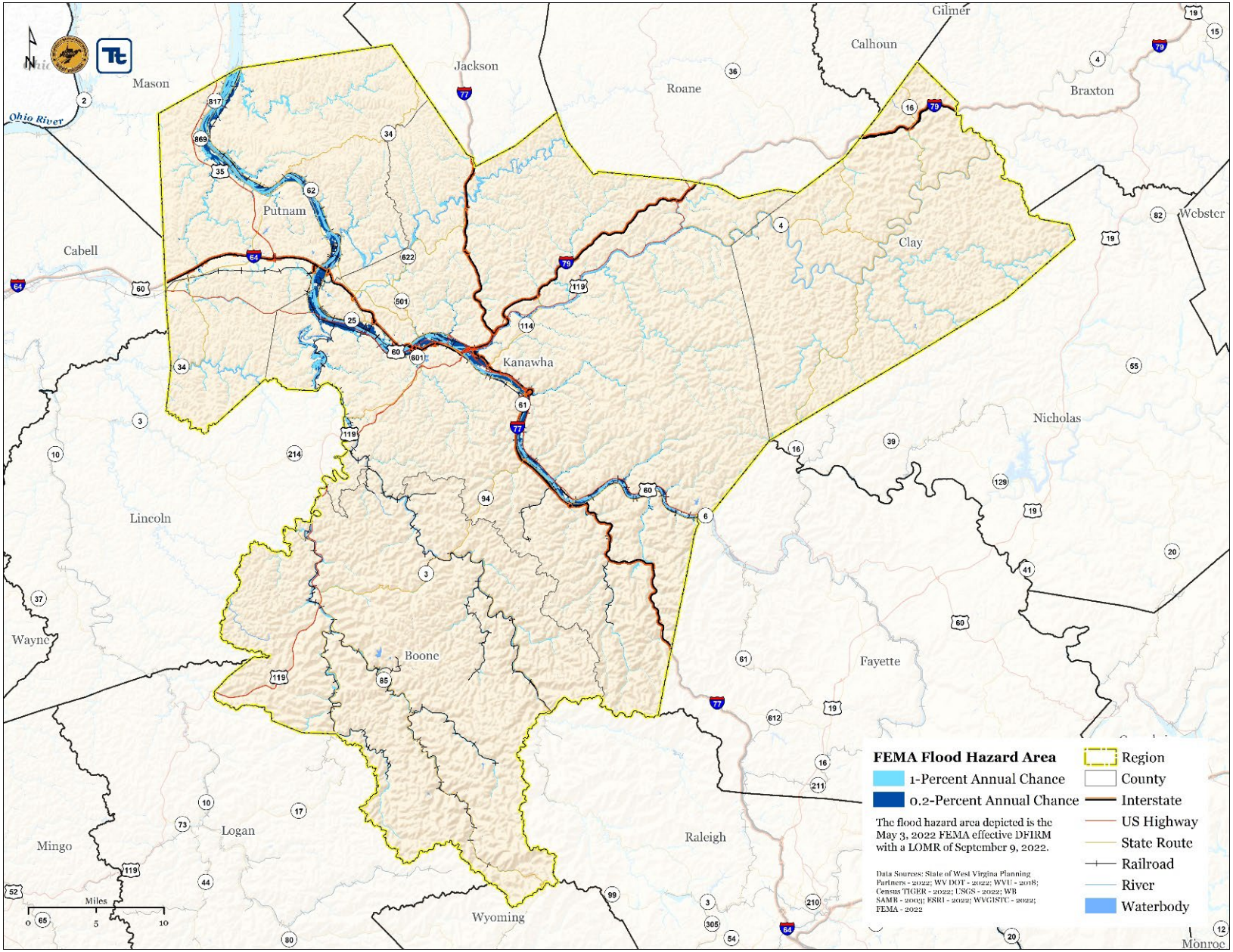


Figure 5.5-6. SFHA in Region 4 of the State of West Virginia

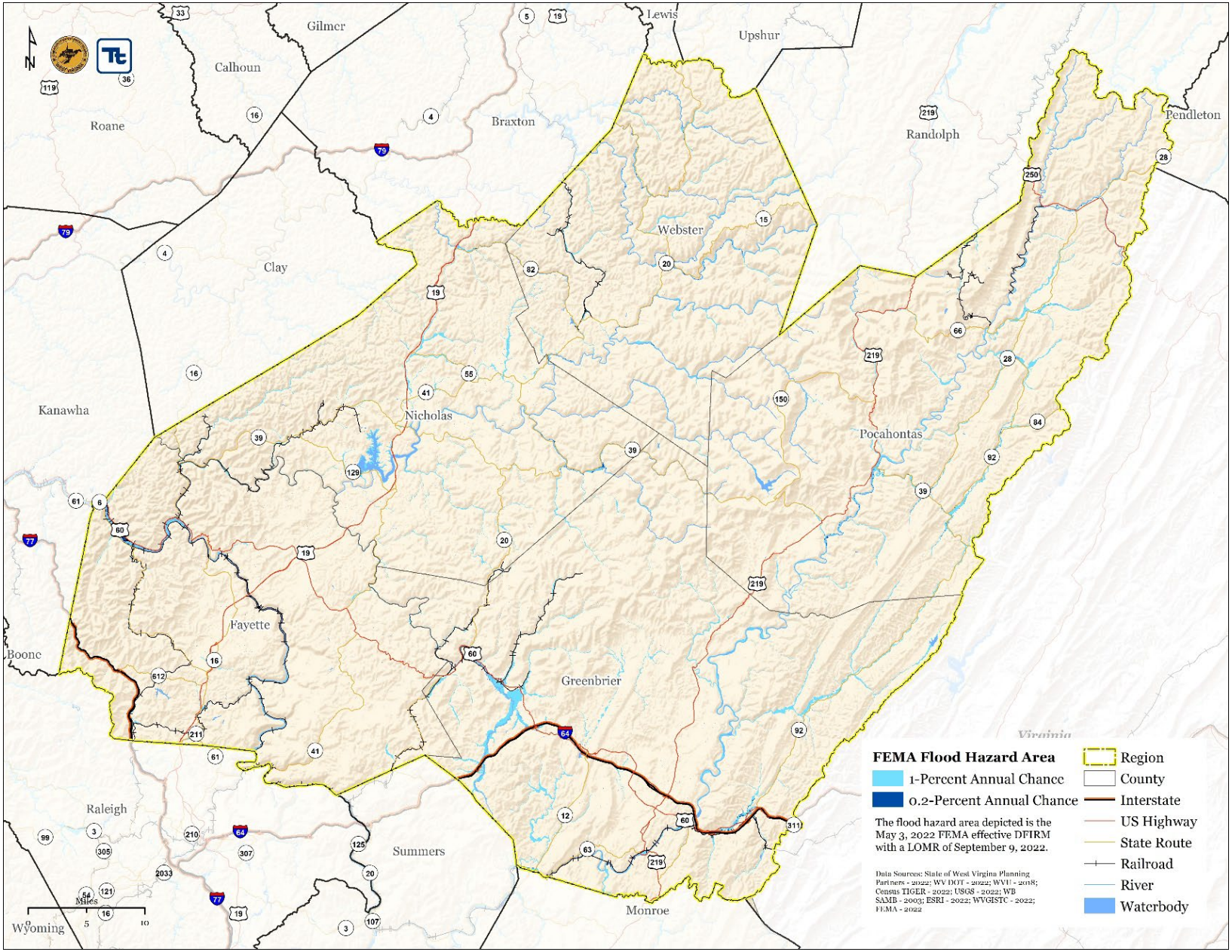


Figure 5.5-7. SFHA in Region 5 of the State of West Virginia

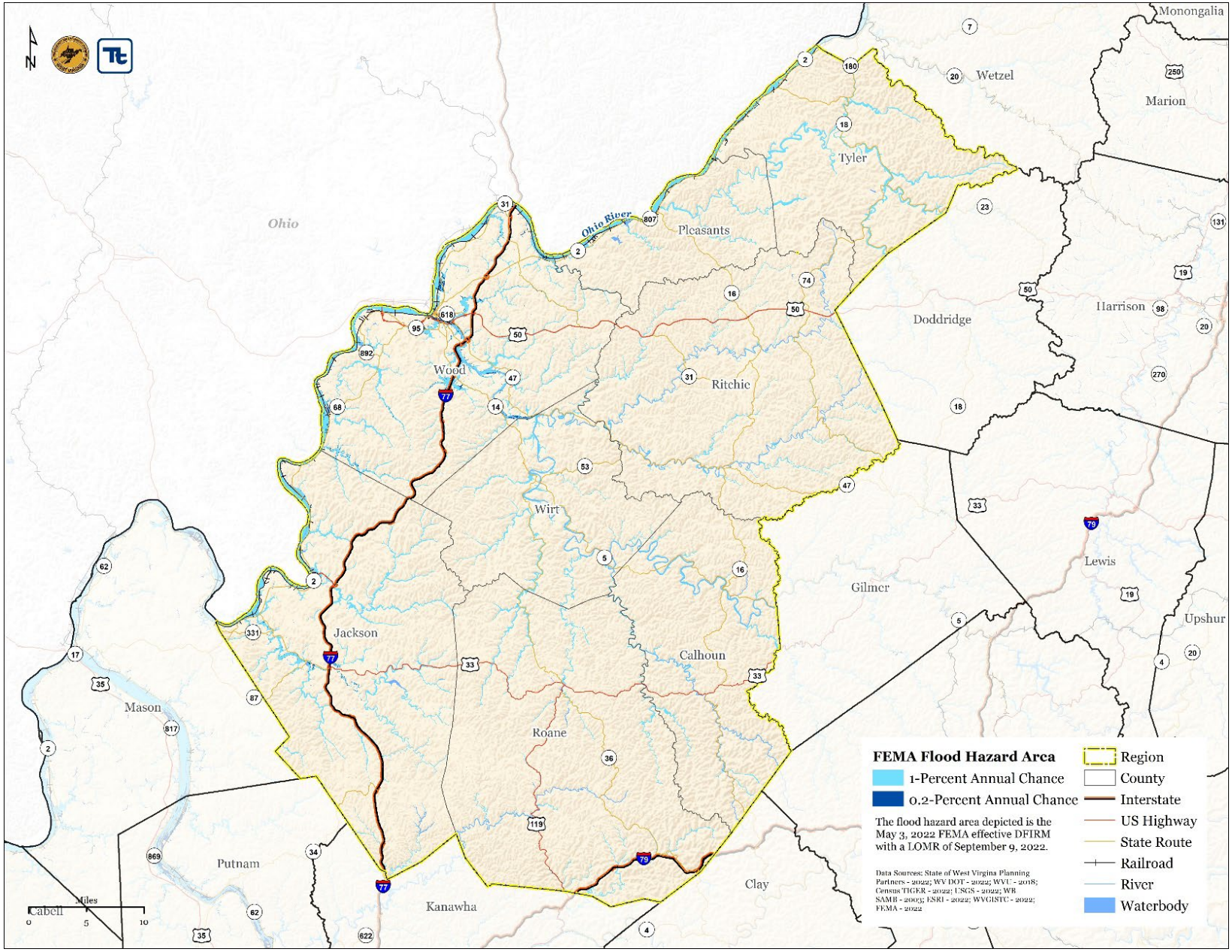


Figure 5.5-8. SFHA in Region 6 of the State of West Virginia

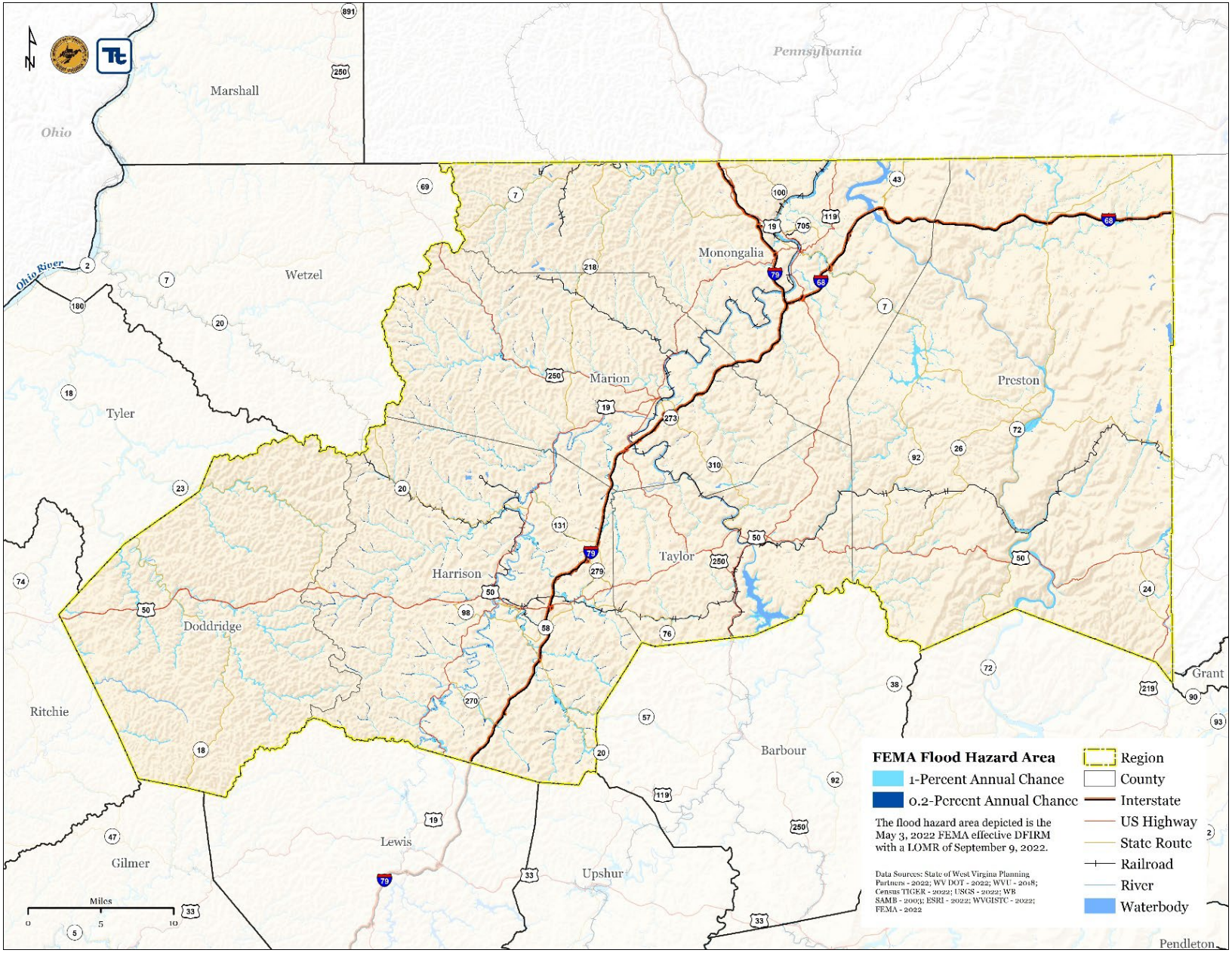


Figure 5.5-9. SFHA in Region 7 of the State of West Virginia

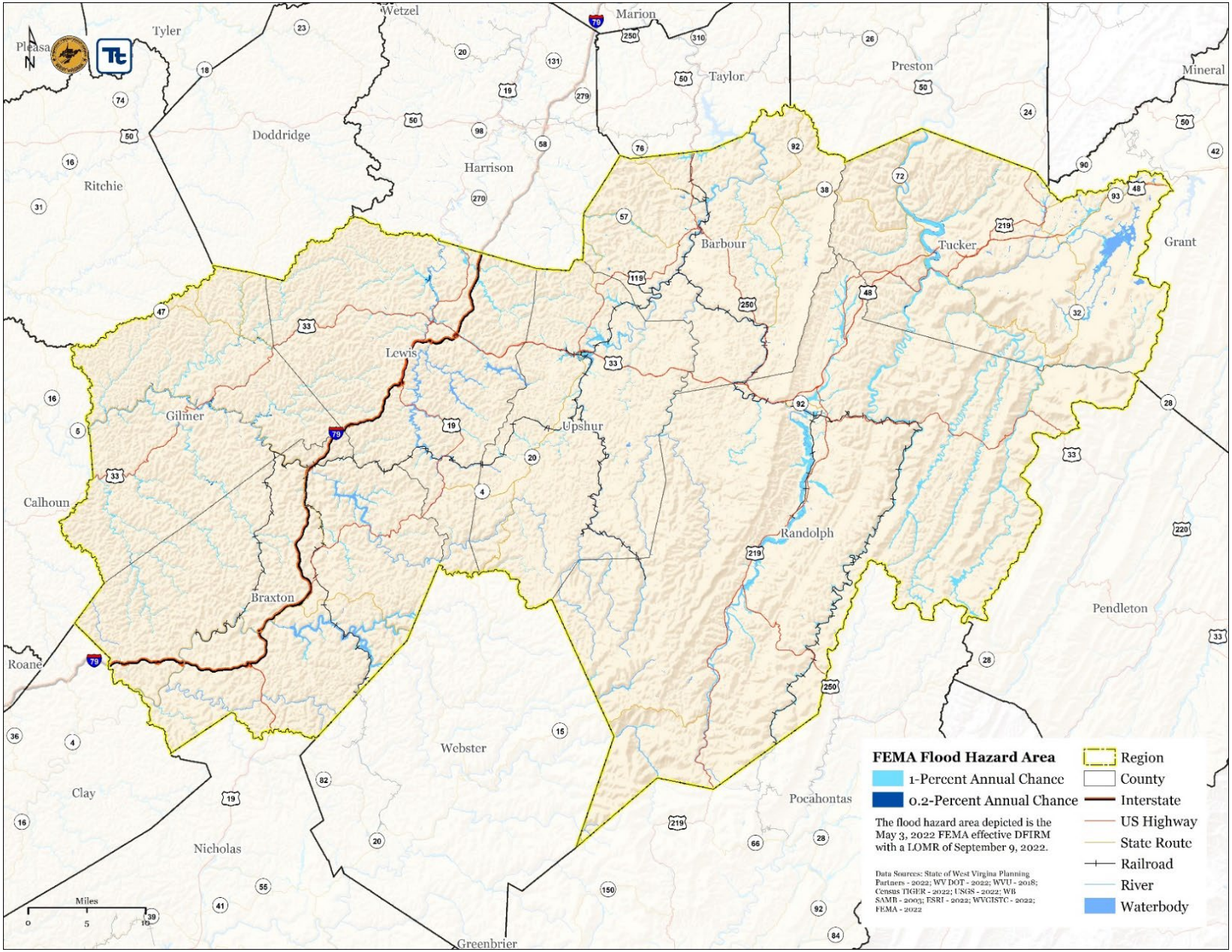


Figure 5.5-10. SFHA in Region 8 of the State of West Virginia

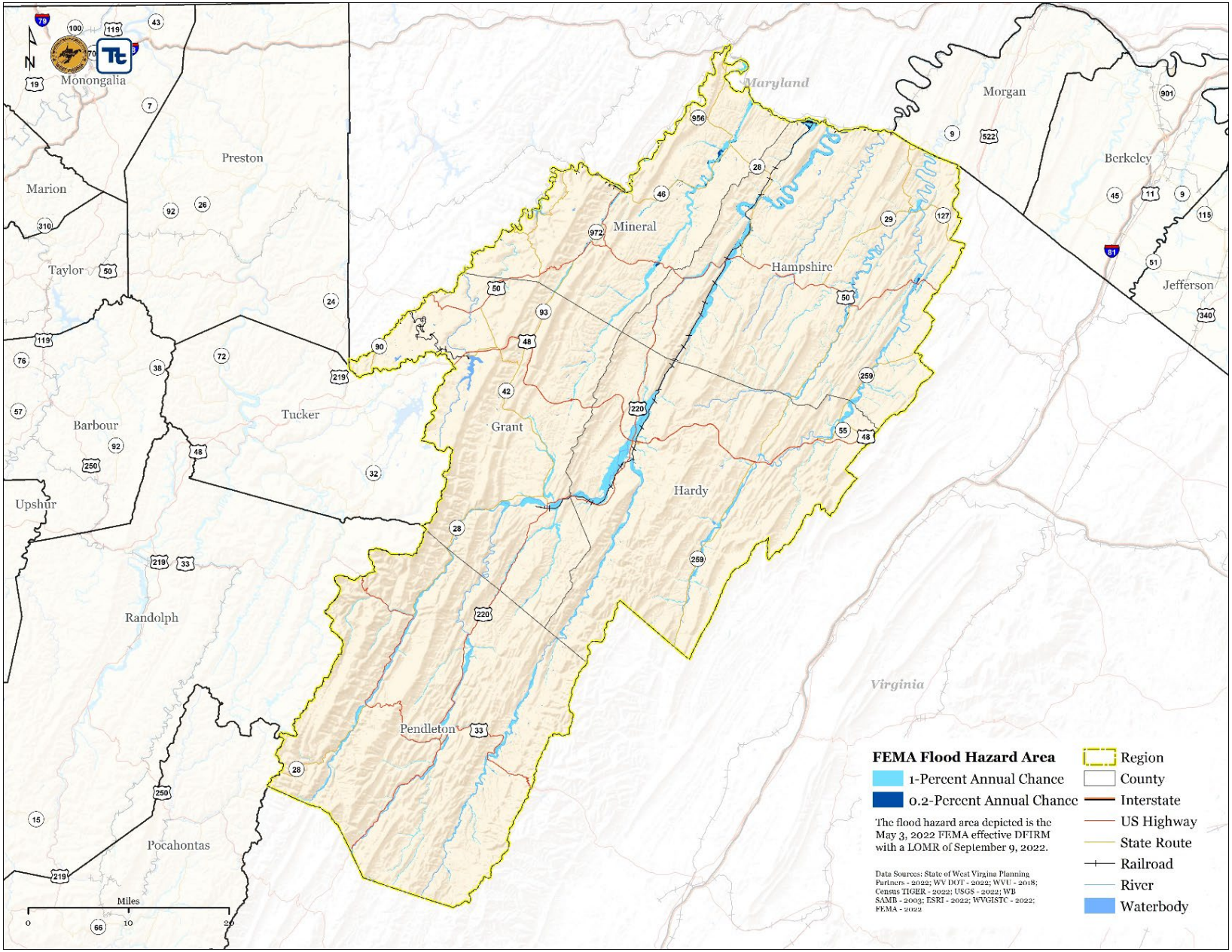


Figure 5.5-11. SFHA in Region 9 of the State of West Virginia

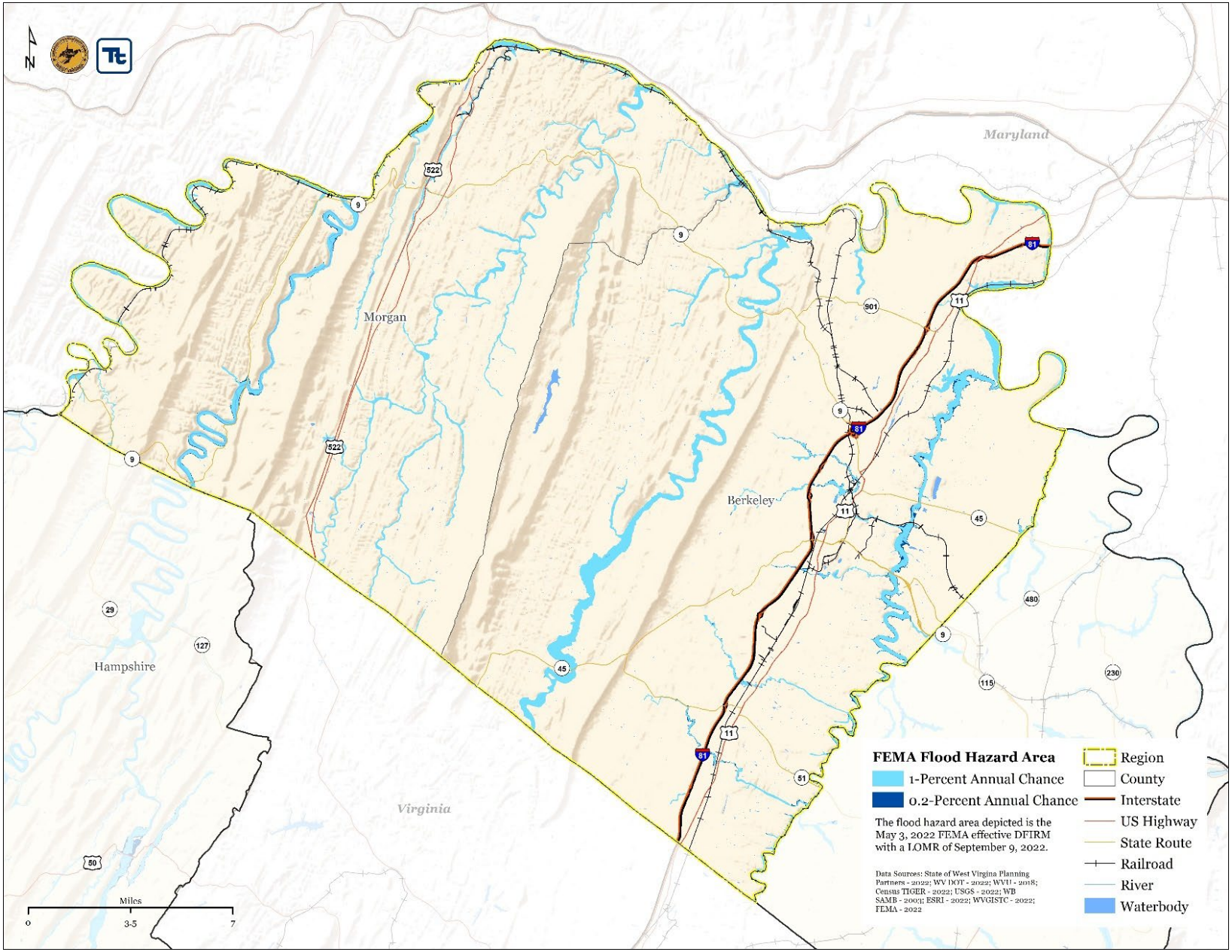


Figure 5.5-12. SFHA in Region 10 of the State of West Virginia

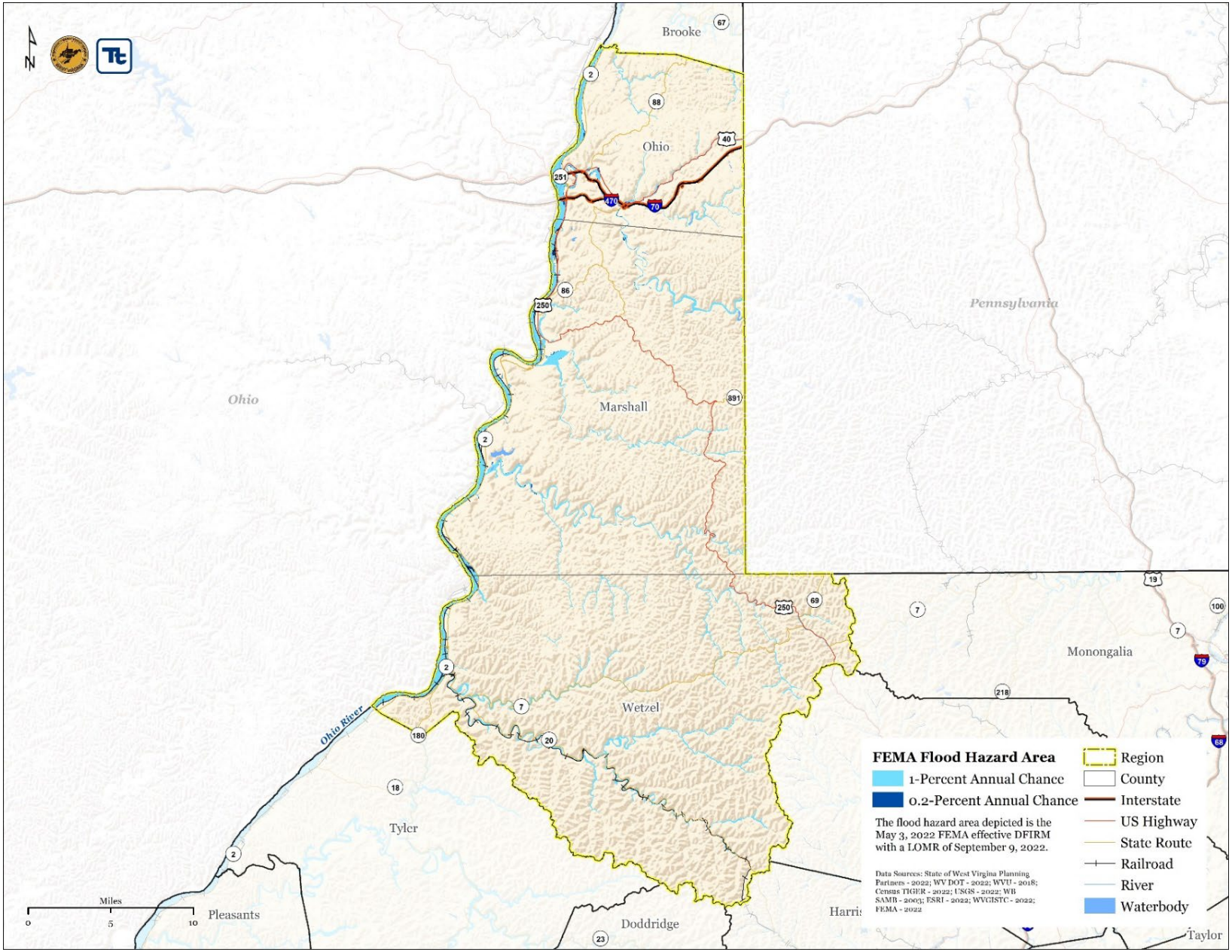


Figure 5.5-13. SFHA in Region 11 of the State of West Virginia

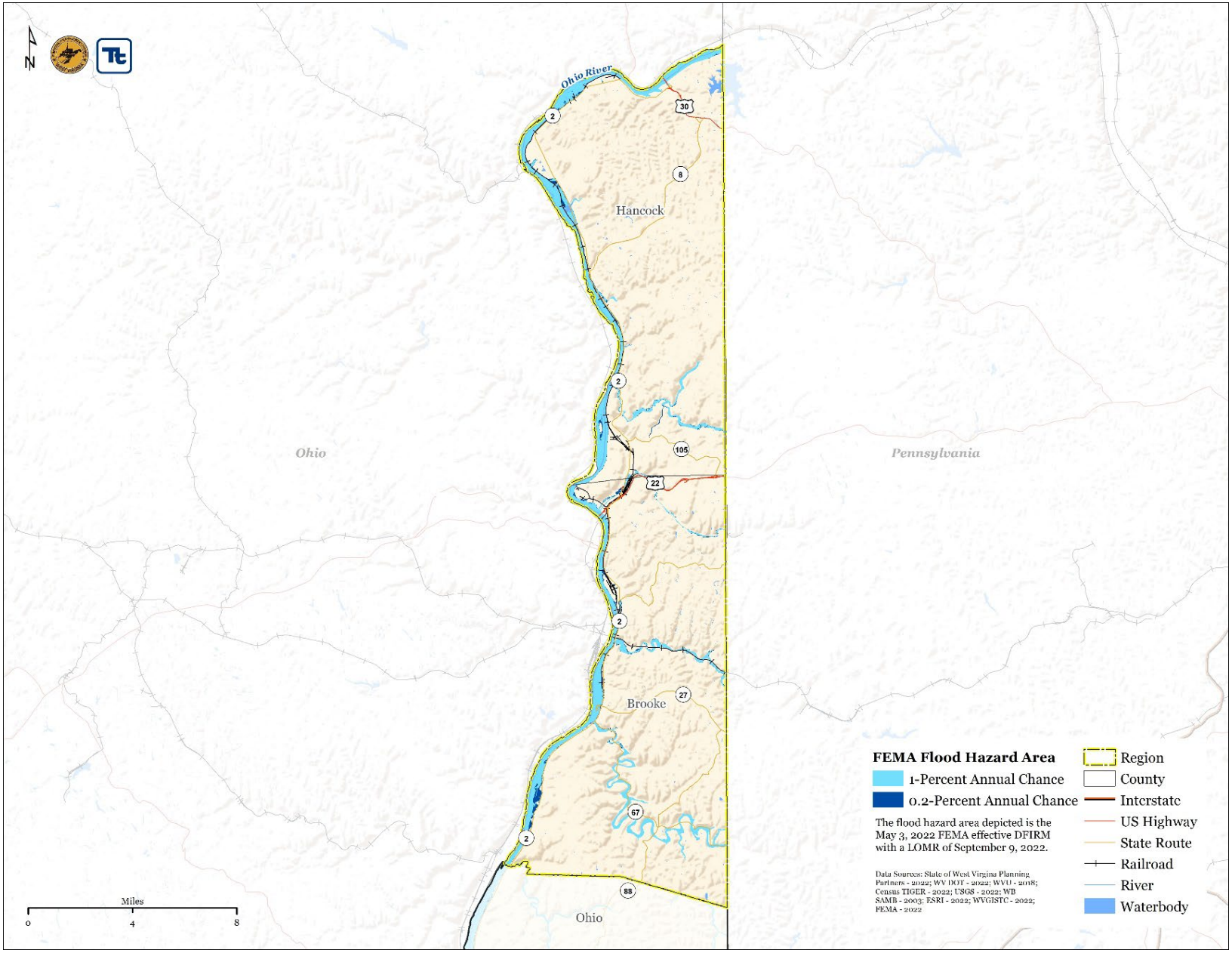
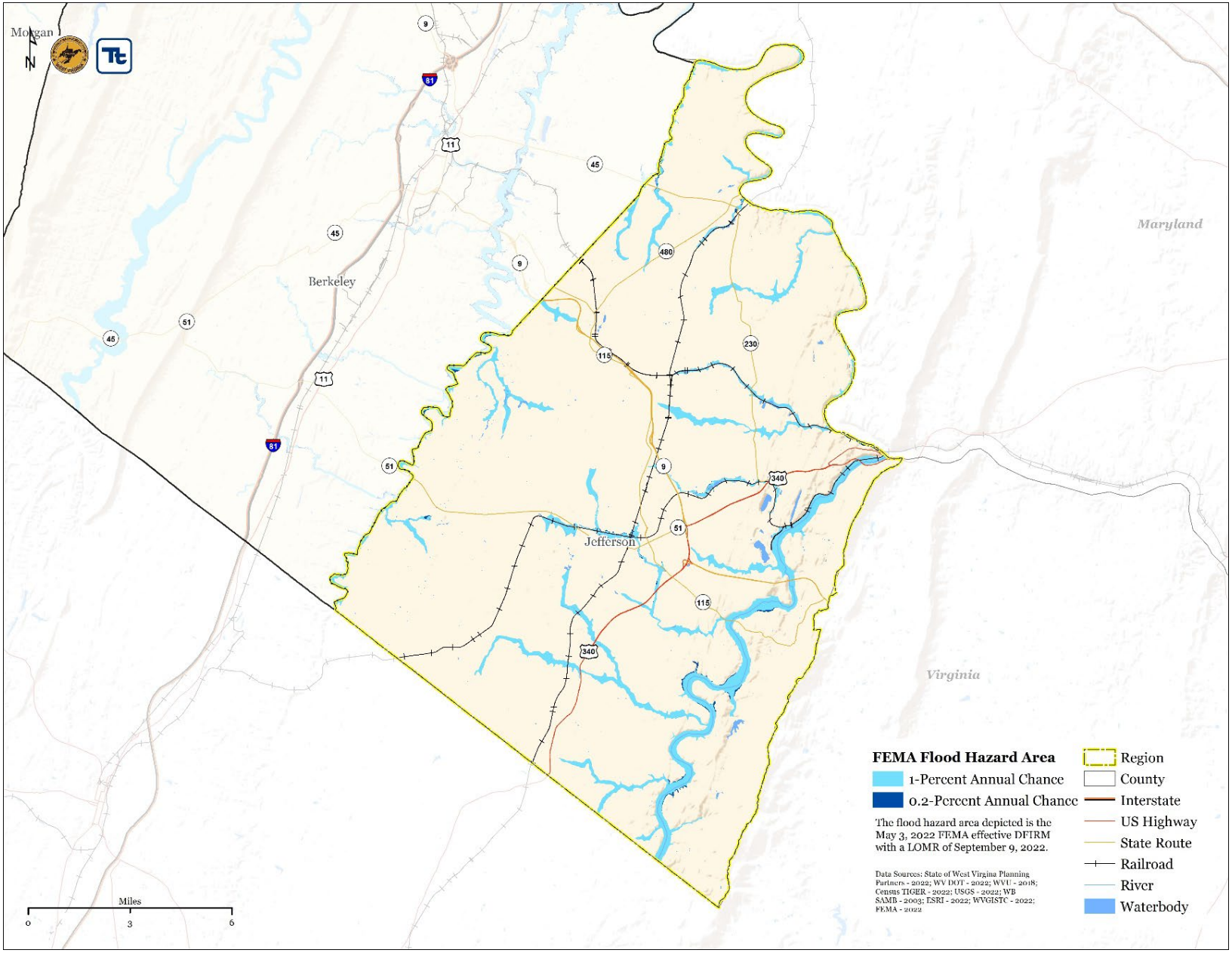


Figure 5.5-14. SFHA in Region 12 of the State of West Virginia



FEMA Flood Insurance Study (FIS)

A FEMA FIS is an engineering study performed to determine a community's risk to flood hazards. A FIS is a compilation and presentation of flood hazard areas along rivers, streams, coasts, and lakes within a community. A FIS is based on different information, including historic information such as river flow, rainfall data, meteorological data, topographic data, hydrologic data, open-space conditions, flood control works, and development (FEMA 2020).

There are a total of 55 counties in the State. Table 5.5-2 identifies the county, the dates of the FIS, and the total number of Flood Insurance Rate Map (FIRM) panels of all the incorporated jurisdictions within each county in the state. It can be common to see a single county with multiple FIS reports, as not all portions of a county may be covered in one FIS report and must be covered in a second or portions of one county were covered in a neighboring county's FIS report.

Table 5.5-2. West Virginia FIS and FIRM Panel Identification by County

County	FIS Report Effective Date(s)	Total Number of FIRM Panels
Barbour County	May 3, 2011	27
Berkeley County	July 7, 2009	34
Boone County	May 16, 2013	36
Braxton County	April 19, 2010	39
Brooke County	April 19, 2010	36
Cabell County	February 19, 2014	71
Calhoun County	June 18, 2010	20
Clay County	February 6, 2013	34
Doddridge County	October 4, 2011	25
Fayette County	September 3, 2010	32
Gilmer County	June 16, 2009	44
Grant County	February 1, 2019	23
Greenbrier County	June 7, 2002, October 16, 2012	57
Hampshire County	November 7, 2002	93
Hancock County	April 19, 2010	28
Hardy County	September 2, 2009	25
Harrison County	October 2, 2012	104
Jackson County	February 18, 2004	70
Jefferson County	December 18, 2009	26
Kanawha County	February 6, 2008 September 3, 2010	132
Lewis County	April 9, 2010	20
Lincoln County	October 16, 2013	89
Logan County	February 6, 2008	59
Marion County	April 5, 2019	66
Marshall County	September 25, 2009	31
Mason County	December 3, 2013	40
McDowell County	June 16, 2005	54
Mercer County	March 2, 2005	80

County	FIS Report Effective Date(s)	Total Number of FIRM Panels
Mineral County	March 19, 2013	39
Mingo County	August 17, 2016	86
Monongalia County	April 5, 2019	35
Monroe County	June 17, 2002	40
Morgan County	September 25, 2009	29
Nicholas County	September 24, 2021	57
Ohio County	July 17, 2006	24
Pendleton County	May 9, 2023	23
Pleasants County	May 5, 2014	30
Pocahontas County	November 4, 2010	108
Preston County	June 5, 2012	42
Putnam County	February 6, 2008 February 2, 2012	56
Raleigh County	June 16, 2009	87
Randolph County	September 29, 2010	46
Ritchie County	February 2, 2012	22
Roane County	March 2, 2012	28
Summers County	October 7, 2021	29
Taylor County	August 2, 2011	19
Tucker County	July 6, 2010	32
Tyler County	September 25, 2009 May 3, 2010	27
Upshur County	September 29, 2010	21
Wayne County	February 19, 2014 September 2, 2016	85
Webster County	May 3, 2022	53
Wetzel County	September 25, 2009	29
Wirt County	August 2, 2012	16
Wood County	November 6, 2013	118
Wyoming County	May 16, 2006	70

Source: FEMA 2023

EXTENT

