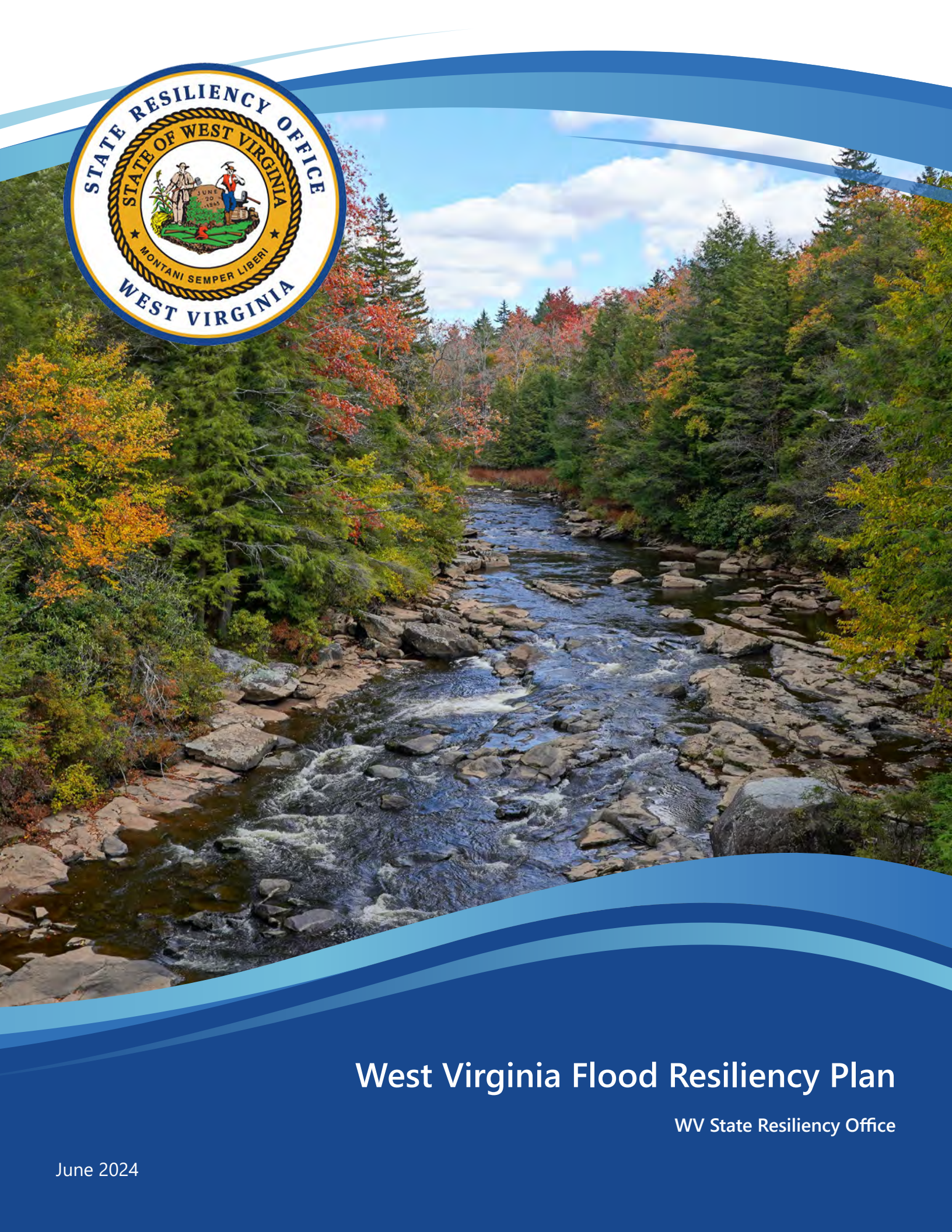



# West Virginia Flood Resiliency Plan

**WV State Resiliency Office**

June 2024

# I Authorization and Document Guide

*Cheat River*

# I. Authorization and Document Guide

**WV Code §29-31-3** tasks the West Virginia State Resiliency Office with creating the West Virginia Flood Resiliency Plan (WVFRP). This first version of the WVFRP has utilized the 2004 Flood Protection Plan and the 2022 review of that document to establish the framework of the plan. Certain recommendations from the 2004 plan have been affirmed as remaining relevant and are included as potential actions to be taken. A format which arranges those potential actions by sector and by organization has been utilized to facilitate adoption by local, county, state, and non-governmental organizations. This design is intended to allow for simplistic updates and assimilation of the plan's elements into other planning efforts.

The components of the West Virginia Flood Resiliency Plan are:



The West Virginia Flood Resiliency Plan is intended to be used as an internet-connected application. Active links to webpages are used throughout the document to provide the user with fast access to relevant resources and data. Functionality and access to various data components will be lost when used in printed form or in digital format without an internet connection.

This first iteration was presented to the Resiliency Office Board on or before June 30th, 2024. Reviews will be performed in odd years and updates performed in even years following this initial plan development.

# II Executive Summary

*Ohio River*

# II. Executive Summary

After recognizing that a long-term strategy was needed to mitigate flooding in our state, the West Virginia Conservation Agency (WVCA) catalyzed creation of the state's first flood protection plan. Then Senator Robert C. Byrd supported the project by providing funding to the U.S. Army Corps of Engineers to facilitate joint development of the plan with the Conservation Agency. With additional financial and programmatic support from the WV Governor's Office, the WV Legislature, and the Natural Resources Conservation Service, a framework for the statewide plan was created. That framework specified the need for a joint task force that could provide the expertise and experience required to address the complex flooding issues within West Virginia. The task force, composed of 20 Federal, State, regional, local, and non-governmental agencies, in turn dedicated staff and other resources to the development of the comprehensive strategic plan. Representatives from the Governor's and Senator Byrd's offices attended the task force meetings as well. The **West Virginia Flood Protection Plan (WVFPP)** was completed in 2004 as a result of those extensive efforts.

*Anthony Creek*

Although it was completed two decades ago, the following excerpt taken from that plan provides an accurate description of the history of flooding in West Virginia.

*The State of West Virginia is blessed with great natural beauty and a rugged landscape that enticed the explorer, the pioneer, and the settler to travel through and settle within its majestic countryside. Prior to the advent of modern earth-moving equipment and construction technology, streams and rivers and their narrow floodplains defined the pathways and wagon trails throughout West Virginia. With the exception of recent interstate highways that crisscross numerous watersheds within the State, most U.S. and State highways and Class I railroads extend the length of every major river valley in the State. The historic use of the State's rivers for commercial navigation further reinforced this floodplain-centered transportation system.*

*Early villages and towns sprang up at the confluence of streams and rivers to take advantage of those transportation opportunities and the nutrient-rich floodplain. Unknowingly, these early settlers initiated patterns of movement and development that would place countless thousands of West Virginians in harm's way. As abundant natural resources were discovered and exploited, the economic fortunes of the State improved, and floodplain communities increased in size and density to accommodate the inflow of new workers and their families. Thousands of acres of forestland were cleared for resource development. The newly constructed railroads and massive resource processing facilities further crowded the floodplains. Excess runoff generated by the combination of*

*expanding communities and resources development quickly overwhelmed the channel capacity of the resident streams and rivers leading to flooding, losses of life and property damage.*

*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. Thousands of West Virginians have suffered through damaged homes and businesses, lost loved ones, and deteriorating communities. Addressing a problem of this magnitude and complexity necessitated initiation of a strategic planning process that would be comprehensive in scope, sensitive to the needs of the stakeholders and their environment and well-coordinated. The Statewide Flood Protection Plan is a result of that process."*

# Transition to the Flood Resiliency Plan

In response to devastating flooding in 2016, the West Virginia State Resiliency Office was created. One of the tasks delegated to that office was an annual review and biennial update of the Flood Protection Plan. In 2022 the first official review of the plan was performed. As was employed during the creation of the plan, Federal, State, regional, local, and non-governmental agencies assisted in the process. In addition, a Flood Symposium was held to gather crowdsourced feedback on the status of the plan and to collect data for development of the update. **The consensus determination from that process was that the Goals, Objectives, and Potential Actions detailed in the 2004 plan are as relevant today as they were in 2004 when the plan was created.**

**The Resiliency Bubble highlights the importance of proactive and holistic measures to enhance resilience, mitigate hazards, recover from impacts, and be prepared for challenges posed by flood hazards.**


These definitions of the bubble components demonstrate the State Resiliency Office's approach to resilience:

**Preparedness:** Modifications in procedures, protocols, and frameworks to mitigate potential risks or capitalize on opportunities by devising adaptation strategies and putting into effect measures to address present and future hazards.

**Response:** The capability to adapt to potential harm, seize opportunities, or react to outcomes by implementing adaptive measures and strategies to mitigate impacts and risks.

**Recovery:** The process of making changes in response to current or anticipated events or their impacts to minimize negative consequences or take advantage of positive opportunities. This process includes the restoration of systems, institutions, and communities following a hazardous event or disruption.

**Hazard Mitigation:** Initiatives, measures, tactics, or guidelines designed to minimize the probability and/or severity of potential negative outcomes following an evaluation of perceived risks.

**Resilience:** The capability to adapt to potential disruptions, seize opportunities, and effectively respond to outcomes. This involves reorganizing in a manner that preserves communities' fundamental function, identity, and structure, while also facilitating adaptation, learning, and transformation.

As the update of the WVFPP was contemplated, the legislature made changes to WV §29-31-3 via **Senate Bill 677**. With adoption of the bill, the update of the Flood Protection Plan was replaced with the Resiliency Office's new directive to create West Virginia's first Flood Resiliency Plan. This new plan must be presented to the West Virginia State Resiliency Office Board by June 30th, 2024, with reviews and updates required on a biennial basis in subsequent years.

Because review of the Flood Protection Plan determined that the goals, objectives, and potential actions remain relevant, continued utilization of those concepts provides a sound foundation upon which to build this Flood Resiliency Plan.

The six goals, the objectives supporting them, and the broader potential actions that provide the framework of the Flood Resiliency Plan are:

Goal 1 is focused on mitigating the impact of flooding in West Virginia through the development of a comprehensive flood preparedness and response strategy to reduce the loss of life from flood events. This involves implementing an efficient flood warning system, educating individuals residing in flood-prone areas, training government officials, establishing evacuation protocols, and prioritizing projects aimed at reducing flood damage.

## **Goal 1:** Reduce the unnecessary loss of lives due to flooding in West Virginia

| Objective 1.1 | Objective 1.2 | Objective 1.3 | Objective 1.4 | Objective 1.5 | Objective 1.6 |
|---|---|---|---|---|---|
| Develop and maintain an effective and reliable flood warning system for West Virginia, including recommendations for new and updated gauges, software, and hardware needs, and coordination between Federal and State agencies. | Identify available education, information, and equipment necessary for floodplain occupants to receive and comprehend flood warnings. | Identify needed equipment and training for public officials in each county so that flood warnings are received and disseminated in an effective and timely manner. | Develop a framework for creation of emergency evacuation plans for each county that identifies emergency service resources, escape routes, and temporary evacuation centers, and establishes a communications network between emergency service organizations. | Identify education and information resources to be disseminated to floodplain residents on the hazards of the floodplain and potential for loss of life due to flooding. | Prioritize proposed flood damage reduction projects and programs such that structures located within the regulated floodway are expeditiously evacuated. |

Goal 2 aims to mitigate flood-related property damage by identifying floodplain mapping needs, securing resources for mapping, informing floodplain managers for better permit decisions, encouraging avoidance of floodplain development, addressing certification needs for managers, advocating for financial support (both structural and non-structural), and exploring funding sources for flood insurance subsidies.

## **Goal 2:** Reduce private and public property damage

| Objective 2.1 | Objective 2.2 | Objective 2.3 | Objective 2.4 | Objective 2.5 | Objective 2.6 | Objective 2.7 |
|---|---|---|---|---|---|---|
| Identify floodplain mapping needs for previously unmapped areas and areas with outdated mapping. | Identify financial and technical resources to acquire needed floodplain mapping. | Identify educational data and information that can be disseminated to county and municipal floodplain managers to enable more informed permit decisions. | Promote avoidance of floodplain development (structures and facilities) by public (Federal, State, county and municipal) agencies. | Identify needs for county and municipal floodplain managers and legislative action to require State certification of floodplain managers. | Promote and identify financial support for both structural and non-structural flood damage reduction measures through Federal and State agencies. | Identify the need for and sources of funding for flood insurance subsidies. |

Under Goal 3, the State Resiliency Office and its partners will work towards facilitating effective floodplain management through the development of technical, administrative, regulatory enforcement, and legislative tools. This will involve actions such as identifying reliable hydrologic/hydraulic models, gathering watershed data, formalizing Task Force responsibilities, recommending legislative measures, offering educational resources for floodplain managers, and acknowledging the importance of Watershed Associations through State legislation.

## **Goal 3:** Develop technical, administrative, regulatory enforcement, and legislative tools that will facilitate implementation of a sound program of flood loss reduction and floodplain management

| Objective 3.1 | Objective 3.2 | Objective 3.3 | Objective 3.4 | Objective 3.5 | Objective 3.6 |
|---|---|---|---|---|---|
| Identify effective hydrologic / hydraulic models that can be implemented at the county and municipal level to predict and plan for future flooding. | Promote continued collection and analysis of watershed level hydrologic and hydraulic data to better define flood frequencies, runoff characteristics, and flooding risks. | Formalize the roles, tasks, and responsibilities of the Task Force and execute a partnership agreement among the members that will ensure its continuation and effectiveness. | Identify legislative proposals (either new legislation or modification of existing law) that will facilitate needed infrastructure protection, establish flood damage reduction funding sources, and enable more effective enforcement of existing programs. | Develop and deploy an education and training package for county and municipal floodplain managers, county commissioners, and city councils based upon existing FEMA data and information. | Recognize and legitimize the role of Watershed Associations in the planning and implementation of flood damage reduction and floodplain management activities through State legislation. |

The target of Goal 4 is to facilitate the implementation of tools and regulations for efficient stormwater management. Key initiatives include identifying accountable entities, offering State support for stormwater regulations, and evaluating the impact of runoff resulting from resource extraction on streams and floodplains.

## **Goal 4:** Promote technical, administrative, regulatory enforcement, and legislative tools that will reduce incrementally excessive runoff from land-conversion activities in West Virginia and floodplain management

| Objective 4.1 | Objective 4.2 | Objective 4.3 | Objective 4.4 | Objective 4.5 |
|---|---|---|---|---|
| Identify needs for stormwater management and deployment (legislation, program enforcement, and State subsidies) of technical, administrative, and legislative components. | Identify the potential agency or agencies responsible for oversight of statewide stormwater management programs. | Identify needs for State subsidies to assist counties and municipalities in establishing stormwater ordinances and enforcement administration. | Identify land-conversion activities that generate excessive runoff leading to property damage from flooding. | Use appropriate available data and information existing or being developed to determine the potential effects of runoff from resource extraction activities on streams and floodplain development. |

Under Goal 5, the State Resiliency Office will create a comprehensive strategy aimed at reducing flood-related losses and supporting the State's economy. Key initiatives will involve identifying affordable solutions for minimizing property damage, maximizing Federal funding opportunities, investigating potential State revenue streams, and advocating for development practices that prioritize both economic advancement and floodplain preservation.

## **Goal 5:** Reduce personal and economic losses due to flooding while supporting a viable state economy

| Objective 5.1 | Objective 5.2 | Objective 5.3 | Objective 5.4 | Objective 5.5 |
|---|---|---|---|---|
| Identify a long-range strategy for reducing personal and economic losses due to flooding. | Identify property damage reduction solutions that are economically efficient and leverage Federal matching funds. | Identify sources of Federal funds to support implementation of the Plan's goals. | Identify potential State revenue sources for property damage reduction projects and floodplain management activities. | Identify alternative development processes that facilitate economic growth (jobs and revenues) while avoiding unnecessary impacts to the State's floodplains. |

The objectives outlined in Goal 6 focus on protecting the State's waterways and floodplains by identifying stable stream reaches to prevent dredging, modification, restoration, or inundation. It is important to acknowledge streams with legally protected aquatic or terrestrial resources and establish a Memorandum of Agreement between Federal and State agencies for stream protection. Restoration efforts should be coordinated using existing State and Federal programs, and education should be promoted to encourage responsible use of streams and floodplains.

## **Goal 6:** Protect the state's waterway and floodplain environments

| Objective 6.1 | Objective 6.2 | Objective 6.3 | Objective 6.4 | Objective 6.5 |
|---|---|---|---|---|
| Identify stable reaches of streams to be protected from dredging, modification, restoration, or inundation. | Identify streams or reaches of streams with aquatic or terrestrial resources protected by laws or regulations. | Prepare and execute a Memorandum of Agreement between Federal and State agencies on protected streams. | Identify streams or reaches of streams requiring restoration of aquatic resources that can be addressed by available State and Federal restoration programs. | Promote wise use of the State's streams and floodplains through the State's education system. |

*New River*

## General Potential Actions

### A. Floodplain Management

Increase resources in the West Virginia Emergency Management Division to support local floodplain managers statewide. Require owners of all new structures to obtain a permit certifying whether or not the structures are in the floodplain. Improve enforcement of floodplain management ordinances.

### B. Flood Warning System

Improve and expand the network of existing rain and stream gauges in the State and connect those instruments to a proposed statewide flood warning system. This system would enable the National Weather Service to issue credible and reliable flood warnings. Provide markers along roads and at stream crossings subject to frequent inundation warning motorists of possible hazards at these locations.

### C. Floodplain Mapping

Update floodplain mapping to more precisely delineate floodplain areas and create more detailed hydrographic networks to improve flow models and flood risk assessment.

### D. Flood Damage Assessment

Designate a single agency or point of contact where flood damage data from Federal and State resources could be stored. Develop a system that integrates the capability of Geographic Information Systems (GIS) with flood damage data so that damage information could be used as the basis for flood protection planning.

### E. Building Codes, Permitting and Enforcement

Continue to support and adopt updates of International Building Code, which covers residential building, plumbing, mechanical, fuel-gas and private sewage disposal requirements and meets minimal flood-resistant design standards. Provide education and technical assistance to the public on the regulatory permit process.

### F. Environmental Impacts of Flooding

Enact legislation that recognizes the attributes and hazards of the State's floodplains and the needs for stricter enforcement of floodplain ordinances. The legislation should declare floodway zones to be off-limits to new development (with some exceptions) and encourage Federal agencies to evaluate all proposed projects for effects on the State's floodplains. Legislate stricter enforcement of regulations for anchoring floatable materials and structures in the floodway and flood fringe. Convene a "Stream Summit" to formulate a standard classification of stream quality in the State. Enact legislation that supports local regulation of stormwater runoff volume. Enact guidelines for the emergency removal of stream debris to avoid long-term environmental damage. Fund studies for identification of stable stream reaches that require protection from development.

### G. Stream Crossings and Access Roads

Establish guidelines for the sizing, installation and maintenance of culverts, drainage structures and stream or river crossings. Identify ownership of abandoned stream crossings and move to demolish unused crossings.

### H. Dredging

The practice of local stream dredging to reduce the damage associated with large regional floods should be terminated. Channel modifications projects (which include some dredging) where economically justified and environmentally sound should be supported to reduce flood damages. Allocate funds for stream restoration projects that can reduce flood damage and return the natural functions of damaged streams and ecosystems.

### I. Resource Extraction

The Task Force supports the recommendations of the study conducted by WVDEP regarding mining. In addition, the Task Force recommends the WV Division of Forestry accelerate revisions to Best Management Practices to reduce the impacts of forestry operations on flooding and develop BMPs on areas severely burned by wildfire.

### J. Stormwater Management

The Task Force recommends that all counties implement a stormwater ordinance to control the quantity and quality of stormwater and to guide the development and implementation of a stormwater management plan. It is recommended that a State agency inspects stormwater facilities and serve as a backup for local inspection and enforcement of regulations on design, installation, operation, and maintenance of these facilities. It is also recommended that special stormwater regulations be prepared for karst areas in West Virginia.

### K. Education

Encourage State, county, and local officials to take the Federal Emergency Management Agency independent study course related to flooding, flood mitigation and floodplain management. Encourage education outlets to develop classes and curriculums that address floodplain and flood issues. Provide visible markers to identify for the public the Base Flood Elevation level.

### L. Existing Flood-Prone Structures and Facilities

Evaluate the major watersheds in the State to identify opportunities to construct upstream retention facilities for flood control and water supply. Evaluate the existing municipalities in the State to identify opportunities for protection in place of those communities serving as the economic and political centers of their respective counties. Establish a voluntary program of permanent acquisition for structures within the designated floodways and a voluntary program of floodproofing and relocations to address existing structures in the flood fringe areas.

## Implementation of Resiliency Efforts in West Virginia

As previously detailed, various stakeholders reviewed the 2004 plan and affirmed that the goals, objectives, and recommendations housed within the 2004 plan are as relevant today as they were when the plan was created. The 2004 recommendations were classified into 12 categories which captured the primary issues within the state surrounding flooding. This Flood Resiliency Plan utilizes those 2004 recommendations as the basis for ***potential actions*** entities across the state may elect to implement to further resiliency in West Virginia. **Section IV** of this plan provides a detailed list of each of the potential actions proposed in Chapter 6 of the 2004 FPP. Those potential actions have been recategorized by sector and organization as opposed to the issue-centric format previously utilized. The intent is to allow applicable organizations to easily access the data most pertinent to them. This framework also provides for simplistic updates as new actions are developed, existing ones are implemented, or older ones are determined to no longer be applicable.

**Section III** of this plan provides guidance on what variables organizations may want to consider when pursuing implementation. It is anticipated that sections III and IV will be used in conjunction with each other. The primary foci for prioritization in this Flood Resiliency Plan include:

- **A. Implement actions that support existing plans, programs, and laws**
- **B. Use of statistical data in determining where to concentrate efforts**
- **C. Implementing a multiple benefit approach**

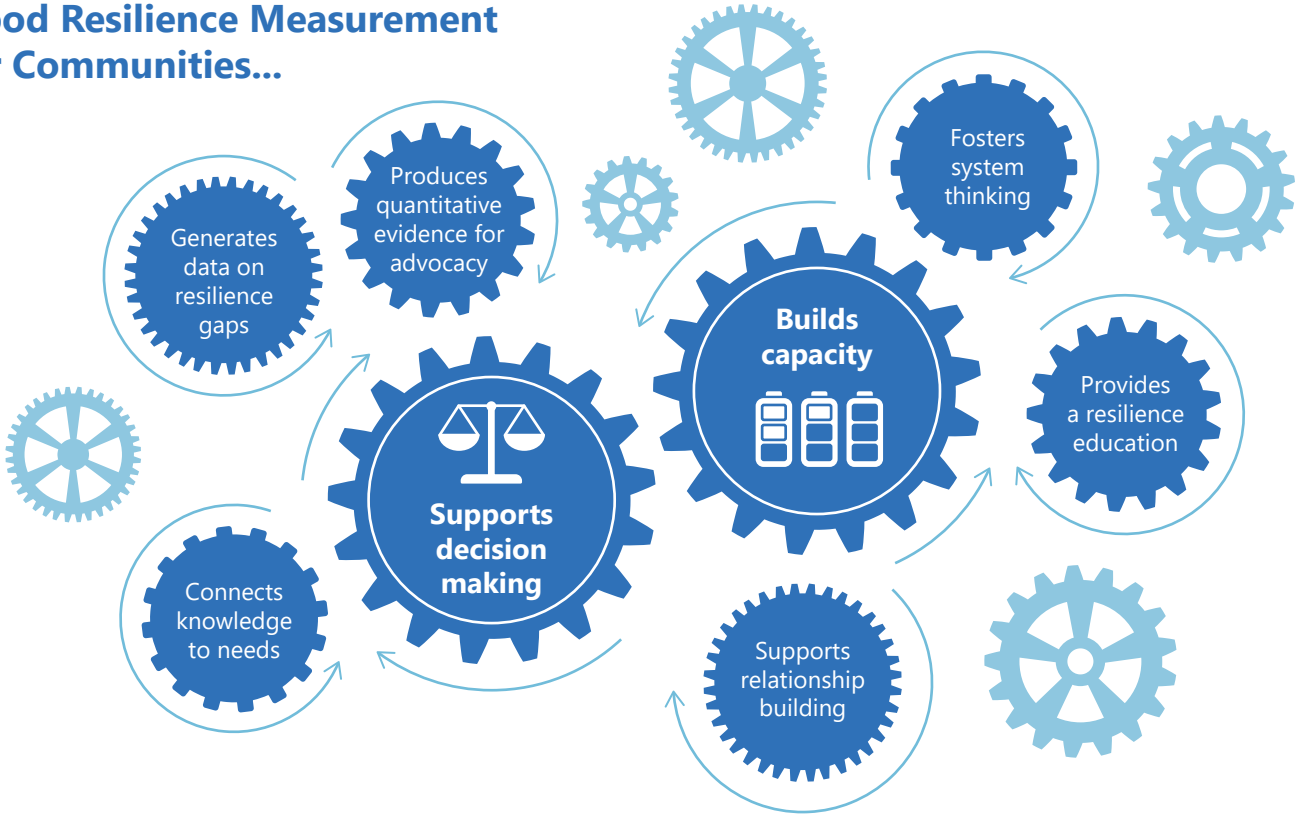
Details and examples of each are housed in the applicable section.

