

# A Statewide Approach to Risk Studies

## WVU Multi-Hazard Risk Assessment Proposal



**Floods**



**Dam / Levee Failures**



**Landslides**

Technical Support to Local  
Natural Hazard Mitigation  
Planning for Flood, Landslide,  
and Dam/Levee Failure



**Kurt Donaldson & Eric Hopkins**

WV GIS Technical Center

West Virginia University

27 October 2016

# PROJECT OVERVIEW

- **Risk Assessments for Local Hazard Mitigation Plans (55 Counties)**
  - Riverine 1% Annual Chance Flood
  - Dam/Levee Failure (led by USACE)
  - Landslides
- **Detailed Building Inventories (State-Level Integration)**
  - GIS Parcels – 55 county assessor GIS parcel files standardized and integrated
  - Centralized CAMA/Assessment Records for building characteristics
  - GIS Addresses – WV DHSEM Statewide Addressing & Mapping System
- **Risk Assessments Published on State/Federal GeoPlatforms**
  - State GeoPlatform (WV Flood Tool - [www.mapWV.gov/Flood](http://www.mapWV.gov/Flood))
  - Federal GeoPlatform ([www.geoplatform.gov](http://www.geoplatform.gov))
- **Preliminary Proposal Accepted by State Hazard Mitigation Office**
  - Funding proposed through Hazard Mitigation Grant Program (HMGP)

# PROJECT HISTORY

2014	Project concept initiated by Cynthia McCoy, FEMA Region III
2015	West Virginia selected by FEMA for Building Inventory Tool pilot
2015	The Polis Center at IUPUI Completes Project Workflow for Hazus-MH Model Building Inventory for West Virginia
2016	Flood and Landslide Risk Assessment studies completed for pilot county
2016	Preliminary proposal accepted by State Hazard Mitigation Office for state technical support services to regional and local governments for Local Hazard Mitigation Plans

# Goal 1: Communication and Training Network

Establish a **communication and training network** for exchanging risk assessment information and technical skills among local, state, federal, and other entities.

- **Multi-Agency Coordination**
- **Risk Assessment Lifecycle**

# Risk Assessment Lifecycle

**Start Early - Best Practice!**

Local *Hazard Mitigation Plan* updates should begin a minimum of one year in advance, preferably **two years** before the expiration date

*Diagram courtesy of Cynthia McCoy, FEMA Region X*



# Multi-Agency Coordination

Federal Agencies

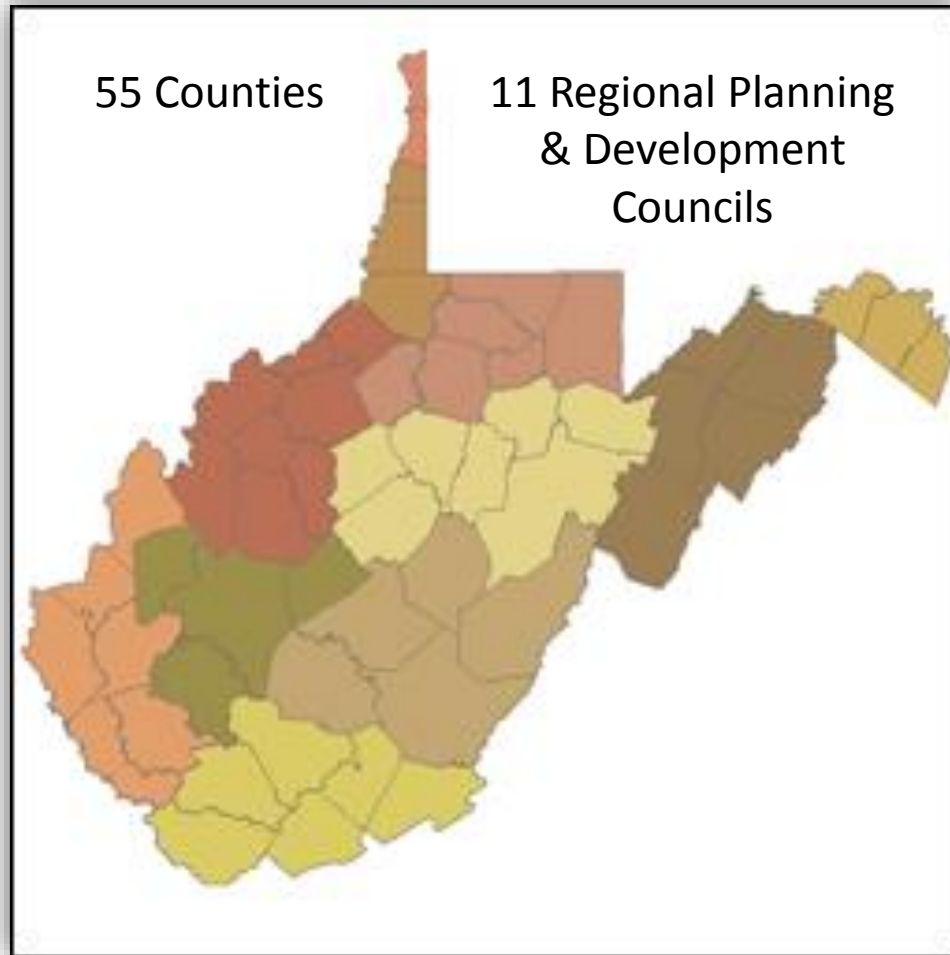
State Agencies

Universities

Regional Councils

Local Counties

Private Companies



FEMA



WV State GIS Data Clearinghouse

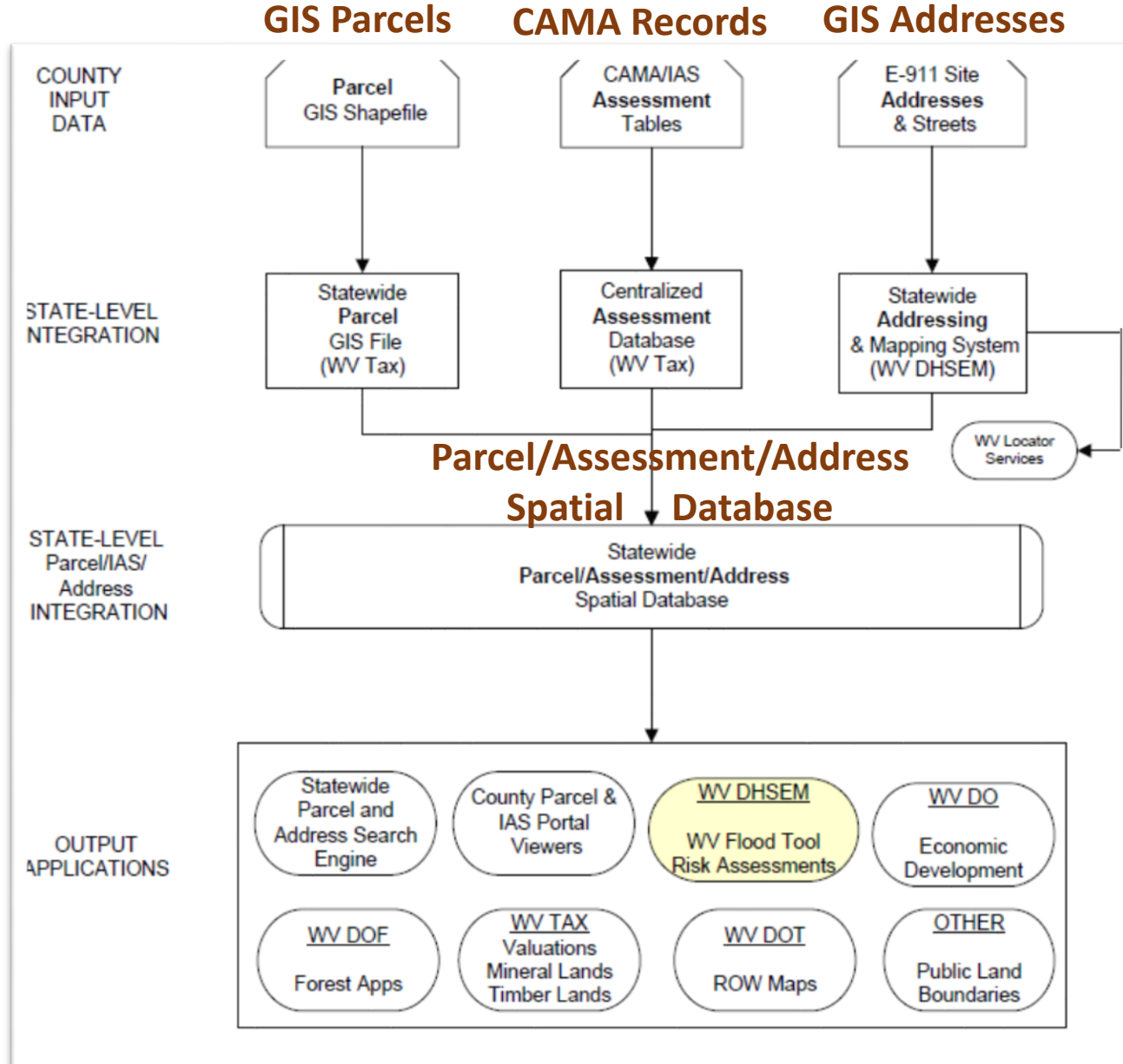


# Goal 2: Exchange Best Available Data

Exchange the **best available risk assessment data** among local, state, and federal GeoPlatforms. Incorporate **historical flood data** into risk assessment studies. Use **online map validation tools** for local communities to validate risk assessment data.

- **Best Available Risk Assessment Data**
- **Historical Flood Data**
- **Online Map Validation Tools**

# Best Available Site-Specific Data



**What is the “sweet spot” for comprehensive information about structures and ownership?**

Answer: Statewide integration of multiple data sources, especially (1) *parcels*, (2) *CAMA assessment records*, and (3) *E-911 addresses*



**WV Flood Tool**  
Remember: When In Doubt, It's Not Out!

Views: Public | Expert | Risk MAP | Flood | Reference | Basemaps

Search: 197 RODEO DR, WV, 25403

Tools: [Icons for search, print, share, etc.]