The strength or magnitude of a flood varies based meteorological, environmental, and geological factors, including latitude, altitude, topography, and atmospheric conditions. Flooding is also affected by seasonal variation, storm characteristics, warning time, speed of onset, and duration. Most floods are preceded by a warning period that allows emergency managers to communicate the need to prepare for the event. A flood may last from minutes to days (O'Connor, Grant and Costa 2002).

Warnings issued through official sources, such as the National Weather Service (NWS) and the Storm Prediction Center, provide the most reliable and timely preparedness information, but the exact flood location and depth depends on the amount, duration, and location of rainfall. Many floods, especially flash floods, occur outside of FEMA-designated flood zones.

In the case of riverine flood hazard, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat:

- Minor Flooding - Minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding - Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding - Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations (NOAA 2021).

Flood Advisory Definitions

Flash Flood Watch: Issued generally when there is the possibility of flash flooding or urban flooding over an area within the next 36 hours.

Flash Flood Warning: Issued when flash flooding is imminent, generally within the next 1 to 3 hours. Usually issued based on observed heavy rainfall (measured or radar estimated), but may also be issued for significant dam breaks that have occurred or are imminent.

Flood Watch: Issued when there is the possibility of widespread general flooding over an area within the next 36 hours.

Flood Warning for River Forecast Point: Issued when a river gauge has exceeded, or is forecast to exceed, a predetermined flood stage.

Flood Advisory: Issued when flooding is imminent or occurring, generally within the next 1 to 3 hours, but is not expected to substantially threaten life and property.

The severity of a flood depends not only on the amount of water that accumulates in a period of time but also on the land's ability to manage this water. The size of rivers and streams in an area and infiltration rates are significant factors. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration rates decrease and any more water that accumulates must flow as runoff (Harris 2001).

The frequency and severity of riverine flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1 percent chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river (USGS 2018).

The extent of flooding associated with a 1 percent annual probability of occurrence (the base flood or 100-year flood) is used by the NFIP as the standard for floodplain management and to determine the need for flood insurance, as well as the regulatory flood boundary by many agencies. Also referred to as the SFHA, this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the water elevation resulting from a given discharge level, which is one of the most important factors used in estimating flood damage. A structure located within an SFHA shown on an NFIP map has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage (FEMA n.d.).

The term "500-year flood" is the flood that has a 0.2 percent chance of being equaled or exceeded each year. The 500-year flood could occur more than once in a relatively short period of time. Statistically, the 0.2 percent (500-year) flood has a 6 percent chance of occurring during a 30-year period of time, the length of many mortgages. The 500-year floodplain is referred to as Zone X500 for insurance purposes on FIRMs. Base flood elevations or depths are not shown within this zone, and insurance purchase is not required in this zone (FEMA 2022).

Flood Control Structures

Flood control structures can significantly alter the extent of flooding in an area. Major flood control structures in the state include dams and levees. For details regarding dams, refer to Section 5.1 (Dam Failure); for details regarding levees, refer to Section 5.8 (Levee Failure).

Warning Time

It is unusual for a flood to occur without warning. Warning time for floods are typically between 24 and 48 hours. Flood warnings and watches are issued by the local National Weather Service (NWS) office. The NWS will update the watches and warnings and will notify the public when they are no longer in effect.