## Monitoring Trends to Guide Future Resiliency Efforts

The 2004 Flood Protection Plan was an expansive document which provided numerous recommendations to address flooding in the Mountain State. Unfortunately, no system or entity was created to monitor success or provide guidance in implementation after the plan was created. A State Flood Protection Planning Council was proposed in the 2005 West Virginia legislative session, but the proposed bill failed to make it out of committee. It was not until the West Virginia State Resiliency Office was formed in 2017 that an entity officially had responsibility for the Flood Protection Plan.

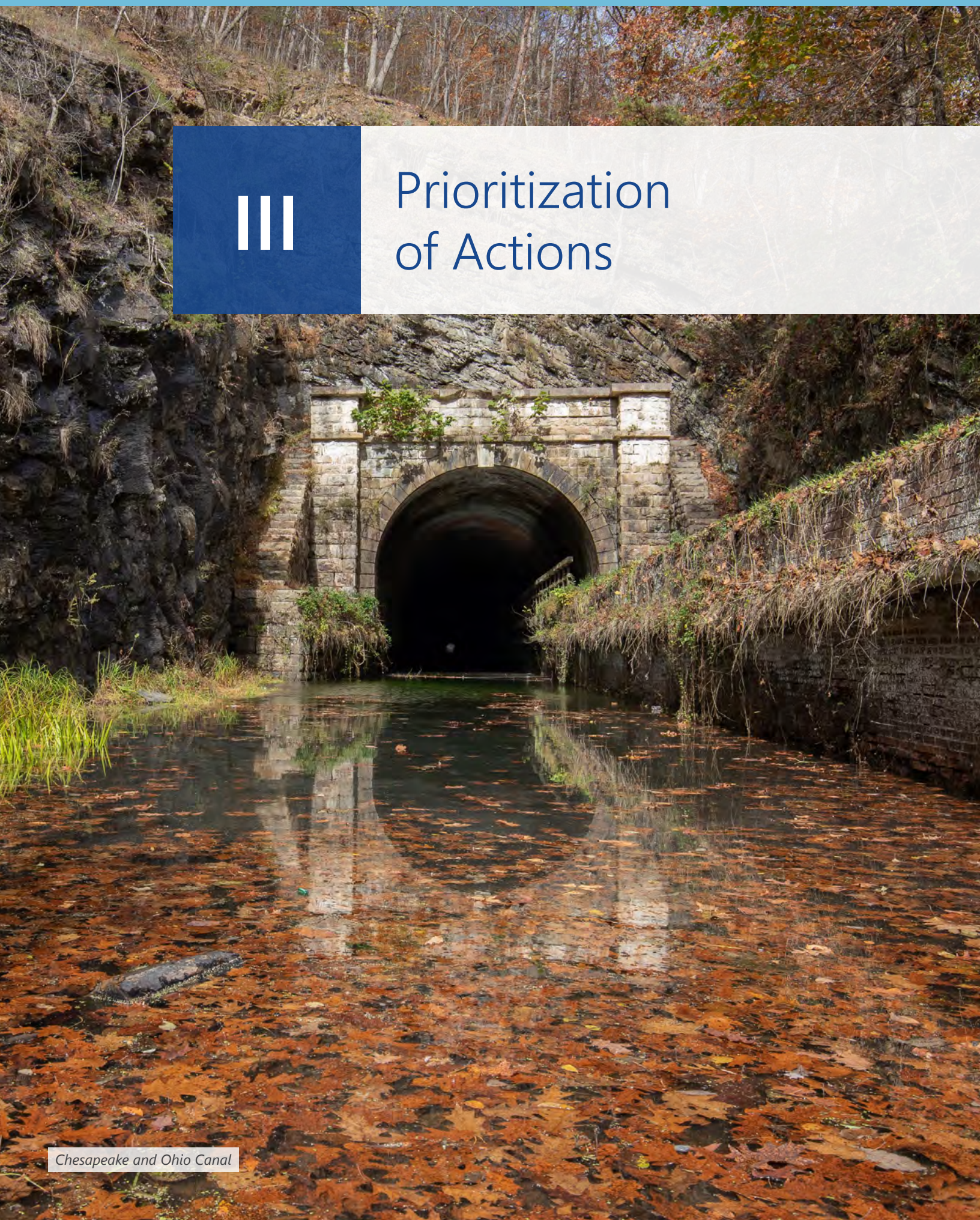
Developing this resiliency plan is the next step in creating a more flood resilient West Virginia. This ***voluntary plan*** cannot be fully implemented without a mechanism for monitoring activities, reviewing potential actions, and assuring that the plan remains relevant. To address these gaps, a dashboard is being constructed to monitor resiliency trends within the state. **Section V** of this plan provides an overview of the concept. Metrics will include monetary expenditures, project completions, education and training participation, action implementation, and crowdsourced ratings. A system of weighting will be utilized to prevent one metric from overshadowing the others. The intended result is a composite score that can be tracked over time to establish a trend line. This will create a mechanism to monitor momentum, catalog resiliency activities, and provide a means to analyze data to inform future guidance on resiliency efforts across West Virginia.

## Flood Resilience Measurement for Communities...




*Tygart Dam on the Tygart Valley River*

# III Prioritization of Actions

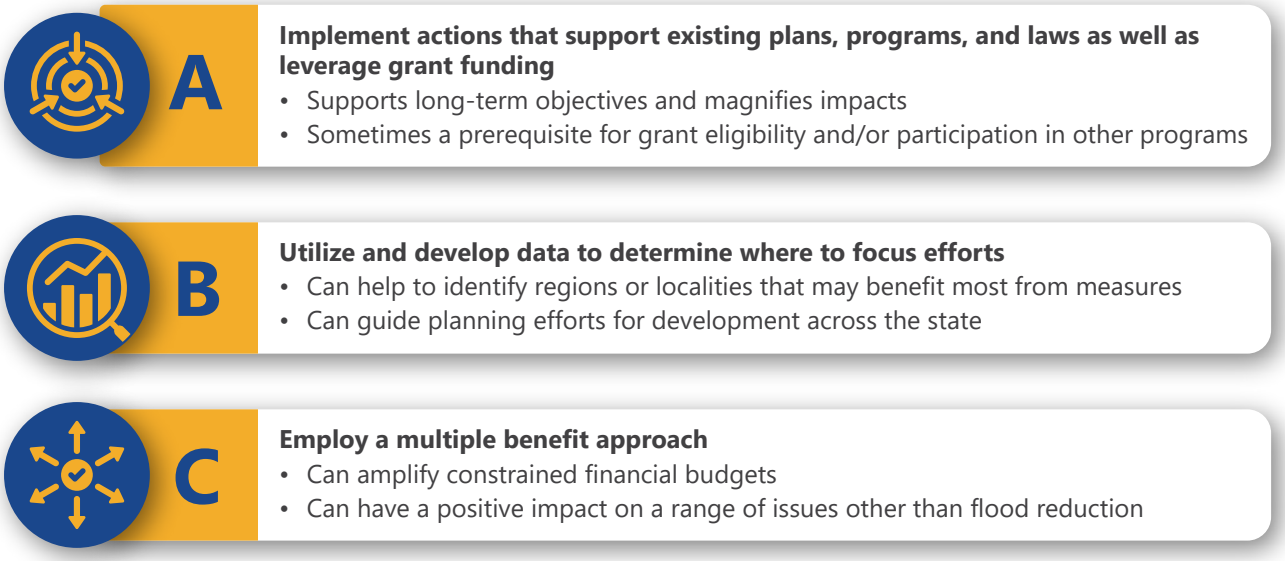


*Chesapeake and Ohio Canal*

# III. Prioritization of Actions

This section provides guidance on how entities may choose to focus their efforts during this first biennial implementation period. Three methodologies have been identified that strive to support the goals and objectives of the plan, leverage available funding platforms, and assist in identifying some of the most impactful statutory options for consideration by the legislature, executive branch, local government, and regulatory agencies.

Those methodologies are:




Adoption and/or implementation of the actions detailed in section IV will require a commitment to resiliency investment by all of the entities addressed. Given the number of potential actions, the logistics of implementation, and the costs associated with implementation, deciding where to focus early efforts upon is crucial to successful implementation of resiliency measures throughout West Virginia.

The remainder of this section provides applicable examples for each of the resiliency prioritizations previously mentioned.

# A. Implement actions that support existing plans, programs, and laws as well leverage grant funding

There are numerous programs and plans implemented at the federal, state, regional and local level that target flood preparedness, recovery, and mitigation. Additionally, participation in some of these programs is a prerequisite for grant eligibility and/or participation in other programs. Implementing actions which provide support for these plans and programs is crucial in accessing all available resources.

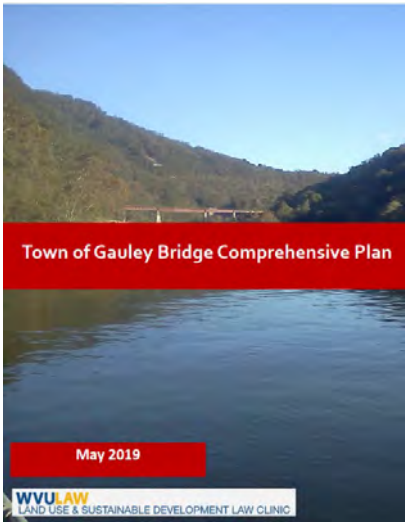
## Plans to Support

### Hazard Mitigation Plans


Hazard Mitigation Plans are used to identify and assess hazards that impact a state, region or community, develop a strategy to reduce losses from those hazards, and establish a coordinated process to implement the strategy (WVEMD, n.d.). The **2023 West Virginia Hazard Mitigation Plan** is provided here as an example.

In addition to statewide hazard mitigation plans, each of the twelve Regional Planning and Development Councils in West Virginia generates a hazard mitigation plan specific to their area in order to be eligible for FEMA funding. Click **here** to view Region 4's Hazard Mitigation Plan Update.

### Comprehensive Plans




Comprehensive Plans are characterized in **WV §8A-3-4** as written statements on present and future land use and development patterns consisting of descriptive materials, including text, graphics and maps, covering the objectives, principles and guidelines for the orderly and balanced present and future economic, social, physical, environmental and fiscal development of an area under the jurisdiction of the planning commission. The **WVU Land Use and Sustainable Development Law Clinic** has worked with a number of communities across the state to assist in developing these plans. Comprehensive plans completed in whole or in part by the Clinic are provided **here** as examples of comprehensive plans.

## Programs to Support

### NRCS Watershed and Flood prevention Operations Program (NRCS WFPO)


The NRCS Watershed and Flood Prevention Operations Program (NRCS WFPO) provides assistance to help plan and implement watershed projects for flood prevention, watershed protection, recreation, fish and wildlife, water quality, and water supply and management. These projects are uniquely designed for each watershed. WV has a robust watershed program, with 170 dams and other conservation measures in place to protect watersheds and improve resiliency (NRCS, n.d.).

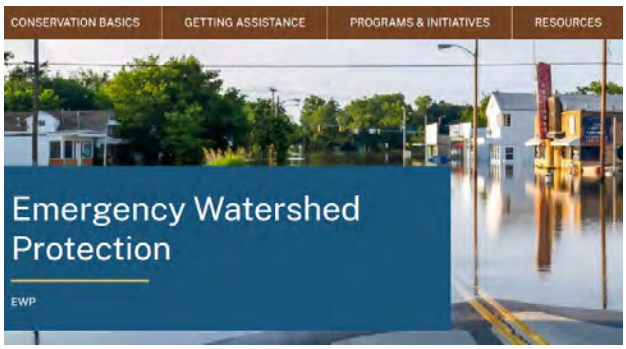
### National Flood Insurance Program

Created by Congress in 1968, the National Flood Insurance Program (NFIP) provides insurance to help reduce the socio-economic impact of floods. Flood insurance is a separate policy that can cover buildings, the contents in a building, or both. The NFIP provides flood insurance to property owners, renters, and businesses, and having this coverage helps them recover faster when floodwaters recede (NFIP, n.d.).

### Community Rating System


The Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements of the NFIP. Over 1,500 communities participate nationwide (FEMA, 2024).

### Emergency Watershed Protection Program




The NRCS Emergency Watershed Protection (EWP) program offers technical and financial assistance to help local communities relieve imminent threats to life and property caused by floods, fires, windstorms and other natural disasters that impair a watershed. EWP does not require a disaster declaration by federal or state government officials for program assistance to begin. The NRCS State Conservationist can declare a local watershed emergency and initiate EWP program assistance in cooperation with an eligible sponsor. NRCS will not provide funding for activities undertaken by a sponsor prior to the signing of a cooperative agreement between NRCS and the sponsor. This program can remove debris from stream channels, road culverts and bridges; reshape

and protect eroded streambanks; correct damaged or destroyed drainage facilities; establish vegetative cover on critically eroding lands; repair levees and structures; repair certain conservation practices, and purchase of EWP Buyouts (NRCS, n.d.).

### Individuals and Households Program

The 🔗 **Individuals and Households Program (IHP)** provides financial and direct services to eligible individuals and households affected by a disaster, who have uninsured or under-insured necessary expenses and serious needs. IHP assistance is not a substitute for insurance and cannot compensate for all losses caused by a disaster. The assistance is intended to meet your basic needs and supplement disaster recovery efforts (FEMA, 2024).

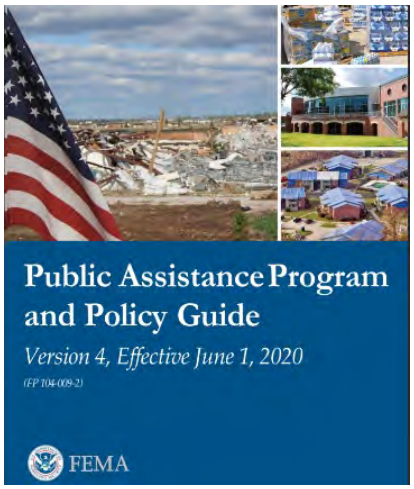
### FEMA Public Assistance

FEMA's 🔗 **Public Assistance (PA)** Program provides supplemental grants to state, tribal, territorial, and local governments, and certain types of private non-profits so communities can quickly respond to and recover from major disasters or emergencies (FEMA, 2024).

### West Virginia Department of Environmental Protection Programs

The 🔗 **West Virginia Department of Environmental Protection** houses two programs related to dam safety. The 🔗 **Division of Mining and Reclamation** provides regulatory oversight of coal impoundments. All other high hazard dams in the state are under the purview of the 🔗 **WV Dam Safety Section** which is housed in the Division of Water and Waste Management. Their mission is to protect lives and property from the danger of a dam failure (WVDEP, n.d.).

*Auxiliary Spillway Failure*

## Codes and Regulations to Support

- §19-21A. – Conservation Districts
- §29-31-1. – State Resiliency and Flood Protection Act
- §7-1-3u. Authority of Counties and Municipalities to Treat Streams to Prevent Floods
- §15-5-1. Division of Homeland Security and Emergency Management
- §15A-10-1. State Fire Marshal and Office of the State Fire Marshal
- §8A. Land Use Planning

## Grants to Support

### Federal Emergency Management Agency

**Federal Emergency Management Agency (FEMA)** administers multiple grant programs including:

- **Building Resilient Infrastructure and Communities (BRIC)** supports states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. The program's guiding principles are supporting communities through capability and capacity building; encouraging and enabling innovation; promoting partnerships; enabling large infrastructure projects; maintaining flexibility; and providing consistency (FEMA, 2024).
- The **Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM)** Act allows FEMA to award capitalization grants for eligible entities to make funding decisions and award loans directly to local communities (FEMA, 2024).
- The **Flood Mitigation Assistance (FMA)** grant program is a competitive program that provides funding to states, federally recognized Tribal governments, U.S. territories, and local governments. Since the National Flood Insurance Reform Act of 1994 was signed into law, funds are used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the National Flood Insurance Program (FEMA, 2024).

### The Economic Development Administration

The **Economic Development Administration (EDA)** mission is to lead the Federal economic development agenda by promoting innovation and competitiveness, and preparing American regions for growth and success in the worldwide economy. Through this Disaster Supplemental NOFO, EDA will award investments in regions experiencing severe economic distress or other economic harm resulting from Hurricanes Ian and Fiona, and of wildfires, flooding, and other natural disasters occurring in calendar years 2021 and 2022. Under this announcement, EDA solicits applications under the authority of its Economic Adjustment Assistance (EAA) program. The EAA program is intended to be flexible and responsive to the economic development needs and priorities of local and regional stakeholders, including those seeking assistance recovering from Federally declared disasters (EDA, n.d.).

### The Infrastructure Investment and Jobs Act (IIJA)

The **IIJA** establishes the **Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT)** Program to help make surface transportation more resilient to natural hazards, including climate change, sea level rise, flooding, extreme weather events, and other natural disasters through support of planning activities, resilience improvements, community resilience and evacuation routes, and at-risk coastal infrastructure (Federal Highway Administration, 2022).

### The Small Business Administration

The **Small Business Administration (SBA)** provides low-interest disaster loans to help businesses and homeowners recover from declared disasters (SBA, n.d.).

### Department of Housing and Urban Development

The Department of Housing and Urban Development (HUD) provides flexible **Community Development Block Grant Disaster Recovery (CDBG-DR)** funds to help cities, counties, and states to recover from Presidentially declared disasters (HUD, n.d.).

## B. Utilize and develop data in determining where to focus efforts

Utilization of statistical data provides one mechanism to identify regions or localities within the state that may benefit the most from the implementation of measures to improve resiliency. Indicators can include factors such as socioeconomic data, development density in flood prone areas, a community's proximity to emergency services, and the hazard susceptibility of critical infrastructure. Consideration of this type of data can help to identify areas where residents and/or the local economy may be less equipped to respond and recover from a flood event. Incorporating historic flood information can help to identify gaps in data or to validate current flood models. Additionally, the use of predictive modeling can be used in conjunction with these indicators to guide planning efforts for development across the state.

Collecting and manipulating this data can be effectively performed using Geographic Information System (GIS) technologies. A number of options exist to facilitate the use of GIS technology in West Virginia. The **WV Flood Tool** is an excellent example of an open-source tool that anyone can access. Created and maintained by the **WV GIS Technical Center**, this tool provides a user-friendly method of visualizing property boundaries and how those boundaries interact with the 100 year and 500-year flood plains. The WV GIS Technical Center is also currently building the WV Flood Resiliency Framework (Figure III-1). Once completed, this extension of the WV Flood Tool will provide a suite of risk assessment and visualization tools that can be used by anyone to guide resiliency efforts at any level of planning.

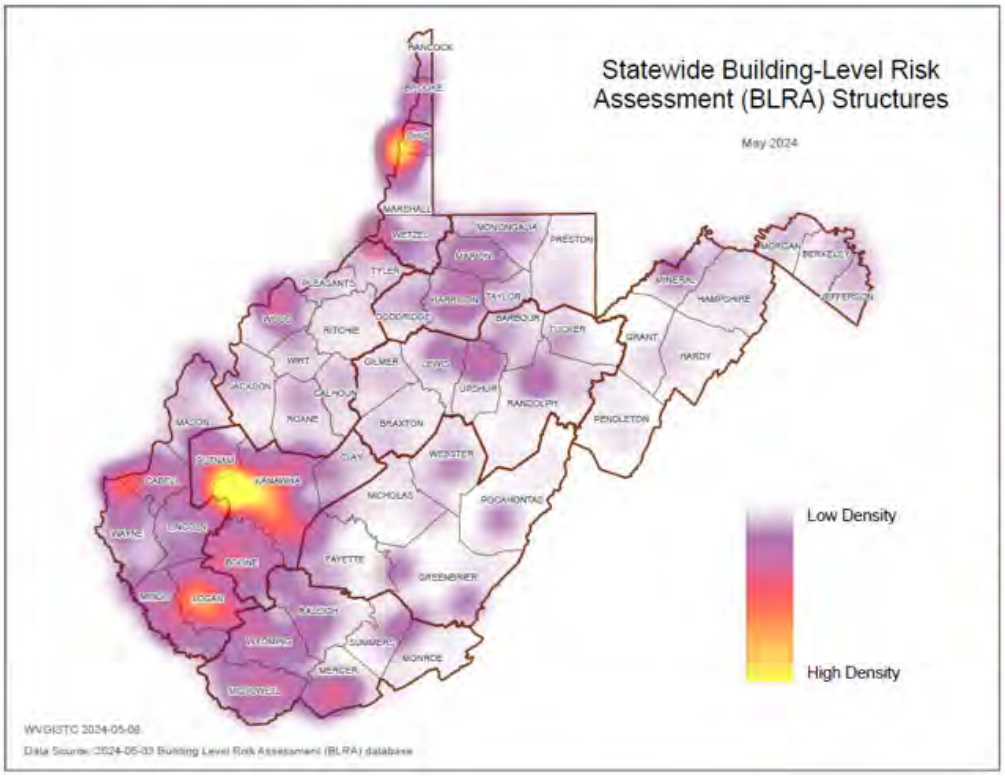
*Sleepy Creek*


**Figure III-1. The West Virginia Flood Risk Framework**

The following examples (Figures III-2 though III-9) utilize some of the most common flood risk indicators such as flood frequency, flood depths, building exposure, building density, building year, repetitive loss, and population ratio to identify areas of West Virginia that may benefit most from resiliency focused investment.

**BUILDING COUNT (STATEWIDE SCALE)**

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| HIGH-RISK REGULATORY ZONES<br>**Buildings in Special Flood Hazard Area**<br>1% Annual Chance (100-YR) Flood Zone | | |
|---|---|---|
| Special Flood Hazard Area | | 84,490 |
| • Detailed Zone AE | 65% | 55,112 |
| • Approximate Zone A | 35% | 29,378 |
| o Zone AE Floodway | 10% | 8,572 |

| HIGH-RISK ADVISORY FLOOD ZONES<br>**Includes Buildings in Non-Regulatory Zones**<br>Future Map 1% AEP (100-YR) Flood Zones | | |
|---|---|---|
| High-Risk Flood Zones | | 97,936 |
| • Mapped No Change | 70% | 69,093 |
| • Mapped out SFHA | 16% | -15,528 |
| • Mapped in SFHA (non-regulatory) * | 14% | 13,315 |
| • SFHA net change | -2% | -2,213 |
| Structures est. in SFHA | | 82,408 |

* 54 counties have Advisory A / AE Flood Zones

| OTHER FLOOD ZONES<br>**Buildings in Shaded X Zones**<br>Moderate or Reduced Flood Risk Areas | |
|---|---|
| High and Moderate Risk Zones | 138,623 |
| • 0.2% annual chance (500-YR) flood (moderate risk) | 44,415 |
| • Levee Protected Zones (reduced risk) | 9,718 |

**SFHA ZONE A STUDY TYPES**
- 70% Approximate A Zones
- 30% Detailed AE Zones

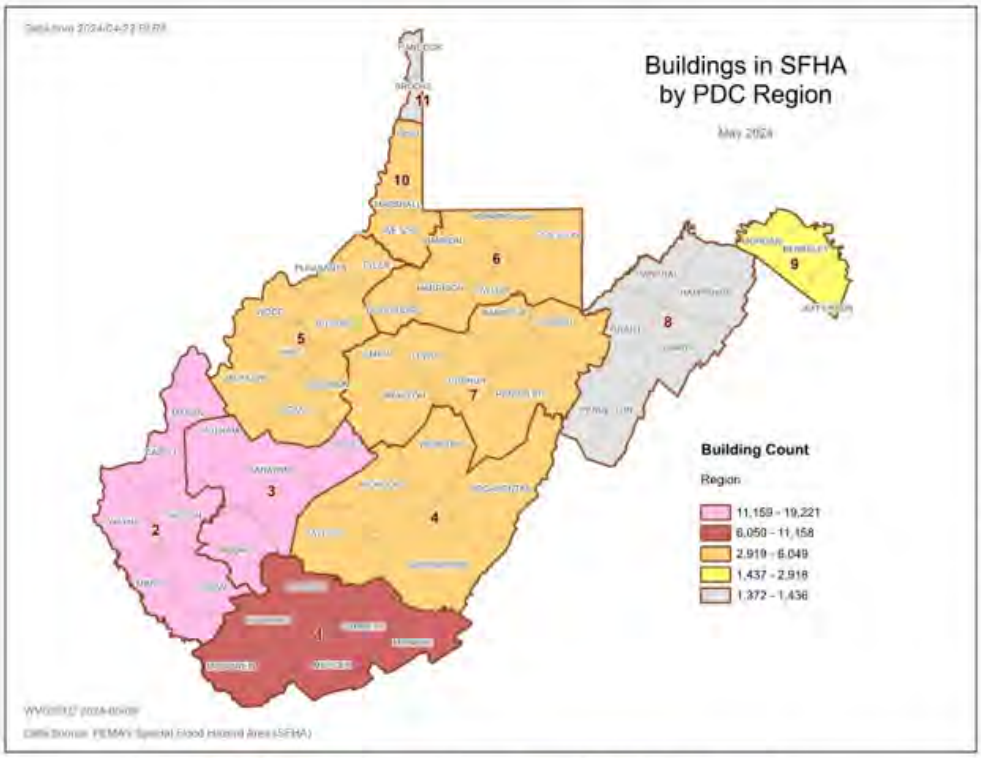
| WEB LINKS: | SFHA Building Density Graphic | SFHA Zone A/AE Study Types | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

