PHOTOS: Courtesy of West Virginia Recovery Office

Understanding Flood Dangers in Central West Virginia

LESSONS LEARNED FROM THE JUNE 2016 FLOOD

FEMA

RiskMAP
Increasing Resilience Together

EXECUTIVE SUMMARY

The floods of June 23 and 24, 2016, devastated communities in West Virginia. Repeated rounds of torrential thunderstorms dumped more than 9 inches of rain in the hardest hit areas, and media reports referred to the storm as a "1 in 1,000-year event." Many residents felt that the flooding was as bad as it could get. However, research by the United States Geological Survey and the Federal Emergency Management Agency shows otherwise. In fact, this type of event could happen more frequently than previously thought. It is critical to understand the June 2016 event so that West Virginia communities can take action to be safer in the future.

There are four important conclusions to take away from this research:

1. The flood insurance rate maps effectively portrayed flood risk along major rivers and streams. Using these maps as a tool will continue to help protect West Virginians.
2. However, many homes outside the special flood hazard area also flooded. Some of these households had flood insurance, but many did not. Home owners with flood insurance recover more quickly than those without.
3. The flood in June 2016 was not a rare, "1 in 1,000 year event." Although the amount of rain that fell was unusual, rainfall and flooding are different.
4. The latest data shows that the level of flooding that occurred in 2016 could happen more frequently than previously thought. In many areas, that event has a least a 1% chance of happening each year in the future.

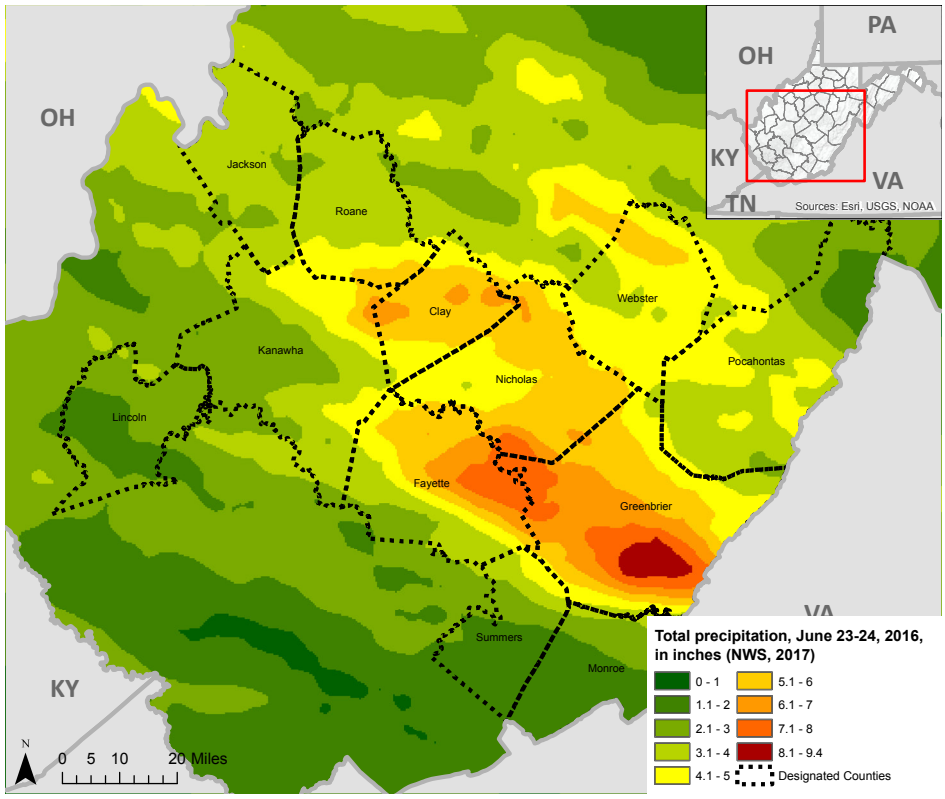
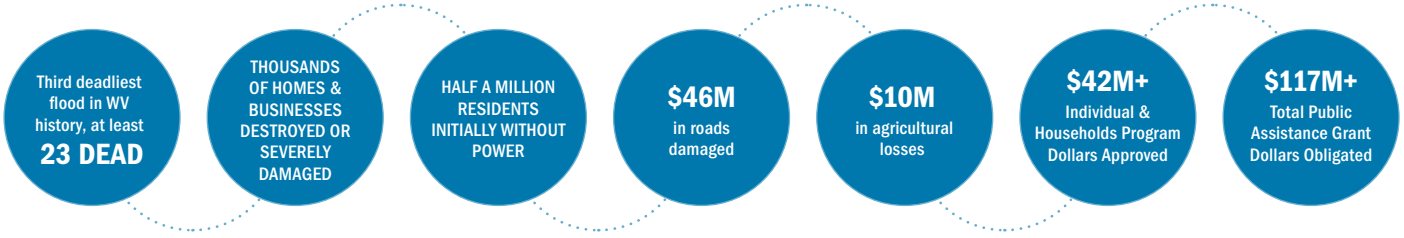


FIGURE 1: Estimated rainfall totals during June 23-24, 2016 floods in West Virginia. The highest rainfall total of 9.37 inches was observed in Maxwelton.

