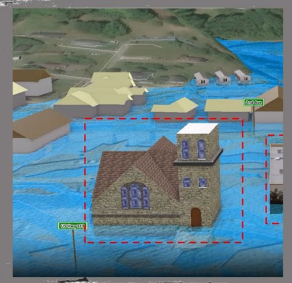
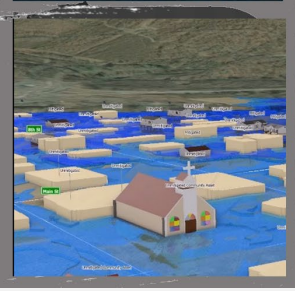




USING 3D GIS VISUALIZATION

for

Flood Risk Planning and Communication

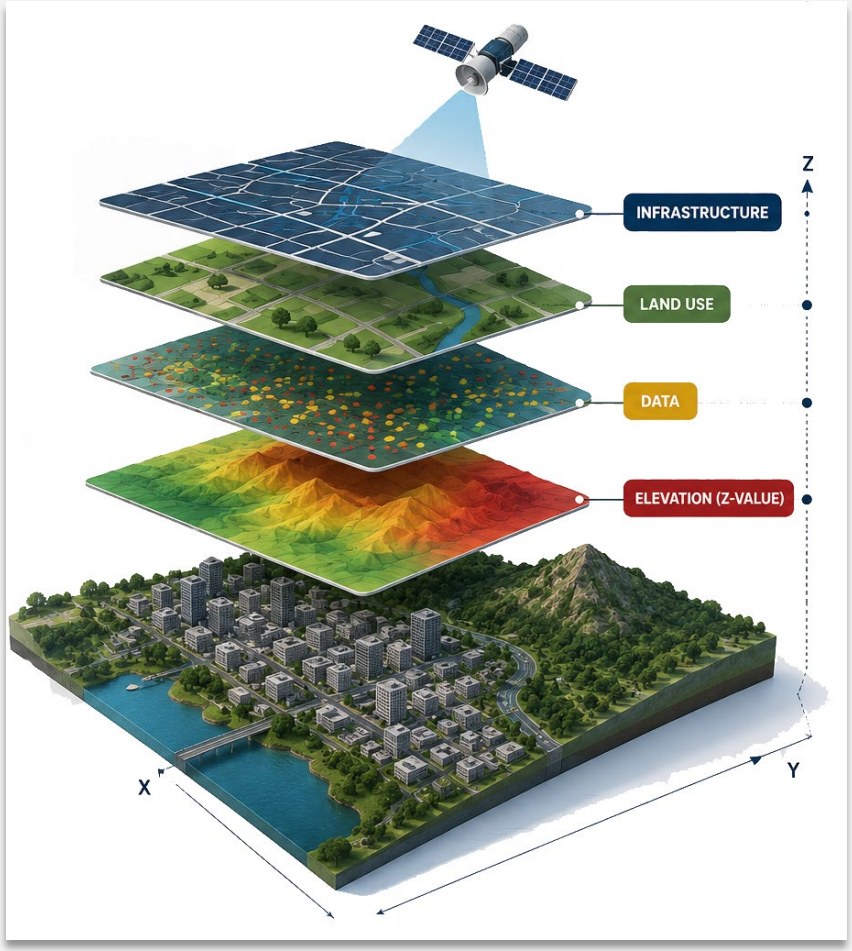
Annie Mahmoudi

WV GIS TECHNICAL CENTER

MAP AROUND AND FIND OUT
WEST VIRGINIA GEOCON 2026

What Is 3D GIS

Three-dimensional GIS data incorporates an additional dimension, known as the z-value, into its spatial definition (x, y, z). Unlike traditional two-dimensional GIS data, which only represents horizontal location (x, y), 3D GIS data includes elevation or height information through the z-value (ESRI, 2021).



- Create realistic visualizations that improve spatial analysis and interpretation
- Improves collaboration and communication with non-GIS users
- Improve decision-making by providing greater spatial insights and a more comprehensive understanding of geographic environments

HOW DOES IT WORK

From GIS Data to 3D insights

1. Using ArcScene
2. Finding the Exact Location
3. Creating the Footprint
4. Giving them Height/Z (Extruding)
5. Using Rule Packages
6. Creating Different Urban Elements
7. Exporting the Scene
8. Making Different Frames
9. Exporting the Animation

USING 3D GIS IN NATURAL DISASTER STUDY

Before Disaster

- *Generating Different Scenarios for the Probable Disasters*
- *Showing the Under Risk Areas (Buildings & Infrastructures)*
- *Planning for Safe Places and Evacuation Networks*

After Disaster

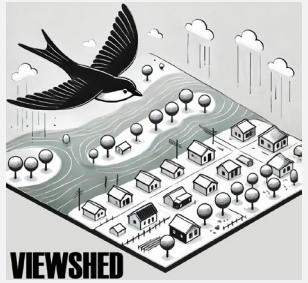
- *Planning for New Construction*
- *Designing Based on Real Data Landform & Topography*

ROLE OF 3D GIS IN FLOOD SCENARIOS

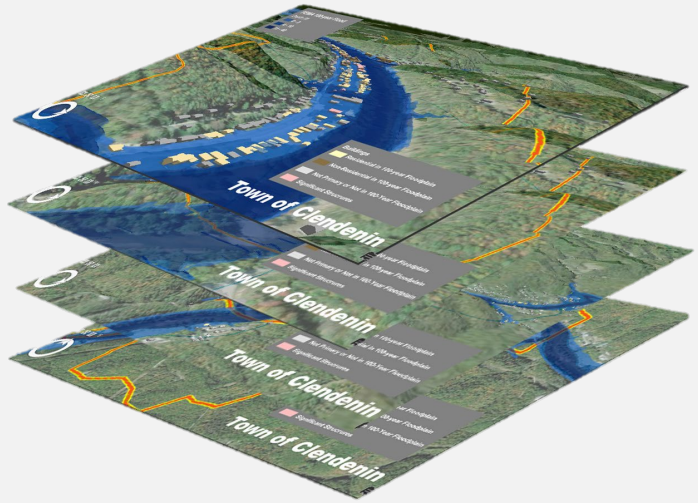
- Presenting the Areas Located in High-Risk Flood Zones
- Making Water Depths by Extruding the Flood Data Polygons
- Accurately Showing the Inundated Areas and the Depth of Inundation
- Camera is Placed at Different Angles to Show the Extension of Flooding (Like a Video Captured by a Drone During Flooding)