**Figure III-2. Building Count in Special Flood Hazard Area (Statewide Scale)**

## BUILDING COUNT (REGIONAL COUNCIL SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Region (11) | Count | % Rank |
|---|---|---|---|
| 1 | Region 3 | 19,221 | 92% |
| 2 | Region 2 | 17,016 | 83% |
| 3 | Region 1 | 11,158 | 75% |
| 4 | Region 6 | 6,049 | 67% |
| 5 | Region 4 | 6,044 | 58% |
| 6 | Region 10 | 6,024 | 50% |
| 7 | Region 5 | 5,752 | 42% |
| 8 | Region 7 | 5,418 | 33% |
| 9 | Region 8 | 2,918 | 25% |
| 10 | Region 9 | 1,436 | 17% |
| 11 | Region 11 | 1,372 | 8% |

| REGIONAL SCALE STATISTICS | |
|---|---|
| Minimum (REGION 11) | 1,372 |
| Maximum (REGION 1) | 19,221 |
| Median | 6,204 |
| Mean | 7,492 |
| Statewide Total | 82,408 |

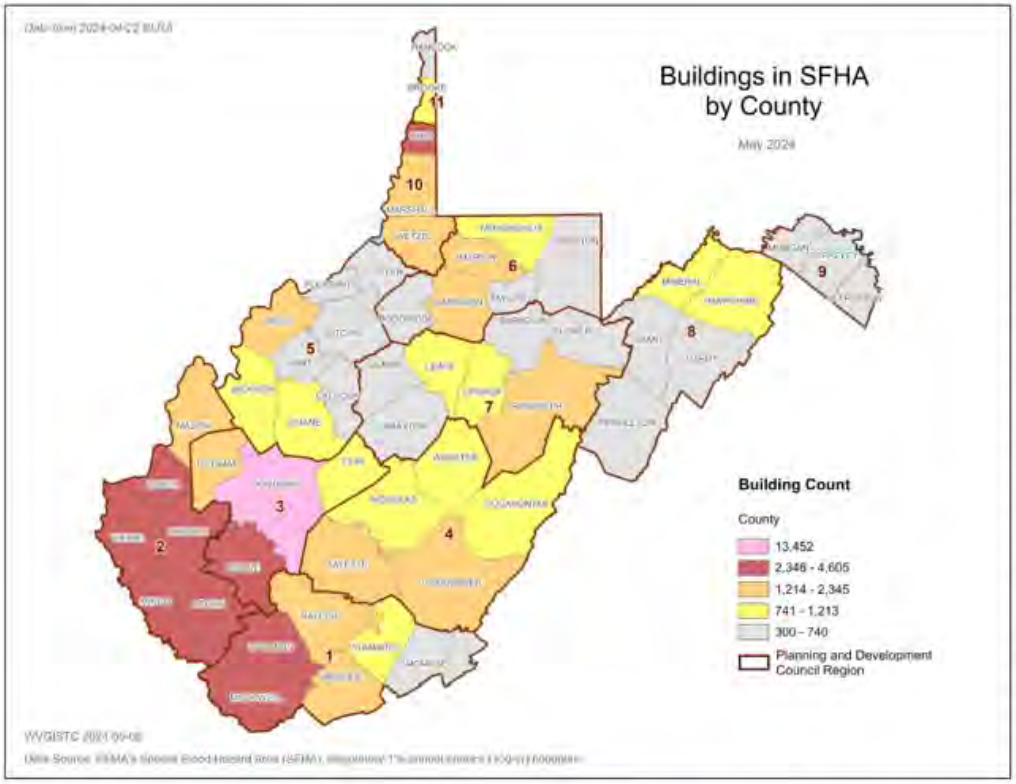
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

**Figure III-3. Building Count in Special Flood Hazard Area (Regional Council Scale)**

## BUILDING COUNT (COUNTY SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | County (55) | Count | % Rank |
|---|---|---|---|
| 1 | KANAWHA | 13,452 | 100% |
| 2 | LOGAN | 4,498 | 98% |
| 3 | MCDOWELL | 3,479 | 96% |
| 4 | MINGO | 3,229 | 94% |
| 5 | BOONE | 3,094 | 93% |
| 6 | OHIO | 2,992 | 91% |
| 7 | CABELL | 2,808 | 89% |
| 8 | WYOMING | 2,592 | 87% |
| 9 | LINCOLN | 2,556 | 85% |
| 10 | WAYNE | 2,485 | 83% |
| 11 | MERCER | 2,019 | 81% |
| 12 | RALEIGH | 1,945 | 80% |
| 13 | PUTNAM | 1,932 | 78% |
| 14 | GREENBRIER | 1,879 | 76% |
| 15 | HARRISON | 1,872 | 74% |
| 16 | WOOD | 1,663 | 72% |
| 17 | MARION | 1,641 | 70% |
| 18 | WETZEL | 1,571 | 69% |
| 19 | MARSHALL | 1,463 | 67% |
| 20 | MASON | 1,440 | 65% |

| COUNTY SCALE STATISTICS | |
|---|---|
| Minimum (GRANT) | 300 |
| Maximum (KANAWHA) | 13,452 |
| Median | 939 |
| Mean | 1,498 |
| Statewide Total | 82,408 |

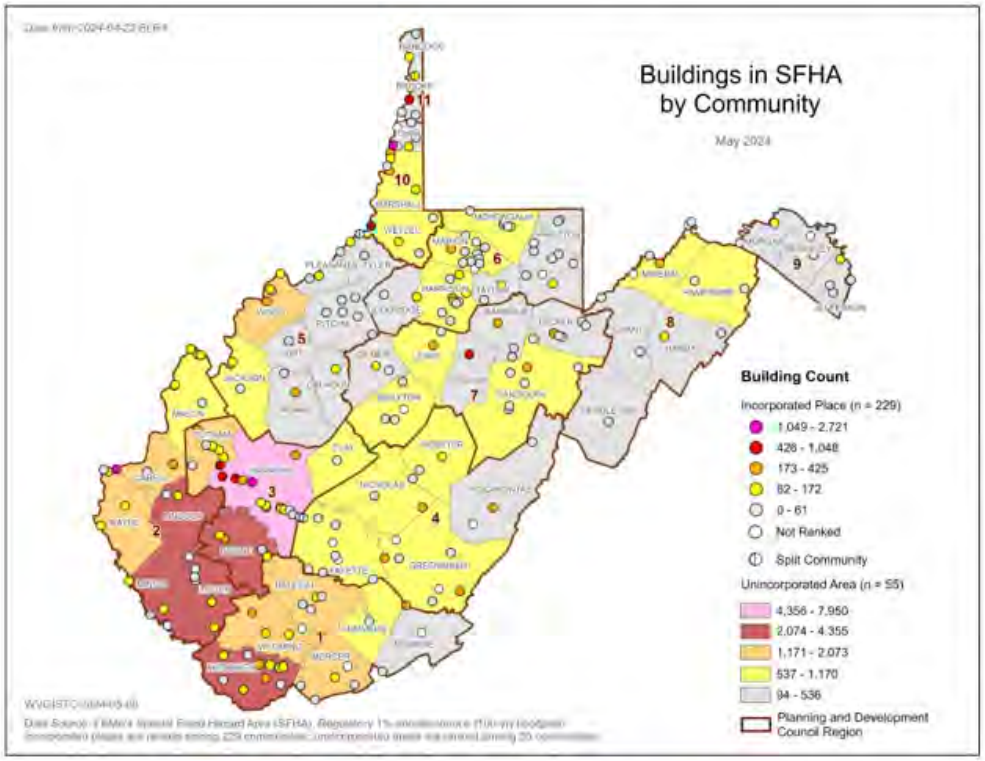
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

**Figure III-4. Building Count in Special Flood Hazard Area (County Scale)**

## BUILDING COUNT (COMMUNITY SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Community (284) | Count | % Rank |
|---|---|---|---|
| 1 | Kanawha County* | 7950 | 100% |
| 2 | Logan County* | 4279 | 100% |
| 3 | Mingo County* | 2899 | 99% |
| 4 | Wheeling** | 2685 | 99% |
| 5 | Boone County* | 2572 | 98% |
| 6 | Lincoln County* | 2407 | 98% |
| 7 | McDowell County* | 2223 | 98% |
| 8 | Wyoming County* | 2059 | 97% |
| 9 | Wayne County* | 1944 | 97% |
| 10 | Raleigh County* | 1818 | 97% |
| 11 | Mercer County* | 1792 | 96% |
| 12 | Charleston | 1512 | 96% |
| 13 | Cabell County* | 1489 | 95% |
| 14 | Wood County* | 1316 | 95% |
| 15 | Putnam County* | 1297 | 95% |
| 16 | Fayette County* | 1157 | 94% |
| 17 | Marion County* | 1112 | 94% |
| 18 | Huntington** | 1099 | 94% |
| 19 | St. Albans | 1043 | 93% |
| 20 | Greenbrier County* | 997 | 93% |

* Unincorporated Area ** Split Community

| COMMUNITY AREA STATISTICS | |
|---|---|
| Minimum | 0 |
| Maximum (Kanawha*) | 7,950 |
| Median | 77 |
| Mean | 310 |
| Communitywide Total | 82,408 |
| Statewide Total | 82,408 |

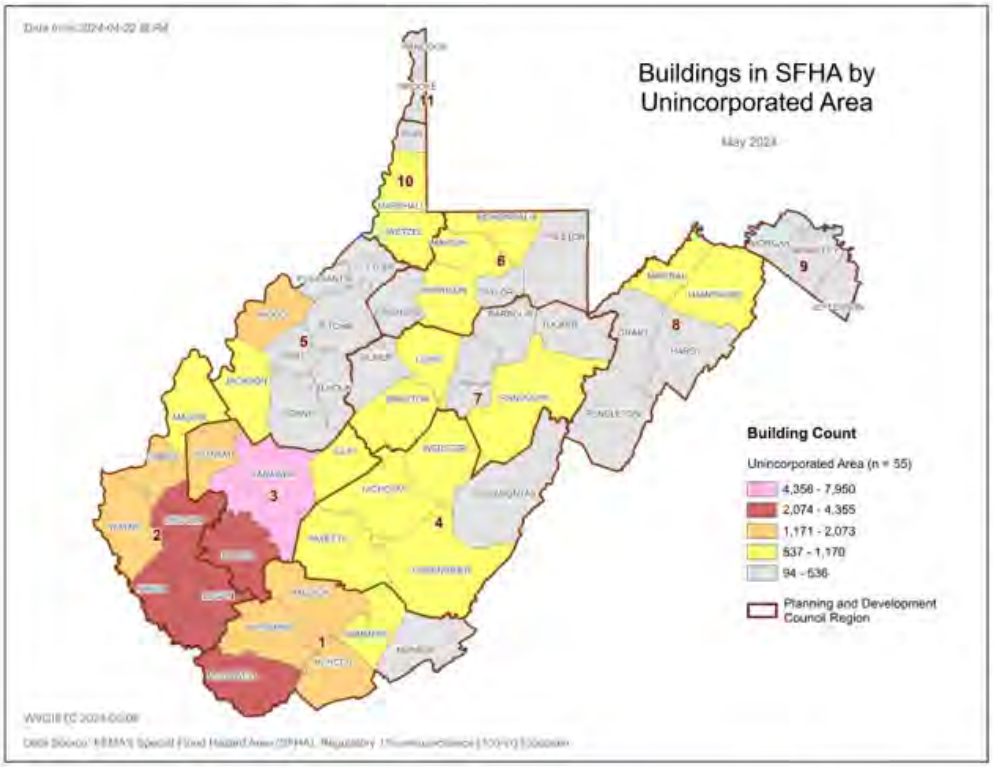
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

**Figure III-5. Building Count in Special Flood Hazard Area (Community Scale)**

## BUILDING COUNT (UNINCORPORATED AREA SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Unincorporated (55) | Count | % Rank |
|---|---|---|---|
| 1 | Kanawha County* | 7,950 | 100% |
| 2 | Logan County* | 4,279 | 98% |
| 3 | Mingo County* | 2,899 | 96% |
| 4 | Boone County* | 2,572 | 94% |
| 5 | Lincoln County* | 2,407 | 93% |
| 6 | McDowell County* | 2,223 | 91% |
| 7 | Wyoming County* | 2,059 | 89% |
| 8 | Wayne County* | 1,944 | 87% |
| 9 | Raleigh County* | 1,818 | 85% |
| 10 | Mercer County* | 1,792 | 83% |
| 11 | Cabell County* | 1,489 | 81% |
| 12 | Wood County* | 1,316 | 80% |
| 13 | Putnam County* | 1,297 | 78% |
| 14 | Fayette County* | 1,157 | 76% |
| 15 | Marion County* | 1,112 | 74% |
| 16 | Greenbrier County* | 997 | 72% |
| 17 | Mason County* | 951 | 70% |
| 18 | Harrison County* | 943 | 69% |
| 19 | Randolph County* | 903 | 67% |
| 20 | Jackson County* | 822 | 65% |

* Unincorporated Area

| UNINCORPORATED AREA STATISTICS | |
|---|---|
| Minimum (Brooke*) | 94 |
| Maximum (Kanawha*) | 7,950 |
| Median | 595 |
| Mean | 1,028 |
| Unincorporated Area Total | 56,529 |
| Statewide Total | 82,408 |

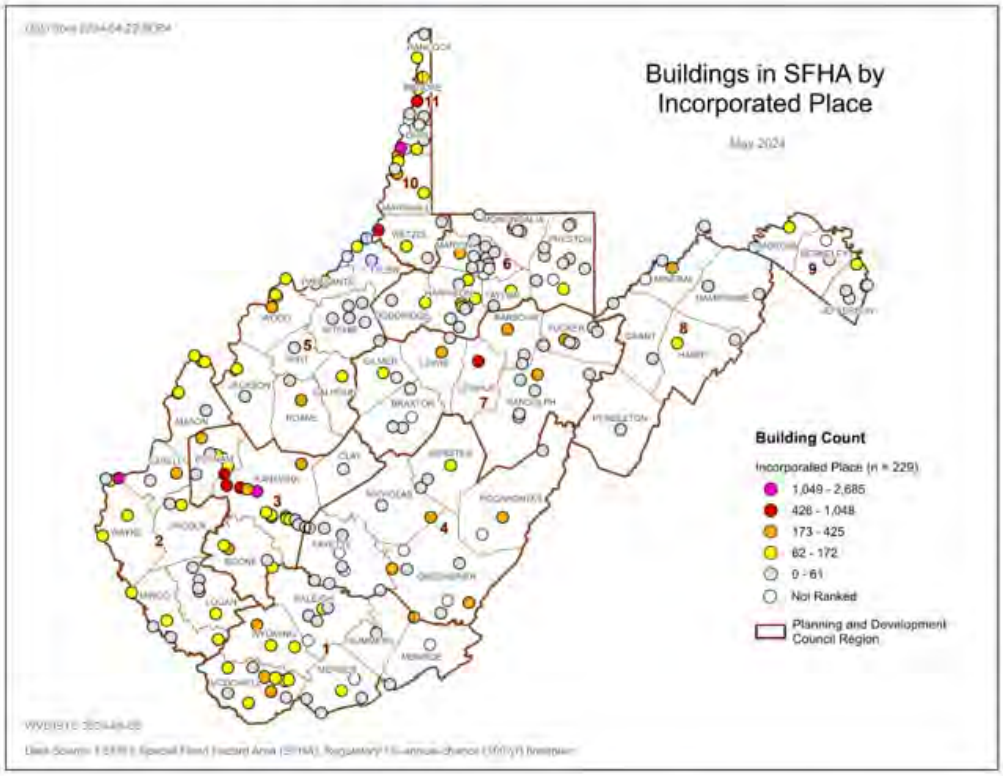
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Report | WEB LINKS: |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

Figure III-6. Building Count in Special Flood Hazard Area (Unincorporated Area Scale)

## BUILDING COUNT (INCORPORATED PLACE SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Incorporated (229) | Count | % Rank |
|---|---|---|---|
| 1 | Wheeling** | 2,685 | 100% |
| 2 | Charleston | 1,512 | 100% |
| 3 | Huntington** | 1,099 | 99% |
| 4 | St. Albans | 1,043 | 99% |
| 5 | Dunbar | 903 | 98% |
| 6 | New Martinsville | 756 | 98% |
| 7 | Wellsburg | 716 | 97% |
| 8 | Nitro** | 659 | 97% |
| 9 | Buckhannon | 568 | 96% |
| 10 | Milton | 407 | 96% |
| 11 | Clarksburg | 394 | 95% |
| 12 | *Marlinton* | 371 | 95% |
| 13 | Keyser | 354 | 94% |
| 14 | *Rainelle* | 336 | 94% |
| 15 | Moundsville | 321 | 93% |
| 16 | South Charleston | 319 | 93% |
| 17 | Welch | 318 | 92% |
| 18 | Benwood | 317 | 92% |
| 19 | Oceana | 303 | 91% |
| 20 | *White Sulphur Spr.* | 302 | 90% |
| 21 | *Clendenin* | 302 | 90% |
| 22 | *Richwood* | 286 | 90% |
| 23 | Gary | 267 | 90% |

** Split Community  *Italicized* = Focus Studies

| INCORPORATED PLACE STATISTICS | |
|---|---|
| Minimum | 0 |
| Maximum (Wheeling) | 2,685 |
| Median | 50 |
| Mean | 123 |
| Incorporated Place Total | 25,879 |
| Statewide Total | 82,408 |

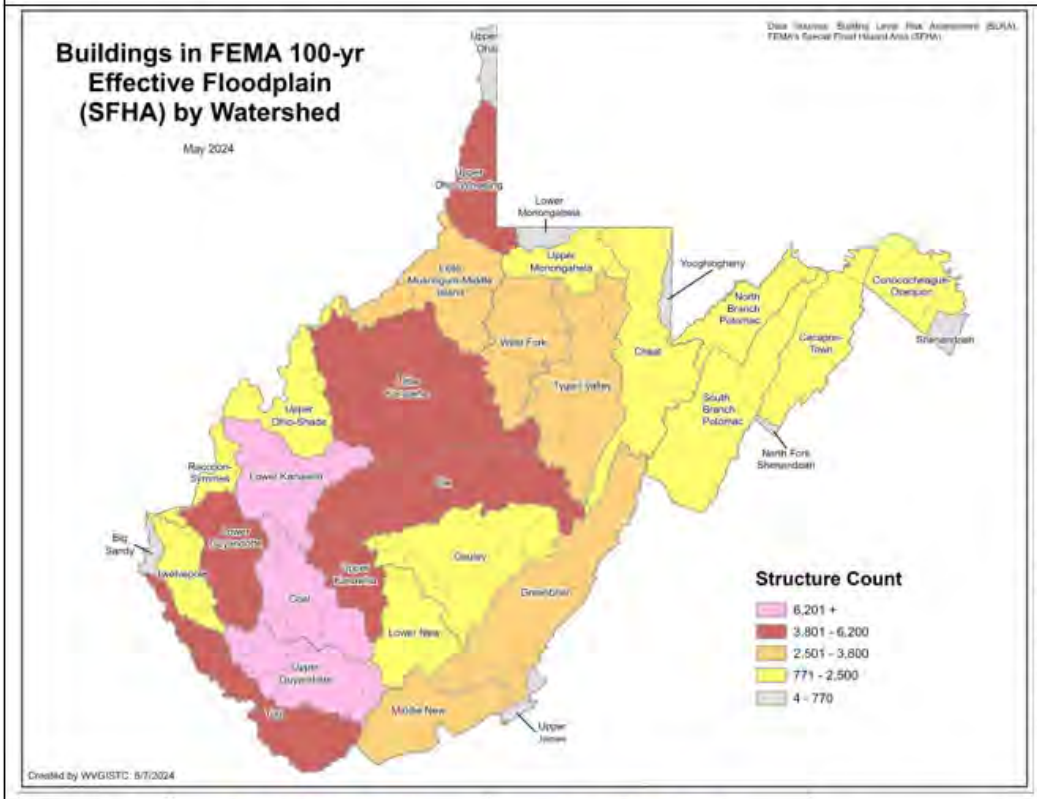
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

**Figure III-7. Building Count in Special Flood Hazard Area (Incorporated Place Scale)**

## BUILDING COUNT (WATERSHED SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Watershed (33) | Count | % Rank |
|---|---|---|---|
| 1 | Lower Kanawha | 7,989 | 100% |
| 2 | Coal | 6,240 | 97% |
| 3 | Upper Guyandotte | 6,211 | 94% |
| 4 | Upper Ohio-Wheeling | 5,845 | 91% |
| 5 | Tug | 5,527 | 88% |
| 6 | Elk | 4,909 | 84% |
| 7 | Upper Kanawha | 4,692 | 81% |
| 8 | Little Kanawha | 4,502 | 78% |
| 9 | Lower Guyandotte | 4,487 | 75% |
| 10 | Little Musringum-Middle Island | 3,518 | 72% |
| 11 | Tygart Valley | 3,194 | 69% |
| 12 | West Fork | 2,902 | 66% |
| 13 | Greenbrier | 2,835 | 63% |
| 14 | Middle New | 2,602 | 59% |
| 15 | Upper Ohio-Shade | 2,390 | 56% |

| WATERSHED SCALE STATISTICS | |
|---|---|
| Minimum (North Fork Shenandoah) | 4 |
| Maximum (Lower Kanawha) | 7,503 |
| Median | 2,042 |
| Mean | 2,631 |
| Statewide Total | 84,490 |

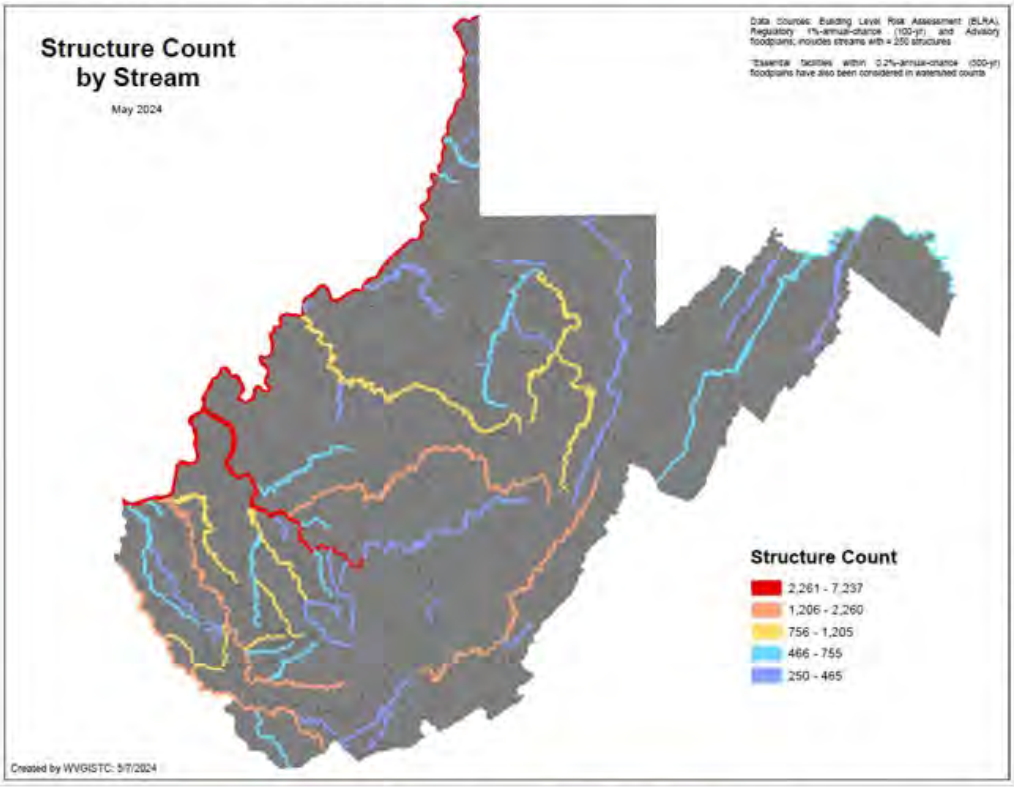
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

**Figure III-8. Building Count in Special Flood Hazard Area (Watershed Scale)**

## BUILDING COUNT (STREAM SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Streams* (6,761) | Count | % Rank |
|---|---|---|---|
| 1 | Ohio River | 7,237 | 100% |
| 2 | Kanawha River | 7,116 | 99% |
| 3 | Elk River | 2,253 | 99% |
| 4 | Greenbrier River | 1,821 | 98% |
| 5 | Guyandotte River | 1,494 | 97% |
| 6 | Tug Fork | 1,410 | 97% |
| 7 | Little Kanawha R. | 1,205 | 96% |
| 8 | Mud River | 1,133 | 95% |
| 9 | Island Creek | 1,110 | 95% |
| 10 | Buckhannon River | 951 | 94% |
| 11 | Pond Fork | 948 | 94% |
| 12 | Coal River | 933 | 93% |
| 13 | Buffalo Creek | 932 | 92% |
| 14 | Big Coal River | 904 | 92% |
| 15 | Tygart Valley River | 891 | 91% |
| 16 | Pigeon Creek | 855 | 90% |
| 17 | Wheeling Creek | 755 | 90% |

