

STATE ADVANCEMENT OF WV 2018 HMP MITIGATION ACTIONS

Notes for 2023 WV Hazard Mitigation Plan Preparation



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WV GIS TECHNICAL CENTER
West Virginia University

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2018-WVDHSEM-FL-01 (FLOOD). Promote/Enhance RL/SRL Program

5.6. Annually perform data synthesis and update the Bureau Net Database in coordination with FEMA Region III - provide RL and SRL datasets to local governments for use in their RL and SRL targeting efforts.

In collaboration with the State Mitigation Office, RL structures were geocoded by WVGISTC in 2019 for the state.

Data quality issues: Of the 3,132 RL structures evaluated in 2019, only 73% could be geocoded because of unsuitable addresses.

Areas of Mitigation Interest (includes RL and SRL targeting efforts): The RL/SRL structure data (even if incomplete for certain communities) should be combined with other flood risk data indicators (e.g., Hazus building-level substantial damage estimates, mitigated properties, high flood depths, high-water marks) to identify Areas of Mitigation interest (AoMI) in support of hazard mitigation plans and flood reduction efforts. The statewide building-level risk assessment database also allows for the identification of mitigation adaptive measures (e.g., flood vents) based on the building foundation type and flood depth. Both these activities are being funded by the 2022-23 CTP grant.

Repetitive Loss Graphics:

- [RL Community](#)
- [RL Structures](#)

Areas of Mitigation Interest Graphics:

- [Areas of Mitigation Interest](#) (AoMI) *incomplete mapping statewide*
 - Identification Criteria: Identified by Repetitive Loss Structures, Substantial Damage Estimates, Mitigated Properties, High Flood Depths, High Water Marks, Similar Topography
 - Example [Region 4 AoMIs and Top Post-FIRM Minus Rated Structures](#)
- [Potential Buildings for Mitigation Adaptive Measures](#). (Residential & Non-Residential)

2018-WVDHSEM-FL-02 (FLOOD). Promote/Enhance CRS Program

This Mitigation Action will focus on promoting and enhancing the Community Rating System program. Specific activities to support this initiative include, but are not limited to:

1. *Target and provide technical assistance to local communities.*
2. *Develop a CRS application to capture critical information.*
3. *Provide detailed directions to assist communities with the applicable process.*
4. *Identify communities which could benefit from CRS participation*

From the statewide high-risk floodplain building inventory, the WV GIS Technical Center periodically publishes the programming variables (bSF, aSFHA) needed for the initial/renewal certification of the 13 CRS communities in the state. It also performed an Open Space Preservation CRS credit analysis for select communities.

CRS Resources:

- [CRS Graphic 8.5 x 11](#) | [CRS Graphic 11 x 17](#)
- Example Community Open Space Credits [Report](#) | [Credits](#) | [Table](#)
- [State-Based CRS Points](#)
- [CRS 2017 Manual Maximum Points](#)

2018-WVDHSEM-FL-03 (FLOOD). Promote/Enhance NFIP

This Mitigation Action will focus on promoting and enhancing the National Flood Insurance Program. Specific activities to support this initiative include, but are not limited to:

1. Conduct an outreach campaign to property owners located in Special Flood Hazard Areas regarding flood insurance and mitigation. This Mitigation Action will focus on promoting and enhancing the National Flood Insurance Program.

When new FEMA Preliminary maps are published for communities, the WV GIS Technical Center can provide support to communities and State NFIP Office for outreach letters targeting buildings being mapped into or out of the Special Flood Hazard Area (SFHA). This activity is being supported by 2022-23 CTP grant funding.

- Communications for SFHA Changes from Flood Studies
 - Provide risk assessment structures based on FEMA's preliminary flood studies (mapped into SFHA, mapped out of SFHA, new BFE's) for outreach communications to affected homeowners. In addition, restudied areas require updating floodplain management ordinance and an opportunity to review state model ordinance and incorporate higher standards. Refer to procedural instructions for more information.
 - [Mail Merge SFHA Change Template and Instructions](#)
 - Target Audience: Homeowners affected by new flood studies
 - This activity requires community participation from the floodplain manager for successful execution.
 - Uses FEMA's R3 Local Official Toolkit templates for communities with new flood maps.

