FEMA

Total Exposure in Floodplain (TEIF) Potential Flood Risk Estimation

Tess Grubb. FEMA Region III,
Cynthia McCoy, FEMA Region III,
Mike McGeehin, RAMPP and
Glenn Locke, Tetra Tech

RiskMAP
Increasing Resilience Together

Many Roads to the Same Goal – Flood Risk Assessment

- **FEMA Region III utilizes multiple tools to asses potential flood risk**
  - SLOSH, Hec RAZ, Hurrevac, HAZUS-MH, Arc-GIS, *Total Exposure in Floodplain*

- **Total Exposure in Floodplain (TEIF)** Provides an approximate value of potential economic losses in the Special Flood Hazard Areas and a relative comparison of potential flood loss.

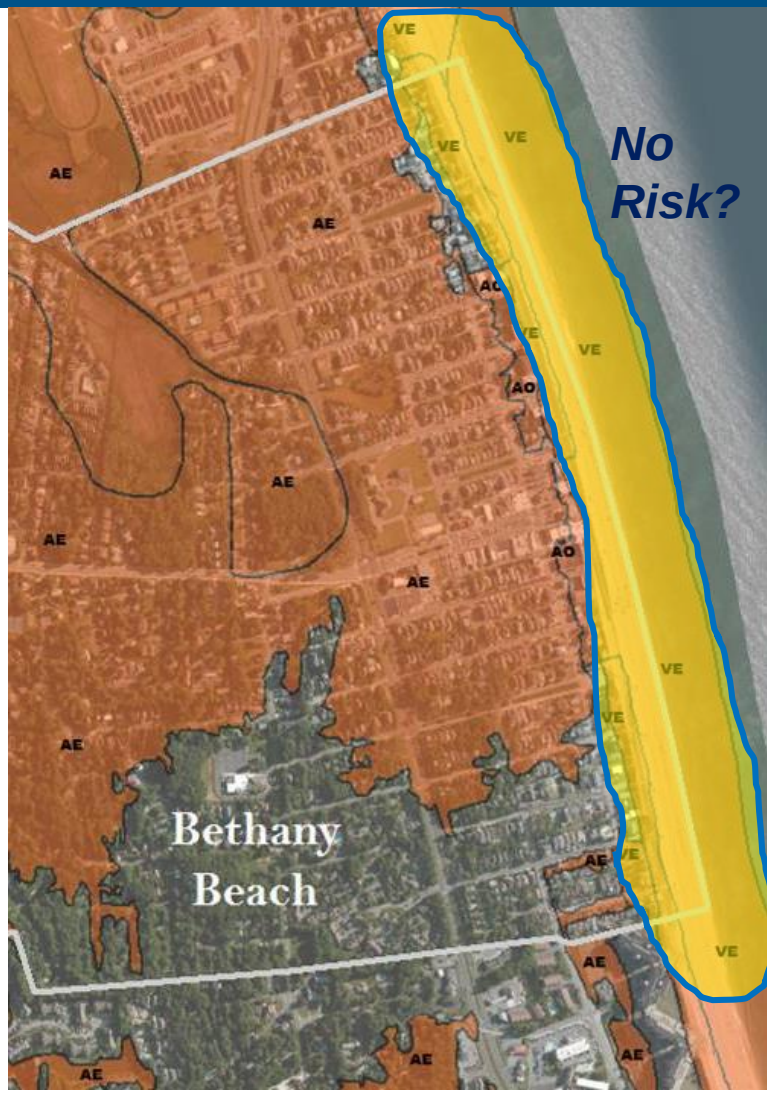
  Identify areas and populations of highest risk, prioritize hazard mitigation projects and inform resource allocation for pre-disaster planning.

- **FEMA Region III uses TEIF to…..**
  - Inform community engagement priorities
  - Identify highest risk communities
  - Illustrate to communities the value of developing enhanced HAZUS risk assessments through Risk MAP
  - Used to Prioritize Community Assistance Visits meeting schedule

- **TEIF has been produced for all states in FEMA Region III** (D.C., DE, MD, PA, VA and WV) **and can be given to whoever wants it**

Need - Alternative Approach to Evaluate Potential Risk

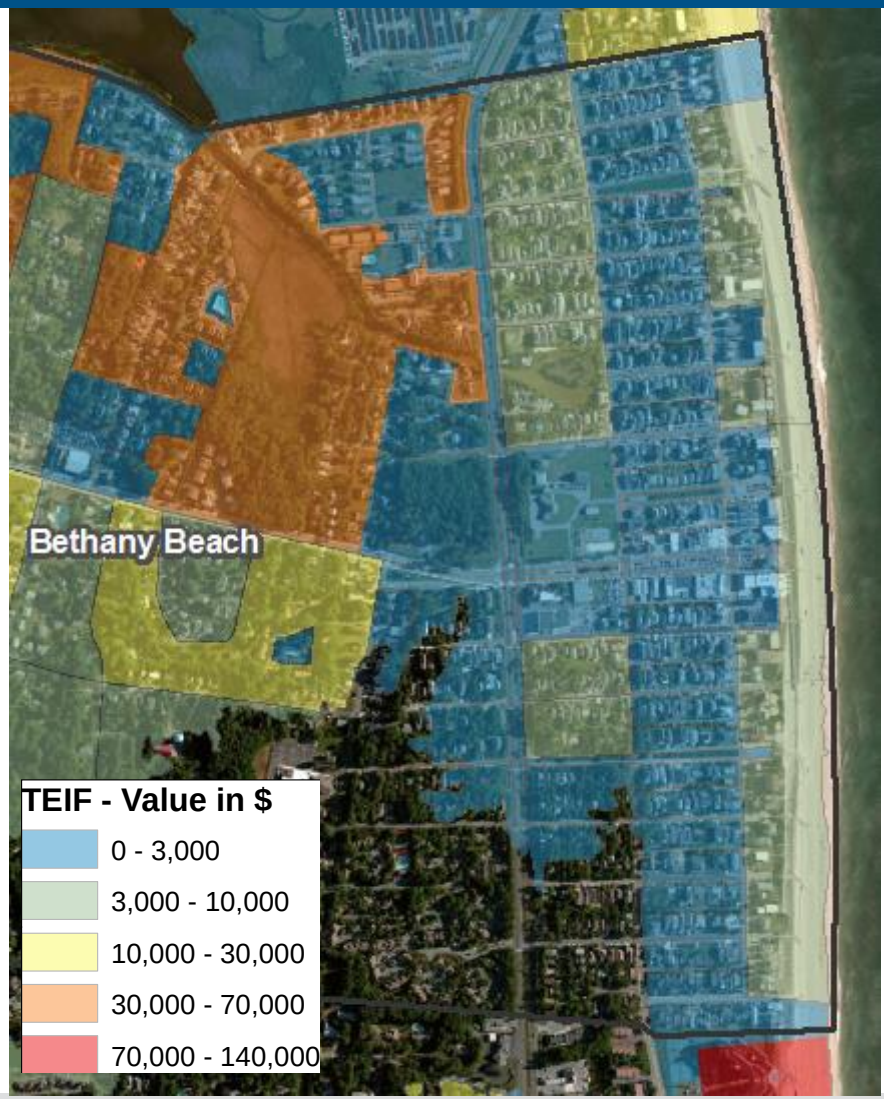
- FEMA Region III utilizes multiple parameters to prioritize Risk MAP communities for **engagement** to increase **resilience**.
  - *At-risk population, existing relationships, level of potential risk*
- The Average Annualized Loss (AAL) study has been used to identify and compare at risk communities.
  - ***LIMITATIONS****: Based on the 2000 Census,* County-wide study regions, and utilized coarse 30 meter DEM
- **CHALLENGE -** The AAL underestimates losses even when used for relative comparison
  - *Especially in coastal communities.*
  - *Ex. Bethany Beach, DE (Sussex Co) – AAL reports **NO coastal flood losses***



New Approach - Total Exposure in Floodplain (TEIF) version 1.0

- **FEMA Region IV released 2010 Census and ACS data integrated into HAZUS**
  - Updated to census tracts, applying 2012 RS Means valuations.
  - Includes update to the 2010 nationwide total exposure data.