* Streams with buildings > 100

| STREAM SCALE STATISTICS | | |
|---|---|---|
| Total Named Streams | | 6,748 |
| • Streams >= 1 Building | 46% | 3,115 |
| • Streams > 100 Bldgs. | 2% | 155 |

Stream and River Statistics

| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

**Figure III-9. Building Count in Special Flood Hazard Area (Stream Scale)**

Table 1. Cumulative Flood Risk Index of 29 Flood Factors for Clendenin, WV from the Clendenin Flood Risk Report

| Category | Flood Risk Indicator | Value for Clendenin (Red – Top 10%) (Orange – Top 20%) | Indicator Score (0 - 100%) |
|---|---|---|---|
| FLOODPLAIN CHARCTERISTICS | Declared Flood Disasters ⓘ | 24 | 88.1% |
| | Median Flood Depth (Feet) ⓘ | 6.4 | 96.0% |
| BUILDING EXPOSURE | Buildings in High-Risk Flood Zone ⓘ | 302 | 91.2% |
| | Floodplain to Community Bldg. Ratio ⓘ | 52.5% | 97.8% |
| | Building Density per acre | 1.28 | 80.2% |
| BUILDING CHARACTERISTICS | Post-FIRM Buildings (Minus-Rated) | 10.9% | 88.5% |
| CRITICAL INFRASTRUCTURE | Roads Inundated Ratio | 51.8% | 98.6% |
| COMMUNITY ASSETS | Historical Community Assets | 54 | 98.2% |
| | Non-Historical Community Assets | 16 | 98.2% |
| ESTIMATED / PREVIOUS DAMAGE | Substantial Damage Count | 46 | 98.2% |
| | Substantial Damage Ratio | 15.2% | 99.5% |
| | Total Number of Previous Claims | 122 | 88.1% |
| | Number of Repetitive Losses | 24 | 88.3% |
| PEOPLE / SOCIAL | Population % Residing in Floodplain | 66.8% | 94.7% |
| | Displaced Population | 63.0% | 96.9% |
| Cumulative Flood Index Score of 29 Risk Factors (229 municipalities in WV) | | | 100% (1st Rank) |

Table 2. General Information and Comparison Statistics for Clendenin, WV from the Clendenin Flood Risk Report

| | Total Area (Acres) | Total Structures | Total Population | Population Density (per sq mi) | Number of Households | Average Household Size |
|---|---|---|---|---|---|---|
| Clendenin | 974 | 575 | 1,297 | 852.9 | 370 | 3.5 |
| STATE STATS | 15,500,454 | 1,118,761 | 1,801,049 | 74.4 | 711,352 | 2.5 |
| INCORPORATED PLACE | 1,297 | 1,475 | 2,763 | 1,2530 | 1,142 | 2.6 |
| Median | 559 | 559 | 940 | 1,056 | 354 | 2.5 |
| Mean | 1,297 | 1,475 | 2,763 | 1,2530 | 1,142 | 2.6 |
| Minimum | 34 (Sylvester) | 28 (Thurmond) | 4 (Thurmond) | 42.5 (Thurmond) | 4 (Thurmond) | 1 (Thurmond) |
| Maximum | 20,648 (Charleston) | 28,045 (Charleston) | 49,055 (Charleston) | 4,618.1 (Huntington**) | 21779 (Charleston) | 4.7 (Pullman) |

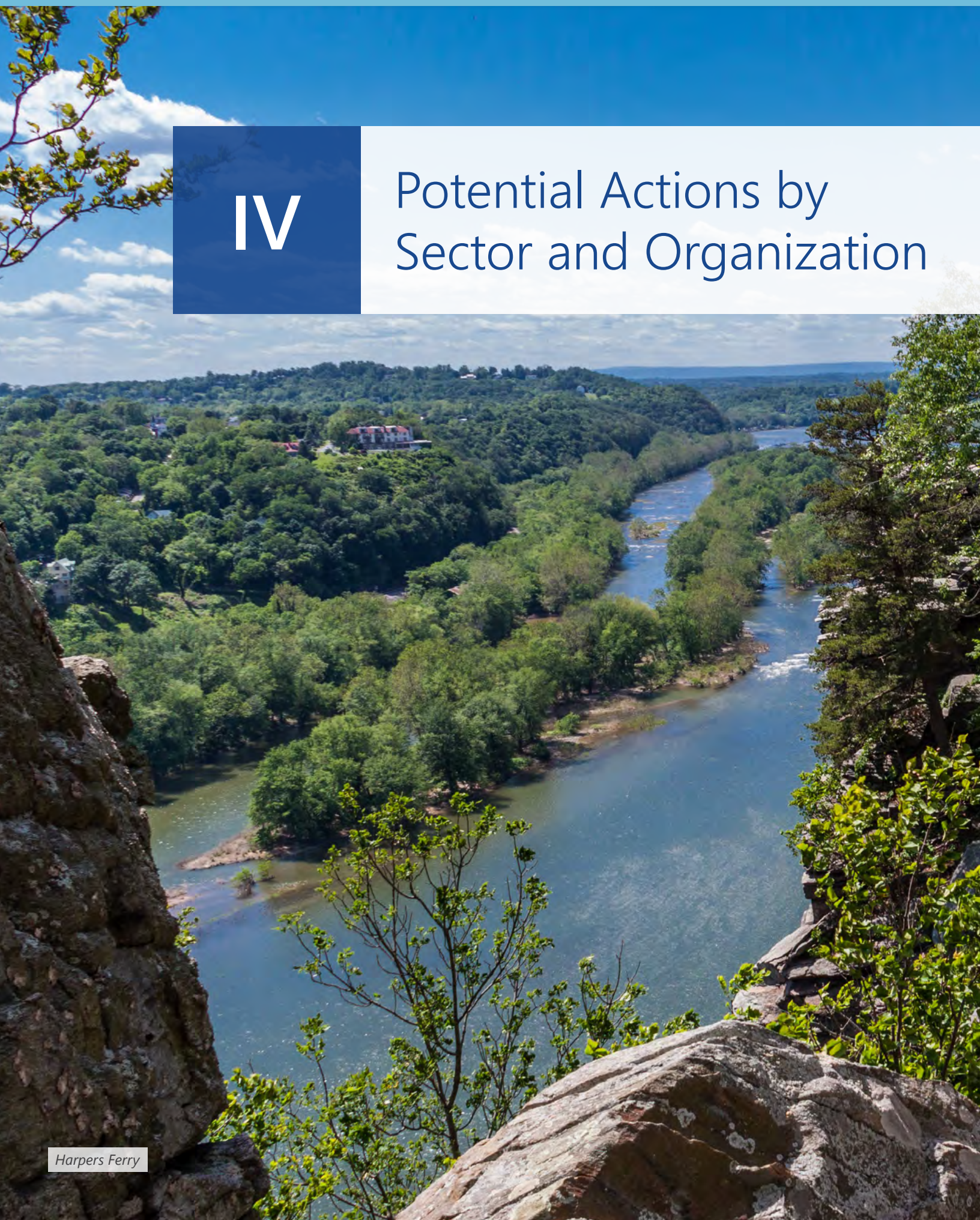
## C. Employ a Multiple Benefit Approach

Resiliency projects can have a positive impact on a range of issues other than flood reduction. Mitigative efforts such as floodplain restoration and natural stream restoration often reduce sediment and nutrient inputs into a watershed. Buyout programs for flood damaged structures create an opportunity to remove blighted buildings and create community green space. Floodproofing existing structures helps to stabilize local economies and decreases flood insurance premiums. Many of these approaches can be implemented in conjunction with one another. Additionally, implementing measures that provide benefits across multiple systems is an excellent method of amplifying constrained financial budgets. Considering these additional benefits when implementing actions or projects provides another method for prioritizing investment in resiliency.

The following project examples, sourced from FEMA's case study library, illustrate how resiliency projects can impact multiple systems to provide uplift beyond flood mitigation and provide some ideas for entities to help shape future projects.

- ***North Carolina: Upper Yadkin River Floodplain Resiliency Initiative for Town of Jonesville***
  (FEMA, n.d.)
- ***Virginia: City of Portsmouth - Lake Meade Dam Adaptations***
  (FEMA, n.d.)
- ***Georgia: City of Tennille Drainage Project***
  (FEMA, n.d.)
- ***West Virginia: West Virginia Flood Tool***
  (FEMA, 2021)
- ***Hampshire County, West Virginia: Unger Acquisition***
  (FEMA, n.d.)
- **Berkeley County, West Virginia: Sportsman's Paradise**
  (FEMA, n.d.)
- ***Mingo County, West Virginia: Soil Nailing Protects Roads from Flood Damage***
  (FEMA, n.d.)
- ***Wyoming County, West Virginia: Brenton, Wyoming County Pre-Disaster Mitigation***
  (FEMA, n.d.)

# IV Potential Actions by Sector and Organization



*Harpers Ferry*

# IV. Potential Actions by Sector and Organization

The goals, objectives, and recommendations generated for the 2004 Flood Protection Plan provide a starting point and the framework upon which this ***voluntary*** Flood Resiliency Plan has been built. Although the original format is informative, the quantity of material an individual must navigate to determine which actions are pertinent to their organization is overwhelming. In an effort to simplify the use and adoption of this flood resiliency plan, those potential actions have been grouped into ***nine organizational sectors***. Updated versions of the Flood Resiliency Plan will add and remove actions and organizations as necessary. Pertinent organizations which were not addressed in the 2004 Flood Protection Plan have been labeled as "reserved" for future iterations of this plan.

To navigate this section of the plan, first select the appropriate sector. Potential actions are listed for each organization. Note that some of these actions have been edited to adjust for changes throughout the state since the 2004 Flood Protection Plan was released. Access to that document is provided **here** for cross reference purposes.

- West Virginia Emergency Management Division (WVEMD)
- West Virginia Department of Environmental Protection (WVDEP)
- West Virginia Division of Natural Resources (WVDNR)
- West Virginia Department of Economic Development (WVDED)
- West Virginia Department of Transportation (WVDOT)
- West Virginia Division of Forestry (WVDOF)
- West Virginia Department of Agriculture (WVDA)
- Public Service Commission of West Virginia (WVPSC)
- West Virginia Department of Health (WVDH)
- West Virginia Department of Human Services (WVDoHS)
- West Virginia Division of Labor (WVDL)
- West Virginia Department of Education (WVDE)
- West Virginia State Historic Preservation Office (WVSHPO)
- West Virginia Offices of the Insurance Commissioner (WVOIC)

**Sector 3: Regional Government**

**Sector 4: County Government**

**Sector 5: City Government**

**Sector 6: Non-Governmental Organizations**

**Sector 7: Industries and Utilities**

**Sector 8: Businesses, and Associations**

**Sector 9: Residents and/or Landowners**

# Sector 1: Federal Government

*Please note that these potential actions were developed when the Flood Protection Plan was created in 2004 and were affirmed by reviewing stakeholders as relevant when that plan was reviewed in 2022. They are presented as a 'menu' of options for consideration and are in no way the only actions an organization should consider. Adoption of these actions is entirely voluntary.*

## Federal Emergency Management Agency (FEMA)

- FEMA and WVEMD could meet FEMA's stated goal of conducting a Community Assistance Visit in every community once every 5 years to ensure that the floodplain ordinances are being properly implemented and enforced. This would require them to conduct approximately 72 Community Assistance Visits each year in West Virginia.
- Brochures could be prepared and distributed on flood proofing methods, flood resistant construction techniques, and strategies for reducing flood-insurance premiums to all National Flood Insurance Program policyholders in WV.

## National Weather Service (NWS)

- Encourage local communities to participate in the StormReady program conducted by the National Weather Service.

## Natural Resources Conservation Service (NRCS)

- The WV Department of Agriculture, the WV Conservation Agency, and the USDA – Natural Resources Conservation Service could review existing BMPs and expand the number of agricultural facilities adhering to them.
- Through a collaborative effort, the USACE and NRCS could work jointly with the WVCA and other applicable agencies to assess the State's major watersheds. The purpose of this assessment would be to determine whether there are any opportunities to construct additional upstream flood storage/retention facilities in the watersheds that would reduce downstream flood damages, potentially provide a reliable source of potable water for communities within the region and provide improvements in downstream water quality and flow. Several of the watersheds shown on the statewide watershed map (see Figure 1-5) have existing storage facilities (see Appendix L) operating for flood control, low-flow augmentation, and water supply. Previous studies conducted for the watersheds by various Federal and State agencies would form the basis for these studies.

  This assessment could be funded in part through the USACE Section 22 Planning Assistance to States program for State/regional flood protection studies. Full consideration of the anticipated environmental effects of these potential storage facilities would be coordinated with the WVDNR, WVDEP and USFWS during the assessment. Those potential storage projects generating substantial flood protection benefits would be proposed for more detailed study through existing or new Congressional authorities. More detailed feasibility evaluations would be initiated only after firm commitments from eligible and financially capable non-Federal sponsors.

- The USACE and NRCS could work jointly with WVCA and other applicable agencies to conduct watershed specific assessments that determine whether existing municipalities and major unincorporated commercial/industrial centers within the State need to be protected in place (floodwalls, levees, channel modifications, relocations) to preserve the commercial, service and employment base that now supports the surrounding county population. These protected centers also can serve as relocation sites for commercial and residential development acquired from the floodway (see item 3 below). Existing data from previous protection studies for these communities can form the basis for this assessment. The recommendations of these watershed assessments would form the basis for funding requests to pursue specific protection projects at critical municipal centers.

  The watershed assessments may be conducted through programs such as the Section 22 PAS and PL 83-566 Watershed Protection and Flood Prevention Act. Full consideration of the environmental effects of these potential structures would be coordinated with the WVDNR, WVDEP and USFWS during the assessment.

- Update existing damage assessment data for 11-digit Hydrologic Unit Catalog (HUC) code watersheds for use as a planning tool. The U. S. Army Corps of Engineers and the Natural Resources Conservation Service should collaborate to develop flood damage data along all rivers within the State. Individually authorized protection projects will still have to develop damage estimates for their own cost-benefit analyses. Copies of this project specific data will be provided to the clearinghouse discussed above.

## U.S. Army Corps of Engineers (USACE)

- The appropriate Corps of Engineer District offices and State offices involved in the issuance of regulatory permits in West Virginia waters develop and deploy a public information and awareness program for local officials and private landowners.

- Regulatory permit requests for dredging operations in the State as a means of reducing flood damages should be approved only where documentation demonstrates that flooding will be mitigated, environmental impacts are not excessive, and where annual maintenance is assured through executed agreements. This should not hinder permitted channel modifications that are designed and maintained to reduce flood elevations of high frequency floods (low level), stream restoration, or restoration of aquatic environments. Nor should this hinder efforts by any Federal or State agency to address major flood events through an authorized and designed channel modification or a snagging and clearing operation where that activity is proven through engineering documentation to be an effective and cost efficient method for reducing flood heights and where annual maintenance is assured through local agreements.

- Through a collaborative effort, the USACE and NRCS could work jointly with the WVCA and other applicable agencies to assess the State's major watersheds. The purpose of this assessment would be to determine whether there are any opportunities to construct additional upstream flood storage/retention facilities in the watersheds that would reduce downstream flood damages, potentially provide a reliable source of potable water for communities within the region and provide improvements in downstream water quality and flow. Several of the watersheds shown on the statewide watershed map (see Figure 1-5) have existing storage facilities (see Appendix L) operating for flood control, low-flow augmentation, and water supply. Previous studies conducted for the watersheds by various Federal and State agencies would form the basis for these studies.

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*Harpers Ferry National Park*

## U.S. Department of Housing and Urban Development (HUD) – (Reserved)

## U.S. Fish & Wildlife Service (USFWS)

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## U.S. Forest Service (USFS)

- Continue the development of new regional hydrological models specifically for forested areas by the USFS.

## U.S. Geological Survey (USGS) – (Reserved)

# Sector 2: State Government

*Please note that these potential actions were developed when the Flood Protection Plan was created in 2004 and were affirmed by reviewing stakeholders as relevant when that plan was reviewed in 2022. They are presented as a 'menu' of options for consideration and are in no way the only actions an organization should consider. Adoption of these actions is entirely voluntary.*

## Policy Makers

- The appropriate Corps of Engineer District offices and State offices involved in the issuance of regulatory permits in West Virginia waters develop and deploy a public information and awareness program for local officials and private landowners.
- A consistent policy could be established to address the following issues:
  - Areas outside the State's boundaries that affect flooding events within West Virginia,
  - Islands with residences or industry located entirely within the floodplain.
  - County seats located within the floodway,
  - Recreational areas in floodplain, ponds and dams removed or altered and the subsequent planned or inadvertent reduction of flood protection.
- The flood warning system could be improved in incremental steps over a 5-year period by:
  - Adding ALERT and GOES transmission equipment at stream gages.
  - Install additional rain gages.
  - Install additional stream gages with ALERT and GOES communications.
  - Install additional radio repeaters for the ALERT communication system.
- Sufficient funding and staffing should be maintained for the West Virginia Division of Emergency Management to ensure adequate operations and maintenance of the expanded IFLOWS gauges and system.
- The process for dissemination of flood warnings and other disaster warnings could be improved by mandating the rebroadcast of warnings on all fire, police, and emergency medical-service frequencies. Individuals and businesses with radio scanners will receive these warnings in a more timely and reliable fashion.
- Local communities could be encouraged to participate in the StormReady program conducted by the National Weather Service. A chart could be developed that identifies specific Federal and State offices where flooding information or assistance may be obtained. This chart should be available in printed and web-based versions.
- The State could create a technical assistance program that includes funding and resources for a State agency to provide assistance in the design, installation, and maintenance of public and private stream crossings.
- Historical data could be better maintained by providing funding for archiving of data from rain and stream gages on a statewide level.

*Sleepy Creek*

- A single agency could be designated within the State government as a point of contact or clearinghouse where a flood data repository could be established. This agency could be mandated to manage all flood data including an inventory of at-risk structures, repetitive loss data, flood control project data, and other databases. This data should include information on losses sustained by residences, businesses, farms/ agricultural losses, roadways, railroads, and other types of losses.
- Flood and flood damage data could be developed with latitude, longitude, and elevation data so that both counties and watersheds can be used as the geographic basis for planning.
- Existing damage assessment data could be updated for 11-digit Hydrologic Unit Catalog (HUC) code watersheds for use as a planning tool. The U. S. Army Corps of Engineers and the Natural Resources Conservation Service should collaborate to develop flood damage data along all rivers within the State. Individually authorized protection projects will still have to develop damage estimates for their own cost-benefit analyses. Copies of this project specific data could be provided to the clearinghouse discussed above.
- State guidelines for emergency removal of stream debris could be developed that would guide emergency response agencies and contractors during these removal operations. Such guidelines could be developed through a collaborative effort of applicable agencies. These guidelines would ensure that in-stream debris removal following a flood event would not result in excessive, long-term environmental damage to the stream or river affected. The guidelines would increase awareness of the need for permits for in-stream work and ensure that debris disposal does not further inhibit floodwaters. Included within these guidelines would be information on the location of stable streams and high quality streams (when available) and a series of best management practices to guide response agencies and their contractors.
- The State could provide additional funding for stream restoration programs to match Federal programs and regulations for preservation of stable streams could be developed through a collaborative effort of the WVDEP, WVCA and WVDNR.
- Guidelines for the disposal of removed stream obstructions and debris could be developed through a joint effort of Federal and State agencies.
- A State agency could inspect stormwater facilities and serve as a backup for local inspection and enforcement of regulations on design, installation, operation, and maintenance of these facilities. In the event no suitable State agency is found to provide the technical assistance and enforcement support needed, it is recommended that the regional watershed flood protection authorities based on the eight digit watershed basins be given this responsibility. Details on these groups are provided above.

- State, county, and municipal officials could be encouraged to get involved in floodplain management, community planning, building inspection, emergency services, or enforcement of land use planning and to take the Federal Emergency Management Agency Independent Study Courses related to flooding, flood mitigation, and floodplain management.
- The State could reimburse qualifying jurisdictions for a portion of the salary of trained and nationally certified floodplain managers and certified building inspectors.
- Participation in floodplain management training activities could be encouraged by providing certification or continuing-education credits for courses and workshops. Attendees could include: (a) State, county, and municipal government, (b) insurance companies, (c) financial institutions, (d) real estate companies, (e) utility companies, (f ) watershed associations, (g) professional land surveyors, (h) professional engineers, (i) floodplain managers, ( j) public officials, (k) elected officials, (l) building inspectors, (m) community planners, and (n) other interested parties.
- Educational outlets in West Virginia (Vo-tech, Community Colleges, publicly owned colleges, and universities) could be encouraged to develop classes and curriculums that address floodplain and flood issues. Floodplain management and flooding should be addressed during appropriate sessions of the current curriculum.
- Brochures could be prepared and distributed on flood proofing methods, flood resistant construction techniques, and strategies for reducing flood-insurance premiums to all National Flood Insurance Program policyholders in WV.
- A brochure on the values and concepts of protecting stable streams could be prepared and distributed.
- A voluntary program of permanent floodway acquisition could be established to address the inventory of existing structures in the regulatory floodway. These structures and their associated facilities are subject to frequent and severe flooding and impact damage by floating debris. During flood events, these structures can become floatable debris blocking stream crossings and battering other downstream floodplain development. These structures can also serve as point sources of stream pollution. The floodway acquisition program would be initiated in the non-municipal areas to avoid interference with possible structural protection of incorporated cities, towns, villages and communities and commercial centers discussed in item 2 above. The program would be voluntary in nature and relocation benefits and services would be provided to assist families to secure flood-safe replacement housing. Feasible commercial and industrial relocations would be assisted through Federal and State economic development grant and loan programs. Federal, State and local government offices and facilities would be relocated to flood-safe sites.

  The Section 202 Nonstructural flood Damage Reduction program, being implemented in the Tug Fork Valley since 1985, has acquired several hundred floodway structures in West Virginia and Kentucky. This action has resulted in an overall reduction in flood damage and a reduction in the 100-year frequency flood profile in project areas. In conjunction with this program, three replacement housing sites were constructed to accommodate relocated families. In some cases, commercial structures were acquired in the floodway and relocated within communities protected by local protection projects (floodwalls). WVEMD projects administered through FEMA's Hazard Mitigation Grant Program have also successfully acquired floodway structures throughout the State.

  The proposed floodway acquisition program could be best administered through FEMA (Pre-Disaster Mitigation Program) in cooperation with WVEMD. The WVHDF and WVDO could support this effort through identification and funding of replacement housing and commercial relocation sites. The success of the

floodway acquisition program would be partially contingent upon the ability to secure decent, safe, and sanitary replacement housing outside of the floodplain. Equally important would be a site development process for commercial relocations from the floodplain.

- Funds could be allocated to the "Flood Loss Reduction Fund." This fund could provide: non-federal cost share to match federal funds for flood damage reduction projects (structural or non-structural), standalone funds for State initiated flood damage reduction projects, and grants to improve local floodplain management.

  ** In 2023, the legislature created the Flood Resiliency Trust Fund. If funded, it would provide the same benefits as the conceptual fund noted above.*

- The State could provide monetary incentives to encourage communities to participate in FEMA's Community Rating System (CRS) program. The State could further promote the CRS by coordinating activities too extensive for every community to do on their own.

- All participating communities could be encouraged to adopt and enforce improved floodplain ordinances or to enter into enforcement compacts with adjacent local governments. Municipalities could also be required to adopt surrounding floodplain maps at some stage in the annexation process.

- All new floodplain ordinances could prohibit storage of floatable materials in the floodway and establish a program to identify and either remove, stabilize, or anchor floatable structures and materials in the floodplain.

- All propane and fuel-oil dealers could be required to ensure that all LPG and propane tanks over 30 pounds in size and all fuel-oil tanks located within the regulated floodplain or within 50 feet of a perennial stream to be anchored to a fixed structure to resist expected flood waters and impact from debris.

- All participating communities could be required to have a certified floodplain manager (CFM) on staff or on retainer by 2030. Where fiscal restraints limit a county or municipal government from complying with this requirement, counties and municipalities could enter into cooperative agreements that allow sharing the costs for a regional floodplain manager.