DEVELOPING FLOOD SCENARIOS by WV GISTC

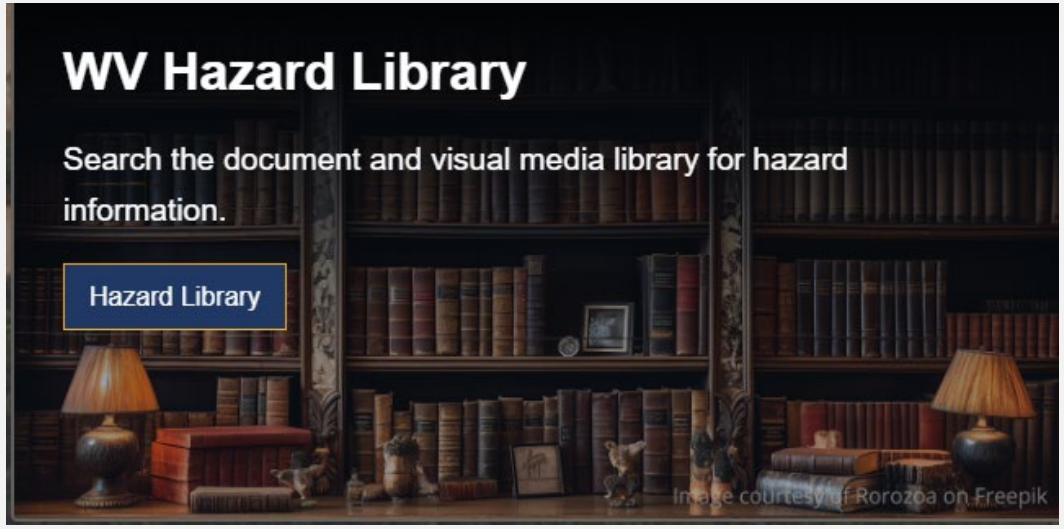
VIEWSHEDS

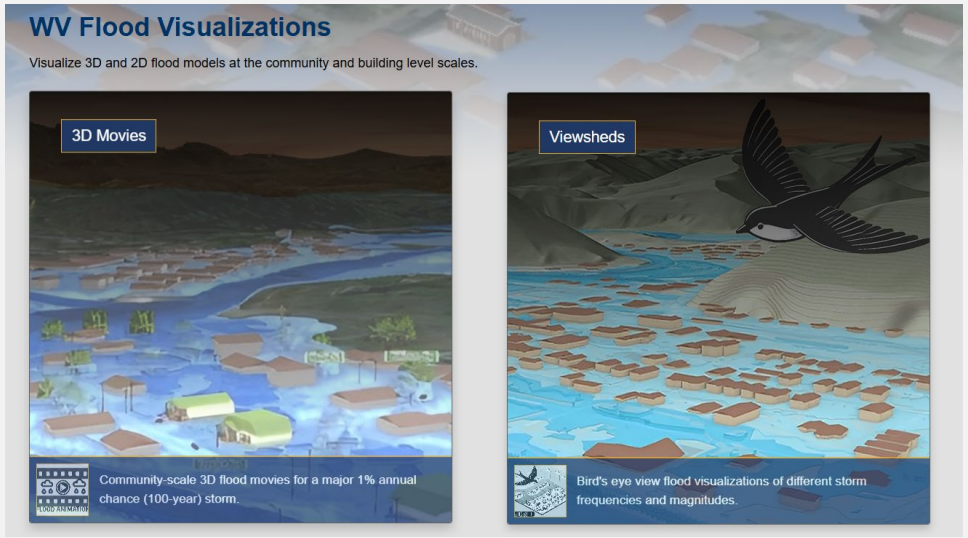


Showing Different Flood Intervals (10-year, 25-year, 50-year, 100-year, and 500-year) in a Community. The Inundated Areas are calculated, and the flooded areas are presented.

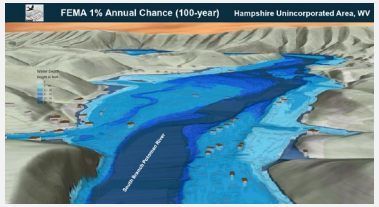


Accessible Through WV Hazard Library & WV Risk Explorer.

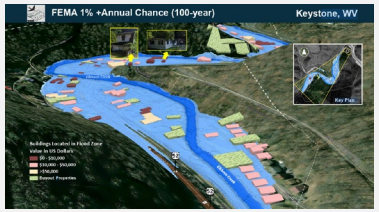




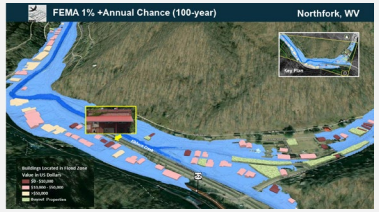
VIEWSHED



Hampshire Unincorporated Area

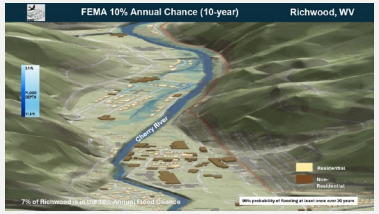


Keystone, McDowell County



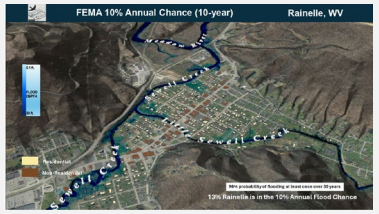
Northfork, McDowell County

Island Creek, Logan County

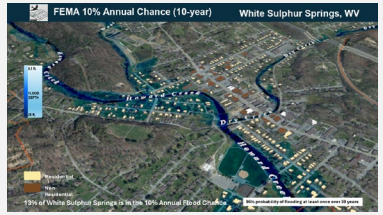


Richwood, Nicholas County

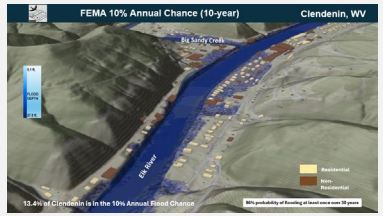
Camden on Gauley, Webster County



Rainelle, Greenbrier County



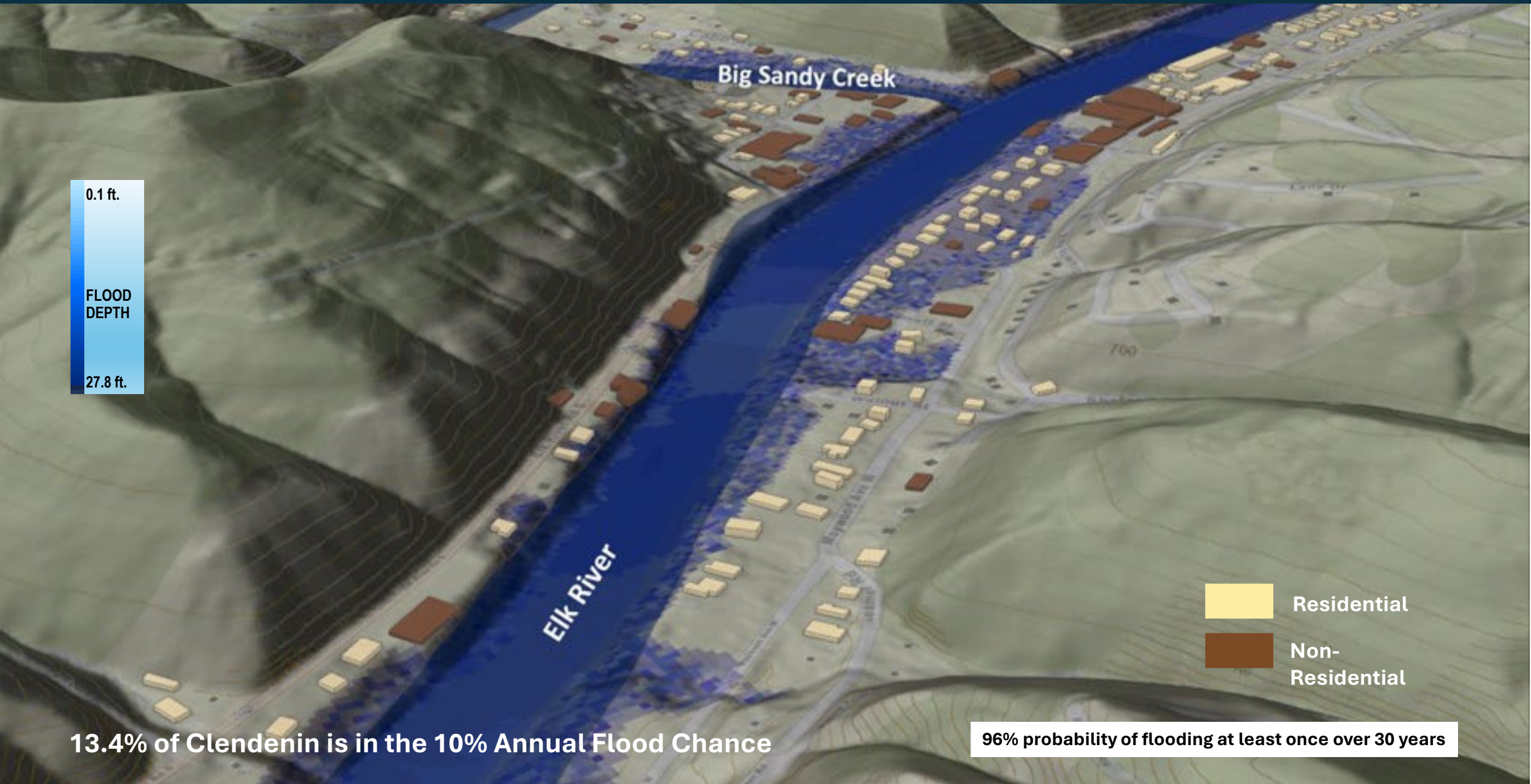
White Sulphur Springs, Greenbrier County