The NWS issues the following flood advisories, watches, and warnings (National Weather Service n.d.):

- **Flood Watch**—A Flood Watch means heavy rain leading to flash flooding is possible. People in the area of a flash flood watch should be prepared for heavy rains and potential flooding. Flood Watches may be issued up to 48 hours before flash flooding is expected.
- **Flood Advisory**—A Flood Advisory means nuisance flooding is occurring or imminent. A Flood Advisory may be upgraded to a Flash Flood Warning if flooding worsens and poses a threat to life and property.
- **Flash Flood Watch**—A Flash Flood Watch means flash flooding is possible due to either 1) causes other than heavy rain (e.g., dam or levee failure), or 2) heavy rain on burn scars leading to the threat of flash flooding and debris flows.
- **Flash Flood Warning**—A Flash Flood Warning means that flooding is occurring or will develop quickly. If a Flash Flood Warning is issued for an area, the population needs to take shelter and/or move to high ground as necessary. Never drive or walk across a flooded roadway.

Previous Occurrences and Losses

Federal Emergency Management Agency (FEMA) Disaster Declarations

Between 1953 and 2022, the State was included in 33 disaster (DR) or emergency (EM) declarations for flood-related events. Generally, these disasters cover a wide region of the state; therefore, they can impact many counties. However, not all counties were included in the disaster declarations as determined by FEMA (FEMA 2022). Table 5.5-3 summarizes the flood-related FEMA disaster declarations between January 1, 1953 and December 31, 2022.

Table 5.5-3. Flood-Related Federal Declarations (1953 to 2022)

Date(s) of Event	Event Type	Federal Designation	Counties Affected
August 4, 1954	Flood	DR-21-WV	Statewide
January 31, 1957	Flood	DR-67-WV	Statewide
July 23, 1961	Floods	DR-117-WV	Statewide

Date(s) of Event	Event Type	Federal Designation	Counties Affected
March 9, 1962	Severe Storm, High Tides, and Flooding	DR-125-WV	Statewide
March 13, 1963	Severe Storms and Flooding	DR-147-WV	Statewide
March 20, 1964	Severe Storms and Flooding	DR-165-WV	Statewide
March 13, 1967	Flooding	DR-224-WV	Barbour, Boone, Braxton, Cabell, Calhoun, Clay, Doddridge, Fayette, Gilmer, Greenbrier, Hampshire, Hardy, Harrison, Jackson, Kanawha, Lewis, Lincoln, Logan, Marion, Mason, Mercer, Mineral, Mingo, Monroe, Morgan, Nicholas, Pocahontas, Putnam, Raleigh, Summers, Tucker, Upshur, Wayne, Wirt, Wood, Wyoming
September 3, 1969	Severe Storms and Flooding	DR-278-WV	Greenbrier, Nicholas, Pocahontas
September 24, 1969	Severe Storms and Flooding	DR-279-WV	Greenbrier
February 27, 1972	Heavy Rains and Flooding	DR-323-WV	Boone, Kanawha, Lincoln, Logan, Mingo, Raleigh, Wyoming
July 3, 1972	Tropical Storm Agnes	DR-344-WV	Barbour, Berkeley, Brooke, Greenbrier, Hampshire, Hancock, Hardy, Jefferson, Marshall, Monongalia, Monroe, Morgan, Ohio, Preston, Wetzel
August 23, 1972	Heavy Rains and Flooding	DR-349-WV	Logan, McDowell, Mingo, Wyoming
January 29, 1974	Severe Storms and Flooding	DR-416-WV	Kanawha, Lincoln, Logan, Mingo, Wayne,
April 11, 1974	Severe Storms and Flooding	DR-426-WV	Fayette, Greenbrier, Raleigh, Wyoming
September 12, 1975	Heavy Rains and Flooding	DR-481-WV	Marshall, Ohio
April 7, 1977	Severe Storms and Flooding	DR-531-WV	Cabell, Greenbrier, Lincoln, Logan, McDowell, Mercer, Mingo, Raleigh, Summers, Wayne, Wyoming
August 24, 1977	Severe Storms, Landslides, and Flooding	EM-3052-WV	Boone, Logan, Mingo
December 14, 1978	Severe Storms and Flooding	DR-569-WV	Cabell, Jackson, Lincoln, Mingo, Wayne
August 15-22, 1980	Severe Storms and Flooding	DR-628-WV	Fayette, Hancock, Harrison, Jackson, Kanawha, Marion, Marshall, Monongalia, Nicholas, Ohio, Preston, Putnam, Raleigh, Taylor, Webster
May 15, 1984	Severe Storms and Flooding	DR-706-WV	Logan, McDowell, Mingo, Wayne
November 3-7, 1985	Severe Storms and Flooding	DR-753-WV	Barbour, Berkeley, Braxton, Calhoun, Doddridge, Gilmer, Grant, Greenbrier, Hampshire, Hardy, Harrison, Jefferson, Lewis, Marion, Mineral, Monongalia, Monroe, Morgan, Nicholas, Pendleton, Pocahontas, Preston, Randolph, Summers, Taylor, Tucker, Tyler, Upshur, Webster
June 23-28, 1995	Severe Storms, Heavy Rains, Flooding, Mudslides	DR-1060-WV	Mercer, Mineral, Nicholas