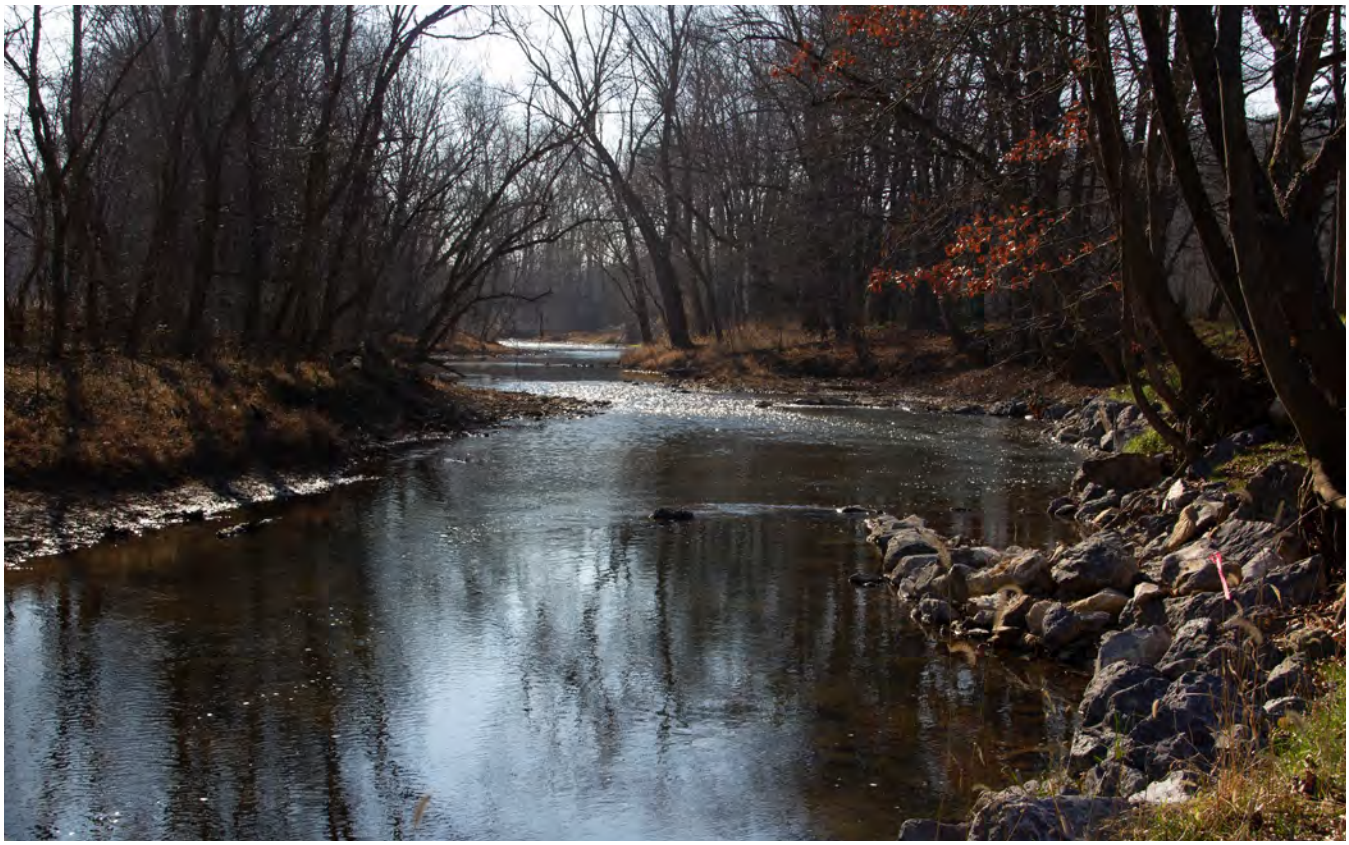
- The State could encourage participation and membership in the Association of State Floodplain Managers.

- Real Estate Agents could be required to determine location of structures by latitude and longitude, city-style street address, or Tax Parcel number and whether the structure is within the regulated floodplain before the structure is listed for sale. The agent must notify potential purchasers of the location and whether the structure is within the regulated floodplain prior to execution of a purchase agreement.

- Construction, installation, or renovation of a structure within the floodplain without a permit could be made punishable by a fine of not less than $5,000 and removal of the structure if any deficiencies are not corrected. A copy of this permit must be provided to the utility company before the utility is connected. All utility companies must receive and keep a copy of the approved permit prior to connecting the utility.

  Should no permit be obtained prior to construction, the builder, homeowner, utility company, and property owner could be held liable. Where local communities have adopted combined building code and floodplain ordinance enforcement and permitting, the local code enforcement office may provide such certification if he or she holds the CFM designation and appropriate CABO and/or ICBO certification through the local permitting processes.

- Builders, homeowners, mobile-home installers, or property owners provide a copy of a certification signed and sealed by a WV Registered Professional Engineer, confirming that the manufactured home is properly installed (including anchoring) to the utility company before the utility is connected. All utility companies could be required to receive and keep a copy of this certification. If a certification is unavailable, the manufactured home must be inspected, and a certificate signed and sealed by a WV Registered Professional Engineer. This document could confirm that the manufactured home has been properly installed before any utility can be connected.
- All surveyors and professional engineers could be required to include the floodplain boundaries, when applicable, as delineated on the FIRM on registered plat maps with the latitude, longitude, and elevation of a reference point.
- Development within the floodplain could be discouraged through relocation assistance to property owners in the floodway, floodplain ordinances to forbid future development in floodways, legislation to prohibit installation of new infrastructure in floodways unless there is no other alternative.
- Local governments and public institutions could be discouraged from constructing new buildings or entering into new leases in buildings located in the regulated floodplain.
- If a regional or State agency is providing floodplain management assistance to a local government, that local government could be required to consult with the regional or State agency providing assistance on all proposed variances from the floodplain ordinances.



*Sleepy Creek*

*Back Creek*

- All new public structures or significant improvements to existing public structures within the regulated floodplain could be required to be constructed in a flood-resistant manner.
- A program to relocate all critical facilities could be created, such as government administration buildings, hospitals, jails, and water and sewer treatment plants out of the floodway.
- All State agencies could be required to prepare a 10-year plan to eliminate, relocate or renovate structures and facilities within the regulated floodplain that are not constructed in a flood resistant manner.
- Section 7-1-3 of the West Virginia State Code could be amended as follows:
  - Do not restrict local governments to the minimum floodplain standards established in the NFIP.
  - Require all new development to obtain a permit at least to the floodplain determination stage. This permit process would require the developer to obtain documents delineating the site location relative to the floodplain.
  - Mandate that communities must have language in their floodplain management ordinance that requires a buffer zone equal to twice the width of the stream from the top of the bank of all perennial streams without a delineated floodway.

- The WV Department of Environmental Protection, Division of Water and Waste Management Dam Safety Program could be provided additional staff, resources and funding from the general fund specifically targeted to provide improved capability for Monitoring and Emergency Action Plans (EAP) technical review, approval, and exercise. The dam related EAPs could be improved through public education and enhanced capability to review new and updated plans in coordination with local emergency services offices. Tabletop and field exercises of existing EAPs could be performed.
- The Department of Transportation could design and install signage similar to the "Bridge Freezes Before Road" sign to identify State highways that are frequently blocked by high water.
- Legislation could be enacted that will empower local floodplain management officials to prohibit placement or storage of floatable material within floodways that does not include suitable anchoring. Administration and enforcement of these regulations could be through county and municipal floodplain managers using the enforcement powers contained in the floodplain management ordinances.
- The WV Division of Highways or another state agency could be provided funds from the general fund for a study of abandoned stream crossings (public or private road or railroad bridges or culverts) to ascertain ownership of said facilities and provide recommendations for condemnation and removal if deemed necessary to reduce flood damages.
- Regulations and/or best management practices including minimum criteria for construction and closure, or abandonment of access roads could be developed and applied consistently to all industries throughout West Virginia.
- The WV Emergency Management Division could hire staff to support local floodplain managers statewide. The 55 counties and 248 municipalities may require additional human resources and support could be provided. This increase in staff could include a staff member to handle training and education of State agencies and regional floodplain technical specialists, a staff member to handle disbursement of grant funds and to coordinate regional meetings of floodplain managers that will focus on training and peer support for county and local floodplain managers, and staff members to provide technical support to local government units and State agency projects throughout the State.
- The WV Public Land Corporation through legislative enactment and increased staffing could enforce current permitting requirements for in-stream construction or channel alteration.
- The WV Public Land Corporation could develop and enforce a legal contract requiring permit applicants to agree to maintain a specified minimum hydraulic carrying capacity of the structure being installed.
- The WV Division of Forestry could be provided the resources and authorization to employ additional employees including: Forest Hydrologist, Wildfire Specialists and Foresters to address timber management and field enforcement of BMP's.
- Additional resources in staff and funds could be provided to the WV DOF to address wildfires. Due to rugged terrain and limited access into some areas, wildfires are a serious threat to the forest resources. These forested lands absorb tremendous quantities of rainfall that would otherwise reach the State's streams and rivers. Forests devastated by wildfires do not have the capability to absorb rainfall and therefore increased runoff and erosion occurs.

## West Virginia National Guard (WVNG) – (Reserved)

## State Resiliency Office (WVSRO) – (Reserved)

## West Virginia Conservation Agency (WVCA)

- The WV Department of Agriculture, the WV Conservation Agency, and the USDA – Natural Resources Conservation Service could review existing BMPs and expand the number of agricultural facilities adhering to them.
- The State could provide funding for stream restoration programs to match existing Federal programs and that regulations for preservation of stable streams be developed through a collaborative effort of the WVDEP, WVCA and WVDNR.
- Through a collaborative effort, the USACE and NRCS work jointly with the WVCA and other applicable agencies to assess the State's major watersheds. The purpose of this assessment would be to determine whether there are any opportunities to construct additional upstream flood storage/retention facilities in the watersheds that would reduce downstream flood damages, potentially provide a reliable source of potable water for communities within the region and provide improvements in downstream water quality and flow. Several of the watersheds shown on the statewide watershed map (see Figure 1-5) have existing storage facilities (see Appendix L) operating for flood control, low-flow augmentation, and water supply. Previous studies conducted for the watersheds by various Federal and State agencies would form the basis for these studies.

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## West Virginia Department of Homeland Security (WVDHS) - Reserved

## WV Emergency Management Division (WVEMD)

- The WV Emergency Management Division could hire staff to support local floodplain managers statewide. The 55 counties and 248 municipalities may require additional human resources and support could be provided. This increase in staff could include a staff member to handle training and education of State agencies and regional floodplain technical specialists, a staff member to handle disbursement of grant funds and to coordinate regional meetings of floodplain managers that will focus on training and peer support for county and local floodplain managers, and staff members to provide technical support to local government units and State agency projects throughout the State.
- The WVEMD could establish procedures for the review and updating of existing county emergency evacuation plans related to flooding.
- WVEMD could present at least one Federal Emergency Management Agency field course specifically addressing flooding each year in West Virginia.
- WVEMD could develop and present at least 1 state-specific workshop each year that is related to flooding in West Virginia. Topics could include:
  - Local floodplain ordinances
  - Relevant sections of the West Virginia State Code
  - Flood Insurance Rate Maps, Digital Flood Insurance Rate Maps, Q3, GIS data and other data sources used to update flood maps
  - Updating flood maps
  - Land-use management
  - Stormwater management
  - Flood damages
  - Floodplain management
  - Floodplain protection
  - Potential impact of flooding in their region
  - Factors contributing to flooding (floatable debris in the floodway, constricted floodways, undersized or poorly constructed stream crossings)
  - Perils of building in the floodplain
  - Flood proofing
  - Flood-resistant construction techniques
  - Reducing flood-insurance premiums
  - Concepts of stable streams.
  - Benefit-cost analysis of flood damage reduction
  - Elevation certificates.
  - Dam Safety Monitoring and Emergency Action Plans
  - Natural Stream Restoration and the inter-relationship of stream morphology, land use, channel encroachment, dredging, stormwater/ erosion control, stable streams, and flooding.
- WVEMD could make training in maps and map reading available to all Federal, State, local and volunteer personnel involved in flooding in West Virginia on a regular basis.

- A program to identify "gap" structures (structures that affect the flow characteristics of a stream, such as bridges, retaining walls, culverts etc., constructed during the gap between the time the watershed was studied, and the Flood Insurance Rate Map (FIRM) was published) could be developed and such structures could be reported to WVEMD so the appropriate watersheds can be moved to a higher priority for restudy.
- FEMA and WVEMD could meet FEMA's stated goal of conducting a Community Assistance Visit in every community once every 5 years to ensure that the floodplain ordinances are being properly implemented and enforced. This would require them to conduct approximately 72 Community Assistance Visits each year in West Virginia.
- Sufficient funding and staffing should be maintained for the West Virginia Division of Emergency Management to ensure adequate operations and maintenance of the expanded IFLOWS gauges and system.
- A voluntary program of permanent floodway acquisition could be established to address the inventory of existing structures in the regulatory floodway. These structures and their associated facilities are subject to frequent and severe flooding and impact damage by floating debris. During flood events, these structures can become floatable debris blocking stream crossings and battering other downstream floodplain development. These structures can also serve as point sources of stream pollution. The floodway acquisition program would be initiated in the non-municipal areas to avoid interference with possible structural protection of incorporated cities, towns, villages and communities and commercial centers discussed in item 2 above. The program would be voluntary in nature and relocation benefits and services would be provided to assist families to secure flood-safe replacement housing. Feasible commercial and industrial relocations would be assisted through Federal and State economic development grant and loan programs. Federal, State, and local government offices and facilities would be relocated to flood-safe sites.

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## West Virginia Department of Environmental Protection (WVDEP)

- Location standards could be developed that prohibit locating floatable materials within the regulated floodplain at the following types of facilities: Solid Waste non-disposal facilities, Solid Waste disposal facilities, Hazardous Waste treatment, storage and disposal facilities, Natural Gas facilities, and Underground storage tank facilities.
- Any storm water detention facility discharging to a cold-water trout stream could be designed to detain water for no more than 12 hours. In addition, the pond could be designed so that it discharges from the bottom, cooler portion of the pond. Detention facilities discharging into warm water streams could be designed to detain stormwater for at least 24 hours.
- Through a collaborative effort, the USACE and NRCS work jointly with the WVCA and other applicable agencies to assess the State's major watersheds. The purpose of this assessment would be to determine whether there are any opportunities to construct additional upstream flood storage/retention facilities in the watersheds that would reduce downstream flood damages, potentially provide a reliable source of potable water for communities within the region and provide improvements in downstream water quality and flow. Several of the watersheds shown on the statewide watershed map (see Figure 1-5) have existing storage facilities (see Appendix L) operating for flood control, low-flow augmentation, and water supply. Previous studies conducted for the watersheds by various Federal and State agencies would form the basis for these studies.

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  The watershed assessments may be conducted through programs such as the Section 22 PAS and PL 83-566 Watershed Protection and Flood Prevention Act. Full consideration of the environmental effects of these potential structures would be coordinated with the WVDNR, WVDEP and USFWS during the assessment.
- The State could provide funding for stream restoration programs to match existing Federal programs and that regulations for preservation of stable streams be developed through a collaborative effort of the WVDEP, WVCA and WVDNR.

- The WV Department of Environmental Protection, Division of Water and Waste Management Dam Safety Program could be provided additional staff, resources and funding from the general fund specifically targeted to provide improved capability for Monitoring and Emergency Action Plans (EAP) technical review, approval, and exercise. Improve the dam related EAPs through public education and enhanced capability to review new and updated plans in coordination with local emergency services offices. Perform tabletop and field exercises of existing EAPs.
- The WV DOF and the WV DEP, Office of Environmental Enforcement could determine the need for a Memorandum of Understanding to clearly define each organization's responsibility and improve enforcement efficiency.

## West Virginia Division of Natural Resources (WVDNR)

- The WV Public Land Corporation through legislative enactment and increased staffing could enforce current permitting requirements for in-stream construction or channel alteration.
- The WV Public Land Corporation could develop and enforce a legal contract requiring permit applicants to agree to maintain a specified minimum hydraulic carrying capacity of the structure being installed.
- The State could provide funding for stream restoration programs to match existing Federal programs and that regulations for preservation of stable streams be developed through a collaborative effort of the WVDEP, WVCA and WVDNR.
- Through a collaborative effort, the USACE and NRCS work jointly with the WVCA and other applicable agencies to assess the State's major watersheds. The purpose of this assessment would be to determine whether there are any opportunities to construct additional upstream flood storage/retention facilities in the watersheds that would reduce downstream flood damages, potentially provide a reliable source of potable water for communities within the region and provide improvements in downstream water quality and flow. Several of the watersheds shown on the statewide watershed map (see Figure 1-5) have existing storage facilities (see Appendix L) operating for flood control, low-flow augmentation, and water supply. Previous studies conducted for the watersheds by various Federal and State agencies would form the basis for these studies.

  This assessment could be funded in part through the USACE Section 22 Planning Assistance to States program for State/regional flood protection studies. Full consideration of the anticipated environmental effects of these potential storage facilities would be coordinated with the WVDNR, WVDEP and USFWS during the assessment. Those potential storage projects generating substantial flood protection benefits would be proposed for more detailed study through existing or new Congressional authorities. More detailed feasibility evaluations would be initiated only after firm commitments from eligible and financially capable non-Federal sponsors.
- The USACE and NRCS could work jointly with WVCA and other applicable agencies to conduct watershed specific assessments that determine whether existing municipalities and major unincorporated commercial/industrial centers within the State need to be protected in place (floodwalls, levees, channel modifications, relocations) to preserve the commercial, service and employment base that now supports the surrounding county population. These protected centers also can serve as relocation sites for commercial and residential development acquired from the floodway (see item 3 below). Existing data from previous protection studies for these communities can form the basis for this assessment. The recommendations

of these watershed assessments would form the basis for funding requests to pursue specific protection projects at critical municipal centers.

The watershed assessments may be conducted through programs such as the Section 22 PAS and PL 83-566 Watershed Protection and Flood Prevention Act. Full consideration of the environmental effects of these potential structures would be coordinated with the WVDNR, WVDEP and USFWS during the assessment.

## West Virginia Department of Economic Development (WVDED)

- A model sub-division regulation could be prepared and disseminated to counties and municipalities that contains a requirement that every residential, commercial, or industrial lot include a portion of developable land that is out of the floodway for construction of a structure.

*Harpers Ferry*

## West Virginia Department of Transportation (WVDOT)

- Voluntary guidelines or Best Management Practices (BMP) could be developed for the sizing, installation, and maintenance of culverts, drainage structures and stream/river crossings. Municipalities and individuals installing steam crossings should install one with a diameter or cross section at least as large as the closest appropriate downstream Division of Highways crossing unless an alternative size is provided by a professional engineering study that would ensure that these facilities would carry the stream capacity during a 10-year storm event without contributing to flood damages.
- Guidelines or BMPs could be developed for installation and maintenance of stream crossings for the 10-year storm event without causing additional upstream flooding. Appropriate sizing for culverts and bridge openings must consider the potential for future development in the watershed. Where such development potential exists, culverts and bridge cross sections should be enlarged to handle anticipated runoff. Establish a program, including a permitting process, within a State agency to control the design, installation, and maintenance of private and public non-highway drainage structures.
- All stormwater conveyances (ditches, culverts, piping etc.) could be sized no smaller than the nearest appropriate downstream Department of Transportation stormwater conveyance unless hydraulic/hydrology studies indicate otherwise. It is further recommended that the Department of Transportation be allocated funding to provide technical assistance on determining the appropriate size for persons installing stormwater conveyances.
- The Department of Transportation could design signage similar to the "Bridge Freezes Before Road" sign to identify roads that are frequently blocked by storm water.
- The WVDOH could establish or reestablish elevation reference marks on all bridges.
- The Department of Transportation could design and install signage similar to the "Bridge Freezes Before Road" sign to identify State highways that are frequently blocked by high water.
- The WV Division of Highways or another state agency could study abandoned stream crossings (public or private road or railroad bridges or culverts) to ascertain ownership of said facilities and provide recommendations for condemnation and removal if deemed necessary to reduce flood damages.
- The Department of Motor Vehicles could identify the dangers of flooded roadways through all drivers' education classes and through the license testing process.

## West Virginia Division of Forestry (WVDOF)

- The organizational structure of the WV DOF could be realigned to prioritize the inspection of each logging job during and at the end of each operation and reemphasize the need for a reduction in the number and severity of wildfires.
- The WV DOF could develop BMPs for the restoration of areas that have been severely burned by wildfire to prevent erosion.

- The WV DOF and the WV DEP, Office of Environmental Enforcement could determine the need for a Memorandum of Understanding to clearly define each organization's responsibility and improve enforcement efficiency.
- The WV DOF could improve quality control of inspections by publishing an annual report of logging operations and inspections.
- The WV DOF could continue to provide training and technical assistance to loggers in regard to BMPs.
- The WV DOF could prepare educational material on the effects of wildfires and repetitive wildfires on soils and the resulting increase in runoff and flood damages for presentation to high school students, landowners, public officials, floodplain managers and the public.
- The WV DOF could investigate possibilities for economic uses for slash, logging waste and less desirable wood to prevent logging waste from being left in and along streams.
- The WV DOF could be provided the resources and authorization to employ additional employees including: Forest Hydrologist, Wildfire Specialists and Foresters to address timber management and field enforcement of BMP's.
- Additional resources in staff and funds could be provided to the WV DOF to address wildfires. Due to rugged terrain and limited access into some areas, wildfires are a serious threat to the forest resources. These forested lands absorb tremendous quantities of rainfall that would otherwise reach the State's streams and rivers. Forests devastated by wildfires do not have the capability to absorb rainfall and therefore increased runoff and erosion occurs.

## West Virginia Department of Agriculture (WVDA)

- The WV Department of Agriculture, the WV Conservation Agency, and the USDA – Natural Resources Conservation Service could review existing BMPs and expand the number of agricultural facilities adhering to them.

## Public Service Commission of West Virginia (WVPSC) - Reserved

## West Virginia Department of Health (WVDH)

- A study of the expected mortality from flooding at different recurrence levels could be developed.

## West Virginia Department of Human Services (WVDoHS) - Reserved

## West Virginia Division of Labor (WVDL)

- The WVDL could require all appropriate staff to become conversant with floodplain management issues and incorporate the use of Flood Insurance Rate Maps in inspection procedures.

## West Virginia Department of Education (WVDE)

- The public could be provided with a readily visible indication of the Base Flood Elevation (BFE) (elevation of the 100-year frequency flood) if surveying classes prepare projects that require students to survey the BFE and indicate this elevation on utility poles and/or street signposts, where practical, within a community. These would be general guides and wouldn't be legal reference points for determining flood-insurance premiums.
- All surveying classes (college, university, vocational, and high school levels) could include a session on the completion of elevation certificates, their importance in floodplain management, and a general outline of the floodplain permitting process.

## West Virginia State Historic Preservation Office (WVSHPO) - Reserved

## West Virginia Offices of the Insurance Commissioner (WVOIC)

- The WV Insurance Commission could require all insurance agents selling property insurance in West Virginia to either offer flood insurance or maintain a referral list of agents who do offer flood insurance in their community.
- A signature on a statement could be obtained that acknowledges that the purchaser is aware that flood insurance is not included in their standard policy.
- A separate signature could be obtained stating that the client has declined purchase of a separate policy to cover flood damages if they decline to purchase such a policy.
- The Insurance Commission could provide incentives for insurance agents to be educated about the National Flood Insurance Program (NFIP). Ten to twenty agents could be randomly checked each year to ensure that they are offering flood insurance to businesses and residents or providing appropriate referrals; and to determine if flood policies are being rated properly.
- Brochures could be prepared and distributed on flood proofing methods, flood resistant construction techniques, and strategies for reducing flood-insurance premiums to all National Flood Insurance Program policyholders in WV.

# Sector 3: Regional Government

*Please note that these potential actions were developed when the Flood Protection Plan was created in 2004 and were affirmed by reviewing stakeholders as relevant when that plan was reviewed in 2022. They are presented as a 'menu' of options for consideration and are in no way the only actions an organization should consider. Adoption of these actions is entirely voluntary.*

## West Virginia Regional Planning and Development Councils (WVRPDCs) – (Reserved)

## West Virginia Conservation Districts (WVCDs) – (Reserved)

# Sector 4: County Government

*Please note that these potential actions were developed when the Flood Protection Plan was created in 2004 and were affirmed by reviewing stakeholders as relevant when that plan was reviewed in 2022. They are presented as a 'menu' of options for consideration and are in no way the only actions an organization should consider. Adoption of these actions is entirely voluntary.*

## County Commissioners Association of West Virginia (CCAWV)

- If a regional or State agency is providing floodplain management assistance to a local government, that local government could be required to consult with the regional or State agency providing assistance on all proposed variances from the floodplain ordinances.

*Ohio River*

- Every county could identify and prepare relocation areas for use in the event of a disaster. These areas could be provided with water and sewage services. In the interim, these areas could be developed as parks, athletic fields, or similar recreational uses.
- All counties in West Virginia could implement a storm water ordinance to control the quantity and quality of storm water and to guide the development and implementation of a stormwater management plan. These local ordinances would be at least as strict as State regulations. Local jurisdictions would provide for enforcement of their own ordinances.
- Any county with karst topography could develop specific ordinances to protect the karst topography and groundwater supply from the effects of excessive stormwater.
- The Vocational Technical schools could incorporate training on retrofitting floodplain structures and other flood mitigation techniques in all construction-related courses. Individuals receiving such training could be encouraged by counties to work with communities and individuals immediately after a flood event to "build back smarter " and in a sustainable manner.
- All surveying classes (college, university, vocational, and high school levels) could include a session on the completion of elevation certificates, their importance in floodplain management, and a general outline of the floodplain permitting process.
- The public could be provided with a readily visible indication of the Base Flood Elevation (BFE) (elevation of the 100-year frequency flood) if surveying classes prepare projects that require students to survey the BFE and indicate this elevation on utility poles and/or street signposts, where practical, within a community. These would be general guides and wouldn't be legal reference points for determining flood-insurance premiums.