**Address Search**  
Locator: WV Site Locator  
Standard Input Address: 197 RODEO DR, MARTINSBURG, WV, 25403  
Warning: Verify the building address on the map. If the map location is incorrect, then navigate to the correct location.  
Geographic Coordinate: (-77.991515, 39.484073)

**Integrated Assessment System**  
Click on each tab to view the IAS table.

Assessment	CAMA	Address
STORIES	2	
EXTWALL	07	
STYLE	08	
YRBLT	2010	
RMTOT	8	
FIXBATH	4	
RMBED	1	
RMFAM	4	
FIXHALF	1	
FIXADDL	2	
FIXTOT	16	
REMKIT		
REMBATH		
BSMT	4	

**Flood Hazard Area:** Location is WITHIN the FEMA 100-year floodplain.  
**Flood Zone:** A Stream: DR

**FEMA Map:** 54003C0151E  
Map Effective Date: 7/7/2009  
Contacts: Berkeley  
CRS Information: Berkeley County  
Location (long, lat): (77.991488 W, 39.484148 N)  
Location (UTM 17N): (758, 4274826)  
Elevation: About 1000 feet  
Parcel Information: 37M-13  
Label: 37M-13  
Root ID: 2-04-037M-0013  
District: Null(04)  
Parcel: 0013  
Acres (deed): Null  
Legal: LOT 13 SOUTH SEC PHASE II  
IAS Report

**2016 AERIAL PHOTOS**

**GOOGLE MAP LINK**

**197 Rodeo Drive, Martinsburg, WV**

**GIS ADDRESS**

**GIS PARCEL**

**CAMA BLDG INFO**

**OWNER INFO**

**FEMA MAP LINK**

# Seamless Data Integration

## Local Data Sources

GIS ADDRESS

GEOCODE ADDRESS

GIS PARCEL

CAMA Assessment

AERIAL PHOTOS

## External Map Links

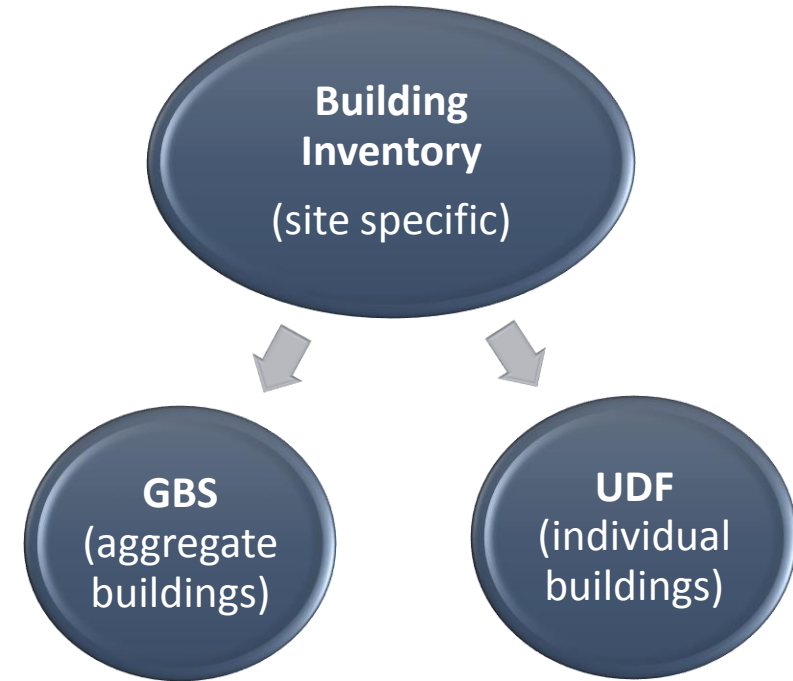
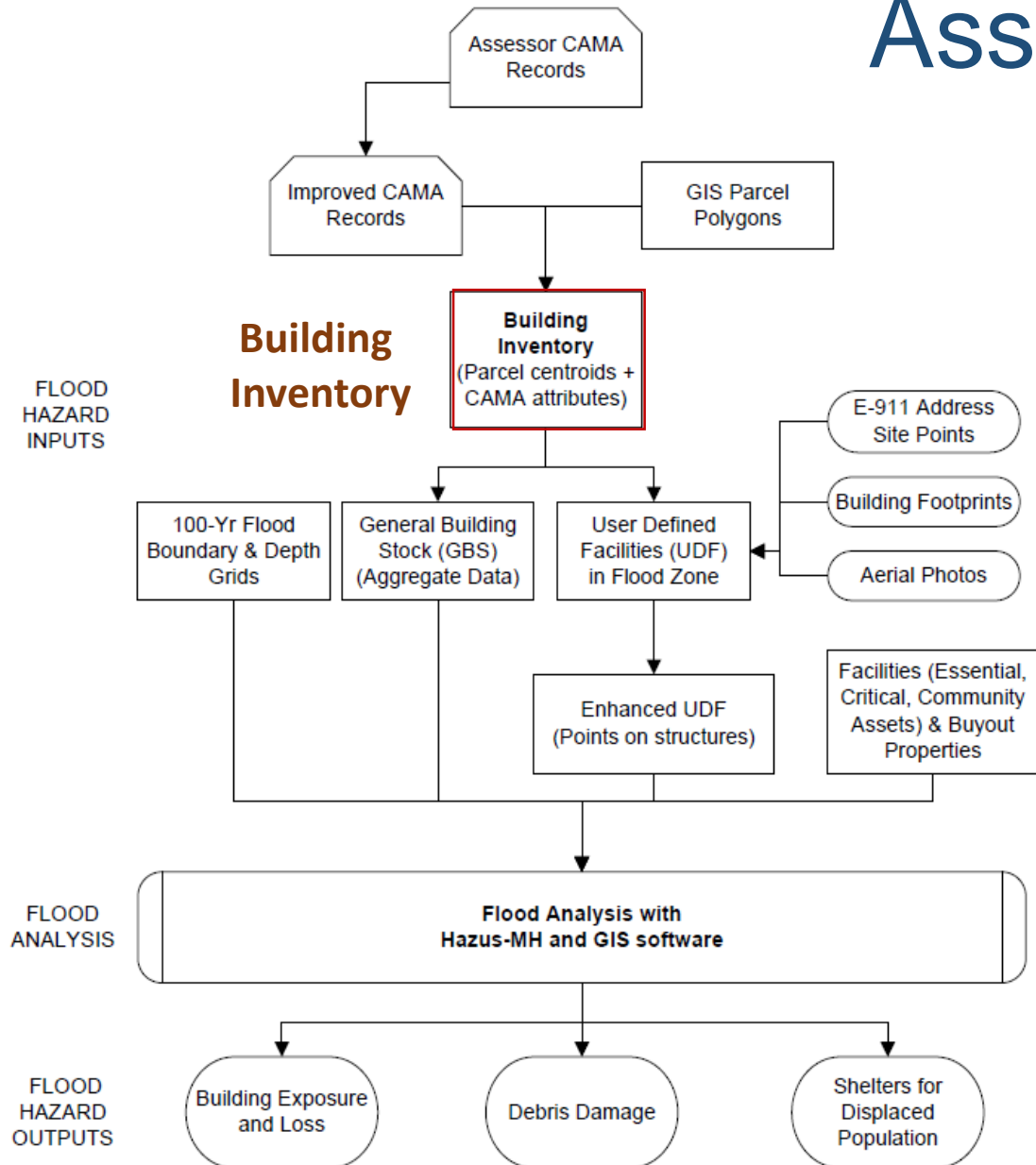
GOOGLE MAP LINK

FEMA MAP LINK

# Goal 3: Statewide Building Inventories

Create a statewide inventory of all **buildings and facilities exposed** (with replacement costs) in flood hazard, dam/levee failure, and landslide susceptibility zones.

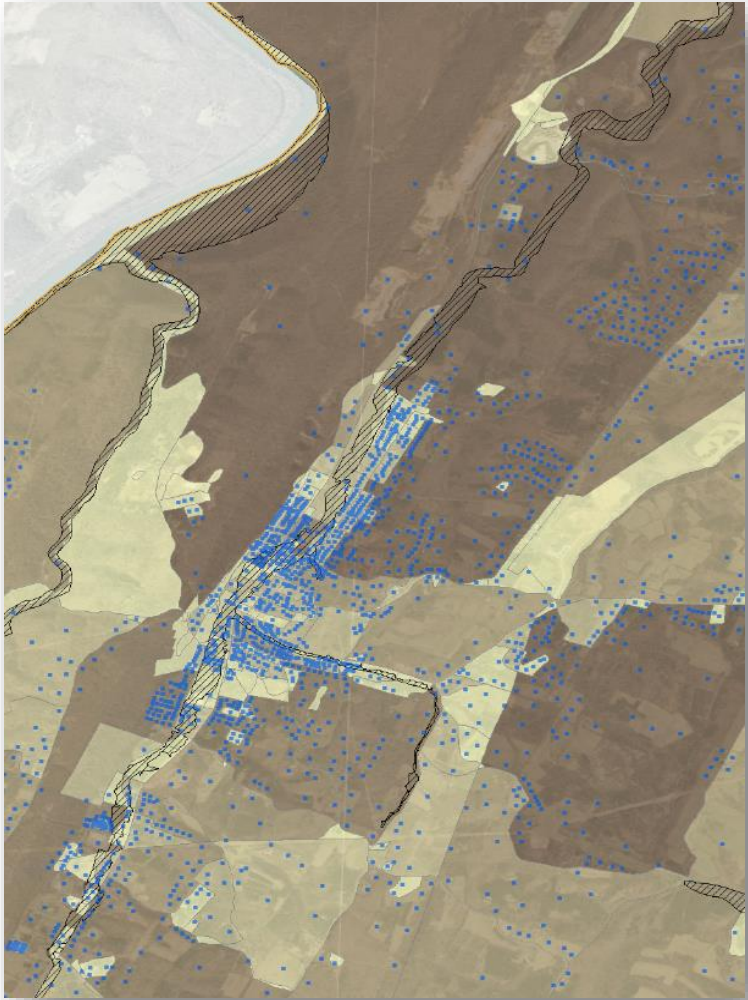
# Work Flow for Building Inventory & Flood Risk Assessments



Hazus GBS and UDF Inventory Data. The **General Building Stock** (aggregate buildings) and **User Defined Facilities** (individual buildings) are derived from the Building Inventory.