- **Development of Total Exposure in Floodplain (TEIF)** -
  - Create a dataset using Arc GIS and MS Excel.
  - Determine an approximate value of Total Exposure in the SFHAs. (**Effective & Preliminary Maps – from May 2013**)
  - Use in lieu of the AAL study.
  - Utilized for relative comparison for community engagement and action potential ranking.



Comparison: AAL & TEIF

County	Community	TEIF 2010	Rank TEIF 2010	AAL 2000	AAL 2000 Rank	Rank Difference
New Castle	Arden village	$1,868,499	44	$0	32	-12
New Castle	Ardentown village	$645,440	46	$0	32	-14
Sussex	Bethany Beach town	$312,223,159	5	$0	32	27
Sussex	Bethel town	$2,156,920	43	$26,000	24	-19
Sussex	Blades town	$6,459,923	36	$108,000	20	-16
Kent	Bowers town	$25,931,333	20	$680,000	12	-8
Sussex	Bridgeville town	$4,457,917	39	$0	32	-7
Kent	Camden town	$5,157,912	38	$85,000	21	-17
Kent	Cheswold town	$435,279	47	$0	32	-15
Kent	Clayton town	$19,835,423	25	$0	32	7
Sussex	Dagsboro town	$7,708,621	35	$0	32	-3
New Castle	Delaware City city	$70,867,885	16	$117,000	19	3
Sussex	**Dewey Beach town**	**$201,161,639**	**9**	**$0**	**32**	**23**
Kent	Dover city	$307,809,596	6	$3,644,000	6	0
New Castle	Elsmere town	$93,940,120	13	$0	32	19

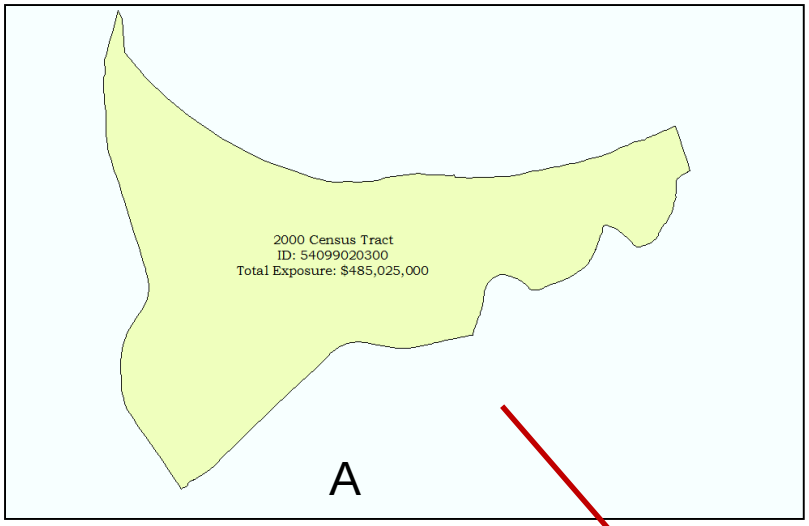
GIS Solution – A Three Step Process

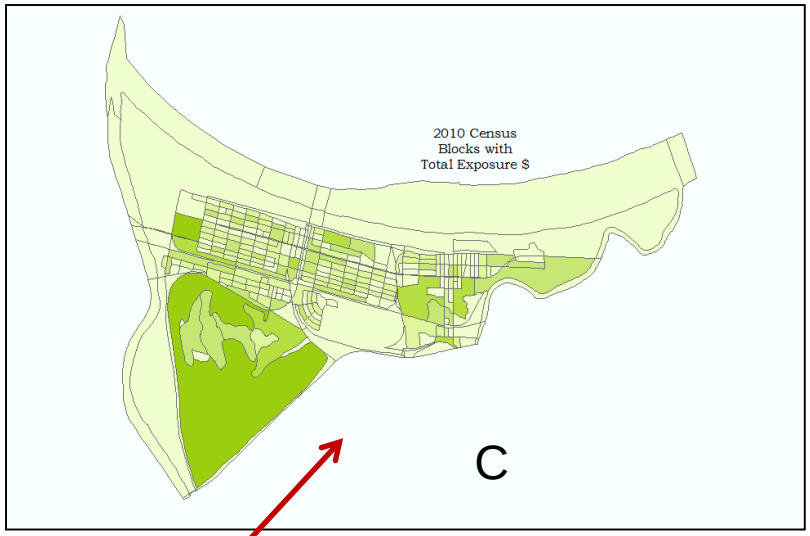
- **Step 1**
  - **Transfer 2000 Census Tract Total Exposure Dollar Values (Updated by Region IV) to 2010 Census Blocks.**
  - 2010 Census Building Counts were used to distribute the 2000 Census Tract Dollar amount to the 2010 Census Block units through binomial areal interpolation.

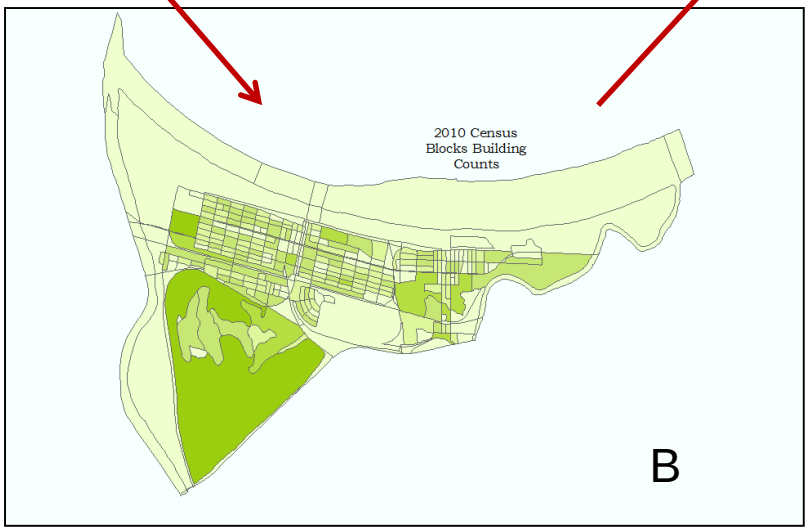
- **Step 2**
  - **Assemble a statewide SFHA layer.**
  - Effective DFIRMs in the NFHL, Current Draft Preliminary DFIRMs, Preliminary DFIRMs, DFIRMs at LFD, or newly effective DFIRMs

- **Step 3**
  - **Intersect the 2010 Census Block Geography with Total Exposure Dollar values and the statewide SFHA**
  - Areal Interpolation of 2010 Census Block in SFHA resulted in the ultimate TEIF value