Destruction like that caused by the 2016 floods can be minimized through dedicated education, planning, and action. To these ends, FEMA has resources available to help communities analyze, reduce, and insure their flood risks.

FIGURE 2: The 2016 Flood at a Glance



DISASTER STRIKES

Early in the morning of June 23, 2016, heavy rain began falling throughout central and southeastern West Virginia. Over the course of the next 24 hours, bands of torrential rain pummeled the area and caused widespread flooding. National Weather Service (NWS) meteorologists also reported that West Virginia received one-quarter of its annual rainfall in a single day (Reuters Staff, 2016).

The extreme precipitation was quickly followed by devastating flooding. Thousands of buildings were destroyed or damaged, at least 23 people were killed, and communities throughout West Virginia were inundated with floodwaters. A State of Emergency was declared in 44 of West Virginia's 55 counties, and 12 of these counties received a Presidential Disaster Declaration. The National Oceanic and Atmospheric Administration (NOAA) estimated that overall damages from the storm system amounted to over $1 billion (2017).

The flood's impact varied across the State. Moderate flooding was widespread throughout south-central West Virginia, while localized extreme flooding affected the Elk, Gauley, and Greenbrier River basins. In the most severely flooded parts of the State, homes were washed off their foundations in a stunning show of water's force.

The June 2016 rain event was so destructive, in part, because the region had already received above-average rainfall in May and the first three weeks of June. With the ground already saturated, runoff from West Virginia's steep mountains ran quickly into narrow valleys. Reaching the valleys, the floodwater wreaked havoc on some of the State's most densely populated communities.

UNDERSTANDING THE LANGUAGE OF FLOOD RISK

The term "100-year flood" can be misleading. Many people think it means that a flood of this size will only happen once in a hundred years. That isn't true. The 100-year flood has a 1% chance of happening in any given year. That's why we prefer to call it the 1% annual chance flood.

In fact, if you own a home in the 1% annual chance floodplain, there is a 26% chance it will flood over the life of a 30 year mortgage.

WRONG: "100-year flood" means a flood occurs once in a century.

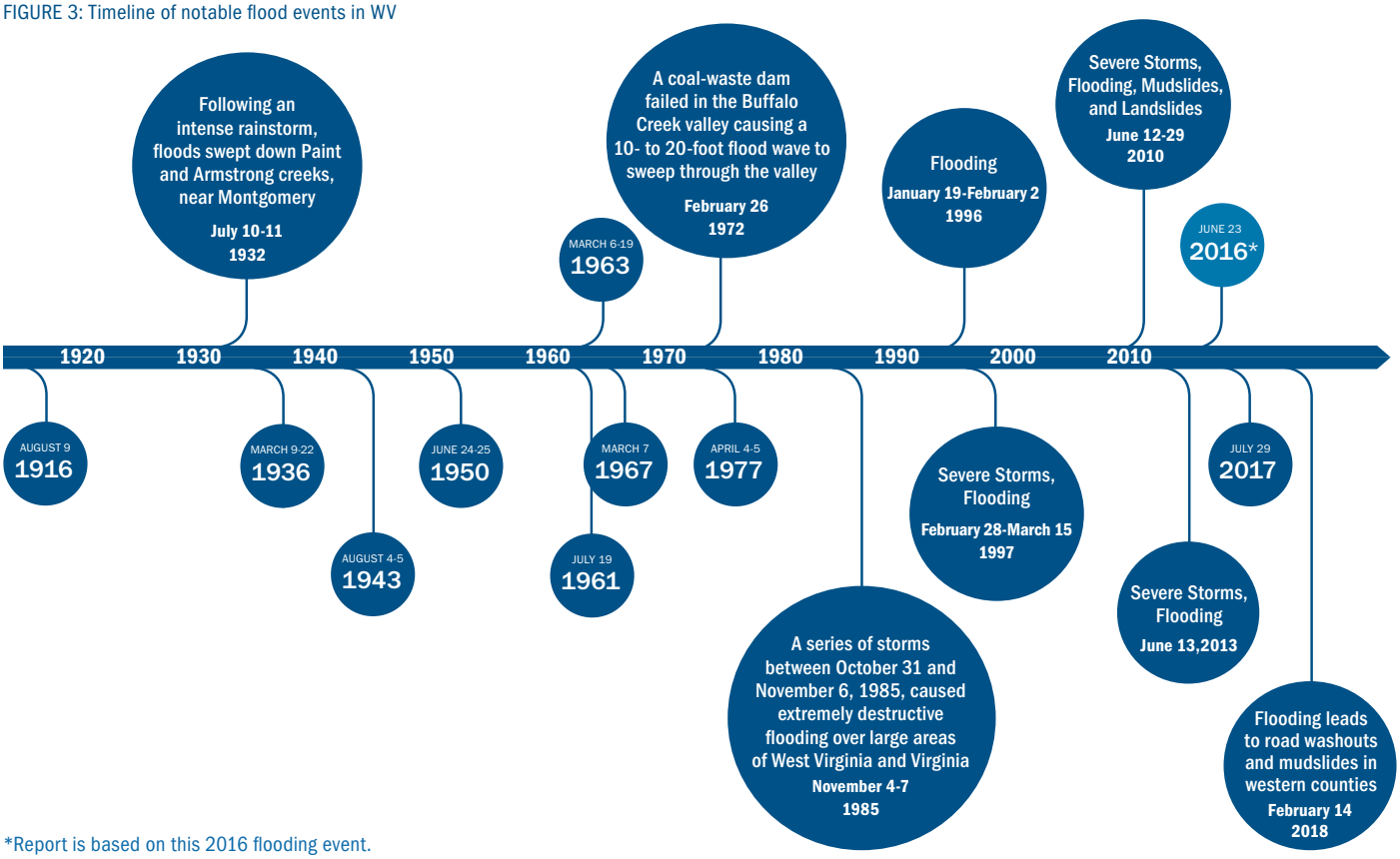
CORRECT: A large flood can happen any year.