## County Emergency Managers – (Reserved)

## County Floodplain Managers – (Reserved)

## County Boards of Education

- Educational outlets in West Virginia (Vo-tech, Community Colleges, publicly owned colleges, and universities) could be encouraged to develop classes and curriculums that address floodplain and flood issues. Floodplain management and flooding should be addressed during appropriate sessions of the current curriculum.
- All surveying classes (college, university, vocational, and high school levels) could include a session on the completion of elevation certificates, their importance in floodplain management, and a general outline of the floodplain permitting process.
- The public could be provided with a readily visible indication of the Base Flood Elevation (BFE) (elevation of the 100-year frequency flood) if surveying classes prepare projects that require students to survey the BFE and indicate this elevation on utility poles and/or street signposts, where practical, within a community. These would be general guides and wouldn't be legal reference points for determining flood-insurance premiums.

*Kanawa River*

# Sector 5: City Government

*Please note that these potential actions were developed when the Flood Protection Plan was created in 2004 and were affirmed by reviewing stakeholders as relevant when that plan was reviewed in 2022. They are presented as a 'menu' of options for consideration and are in no way the only actions an organization should consider. Adoption of these actions is entirely voluntary.*

## City Councils

- Repetitive-loss data could be obtained from WVEMD to determine latitude, longitude, and elevation figures for each repetitive-loss structure in their jurisdiction so this data could be included in a GIS database for use by local, State, and Federal agencies.
- If a regional or State agency is providing floodplain management assistance to a local government, that local government could be required to consult with the regional or State agency providing assistance on all proposed variances from the floodplain ordinances.

## Municipal Floodplain Managers – (Reserved)

# Sector 6: Non-Governmental Organizations

*Please note that these potential actions were developed when the Flood Protection Plan was created in 2004 and were affirmed by reviewing stakeholders as relevant when that plan was reviewed in 2022. They are presented as a 'menu' of options for consideration and are in no way the only actions an organization should consider. Adoption of these actions is entirely voluntary.*

## West Virginia Voluntary Organizations Active in Disaster (WVVOAD) – (Reserved)

## West Virginia Community Action Partnership (WVCAP) – (Reserved)

## American Red Cross Central Appalachia Region – (Reserved)

## Academia

- Educational outlets in West Virginia (Vo-tech, Community Colleges, publicly owned colleges, and universities) could be encouraged to develop classes and curriculums that address floodplain and flood issues. Floodplain management and flooding should be addressed during appropriate sessions of the current curriculum.
- The Vocational Technical schools could incorporate training on retrofitting floodplain structures and other flood mitigation techniques in all construction-related courses. Individuals receiving such training could be encouraged by counties to work with communities and individuals immediately after a flood event to "build back smarter" and in a sustainable manner.
- All surveying classes (college, university, vocational, and high school levels) could include a session on the completion of elevation certificates, their importance in floodplain management, and a general outline of the floodplain permitting process.

## Community Action Groups – (Reserved)

## Religious Organizations – (Reserved)

*Back Creek*

## Sector 7: Industries and Utilities

*Please note that these potential actions were developed when the Flood Protection Plan was created in 2004 and were affirmed by reviewing stakeholders as relevant when that plan was reviewed in 2022. They are presented as a 'menu' of options for consideration and are in no way the only actions an organization should consider. Adoption of these actions is entirely voluntary.*

### Power – (Reserved)

### Water and Sewer – (Reserved)

### Natural Gas – (Reserved)

### Liquid Propane/ Fuel Oil

- Propane and fuel-oil dealers could ensure that all LPG and propane tanks over 30 pounds in size and all fuel-oil tanks located within the regulated floodplain or within 50 feet of a perennial stream are anchored to a fixed structure to resist expected flood waters and impact from debris.

### Communications – (Reserved)

### Mines and Quarries – (Reserved)

### Oil and Gas – (Reserved)

# Sector 8: Businesses, and Associations

*Please note that these potential actions were developed when the Flood Protection Plan was created in 2004 and were affirmed by reviewing stakeholders as relevant when that plan was reviewed in 2022. They are presented as a 'menu' of options for consideration and are in no way the only actions an organization should consider. Adoption of these actions is entirely voluntary.*

## West Virginia Association of Realtors (WVAR)

- Real Estate Agents could determine location of structures by latitude and longitude, city-style street address, or Tax Parcel number and whether the structure is within the regulated floodplain before the structure is listed for sale. The agent could notify potential purchasers of the location and whether the structure is within the regulated floodplain prior to execution of a purchase agreement.

## West Virginia Association of Insurance Companies (WVAIC)

- Brochures could be prepared and distributed on flood proofing methods, flood resistant construction techniques, and strategies for reducing flood-insurance premiums to all flood insurance policyholders in WV.

## West Virginia Municipal League (WVML) – (Reserved)

## West Virginia Floodplain Management Association (WVFMA) – (Reserved)

## West Virginia Emergency Management Council (WVEMC) – (Reserved)

## Contractors Association of West Virginia (CAWV) – (Reserved)

# Sector 9: Residents and/or Landowners – (Reserved)

*Please note that these potential actions were developed when the Flood Protection Plan was created in 2004 and were affirmed by reviewing stakeholders as relevant when that plan was reviewed in 2022. They are presented as a 'menu' of options for consideration and are in no way the only actions an organization should consider. Adoption of these actions is entirely voluntary.*

# V Monitoring Trends to Guide Future Efforts

*New River*

# V. Monitoring Trends to Guide Future Efforts

This resiliency plan provides for three primary methods of prioritizing resiliency actions in West Virginia:

**1**
Implement actions that support existing plans, programs, and laws as well as leverage grant funding.

**2**
Utilize and develop data to determine where to focus efforts.

**3**
Employ a multiple benefit approach.

This section of the plan is focused on a way of collectively integrating the above methodologies into an interactive dashboard. Specifically, documenting, developing, and organizing resiliency activities across the state will provide the necessary information needed to make data driven decisions. The state is developing a mechanism to collect and assimilate all of the work being done related to flood resiliency. Organizations are collecting and archiving their own data, but historically this information has been reported separately to various entities. Organizing and aggregating this data will provide information on resiliency investment at each of the sector levels as well as at the organizational level.

A data collection and analysis tool is under construction which, in concept, should allow organizations to upload resiliency projects at completion. Upon submission, the data will automatically be integrated with all other self-reported projects. Additionally, the platform is being designed to accept legacy data to capture as much information as possible. A public and private version of the Resiliency Dashboard will be available to show statewide trends. In addition to monetary investment, other metrics which will be collected and aggregated include education and outreach participation, project type, project uplift, flood insurance data, legislation passed, and crowdsourced feedback. The goal is to have a beta version of this Trend Calculator in late 2024 and a fully operational platform in place to assist in the mandatory reviews and updates of this resiliency plan.


**Figure V-1. West Virginia Flood Resiliency Dashboard Flood Mitigation data entry form**

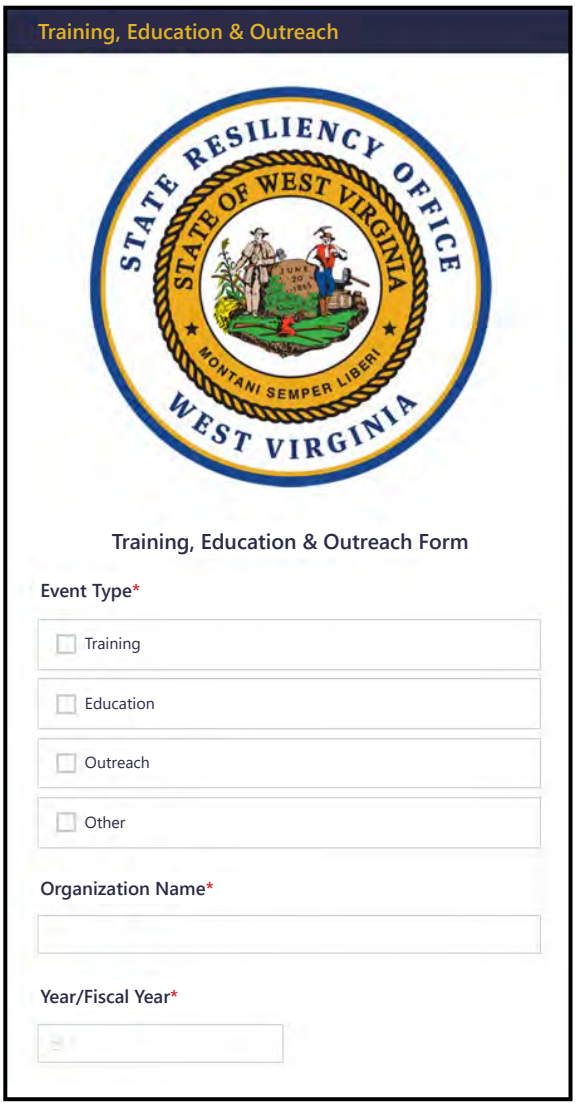


Figure V-2. West Virginia Flood Resiliency Dashboard Training, Education, and Outreach data entry form


Figure V-3. West Virginia Flood Resiliency Dashboard Survey & Direct Feedback data entry form

# VI Appendices

*Monongahela River*

# Appendix I: Contributing Organizations

West Virginia State Resiliency Office
*Robert T. Martin, Director & Edwin R. Martin, Deputy Director*

West Virginia Department of Commerce

West Virginia Division of Natural Resources

West Virginia Department of Environmental Protection

West Virginia State Conservation Agency

West Virginia Emergency Management Council

West Virginia Department of Homeland Security

West Virginia Department of Transportation

West Virginia Department of Health

West Virginia National Guard

West Virginia Emergency Management Division

West Virginia Senate

West Virginia House of Delegates

West Virginia Department of Economic Development

West Virginia Floodplain managers Association

National Oceanic and Atmospheric Administration

Federal Emergency Management Agency

Natural Resource Conservation Service

West Virginia University

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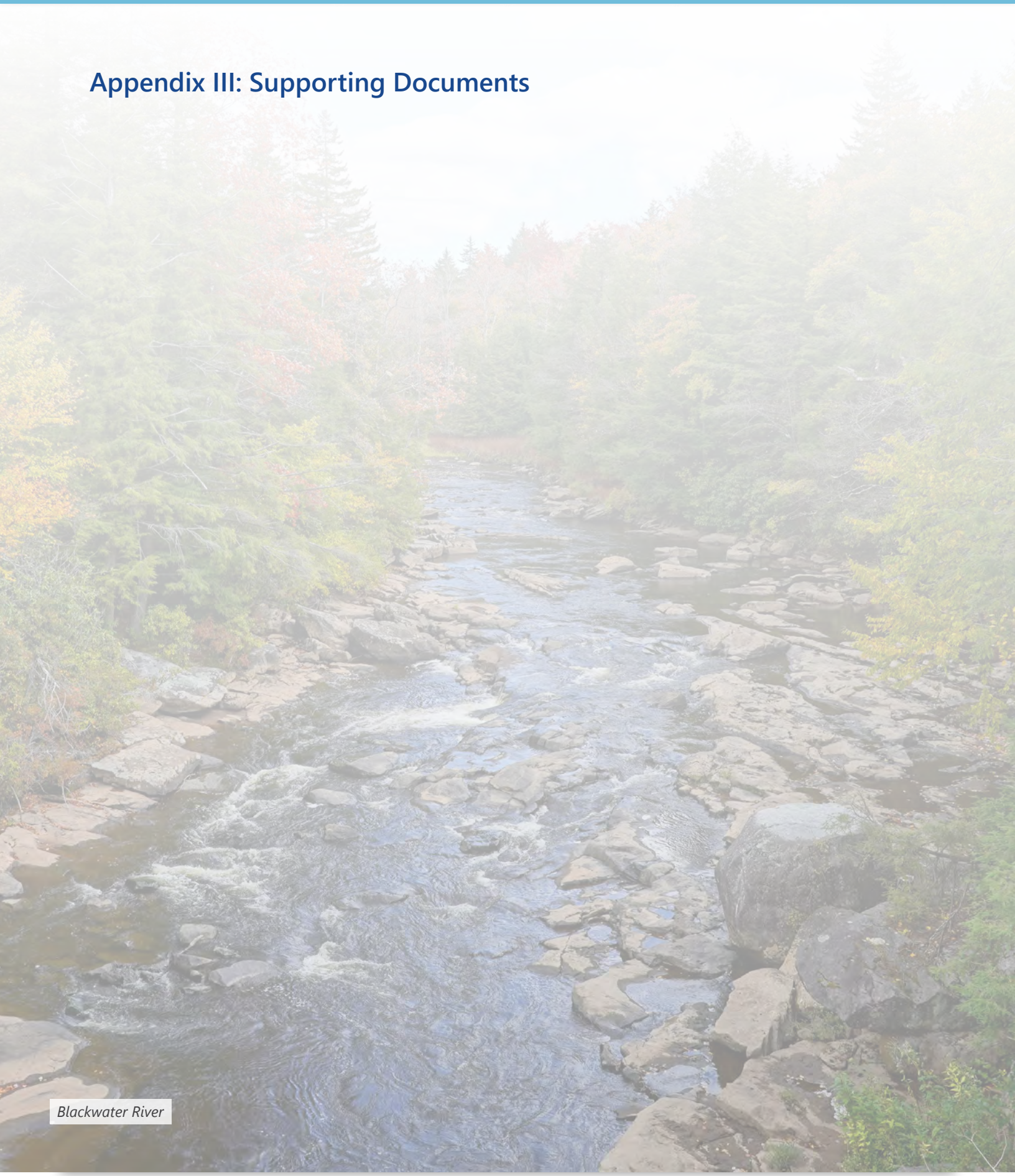
# Appendix III: Supporting Documents



*Blackwater River*

# APPENDIX A: **Building Counts** Risk Indicator

Detailed Analyses of **Building Counts** at 8 aggregate scales along with findings, description, rationale, recommendations, and data sources.

## BUILDING COUNT Fast Facts and Graphics

### Statewide

- **Building Risk Percentage by FEMA Mapped Flood Zones.** Of the estimated 1.1 million primary structures in West Virginia, 13% of the buildings (138,623) in the state are subject to riverine and flash flooding, according to FEMA's mapped flood zones of reduced/moderate risk (Shaded X Zones) and high risk (A and AE Zones).
    - **Building Count by Special Flood Hazard Area (SFHA).** In West Virginia, 84,490 primary structure or 8% of all structures in the state are in the high-risk Special Flood Hazard Area or 1%-annual chance (100-YR) floodplain.
    - **Building Count by Floodway.** 10% of all structures (8,572) in the state are in the Regulatory Floodway, the main channel of the river or stream that is subject to the greatest flood depths, highest velocities, and greatest debris potential.
    - **Building Count by Flood Study Type.** A breakdown of buildings within the high-risk flood areas reveals that 65% of the buildings (55,112) are in Detailed "Zone AE" studies and 35% (29,378) in "Approximate Zone A" studies.
    - **Building County by High-Risk Advisory Zones / Future Map Conditions.** Currently 54 of 55 counties in the state have advisory floodplains, increasing the high-risk effective and advisory floodplain building count of 97,936 structures. If the future flood studies were to become effective, then an additional 14% structures will be mapped into the SFHA, 16% structures mapped out, resulting in a decrease of 2% structures stateside, and the remaining 70% no change.
    - **Flood Zone Study Types.** Of the 14,255 miles of Special Flood Hazard Areas in the state, the flood studies comprised 70% Approximate A Zones and 30% Detailed AE Zones.

      Static Map Links: SFHA Building Density Graphic | SFHA Zone A/AE Study Types

### Regions

- 3 Regional Councils in the southern and southwestern parts of the state have the highest building floodplain counts greater than 11,000 structures, representing 58% of all high-risk floodplain structures in the state: Region 3 (19,221 buildings), Region 2 (17,016), and Region 1 (11,158).

  Static Map Links: Natural Break Graphic | Percent Rank Graphic

## Counties

- The top 10% counties with the highest building counties are Kanawha (13,452), Logan (4,498), McDowell (3,479), Mingo (3,229), Boone (3,094), and Ohio (2,992) counties.
- In the high-risk Special Flood Hazard Area, Kanawha County has the most primary structures of 13,452, three times the second ranked Logan County of 4,498 structures.

Static Map Links: Natural Break Graphic | Percent Rank Graphic

## Communities

- The unincorporated areas of Kanawha, Logan, and Mingo counties, followed by the city of Wheeling, are the top four ranked communities with the highest building counts in the Special Flood Hazard Area.
- Of the 28 unincorporated and incorporated communities which comprise the top 10% of all 266 floodprone communities, four are municipalities are located on the Ohio and Kanawha Rivers: Wheeling (Ranked 4th), Charleston (12th), Huntington (18th), St. Albans (19th), and Dunbar (23rd).

Static Map Links: Natural Break Graphic | Percent Rank Graphic

## Unincorporated Areas

- The top 10% ranked unincorporated areas (1-Kanawha, 2-Logan, 3-Mingo, 4-Boone, **5-Lincoln**, 6-McDowell) are the same as the top 10% counties (1-Kanawha, 2-Logan, 3-McDowell, 4-Mingo, 5-Boone, **6-Ohio**) except that Ohio County is ranked 5th and Lincoln County ranked 9th for the countywide floodplain totals.

- Static Map Links: Natural Break Graphic | Percent Rank Graphic

## Incorporated Places

- The top 8 ranked municipalities and nearly half of the top 10% places are located along the Ohio or Kanawha Rivers: Wheeling (2,685 structures), Charleston (1,512), Huntington (1,099), St. Albans (1,043), Dunbar (903), New Martinsville (756), Wellsburg (716), and Nitro (659).
- The city of Wheeling has the highest number of structures at 2,685 followed by the cities Charleston and Huntington with more than a thousand structures in the Special Flood Hazard Area. Additionally, the cities of Charleston and Huntington intersect three different HUC-8 subbasin watersheds, which are analogous to medium sized river basins.
- All the top 10% or top-ranked 23 places have multiple flood sources, or at least a single confluence where a tributary joins a larger river, which during major storms can lead to backwater flooding and much higher flood depths.
- A new floodwall planned for the incorporated place of Milton, Cabell County, currently ranked tenth in state with 407 structures in the Special Flood Hazard Area, will significantly reduce the town's flood risk.

Static Map Links: Natural Break Graphic | Percent Rank Graphic

## Watersheds

- The top 10% ranked, or top 4 subbasins of 33 HUC-8 watersheds in the state, according to the most buildings in the high-risk Special Flood Hazard Area, are the Lower Kanawha (7,989 buildings), Coal (6,240), Upper Guyandotte (6,211), and Upper Ohio-Wheeling (5,845) watersheds.

  Static Map Links: Natural Break Graphic | Percent Rank Graphic

## Streams

- The top 5% ranked streams with more than a thousand floodplain structures are the Ohio River (7,237 buildings), Kanawha River (7,116), Elk river (2,253), Greenbrier River (1,821), Guyandotte River (1.494), Tug Fork (1,410), Little Kanawha River (1,205), Mud River (1,133), and Island Creek (1,110).
- Only 2% of all the named streams or rivers (n=6,748 streams) in the State have more than 100 buildings, while 46% of all names streams have a minimum of 1 building.

  Static Map Links: Natural Break Graphic | Percent Rank Graphic

# BUILDING COUNT Detailed Findings

## STATEWIDE

**SPECIAL FLOOD HAZARD AREA.** In West Virginia, 84,490 primary structure or 8% of all structures in the state are in the high-risk Special Flood Hazard Area or 1%-annual chance (100-YR) floodplain. In the Special Flood Hazard Area, flood insurance is mandatory for structures with federally-back mortgages. A breakdown of buildings within the high-risk flood areas reveals that 65% of the buildings (55,112) are in Detailed "Zone AE" studies and 35% (29,378) in "Approximate Zone A" studies. Zone AE studies are studied in more detail to include floodways and field surveys. Ten percent of all structures (8,572) in the state are in the Regulatory Floodway, the main channel of the river or stream that is subject to the greatest flood depths, highest velocities, and greatest debris potential. Development is not allowed in the floodway unless "no rise" in flood levels is certified.

**HIGH-RISK ADVISORY FLOOD ZONES.** Advisory flood studies represent future map conditions for floodplain boundaries and base flood elevations. Type of advisory floodplains are (1) Advisory Flood Heights (Approximate A Zones), (2) Redelineated Updated AE Zones, (3) and Draft/Preliminary National Flood Hazard Layers generated during ongoing restudies. For floodplain determinations, the best-available flood information should always be considered.

The state has published non-regulatory flood studies for 54 counties in which it is estimated 30% of all the SHFA structures will either be mapped in or out of the SFHA. Although more detailed mapping of smaller watersheds is resulting in additional structures being mapped into the Special Flood Hazard Area, more structures are being mapped out of the SFHA because of better-quality LiDAR-derived topography and flood models. Currently there are 97,936 structures in the high-risk, effective and

advisory flood areas, of which it is estimated that as future flood studies become effective, 16% of the statewide structures will be mapped out of the SFHA, while 14% of the structures mapped into the SFHA, resulting in a net statewide decrease of 2% structures mapped out of the SFHA.

**OTHER FLOOD ZONES.** If buildings are counted in other flood zones, such as the moderate risk 0.2% annual chance (500-YR) and reduced risk levee protected zones, then 138,623 structures or13% of all structures in the state are at flood risk. Besides riverine flooding, many homes outside the Special Flood Hazard Area may be vulnerable to other types of flooding, particularly flash flooding on small streams, runoff rushing down mountainsides, and urban stormwater flooding. In fact, FEMA makes a regular point of noting that 25 percent of flood claims come from areas outside the Special Flood Hazard Area with low-to-moderate risk. For example, during the major June 2016 flood, multiple houses were swept away and a person died in an unmapped FEMA flood zone during the flash flooding of a small stream named Jordan Creek, a tributary of the Elk River near Clendenin, WV. Historical research of flood fatalities in the state reveals that extreme rainfall events and flash flooding in the headwaters of watersheds can turn small streams like Jordan Creek into raging rivers, resulting in loss of life and property.

In summary, of the estimated 1.1 million primary structures in West Virginia, 13% of the structures (138,623) are subject to riverine and flash flooding. In the Special Flood Hazard Area, it is estimated that 8% of all primary structure (84,490) in the state are subject to the highest risk of flooding, of which 1% of these structures are mapped in the floodway where the highest flood depths and velocities can occur.

**FLOOD ZONE STUDY TYPES.** Of the 14,255 miles of Special Flood Hazard Areas in the state, the flood studies comprised 70% Approximate A Zones and 30% Detailed AE Zones. For many rural counties with few metropolitan centers, most of the flood zones mapped in the county are Approximate A Zones.

During FEMA's Discovery Phase of Risk MAP studies, the state should identify Approximate A Zone stream reaches with a high density of structures and loss potential for upgrading to detailed studies. Typically, detailed studies use more refined hydrologic modeling instead of just using regression equations. In addition, detailed studies include the floodway and hydraulic models with structure and bathymetric surveys. Extra FEMA products such as the "floodway data table" and "flood profiles" are only included in detailed studies. Per federal regulations, FEMA cannot publish base flood elevations for Approximate A Zones like is done on the WV Flood Tool.

Fewer miles of floodplain in West Virginia are detailed studies because of the higher costs. Prices differ by mapping contractor, but the costs are approximately $350 per Zone A mile and $2,500 per Zone AE mile.

## REGIONS (11)

Three Regional Councils in the southern and southwestern parts of the state have the highest building floodplain counts greater than 11,000 structures: Region 3 (19,221 buildings), Region 2 (17,016), and Region 1 (11,158). Although Region 1 (6 counties), Region 2 (6 counties), and Region 3 (4 counties) represent 29% of all 55 counties, this contiguous southwest portion of the state has 58% of all high-risk floodplain structures in the state. These three regions also contain the top 5 ranked countywide building count totals: Region 3 – Kanawha and Boone counties; Region 2 – Logan and Mingo counties; and Region 1 – McDowell County.

Region 11 (2 counties) in the Northern Panhandle and Region 9 (3 counties) in the Eastern Panhandle have the least number of structures of 1,372 and 1,436, respectively. The median and mean statistics of 11 Regional Planning and Development Councils in the state are 6,204 and 7,492 structures, respectively. The eight split communities across regional and county borders are summarized accordingly to the corresponding Regional Council or county.

## COUNTIES (55)

The top 10% counties with the highest building counties are Kanawha (13,452), Logan (4,498), McDowell (3,479), Mingo (3,229), Boone (3,094), and Ohio (2,992) counties. In the high-risk Special Flood Hazard Area, Kanawha County has the most primary structures of 13,452, three times the second ranked Logan County of 4,498 structures. While Kanawha County, the fourth largest county in the state by land area, has the most buildings in the Special Flood Hazard Area, Grant County, ranked 19th in land size, has the least number of structures for a county with 300 buildings. Regionally, except for Ohio County in the Northern Panhandle with the large urban center of Wheeling, the counties with the most structures in the Special Flood Hazard Area are in the southwestern part of West Virginia. The median and mean statistics of 55 counties in the state are 939 and 1,498 structures, respectively. Additionally, Mason County has the highest percentage of detailed Zone AE flood zones at 71%, while Ritchie County has the lowest percentage of detailed flood zones at 0.4%.

## COMMUNITIES (284)

There are 284 communities in the state comprised of 55 unincorporated areas and 229 incorporated places. The incorporated places are further subdivided into 211 floodprone communities and 18 communities with no Special Flood Hazard Areas. Additionally, there are 8 incorporated places that are split across the county boundary (Wheeling, Huntington, Nitro, Alderson, etc.). At the community level, floodplain managers enforce the floodplain management ordinance as participants of FEMA's National Flood Insurance Program.