GIS Solution – Step 1

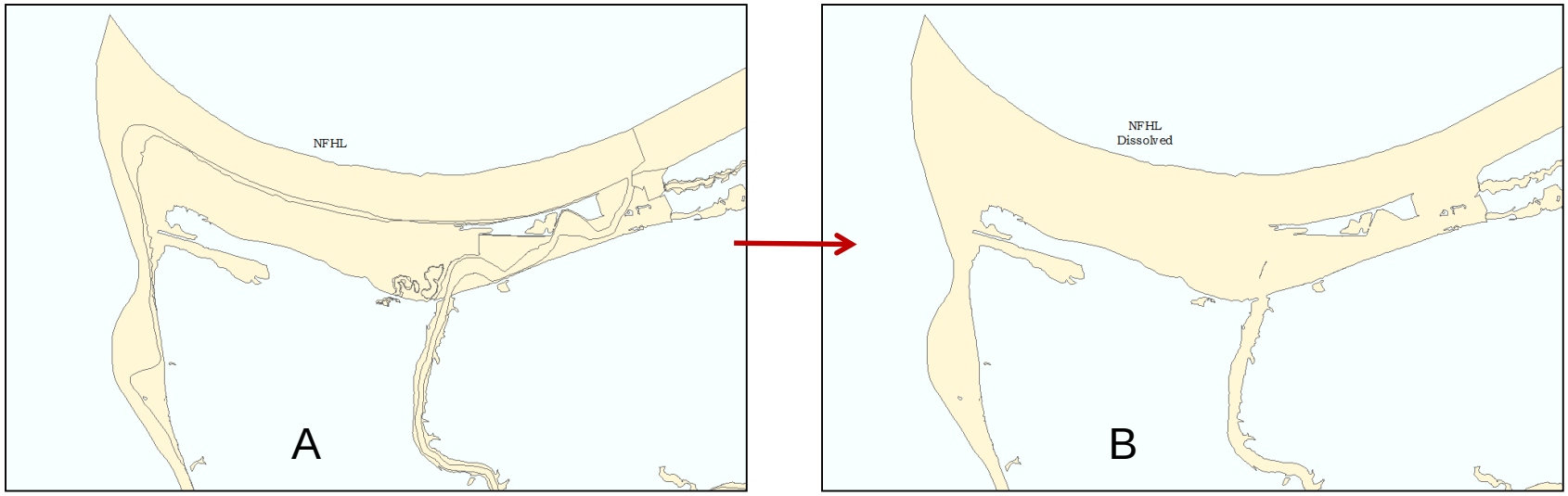






Transfer 2000 Census Tract Total Exposure Dollar Values to 2010 Census Blocks based On 2010 Building Counts.

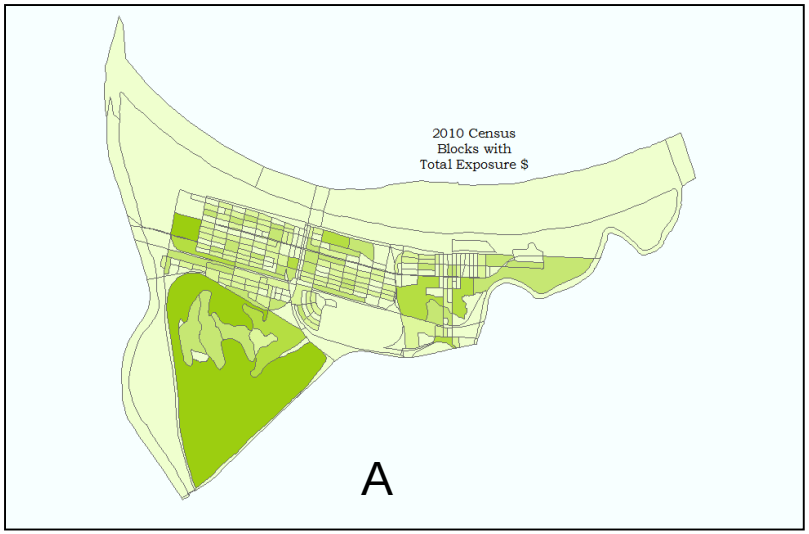
GIS Solution – Step 2



Assemble and Dissolve a statewide SFHA layer

Zones: A, AE, AH, AO, V, VE, and X Prot. By Levee

GIS Solution – Step 3



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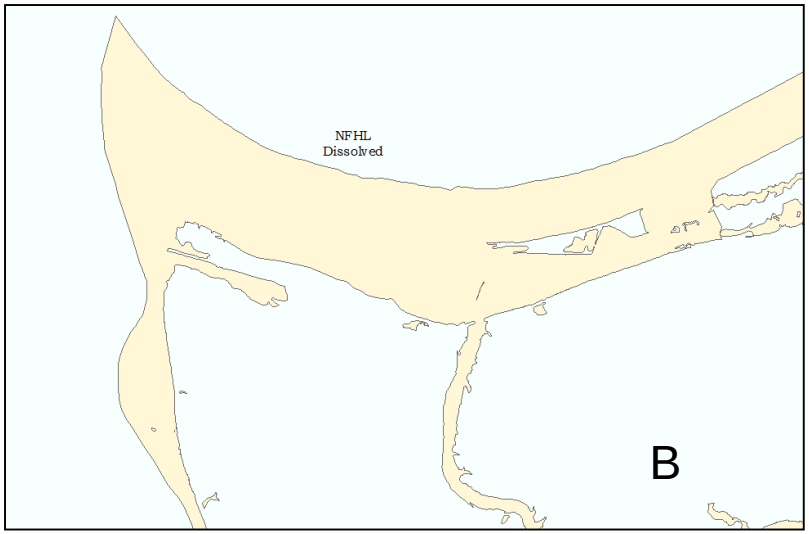
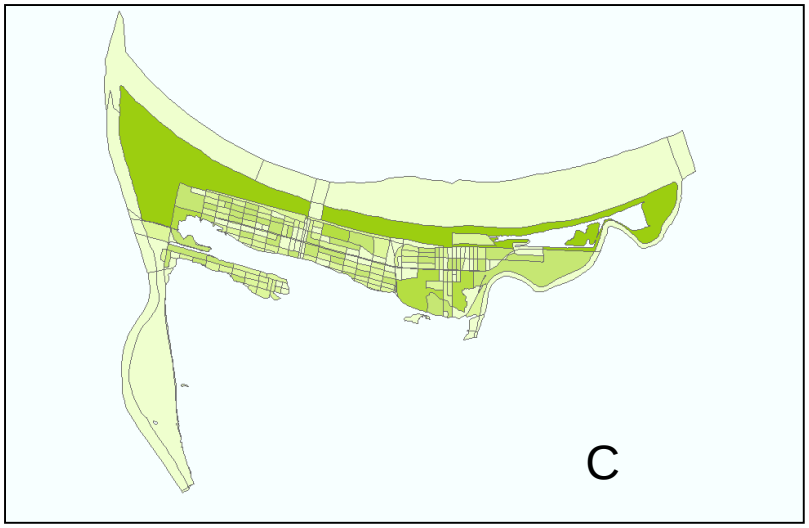
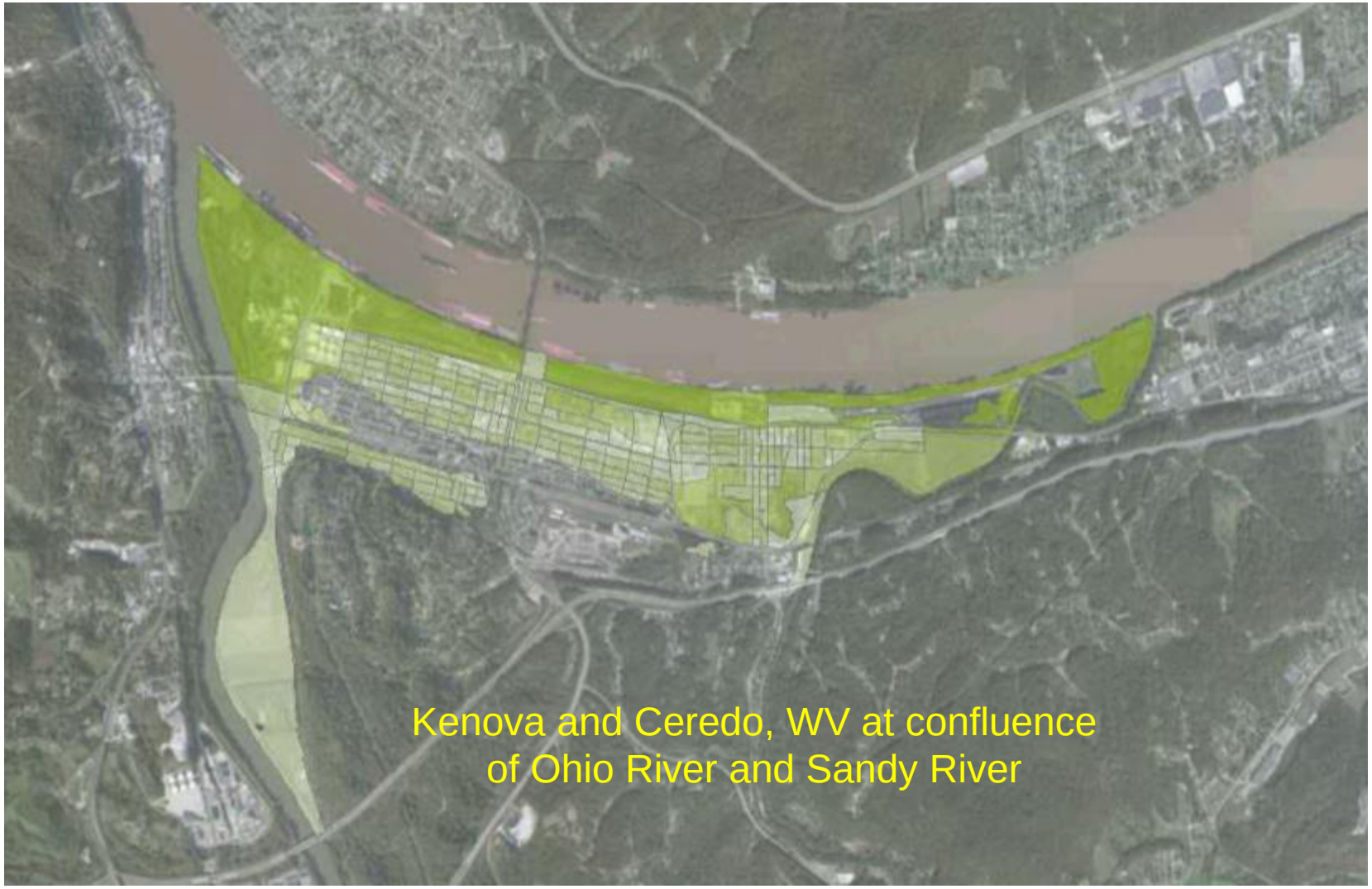