Clendenin, Kanawha County

FEMA 10% Annual Chance (10-year)

Clendenin, WV

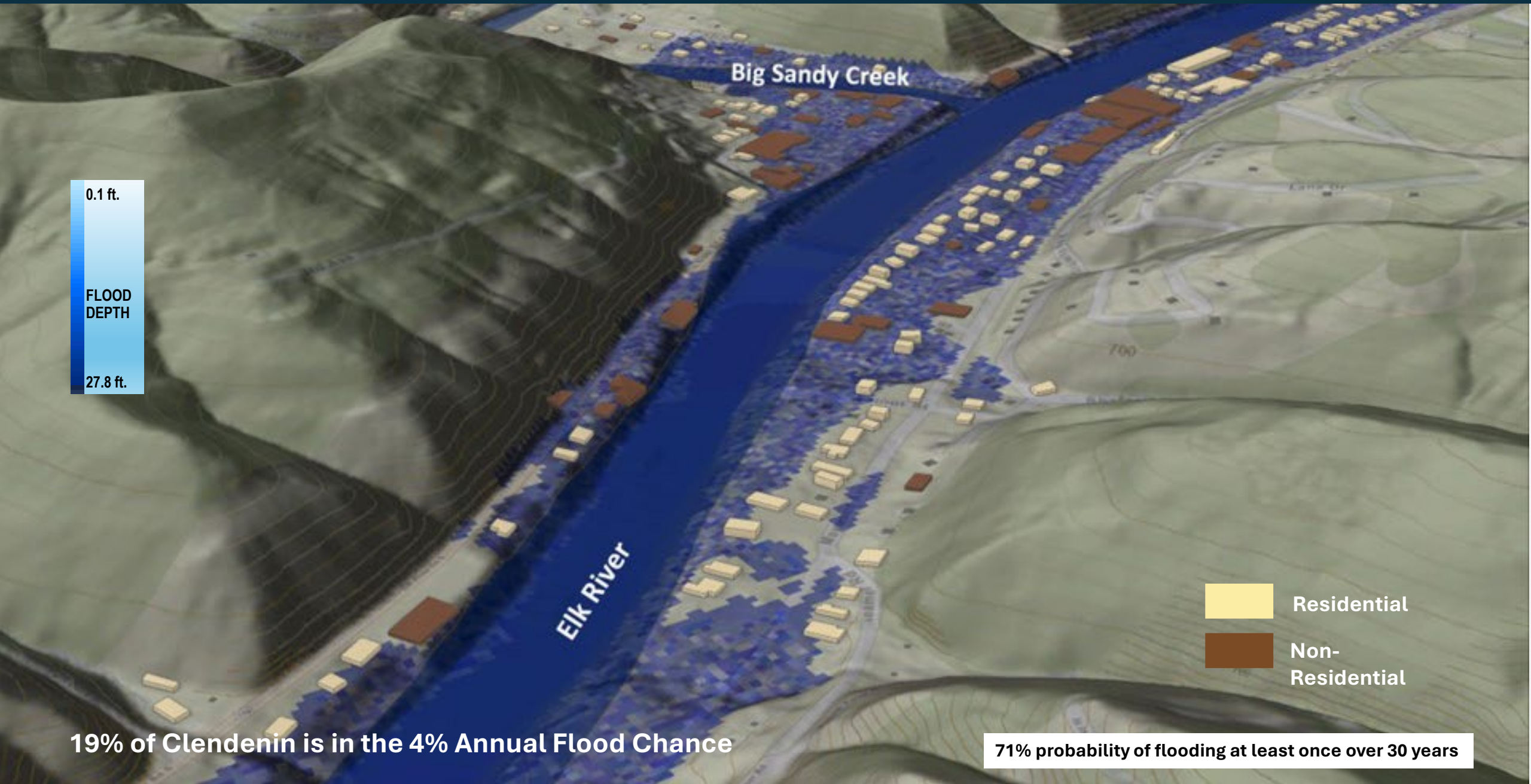


13.4% of Clendenin is in the 10% Annual Flood Chance

96% probability of flooding at least once over 30 years

FEMA 4% Annual Chance (25-year)