2. Coordinate efforts to reduce Flood Insurance Premiums by focusing on Pre-FIRM and approximate A zone.

The FIRM status of all structures in the 1% Annual Chance (100-yr) floodplain is 23% (22,812) Post-FIRM, 69% (67,815) Pre-FIRM, and 8% (7,838) Unknown. The statewide floor risk assessment (TEIF project) revealed there are 22,319 structures (23% of total 1% floodplain inventory) that are Pre-FIRM and in the Approximate A Zone. Structures that are Pre-FIRM and located in the detailed AE Zone is 42,141 structures or 43% of all 1% floodplain structures. FEMA's new Risk Rating 2.0 system may alter the coordination of this insurance outreach activity as it relates to the FIRM status of buildings in the floodplain.

- [Post-FIRM Buildings Percent](#) (Post-FIRM structures 23%; n=22,812)
- [Minus Rated with FIRM Status](#) (20% Post-FIRM, 71% Pre-FIRM, 9% Unknown)

2018-WVUGISTC-FL-04 (FLOOD). Conduct Flood Mitigation Planning

1. Create advisory flood heights for all Zone A (100-year floodplain) in state;

Status of statewide advisory base flood elevations for Approximate A Zones. As of February 2023, 38 counties have Advisory Flood Heights (AFH), 3 counties (Randolph, Upshur, and Wetzel) are being mapped by contractor WSP through the State CTP project, and in the future the remaining 14 counties will be mapped by FEMA's Risk MAP program. Refer to flood study status graphics below. This past year the detailed AE Zones were updated by redelineation mapping for all 55 counties using the new FEMA-purchased lidar elevation data. In addition, as part of CTP funding, new and more accurate statewide composite flood risk depth grids for flood loss estimate models were generated and published to the WV Flood Tool.

- **Depth Grids:** A more accurate statewide composite flood depth grid of 1-meter cell resolution was created from the best available sources for use in the Hazus flood loss damage and transportation inundation models.
- **Water Surface Elevation (WSEL) Grids:** Water surface elevation grids were created from the FEMA CTP Projects and referenced for flood risk assessments.

Flood Depth/WSEL Sources:

- [FEMA Studies](#)
- [Advisory A Flood Heights](#)
- [Updated AE Redelineation](#)
- [Flood Zone Types](#)

FEMA QL2 LiDAR: The delivery of FEMA-purchased [QL2 LiDAR](#) improved the accuracy of the [water depth grids](#). It also improved the accuracy of landslide mapping for predictive models and now allows for online LOMA submissions using LiDAR. See [FEMA-purchased LiDAR projects](#) graphic.

2. Develop prioritized list of state-owned or leased facilities at risk to flood and conduct detailed site assessment to develop site-specific mitigation action plans.

According to the statewide building-level risk assessment database, there are 239 federal (0.24%) and 84 state-owned (0.08%) flood-prone building in high-risk flood areas. Two state-owned structures, the Levee Union building in Charleston and Beech Fork State Park Headquarters building, show high potential flood damage according to site-specific Hazus flood loss models. In addition, several military complexes in the state like Camp Dawson in Preston County have high exposure to flooding. Lastly, non-residential buildings, especially utilities near flood sources, have high property exposure as well.

WV EMD Goals and Recommendations (2022 State HMP). The BRIM data needs to be transitioned to a geospatial database to be more useful for determining building values of the state's non-residential and tax-exempt structures. Acquire the real estate database of the WV Department of Administration for state-owned and leased buildings from the WV Department of Administration for flood studies.