The unincorporated areas of Kanawha, Logan, and Mingo counties, followed by the city of Wheeling, are the top four ranked communities with the highest building counts in the Special Flood Hazard Area. Of the 28 unincorporated and incorporated communities which comprise the top 10% of all 266 floodprone communities, four are municipalities are located on the Ohio and Kanawha Rivers: Wheeling (Ranked 4th), Charleston (12th), Huntington (18th), St. Albans (19th), and Dunbar (23rd). The median and mean statistics of 266 floodprone communities in the state are 77 and 310 structures, respectively. It should also be noted that typically both the unincorporated area and countywide rankings are similar.

## UNINCORPORATED AREAS (55)

The top 10% ranked unincorporated areas (1-Kanawha, 2-Logan, 3-Mingo, 4-Boone, **5-Lincoln**, 6-McDowell) are the same as the top 10% counties (1-Kanawha, 2-Logan, 3-McDowell, 4-Mingo, 5-Boone, **6-Ohio**) except that Ohio County is ranked 5th and Lincoln County ranked 9th for the countywide floodplain totals. Kanawha County Unincorporated has the highest floodplain building count of 7,950 structures, which is greater than all the countywide totals of all the other counties in the state. Brooke County has the smallest count of floodplain structures of 94 in the high-risk Special Flood Hazard Area.

The median and mean statistics of the 55 unincorporated areas in the state are 595 and 1,028 structures, respectively.

## INCORPORATED PLACES (229)

Twenty-three municipalities comprise the top 10% of all the 211 *floodprone* municipalities. The top 8 ranked municipalities and nearly half of the top 10% places are located along the Ohio or Kanawha Rivers: Wheeling (2,685 structures), Charleston (1,512), Huntington (1,099), St. Albans (1,043), Dunbar (903), New Martinsville (756), Wellsburg (716), and Nitro (659). The city of Wheeling has the highest number of structures at 2,685 followed by the cities Charleston and Huntington with more than a thousand structures in the Special Flood Hazard Area. The median and mean statistics of 211 floodprone incorporated places in the state are 50 and 123 structures, respectively.

All the top 10% or top-ranked 23 places have multiple flood sources, or at least a single confluence where a tributary joins a larger river, which during major storms can lead to backwater flooding and much higher flood depths. Five of the top ranked communities are in the Lower Kanawha Watershed and four communities in the Upper-Ohio Wheeling Watershed. The cities of Charleston and Huntington intersect three different HUC-8 subbasin watersheds, which are analogous to medium sized river basins.

A new floodwall planned for the incorporated place of Milton, Cabell County, currently ranked tenth in state with 407 structures in the Special Flood Hazard Area, will significantly reduce the town's flood risk. The proposed new flood mitigation project for Milton will protect over 600 homes and businesses in the town after constructing a 1.5-mile-long earthen levee estimated at a cost of 190.7 million. Like other floodwalls (e.g., Matewan, Williamson, Huntington), the Milton floodwall project along the Lower Mud River will substantially reduce the flood risk behind the levee. It is estimated the new floodwall will lower the annual chance of exceedance to 0.4% (250-YR flood), thereby removing a significant number of structures from the high-risk Special Flood Hazard Area or 1% annual chance floodplain.

## STREAMS/RIVERS (6,748)

There are 6,748 named streams in the state, of which 3,115 streams or 46% of the total named streams have a minimum of one building in the Special Flood Hazard Area, and 115 or 2% of all the named streams have more than 100 buildings.

The Ohio and Kanawha Rivers have more than 7,000 buildings in the high-risk floodplains at 7,237 and 7,116 structures, respectively. The top 5% ranked streams with more than a thousand floodplain structures are the Ohio River (7,237 buildings), Kanawha River (7,116), Elk River (2,253), Greenbrier River (1,821), Guyandotte River (1.494), Tug Fork (1,410), Little Kanawha River (1,205), Mud River (1,133), and Island Creek (1,110).

## WATERSHEDS (33)

The top 10% ranked, or top 4 subbasins of 33 HUC-8 watersheds in the state, according to the most buildings in the high-risk Special Flood Hazard Area, are the Lower Kanawha (7,989 buildings), Coal (6,240), Upper Guyandotte (6,211), and Upper Ohio-Wheeling (5,845) watersheds.

Of the 33 watersheds, the geographic extents of only 13 of these watersheds are totally within West Virginia. In terms of watershed size, the largest four watersheds in square miles are the Little Kanawha, Greenbrier, Elk, and Gauley watersheds.

# BUILDING COUNT Top Rankings and Maps

**DESCRIPTION.** A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).

**RATIONALE.**

- The higher number of buildings in the floodplain indicates higher physical and human exposure to riverine flooding. If a building owner has a mortgage from a federally regulated lender and the property is in the Special Flood Hazard Area, then the building owner is required by Federal law to carry flood insurance.
- The building count in the SFHA is a programming variable required for those communities participating in FEMA's Community Rating System (CRS) program.

**RECOMMENDATIONS.**

- Communities with a high floodplain building count should actively engage property owners about flood insurance and minimizing flood losses of property owners. See Floodsmart.gov for more information.
- Communities can become more resilient to flooding by exceeding the minimum NFIP requirements. Higher building standards adopted by local communities may include increasing the freeboard of the base flood elevation; or encourage property owners to build to the higher 500-year flood elevation or historical high-water mark.
- Floodplain managers and emergency planners should pre-load at-risk structures into substantial damage estimator software. Local officials should review early warning systems as well as short-term shelters located outside the floodplain and away from inundated roads.
- State and county leaders should prioritize pre-disaster planning for communities with many flood-prone buildings.

**METHODOLOGY.** A statewide, detailed inventory of all primary structures in the Special Flood Hazard Area was validated using the best available data, including leaf-off aerial imagery, tax parcels, E-911 addresses, and other reference layers. The following key attributes were inventoried and checked individually for each building: building value, occupancy class, foundation type, number of stories, and building area. A unique identifier was assigned to each building by combining the Parcel ID and Address Number. The statewide building inventory is updated when new flood studies become available and periodically from new tax assessment data. For structures located in the reduced and moderate risk flood zones, structures were only inventoried using building footprints in which full building characteristics were not individually collected or verified.

## 8 GEOGRAPHIC SCALES ANALYSES

1) Statewide

2) 11 Regional Councils

3) 55 Counties

4) 284 Communities

    5) 55 Unincorporated Areas

    6) 229 incorporated Places
       (8 split municipalities across county border)

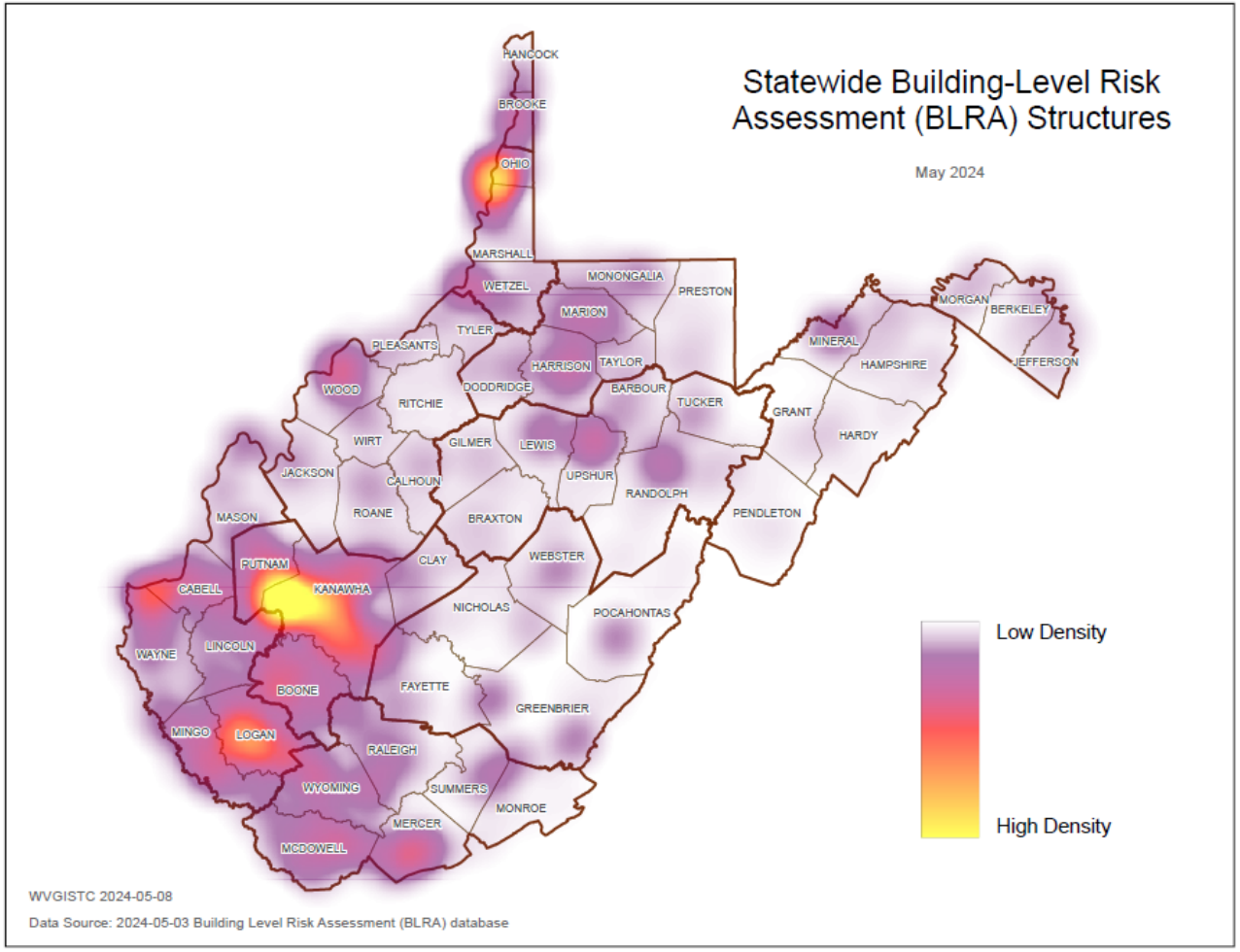
7) 33 Watersheds

8) 6,748 Named Streams

Figure BC-1. Building Count in Special Flood Hazard Area (Statewide Scale)

## BUILDING COUNT (STATEWIDE SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| HIGH-RISK REGULATORY ZONES | | |
|---|---|---|
| **Buildings in Special Flood Hazard Area** 1% Annual Chance (100-YR) Flood Zone | | |
| Special Flood Hazard Area | | 84,490 |
| • Detailed Zone AE | 65% | 55,112 |
| • Approximate Zone A | 35% | 29,378 |
| ○ Zone AE Floodway | 10% | 8,572 |

| HIGH-RISK ADVISORY FLOOD ZONES | | |
|---|---|---|
| **Includes Buildings in Non-Regulatory Zones** Future Map 1% AEP (100-YR) Flood Zones | | |
| High-Risk Flood Zones | | 97,936 |
| • Mapped No Change | 70% | 69,093 |
| • Mapped out SFHA | 16% | -15,528 |
| • Mapped in SFHA (non-regulatory) * | 14% | 13,315 |
| • SFHA net change | -2% | -2,213 |
| Structures est. in SFHA | | 82,408 |

* 54 counties have Advisory A / AE Flood Zones

| OTHER FLOOD ZONES | |
|---|---|
| **Buildings in Shaded X Zones** Moderate or Reduced Flood Risk Areas | |
| High and Moderate Risk Zones | 138,623 |
| • 0.2% annual chance (500-YR) flood (moderate risk) | 44,415 |
| • Levee Protected Zones (reduced risk) | 9,718 |

**SFHA ZONE A STUDY TYPES**

- 70% Approximate A Zones
- 30% Detailed AE Zones

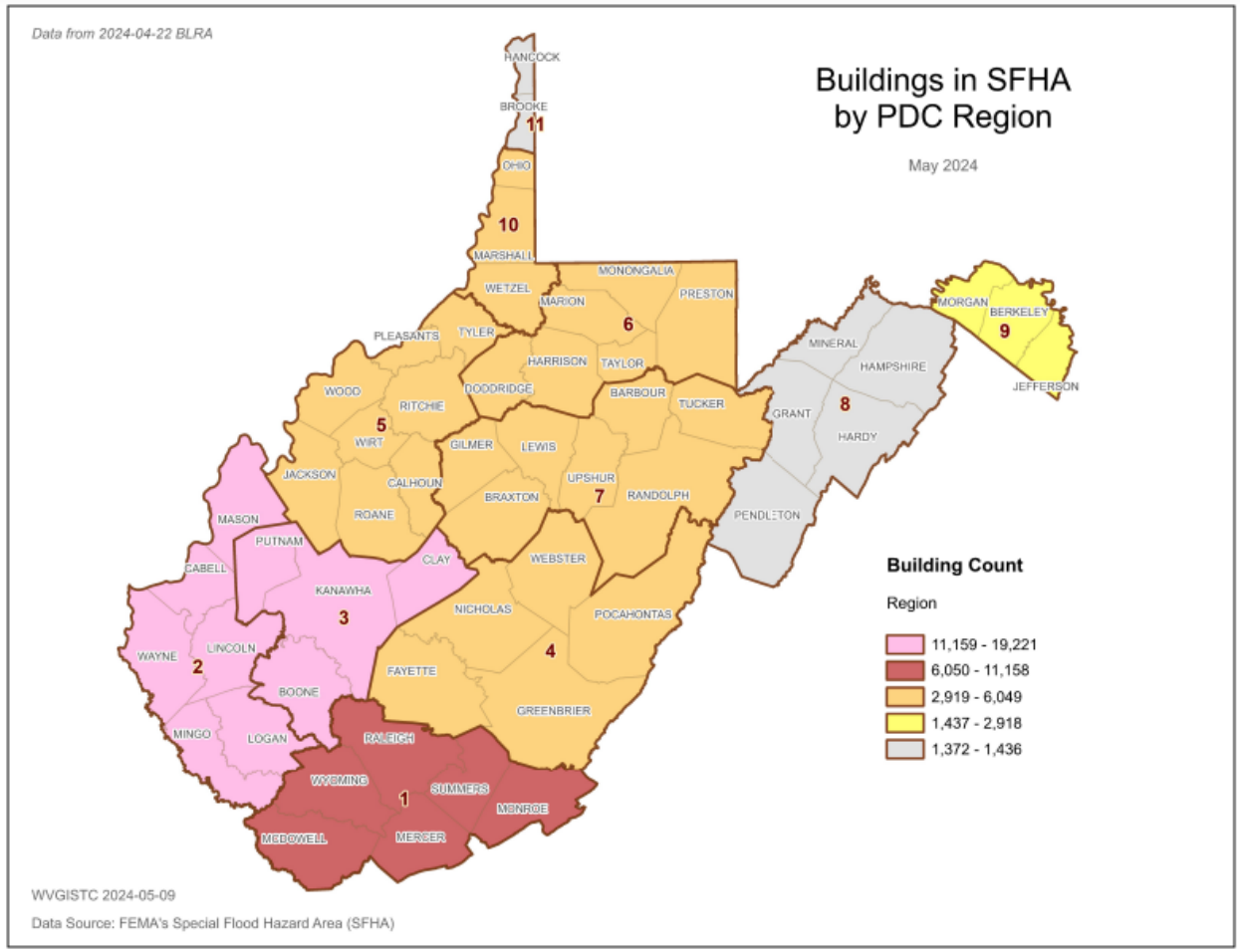
| WEB LINKS: | SFHA Building Density Graphic | SFHA Zone A/AE Study Types | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

Figure BC-2. Building Count in Special Flood Hazard Area (County Scale)

## BUILDING COUNT (REGIONAL COUNCIL SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Region (11) | Count | % Rank |
|---|---|---|---|
| 1 | Region 3 | 19,221 | 92% |
| 2 | Region 2 | 17,016 | 83% |
| 3 | Region 1 | 11,158 | 75% |
| 4 | Region 6 | 6,049 | 67% |
| 5 | Region 4 | 6,044 | 58% |
| 6 | Region 10 | 6,024 | 50% |
| 7 | Region 5 | 5,752 | 42% |
| 8 | Region 7 | 5,418 | 33% |
| 9 | Region 8 | 2,918 | 25% |
| 10 | Region 9 | 1,436 | 17% |
| 11 | Region 11 | 1,372 | 8% |

| REGIONAL SCALE STATISTICS | |
|---|---|
| Minimum (REGION 11) | 1,372 |
| Maximum (REGION 1) | 19,221 |
| Median | 6,204 |
| Mean | 7,492 |
| Statewide Total | 82,408 |

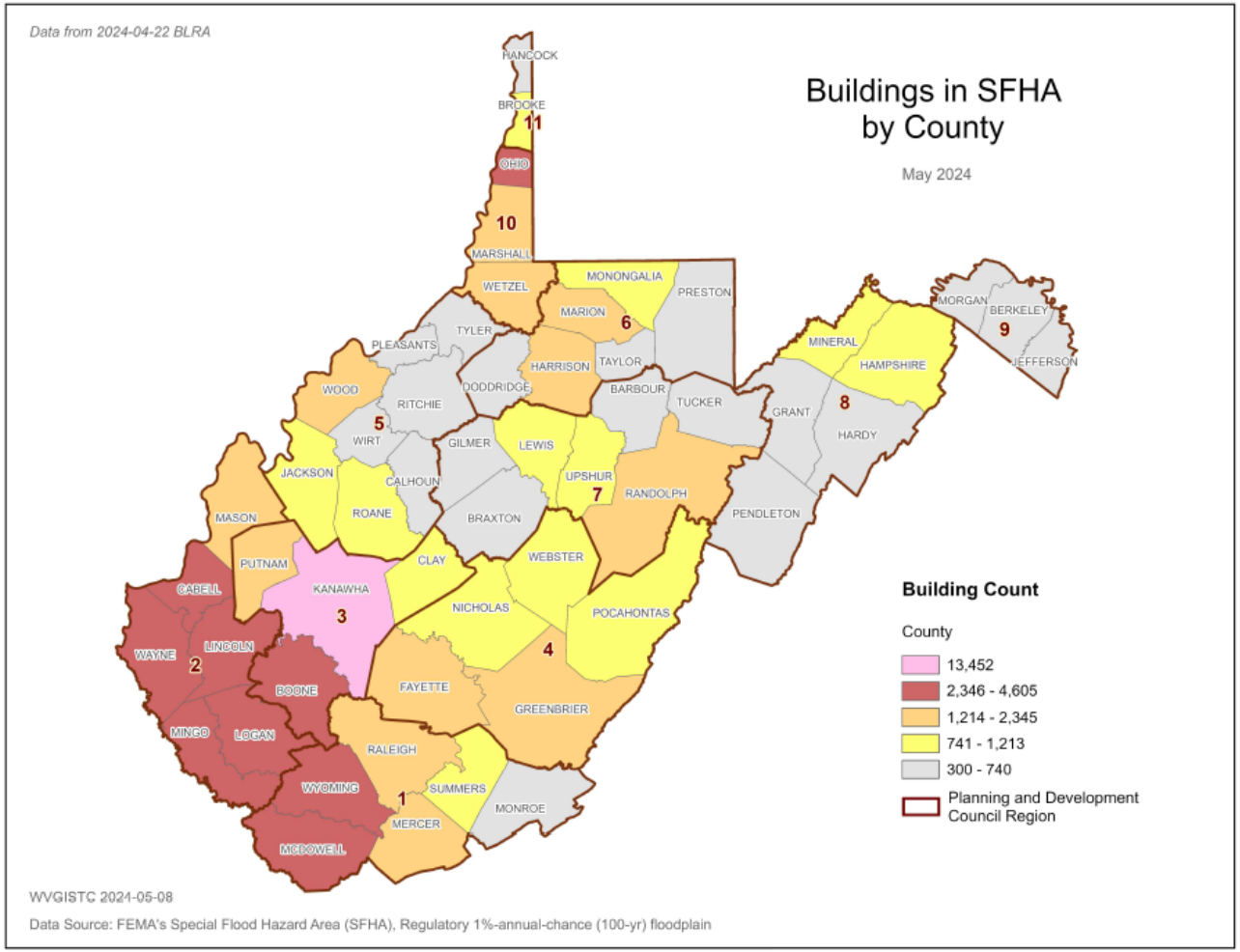
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

Figure BC-3. Building Count in Special Flood Hazard Area (County Scale)

## BUILDING COUNT (COUNTY SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | County (55) | Count | % Rank |
|---|---|---|---|
| 1 | KANAWHA | 13,452 | 100% |
| 2 | LOGAN | 4,498 | 98% |
| 3 | MCDOWELL | 3,479 | 96% |
| 4 | MINGO | 3,229 | 94% |
| 5 | BOONE | 3,094 | 93% |
| 6 | OHIO | 2,992 | 91% |
| 7 | CABELL | 2,808 | 89% |
| 8 | WYOMING | 2,592 | 87% |
| 9 | LINCOLN | 2,556 | 85% |
| 10 | WAYNE | 2,485 | 83% |
| 11 | MERCER | 2,019 | 81% |
| 12 | RALEIGH | 1,945 | 80% |
| 13 | PUTNAM | 1,932 | 78% |
| 14 | GREENBRIER | 1,879 | 76% |
| 15 | HARRISON | 1,872 | 74% |
| 16 | WOOD | 1,663 | 72% |
| 17 | MARION | 1,641 | 70% |
| 18 | WETZEL | 1,571 | 69% |
| 19 | MARSHALL | 1,463 | 67% |
| 20 | MASON | 1,440 | 65% |

| COUNTY SCALE STATISTICS | |
|---|---|
| Minimum (GRANT) | 300 |
| Maximum (KANAWHA) | 13,452 |
| Median | 939 |
| Mean | 1,498 |
| Statewide Total | 82,408 |

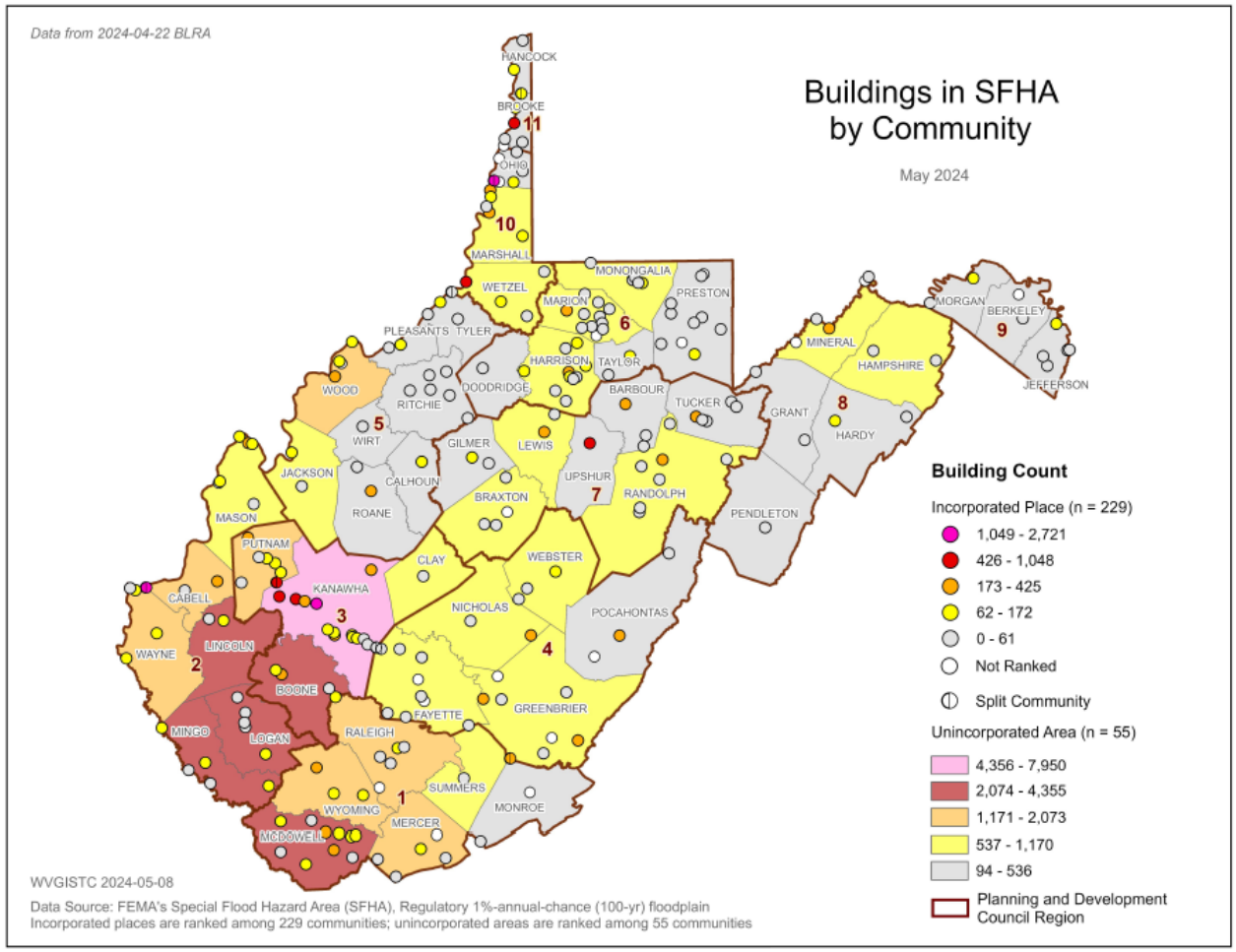
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