Date(s) of Event	Event Type	Federal Designation	Counties Affected
January 19- February 2, 1996	Flooding	DR-1096-WV	Berkeley, Brooke, Grant, Greenbrier, Hampshire, Hancock, Hardy, Jefferson, Marshall, Mason, Mercer, Minera, Monroe, Morgan, Nicholas, Ohio, Pendleton, Pleasants, Pocahontas, Preston, Raleigh, Randolph, Summers, Tucker, Tyler, Webster, Wetzel, Wood
May 15- June 10, 1996	Flooding, Heavy Winds	DR-1115-WV	Barbour, Boone, Harrison, Lincoln, Logan, McDowell, Mercer, Mingo, Pendleton, Pocahontas, Raleigh, Randolph, Tucker, Upshur, Wayne, Wetzel, Wyoming
February 28- March 15, 1997	Heavy and Wind Driven Rain, High Winds, Flooding, Landslides, and Mudslides	DR-1168-WV	Braxton, Cabell, Calhoun, Clay, Gilmer, Jackson, Kanawha, Lincoln, Mason, Putnam, Roane, Tyler, Wayne, Wetzel, Wirt, Wood
February 18-22, 2000	Flooding, Severe Storms, and Landslides	DR-1319-WV	Barbour, Braxton, Cabell, Calhoun, Doddridge, Gilmer, Harrison, Jackson, Kanawha, Lewis, Lincoln, Marion, Mason, Monongalia, Preston, Putnam, Randolph, Ritchie, Roane, Taylor, Tucker, Tyler, Upshur, Wetzel, Wirt
June 12-29, 2010	Severe Storms, Flooding, Mudslides, and Landslides	DR-1918-WV	Lewis, Logan, McDowell, Mingo, Wyoming
June 13, 2013	Severe Storms and Flooding	DR-4132-WV	Mason, Roane
April 8-11, 2015	Severe Storms, Flooding, Landslides, and Mudslides	DR-4220-WV	Braxton, Brooke, Doddridge, Gilmer, Jackson, Lewis, Marshall, Ohio, Pleasants, Ritchie, Tyler, Wetzel
April 13-15, 2015	Severe Storms, Flooding, Landslides, and Mudslides	DR-4221-WV	Cabell, Calhoun, Greenbrier, Jackson, Pleasants, Roane, Summers, Wirt
June 22-29, 2016	Severe Storms, Flooding, Landslides, and Mudslides	DR-4273-WV	Clay, Fayette, Greenbrier, Jackson, Kanawha, Lincoln, Monroe, Nicholas, Pocahontas, Roane, Summers, Webster
June 29-30, 2019	Severe Storms, Flooding, Landslides, and Mudslides	DR-4455-WV	Grant, Pendleton, Preston, Randolph, Tucker
February 27-4, 2021	Severe Storms and Flooding	DR-4605-WV	Boone, Kanawha, Lincoln, Logan, Mingo, Wayne
July 12-13, 2022	Severe Storms, Flooding, Landslides, and Mudslides	DR-4678-WV	McDowell
August 14-15, 2022	Severe Storms, Flooding, Landslides, and Mudslides	DR-4679-WV	Fayette

Source: FEMA 2023

U.S. Department of Agriculture (USDA) Disaster Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2012 and 2022, West Virginia was included in 14 flood-related agricultural disaster declarations, as shown in Table 5.5-4.

Table 5.5-4. Flood-Related USDA Declarations (2012 to 2022)

Date(s) of Event	USDA Designation	Description of Disaster	Counties Declared
May 2-4, 2019	USDA-S3386	Flood, Flash Flooding / Excessive Rain, Moisture, Humidity	Cabell, Jackson, Mason, Wood
March 1-August 25, 2015	USDA-S3934	Flood, Flash Flooding / Excessive Rain, Moisture, Humidity	Cabell, Hancock, Jackson, Marshall, Mason, Ohio, Pleasants, Tyler, Wayne, Wetzel, Wood
July 21, 2018-continuing	USDA-S4465	Flood, Flash Flooding / Excessive Rain, Moisture, Humidity	Brook, Hancock, Marshall, Monongalia, Ohio, Preston, Wayne, Wetzel
April 1-December 31, 2018	USDA-S4480	Flood, Flash Flooding / Excessive Rain, Moisture, Humidity / Hail	Braxton, Cabell, Calhoun, Clay, Doddridge, Fayette, Gilmer, Greenbrier, Jackson, Kanawha, Lewis, Mason, Nicholas, Pleasants, Pocahontas, Putnam, Randolph, Ritchie, Roane, Tyler, Upshur, Webster, Wirt, Wood
April 15, 2018-continuing	USDA-S4493	Flood, Flash Flooding / Excessive Rain, Moisture, Humidity / Hail	Hardy, Pendleton
January 20-February 1, 2019	USDA-S4498	Flood, Flash Flooding / Excessive Rain, Moisture, Humidity	Pleasants, Tyler, Wood
January 1-August 13, 2019	USDA-S4532	Flood, Flash Flooding / Excessive Rain, Moisture, Humidity	Cabell, Jackson, Mason, Pleasants, Tyler, Wayne, Wood
January 19-September 4, 2019	USDA-S4541	Flood, Flash Flooding / Excessive Rain, Moisture, Humidity	Marshall, Ohio, Tyler, Wetzel
January 1-August 20, 2019	USDA-S4539	Flood, Flash Flooding / Excessive Rain, Moisture, Humidity	Brooke, Hancock, Ohio,
April 10-May 30, 2020	USDA-S4733	Excessive Rain, Moisture, Humidity	Pleasants, Tyler, Wood
April 10-May 30, 2020	USDA-S4734	Excessive Rain, Moisture, Humidity	Cabell, Wayne
April 10-May 30, 2020	USDA-S4735	Excessive Rain, Moisture, Humidity	Cabell, Jackson, Mason, Wood
April 23-June 5, 2020	USDA-S4747	Excessive Rain, Moisture, Humidity	Wood
July 26-29, 2022	USDA-S5322	Flood, Flash Flooding / Excessive Rain, Moisture, Humidity	Mingo, Wayne

Source: USDA 2023

Previous Events

Many sources provided flooding information regarding previous occurrences and losses associated with flooding events throughout the State. The 2018 SHMP discussed specific flooding events that occurred in the State through 2018. For this 2023 SHMP, flood events were summarized between January 1, 2018, and December 31, 2022.

Table 5.5-5 includes details of major flooding events that occurred in the state between 2018 and 2022. Major events include those that resulted in losses or fatalities, as reported by the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) events that led to a FEMA disaster declaration, and/or event that led to a USDA declaration. Due to over 1,000 events having been recorded between 2018 and 2022, the following criteria was used to narrow the events shown in Table 5.5-5:

- USDA-declared disasters are not included in the below table and can instead be found in Table 5.5-4.

- Only events from the NOAA NCEI Storm Events Database were used in Table 5.5-5.
- Episode narratives are used for the event description.
- Event narratives are not included in the event description.
- Events with fewer than $100,000 in property and/or crop damages are not included in Table 5.5-5.

Table 5.5-5. Flood Events in the State of West Virginia 2018 to 2022

Date(s) of Event	Event Type	Federal Disaster Declaration (if applicable)	Counties Affected	Description
February 16-21, 2018	Flood	DR-4359-WV	Barbour, Cabell, Doddridge, Gilmer, Jackson, Harrison, Kanawha, Lewis, Lincoln, Logan, Mason, Pleasants, Putnam, Randolph, Ritchie, Roane, Taylor, Tyler, Upshur, Wayne, Wood	A wave of low pressure and surface front crossed West Virginia, producing heavy rainfall on the 16th. Generally, 1 to 2 inches of rain fell on already saturated soil. This resulted in creek and stream flooding on the 16th and into the 17th. As the rain drained through the river system, smaller main stem rivers flooded. This eventually led to flooding along the Ohio River. $168,500 of property damages were incurred from this event.
April 15-18, 2018	Flood, Flash Flood, Heavy Rain	N/A	Barbour, Berkeley, Braxton, Fayette, Gilmer,Grant, Greenbrier, Hampshire, Hardy, Harrison, Jefferson, Lewis, Marion, Mason,McDowell, Monongalia, Monroe, Morgan, Nicholas, Pendleton,Pocahontas, Preston,Randolph, Taylor, Tyler, Upshur, Webster	A strong upper-level system combined with a lot of low-level moisture led to a period of heavy rainfall on the 15th into the 16th. Widespread rainfall amounts of 2 to 3 inches fell in 24 to 36 hours from north-central West Virginia into the mountainous counties. This led to flooding on many rivers and streams. Over-saturated ground because of several rounds of rain across the area also lead to several landslides, which did cause some problems in western Pennsylvania and northern West Virginia. Heavy rain of 2 to 4 inches fell in portions of the state, causing flooding mainly in Grant, Pendleton, and Hardy Counties. This water then moved downstream, causing flooding of larger rivers on the 17th and 18th. $136,000 of property damages were incurred from this event.
May 5- 6, 2018	Flood	N/A	Cabell, Greenbrier, Kanawha, Lincoln, Monroe, Pocahontas, Putnam, Randolph, Summers	An upper trough and frontal passage on May 5-6 brought pockets of moderate to heavy rainfall with amounts of 2 to 3 inches across portions of southeast West Virginia. One to two inches of rain fell in 6-12 hours. With saturated ground in place from previous rain, this led to flooding of small creeks, streams, and rivers. $114,000 of property damages were incurred from this event.
May 16-23, 2018	Flood, Flash Flood	N/A	Berkeley, Calhoun, Gilmer, Grant, Greenbrier,	Moderate rain over a two-day period totaled 1-3 inches and was enough to produce some flooding during the afternoon of May 16th. Additional heavy rain affected the far eastern West Virginia panhandle during the evening hours of the 16th, producing 3-5

Date(s) of Event	Event Type	Federal Disaster Declaration (if applicable)	Counties Affected	Description
			Hampshire, Jefferson, Marshall, Mineral, Monroe, Morgan, Tyler, Webster	inches of rain and causing additional flooding. Moderate rain continued through the 18th, causing stream flooding beginning the 17th and continuing through the early morning hours of the 21st. Another band of heavy rain fell in Grant County on May 21st, with 1-3 inches of rain causing flooding in the southeastern part of the county. A cluster of slow-moving thunderstorms over the central portion of the county produced 3 to 4 inches of rain in about a 3-hour period showers and thunderstorms developed in an unstable airmass on the afternoon and evening of the 22nd. The multiple rounds of rain led isolated flooding. $234,000 of property damages and $1,000 in crop damages were incurred from this event.
May 26-28, 2018	Flash Flood	N/A	Braxton, Cabell, Kanawha, Lewis, Mercer, Mineral, Putnam, Summers	The combination of daytime heating and an approaching upper-level trough led to scattered thunderstorm development on the afternoon and evenings of the 26th, 27th, and 28th. While these storms were slow-moving, most moved enough to limit flooding. However, several storms stalled out or kept regenerating over one spot, leading to flash flooding. Locally heavy downpours over central Mercer County produced flash flooding in several small basins near Athens, WV. $3.291 million of property damages were incurred from this event.
July 27-30, 2018	Flash Flood, Heavy Rain	N/A	Braxton, Calhoun, Kanawha, Mercer, Roane	Showers and thunderstorms formed on the 27th as a cold front moved through. Some areas also experienced repetitive storms, causing high water in spots. A nearly stationary cluster of thunderstorms centered between Princeton and Spanishburg dropped rainfall amounts of 4 to 6 inches. Most of the rain fell within about a three-hour period from 830 to 1130 PM. A warm front lifted through West Virginia on the morning of the 30th resulted in a slow-moving thunderstorm that produced excessive rainfall across sections of Central West Virginia. $310,000 of property damages were incurred from this event.
August 3-7, 2018	Flood, Flash, Flood	N/A	Berkeley, Braxton, Jackson, Marshall, Putnam, Wirt,	An upper-level disturbance moved through West Virginia on the 3rd. This resulted in showers and thunderstorms with heavy rain, leading to isolated flash flooding. Torrential downpours combined with convection training over the same areas led to flooding along the Opequon Creek. Isolated thunderstorms managed to form in a hot and humid pattern. Localized flash flooding took place in Marshall County. Showers and thunderstorms on the 7th, produced heavy rainfall and flash flooding in Braxton County. $515,000 of property damages were incurred from this event.
February 20-25, 2019	Flood, Heavy Rain	N/A	Doddridge, Fayette, Harrison, Jackson, Kanawha, Lincoln,	From February 20th to 25th, multiple rounds of precipitation passed across southeast West Virginia resulting in liquid accumulations ranging from around 1.5 to 3 inches. The storm started out on the 20th as a combination of snow, sleet and freezing rain across

Date(s) of Event	Event Type	Federal Disaster Declaration (if applicable)	Counties Affected	Description
			Logan, Mason, McDowell, Mercer, Mineral, Mingo, Monroe, Ritchie, Tyler	the mountains with liquid equivalents of 0.50 up to 2 inches. The next storm arrived early late on February 21st, with warmer air arriving with the system allowing the precipitation to fall mainly as rain, which helped to quickly melt the frozen precipitation which fell during the 24-36 hours prior. With soils already saturated from previous precipitation, runoff from this storm caused mainly minor stream flooding and at least one significant landslide. A warm front lifted northward into West Virginia on the evening of the 23rd, promoting widespread showers and a few isolated thunderstorms due to the proximity of an approaching cold front. Generally, 1 to 1.75 inches of rain fell between the evening of the 23rd and the morning of the 24th. This led to flooding across southern and western portions of the state. Combined with the soggy ground, high winds led to widespread power outages due to downed trees and power lines. $120,000 of property damages were incurred from this event, of which $70,000 were attributed to flooding.
June 30, 2019	Flood, Flash Flood	DR-4455-WV	Grant, Pendleton, Preston, Randolph, Tucker	An unstable environment, plus residual outflow boundaries from previous convection, helped to expand thunderstorm coverage during the evening of the 29th and into the early morning hours of the 30th ahead of a sagging cold front. Storms pushed across Preston and Tucker Counties starting after 10 PM on the 29th. Periods of moderate to heavy rain occurred until around 5 AM the following morning as back building storms continued through the night. Rainfall totals of 2 to 4 inches were observed over southern portions of Preston County and over much of Tucker County, resulting in some reports of flash flooding. A few water rescues were necessary at Arnold Park Campground, as well as in Jenningston. Heavy amounts of rain in a short period of time fell in areas near the Appalachian Mountains in West Virginia. The heavy amounts of rain caused creeks and streams to rapidly rise out of their banks. $1.053 million of property damages were incurred from this event.
June 17-21, 2020	Flood, Flash Flood, Heavy Rain	N/A	Calhoun, Greenbrier,Monroe, Pendleton, Summers, Webster	Persistent rainfall led to flooding. There were repeated rounds of heavy rainfall with widespread amounts of 2 to 5 inches. The most notable rainfall was a localized thunderstorm near Alderson, WV that caused severe flash flood damage on the afternoon of June 17th. An upper-level disturbance parked over the Ohio Valley resulted in afternoon showers and thunderstorms on the 18th and 19th across portions of West Virginia. This spawned local flooding issues in Calhoun and Webster Counties. Previous rainfall and slow-moving storms contributed to high water issues on both days. Roughly $1.341 million of property damages were incurred from this event.