# Building Inventory Exposure (\$) for Multi-Hazards

Occupancy Classification	Building Count	Total Building Exposure (\$)	Percent of Total
Berkeley County (including all jurisdictions)			
Residential	35,667	\$7,232,609,000	83.9%
Commercial	3,418	\$1,231,879,000	14.3%
Industrial	94	\$143,923,000	1.7%
Agricultural	31	\$7,338,000	0.1%
Religious	6	\$4,614,000	0.1%
Government	1	\$249,000	0.0%
Education	2	\$4,847,000	0.1%
<b>TOTAL</b>	<b>39,219</b>	<b>\$8,625,459,000</b>	<b>100%</b>
Martinsburg			
Residential	5,644	\$1,167,904,000	83.9%
Commercial	496	\$199,408,000	14.3%
Industrial	19	\$22,158,000	1.6%
Agricultural	0	\$0	0.0%
Religious	3	\$2,307,000	0.2%
Government	0	\$0	0.0%
Education	0	\$0	0.0%
<b>TOTAL</b>	<b>6,162</b>	<b>\$1,391,777,000</b>	<b>100.0%</b>



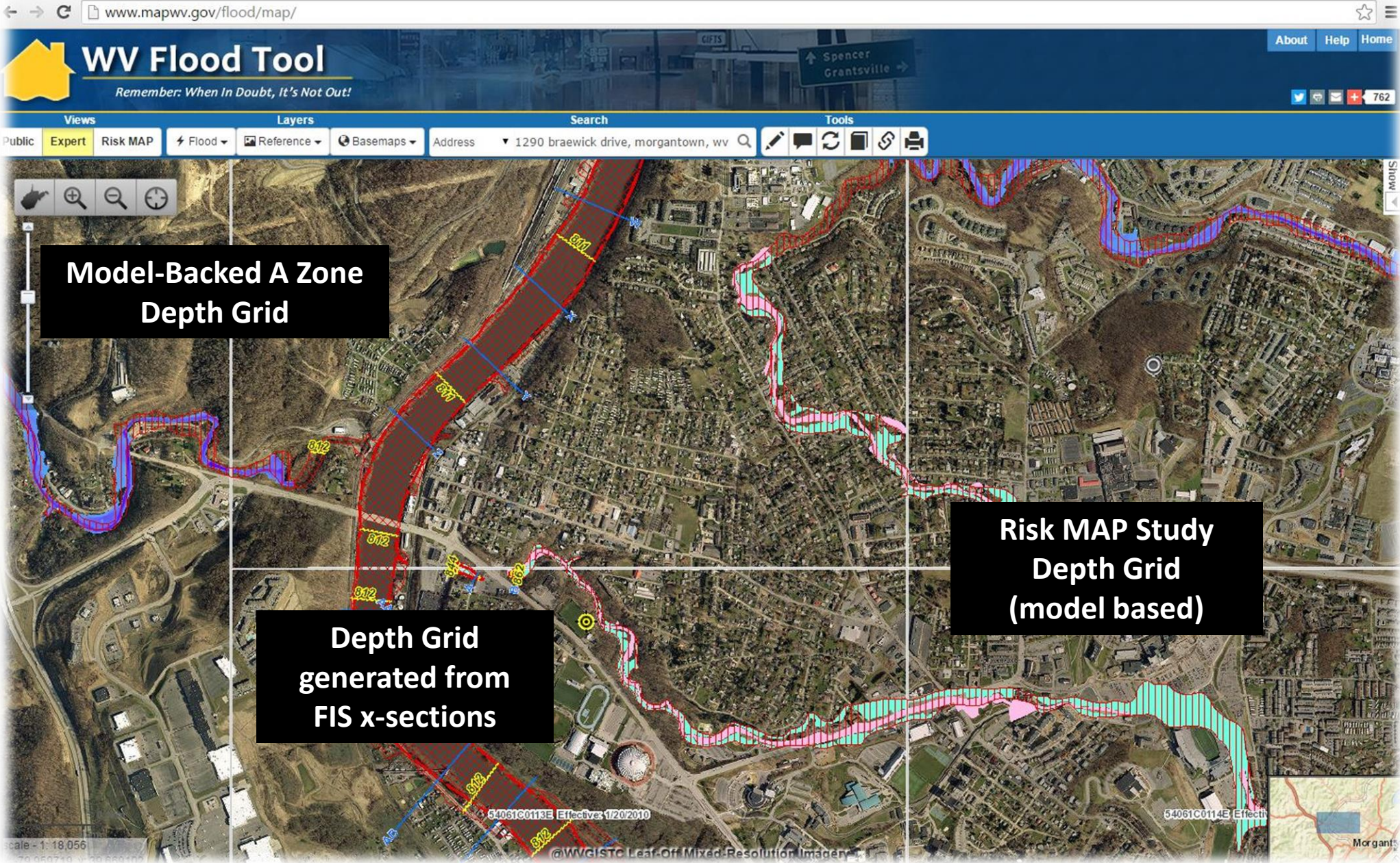
# Goal 4: Statewide Depth Grid

Depth grids are important for (1) water depth visualization in the WV Flood Tool and for (2) estimating building damage costs using Hazus-MH flood loss software. *Its is preferred to use more accurate depth grids from various sources than a generalized depth grid from the Hazus **Enhanced Quick Look** tool.*

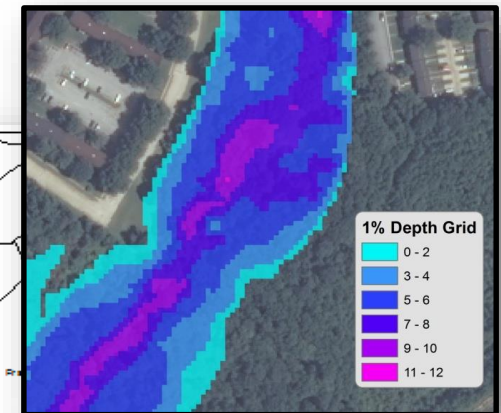
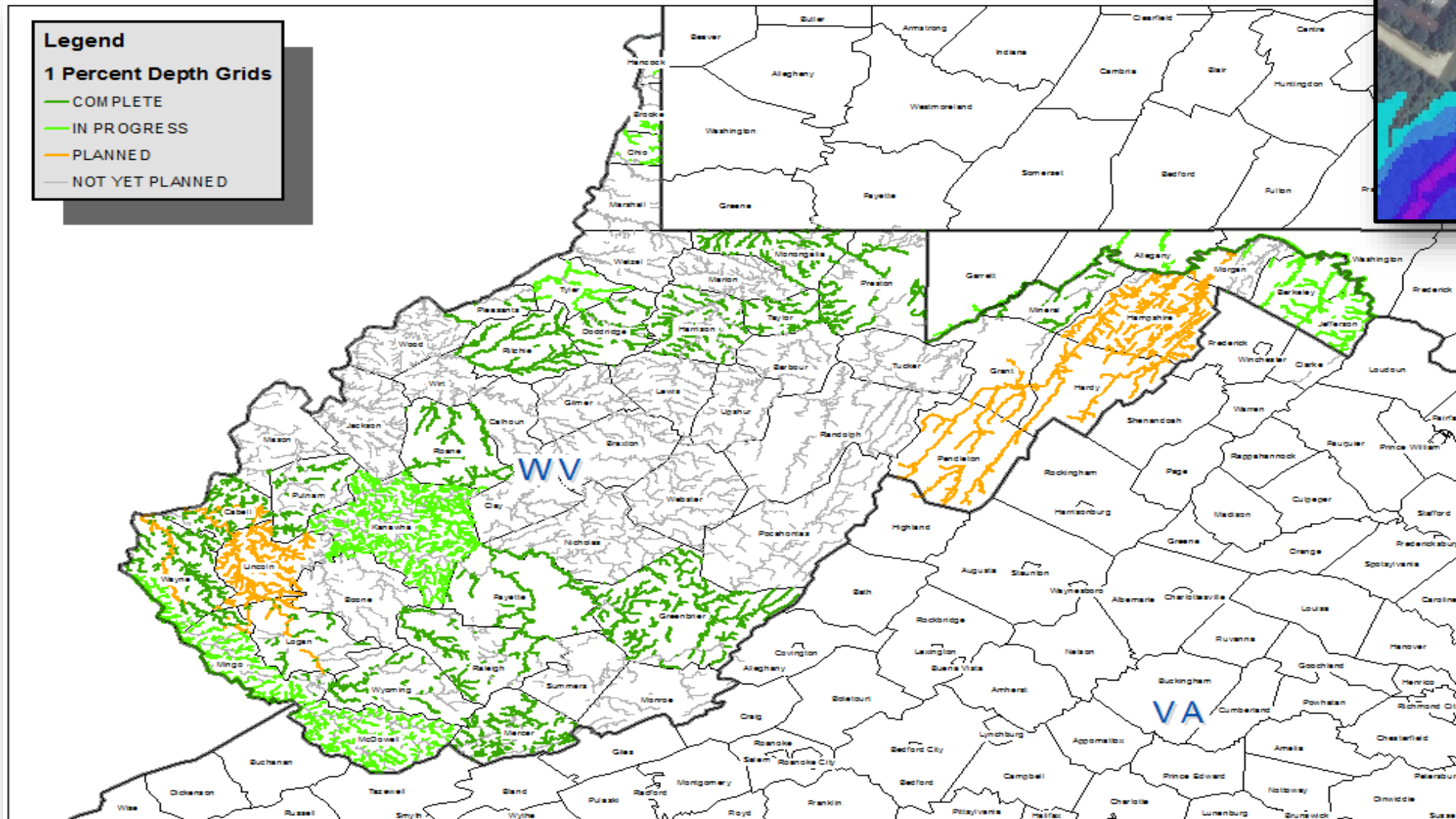
## ▪ Depth Grid Sources

- **Risk MAP Studies** (HEC-RAS hydraulic models)
- **Model-Backed Zone A Studies** (HEC-RAS hydraulic models)
- **FIS X-Sections to Water Elevation Conversion** (no models)
  - Water surface elevations derived from x-sections of detailed flood studies

# Depth Grid Sources



# Tracking Flood Risk Products in GIS - Depth Grids – 1% Annual Chance



## Did you know?

*A million dollars has been dedicated for Model-Backed A Zone Depth Grids in West Virginia*

*Courtesy of Lee Brancheau, FEMA Region III*

# Goal 5: County-Level Risk Assessments

Perform **county-level risk assessments** for 55 counties using site-site specific building inventories.