FLOODS DON'T FOLLOW ANY CALENDARS: If a 100-year flood occurred last year, there's still a 1% chance that a flood of that size can happen this year.

A HISTORY OF FLOODS

Floods are one of West Virginia's most frequent and costly disasters. According to storm data from NOAA, every county in the State reported at least 14 floods between 1991 and 2016. Kanawha County reported the most during this 20 year interval – 69 floods. Given the frequency of flooding in WV, it's important we begin to better analyze the impact of floods and take mitigation action.

FIGURE 3: Timeline of notable flood events in WV



*Report is based on this 2016 flooding event.

A NEW STUDY HELPS MAKE SENSE OF FLOOD RISK

Immediately following the floods of June 2016, USGS and FEMA initiated a joint study to evaluate the flood's magnitude, extent, and probability of happening again. USGS crews went into flooded communities to record the height of floodwaters by looking at hundreds of marks left by water and debris along eight major rivers and streams. These data points were used to create a series of inundation maps showing the greatest extent of the floodwaters along those eight streams. In addition, USGS scientists recorded how high and how quickly streams flowed during the flood. The study methodology and findings are described in Open-File Report 2017-1140, available here: https://pubs.er.usgs.gov/publication/ofr20171140

To supplement the USGS study, FEMA analyzed the locations of households that submitted claims with the National Flood Insurance Program (NFIP) or Individual Assistance applications. Almost 1,000 insured households submitted flood insurance claims after the 2016 floods, and more than 3,500 households applied for disaster assistance for home repairs. Together, these two studies answer some of the most common questions after a flood: "Where exactly did it flood?" "How bad was it?" "How likely is it to happen again?" and "How can we be better prepared?". By answering these questions we hope to provide West Virginia communities and residents with the information they need to make informed decisions about protecting themselves through tools like sound land use planning, targeted capital improvements and mitigation projects.

The joint study produced four major conclusions:

1. The flood insurance rate maps effectively portrayed flood risk along major rivers and streams. Using these maps as a tool will continue to help protect West Virginians.
2. However, many homes outside the special flood hazard area also flooded. Some of these households had flood insurance, but many did not. Homeowners with flood insurance recover more quickly than those without.
3. The flood in June 2016 was not a rare, "1 in 1,000 year event." Although the amount of rain that fell was unusual, rainfall and flooding are different.
4. The latest data shows that the level of flooding that occurred in 2016 could happen more frequently than previously thought. In many areas, that event has at least a 1% chance of happening each year in the future.

FINDING 1: THE FLOOD INSURANCE RATE MAPS EFFECTIVELY PORTRAYED FLOOD RISK ALONG MAJOR RIVERS AND STREAMS. USING THESE MAPS AS A TOOL WILL CONTINUE TO HELP PROTECT WEST VIRGINIANS.

- Flood inundation maps created by the USGS from its collection of more than 400 high water marks show the general extent of the 2016 floodwaters for eight streams in central and southeastern West Virginia. A comparison of these inundation maps to FEMA's effective Flood Insurance Rate Maps (FIRMs) shows that much of the area flooded in 2016 was **within** the 1% annual-chance floodplain, also known as the Special Flood Hazard Area (SFHA) or "100-year floodplain."
- For instance, in the Greenbrier River study reach near Alderson, 93% of the flooded area fell within the 1% annual-chance floodplain, and another 5% fell within the 0.2% annual-chance floodplain (where the risk is lower).
- Along the Howard River study reach, 72% of the flooded area fell within the 1% annual-chance floodplain, and 13% fell within the 0.2% annual-chance floodplain.
- In all eight USGS study areas, the 1% annual-chance floodplain accounted for 85% of the flooded areas. This finding reinforces the importance of mitigation in Special Flood Hazard Areas. Communities that mitigate risk to their properties and infrastructure within areas delineated as high risk on FIRMs will be more prepared for the next flood event.