= TEIF =



GIS Solution – Step 3



TEIF 2.0 – Improved Accuracy

- **Update all Region III community engagement plans with TEIF data**
  - Replace AAL component of prioritization with TEIF
    - Keep AAL-based analysis "on the side" for consideration and use where appropriate
  - Evaluate all Risk MAP project community engagement plans and revise, where appropriate
    - Generally, will not "reduce" engagement status of any community ***BUT*** may increase engagement status of communities shown to have increased engagement needs

- **Eliminate exposure estimates in census blocks which are undeveloped or natural areas based on Land Use Land Cover (LULC)**
  - Include in a Pilot Project for Washington County, MD for TEIF 2.0
- **Continue to validate approach and look for alternate uses**
  - Include Building Footprint data (existing and extracted from LiDAR) in TEIF 2.0 Pilot.

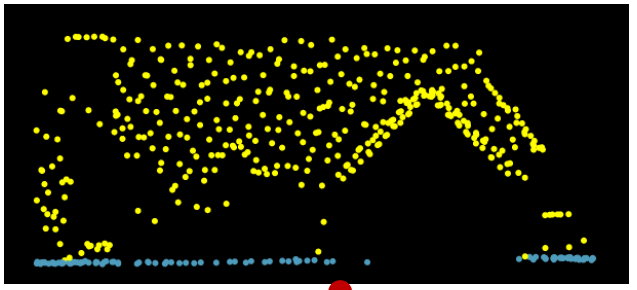
- **Continue to improve TEIF approach and data over time**
  - Should be cost effective to conduct annual updates as new flood data are available, enhanced approaches are considered, etc.

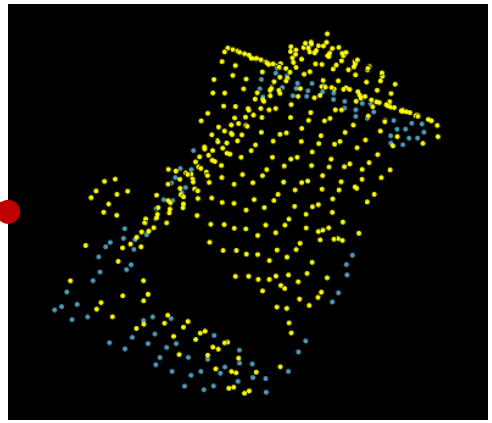
Updated Approach - Total Exposure in Floodplain (TEIF) version 2.0

- **FEMA Region IV released 2010 Census and ACS data integrated into HAZUS**
  - Updated to census tracts, applying 2012 RS Means valuations.
  - Includes update to the 2010 nationwide total exposure data.
- **Development of Total Exposure in Floodplain (TEIF) version 2.0** -
  - Create a dataset using Arc GIS.
  - Determine an approximate value of Total Exposure in Special Flood Hazard Areas (SFHAs).
  - Use Building Counts from LiDAR extracted buildings footprints.
  - Apply Dasymetric approach to eliminate loss estimates being applied to undeveloped areas within Census Blocks.

Extracting Building Footprints from LiDAR Data planar surface recognition

Aerial Photography (2 – D) provides a visual interpretation of on the ground features.



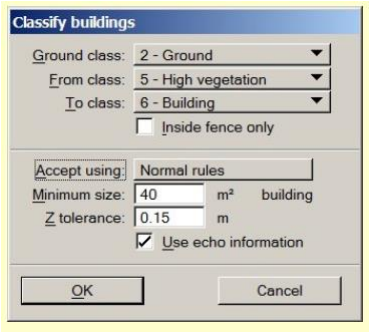


LiDAR Data (3 – D) provides the ability to automate feature extraction of planar surfaces.

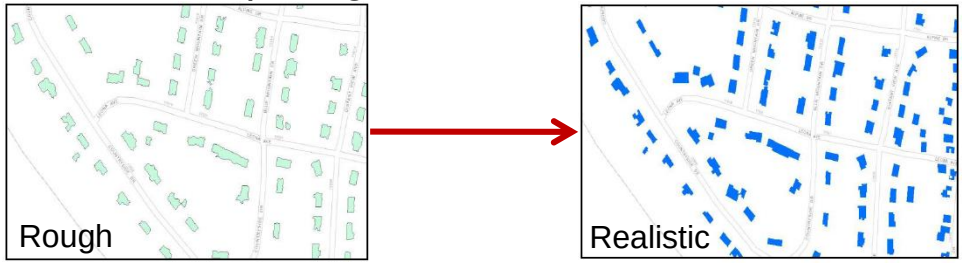
Automated and Manual Process using TerraScan Software and ArcGIS

Automated – Part 1

- TerraScan Software (runs on MicroStation)
  - Building Classification Tool
  - Input needed: Point rich LiDAR file (.las) file with ground classified.