- Buildings NON-RESIDENTIAL
 - Percent Count: [Community](#)
 - Percent Value: [Community](#) | [County](#)
 - Top Non-Residential Structures >=\$24M [Top Non-Residential](#)
 - Top Utility Structures >= \$15M [Top Utility](#)
 - [WV BRIM data](#) for identifying building replacement values of state owned buildings

2018-Forestry-LS-02 (LANDSLIDE). Understanding Landslide Risks

This Mitigation Action will focus on promoting and enhancing a variety of specific mitigation activities. Specific activities to support this initiative include, but are not limited to:

1. Spatially track landslide occurrence along roadways.
 2. Digitize WV landslide quadrangle maps to support.
 3. Digitize information related to landslide prone areas.
 4. Provide landslide information to support landslide risk analysis.
- The TEAL project funded by an HMGP 5% grant inventoried 159,247 landslide features from historical landslide data collections and LiDAR mapping.
 - [LiDAR Mapping](#)
 - 66,151 landslide initiation points mapped using high resolution (1- or 2-m) LiDAR.
 - [Other Sources](#)
 - 46,330 landslide polygons digitized based on WV Geological and Economic Survey 1976 study.
 - 41,307 landslide polygons digitized based on a USGS 1975-1985 study.
 - Other studies and 2016 WV DOT points (n=1,406). Landslide incidents along roadways were incorporated into the
 - FEMA landslide buyout properties
 - LiDAR Mapping: Most common landslides mapped were slides and slumps (97%). Landslide locations were mapped throughout West Virginia using LiDAR elevation data products, including [hillshade](#) and [slopesshade](#) grids. Mapped failure types included slide, debris flow, lateral spread, multiple failures (when several failures were present in a small area, but were too small or close together to map separately), rock falls, and undetermined failure type. The nature of the West Virginia landscape and the LiDAR imagery limited mapping to landslides at least 33 feet wide.
 - FUTURE DIRECTIONS: Landslide mapping of areas where LiDAR coverage was incomplete; LiDAR for these areas was delivered by FEMA in fall 2021. This is a funded 2022-23 CTP activity.
 - Created a [statewide landslide susceptibility map](#)
 - 55 County Landslide Susceptibility Maps. Created [landslide susceptibility maps](#) for all 55 counties. Susceptibility is classified according to low, medium, and high probability of slope failure.
 - Low Risk: 0-30% probability of slope failure
 - Medium: 30-70% probability of slope failure
 - High: 70-100% probability of slope failure
 - Reports. Created a statewide and 11 regional [landslide reports](#) in support of local and state hazard mitigation plans.

SUMMARY OF KEY RISK LANDSLIDE ASSESSMENT PRODUCTS:

Reports and Maps:

- [Regional and Statewide Landslide Risk Assessment Reports](#)
- [County Scale Landslide Susceptibility Maps](#) for all 55 counties
- [Landslide Characteristics by 5 MLRA Regions](#)

Web Tools showing Landslide Incidents and Susceptibility:

- [WV Landslide Tool](#)
- [WV Flood Tool \(RiskMAP View\)](#)

Published Methodology Paper: [Assessing the Generalization of Machine Learning-Based Slope Failure Prediction to New Geographic Extents](#)

Landslide Risk Directory: [Directory](#) of [reports](#), [susceptibility maps](#), [educational brochures](#), [methodology papers](#), [GIS data](#), [community risk assessment tables](#), [graphics](#), etc.

Outreach Materials:

- Brochures
 - Community: [Mitigating Landslide Risk through Planning](#)
 - Homeowner: [Recognizing Landslide Risk on Your Property](#)
- Story Maps
 - [Causes of Landslides in Mountain State](#)
 - [WV Landslides and Slide-Prone Areas, WVGES 1976](#)

Presentations:

- Landslide Risk Assessment (April 2022) [PDF](#) | [PPTX](#)
- GSA Poster Kite et al. (2021) [PDF](#) | [PPTX](#)

2018-WVDEP-DL-01 (DAM/LEEVE). Coordinate Dam and Levee Safety Issues

This Mitigation Action will focus on promoting and enhancing a variety of specific mitigation activities align programs and initiatives related to dam and levee safety.

For the 2022 HMP plan, a goal could be to improve the standardization, visualization, and analyses of digital dam flood inundation zones which became available in 2022. See dam/levee resources below.