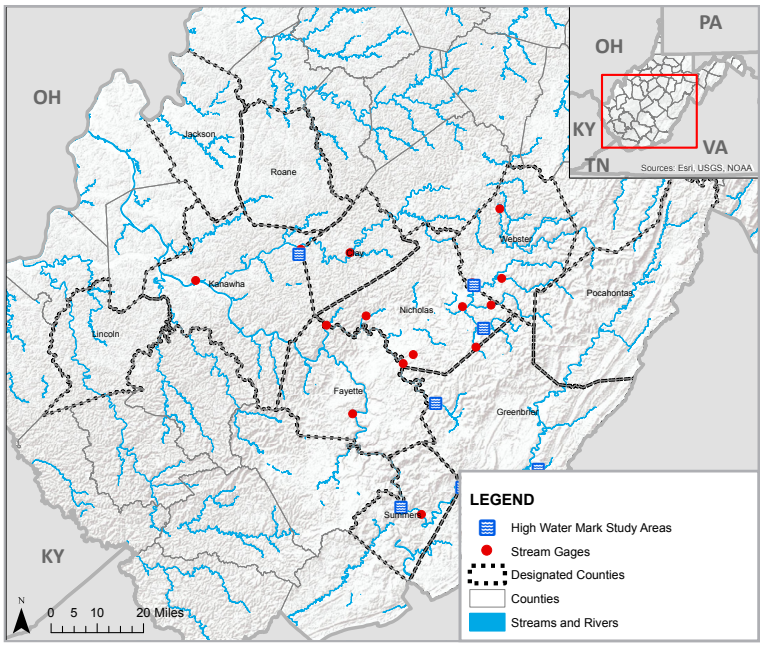


FIGURE 4: Locations of high water marks and stream gaging stations analyzed by USGS following the 2016 floods.

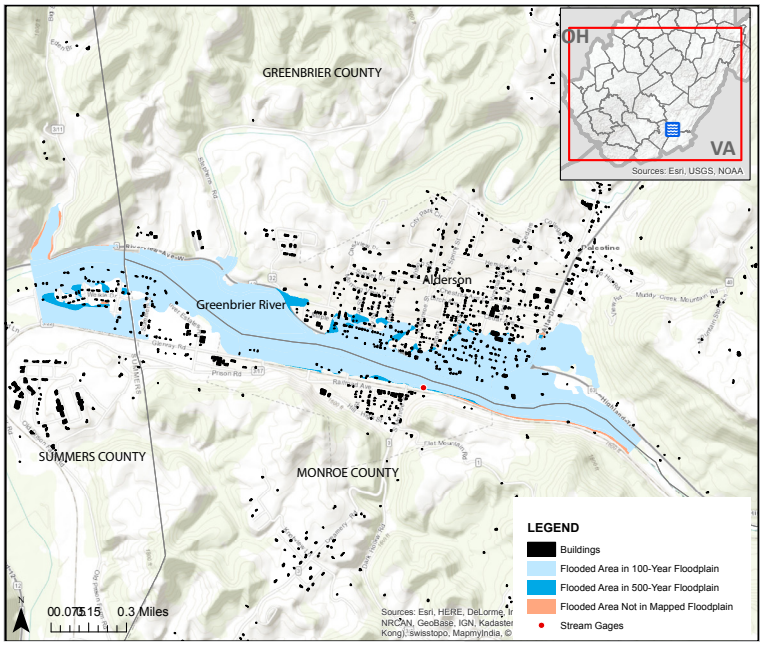


FIGURE 5: Inundated area along the Greenbrier River in Alderson, West Virginia

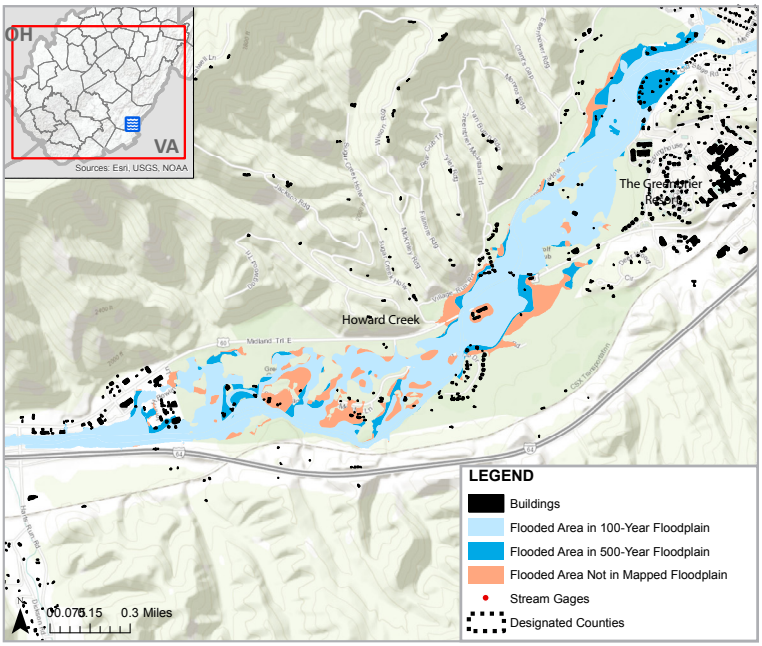


FIGURE 6: Inundated area along Howard Creek, between White Sulphur Springs and Caldwell, West Virginia.