Clendenin, WV

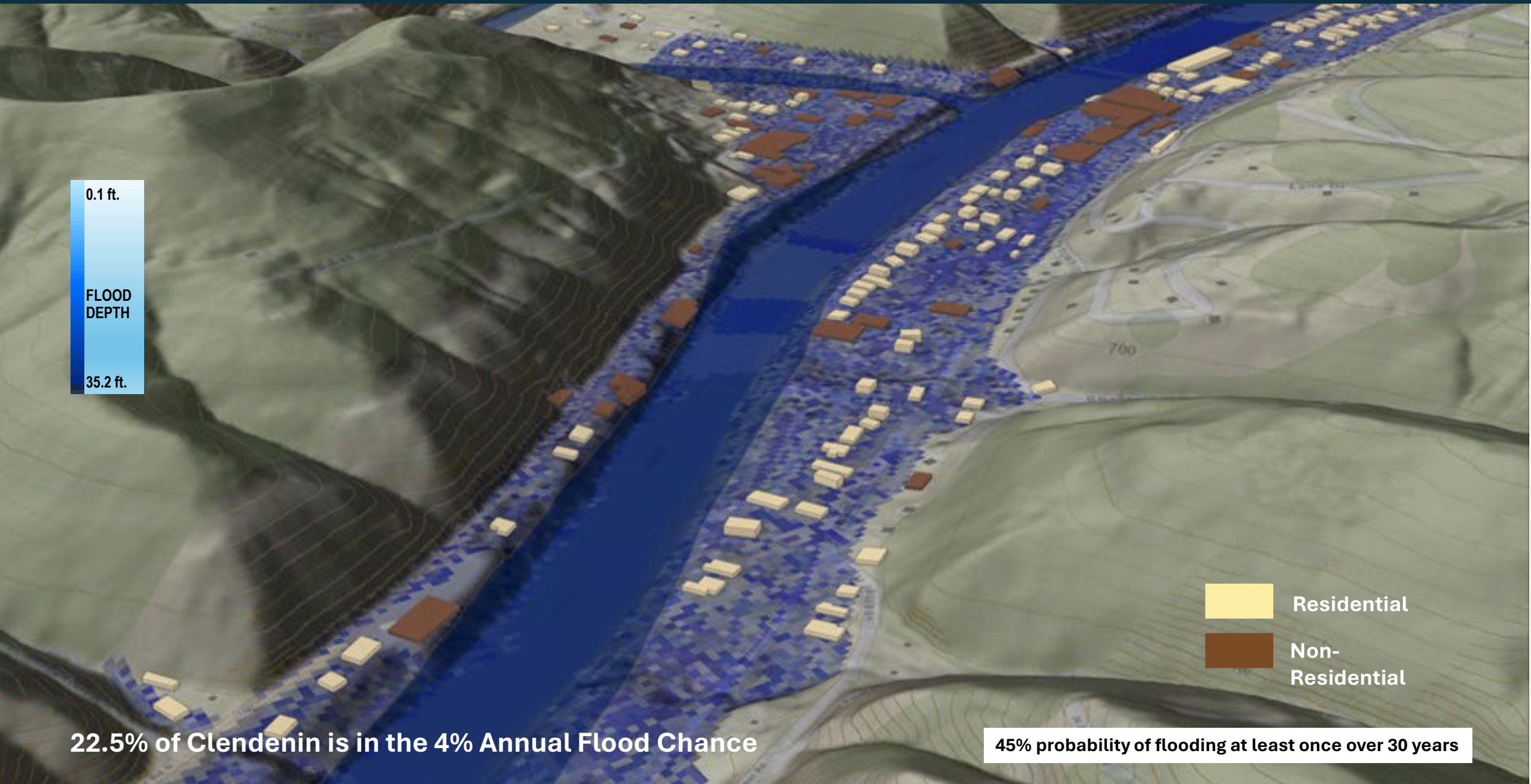


19% of Clendenin is in the 4% Annual Flood Chance

71% probability of flooding at least once over 30 years

FEMA 2% Annual Chance (50-year)

Clendenin, WV

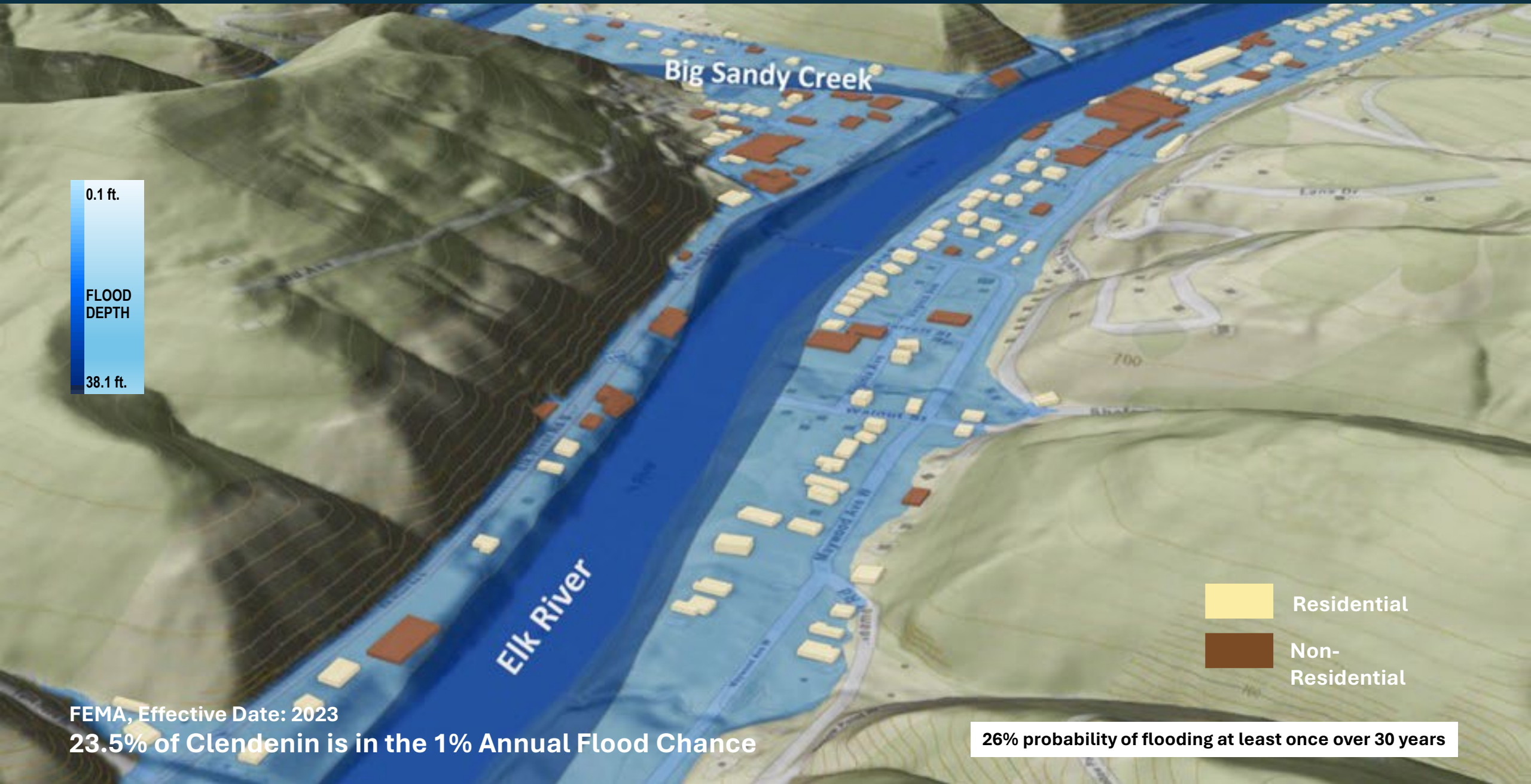


22.5% of Clendenin is in the 4% Annual Flood Chance

45% probability of flooding at least once over 30 years

FEMA 1% Annual Chance (100-year)