- **Riverine Floods (1% Annual Chance)**
- **Dam/Levee Failure**
- **Landslides**





*Devastating*  
**2016 June Flood**



Table 8: Berkeley County Riverine Floodplain (1% Flood) Related Losses

Classification	Number of Buildings Damaged	Total Building Loss (\$)	Total Building Exposure in Jurisdiction	Loss Ratio
Berkeley County (including all jurisdictions)				
Residential	400	20,439,548	7,233,756,128	0.28%
Commercial	599	82,092,330	1,232,221,195	6.66%
Industrial	1	70,570	143,949,150	0.05%
Agricultural	2	396,336	7,354,680	5.39%
Religious	0	0	4,615,104	0.00%
Government	0	0	249,979	0.00%
Education	0	0	4,847,398	0.00%
<b>TOTAL</b>	<b>1,002</b>	<b>\$102,998,784</b>	<b>\$8,625,459,000</b>	
Martinsburg				
Residential	24	549,236	\$1,167,904,000	0.05%
Commercial	12	608,985	\$199,490,922	0.31%
Industrial	1	301,260	\$22,164,947	1.36%
Agricultural	0	0	\$0	0.00%
Religious	0	0	\$2,307,552	0.00%
Government	0	0	\$0	0.00%
Education	0	0	\$0	0.00%
<b>TOTAL</b>	<b>37</b>	<b>\$1,459,481</b>	<b>\$1,391,867,421</b>	

# Building Damage Loss Estimates \$\$\$

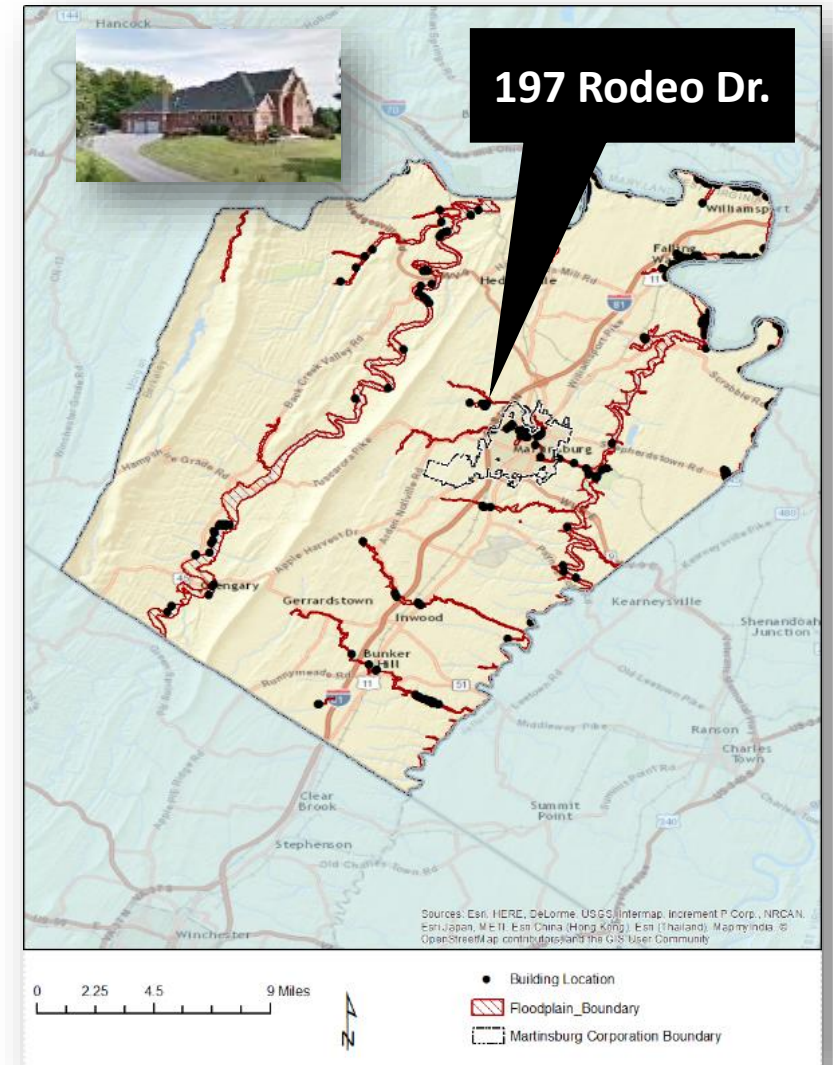


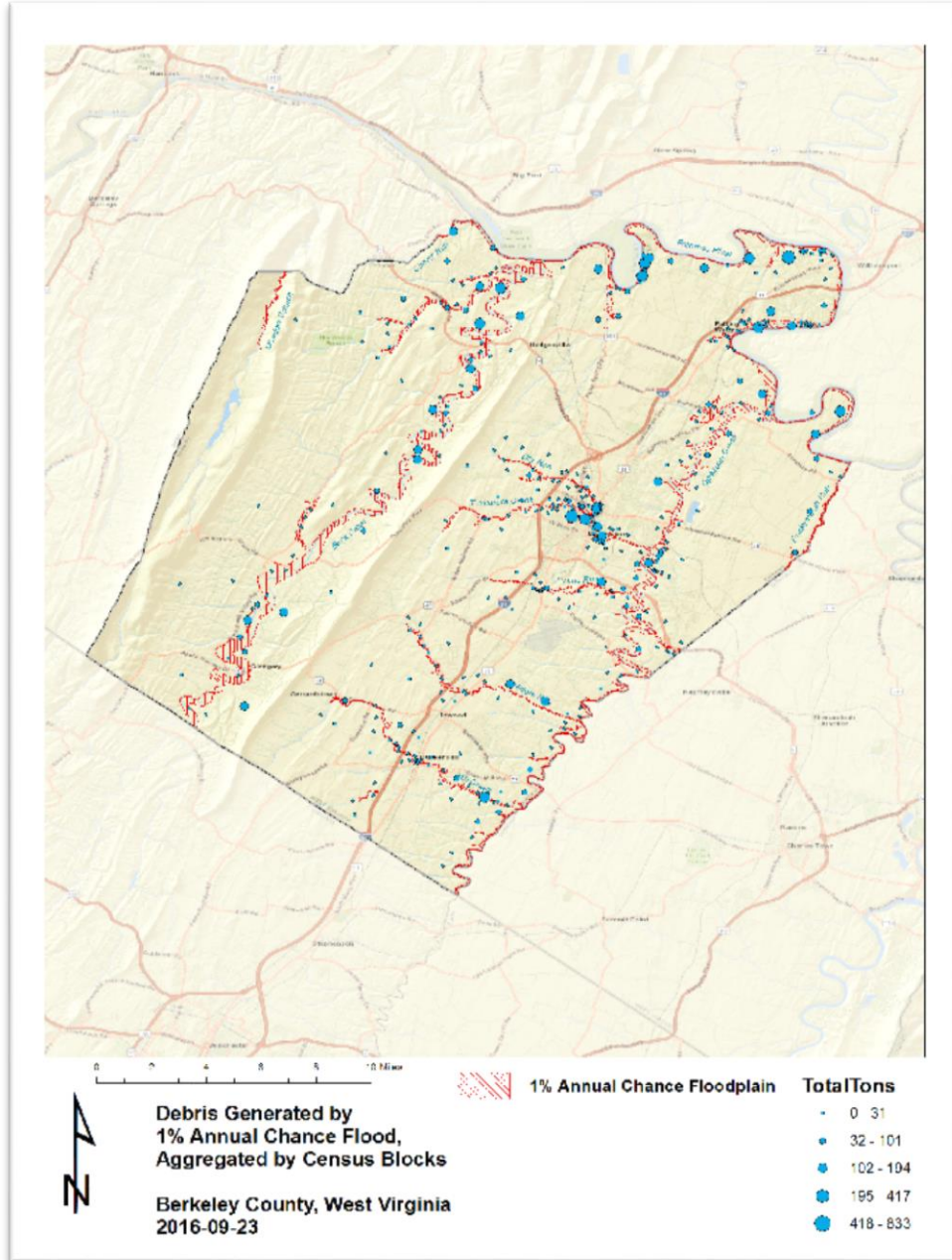
Table 9: High Potential Loss Structures

#	E-911 Street Address	City	Parcel ID	Building Type	Building Loss <sup>1</sup>
Building 1	Exchange PL	Martinsburg	06 10036700000000	Commercial	\$430,813
Building 2	442 Slim LN	Falling Waters	02 11005800000000	Commercial	\$346,365
Building 3	309 Temple DR	Falling Waters	02 3G009400000000	Commercial	\$329,622
Building 4	WR Caskey Dr	Martinsburg	08 80013000000000	Residential	\$281,839
Building 5	197 Rodeo Dr	Martinsburg	04 37M0013000000000	Residential	\$261,354

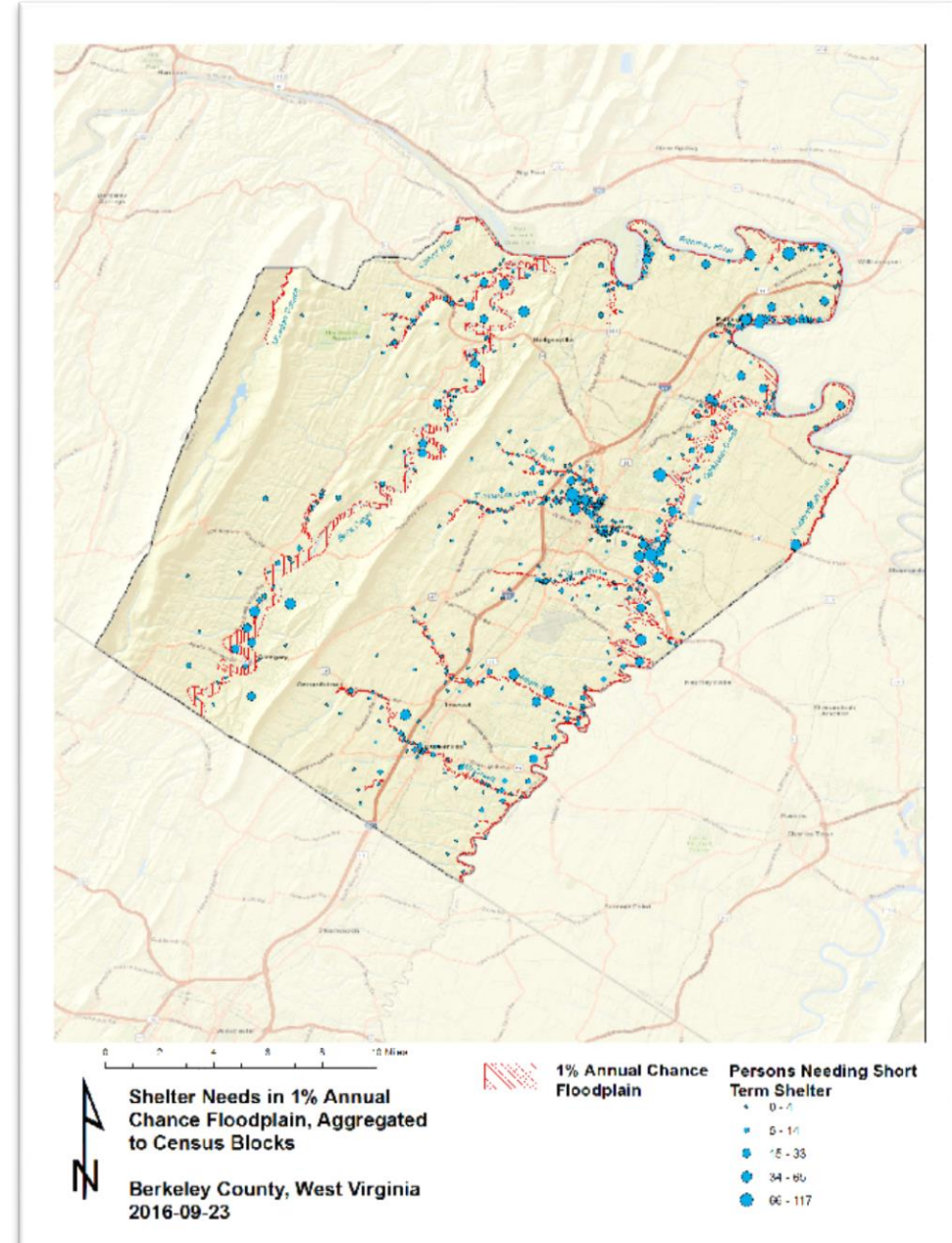
<sup>1</sup> Building Content Loss often exceeds Building Loss.