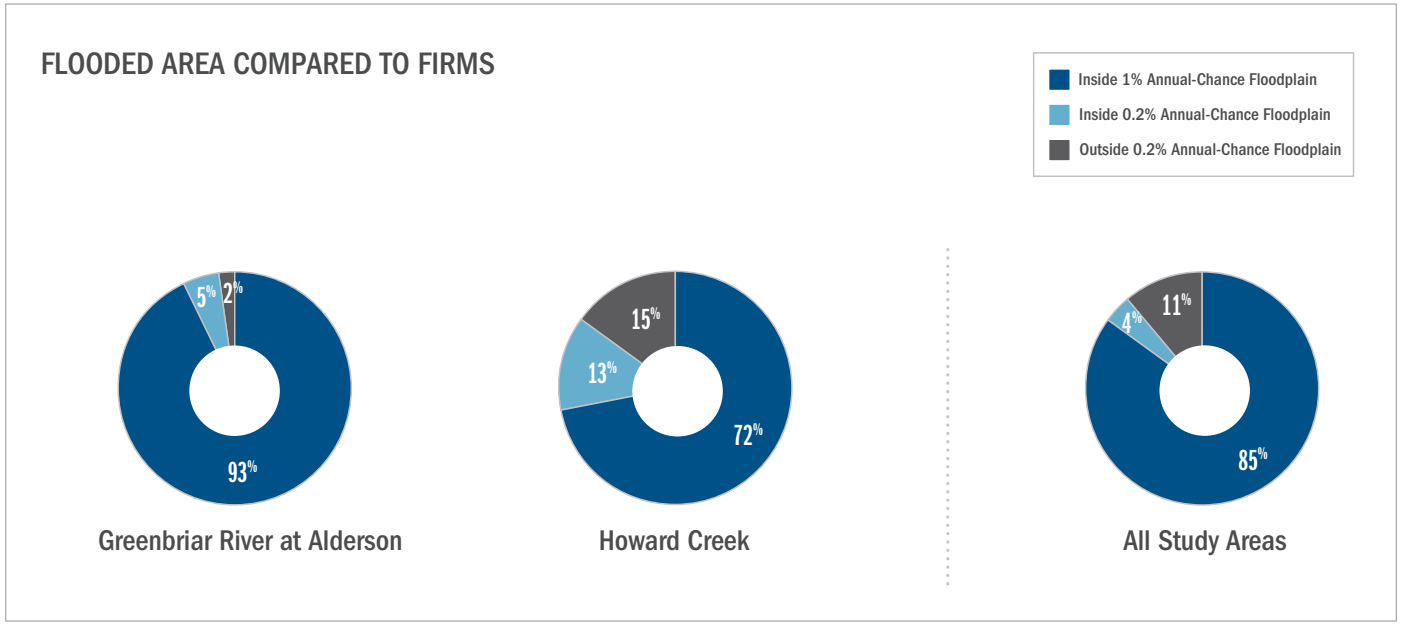


FIGURE 7: Pie charts show the percentage of flooded area that overlapped with the Flood Insurance Rate Maps (FIRMs).

FINDING 2: MANY HOMES OUTSIDE THE SPECIAL FLOOD HAZARD AREA ALSO FLOODED. SOME OF THESE HOUSEHOLDS HAD FLOOD INSURANCE, BUT MANY DID NOT. HOMEOWNERS WITH FLOOD INSURANCE RECOVER MORE QUICKLY THAN THOSE WITHOUT.

- The FIRMs predicted the location of much of the flooding along major rivers and streams, but extensive property damage also occurred outside the Special Flood Hazard Areas.
- Of the nearly 1,000 flood insurance claims in the declared counties, 77% were in the 1% annual-chance floodplain and approximately 23% of the insurance claims were outside.[1] On average, in floods across the country, about 25% of claims are outside the Special Flood Hazard Area, so this is consistent with the national trend.
- Over 3,500 people applied for FEMA's Individual Assistance (IA) program, which provides a small amount of grant funding to disaster survivors who do not have flood insurance. Approximately 32% of these applicants lived in the Special Flood Hazard Area and 68% were outside.
- The flood damage outside the high-risk areas identified on the FIRMs demonstrates that flooding can also come from sources other than overbank flooding on major rivers and streams. Flash flooding on small streams, runoff rushing down mountainsides, and urban stormwater flooding can all contribute to significant damage outside designated Special Flood Hazard Areas. This is why it is critical for local communities to understand and mitigate the risk of many forms of flooding.
- After this disaster, about 4,500 households sought financial assistance through flood insurance claims or FEMA's Individual Assistance program. People who filed flood insurance claims received an average of $53,500 per claim. People without flood insurance received only $8,363 in individual assistance for property repairs. While IA is intended to help people begin their recovery from a damaging storm, flood insurance can support families to recover more completely.
- Throughout the State of West Virginia, approximately 78,000 residential buildings are in Special Flood Hazard Areas. Only 12% of those structures are covered by flood insurance, in comparison to a national average of 30%. Increasing the percentage of properties with flood insurance, both inside and outside the SFHA, could significantly improve West Virginia's ability to recover from future disasters.