Clendenin, WV



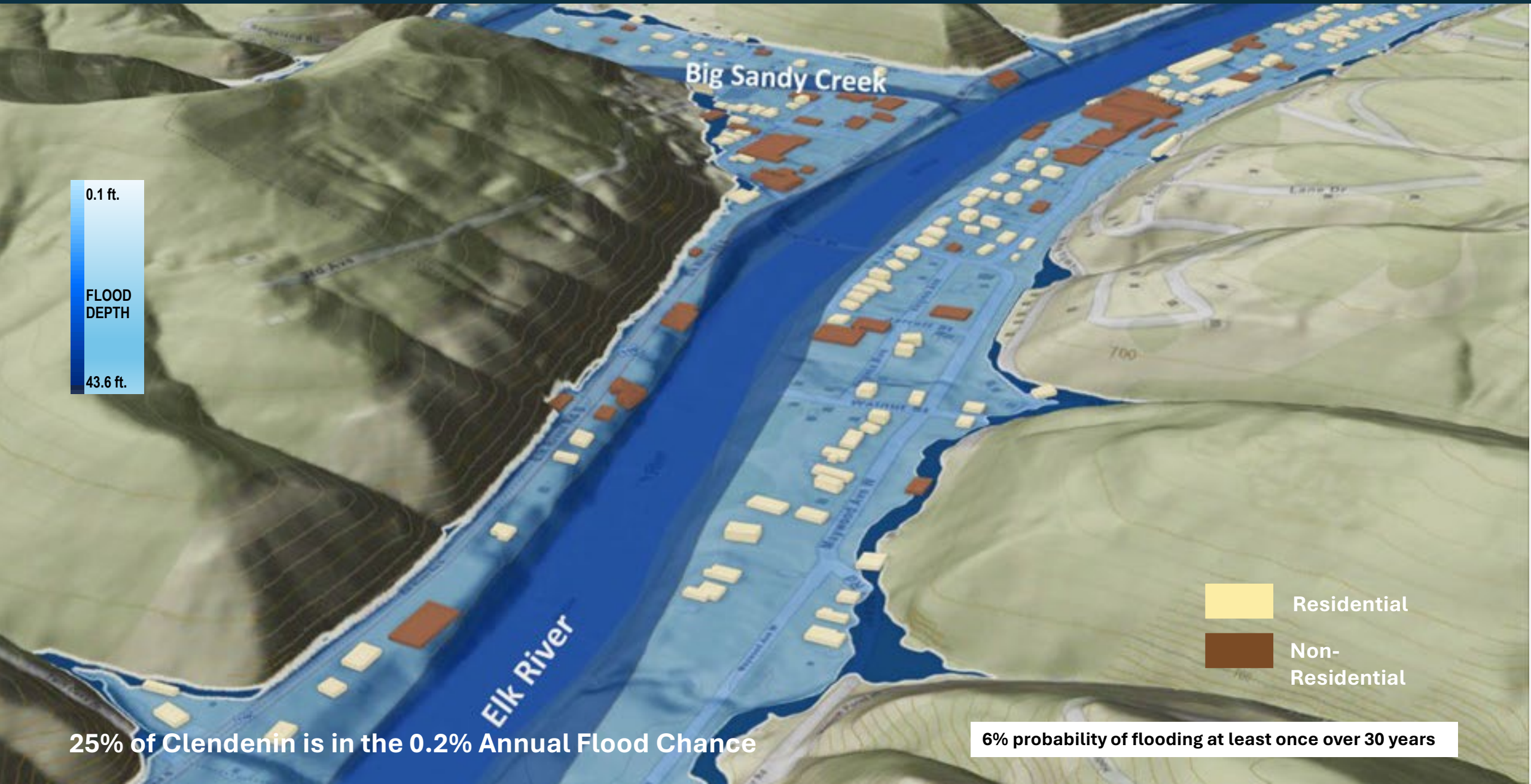
FEMA, Effective Date: 2023

23.5% of Clendenin is in the 1% Annual Flood Chance

26% probability of flooding at least once over 30 years

FEMA 0.2% Annual Chance (500-year)

Clendenin, WV



25% of Clendenin is in the 0.2% Annual Flood Chance

6% probability of flooding at least once over 30 years

DEVELOPING FLOOD SCENARIOS by WV GISTC

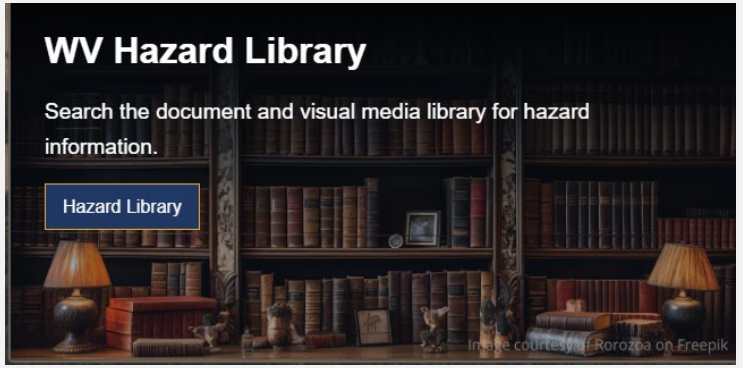
3D FLOOD MODELING

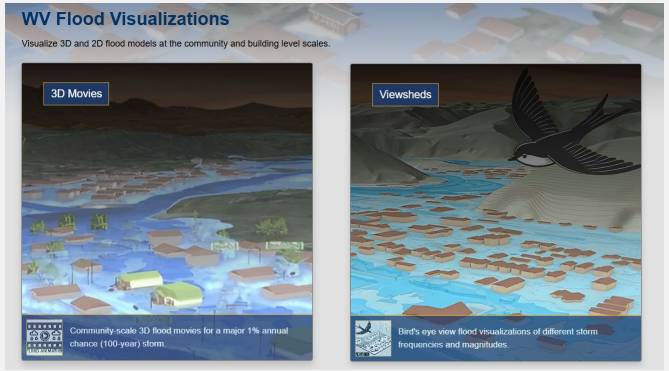
A Flood Animation is made in ArcGIS Pro to show a 100-year or 500-year Flood in a Community. It highlights flood depths and Inundated Buildings, Roads, and Critical Infrastructures.

IMPORTANT

3D modeling and animation are powerful tools for visualizing flood hazards. They allow local communities to see the real-world impact of a flood, providing clarity that technical 2D maps often fail to convey.

Accessible Through WV Hazard Library & WV Risk Explorer.