Date(s) of Event	Event Type	Federal Disaster Declaration (if applicable)	Counties Affected	Description
July 30, 2020	Flash Flood	N/A	Braxton, Calhoun, McDowell, Upshur	Slow-moving showers and storms produced very heavy rainfall through the afternoon and evening. In the areas of heaviest rain, which stretched from Huntington northeastward to near Elkins, 2 to 4 inches of rain was common, and several gauges indicated more than 4 fell. In fact, two gauges around Grantsville measured 5.12 and 5.04 of rain. A second, more localized, area of heavy rain fell in Tazewell County, VA northward into the headwaters of the Dry Fork of the Tug River in McDowell and Mercer Counties. Runoff from this heavy rain flowed down the Dry Fork of the Tug River overnight causing flooding. $471,000 of property damages were incurred from this event.
August 27-28, 2020	Flood, Flash Flood	N/A	Braxton, Clay, Nicholas, Ohio, Roane, Webster, Wirt	Tropical moisture from the remnants of Marco and Laura led to showers and thunderstorms on the 27th. Multiple rounds of rain resulted in a narrow swath of 2 to almost 5 inches of rain across the foothills of West Virginia. Compromised soils from previous rainfall earlier in the week made this area very susceptible to flooding, leading to local high water issues along the roadways. Flooding was also reported in Ohio County. $105,000 of property damages were incurred from this event.
February 27-March 2, 2021	Flood, Flash Flood, Heavy Rain	DR-4605-WV	Barbour, Boone, Braxton, Cabell, Clay, Fayette, Greenbrier, Hampshire, Kanawha, Jackson, Jefferson,Lincoln, Logan, Mason, McDowell, Mercer, Mineral, Mingo, Morgan, Pocahontas, Putnam, Raleigh, Randolph, Ritchie, Roane, Summers, Tyler, Wayne, Webster, Wirt, Wood, Wyoming	Rainfall amounts ranging generally from 1.25 to nearly 2 inches across Mercer County. Most of the rain fell across a 4- to 5-hour period during the morning. Waves of rain, heavy at times, moved across the region during the afternoon of February 26th through the morning of March 1st. Creeks and streams rose out of their banks by the final day of February, resulting in flooded roadways across West Virginia. Several water rescues were conducted in Putnam County on the 28th due to vehicles becoming submerged by rapidly rising water. An additional inch or two of rainfall on February 28th, along with partial melting of snowpack in the mountains, led to some isolated flooding across eastern West Virginia. Over 4 inches of rain fell across West Virginia from the final few days of February through the morning of Monday, March 1st. Multiple disturbances passed through the state during this time and caused periods of heavy rain. The most rain from this event fell south of the I-64 corridor, but the entire state observed at least 1 to 2 inches of rain over the span of four days. This contributed to notable flooding across West Virginia as local creeks rose out of their banks and spilled onto local roadways. Moderate river flooding took place during the first few days of March, with some river gauges recording historic crests, including the Coal, Elk, and Tug Fork Rivers. $554,560 of property damages were incurred from this event.
June 9-11, 2021	Flood, Flash Flood	N/A	Braxton, Cabell, Calhoun, Clay,	Showers and thunderstorms occurred over the span of a few days, which resulted in several instances of flash flooding in West Virginia. The most substantial flooding took

Date(s) of Event	Event Type	Federal Disaster Declaration (if applicable)	Counties Affected	Description
			Doddridge, Gilmer, Hampshire, Hardy, Harrison, Jackson, Jefferson, Kanawha, Lewis, Lincoln, Logan, Marion, Mason, Mineral, Upshur, Webster	place near the Town of Hamlin in Lincoln County, where 25 homes were damaged and 2 were destroyed due to a washed-out culvert. $1.265 million of property damages were incurred from this event.
June 13-14, 2021	Flood, Flash Flood	N/A	Braxton, Boone, Calhoun, Clay, Doddridge, Gilmer, Harrison, Lewis, Marion, Monongalia, Pocahontas, Preston, Roane, Tyler, Upshur, Wood	A strong cold front in accordance with a passing low-pressure system pressed into West Virginia. Strong to severe thunderstorms on the evening of June 13th resulted in heavy downpours. Several counties observed flash flooding. The most notable events occurred in Gilmer County, where a large shed on a golf course was swept away by the rushing high water, and Pocahontas County, where a swift water rescue was conducted in the town of Frost. Several thunderstorms on June 14th became severe that evening which resulted in downed trees and power lines due to damaging wind gusts. Rain from the previous day's severe weather primed the area for flash flooding and heavy downpours on the 14th ultimately resulted in high water issues in the Buckhannon area. $148,000 of property damages were incurred from this event.
August 31-September 1, 2021	Flood, Flash Flood, Heavy Rain	N/A	Barbour, Braxton, Brooke, Cabell, Clay, Jefferson, Lincoln, McDowell, Mingo, Ohio, Preston, Tucker, Upshur, Wayne, Wyoming	The remnant low pressure center of Hurricane Ida passed across West Virginia and the Central Appalachian Mountains from late August 31st through September 1st. The abundant moisture associated with the low intersected a frontal zone, which was nearly stalled in the Ohio Valley, leading to periods of heavy rain over eastern Ohio over the two-day period, both from thunderstorms ahead of the low and from a period of tropical rainfall during the morning of the 1st. Rain tapered off by the afternoon as the remnants of Ida pulled towards the Mid-Atlantic coast. Rainfall totals over the two-day period across the northern panhandle were highest in Brooke and Ohio Counties, with 3 to 5 inches observed. The Town of Bethany had a notable number of closed roads. Similar rain totals were seen in Preston and Tucker Counties as well, with many reports of flooding received. Roads feeding into the Cheat Valley Highway were impacted, and the towns of Tunnelton, Rowlesburg, and Terra Alta reported many road closures. In Albert, several homes were evacuated along Horseshoe Run Road. $152,000 of property damages were incurred from this event.

Date(s) of Event	Event Type	Federal Disaster Declaration (if applicable)	Counties Affected	Description
May 6-8, 2022	Flood, Flash Flood	N/A	Barbour, Berkeley, Boone, Cabell, Calhoun, Clay, Doddridge, Gilmer, Hampshire, Jackson, Jefferson, Kanawha, Lincoln, Mason, Mineral, Morgan, Putnam, Randolph, Roane, Tyler, Upshur, Wayne	Heavy rainfall May 6th. A swath of 3 to 4 inches of rain fell in a narrow corridor from Huntington northeastward to Elkins, with a few isolated pockets of 4 to 5 reported. This led to considerable flash flooding. Multiple water rescues took place throughout the Metro Valley, including a man who was swept away while working on his tractor in Cabell County. Additionally, several vehicles were submerged in floodwaters, and over 100 homes were impacted by high water, with the hardest hit area being the Enslow Park community of Huntington. Flooding occurred across many roadways throughout West Virginia, leaving multiple roads impassable for a time until the water receded. Even after the rain had concluded, several rivers in the state rose out of their banks for the next several days. This resulted in flooding along areas adjacent to the rivers. Roughly $1.132 million of property damages were incurred from this event.
July 12, 2022	Flood, Flash Flood	DR-4678-WV	Kanawha, McDowell, Putnam, Raleigh	Showers and storms with strong winds, large hail, and heavy downpours led to high water issues across the state. Roughly $1.008 million of property damages were incurred from this event.
July 27-August 2, 2022	Flood, Flash Flood	N/A	Braxton, Cabell, Clay, Fayette, Greenbrier, Jackson, McDowell,Mingo, Wayne, Webster, Wyoming	A deluge of showers and thunderstorms continuously rocked West Virginia during the final week of July as a stationary frontal boundary remained draped over the state for a prolonged period. Waves of energy flowing along the front contributed to these bursts of heavy rainfall, which gradually tarnished soil conditions. Up to 5 inches of rain fell in spots south of the Interstate 64 corridor between July 26th and 27th. Flash flooding during this time resulted in local creeks and streams rising out of their banks and spilling onto roads, primarily in Mingo, Fayette, McDowell, and Wyoming Counties. The Scarbro community in Fayette County was evacuated during the early morning hours of the 27th due to the abundance of high water impacting the township. Low pressure drew in a cold front beginning on the afternoon of August 1st. In advance of this feature, afternoon heating and residing unstable conditions contributed to the development of scattered showers and thunderstorms. Antecedent rainfall ahead of this event resulted in susceptible soil conditions, which coupled with heavy rainfall that day, led to flash flooding. Mingo County was inundated with heavy rain on the morning of the 1st and continued to see rain occur into the early afternoon. The quick rise and continued deluge of water of the local creeks and streams resulted in flooding along the adjacent roadways. Residential bridges were washed out because of these heavy rains, and several homes within the county were damaged. The cold front arrived in West Virginia on the morning of August 2nd, which continued the threat for flash flooding across the eastern

Date(s) of Event	Event Type	Federal Disaster Declaration (if applicable)	Counties Affected	Description
				portions of the state. The boundary stalled nearby that afternoon, leading to several rounds of showers and strong thunderstorms. Braxton County observed a combination of strong winds and heavy rainfall, resulting in downed trees and flooded roadways. Roughly $1.630 million of property damages were incurred from this event.
August 10-11, 2022	Flood, Flash Flood	N/A	Cabell, Calhoun, Doddridge, Gilmer, Hampshire, Harrison, Jackson, Kanawha, Nicholas, Ritchie, Wayne, Wood	The combination of slow-moving and repetitive storms led to heavy downpours through August 10th and 11th. 24-hour rainfall amounts reported by local observers and weather stations ranged from 1.5 to 3 inches in most places, with locally higher amounts on the upwards of 5 inches observed across north-central West Virginia. Numerous roads across the northern half of the state became flooded, primarily during the afternoon when storms were at their strongest. This resulted in a few water rescues as vehicles became submerged by the inundating rainfall. Several homes in Ritchie County became surrounded by water for a period of time as well. The most significant damage transpired in Doddridge County, where the building of the local senior center was shoved five feet off its foundation due to the deluge of water. Roughly $2.445 million of property damages were incurred from this event.
August 15-16, 2022	Flash Flood	DR-4679-WV	Fayette, Greenbrier, Kanawha	A narrow band of heavy rain fell across the I-64 corridor during the early morning hours of August 15th. The Charleston airport reported 4.33 inches of rain had fallen since the previous evening, with radar estimates ranging from 2 to 5 inches from Putnam to Fayette Counties. The Campbells Creek area of Kanawha County observed significant damage from flash flooding, with damage costs extending close to one million dollars. Flash flooding was also observed in the Scrabble Creek area of Fayette County. The Governor of West Virginia declared a State of Emergency for Kanawha and Fayette Counties due to the flooding, and recovery and clean-up efforts spanned weeks after the event occurred. Another round of showers and storms transpired on the afternoon of August 16th, which once again caused high water issues within Fayette County. Roughly $10 million of property damages were incurred from this event.

Sources: NOAA NCEI 2023; FEMA 2023
FEMA Federal Emergency Management Agency
N/A Not Applicable
USDA U.S. Department of Agriculture

PROBABILITY OF FUTURE HAZARD EVENTS

Overall Probability

Flooding is common in the State and can take place any time of the year; however, flooding is more frequent during the rainy season, which runs from May through July (NOAA 2022). In recent decades, the state has had flood-related disaster declarations nearly every year. These disasters have often been associated with heavy rainstorms that also caused landslides and mudslides (U.S. EPA 2016). Based on the history of flooding events and the potential impacts from changing future conditions, flooding events will most likely become more frequent throughout the state. Based on the historic flood events in the State, it is clear that there is a high probability of future flood events for the future.

According to FEMA-Designated Disasters, USDA Designated Disasters, the NOAA NCEI Storm Events Database, and the 2018 SHMP, the State experienced over 1,000 flood-related events between 2018 and 2022, as summarized in Table 5.5-6.

Table 5.5-6. Probability of Future Flood Events in West Virginia

Hazard Type	Number of Occurrences between 2018 and 2022	Percent Chance of Occurrence in Any Given Year
Excessive Localized Rainfall (Heavy Rain)	71	98.61
Flash Flood	428	100
Riverine and Stormwater Flood (Flood)	571	100
Total	1,070	100

Sources: FEMA 2023; NOAA NCEI 2023; USDA 2023; State of West Virginia 2018

Based on the history of flood events and the impending impacts of changing future conditions, flood events may become more frequent throughout West Virginia.

Projected Future Conditions

In the future, severe rain events are expected to become more frequent and more intense across the United States (U.S. Global Change Research Program 2018).

Moderate flooding events are expected to become more frequent in most of the Northeast during the 21st century because of more intense precipitation. These extreme precipitation events will likely increase rates of erosion on waterways across the State, particularly in areas without natural or built protection (U.S. Global Change Research Program 2018).

5.5.2 Vulnerability Assessment

To assess the state's risk to the flood hazard, a spatial analysis was conducted using the best available spatially delineated flood hazard areas. In summary, to determine exposure, the hazard areas were overlaid with the assets to determine the total number and replacement cost value located in the hazard areas. If the asset is in the hazard area, it is deemed exposed to the hazard and potentially vulnerable to loss. FEMA's Hazus flood model was used to estimate potential losses to structures from event-based flooding by looking at the depth of flooding at each structure location.

STATE ASSETS

The exposure analysis for the event-based flooding hazard shown in Table 5.5-7. , determined there are 98 State buildings located in the SFHA and 245 in the 0.2 percent annual chance floodplain. Kanawha County has the most State buildings (9), and Preston County has the greatest total replacement cost value ($44.3 million) exposed to the 1 percent annual chance flood. Kanawha County also has the most State buildings (118) and total replacement cost ($507.9 million) exposed to the 0.2 percent annual chance flood.

Table 5.5-7. State Buildings Located in the 1 percent and 0.2 percent Annual Chance Floodplain by County

County	State Buildings in the 1% Annual Chance Floodplain		State Buildings in the 0.2% Annual Chance Floodplain	
	Number	Total Replacement Cost Value (Structure + Contents)	Number	Total Replacement Cost Value (Structure + Contents)
Barbour	4	$898,389	4	$898,389
Berkeley	0	$0	0	$0
Boone	4	$19,654,600	4	$19,654,600
Braxton	0	$0	0	$0
Brooke	2	$60,000	2	$60,000
Cabell	5	$7,801,796	6	$7,805,796
Calhoun	1	$300,000	1	$300,000
Clay	0	$0	0	$0
Doddridge	3	$39,029,601	3	$39,029,601
Fayette	0	$0	1	$31,836,767
Gilmer	0	$0	1	$0
Grant	0	$0	0	$0
Greenbrier	2	$0	2	$0
Hampshire	0	$0	0	$0
Hancock	1	$60,000	1	$60,000
Hardy	0	$0	0	$0
Harrison	1	$1,050,077	3	$5,124,114
Jackson	0	$0	0	$0
Jefferson	0	$0	0	$0
Kanawha	9	$11,355,713	118	$507,895,312
Lewis	5	$848,000	6	$3,088,145
Lincoln	0	$0	0	$0
Logan	3	$15,000	3	$15,000
Marion	3	$525,000	3	$525,000
Marshall	0	$0	2	$514,600
Mason	0	$0	0	$0
McDowell	7	$1,830,000	7	$1,830,000
Mercer	0	$0	7	$2,033,785
Mineral	1	$50,000	2	$50,000
Mingo	0	$0	7	$835,300
Monongalia	2	$754,425	2	$754,425
Monroe	1	$0	1	$0
Morgan	4	$678,600	4	$678,600

County	State Buildings in the 1% Annual Chance Floodplain		State Buildings in the 0.2% Annual Chance Floodplain	
	Number	Total Replacement Cost Value (Structure + Contents)	Number	Total Replacement Cost Value (Structure + Contents)
Nicholas	0	$0	2	$15,000
Ohio	5	$13,735,834	8	$14,918,593
Pendleton	1	$6,900	1	$6,900
Pleasants	0	$0	0	$0
Pocahontas	2	$65,000	2	$65,000
Preston	2	$44,274,475	2	$44,274,475
Putnam	3	$28,928,546	10	$74,341,198
Raleigh	3	$35,000	3	$35,000
Randolph	0	$0	0	$0
Ritchie	2	$434,000	2	$434,000
Roane	2	$2,105,840	2	$2,105,840
Summers	0	$0	0	$0
Taylor	1	$7,096,492	1	$7,096,492
Tucker	1	$52,300	1	$52,300
Tyler	0	$0	1	$10,000
Upshur	0	$0	1	$85,000
Wayne	5	$1,239,769	6	$1,239,769
Webster	2	$55,000	2	$55,000
Wetzel	3	$75,900	3	$75,900
Wirt	1	$28,500	1	$28,500
Wood	6	$949,800	6	$949,800
Wyoming	1	$113,400	1	$113,400
Total (WV State)	**98**	**$184,107,957**	**245**	**$768,891,601**

Source:State of West Virginia Emergency Management Division; FEMA 2022
Note: Replacement cost for structure and contents were provided by the State. Values for various facilities were not provided.