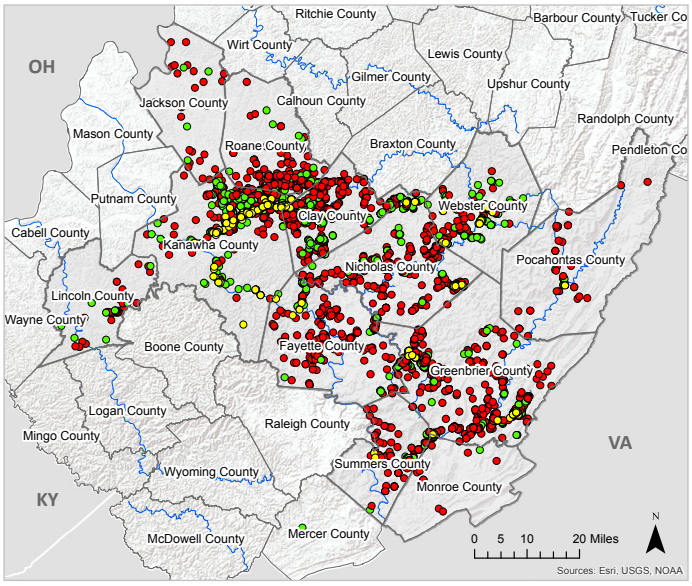


FIGURE 8: Location of NFIP Claims and Individual Assistance Applications. (green = inside 1% annual chance floodplain; yellow = inside 0.2% annual chance floodplain; red = outside mapped floodplain)

FIGURE 9: Water pours down a mountainside towards homes in Richwood, WV. Flash flooding along small streams can cause flood damage outside of the designated Special Flood Hazard Area.

[1] These numbers are based on the flood zone assigned to the insurance policy for rating purposes. It should be consistent with, but is sometimes different from the geographic location of the property within the floodplain.

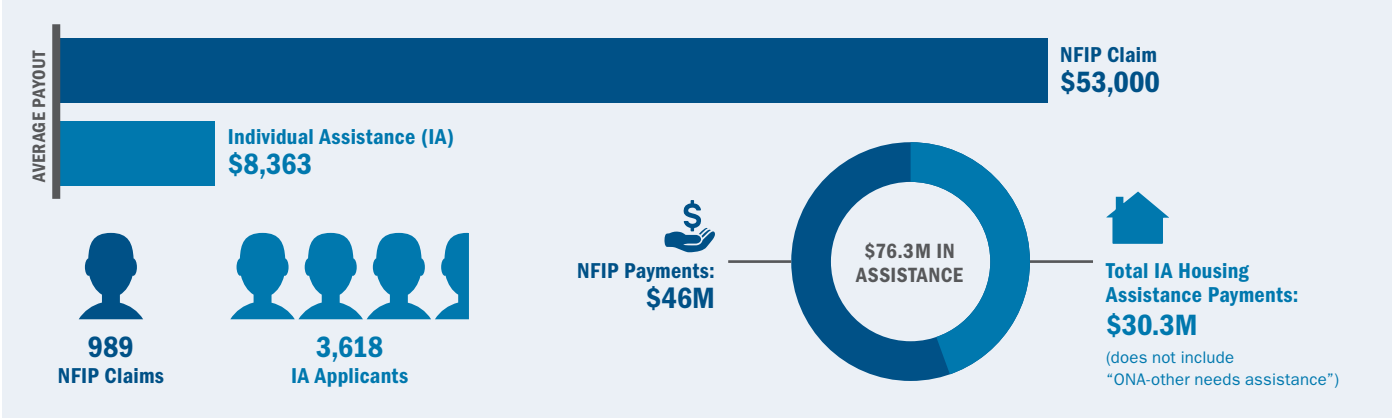


FIGURE 10: Comparison of flood insurance versus individual assistance in the June 2016 flood. Numbers are approximate and date from March 2018. Average NFIP claim is average of claims with payment.

FINDING 3: THE FLOOD IN JUNE 2016 WAS NOT A RARE, "1 IN 1,000 YEAR EVENT." ALTHOUGH THE AMOUNT OF RAIN THAT FELL WAS UNUSUAL, RAINFALL AND FLOODING ARE DIFFERENT.