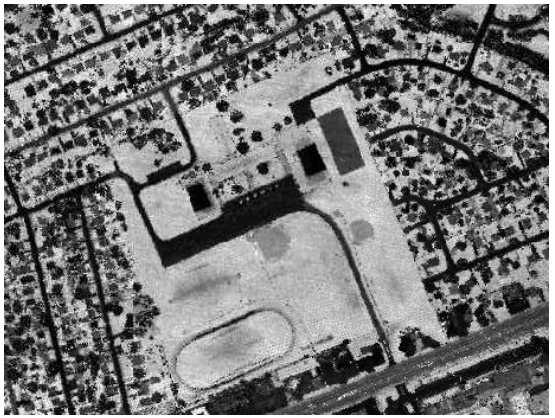


- Produces rough polygon shapes through export to ArcGIS. Automated process can clean up rough outlines.

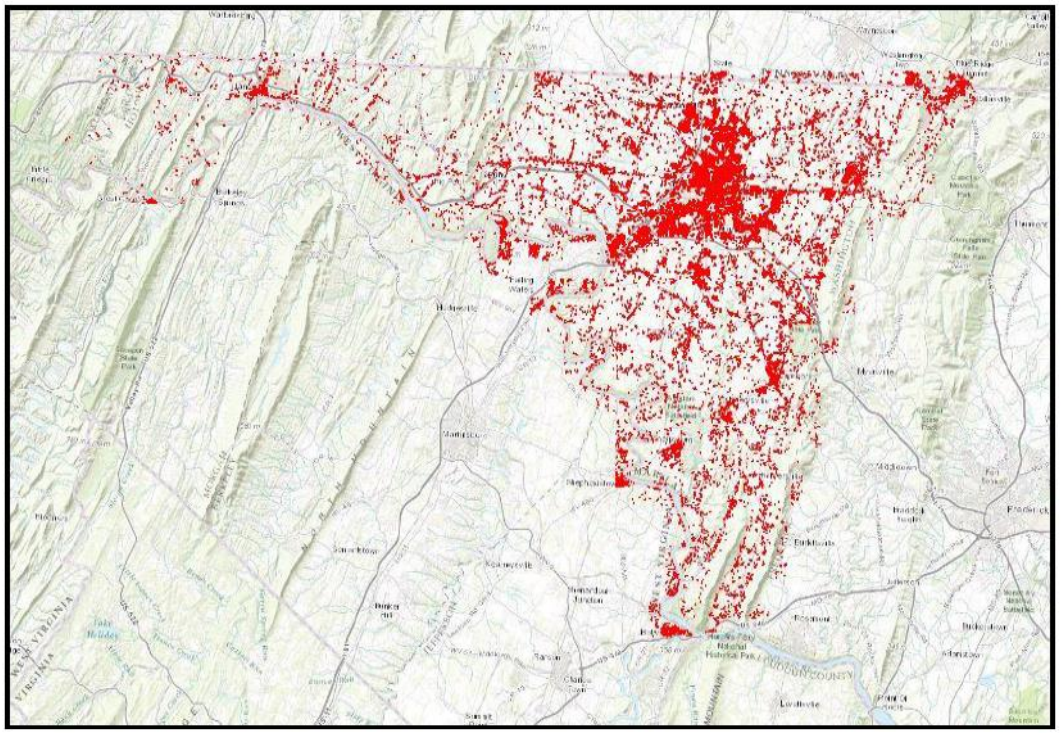


Manual – Part 2

- Automated process is not fool proof. It's incredibly cost efficient, but not 100 % accurate.
- There will be omission (missing footprints) and commission (footprints where no building exists) errors.
- Manual clean up involves spending time with an aerial photo and intensity imagery derived from the LiDAR data.



Results of LiDAR Building Extraction



88.2 % accuracy rate for automated feature extraction

Automated Building Extraction Results				
Number of Initial building 'Blobs'	Features Manually Added	Features Manually Removed	Final Total Number of Buildings	Total 2005 Number of Building from Washington County, MD GIS
67,432	5,775	2,521	70,686	106,658*

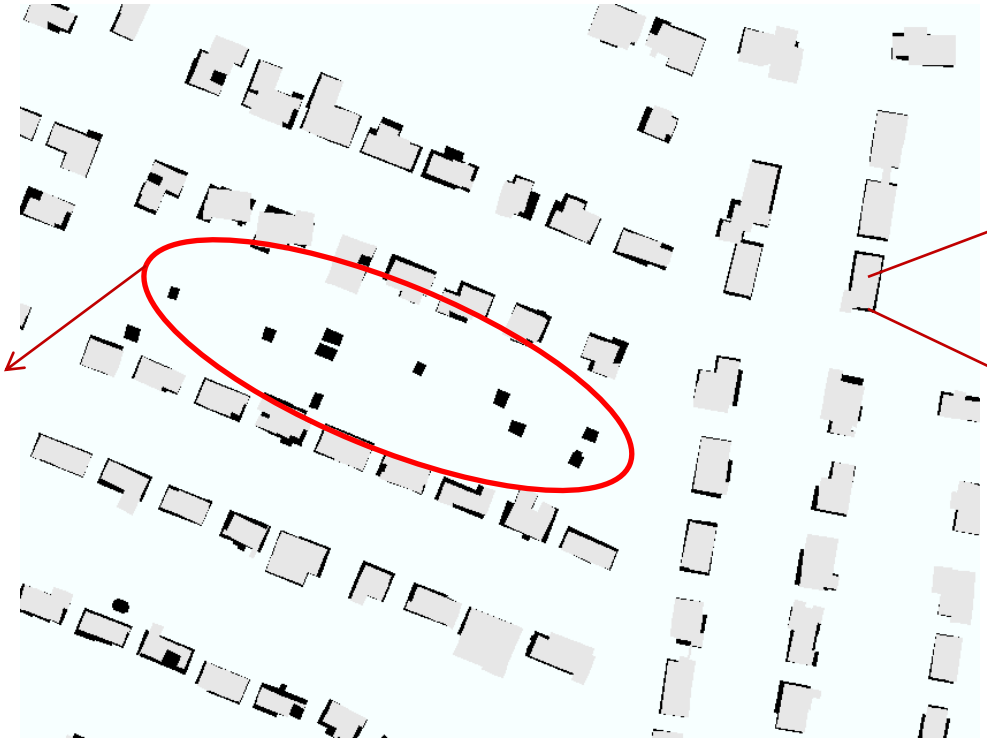
* The difference of 35,972 buildings between the 2005 Washington County, MD Building Footprint shapefile and the LiDAR derived Building footprint layer is attributed to structures less than 40 square meters being excluded. See Supplemental Building Count Summary Sheet for more details.