Table 5.5-8 summarizes State buildings and total replacement costs of those buildings located in the SFHA by agency. The Division of Highways has the greatest number of State buildings (13), and the State Armory Board has the highest total replacement cost value ($74.2 million) exposed in the 1 percent annual chance floodplain. The Department of Health and Human Resources has the greatest number of State buildings (29), and the General Services Division of the Department of Administration has the highest total replacement cost value ($162.0 million) exposed in the 0.2 percent annual chance floodplain.

Table 5.5-8. Replacement Cost Value for State Facilities within the 1 percent and 0.2 percent Annual Chance Floodplain by Agency

Agency	State Buildings in the 1% Annual Chance Floodplain		State Buildings in the 0.2% Annual Chance Floodplain	
	Number	Total Replacement Cost Value (Structure + Contents)	Number	Total Replacement Cost Value (Structure + Contents)
Adjutant General's Office State of West Virginia	0	$0	0	$0
Administration, Secretary of Department of Administration	0	$0	1	$112,000
Agriculture, Department of State of West Virginia	0	$0	1	$10,000

Agency	State Buildings in the 1% Annual Chance Floodplain		State Buildings in the 0.2% Annual Chance Floodplain	
	Number	Total Replacement Cost Value (Structure + Contents)	Number	Total Replacement Cost Value (Structure + Contents)
Air And Environmental Quality Boards State of West Virginia	0	$0	1	$60,000
Alcohol Beverage Control Administration State of West Virginia	0	$0	1	$13,773,535
Architects, Board of State of West Virginia	0	$0	1	$17,000
Armory Board State of West Virginia	7	$74,203,098	10	$106,847,027
Arts, Culture & History, Department of State of West Virginia	1	$6,384	2	$6,384
Attorney General, Office of The State of West Virginia	0	$0	0	$0
Aviation, Division of	0	$0	0	$0
Bar, State State of West Virginia	0	$0	0	$0
Barbers & Cosmetologists, Board of State of West Virginia	0	$0	1	$100,000
Blue Ridge Community & Technical College	0	$0	0	$0
Bluefield State College	0	$0	0	$0
Board of Treasury Investments	0	$0	1	$70,000
Bridgevalley Community & Tech College	0	$0	1	$31,836,767
Cedar Lakes Conference Center State of West Virginia	0	$0	0	$0
Chiropractic Examiners Board State of West Virginia	0	$0	1	$100,000
Commission For National And Community Service, WV	0	$0	1	$80,000
Concord University	0	$0	0	$0
Conservation Agency, West Virginia State of West Virginia	0	$0	1	$9,600
Consolidated Public Retirement Board Department of Administration	0	$0	0	$0
Consumer Advocate, Division of WV Public Service Commission	0	$0	1	$150,000
Corrections, Division of State of West Virginia	2	$38,772,601	6	$51,215,601
Courthouse Facilities Improvement Authority	0	$0	0	$0
Dentistry, Board of State of West Virginia	1	$35,000	1	$35,000
Department of Transportation	0	$0	0	$0
Dietitians, Board of Licensed	0	$0	0	$0
Eastern Panhandle Instructional Coop	2	$515,000	2	$515,000
Eastern WV Community & Tech. College	0	$0	0	$0
Economic Development Authority State of West Virginia	0	$0	0	$0
Economic Development, WV Dept of	0	$0	0	$0
Education, Department of State of West Virginia	3	$19,874,800	4	$19,899,800
Educational Broadcasting Authority State of West Virginia	0	$0	0	$0
Enterprise Resource Planning Board, WV	0	$0	1	$2,000,000
Environmental Protection, Department of State of West Virginia	4	$1,712,680	8	$3,005,439
Ethics Commission, West Virginia Department of Administration	0	$0	1	$130,000
Examiners In Counseling, Board of State of West Virginia	0	$0	1	$6,000
Fairmont State University	0	$0	0	$0
Fire Commission State of West Virginia	0	$0	1	$500,000
Fleet Management Office, Dept of Admin State of West Virginia	0	$0	1	$50,000

Agency	State Buildings in the 1% Annual Chance Floodplain		State Buildings in the 0.2% Annual Chance Floodplain	
	Number	Total Replacement Cost Value (Structure + Contents)	Number	Total Replacement Cost Value (Structure + Contents)
Forestry, Division of State of West Virginia	6	$490,000	6	$490,000
General Services Division Department of Administration	1	$5,143,522	8	$161,979,223
Geological And Economic Survey State of West Virginia	0	$0	0	$0
Glenville State College	0	$0	0	$0
Governor, Office of The State of West Virginia	0	$0	1	$2,000,000
Health & Human Resources, Department of State of West Virginia	9	$4,630,000	29	$159,905,000
Higher Education Policy Commission, WV	0	$0	1	$1,542,246
Highways, Division of State of West Virginia	13	$4,418,259	28	$36,673,672
Homeland Security & Emergency Management Division	0	$0	1	$205,000
Insurance Commissioner, Office of The State of West Virginia	0	$0	0	$0
Investment Management Board, WV State of West Virginia	0	$0	1	$2,500,000
Joint Committee On Government & Finance State of West Virginia	0	$0	0	$0
Justice & Community Services, Div. of	0	$0	1	$750,000
Juvenile Services, Division of	2	$168,200	5	$1,058,200
Labor, Division of State of West Virginia	0	$0	0	$0
Land Division/Dept of Agriculture State of West Virginia	0	$0	0	$0
Landscape Architects, Board of State of West Virginia	0	$0	1	$2,500
Library Commission State of West Virginia	0	$0	0	$0
Lottery Commission State of West Virginia	0	$0	1	$54,700,000
Marshall University	0	$0	0	$0
Military Affairs, Secretary of And Public Safety	0	$0	1	$350,000
Miner's Health Safety, Division of And Training, State of West Virginia	1	$25,000	1	$25,000
Motor Vehicles, Division of State of West Virginia	1	$125,000	6	$1,284,710
Mountain State Esc	0	$0	0	$0
Mountwest Community & Technical College	0	$0	0	$0
National Coal Heritage Area Authority	0	$0	0	$0
Natural Resources, Division of State of West Virginia	5	$721,900	6	$1,721,900
New River Community & Technical College	0	$0	0	$0
Northern Community & Tech College, WV College Square	1	$10,900,000	1	$10,900,000
Occupational Therapy Board State of West Virginia	0	$0	0	$0
Office of Technology/Is&C Department of Administration	0	$0	5	$22,382,000
Osteopathic Medicine, WV Board of State of West Virginia	0	$0	1	$25,000
Osteopathic Medicine, WV School of	0	$0	1	$12,900
Parks, West Virginia State C\O Division of Natural Resources	9	$15,316,188	9	$15,316,188
Pharmacy, Board of State of West Virginia	0	$0	0	$0
Physical Therapy, Board of State of West Virginia	0	$0	0	$0
Pierpont Community And Technical College	0	$0	0	$0
Practical Nurses, Board of State of West Virginia	0	$0	0	$0
Prosecuting Attorneys Institute, WV	0	$0	1	$121,000
Psychologists Examiners, Board of State of West Virginia	0	$0	1	$45,000
Public Service Commission State of West Virginia	0	$0	2	$18,209,069

Agency	State Buildings in the 1% Annual Chance Floodplain		State Buildings in the 0.2% Annual Chance Floodplain	
	Number	Total Replacement Cost Value (Structure + Contents)	Number	Total Replacement Cost Value (Structure + Contents)
Purchasing, Division of Department of Administration	1	$905,000	2	$1,351,000
Rail Authority State of West Virginia	0	$0	0	$0
Real Estate Commission State of West Virginia	0	$0	1	$150,000
Regional Jail & Corr. Fac. Authority State of West Virginia	0	$0	0	$0
Registered Nurses, Board of State of West Virginia	0	$0	1	$250,000
Rehabilitation Services Division of Commerce	3	$463,825	9	$6,614,074
Respiratory Care, WV Board of	0	$0	0	$0
School Building Authority, West Virginia	0	$0	0	$0
Schools For The Deaf And The Blind State of West Virginia	0	$0	0	$0
Senior Services, Bureau of State of West Virginia	0	$0	0	$0
Shepherd University	0	$0	0	$0
Southern Educational Services Coop	0	$0	0	$0
Southern WV Community & Tech College	0	$0	0	$0
Speech Pathology & Audiology Examiners West Virginia Board of	0	$0	0	$0
State Police, West Virginia Dept of Military Affairs & Public Safety	9	$90,000	15	$9,174,223
Supreme Court of Appeals State of West Virginia	9	$468,000	15	$914,100
Tax Appeals, WV Office of	0	$0	1	$130,000
Tax Department State of West Virginia	0	$0	3	$5,110,000
Treasurer of State State of West Virginia	0	$0	1	$365,000
University Physicians And Surgeons	1	$50,000	3	$405,000
Unknown	3	$0	15	$0
Veterans Assistance, Department of State of West Virginia	0	$0	0	$0
Veterinary Medicine, Board of State of West Virginia	0	$0	0	$0
Water Development Authority State of West Virginia	0	$0	1	$7,500,000
West Liberty University	1	$2,500,000	1	$2,500,000
West Virginia Parkways Authority	1	$2,433,500	3	$8,158,500
West Virginia State University - Institute	0	$0	0	$0
West Virginia State University - Malden	0	$0	0	$0
West Virginia University	0	$0	0	$0
West Virginia University Arthurdale	0	$0	0	$0
West Virginia University At Parkersburg	0	$0	0	$0
West Virginia University Beckley	0	$0	0	$0
West Virginia University Bruceton Mills	0	$0	0	$0
West Virginia University Charleston	0	$0	1	$791,798
West Virginia University Fort Ashby	0	$0	0	$0
West Virginia University Granville	0	$0	0	$0
West Virginia University Jacksons Mill	0	$0	0	$0
West Virginia University Kearneysville	0	$0	0	$0
West Virginia University Keyser	0	$0	0	$0
West Virginia University Montgomery	0	$0	0	$0
West Virginia University Reedsville	0	$0	0	$0

Agency	State Buildings in the 1% Annual Chance Floodplain		State Buildings in the 0.2% Annual Chance Floodplain	
	Number	Total Replacement Cost Value (Structure + Contents)	Number	Total Replacement Cost Value (Structure + Contents)
West Virginia University Union	0	$0	0	$0
West Virginia University Wardensville	0	$0	0	$0
West Virginia University Weston	0	$0	1	$2,240,145
Workforce West Virginia	2	$140,000	3	$225,000
WV Public Employees Grievance Board	0	$0	1	$285,000
WVsom Clinic Inc Dba Robert C Byrd Clinic	0	$0	0	$0
Total (WV State)	**98**	**$184,107,957**	**245**	**$768,891,601**

Source: State of West Virginia Emergency Management Division; FEMA 2022

Note: There is a slight Total Replacement Cost Value (RCV) discrepancy when compared with the table organized by County due to default cost values ($1) needing to be assigned where it didn't previously exist to appropriately run our analyses.

Statewide, there are 530.47 miles of state roads exposed to event-based flooding. There is a major public safety hazard when residents attempt to drive on flooded roadways. Many state roads serve as evacuation routes to higher ground. Not only will these roads be closed during a flood event and potentially isolate communities, but the floodwaters may also accelerate the degradation of these roads leading to increased repair and replacement costs. Bridges exposed to flood events can be extremely vulnerable due to the forces transmitted by the velocity and by the impact of debris carried by the water. Table 5.5-9 shows the mileage of state roads in the SFHA by county. Mason County has the greatest number of miles (34.68 miles) exposed, followed by Boone County (32.70 miles) in the 1 percent annual chance floodplain. In the 0.2 percent annual chance floodplain, Kanawha County (55.80 miles) has the greatest number of miles exposed, followed by Mason County (47.31 miles).

Table 5.5-9. State Road Exposure to the 1 percent and 0.2 percent Annual Chance Flood Event by County

County	State Roads located within the 1% Annual Chance Floodplain	State Roads located within the 0.2% Annual Chance Floodplain
	Mileage of Roadway	Mileage of Roadway
Barbour	4.14	4.14
Berkeley	1.49	1.56
Boone	32.70	32.70
Braxton	4.89	4.89
Brooke	4.93	7.56
Cabell	8.39	10.51
Calhoun	9.01	9.01
Clay	7.68	8.07
Doddridge	14.00	14.00
Fayette	7.22	9.55
Gilmer	4.46	19.22
Grant	4.35	4.72
Greenbrier	3.82	4.08
Hampshire	10.36	11.20
Hancock	2.60	3.39
Hardy	2.53	2.53

County	State Roads located within the 1% Annual Chance Floodplain	State Roads located within the 0.2% Annual Chance Floodplain
	Mileage of Roadway	Mileage of Roadway
Harrison	4.70	6.63
Jackson	6.22	8.63
Jefferson	2.56	2.72
Kanawha	22.83	55.80
Lewis	0.23	0.23
Lincoln	18.83	25.23
Logan	24.99	30.70
Marion	1.50	1.61
Marshall	4.06	7.20
Mason	34.68	47.31
McDowell	24.00	30.03
Mercer	11.86	14.31
Mineral	6.42	6.63
Mingo	7.52	14.32
Monongalia	10.22	11.75
Monroe	8.61	8.83
Morgan	3.78	4.18
Nicholas	9.90	11.02
Ohio	2.09	2.77
Pendleton	8.18	8.18
Pleasants	4.75	6.35
Pocahontas	9.64	10.50
Preston	8.86	9.12
Putnam	17.53	34.70
Raleigh	14.40	14.98
Randolph	2.07	2.07
Ritchie	7.33	7.33
Roane	3.63	3.63
Summers	8.75	14.26
Taylor	0.55	0.55
Tucker	1.79	1.98
Tyler	22.30	23.12
Upshur	0.90	1.06
Wayne	20.21	25.03
Webster	10.66	11.78
Wetzel	22.22	22.90
Wirt	8.43	8.43
Wood	10.31	15.75
Wyoming	20.39	24.55
Total	**530.47**	**683.29**

Source: State of West Virginia DOT 2021; FEMA 2022
Notes: GIS Geographic Information System
DOT State Department of Transportation

Critical Facilities and Community Lifelines

Critical transportation hubs and critical infrastructure located in the 1 percent and 0.2 percent annual chance floodplains are exposed to the flood hazard. Utility lines commonly follow roads and those located underground may be impacted, resulting in disruption of services.

Table 5.5-10 summarizes the total number of critical facilities by lifeline category located in the 1 percent annual chance floodplain by county. Kanawha County has the greatest number of critical facilities (3) exposed. Table 5.5-11 summarizes the total number of critical facilities by lifeline category located in the 0.2 percent annual chance floodplain by county. Kanawha County has the greatest number of critical facilities (45) exposed, followed by Mingo County with two critical facilities exposed.

Table 5.5-12 summarizes the critical facilities exposure and potential losses by lifeline category for the 1 percent annual chance floodplain. Safety and Security lifelines have the greatest estimated potential loss at $5 million, followed by the Health and Medical lifeline with $52,556.