- DAM/LEEVE FAILURE RESOURCES:
 - [Dam/Levee Resources](#): High Hazard Dam Risk Assessment Tables, Communities Downstream of High Hazard Dams
 - Graphics
 - 1) [Statewide Dams and Levees](#)
 - 2) [Dams with Inundation Zones](#)
 - 3) [Levees](#)
 - Dam Inundation Zones: The WV Flood Tool's query result panel for the RiskMAP View could be updated to alert a location that falls within a failed dam inundation zone. New flood inundations zones have been made available by the WV Conservation Agency and USACE for select dams. In addition, risk assessments can be done by performing an intersection between the built-up environment and flood inundation zones.
 - [WV Dam Inundation Viewer](#) of 168 High Risk Dams from the WV Conservation Agency
 - USACE Dam Inundation Viewer: <https://nid.usace.army.mil/viewer/index.html>
 - USACE Summersville Dam Example: <https://nid.sec.usace.army.mil/viewer/index.html?dsLibrary=NID-MD00069,NID-WV06702&x=-80.901&y=38.223&z=15>

2018-WVDHSEM-CF-01 (ALL). Complete Threat Assessments

This Mitigation Action will focus on promoting and enhancing a variety of specific mitigation activities. Specific activities to support this initiative include, but are not limited to:

1. Build on current and existing assessment programs to conduct vulnerability assessments of critical facilities and evaluate for potential new mitigation strategies.

A riverine flood vulnerability analysis was performed for all essential facilities and community assets as part of the statewide floodplain building inventory. Flood-prone significant structures are published on the Risk MAP View of the WV Flood Tool. Essential facilities, community assets, and other structures of significance are distinguished in the building-level flood risk inventory and made available as data and reports for inclusion in local and state hazard mitigation plans.

- SIGNIFICANT STRUCTURES OF IMPORTANCE
 - [Essential Facilities](#) (mapped to 0.2% floodplain)
 - Community Assets [Community](#) | [County](#)
- RISK ASSESSMENT REPORTS
 - [Essential Facilities](#)
 - [Community Assets](#)
 - [Building Exposure and Type](#)

2. Support integration of state vulnerability analysis local data into local plan updates for use in prioritizing mitigation projects to include acquisition and demolition projects.

Statewide vulnerability assessments were completed in 2022 for both flood and landslide hazards. Refer to the [Index Guide](#) spreadsheet named “RA_Info_Index.xlsx” to access the various risk assessment products (products, reports, tables, graphics) published in support of FEMA’s Hazard Mitigation Plans and NFIP/CRS activities. Refer to [close-out reports](#) for descriptions of deliverables. A current CTP activity is focused on verifying and expanding the mitigated property databases.

- Published data and products are accessed using the [Risk Information Index](#).
- The past five years WVGISTC coordinated with WV EMD, NRCS, and local communities to improve the buyout properties database. Buyout properties are published on the Risk MAP View of the WV Flood Tool.
 - Buyout Properties [Community](#) | [County](#)
 - [Mitigated Structures](#) (Primarily mitigated structures >= 5 ft.)

2018-WVDHSEM-CF-02 (ALL). Utilize Risk Information in Planning

This Mitigation Action will focus on promoting and enhancing a variety of specific mitigation activities. Specific activities to support this initiative include, but are not limited to:

- *Integrate information from a variety of sources to develop a more detail vulnerability assessment to all types of natural hazards;*
- *Integrate risk information from hazards to identify communities at risk;*
- *Evaluate state-owned/-operate facilities for specific vulnerability and develop methods to mitigate highest risks;*
- *Collect necessary information to generate require threat/hazard assessments; and*
- **Support development of TIEF/TIEL to enhance mapping.**

- **Flood Risk Assessments:** Created building-level flood risk assessments for 268 flood-prone communities (231 municipalities and 55 unincorporated areas). Referred to as the Total Exposure in Floodplains (TEIF) project. Results are published on the WV Flood Tool’s RiskMAP View (www.mapwv.gov/flood) and accessed using the [Risk Assessment Product Index](#). Refer to [Flood Risk Close-Out Report](#).
 - SITE-SPECIFIC FLOOD RISK ASSESSMENTS. Complete Hazus Level 2 flood risk assessments for 55 counties and 213 incorporated communities to supplement Local and State Hazard Mitigation Plans]. The flood risk assessments for the [268 flood-prone areas](#) are calculated for a riverine 1%-annual-chance flood event with Hazus flood loss models using as inputs the flood inundation area and composite of the best available depth grids.