98 % accuracy rate after manual corrections

Comparison with County Building Footprint Data (2005)

- **Face Value Big Difference – 36,000 Missing Footprints?**

Average area of missing building is 35 sq. feet. Non-inhabitable structures (sheds, outbuildings, other storage …)



Gray – LiDAR Extracted Building

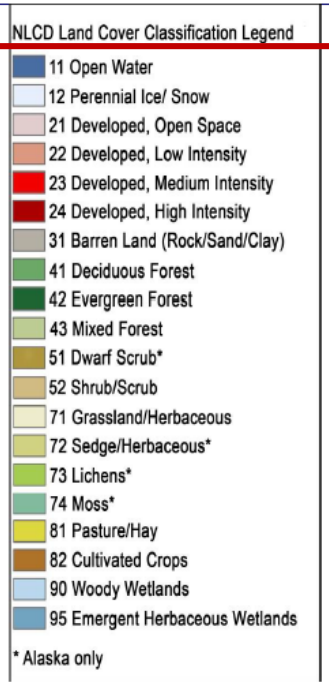
Black – County Building Footprints

Dasymetric Approach to eliminate loss estimates in undeveloped areas

- **Follow Dasymetric Methodology for Hazus Functional Enhancements for General Building Stock exposure distribution**
  - Dasymetric Methodology = Intersect National Land Cover Dataset (NLCD 2011) - TIGER polygons to filter out non-built-up areas

3. Dasymetric GBS exposure distribution approach

- ~~Use of NLCD Land Use Land Cover (LULC)~~
- Suggested inclusion of NLCD 2011 LULC codes:
  - 21 – Developed, Open Space
  - 22 – Developed, Low Intensity
  - 23 – Developed, Medium Intensity
  - 24 – Developed, High Intensity
  - 81 – Pasture/Hay
  - 82 – Cultivated Crops
- Suggested exclusion of NLCD 2011 LULC codes:
  - The remaining 10 general LULCs, and
  - The 4 LULCs for Alaska only



- Only difference was to use a 2010 10 M Resolution Maryland Land Use – Land Cover Dataset.
- Matched Maryland Land Use Codes with the NLCD codes for consistency.

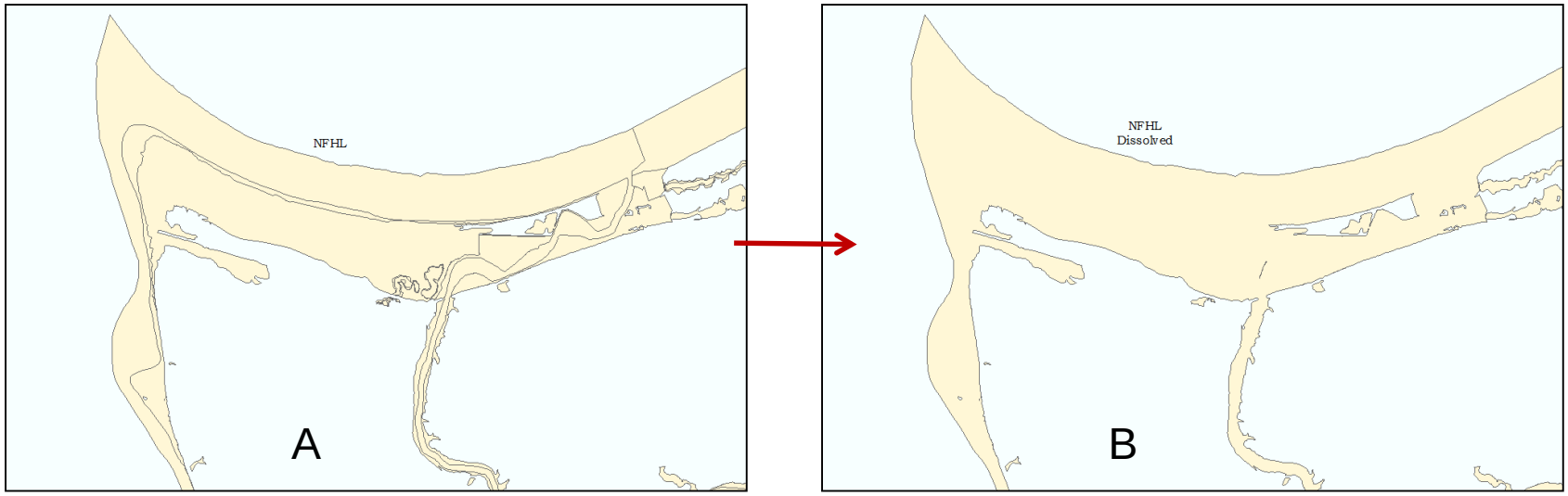
Example in Washington County, MD

TEIF 2.0 GIS Solution – A Three Step Process

- **Step 1**
  - **Transfer 2000 Census Tract Total Exposure Dollar Values (Updated by Region IV) to 2010 Census Blocks.**
  - Building Counts based on LiDAR derived Building Footprints and County Building Footprint layer aggregated to 2010 Census Block data were used to distribute the 2000 Census Tract Dollar amount to the 2010 Census Block units through binomial areal interpolation.
- **Step 2**
  - **Assemble a statewide SFHA layer.**
  - Effective DFIRMs in the NFHL, Current Draft Preliminary DFIRMs, Preliminary DFIRMs, DFIRMs at LFD, or newly effective DFIRMs
- **Step 3**
  - **Intersect the 2010 Census Block Geography minus undeveloped areas with Total Exposure Dollar values and the statewide SFHA**
  - Areal Interpolation of 2010 Census Block in SFHA resulted in the ultimate TEIF value

Step 1 - Transfer 2000 Census Tract Total Exposure Dollar Values (Updated by Region IV) to 2010 Census Blocks.