Figure BC-4. Building Count in Special Flood Hazard Area (Community Scale)

## BUILDING COUNT (COMMUNITY SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Community (284) | Count | % Rank |
|---|---|---|---|
| 1 | Kanawha County* | 7950 | 100% |
| 2 | Logan County* | 4279 | 100% |
| 3 | Mingo County* | 2899 | 99% |
| 4 | Wheeling** | 2685 | 99% |
| 5 | Boone County* | 2572 | 98% |
| 6 | Lincoln County* | 2407 | 98% |
| 7 | McDowell County* | 2223 | 98% |
| 8 | Wyoming County* | 2059 | 97% |
| 9 | Wayne County* | 1944 | 97% |
| 10 | Raleigh County* | 1818 | 97% |
| 11 | Mercer County* | 1792 | 96% |
| 12 | Charleston | 1512 | 96% |
| 13 | Cabell County* | 1489 | 95% |
| 14 | Wood County* | 1316 | 95% |
| 15 | Putnam County* | 1297 | 95% |
| 16 | Fayette County* | 1157 | 94% |
| 17 | Marion County* | 1112 | 94% |
| 18 | Huntington** | 1099 | 94% |
| 19 | St. Albans | 1043 | 93% |
| 20 | Greenbrier County* | 997 | 93% |

* Unincorporated Area ** Split Community

| COMMUNITY AREA STATISTICS | |
|---|---|
| Minimum | 0 |
| Maximum (Kanawha*) | 7,950 |
| Median | 77 |
| Mean | 310 |
| Communitywide Total | 82,408 |
| Statewide Total | 82,408 |

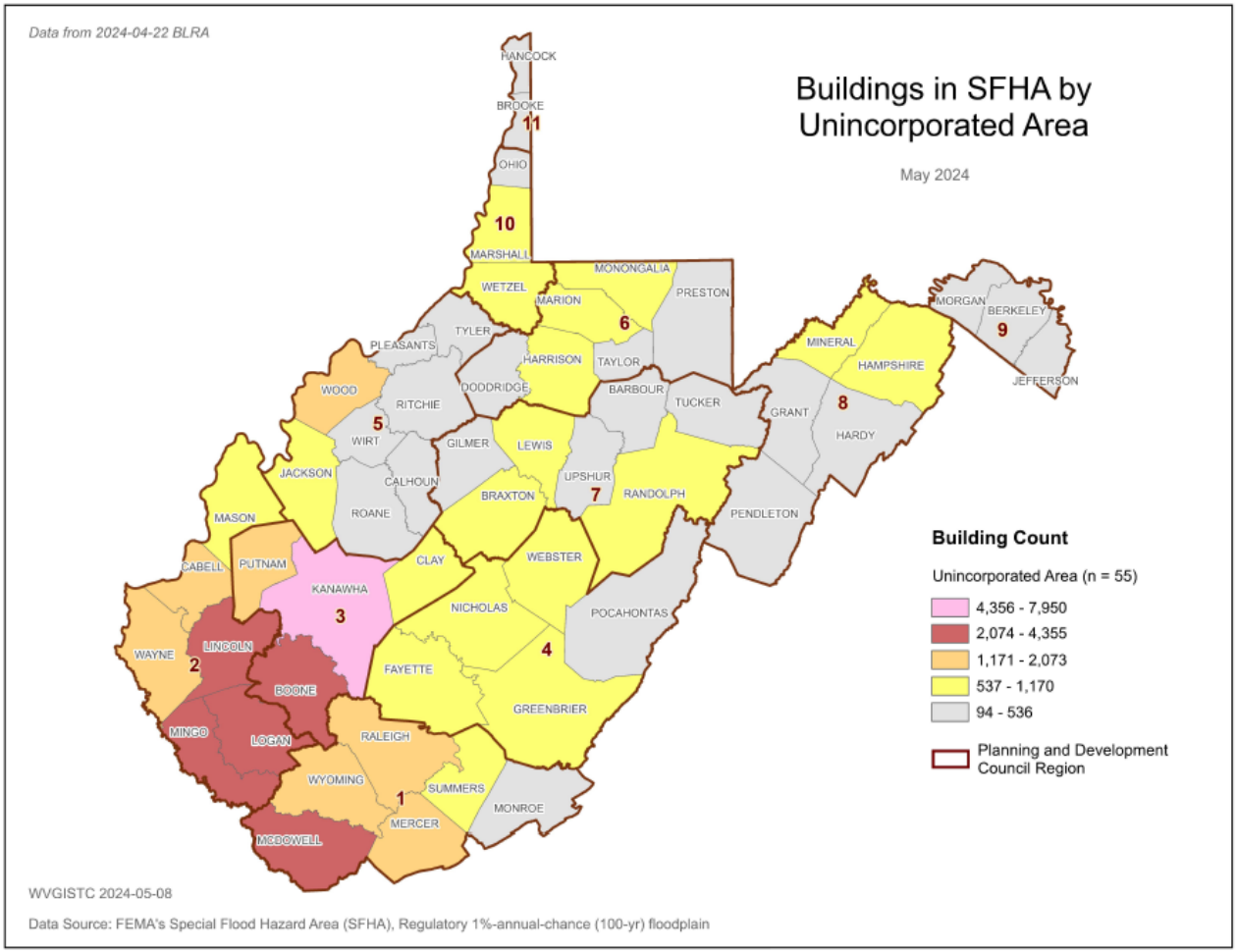
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

Figure BC-5. Building Count in Special Flood Hazard Area (Unincorporated Area Scale)

## BUILDING COUNT (UNINCORPORATED AREA SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Unincorporated (55) | Count | % Rank |
|---|---|---|---|
| 1 | Kanawha County* | 7,950 | 100% |
| 2 | Logan County* | 4,279 | 98% |
| 3 | Mingo County* | 2,899 | 96% |
| 4 | Boone County* | 2,572 | 94% |
| 5 | Lincoln County* | 2,407 | 93% |
| 6 | McDowell County* | 2,223 | 91% |
| 7 | Wyoming County* | 2,059 | 89% |
| 8 | Wayne County* | 1,944 | 87% |
| 9 | Raleigh County* | 1,818 | 85% |
| 10 | Mercer County* | 1,792 | 83% |
| 11 | Cabell County* | 1,489 | 81% |
| 12 | Wood County* | 1,316 | 80% |
| 13 | Putnam County* | 1,297 | 78% |
| 14 | Fayette County* | 1,157 | 76% |
| 15 | Marion County* | 1,112 | 74% |
| 16 | Greenbrier County* | 997 | 72% |
| 17 | Mason County* | 951 | 70% |
| 18 | Harrison County* | 943 | 69% |
| 19 | Randolph County* | 903 | 67% |
| 20 | Jackson County* | 822 | 65% |

* Unincorporated Area

| UNINCORPORATED AREA STATISTICS | |
|---|---|
| Minimum (Brooke*) | 94 |
| Maximum (Kanawha*) | 7,950 |
| Median | 595 |
| Mean | 1,028 |
| Unincorporated Area Total | 56,529 |
| Statewide Total | 82,408 |

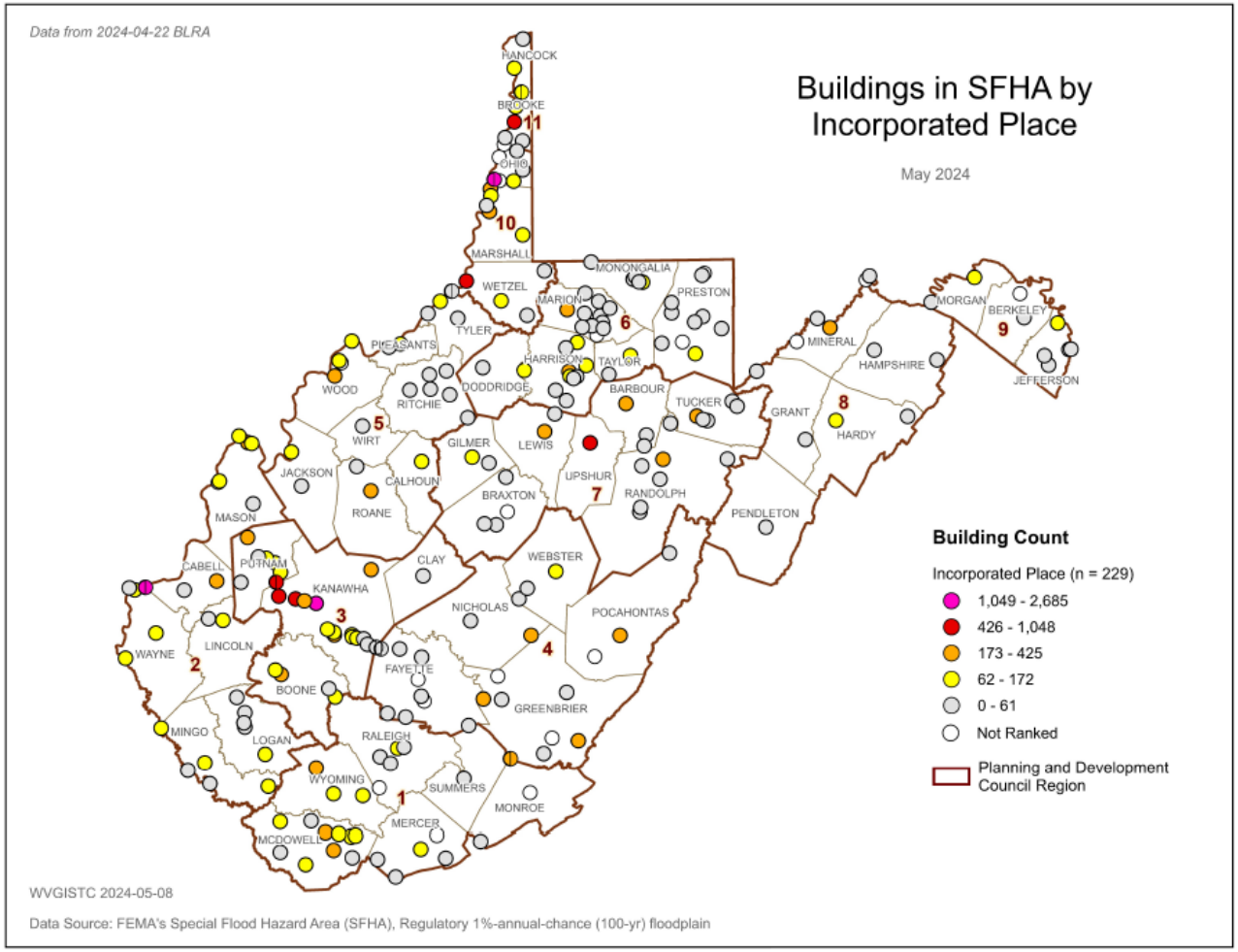
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Report | WEB LINKS: |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

Figure BC-6. Building Count in Special Flood Hazard Area (Incorporated Place Scale)

## BUILDING COUNT (INCORPORATED PLACE SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Incorporated (229) | Count | % Rank |
|---|---|---|---|
| 1 | Wheeling** | 2,685 | 100% |
| 2 | Charleston | 1,512 | 100% |
| 3 | Huntington** | 1,099 | 99% |
| 4 | St. Albans | 1,043 | 99% |
| 5 | Dunbar | 903 | 98% |
| 6 | New Martinsville | 756 | 98% |
| 7 | Wellsburg | 716 | 97% |
| 8 | Nitro** | 659 | 97% |
| 9 | Buckhannon | 568 | 96% |
| 10 | Milton | 407 | 96% |
| 11 | Clarksburg | 394 | 95% |
| 12 | *Marlinton* | 371 | 95% |
| 13 | Keyser | 354 | 94% |
| 14 | *Rainelle* | 336 | 94% |
| 15 | Moundsville | 321 | 93% |
| 16 | South Charleston | 319 | 93% |
| 17 | Welch | 318 | 92% |
| 18 | Benwood | 317 | 92% |
| 19 | Oceana | 303 | 91% |
| 20 | *White Sulphur Spr.* | 302 | 90% |
| 21 | *Clendenin* | 302 | 90% |
| 22 | *Richwood* | 286 | 90% |
| 23 | Gary | 267 | 90% |

** Split Community *Italicized* = Focus Studies

| INCORPORATED PLACE STATISTICS | |
|---|---|
| Minimum | 0 |
| Maximum (Wheeling) | 2,685 |
| Median | 50 |
| Mean | 123 |
| Incorporated Place Total | 25,879 |
| Statewide Total | 82,408 |

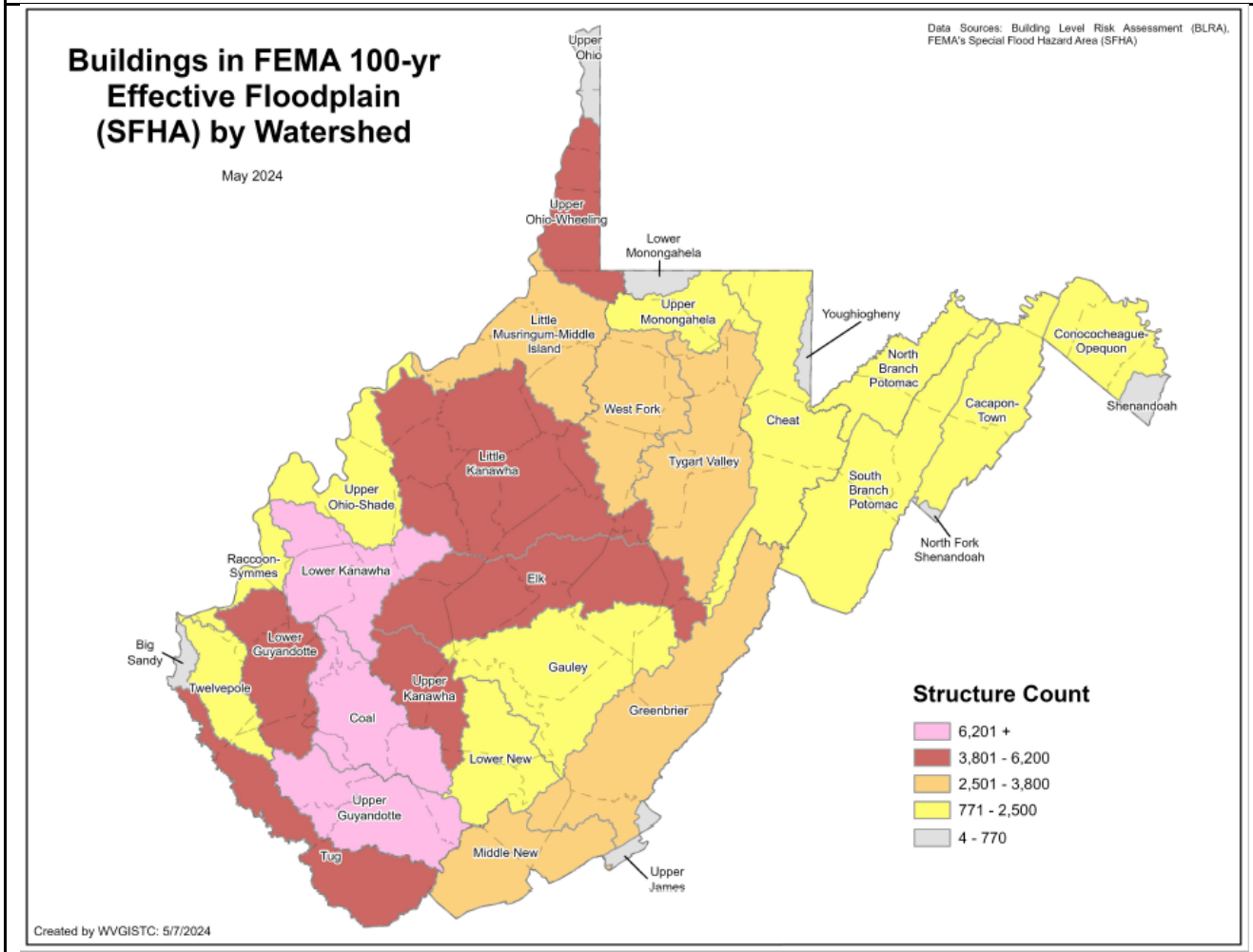
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

Figure BC-7. Building Count in Special Flood Hazard Area (Watershed Scale)

## BUILDING COUNT (WATERSHED SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Watershed (33) | Count | % Rank |
|---|---|---|---|
| 1 | Lower Kanawha | 7,989 | 100% |
| 2 | Coal | 6,240 | 97% |
| 3 | Upper Guyandotte | 6,211 | 94% |
| 4 | Upper Ohio-Wheeling | 5,845 | 91% |
| 5 | Tug | 5,527 | 88% |
| 6 | Elk | 4,909 | 84% |
| 7 | Upper Kanawha | 4,692 | 81% |
| 8 | Little Kanawha | 4,502 | 78% |
| 9 | Lower Guyandotte | 4,487 | 75% |
| 10 | Little Musringum-Middle Island | 3,518 | 72% |
| 11 | Tygart Valley | 3,194 | 69% |
| 12 | West Fork | 2,902 | 66% |
| 13 | Greenbrier | 2,835 | 63% |
| 14 | Middle New | 2,602 | 59% |
| 15 | Upper Ohio-Shade | 2,390 | 56% |

| WATERSHED SCALE STATISTICS | |
|---|---|
| Minimum (North Fork Shenandoah) | 4 |
| Maximum (Lower Kanawha) | 7,503 |
| Median | 2,042 |
| Mean | 2,631 |
| Statewide Total | 84,490 |

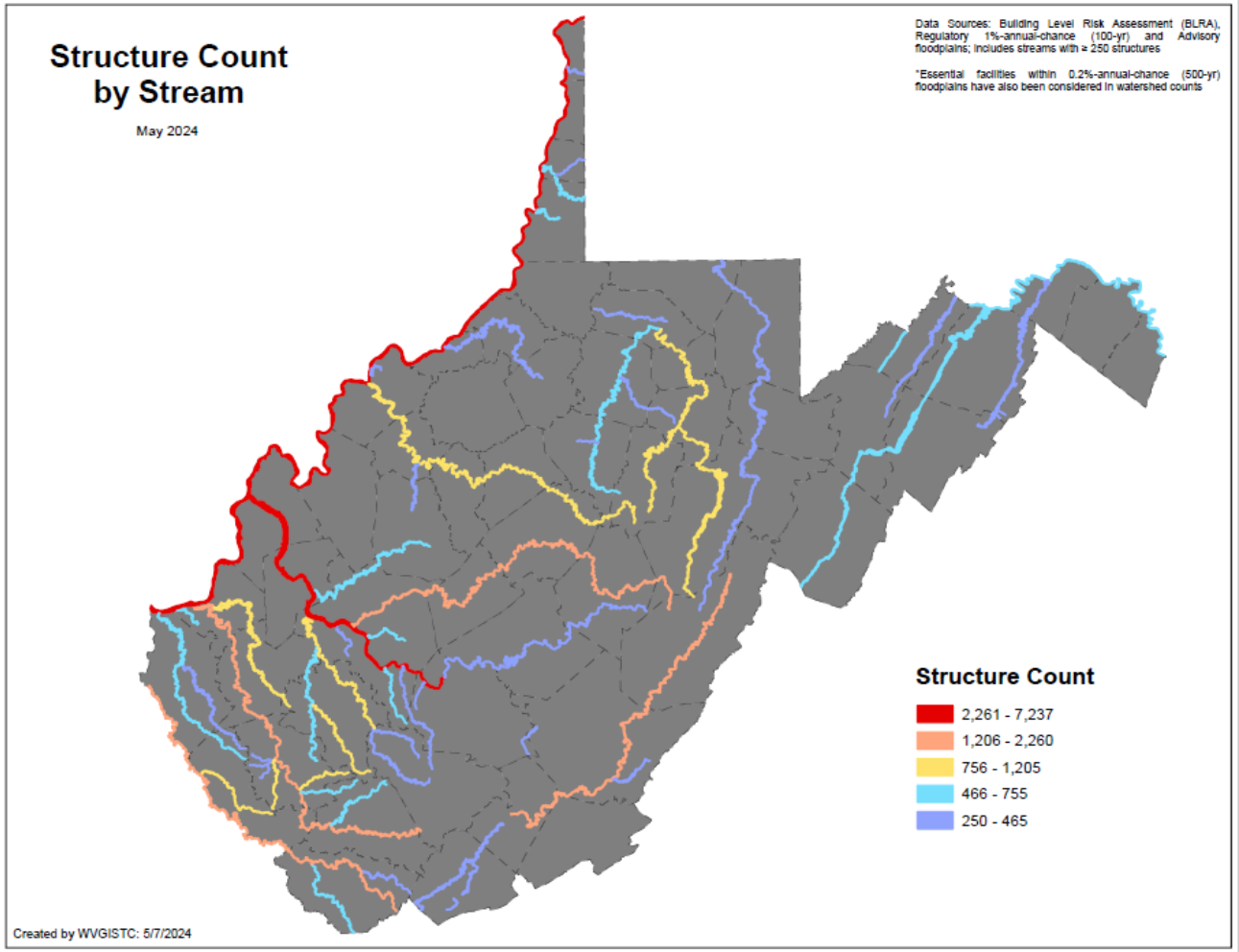
| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

Figure BC-8. Building Count in Special Flood Hazard Area (Stream Scale)

## BUILDING COUNT (STREAM SCALE)

DESCRIPTION: A count of all primary insurable structures in the high-risk, 1%-annual-chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRMs).




| Rank | Streams* (6,761) | Count | % Rank |
|---|---|---|---|
| 1 | Ohio River | 7,237 | 100% |
| 2 | Kanawha River | 7,116 | 99% |
| 3 | Elk River | 2,253 | 99% |
| 4 | Greenbrier River | 1,821 | 98% |
| 5 | Guyandotte River | 1,494 | 97% |
| 6 | Tug Fork | 1,410 | 97% |
| 7 | Little Kanawha R. | 1,205 | 96% |
| 8 | Mud River | 1,133 | 95% |
| 9 | Island Creek | 1,110 | 95% |
| 10 | Buckhannon River | 951 | 94% |
| 11 | Pond Fork | 948 | 94% |
| 12 | Coal River | 933 | 93% |
| 13 | Buffalo Creek | 932 | 92% |
| 14 | Big Coal River | 904 | 92% |
| 15 | Tygart Valley River | 891 | 91% |
| 16 | Pigeon Creek | 855 | 90% |
| 17 | Wheeling Creek | 755 | 90% |

* Streams with buildings > 100

| STREAM SCALE STATISTICS | | |
|---|---|---|
| Total Named Streams | | 6,748 |
| • Streams >= 1 Building | 46% | 3,115 |
| • Streams > 100 Bldgs. | 2% | 155 |

Stream and River Statistics

| WEB LINKS: | Natural Break Graphic | Percent Rank Graphic | Web Map | Web Report |
|---|---|---|---|---|

Sources: WV BLRA (Building-Level-Risk Assessment) for High-Risk Effective/Advisory Zones; FEMA Flood Insurance Rate Maps (FIRMs) for SFHA. Report Date 20240429.

# BUILDING COUNT Description, Rationale, and Recommendations

Table BC-9. **BUILDING COUNTS RISK INDICATOR**: Description, rationale, recommendations, and data sources of risk indicator.

| Category | Indicator | Short Description | Unit | Rationale | Recommendations | Data Sources | State | Region | County | Community | Unincorpora | Community | Stream | Watershed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Physical Exposure | **Building Counts in SFHA** | All primary insurable structures in the effective 100-year Floodplain or Special Flood Hazard Area (SFHA). | # | The higher number of buildings in the floodplain indicates higher physical and human exposure to riverine flooding.<br><br>If a building owner has a mortgage from a federally regulated lender and the property is in the Special Flood Hazard Area, then the building owner is required by Federal law to carry flood insurance.<br><br>The building count in the SFHA is a programming variable required for those communities participating in FEMA's Community Rating System (CRS) program. | Communities with a high floodplain building count should actively engage property owners about flood insurance and minimizing flood losses of property owners. See Floodsmart.gov for more information.<br><br>Communities can become more resilient to flooding by exceeding the minimum NFIP requirements. Higher building standards adopted by local communities may include increasing the freeboard of the base flood elevation; or encourage property owners to build to the higher 500-year flood elevation or historical high-water mark.<br><br>Floodplain managers and emergency planners should pre-load at-risk structures into substantial damage estimator software. Local officials should review early warning systems as well as short-term shelters located outside the floodplain and away from inundated roads.<br><br>State and county leaders should prioritize pre-disaster planning for communities with many flood-prone buildings. | All political scales: FEMA Special Flood Hazard Area (SFHA) for effective 1%-Annual-Chance Floodplains; Watershed and Stream scales: Effective and Advisory Floodplains for 1% Annual-Chance event; BLRA | Y | Y | Y | Y | Y | Y | Y | Y |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