- STATWIDE FLOOD RISK ASSESSMENT. Referred to as the Total Exposure in Floodplains (TEIF) project. Created site-specific flood risk assessments for 286 communities (231 municipalities and 55 unincorporated areas) for the 1%-annual-chance (100-yr) flood event. Detailed risk profiles were generated at the building level and aggregated to the community, regional, and state levels. Risk profiles by stream name and watershed were produced as well.
- FLOOD LOSS MODELS. The building-level flood risk assessments utilized FEMA's Flood Assessment Structure Tool (FAST), a GIS-based, open-source utility designed by FEMA's Hazus Program for estimating potential building losses for a 1%-annual-chance flood event.

WV Building Level Risk Assessment (BLRA) Data and GIS Sources:

- [Statewide BLRA Geodatabase](#) (98,467 building points)
- [BLRA Regional Files](#) organized by WV Planning & Development Regions
- [BLRA Data Extract Tables](#): High Building Value, High Damage Loss, High Minus Ratings
- [BLRA Statewide Top Lists](#): Building Value, Flood Depth, Damage Loss \$, Damage Loss %, Minus Rated, Mitigated Structures

- **Landslide Risk Assessments:** Generated landslide incident and susceptibility maps for 55 counties. Referred to as the Total Exposure in Areas of Landslides (TEAL) project. Results are published on both the WV Flood Tool (www.mapwv.gov/Flood) and the WV Landslide Tool (www.mapwv.gov/Landslide). Refer to [Landslide Risk Close-Out Report](#).
- **GIS Data Development:** Created a *structure-level inventory* of all buildings and facilities exposed to multi-hazards. A more detailed inventory was created of at-risk structures in the floodplain. The building inventories include building occupancy and replacement values of every structure in the State. In addition, key reference GIS data layers (community boundaries, leaf-off aerial imagery, parcels, and site addresses) necessary to fulfill the requirements of county and state hazard risk assessments were updated. For communities in West Virginia, a total of 45 distinctive data development projects were completed for improving leaf-off aerial imagery (30 unique counties; 41 total counties), parcels (7 counties), and E-911 addresses (8 communities). The total cost of the data development projects was \$1,406,528, with the FEMA obligated dollars \$542,541 and the remaining county cost share 61% or \$863,987. Refer to [Data Development Close-Out Report](#).

2018-WVDHSEM-PL-01 (ALL). Enhance Planning Process

This Mitigation Action will focus on promoting and enhancing a variety of specific mitigation activities. Specific activities to support this initiative include, but are not limited to:

- 1. Interface with Regional Planning and Development Council's to make recommendations to improve process for next planning cycle.*
- 2. Collaborate with Regional Planning Development Council's and local jurisdictions for standardizations of hazard data and classification for assessment of hazards in local mitigation plans in order to aid in future roll-up in the state hazard mitigation plan (i.e. standard GIS layers).*
- 3. Identify opportunities to coordinate mitigation and CRS planning efforts.*
- 4. Develop better methods and tools to determine effectiveness of strategies.*

Several 2022-23 CTP-funded activities will utilize the building-level flood risk assessment and community flood studies to *engage* communities about floodplain management compliance and flood mitigation planning. Below are examples of community engagement activities funded by the State NFIP Office.