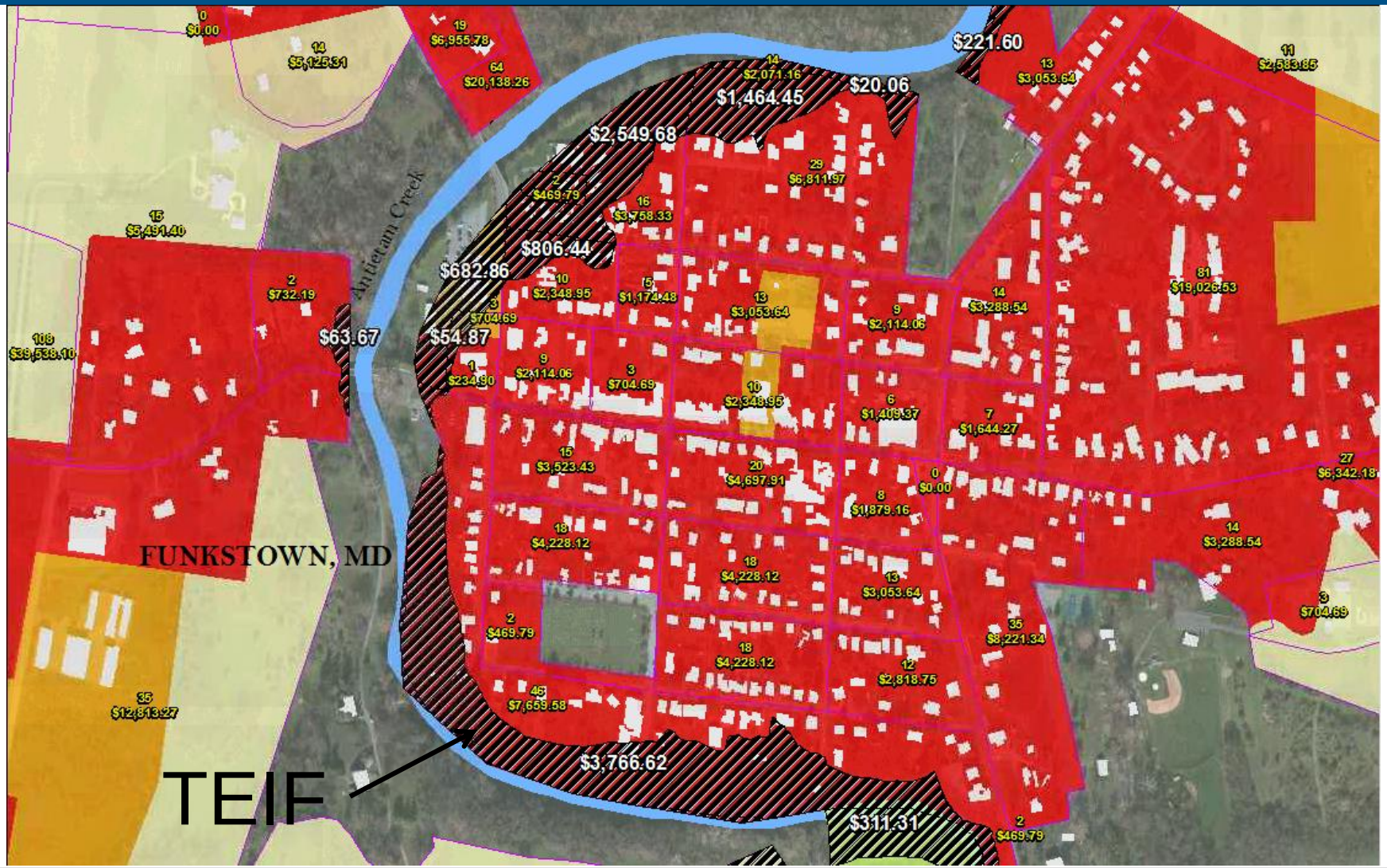
Step 2 – Assemble Statewide SFHA



Assemble and Dissolve a statewide SFHA layer

Zones: A, AE, AH, AO, V, VE, and X Prot. By Levee

Step 3 - Intersect the 2010 Census Block Geography (minus undeveloped areas) with Total Exposure Dollar values and the statewide SFHA.



How Does a Community Use TEIF?

- **Develop a relative comparison of potential flood loss for Public Officials and homeowners**

- **Graphically visualize areas and populations of highest risk to inform resource allocation for pre-disaster planning**
  - Does an at risk area include the community's primary employer, the central business district, or the local School/City Hall/Hospital/Firehouse, elderly community or community of ESL citizens?

- **Enhance State and Local Mitigation Plans**
  - Overlay essential facility layers to determine which may loose function, and others which may need to supplement the loss. Does this require a coordination plan?

- **Prioritize hazard mitigation projects and help screen for cost-effectiveness in FEMA mitigation grant programs**
  - Do projects exist in the highest risk areas? Can a project be written for multiple buyouts or elevations located within one block?

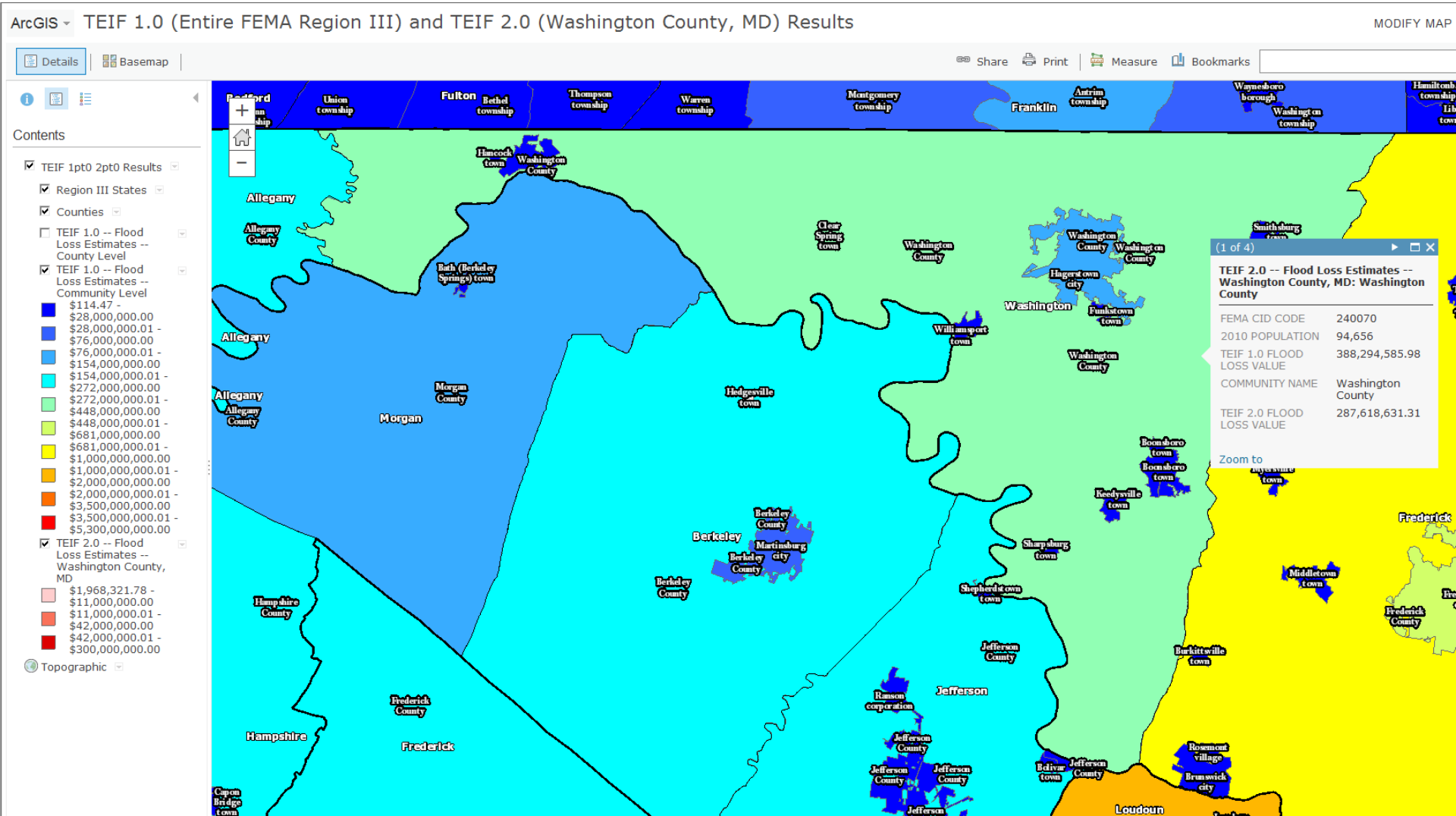
- **Identify areas in need of more refined risk assessments**

Where will TEIF 2.0 be implemented?