**197 Rodeo Dr.**

# Debris Generated



# Shelters Needed



# Dam/Levee Failure Risk Assessment

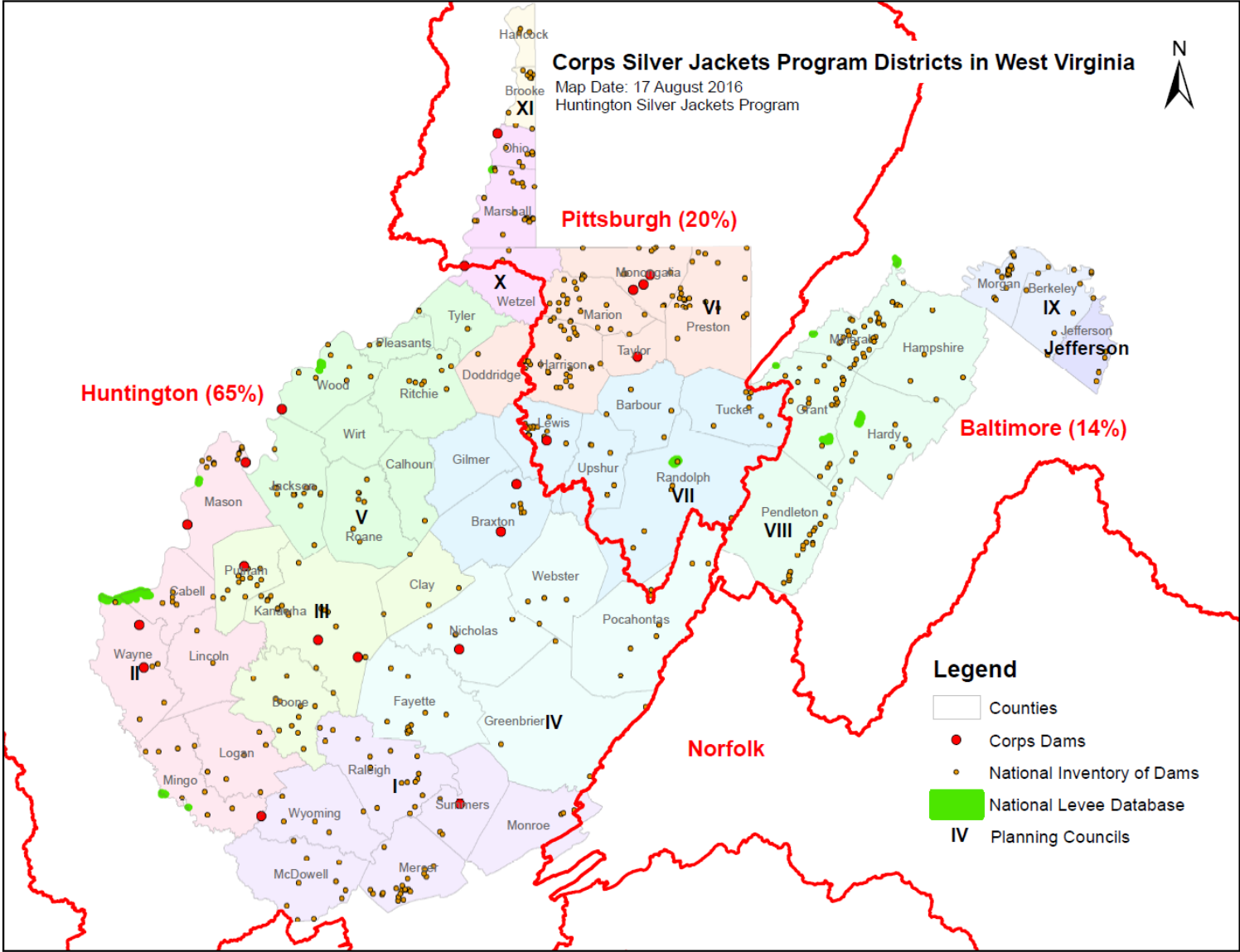
## Goals

- Prioritize dam inspections in accordance with risk and those that do not have an EAP digitized
- Integrate Dam and Levee safety action class (class 1 - 5) for every USACE dam and levee into HIRA and THIRA.
- Produce documentaries about/on aging dam structures around endangered communities (Develop a list of potential dams on which to focus).
- Create a task force to address levee safety in West Virginia (Coordination between NRCS and USACE on levee safety issues).



In recent years, it was discovered that **Bluestone Dam** would be unable to pass the Probable Maximum Flood possible at the site, which could cause failure of the dam. To remedy the problem, the U.S. Army Corps of Engineers has undertaken a Dam Safety Assurance program for Bluestone.

# Dam/Levee Failure – USACE Technical Lead



**Joe Trimboli MSc CFM**  
U.S. Army Corps of Engineers  
Silver Jackets WV Liaison  
<http://wvsj.us/>



# Landslide Risk Assessment

## Goals

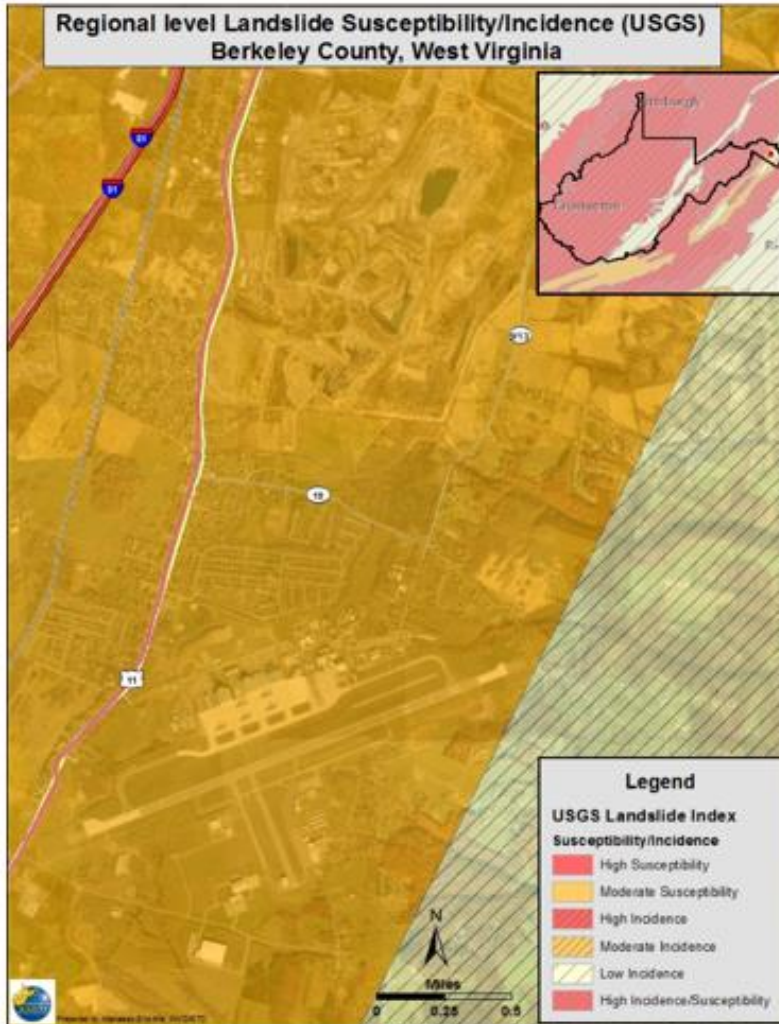
- Develop a landslide inventory
- Create valid landslide models for specific WV regions
- Generate county-level resolution landslide maps
- Create an interactive web map application for displaying landslide models and landslide variables
- Use the new landslide models and information to update the State Hazard Mitigation Plan

### *Did you know?*

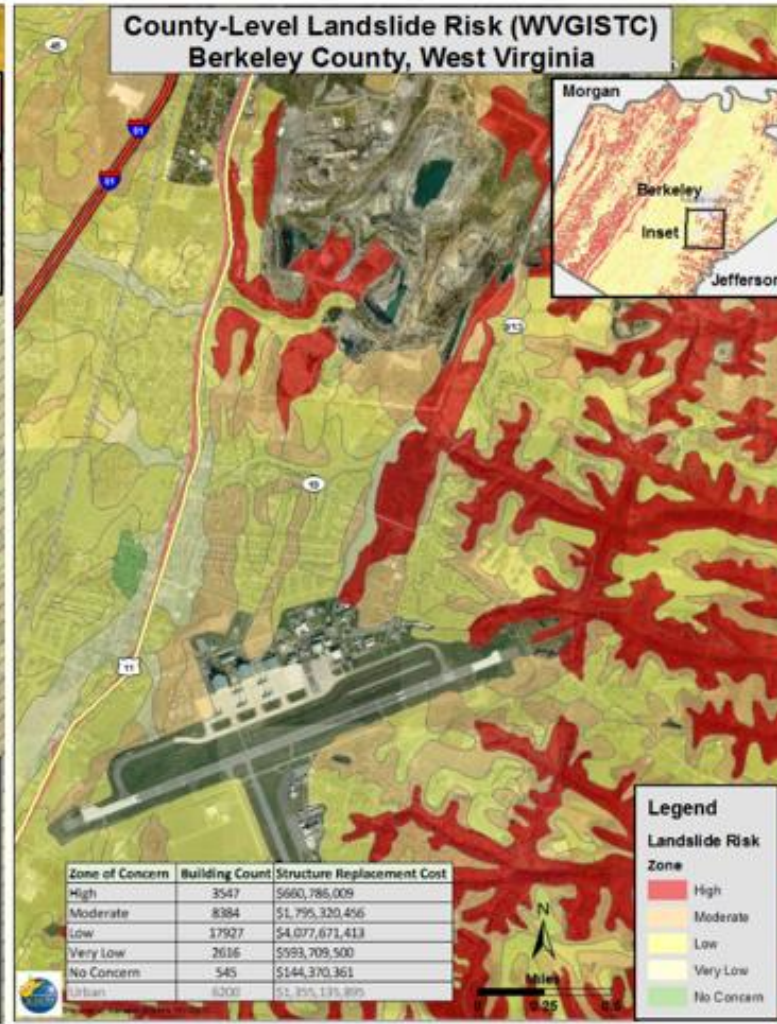
Landslides are the **#2 Hazard** in West Virginia