Table 5.5-10. Critical Facilities Located in the 1 percent Annual Chance Floodplain by County

County	Lifeline Category of Critical Facilities							
	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Total in the 1% Annual Chance Floodplain
Barbour	0	0	0	0	0	1	0	1
Berkeley	0	0	0	0	0	0	0	0
Boone	0	0	0	0	0	1	0	1
Braxton	0	0	0	0	0	0	0	0
Brooke	0	0	0	0	0	0	0	0
Cabell	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0
Doddridge	0	0	0	0	0	1	0	1
Fayette	0	0	0	0	0	0	0	0
Gilmer	0	0	0	0	0	0	0	0
Grant	0	0	0	0	0	0	0	0
Greenbrier	0	0	0	0	0	0	0	0
Hampshire	0	0	0	0	0	0	0	0
Hancock	0	0	0	0	0	0	0	0
Hardy	0	0	0	0	0	0	0	0
Harrison	0	0	0	0	0	0	0	0
Jackson	0	0	0	0	0	0	0	0
Jefferson	0	0	0	0	0	0	0	0
Kanawha	0	0	0	0	1	2	0	3
Lewis	0	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0	0
Logan	0	0	0	0	0	1	0	1
Marion	0	0	0	0	0	0	0	0
Marshall	0	0	0	0	0	0	0	0
Mason	0	0	0	0	0	0	0	0

County	Lifeline Category of Critical Facilities							
	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Total in the 1% Annual Chance Floodplain
McDowell	0	0	0	0	0	1	0	1
Mercer	0	0	0	0	0	0	0	0
Mineral	0	0	0	0	0	0	0	0
Mingo	0	0	0	0	0	0	0	0
Monongalia	0	0	0	0	0	0	0	0
Monroe	0	0	0	0	0	0	0	0
Morgan	0	0	0	0	0	0	0	0
Nicholas	0	0	0	0	0	0	0	0
Ohio	0	0	1	0	0	0	0	1
Pendleton	0	0	0	0	0	0	0	0
Pleasants	0	0	0	0	0	0	0	0
Pocahontas	0	0	0	0	0	0	0	0
Preston	0	0	0	0	0	0	0	0
Putnam	0	0	0	0	0	0	0	0
Raleigh	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0
Ritchie	0	0	0	0	0	0	0	0
Roane	0	0	0	0	0	0	0	0
Summers	0	0	0	0	0	0	0	0
Taylor	0	0	0	0	0	0	0	0
Tucker	0	0	0	0	0	0	0	0
Tyler	0	0	0	0	0	0	0	0
Upshur	0	0	0	0	0	0	0	0
Wayne	0	0	0	0	0	0	0	0
Webster	0	0	0	0	0	0	0	0
Wetzel	0	0	0	0	0	0	0	0
Wirt	0	0	0	0	0	0	0	0
Wood	0	0	0	0	0	0	0	0
Wyoming	0	0	0	0	0	0	0	0
Total	**0**	**0**	**1**	**0**	**1**	**7**	**0**	**9**

Source: West Virginia Emergency Management Division; FEMA 2022

Table 5.5-11. Critical Facilities Located in the 0.2% Annual Chance Floodplain by County

County	Lifeline Category of Critical Facilities							
	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Total in the 0.2% Annual Chance Floodplain
Barbour	0	0	0	0	0	1	0	1
Berkeley	0	0	0	0	0	0	0	0
Boone	0	0	0	0	0	1	0	1
Braxton	0	0	0	0	0	0	0	0
Brooke	0	0	0	0	0	0	0	0

County	Lifeline Category of Critical Facilities							
	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Total in the 0.2% Annual Chance Floodplain
Cabell	0	0	0	0	0	0	0	0
Calhoun	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0
Doddridge	0	0	0	0	0	1	0	1
Fayette	0	0	0	0	0	0	0	0
Gilmer	0	0	0	0	0	0	0	0
Grant	0	0	0	0	0	0	0	0
Greenbrier	0	0	0	0	0	0	0	0
Hampshire	0	0	0	0	0	0	0	0
Hancock	0	0	0	0	0	0	0	0
Hardy	0	0	0	0	0	0	0	0
Harrison	0	0	0	0	0	0	0	0
Jackson	0	0	0	0	0	0	0	0
Jefferson	0	0	0	0	0	0	0	0
Kanawha	5	0	1	0	3	34	2	45
Lewis	0	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0	0
Logan	0	0	0	0	0	0	0	0
Marion	0	0	0	0	0	1	0	1
Marshall	0	0	0	0	0	0	0	0
Mason	0	0	0	0	0	0	0	0
McDowell	0	0	0	0	0	1	0	1
Mercer	0	0	0	0	0	1	0	1
Mineral	0	0	0	0	0	0	0	0
Mingo	0	0	0	0	0	2	0	2
Monongalia	0	0	0	0	0	0	0	0
Monroe	0	0	0	0	0	0	0	0
Morgan	0	0	0	0	0	0	0	0
Nicholas	0	0	0	0	0	0	0	0
Ohio	0	0	1	0	0	1	0	2
Pendleton	0	0	0	0	0	0	0	0
Pleasants	0	0	0	0	0	0	0	0
Pocahontas	0	0	0	0	0	0	0	0
Preston	0	0	0	0	0	0	0	0
Putnam	0	0	0	0	0	1	0	1
Raleigh	0	0	0	0	0	0	0	0
Randolph	0	0	0	0	0	0	0	0
Ritchie	0	0	0	0	0	0	0	0
Roane	0	0	0	0	0	0	0	0
Summers	0	0	0	0	0	0	0	0
Taylor	0	0	0	0	0	0	0	0
Tucker	0	0	0	0	0	0	0	0
Tyler	0	0	0	0	0	0	0	0

County	Lifeline Category of Critical Facilities							
	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Total in the 0.2% Annual Chance Floodplain
Upshur	0	0	0	0	0	0	0	0
Wayne	0	0	0	0	0	0	0	0
Webster	0	0	0	0	0	0	0	0
Wetzel	0	0	0	0	0	0	0	0
Wirt	0	0	0	0	0	0	0	0
Wood	0	0	0	0	0	0	0	0
Wyoming	0	0	0	0	0	0	0	0
Total	**5**	**0**	**2**	**0**	**3**	**44**	**2**	**56**

Source: West Virginia Emergency Management Division; FEMA 2022

Table 5.5-12. Critical Facilities Exposure and Potential Losses by Lifeline Category to the 1 Percent Annual Chance Floodplain

Lifeline Category	Total Replacement Cost Value (RCV)	West Virginia State 1% Annual Chance Floodplain	
		Estimated Total Damage	Percent of Total Building and Contents RCV
Communications	$10,240,007	$0	0.00%
Energy	$0	$0	0.00%
Food, Water, Shelter	$2,384,067	$0	0.00%
Hazardous Materials	$0	$0	0.00%
Health and Medical	$200,276,228	$52,556	0.03%
Safety and Security	$946,402,599	$5,008,277	0.53%
Transportation	$44,654,481	$0	0.00%
Total	**$1,203,957,382**	**$5,060,833**	**0.42%**

Source: Source: WV Emergency Management Division; FEMA 2022; FAST v1.0

POPULATION

Over 81,000 residents statewide reside in the 1 percent annual chance floodplain and just under 118,000 reside in the 0.2 percent annual chance floodplain; refer to Table 5.5-13. These residents may be displaced by the flooding of their homes, requiring them to seek temporary shelter with friends and family or in emergency shelters. Kanawha County has the greatest number of people (13,316) located in the 1 percent floodplain and the greatest number of people (36,945) located in the 0.2 percent floodplain. This analysis does not include the number of tourists and visitors in the state; therefore, this estimate may be underestimating exposure and vulnerability.

While all people located in SFHA are considered exposed and potentially vulnerable, populations considered most vulnerable include the elderly (persons over the age of 65) and individuals living below the U.S. Census poverty threshold. Kanawha County has the largest highly vulnerable population (3,539) exposed to the 1 percent floodplain and the largest highly vulnerable population (11,549) exposed to the 0.2 percent floodplain.

Table 5.5-13. 2020 U.S. Census Population Located in the 1 Percent and 0.2 Percent Annual Chance Floodplain by County

County	Population Located within the 1% Annual Chance Floodplain			Population Located within the 0.2% Annual Chance Floodplain		
	Total Population	Highly Vulnerable Population	% Population Highly Vulnerable	Total Population	Highly Vulnerable Population	% Population Highly Vulnerable
Barbour	62	442	14.0%	76	486	15.7%
Berkeley	334	4,064	8.2%	482	4,598	10.5%
Boone	89	1,632	5.5%	89	1,632	5.5%
Braxton	83	290	28.6%	83	290	28.6%
Brooke	19	1,296	1.5%	61	1,507	4.1%
Cabell	871	4,639	18.8%	975	6,489	15.0%
Calhoun	0	349	0.0%	0	349	0.0%
Clay	116	245	47.5%	117	246	47.8%
Doddridge	0	617	0.0%	0	617	0.0%
Fayette	196	691	28.4%	214	1,024	20.9%
Gilmer	191	531	36.0%	262	673	39.0%
Grant	139	231	59.9%	139	232	59.8%
Greenbrier	899	1,771	50.8%	1,104	1,996	55.3%
Hampshire	296	951	31.1%	311	990	31.4%
Hancock	74	526	14.1%	115	683	16.8%
Hardy	0	265	0.0%	0	265	0.0%
Harrison	359	2,700	13.3%	501	3,678	13.6%
Jackson	0	1,767	0.0%	0	1,852	0.0%
Jefferson	80	2,562	3.1%	84	2,662	3.2%
Kanawha	3,539	13,316	26.6%	11,549	36,945	31.3%
Lewis	70	721	9.7%	97	851	11.4%
Lincoln	269	945	28.5%	280	986	28.4%
Logan	1,443	2,062	70.0%	1,600	2,351	68.1%
Marion	24	1,238	2.0%	26	1,399	1.9%
Marshall	661	1,934	34.2%	753	2,138	35.2%
Mason	0	2,500	0.0%	0	3,260	0.0%
McDowell	171	228	75.3%	184	246	74.6%
Mercer	650	1,516	42.9%	769	1,707	45.0%
Mineral	28	554	5.1%	28	602	4.7%
Mingo	752	1,141	65.9%	1,041	1,528	68.1%
Monongalia	63	1,985	3.2%	90	2,590	3.5%
Monroe	0	316	0.0%	0	317	0.0%
Morgan	0	627	0.0%	0	638	0.0%
Nicholas	0	564	0.0%	0	591	0.0%
Ohio	1,590	5,529	28.8%	1,671	6,223	26.8%
Pendleton	0	218	0.0%	0	218	0.0%
Pleasants	0	301	0.0%	0	316	0.0%
Pocahontas	0	276	0.0%	0	291	0.0%
Preston	56	659	8.5%	56	662	8.5%
Putnam	0	2,683	0.0%	0	4,020	0.0%
Raleigh	997	1,966	50.7%	1,040	2,104	49.4%

County	Population Located within the 1% Annual Chance Floodplain			Population Located within the 0.2% Annual Chance Floodplain		
	Total Population	Highly Vulnerable Population	% Population Highly Vulnerable	Total Population	Highly Vulnerable Population	% Population Highly Vulnerable
Randolph	467	1,409	33.1%	501	1,452	34.5%
Ritchie	0	188	0.0%	0	188	0.0%
Roane	153	401	38.1%	165	414	39.9%
Summers	118	435	27.1%	125	965	13.0%
Taylor	228	575	39.7%	229	583	39.2%
Tucker	0	357	0.0%	0	383	0.0%
Tyler	0	649	0.0%	0	694	0.0%
Upshur	0	1,347	0.0%	0	1,660	0.0%
Wayne	0	1,935	0.0%	0	2,453	0.0%
Webster	0	450	0.0%	0	480	0.0%
Wetzel	0	1,262	0.0%	0	1,344	0.0%
Wirt	0	367	0.0%	0	367	0.0%
Wood	546	4,838	11.3%	851	6,093	14.0%
Wyoming	55	331	16.7%	59	352	16.7%
Total	**15,688**	**81,392**	**19.3%**	**25,727**	**117,680**	**21.9%**

Source: Source: CDC 2020; FEMA 2022

Impacts on Socially Vulnerable Populations

Socially vulnerable populations are most susceptible based on many factors, including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Economically disadvantaged populations are likely to evaluate their risk and make decisions based on the major economic impact to their family and may not have funds to evacuate.

The aftermath of flooding events presents numerous threats to public health and safety, including unsafe food; contaminated drinking and washing water and poor sanitation; mosquitoes and animals; mold and mildew; carbon monoxide poisoning; and mental stress and fatigue. Current loss estimation models such as Hazus are not equipped to measure public health impacts. The best preparation for these effects includes awareness that they can occur, education of the public on prevention, and planning to deal with them during responses to flooding events.

Over 117,000 residents statewide reside in the 1 percent annual chance floodplain; nearly 26,000 of those residents are considered socially vulnerable populations. These residents may be displaced by the flooding of their homes, requiring them to seek temporary shelter with friends and family or in emergency shelters. This analysis does not include the number of tourists and visitors in the state; therefore, this estimate may be underestimating exposure and vulnerability.

Future Changes That May Impact State Vulnerability

Understanding future changes that may impact vulnerability in the state can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The State considered the following factors in examining potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including impacts of future conditions

Potential or Projected Development

Each county participates in the NFIP and has flood damage prevention regulations in place that regulate how development can occur in mapped SFHAs. Future development in these areas will require adherence to flood damage prevention standards. If new development occurs in areas that currently support natural and beneficial floodplain functions, such as in conservation areas, impacts to flooding may be seen throughout the associated locations.

Projected Changes in Population

West Virginia is losing population faster than recent forecasts, which do not account for county-by-county increases. According to population projections in 2022 from the West Virginia University (WVU) Bureau of Business and Economic Research, West Virginia's population was projected to fall from 1,793,716 in 2020 to 1,705,509 in 2040 (West Virginia University 2022). As of July 1, 2019, according to estimates by the U.S. Census Bureau, West Virginia's total population is 1,792,147, representing a 3.3 percent decline since 2010 (approximately 60,487 fewer residents). West Virginia lost population both naturally, with 19,000 more deaths than births, and through migration, with 27,000 more people leaving the state than moving in (WVDOT 2020). Refer to Section 3 (County Profile), which includes a discussion on population trends for the County.

The overall anticipated decrease in population for West Virginia will potentially lower the threat of the flood hazard and its impact on life, but it will not eliminate the hazard. As the population leaves the state, the buildings and structures once resided in will remain standing, leaving the structural risk to the flood hazard the same as before. The groups most vulnerable to the hazard will remain the same, as will the geographic and topographic areas most vulnerable.

Other Factors of Change

Changing rain patterns are certain to alter flood dynamics in the state. Most studies project that the State will see an increase in average annual temperatures and precipitation. It is anticipated that the state will continue to experience direct and indirect impacts of flooding events annually that may induce secondary hazards such as infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents, and inconveniences.

5.5.3 Consequence Analysis

Impacts to the Public

The most at-risk populations include those who live within the FEMA-defined SFHA; however, it is also recognized that the flood hazard is not limited to just that area. Impacts to the public include potential for injury or loss of life, and destruction and/or loss of land and property due to flood. Loss of property can leave people homeless and with a hefty list of assets that need to be replaced, and some of these may be out-of-pocket costs. In general, floods and their aftermath present numerous threats to public health and safety, including:

- **Vehicles in floodwaters** — Floodwaters can carry large amounts of debris, potentially increasing the damage caused by the floodwaters.
- **Unsafe food** — Floodwaters can contain disease-causing bacteria, dirt, oil, human and animal waste, and farm and industrial chemicals. Their contact with food items, including food crops in agricultural lands, can make that food unsafe to eat.
- **Contaminated drinking and washing water and poor sanitation** — Flooding impairs clean water sources with pollutants; pollutants also infiltrate into the groundwater contaminating potable water. Flooded wastewater treatment plants and private sewage disposal systems can be overloaded, resulting in backflows of raw sewage becoming a cause of disease.
- **Mosquitoes and animals** — Floods provide new breeding grounds for mosquitoes in wet areas and stagnant pools; deceased animals can carry viruses and diseases if not disposed of timely and properly.
- **Mold and mildew**—Excessive exposure to mold and mildew can cause flood victims, especially those with allergies and asthma, to contract upper respiratory diseases, triggering cold-like symptoms. Infants, children, elderly people, and pregnant women are considered most vulnerable to mold-induced health problems.
- **Carbon monoxide poisoning** — In the event of power outages, the use of alternative fuels in enclosed or partially enclosed spaces can lead to carbon monoxide poisoning.
- **Hazards when reentering and cleaning flooded homes and buildings** — Flooded buildings can pose significant health and physical hazards to people entering them, including live electrical wires, gas leaks, flood debris, and hazardous materials.
- **Mental stress and fatigue** — People who live through a devastating flood can experience long-term psychological impact (National Geographic 2022) (Centers for Disease Control and Prevention [CDC] 2022) (WHO 2020).