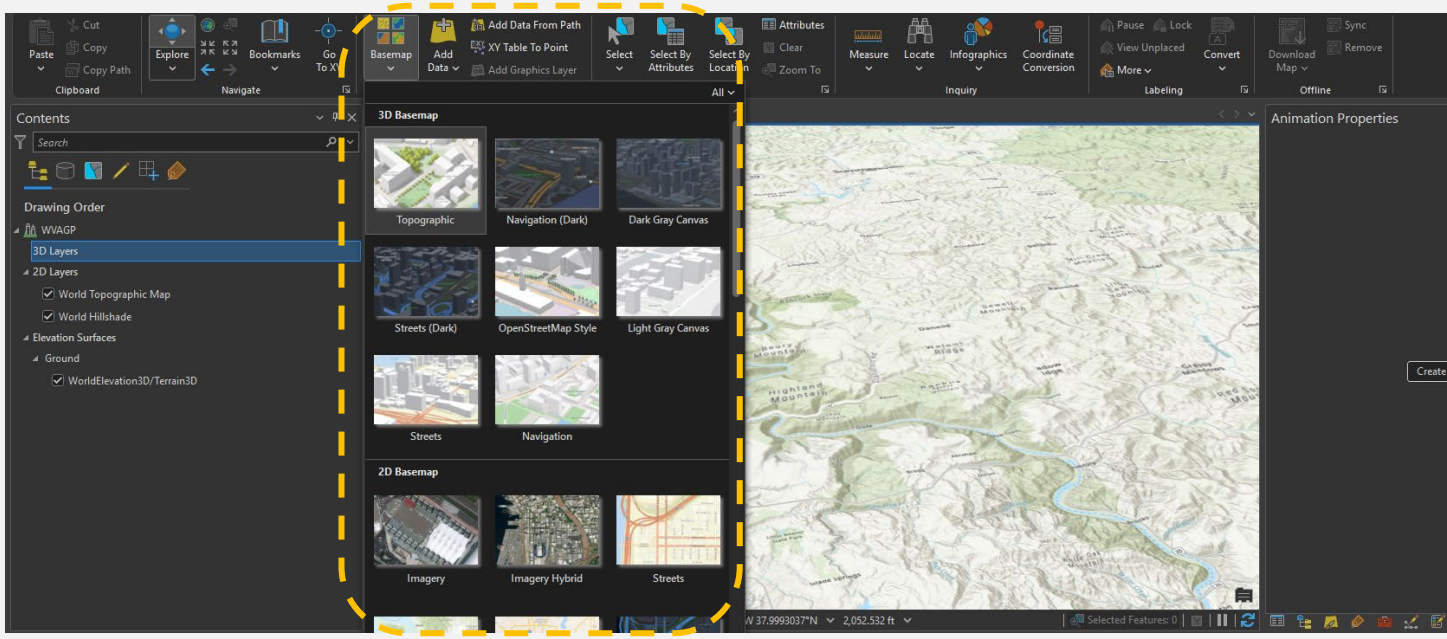




WHAT COMES FIRST in 3D MODELING

Opening a New Local Scene and Selecting a Basemap

Using 3D Basemap OR Footprints?



3D Basemaps

- ✓ Useful for a quick, 3D accurate scene
- ✓ Precise location and height of the Buildings
- ✓ Non-real topography (not imagery)
- ✓ Cubic and simple buildings, all in the same color

Footprints

- ✓ Not a very quick method for large scale areas
- ✓ Precise location and height of the Buildings
- ✓ Can be Placed on 2D Imagery
- ✓ Variety in colors, shapes, and textures of the building

STARTING THE PROCESS...

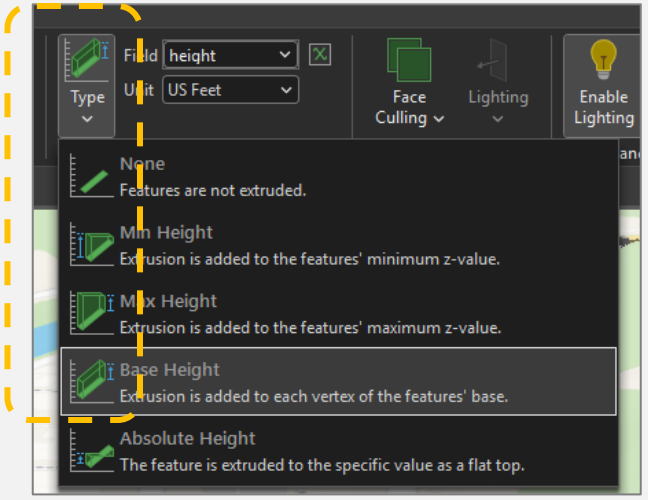
Footprints Sources

Global Building Atlas is used in the WV GIS TC.

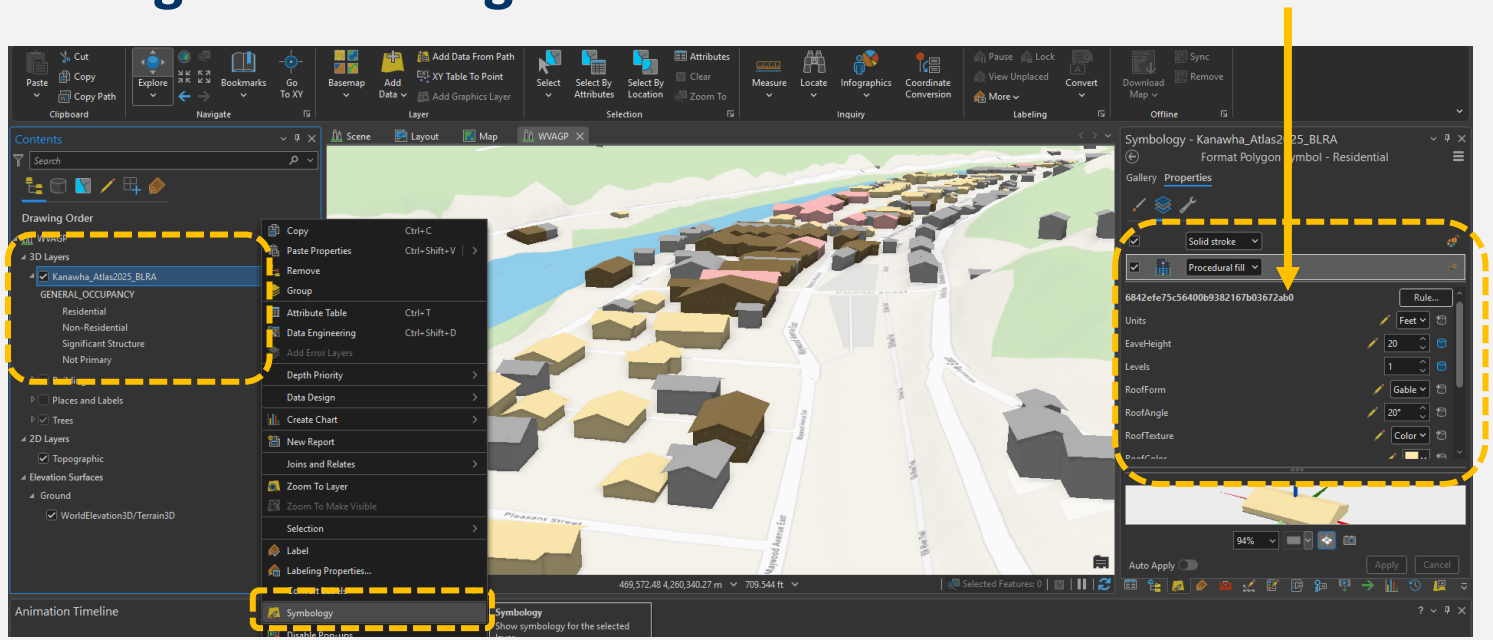
Data

Data Set	Category	Summary Data	Date Created	Download	Web Service
GlobalBuildingAtlas Building Footprints	Man-Made Structures		2022	Download	
WV Microsoft Building Footprints	Man-Made Structures		2023	Download	
WVU Building Footprints	Man-Made Structures		2024	Download	

Extruding them to have 3D Buildings.



Using Rule Packages to add texture.