## REGIONAL LANDSLIDE MAP (USGS)



## COUNTY LANDSLIDE MAP (WVGISTC)



# Landslide Risks

## Buildings Exposed to Landslide Risks

Zone of Concern	Building Count	Structure Replacement Cost
High	3547	\$660,786,009
Moderate	8384	\$1,795,320,456
Low	17927	\$4,077,671,413
Very Low	2616	\$593,709,500
No Concern	545	\$144,370,361
*Urban (No relevant attributes)	6200	\$1,355,135,895

*Risk Assessment table showing building counts along with estimated replacement costs in landslide zones of concern*

*Landslide susceptibility map showing generalized USGS map and detailed WVGISTC map*

# Goal 6: Identify Data Gaps

Review and identify **data gaps** for key GIS data layers for risk assessment studies (parcels, addresses, imagery, elevation, flood layers, critical infrastructure, etc.).

Provide recommendations to the appropriate organizations to improve data management and governance.



# Data Gap Analysis

Table C-1: Data Gap Analysis for Region 9 PDC Counties

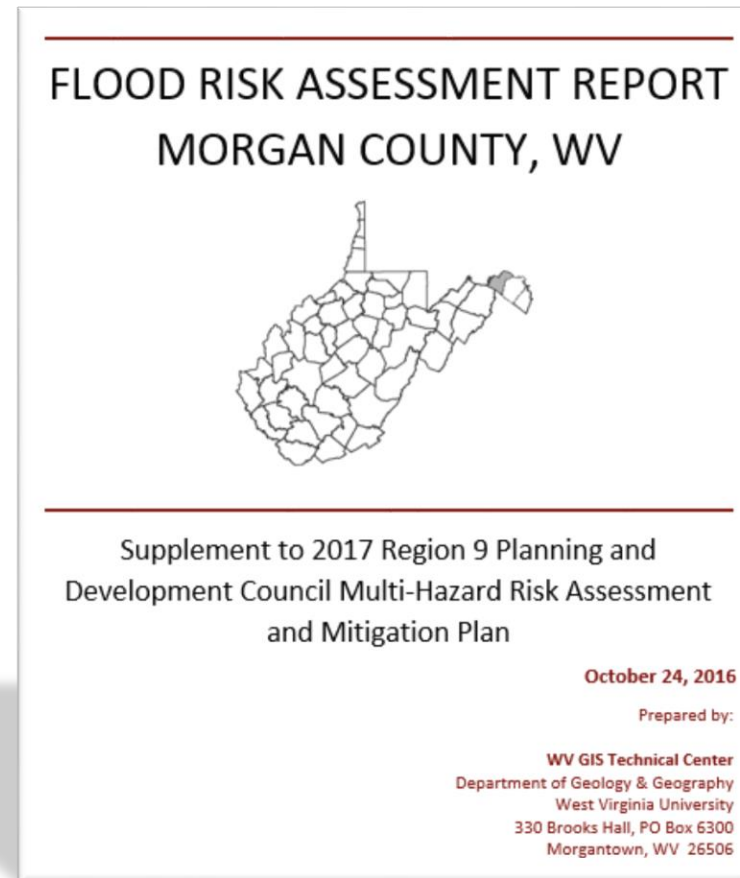
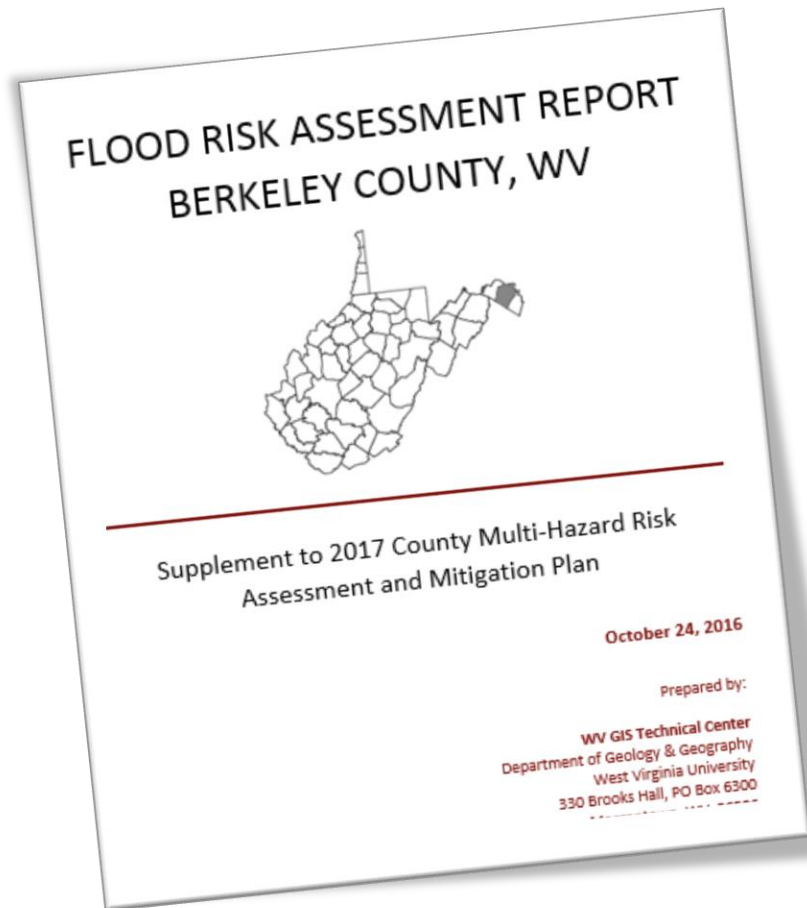
DATA LAYERS	Berkeley County	Morgan County	Jefferson County
<i>IAS/CAMA Tables</i>	2014	2015	2015
<i>Tax Parcels</i>	2015	2016	2016
<i>E-911</i>	2013	2015 (FAIL)	2016
<i>Building Footprints</i>	2008	None	2015
<i>Aerial Imagery</i>	2016	2010 (POOR)	2016
<i>Water Depth Grid</i>	No Advisory Flood Heights	No Advisory Flood Heights	Advisory Flood Heights available
<i>Elevation</i>	No complete Lidar coverage	No complete Lidar coverage	Complete Lidar Coverage
<i>Critical Infrastructure</i>	Incomplete	Incomplete	Incomplete



Data Gap Analysis for Region 9 Counties located in the Eastern Panhandle of West Virginia

# Goal 7: Publish Risk Assessment Reports

Publish supplemental **risk assessment reports** for local and state hazard mitigation plans.



# Goal 8: Publish Model Data

Publish **input and output model data** associated with risk assessments on state and federal GeoPlatforms.

- **FEMA and USACE GeoPlatforms**



- **State GeoPlatforms**

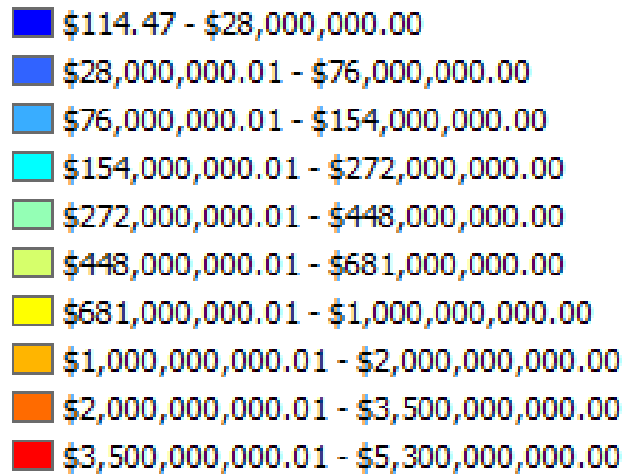
- ✓ WV Flood Tool
- ✓ State Data Clearinghouse