- Individual watershed and storm characteristics help explain how a rainfall event with one frequency can cause a flood event with a different frequency. These characteristics include the duration and intensity of the rainfall, the spatial extent of the rainfall, and the size, slope, and shape of the watershed.
- The thunderstorms of June 23 and 24, 2016 produced different amounts of rainfall across the region. The National Weather Service estimated that the rainfall received by the hardest hit areas has a 1-in-1,000 chance of happening each year. However, many people took this to mean the flooding is a "thousand-year" event.
- Most of the June 2016 peak flows examined by USGS were found to be much more likely than a "1,000 year event." In fact, the most extreme flooding was found to have 0.2% chance of happening in any given year (1 in 500) to a 5% chance (1 in 20).

TABLE 1. The annual chance of the flows recorded during the 2016 storm. The 100 year flood has a 1% chance of happening each year. Everything in this table with a value greater than 1% could happen more frequently.

STREAM GAGE LOCATION	ANNUAL CHANCE
GREENBRIER RIVER AT ALDERSON	1.2%
GREENBRIER RIVER AT HILLDALE	1.6%
WILLIAMS RIVER AT DYER	0.5%
GAULEY RIVER AT CAMDEN-ON-GAULEY	1.3%
CRANBERRY RIVER NEAR RICHWOOD	5.0%
GAULEY RIVER NEAR CRAIGSVILLE	0.9%
MEADOW RIVER AT NALLEN	0.2%
ANGLINS CREEK NEAR NALLEN	2.4%
PETERS CREEK NEAR LOCKWOOD	4.8%
ELK RIVER BELOW WEBSTER SPRINGS	1.4%

FINDING 4: THE LATEST DATA SHOW THAT THE LEVEL OF FLOODING THAT OCCURRED IN 2016 COULD HAPPEN MORE FREQUENTLY THAN PREVIOUSLY THOUGHT. IN MANY AREAS, THAT EVENT HAS AT LEAST A 1% CHANCE OF HAPPENING EACH YEAR IN THE FUTURE.

FEMA uses the best available technical data to create flood maps. Over time, however, the data used to create the maps can become outdated due to changes in development or variations in rainfall. Also, new techniques are developed for measuring and analyzing data (such as using LiDAR imaging to create a digital model of the ground), and new data are collected, such as streamflow records.

The 2016 West Virginia floods provide a perfect example of the importance of integrating new data into flood risk assessment:

- Most of the effective FIRMs for the counties affected by the 2016 flooding were developed with hydrologic data collected in the 1970s, 1980s, and 1990s. To show how the 2016 storm influenced our understanding of flood risk in WV, USGS scientists analyzed the frequency of flooding at 9 gages throughout the state both with and without the most recent data. First they analyzed flood frequency using data through 1990, and then they repeated the analysis using information from 2016.
- In general, the odds are changing and it is not in our favor. The probability of the highest flows happening again has increased.

Given the length of time since the last flood risk studies for the watersheds affected by the 2016 floods, FEMA will initiate a Discovery process for these areas. Discovery is the beginning of FEMA's process for updating flood maps. This begins a dialogue between FEMA and the communities to better understand the local flood risk and how to build resilience to flooding.