Impacts to Responders

In the aftermath of a flood, workers may be involved in a variety of response and recovery operations. Emergency response to floods may involve several first response organizations, ranging from local police, fire and EMS departments, public service workers, specialty response task forces, and sometimes federal agencies. Assessments must be done to determine the current needs of the situation, including evacuation, search and rescue, distribution of resources, relocation of displaced individuals, firefighting, and utility repairs. Emergency responders can be exposed to the dangers from floods, including after-effects from debris and contaminated waters.

Floods may immobilize a region and shut down transportation which, in turn, stops the flow of supplies and disrupts the distribution of medical and emergency services and goods. Floods can quickly engulf buildings, knock down trees, and submerge additional infrastructure, making it difficult for responders to access the incident area. Rural areas may experience isolation for days at a time until first responders can safely access the area.

Impacts to Continuity of Operations

Floods can bring down trees, electrical wires, telephone poles, lines, communication towers; floods can also inundate buildings with water, causing potential mold and mildew issues. Communication and power can be disrupted for days while utility companies work to repair the extensive damage; restoration crews may not be able to clean buildings for several days or weeks following a flood to make the structure is habitable. Floods can obstruct and slow transportation by knocking down trees and utility lines and causing structural collapses in buildings not designed to withstand an influx of water. Floods have the potential to impact airports and roadways, sometimes even closing them completely, stopping the flow of supplies and disrupting continuity of operations in the state and counties.

Impacts to Property, Facilities, and Infrastructure

Economic losses to the State from event-based flooding include but are not limited to general building stock damage, agricultural losses, and business interruption. These losses will negatively affect the tax base. Damage to general building stock can be quantified using Hazus. Other economic components, such as loss of facility use, functional downtime, and social economic factors are less quantifiable. For the purposes of this analysis, the general building stock damage is discussed further.

Low-lying urban areas have the greatest vulnerability to a flood event. To estimate the potential losses by county, the Hazus flood model and default general building stock provided by the model were used. This analysis has been refined since the 2018 SHMP due to the updated and improved flood hazard areas and flood depth grids across the state. Table 5.5-14 summarizes the estimated potential losses to the general building stock by county.

Hazus estimates $27.4 million in statewide potential damages to the general building stock inventory associated with the 1 percent annual chance flood event. Although this loss represents only 0.45 percent of the state's total building replacement cost value, the area flooded comprises some of the most valued in the state. Preston County is estimated to experience the greatest loss: over $14.9 million in building damages (repair or replacement costs), which represents 16.62 percent of the replacement cost value of State facilities in Preston County.

Table 5.5-14. General Building Stock Exposure and Potential Losses to the 1 Percent Annual Chance Floodplain

County	Total Replacement Cost Value (RCV)	West Virginia State 1% Annual Chance Floodplain	
		Estimated Total Damage	Percent of Total Building and Contents Replacement Cost Value
Barbour	$1,226,301	$0	0.00%
Berkeley	$75,495,416	$0	0.00%
Boone	$44,293,611	$4,882,275	11.02%
Braxton	$7,872,767	$0	0.00%
Brooke	$3,180,003	$0	0.00%

County	Total Replacement Cost Value (RCV)	West Virginia State 1% Annual Chance Floodplain	
		Estimated Total Damage	Percent of Total Building and Contents Replacement Cost Value
Cabell	$219,226,653	$5,915,497	2.70%
Calhoun	$378,405	$0	0.00%
Clay	$743,106	$0	0.00%
Doddridge	$75,001,944	$76,866	0.10%
Fayette	$189,552,329	$0	0.00%
Gilmer	$102,229,007	$0	0.00%
Grant	$2,272,485	$0	0.00%
Greenbrier	$114,552,152	$0	0.00%
Hampshire	$81,457,698	$0	0.00%
Hancock	$5,900,061	$0	0.00%
Hardy	$48,772,559	$0	0.00%
Harrison	$92,890,150	$0	0.00%
Jackson	$43,378,014	$0	0.00%
Jefferson	$279,040,412	$0	0.00%
Kanawha	$998,692,998	$1,226,692	0.12%
Lewis	$83,222,741	$0	0.00%
Lincoln	$1,631,008	$0	0.00%
Logan	$90,013,247	$13,237	0.01%
Marion	$269,370,410	$0	0.00%
Marshall	$83,738,272	$0	0.00%
Mason	$75,424,570	$0	0.00%
McDowell	$2,430,014	$23,641	0.97%
Mercer	$343,799,147	$0	0.00%
Mineral	$138,244,637	$10,118	0.01%
Mingo	$23,756,135	$0	0.00%
Monongalia	$1,605,027,842	$0	0.00%
Monroe	$1,463,850	$0	0.00%
Morgan	$93,738,803	$3,041	0.00%
Nicholas	$9,785,397	$0	0.00%
Ohio	$28,660,306	$0	0.00%
Pendleton	$1,191,904	$0	0.00%
Pleasants	$31,131,899	$0	0.00%
Pocahontas	$36,280,530	$0	0.00%
Preston	$89,928,281	$14,947,847	16.62%
Putnam	$91,192,117	$0	0.00%
Raleigh	$162,946,727	$1	0.00%
Randolph	$133,481,150	$0	0.00%
Ritchie	$9,535,900	$154,799	1.62%
Roane	$2,591,249	$0	0.00%
Summers	$61,399,017	$0	0.00%
Taylor	$35,811,537	$0	0.00%
Tucker	$22,322,036	$32,790	0.15%
Tyler	$1,640,214	$0	0.00%
Upshur	$23,678,716	$0	0.00%

County	Total Replacement Cost Value (RCV)	West Virginia State 1% Annual Chance Floodplain	
		Estimated Total Damage	Percent of Total Building and Contents Replacement Cost Value
Wayne	$13,977,493	$23,611	0.17%
Webster	$2,930,121	$0	0.00%
Wetzel	$1,260,909	$0	0.00%
Wirt	$138,503	$0	0.00%
Wood	$145,288,298	$85,424	0.06%
Wyoming	$801,905	$51,172	6.38%
WV State (Total)	$6,103,990,956	**$27,447,011**	**0.45%**

Source: WV Emergency Management Division; FEMA 2022; FAST v1.0

The NFIP data is also a useful tool to determine areas vulnerable to flood. Table 5.5-15 through Table 5.5-17 summarize the NFIP policies, coverage, loss, and payments in the State. Currently, Kanawha County has the highest number of policies in force (1,740) and the highest amount of total coverage ($301,441,600). Meanwhile, the Wirt County has the lowest number of policies in force (26) and the lowest amount of total coverage ($3,340,000). Between November 2018 and June 30, 2022, the State has 8 records of financial loss due to flood, with 60 of those records being closed with payment losses, and 9 closed without payment losses; 10 records remain open. The total amount of payments was recorded at $1,956,983 (FEMA 2022).

Table 5.5-15. Policy Information for the State of West Virginia by County

County	Policies in Force	Total Coverage	Total Written Premium + FPF
Barbour	70	$10,510,000	$92,534
Berkeley	160	$35,268,000	$161,311
Boone	257	$38,972,000	$335,812
Braxton	52	$6,180,000	$39,885
Brooke	175	$20,196,000	$235,961
Cabell	429	$77,438,600	$476,843
Calhoun	45	$5,095,000	$54,716
Clay	72	$13,933,000	$97,886
Doddridge	41	$4,990,000	$42,434
Fayette	134	$25,048,000	$139,911
Gilmer	74	$14,714,000	$119,882
Grant	76	$19,558,000	$102,944
Greenbrier	398	$82,027,000	$522,148
Hampshire	128	$22,876,000	$156,993
Hancock	97	$17,244,000	$133,101
Hardy	108	$27,284,000	$118,468
Harrison	251	$44,885,000	$351,560
Jackson	119	$24,358,000	$126,329
Jefferson	197	$48,513,000	$234,349
Kanawha	1,740	$301,441,600	$2,309,796
Lewis	102	$19,062,000	$191,607
Lincoln	139	$24,205,000	$148,989
Logan	368	$53,194,000	$431,184
Marion	204	$36,606,000	$258,633

County	Policies in Force	Total Coverage	Total Written Premium + FPF
Marshall	181	$25,567,000	$234,750
Mason	125	$19,122,000	$105,875
McDowell	149	$22,451,000	$196,541
Mercer	189	$42,625,000	$257,164
Mineral	156	$24,206,000	$224,121
Mingo	308	$56,785,400	$289,641
Monongalia	200	$54,921,000	$304,180
Monroe	34	$4,514,000	$32,244
Morgan	111	$24,908,000	$131,550
Nicholas	91	$12,963,000	$150,353
Ohio	495	$69,531,000	$905,250
Pendleton	82	$14,881,000	$82,950
Pleasants	36	$7,201,000	$32,551
Pocahontas	193	$34,899,000	$282,257
Preston	78	$16,733,000	$113,340
Putnam	363	$83,881,000	$366,282
Raleigh	141	$23,781,000	$165,175
Randolph	196	$31,073,000	$202,417
Ritchie	41	$6,411,000	$40,644
Roane	110	$16,175,000	$116,701
Summers	126	$17,908,000	$103,794
Taylor	40	$7,084,000	$43,715
Tucker	118	$21,286,000	$182,201
Tyler	39	$5,147,000	$34,614
Upshur	150	$23,537,000	$161,324
Wayne	215	$32,730,000	$255,778
Webster	97	$15,043,000	$130,242
Wetzel	172	$19,570,000	$222,022
Wirt	26	$3,340,000	$19,133
Wood	326	$63,400,000	$376,518
Wyoming	268	$45,620,000	$318,059
Total	**10,292**	**$1,820,891,600**	**$12,964,622**

Source: FEMA 2023
Notes: All data shown is current as of March 31, 2023.
FPF Federal Policy Fee

Table 5.5-16. Policy Statistics for the State of West Virginia by Rated Flood Zone

Rated Flood Zone	Building Only			Contents Only			Building and Contents		
	Policies in Force	Premium + FPF	Coverage	Policies in Force	Premium + FPF	Coverage	Policies in Force	Premium + FPF	Coverage
All A Zones	4,750	$5,603,615	$523,766,400	56	$164,525	$11,436,100	1,992	$4,604,476	$421,021,700
D Zone	1	$1,454	$51,800	0	$0	$0	1	$785	$51,500
X Zone	191	$267,255	$23,382,400	37	$26,304	$4,531,800	2,368	$1,825,033	$637,171,400
Unknown or Invalid	391	$537,204	$48,082,100	9	$9,257	$780,100	378	$577,148	$87,689,400
Total	**5,333**	**$6,409,528**	**$595,282,700**	**102**	**$200,086**	**$16,748,000**	**4,739**	**$7,007,442**	**$1,145,934,000**

Source: FEMA 2023
Notes: All data shown is current as of June 30, 2022.
FPF Federal Policy Fee
The rated flood zones represents a grouping of flood zones into categories. A includes all policies with an A zone, A01-A30, AH, AHB, AO, AOB, A0B, A00, AR, ARE, ARH, ARO, ARA, or A99 zone. D zone includes only D zones, All V Zone includes V, VE, and V01-V30 zones, X Zone includes B, C, and Z zones, EMG includes all records with a null flood zone and an emergency program indicator, and Zone Unknown or Invalid includes all other records, due to invalid or blank flood zones.

Table 5.5-17. Loss Statistics for the State of West Virginia by Flood Zone Group

Flood Zone Group	Single Family		2-4 Family		Other Residential		Non-Residential Small Business		Non-Residential Non-Small Business		Unknown	
	Losses	Payments	Losses	Payments	Losses	Payments	Losses	Payments	Losses	Payments	Losses	Payments
A	5,609	$55,063,931	164	$1,662,680	70	$1,071,733	2	$60,272	1,307	$31,669,521	2	$3,950
AE	8,061	$92,850,553	470	$5,087,296	132	$3,612,807	17	$1,173,690	1,498	$44,203,983	3	$31,649
AO	0	$0	0	$0	0	$0	0	$0	1	$0	0	$0
BLANK	834	$5,776,004	13	$116,259	3	$27,193	0	$0	69	$1,308,684	5	$77,836
D	105	$316,647	7	$19,054	0	$0	0	$0	31	$197,992	0	$0
EMG	3,011	$14,858,464	65	$215,279	47	$260,392	0	$0	616	$5,435,226	1	$35,000
VE	1	$1,000	0	$0	0	$0	0	$0	0	$0	0	$0
X	3,797	$47,263,852	107	$926,346	53	$1,013,734	4	$92,785	550	$13,029,520	0	$0
Total	**21,418**	**$215,130,451**	**826**	**$8,026,914**	**305**	**$5,985,858**	**23**	**$1,326,747**	**4,072**	**$95,844,925**	**11**	**$148,435**

Source: FEMA 2023
Notes: All data shown is current as of June 30, 2022.
FPF Federal Policy Fee
The flood zone group combines flood zones into categories. "AE" includes AE and zones A01 through A30, "AH" includes AH and AHB zones, "AO" includes AO, AOB, A0B, and A00 zones, "AR" includes AR, ARE, ARH, ARA, and ARO zones, "A", "A99","D", and "V" zones each represent those specific flood zones, "VE" includes V01 through V30 and

VE zones, "X" includes B, C, and X zones, "EMG" includes all policies without a valid flood zone but which have an emergency program indicator, and "BLANK" includes all remaining policies without a valid flood zone.

The occupancy/business group filter and header combines the occupancy type and small business code fields. "Single Family" includes all losses with an occupancy type of 1. "Two-to-Four Family" includes all losses with an occupancy type of 2. "Other Residential" includes all losses with an occupancy type of 3. "Non-Residential Small Business" includes all losses with an occupancy type of 4 and a small business value of Y. "Non-Residential Non-Small Business" includes all losses with an occupancy type of 4 and any other small business values. "Non-Residential Business" includes all losses with an occupancy type of 6. "Unknown" includes all other losses with a missing or invalid occupancy type.

Impacts to the Environment

The loss of natural resources statewide is difficult to quantify. Environmental resources are valuable assets to the environment and overall economy in the state. Damage to natural floodplain function would increase future flood risk as floodplains provide a buffer and protect from flood impacts. Flooding has a range of impacts on the environment, including the following:

- Wildlife habitats can be destroyed
- Contaminated floodwater can pollute rivers and habitats.
- Silt and sediment can destroy crops and vegetation.
- River banks and natural levees can be eliminated as rivers reach bank full capacity.
- Rivers can be widened, and deposition can increase downstream.
- Trees can be uprooted by high-velocity water flow.
- Plants may die due to the soil being overly saturated (National Geographic 2022).

Septic tanks, cesspools, and other sewage disposal systems (OSDS) as well as other hazard materials/waste storage and disposal sites could be impacted by the inundation of water, which would oversaturate soils.

Impacts to the Economic Condition of the State

Flood events can have major economic impacts on a community from the initial loss of structures as well as the subsequent loss of revenue from destroyed businesses. Floods do not only damage assets; they also suspend economic activity. Floods have the capability to shut down facilities, cut off power, or interrupt water supplies. Supply chain sales and distribution may be disrupted; staff may be prevented from getting to work. Losses from business interruption can approach, or even exceed, those from damage to property and assets (MarshMcLennan 2021).

In the most serious events, suspension of business activity can lead to bankruptcies among small and medium-sized enterprises with low levels of working capital and no business interruption coverage. In the United States, between 40 percent and 60 percent of small businesses shut down by disasters remain closed indefinitely (MarshMcLennan 2021).

Floods not only have the potential to change the landscape of areas that draw in tourists but also to drive people away. Tourists and outdoors enthusiasts tend to avoid State and National Parks when heavy rains are present, and this can have a widespread impact on other industries as well. In this way, floods, and its precursors, can also negatively affect hospitality, restaurant, and other industries present in these key locations (Southon and van der Merwe 2018).

Impacts to Public Confidence in State Governance

The public confidence in state governance primarily depends on how effective the State has been in the past at preparing and responding to flood events. Public confidence also depends on the size of the event and the preparation the State takes for each potential event. In general, if the State is transparent in sharing relevant information with the public regarding flood events and demonstrates its reliability to the public through availability of programs and services relevant to floods, then the public will remain confident in the State's governance (Chew, et al. 2021).