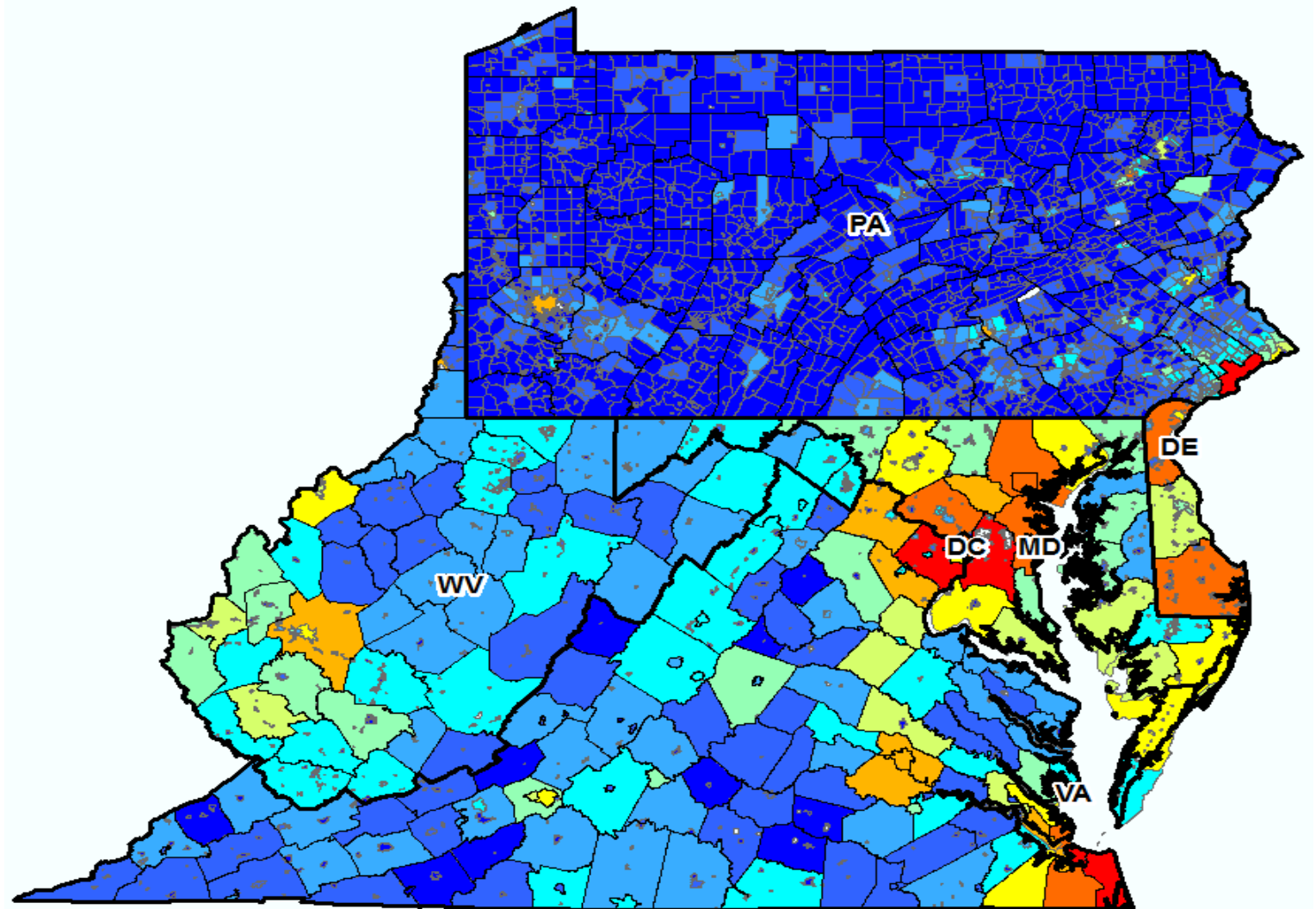
# FEMA's Total Exposure in Floodplain (TEIF)

<http://bit.ly/1r1vRBg>

TEIF 1.0 -- Flood Loss Estimates -- Community Level



More detailed flood risk assessments from local mitigation plans can be vertically integrated to state and federal GeoPlatforms.



*Courtesy of Lee Brancheau, FEMA Region III*

# Goal 9: RiskMAP View of WV Flood tool

Upload **2D/3D flood risk and dam failure maps** to the **RiskMAP View of the WV Flood Tool** ([www.mapWV.gov/Flood](http://www.mapWV.gov/Flood)).

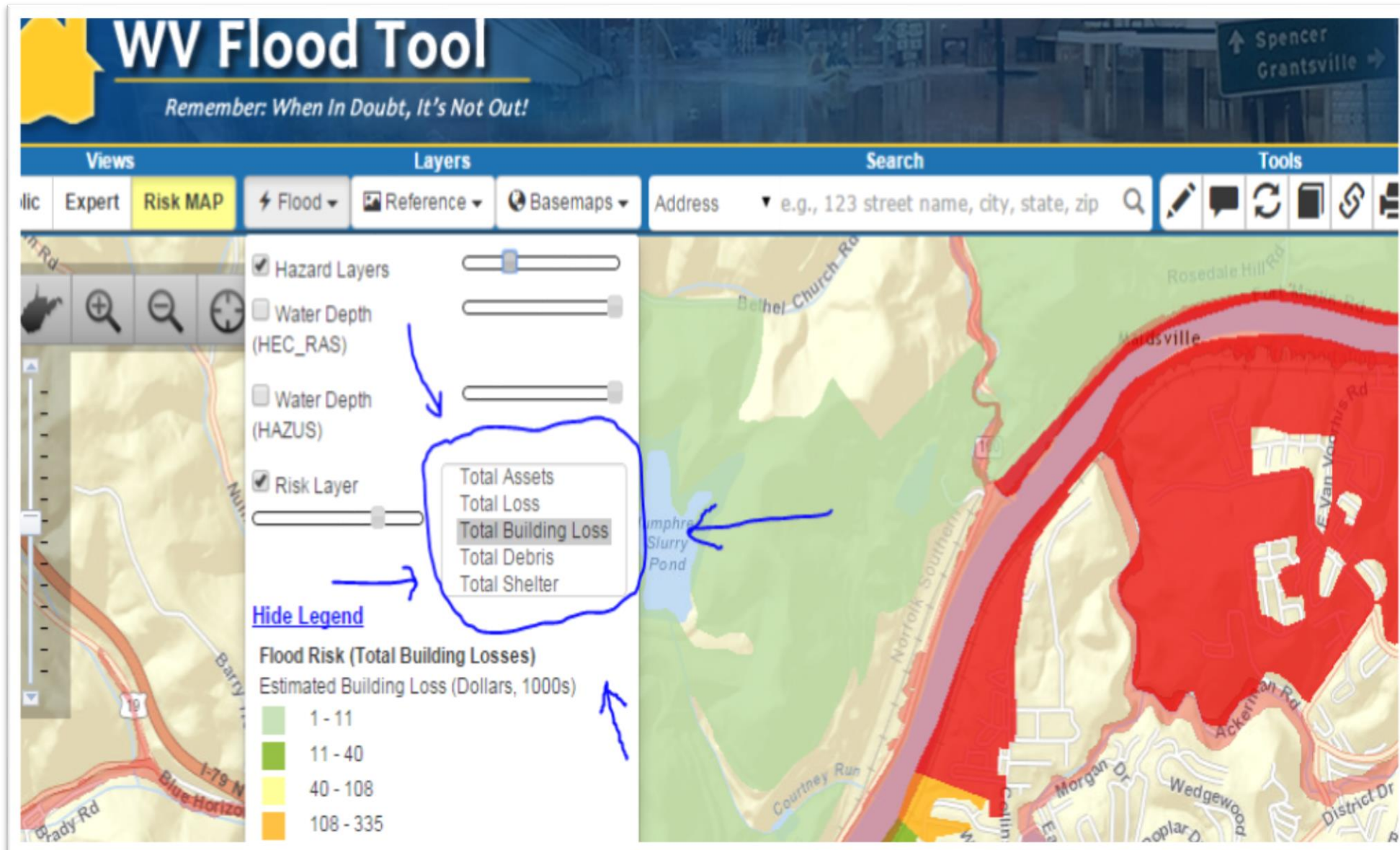
Provide a **web planning tool** to estimate physical building damage, debris removal, and temporary shelter needs.

This flood risk assessment information permits communities or individual property owners to decide how to **allocate resources** for the most effective and efficient response and recovery, and to **prioritize mitigation measures** to reduce future loss.

# RiskMAP View: Hazus Level 2 Data

- Total Assets Exposed
- Building Damage
- Debris Removal
- Shelters Needed

Update RiskMAP View with more detailed **Hazus Level 2 “User Modified”** Data for *Building Damage Estimates, Debris Removal, and Shelter Needs*



# 3D Flood Visualization – Individual Structures

One-Story Home

Two-Story Duplex

High Rise Apartment

**WATER  
DEPTH**

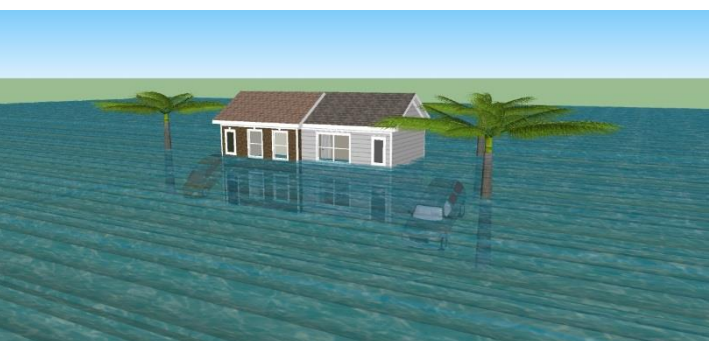
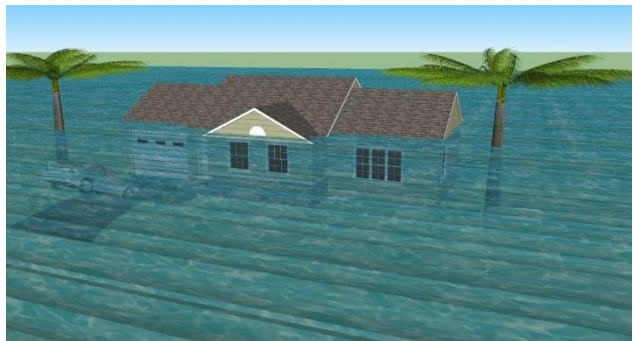
0 Feet