Example Activities for Community Engagement:

- Floodplain Management Compliance and Mitigation. Courtesy check-ups may be performed with the NFIP Office of CRS and non-CRS communities to confirm the mitigation status of Post-FIRM, Minus-Rated structures identified from the statewide flood risk assessment (TEIF project). The checkups can include reviewing mitigation activities by evaluating each community's Post-FIRM construction (permits and EC's), buyout properties, repetitive loss structures, mapped Areas of Mitigation Interest (AoMI), etc. Feedback will be provided in reports to both the floodplain management and planning communities.
- Minus Rated, Post Firm Structures. Validate mitigation status of Post-FIRM, minus-rated structures.
 - [Minus Rated with FIRM Status](#) (20% Post-FIRM, 71% Pre-FIRM, 9% Unknown)
 - [Top Minus-Rated Post-FIRM Structures](#). Structures \geq 3 ft. Water Depth-in-Structure. Table on graphic lists top 20 Post-FIRM structures with water depth values \geq 17 ft.
 - Total Post-FIRM (n=4,223)
 - 3-5 ft. (n=1,111)
 - 10-15 ft. (n=187)
 - \geq 15 ft. (n=46)
- Pre-Disaster Planning. Coordinate with the State NFIP Office on pre-loading building characteristics of inventoried floodplain structures into FEMA's Substantial Damage Estimator (SDE) software. Support State NFIP Office with training and data uploads. For pre-disaster planning, substantial damage ICC and CRS credits, preload at-risk buildings from Statewide Flood Risk Assessment into FEMA's Substantial Damage Estimator (SDE) Tool.
 - Preload Flood Risk Structures into FEMA's Substantial Damage Estimator (SDE) Tool. The entire statewide flood risk inventory of 98,347 1% floodplain structures can be preloaded into FEMA's SDE Tool. Refer to procedural guide on how to upload building inventory data into SDE.
 - [WV SDE Data Import and Instructions](#)
 - Target Audience: Emergency management officials and floodplain managers

2018-WVDHSEM-PL-02 (ALL). Utilization of Benefit-Cost Analysis

This Mitigation Action will focus on promoting and enhancing a variety of specific mitigation activities. Specific activities to support this initiative include, but are not limited to:

- 1. Create guidance on how to document losses due to high frequency, low impact events for use in developing Benefit-Cost Analyses.*
- 2. Geospatially map current Benefit Cost Analysis data sets in order to facilitate geographic assessment of grant applications.*
- 3. Provide BCA information (to policy maker, property owners, etc.) to promote use of mitigation measures.*

A Cost-Benefit Analysis of Converting Approximate A Zones to Detailed AE Zones. Approximate A Zones comprise 69% of the flood zones in West Virginia. To perform a benefit-cost analysis of which A Zones should be targeted for potential restudies as AE Zones, a cluster analysis of model-backed depth grids and the statewide building-level floodplain inventory was conducted. The river/stream results of the analyses were communicated to the State NFIP Office and FEMA Region III. The 2010 Hazus depth grid was used where model-backed depth grids did not exist.

- [A Zone Structure Clusters](#) (5ft depth, 10ft. depth, 15 ft. depth; information forwarded to FEMA for consideration of mapping Approximate A Zones as detailed AE zones.
- More [documentation](#) about Zone A Cluster Analysis using Building-Level Risk Assessments (building exposure values, damage loss estimates) and best-available Flood Depth Grids.

2018-WVUGISTC-PL-03 (ALL). Integration of Climate/Land Use Change into Planning

This Mitigation Action will focus on promoting and enhancing the Community Rating System program. Specific activities to support this initiative include, but are not limited to:

- 1. Target and provide technical assistance to local communities.*
- 2. Develop a CRS application to capture critical information.*
- 3. Provide detailed directions to assist communities with the applicable process.*
- 4. Identify communities which could benefit from CRS participation.*

Below are two 2022-23 CTP-funded Community Outreach and Mitigation Strategies (COMS) for flood and landslide hazards that integrate climate change data models. Refer to [CTP Progress Report](#) and [Greenbrier Study Resources](#) notes for progress on this mitigation action item.

Map Riverine Flood Impacts of Vulnerably Disadvantaged Communities with Higher Stream Flow Change Forecast Models.