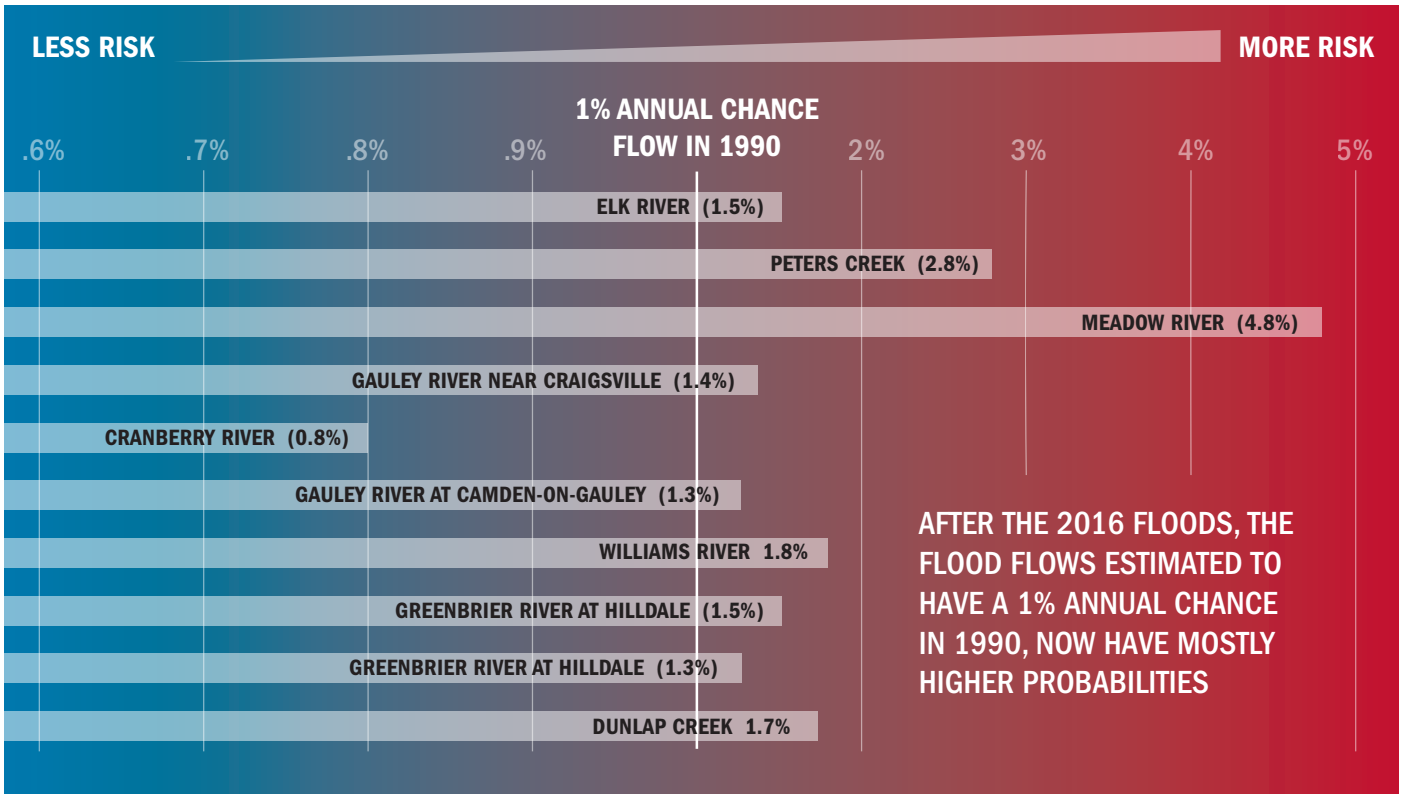


FIGURE 11: This chart shows how the probability of a 100-year-flow at each stream gage based on 1990 data has changed when information from 2016 is included. For all but one of the gages analyzed, what used to have a 1% chance of happening each year, now has a greater chance of happening each year. In other words, what was considered the "100 year flow" could now be called the "21 year flow" for the gage at the Meadow River at Nallen or the "77 year flow" for the Greenbrier River at Alderson.

RECOMMENDED STRATEGIES TO MITIGATE RISK

The 2016 West Virginia floods demonstrated the destructive force of nature. However, both communities and individual property owners can take actions to minimize the damage caused by future floods. The goal of mitigation is to reduce the risk to life and property, which includes existing structures and future construction. This can be achieved through regulations, local ordinances, land use, and building practices, in addition to physical mitigation projects that reduce or minimize long-term risk from flood hazards.

WHAT LOCAL GOVERNMENTS CAN DO:

- Use land use codes to regulate how closely structures may be built to bodies of water. This minimizes the risk of a structure being damaged by a flood, since the areas immediately surrounding bodies of water are usually within the floodplain.
- Similarly, use land use codes to regulate how close structures may be built to the boundaries of the 1% annual-chance floodplain. These boundaries are not exact and have some uncertainty. Structures just outside but close to a SFHA could easily be subject to flooding from a 1% annual-chance flooding event.
- Governments can consider acquiring or elevating any buildings that are already within the floodplain, to eliminate the immediate risk to life and property.
- Communities near bodies of water should consider prioritizing the relocation or elevation of critical facilities, such as hospitals, police precincts, and fire stations. This improves the likelihood that the most critical resources are available and operational during a flood.
- By preserving open spaces along floodways and in floodplains, communities can mitigate flood risk. Open spaces also make more permeable surface area available to absorb excess floodwater. For example, the City of Huntington's future land use map calls for riverfront areas in the Guyandotte and Altizer neighborhood to be preserved as a mix of public and private recreation space.
- Community officials can also encourage their citizens to purchase flood insurance. The National Flood Insurance Program's Community Rating System (CRS) provides incentives for a community to go beyond the minimum actions required to reduce flood risk. Volunteering to participate in CRS makes a community eligible to receive insurance premium reductions contingent on its level of involvement with the program. These reductions are shown in Table 2.

FIGURE 12: Examples of elevated Houses

Table 2: Summary of flood insurance premium reductions based on Community Rating System credits.

CLASS	PREMIUM REDUCTION SFHA*
1	45%
2	40%
3	35%
4	30%
5	25%
6	20%
7	15%
8	10%
9	5%
10	0

Special Flood Hazard Area

WHAT PROPERTY OWNERS CAN DO:

a. Purchase a flood insurance policy for your home, even if it is not in the Special Flood Hazard Area.

b. Maintain proper water drainage around your property

c. Elevate and anchor utilities inside and outside your home.

d. Protect your valuable possessions.

e. Seal your foundation and basement walls.

"Protect Your Home from Flooding: Low-Cost Projects You Can Do Yourself"

www.fema.gov/risk-map-region-iii-resources

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