4 Feet

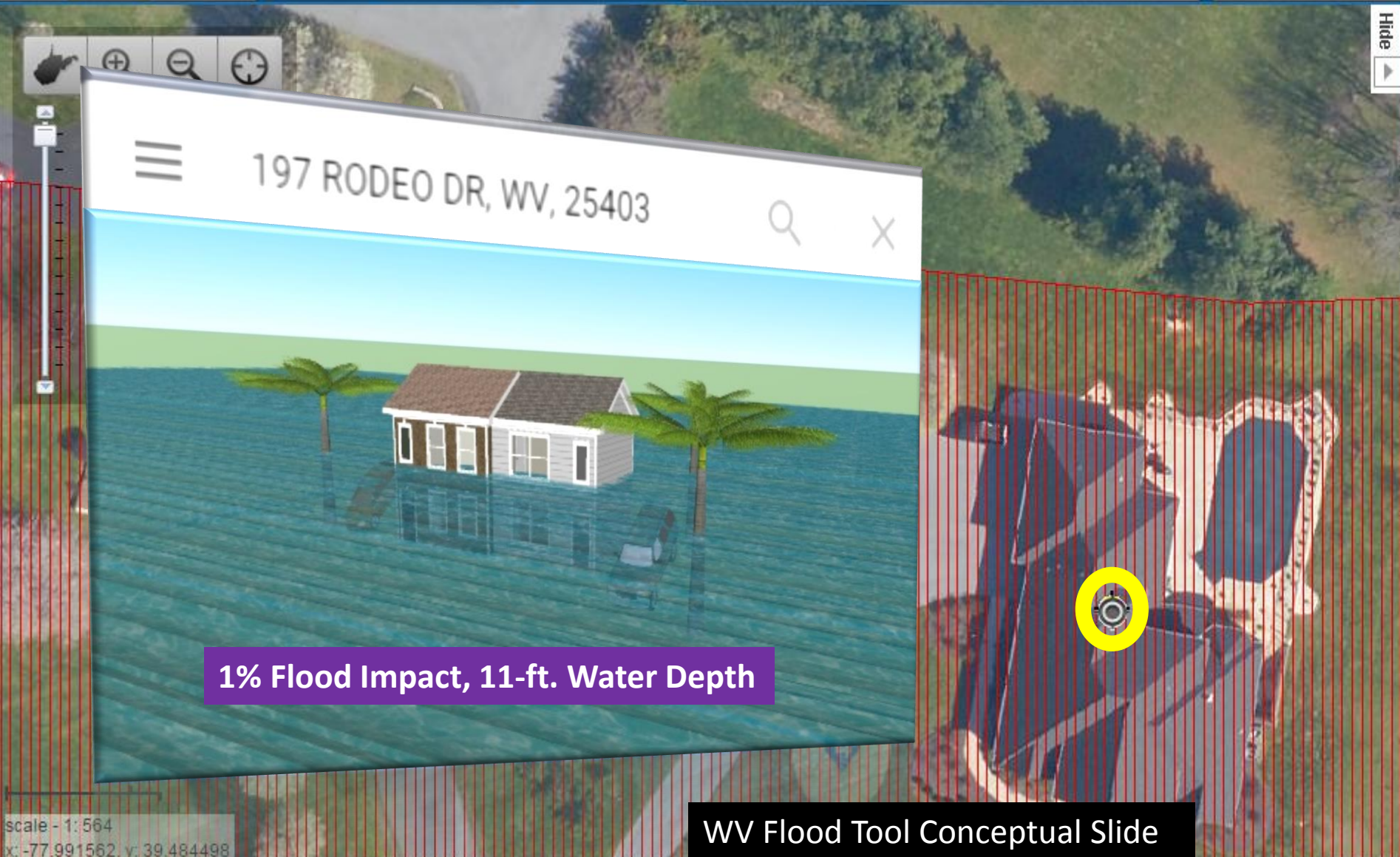


12 Feet



Remember: When In Doubt, It's Not Out!

Views: Public | Expert | **Risk MAP** | Layers: Flood | Reference | Basemaps | Search: 197 Rodeo Dr, WV 25403 | Tools: [Icons]



**Flood Hazard Area:** Location is **WITHIN** the FEMA 100-year floodplain.

**Flood Zone:** A Stream: DRY RUN Tributary

**Watershed (HUC8):** Conococheague-Opequon (2070004)

**FEMA Issued Flood Map:** 54003C0151E [Link] [Download]

**Map Effective Date:** 7/7/2009

**Contacts:** Berkeley

**Advisory Flood Height:** N/A [Disclaimer]

**Water Depth:** N/A

**HEC-RAS Model:** N/A

**Flood Profile:**

**CRS Information:** Berkeley County

**Location (long, lat):** (77.991515 W, 39.484076 N)

**Location (UTM 17N):** (758749, 4374818)

**Elevation:** About 518 ft

**Parcel Information:** 37M-13 [Disclaimer]

**Label:** 37M-13

**Root ID:** 2-04-037M-0013-0000

**District:** Null(04) **Map:** 037M

**Parcel:** 0013 **Suffix:** 0000

WV Flood Tool Conceptual Slide

**3D Flood Visualization of Structure at 197 Rodeo Drive**



## Parcel/Address Identity Info

County ID	2 (Berkeley)
<b>Parcel ID</b>	<b>04037M001300000000</b>
Street Address	<b>197 Rodeo Drive</b>
City	<b>Martinsburg</b>
Zip Code	<b>25403</b>
Deed or GIS Acreage	2.3 Acres
Legal Description	LOT 13 SOUTH SEC PHASE II
Property Owner(s)	XXXXXXXXXXXXXXXXXXXX

## CAMA Assessment Data

Land Appraisal	55,100
Building Appraisal	321,700
Total Appraisal	376,800

## CAMA Building Data

Tax Year	2015
Tax Card	1
Tax Class	2
Land Use Code	101
STORIES	2
Exterior Wall – <i>Construction Type</i>	7
Style	8
Year Built	2010
Total Rooms	8
AREASUM	3,981
GRADE – <i>Building Condition</i>	A-
Basement – <i>Foundation Type &amp; First Floor Height</i>	4
DWELVAL	398,400
OBVVAL	8,450
COMVAL	0

## Exposure/ Replacement Cost (BI)

ReplCost	506,940
ContCost	603,075
BldgArea	3,981
hzOccCode	Res1
NumStories	2
YearBuilt	2010
BldgConstruction	Brick
BldgCondition	High
BldgFoundation	Basement
FirstFloorHt	4

## Damage Estimates (UDF)

BldgDmgPct	51.6
BldgLossUSD	261,354
ContDmgPct	47.9
ContLossUSD	121,326

A unique **parcel identifier** links assessment/building data, replacement costs, and damage loss estimates for each structure

# 3D Flood Visualization – Neighborhood

The screenshot displays the WV Flood Tool interface. At the top, the logo features a yellow house icon and the text "WV Flood Tool" with the slogan "Remember: When In Doubt, It's Not Out!". Navigation links for "About", "Help", and "Home" are in the top right. Below the header, a menu bar includes "Views" (Public, Expert, Risk MAP), "Layers" (Flood, Reference, Basemaps), a "Search" bar with the address "197 Rodeo Dr, WV 25403", and "Tools" (edit, comment, refresh, print, share). The main area shows an aerial map with flood zones and a 3D view window titled "Baltimore Street, Martinsburg, WV" showing red buildings and yellow flood areas. A yellow dashed line on the map indicates the 3D view's perspective. A scale bar at the bottom left shows "scale - 1:4,514" and coordinates. A small inset map at the bottom right shows the location within Martinsburg, WV.

**WV Flood Tool**  
*Remember: When In Doubt, It's Not Out!*

Views: Public, Expert, Risk MAP  
Layers: Flood, Reference, Basemaps  
Search: Address 197 Rodeo Dr, WV 25403  
Tools: [Icons for edit, comment, refresh, print, share]

**3D Northwest View**

Baltimore Street, Martinsburg, WV

scale - 1:4,514  
x: -77.967507, y: 39.464872

WV Flood Tool Conceptual Slide

# Resources: WV Flood Risk Reports

<b>October 2016</b>	<b>Flood Risk Assessment Supplement to 2017 Region 9 Planning and Development Council Hazard Mitigation Plans – WV GIS Technical Center</b>  <b>Berkeley County, WV</b> <a href="ftp://ftp.wvgis.wvu.edu/pub/temp/FEMA/FRA/Berkeley_FloodRiskRpt_20161026.pdf">ftp://ftp.wvgis.wvu.edu/pub/temp/FEMA/FRA/Berkeley_FloodRiskRpt_20161026.pdf</a>  <b>Morgan county, WV</b> <a href="ftp://ftp.wvgis.wvu.edu/pub/temp/FEMA/FRA/Morgan_FloodRiskRpt_20161026.pdf">ftp://ftp.wvgis.wvu.edu/pub/temp/FEMA/FRA/Morgan_FloodRiskRpt_20161026.pdf</a>
-------------------------	---

# Resources: Previous NCR HUG Calls

Dec. 2013	<b>Total Exposure in Floodplain (TEIF) 2.0 – Glenn Locke, Tetra Tech</b> <a href="http://www.usehazus.com/uploads/forum/December192013_NationalCapitolRegionHUG_Presentaiton_FINAL.pdf">http://www.usehazus.com/uploads/forum/December192013_NationalCapitolRegionHUG_Presentaiton_FINAL.pdf</a> <a href="http://www.usehazus.com/ncrhug">http://www.usehazus.com/ncrhug</a>
March 2015	<b>Cook County HMP Risk Assessment – Carol Bauman, Tetra Tech</b> <a href="http://www.usehazus.com/uploads/forum/March262015_NationalCapitolRegionHUG_Presentaiton.pdf">http://www.usehazus.com/uploads/forum/March262015_NationalCapitolRegionHUG_Presentaiton.pdf</a>
Feb. 2016	<b>Multi-Hazard Risk Assessment Lifecycle Cradle-to-Cradle - Rethinking the Way We Use Risk Assessments – Cynthia McCoy, FEMA Region X</b> <a href="http://www.usehazus.com/uploads/forum/February252016_NationalCapitolRegionHUG_Presentaiton2.pdf">http://www.usehazus.com/uploads/forum/February252016_NationalCapitolRegionHUG_Presentaiton2.pdf</a>
March 2016	<b>Data Creation Geared to the World as We Know it! – Steve Kocsis, Cambria County, PA GIS Center; Visualization of the Month – 3D Flood Impact</b> <a href="http://www.usehazus.com/uploads/forum/March312016_NationalCapitolRegionHUG_Presentaiton.pdf">http://www.usehazus.com/uploads/forum/March312016_NationalCapitolRegionHUG_Presentaiton.pdf</a>

# FUTURE DIRECTIONS

- **Officially Start Project in 2017**
- **Refine Building Inventory Tool**
  - Better integration of parcels/assessment records with E-911 addresses
  - Review CAMA default values/null values/assumptions
    - Null values for certain building characteristics of commercial and industrial properties
    - Tax-Exempt Properties
  - Upgrade to current Hazus-MH software version
- **Upgrade RiskMAP View of WV Flood Tool**
  - Add Hazus Level 2 Data (building loss estimates, debris removal, shelter needs)
  - At-Risk Structures in Flood Zones
    - Display parcel/assessment/address and building loss info for individual structures
    - Create 3D flood visualizations of at-risk structures
  - Incorporate flood/levee inundation maps
- **Coordinate with Technical Partners**
  - Statewide Depth Grid, Dam/Levee Assessments, Landslide Model Validation, etc.

# SPECIAL THANKS



Special thanks for support from

**FEMA**

**WV Division of Homeland Security and Emergency Management**

**The Polis Center at Indiana University–Purdue University Indianapolis**



# CONTACT INFORMATION

**Kurt Donaldson**

GIS Manager

WV GIS Technical Center

West Virginia University

[kdonalds@wvu.edu](mailto:kdonalds@wvu.edu)

**Eric Hopkins**

GIS Specialist

WV GIS Technical Center

West Virginia University

[Eric.Hopkins@mail.wvu.edu](mailto:Eric.Hopkins@mail.wvu.edu)