- [USACE forecast models](#) predict higher stream flows in the future for central and southern West Virginia. In addition to forecasted higher stream flows, many of the disadvantaged

communities in this region have a moderate to high Social Vulnerability Index. Small, incorporated communities in which large tracts of the community are in the Special Flood Hazard Area are especially vulnerable to climate change riverine flood impacts. Many of the vulnerable communities were established in the early-20th century along narrow river valleys and steep mountainsides during the boom of coal mining and timbering extraction industries. Specifically, this project will map the riverine flood impacts of vulnerably disadvantaged communities facing higher stream flow change forecast models. The targeted five disadvantaged communities (Clendenin, Rainelle, White Sulphur Springs, Camden-on-Gauley, and Richwood) incorporate the new 2016 flood studies recently published by FEMA. All five disadvantaged communities had a negative population growth rate between the 2010 and 2020 censuses. Both 2D and 3D maps will show changes in the floodplain forecast models and substantial damage impact on the built environment, including critical facilities, for the following scenarios: (1) Base Flood, (2) 500-YR Flood, and (3) Climate Change Flood Model. For climate change scenarios, both FEMA flood map BFE plus constant (2' and 3' values) and the [First Street Foundation climate model](#) will be incorporated. This activity will also incorporate the largest flood disaster mitigated reconstruction dataset in the State to date since the devastating April 1977 flood of the Tug Fork Basin in which the [USACE Section 202 Mitigation Program](#) was established in 1981. Primary objectives of this project are to communicate the flood risk facing these disadvantaged communities based on current and future climate changing models, and to evaluate how various flood protection measures (e.g., elevated structures from mitigated reconstruction) implemented recently in these communities will adapt to changing environmental factors due to the impacts of climate change. See Table 1 of Appendix A for a more detailed project description including a [3D Flood Visualization Movie](#) example as a visual means to effectively communicate flood risk information.

Map Landslide Incidents from the New FEMA LiDAR for 38 Counties. Correlate Climate Change (Precipitation) to Higher Landslide Incidents.

- Landslides are identified in the State Hazard Mitigation Plan as the #2 hazard in West Virginia. Climate change models for West Virginia that forecast heavy precipitation events for mountainous terrain with steep slopes will result in a higher incidence of landslides. Where possible, climate change data (precipitation) will be incorporated into predictive landslide mapping/modeling. Specifically, this activity will map landslides from the new FEMA-purchased LiDAR delivered in September 2021 that covers 38 counties. Landslide incidents and the type of landslide are used to generate the statewide landslide susceptibility map. The new LiDAR covers physiographic provinces in West Virginia that are most susceptible to landslide hazards. Mapped landslide incidents are published to the [WV Flood Tool](#) (RiskMAP View) and [WV Landslide Tool](#). Landslide incidents can also be submitted to the USGS Landslide Inventory.

2018-WVDHSEM-TE-01 (ALL). Conduct Public Outreach

This Mitigation Action will focus on promoting and enhancing a variety of specific mitigation activities. Specific activities to support this initiative include, but are not limited to:

- 1. Conduct presentations and outreach programs to homeowner associations, civic organizations, and other groups to recommend mitigations measures;*
- 2. Disseminate information for communities at risk for specific hazards (i.e. communities near coal impoundments);*
- 3. Produce multi-media information related to hazards to increase awareness;*
- 4. Conduct an outreach campaign to engaging in hazard reduction programs (i.e. use of the FIREWISE program to promote measures to reduce wildfire threats);*
- 5. Display information related to historical hazard occurrence to promote awareness (i.e. flood high water marks to increase flood awareness).*

Various outreach materials were created from the TIEF/TEAL HMGP 5% project for public outreach. This information should be included in hazard mitigation outreach efforts.

Landslide Outreach Materials:

- Brochures
 - Community: [Mitigating Landslide Risk through Planning](#)
 - Homeowner: [Recognizing Landslide Risk on Your Property](#)
- Story Maps
 - [Causes of Landslides in Mountain State](#)
 - [WV Landslides and Slide-Prone Areas, WVGES 1976](#)