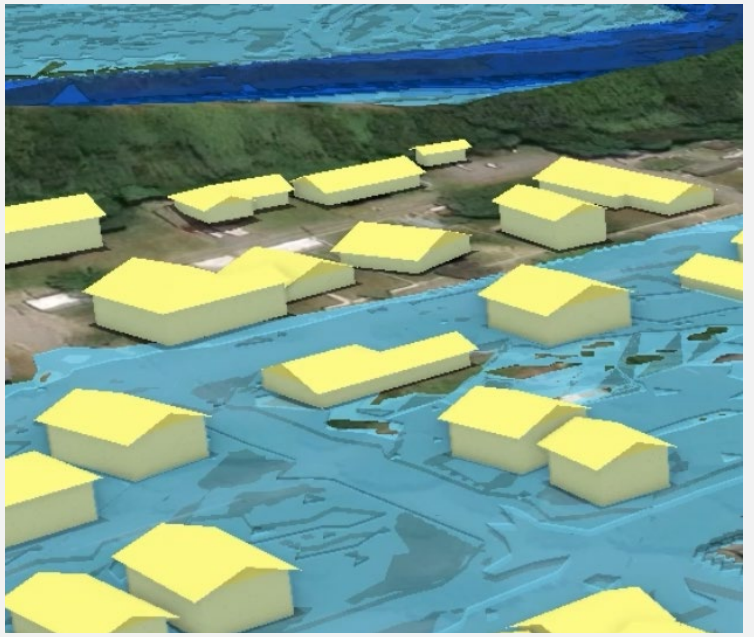


Where can we get Rule Packages?

✓ Found in ArcGIS Online

CONTINUING THE PROCESS…

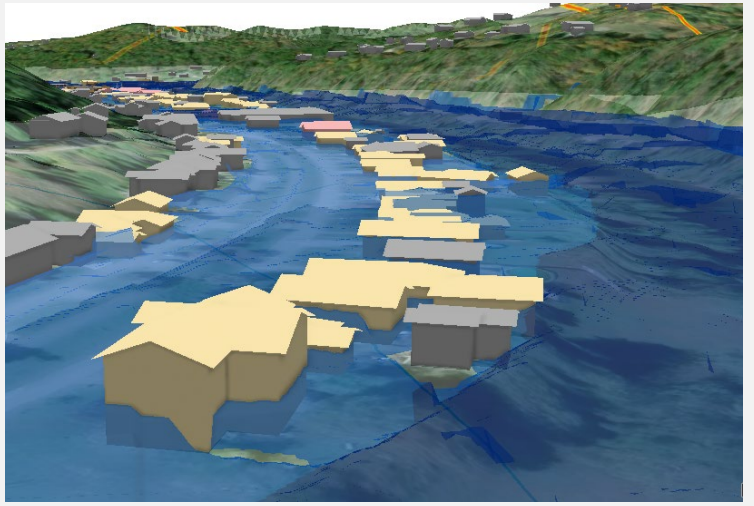
Making a Water Depth Layer



❑ Vector

- ✓ Easy conversion of the depth layer from raster to vector
- ✓ Thousands of polygons are created
- ✓ Each polygon can be extruded based on its depth value (height)

- ▪ Produces a large and heavy file
- ▪ Takes longer to load
- ▪ The animation may NOT be very smooth



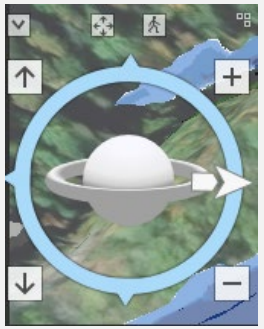
❑ Raster

- ✓ No conversion is required
- ✓ Should be placed on a new ground surface generated from the DEM
- ✓ All the structures should be placed on the new surface
- ✓ Produces a smoother and more realistic appearance

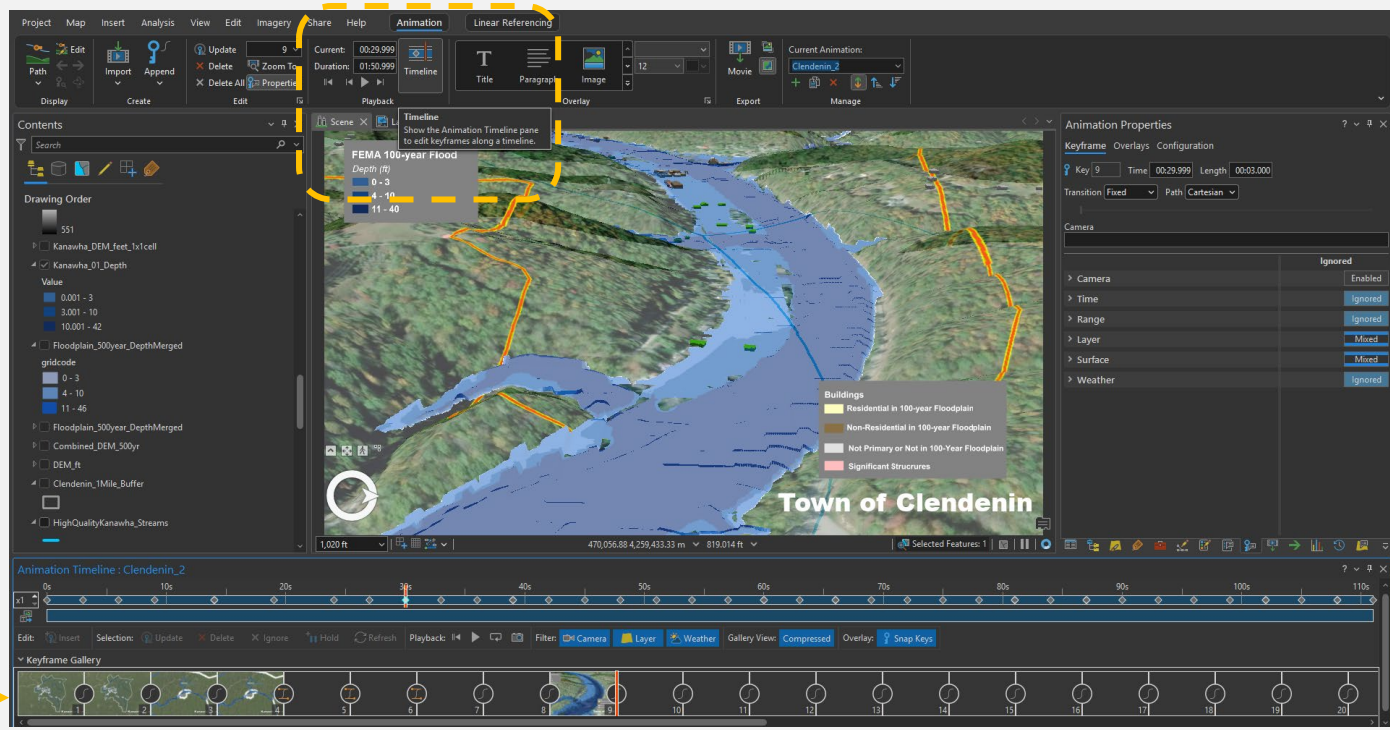
- ▪ Creating a new surface can sometimes be challenging
- ▪ The units of the surface and raster layer must match
- ▪ Structures should be checked to ensure correct inundation depth

MAKING an ANIMATION

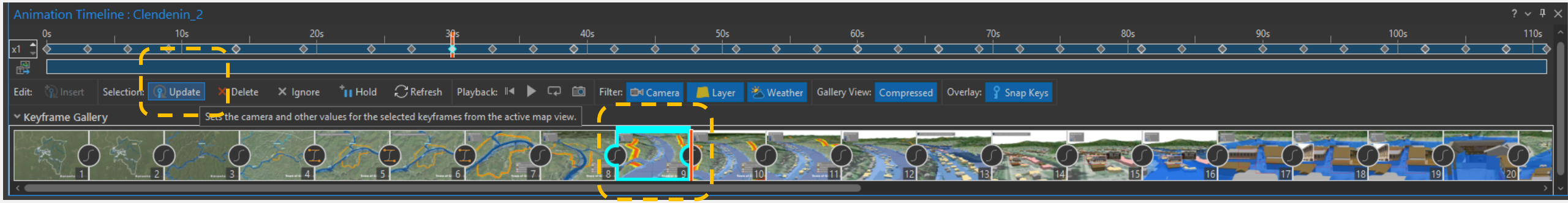
1- Import the timeline to display the sequence of frames.



2- Use the orbit tool to rotate the camera and set different viewing angles to capture the best scene.



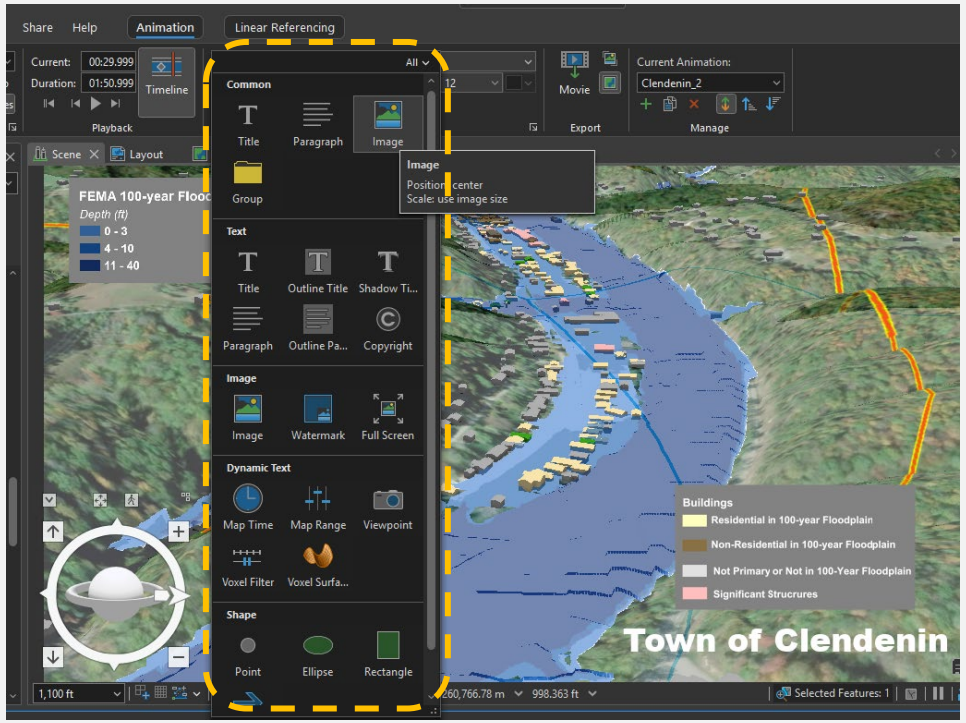
3- Once the desired camera angle is selected, click “Update”.



Gif Courtesy: https://commons.wikimedia.org/wiki/File:Flip_Book_Movie_v2.gif

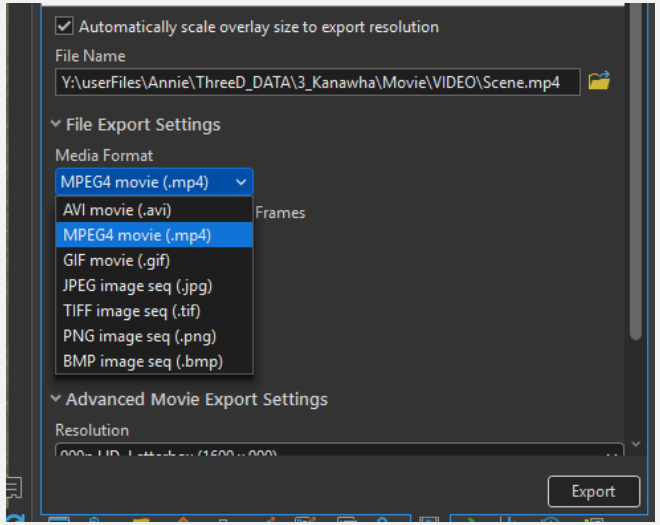
MAKING an ANIMATION

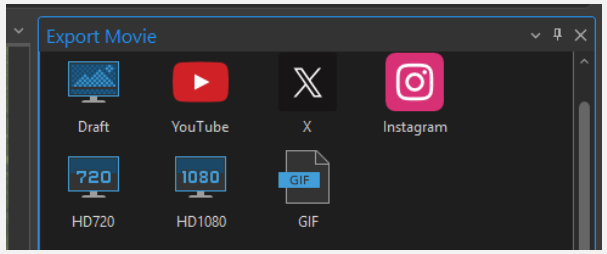
4- Images, shapes and texts can be easily added.



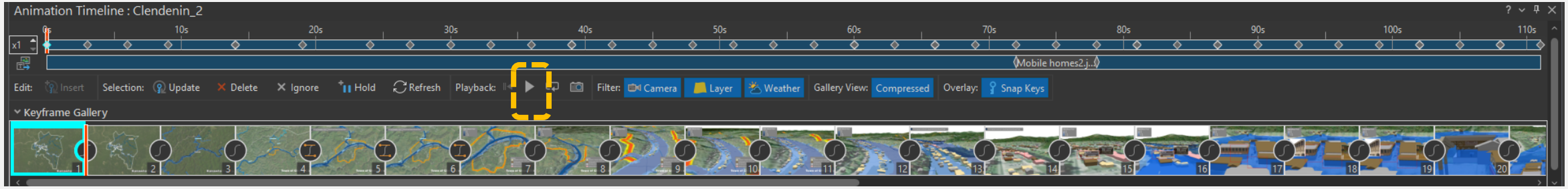
5- Multiple export formats are supported.

6- Animations can be easily shared across different platforms.





7- The animation can be previewed before.

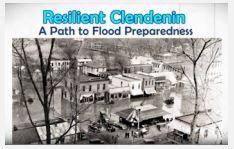


3D Flood Visualizations

White Sulphur Springs, Greenbrier County

Rainelle, Greenbrier County

Shepherdstown, Jefferson County

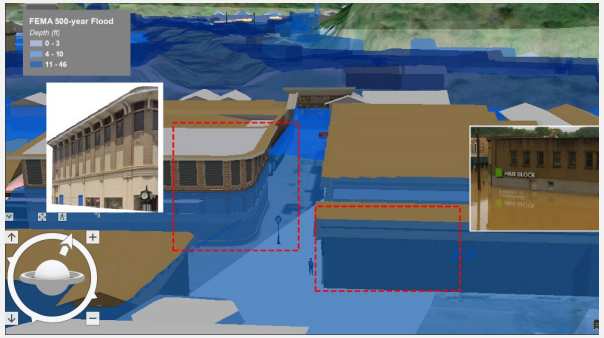


Clendenin, Kanawha County

Harpers Ferry, Kanawha County

Island Creek, Logan County

Marlinton, Pocahontas County



Clendenin, Kanawha County, (500-year, Under Process)