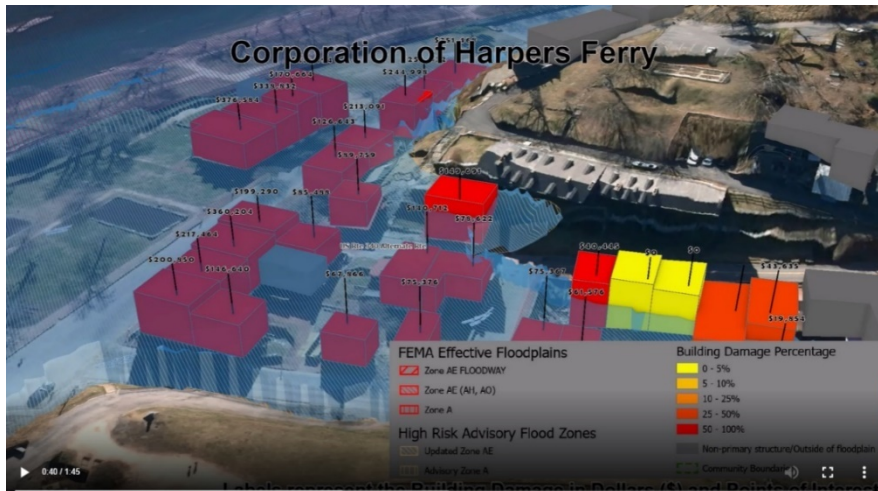
Riverine Flooding Outreach Materials:

- Historical Flooding – Story Maps
 - [Flood Risk in West Virginia: What We Learned from the June 2016 Flood](#)
 - [WV Flooded Towns, June 2016. The Historic Flooding of Southern West Virginia on June 23, 2016](#)
 - [1985 Flood: The Historic WV Flooding of November 4-5 1985](#)

3D Flood Risk Visualizations:

3D visualizations for every individual flood-risk structure and neighborhood scale flood visualizations for select communities.

- SINGLE BUILDING 3D VIEW. 3D static visualizations were created of every flood-risk structure in the 100-year floodplain where a depth grid existed.
- COMMUNITY STRUCTURES 3D VIEW. [3D flood movies](#) for visualizing damage loss estimates were created for five communities in Jefferson County. Sample [Harpers Ferry Flood Risk 3D Visualization Movie](#)



Example screenshot of 3D flood visualization movie

2018-WVDHSEM-TE-02 (ALL). Improve Use of Media

This Mitigation Action will focus on promoting and enhancing a variety of specific mitigation activities. Specific activities to support this initiative include, but are not limited to:

1. *Develop preparedness presentations, videos, fliers, information packets, etc.;*
2. *Develop education programs related to hazards, mitigation, and preparedness for schools;*
3. *Encourage all media to run stories about preparedness and mitigation activities;*
4. *Ensure that preparedness information is available for all media formats;*
5. *Promote the whole community approach for all-hazards.*
6. *Develop an interagency flood risk management team (i.e. Silver Jackets Program).*

See Mitigation Action Number 2018-WVDHSEM-TE-02 Improve Use of Media.

2018-WVDHSEM-GL-02 (ALL). Explore Enhanced Funding Methods

This Mitigation Action will focus on promoting and enhancing a variety of specific mitigation activities. Specific activities to support this initiative include, but are not limited to:

- 1. Identify stable and annual funding source for future regional hazard mitigation plans;*
- 2. Evaluate funding levels available through various grants;*
- 3. Explore alternative sources of funding to address mitigation efforts;*
- 4. Allocate portion of available state funds to address projects that do not meet FEMA eligibility requirements.*

External agencies (NRCS, USACE, National Science Foundation) have provided additional funding and in-kind labor for mitigation activities in the state. Examples are listed below.

- SUPPORT OF OTHER FEDERAL AGENCIES. The flood risk assessment data has successfully supported other risk reduction projects as well in West Virginia.
 - [“Voluntary Floodplain Buyout along Elkhorn Creek/Tug Fork River, McDowell County”](#) report. Work for the Watershed Plan and Environmental Assessment performed by the West Virginia University Land Use and Sustainable Development Law Clinic and the [Natural Resources Conservation Service](#).
 - Provided USACE with project information to develop a collaborative [Silver Jackets](#) proposal in support of the statewide flood risk assessment.
 - A team of West Virginia University researchers received a [CIVIC 2022 Stage 1 Planning Grant](#) to study resiliency of flood-devastated communities in Greenbrier County with support from the National Science Foundation. See preliminary results of [Greenbrier Study](#).