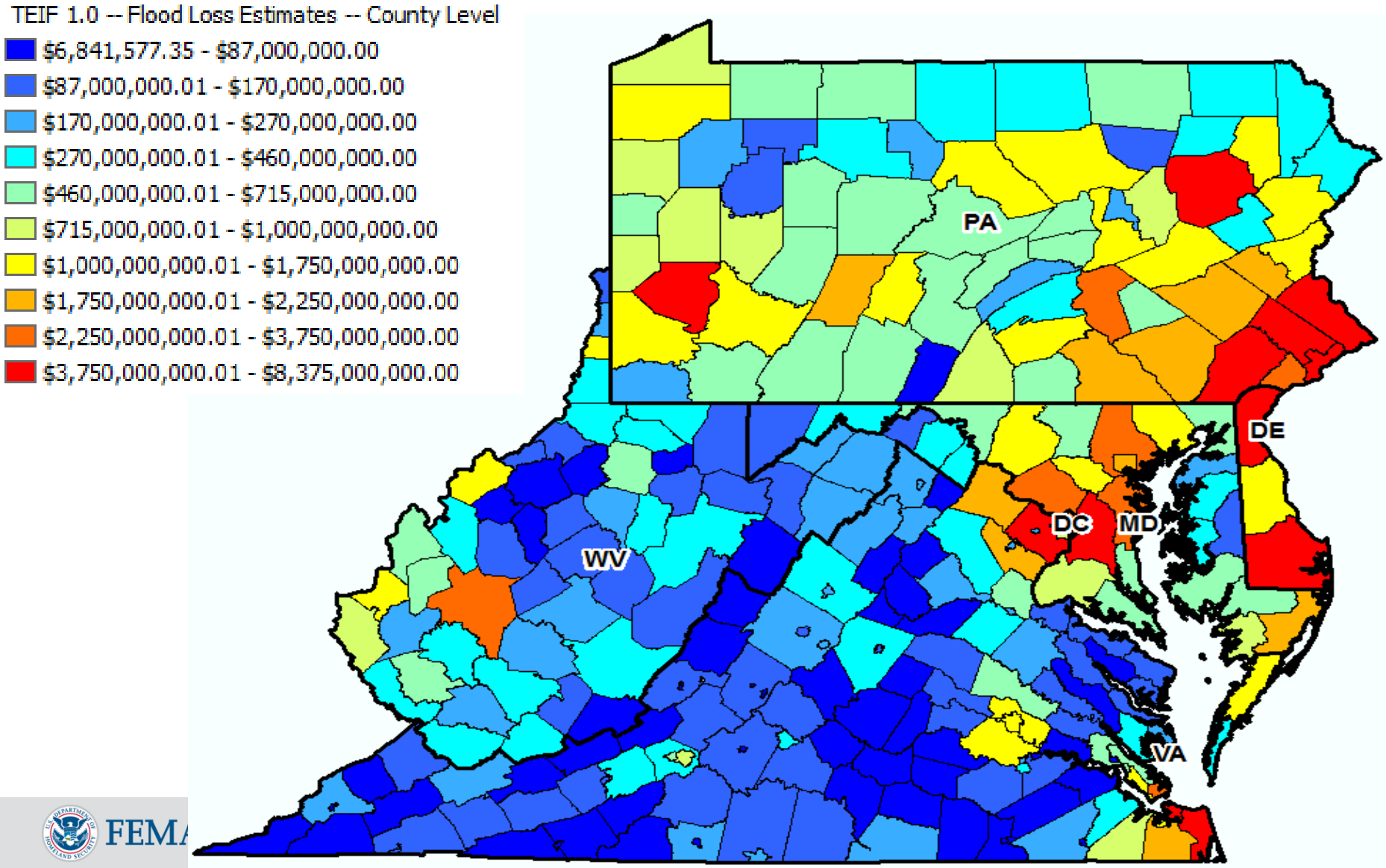
- **Counties with high resolution topo data – Preferably LiDAR, OR**
- **Counties with a building footprint/point shapefile,**
  - Either should be representative of current development
- **Priority given to areas with….**
  - High risk to riverine and/or coastal flooding
  - Increasing population in the SFHA
  - Deficient geospatial data
    - Building replacement value, Age, Total built area, FFE, Occupancy type (land use)

TEIF Live Demo

- http://bit.ly/1r1vRBg



TEIF Demo


TEIF 1.0 -- Flood Loss Estimates -- County Level
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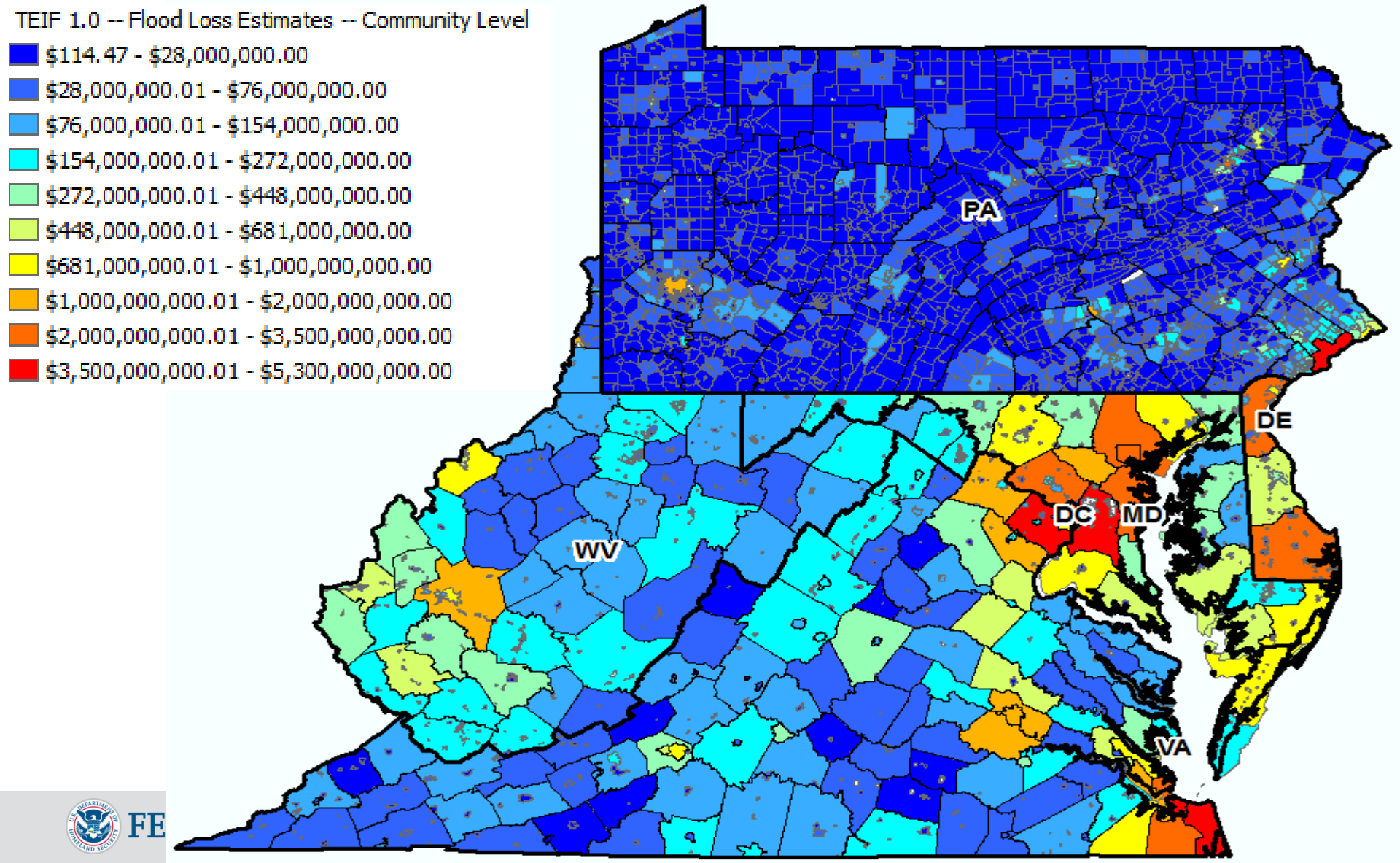
$87,000,000.01 - $170,000,000.00
$170,000,000.01 - $270,000,000.00
$270,000,000.01 - $460,000,000.00
$460,000,000.01 - $715,000,000.00
$715,000,000.01 - $1,000,000,000.00
$1,000,000,000.01 - $1,750,000,000.00
$1,750,000,000.01 - $2,250,000,000.00
$2,250,000,000.01 - $3,750,000,000.00
$3,750,000,000.01 - $8,375,000,000.00
PA
DE
DC
MD
WV
VA

TEIF Demo


TEIF 1.0 -- Flood Loss Estimates -- Community Level
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$28,000,000.01 - $76,000,000.00
$76,000,000.01 - $154,000,000.00
$154,000,000.01 - $272,000,000.00
$272,000,000.01 - $448,000,000.00
$448,000,000.01 - $681,000,000.00
$681,000,000.01 - $1,000,000,000.00
$1,000,000,000.01 - $2,000,000,000.00
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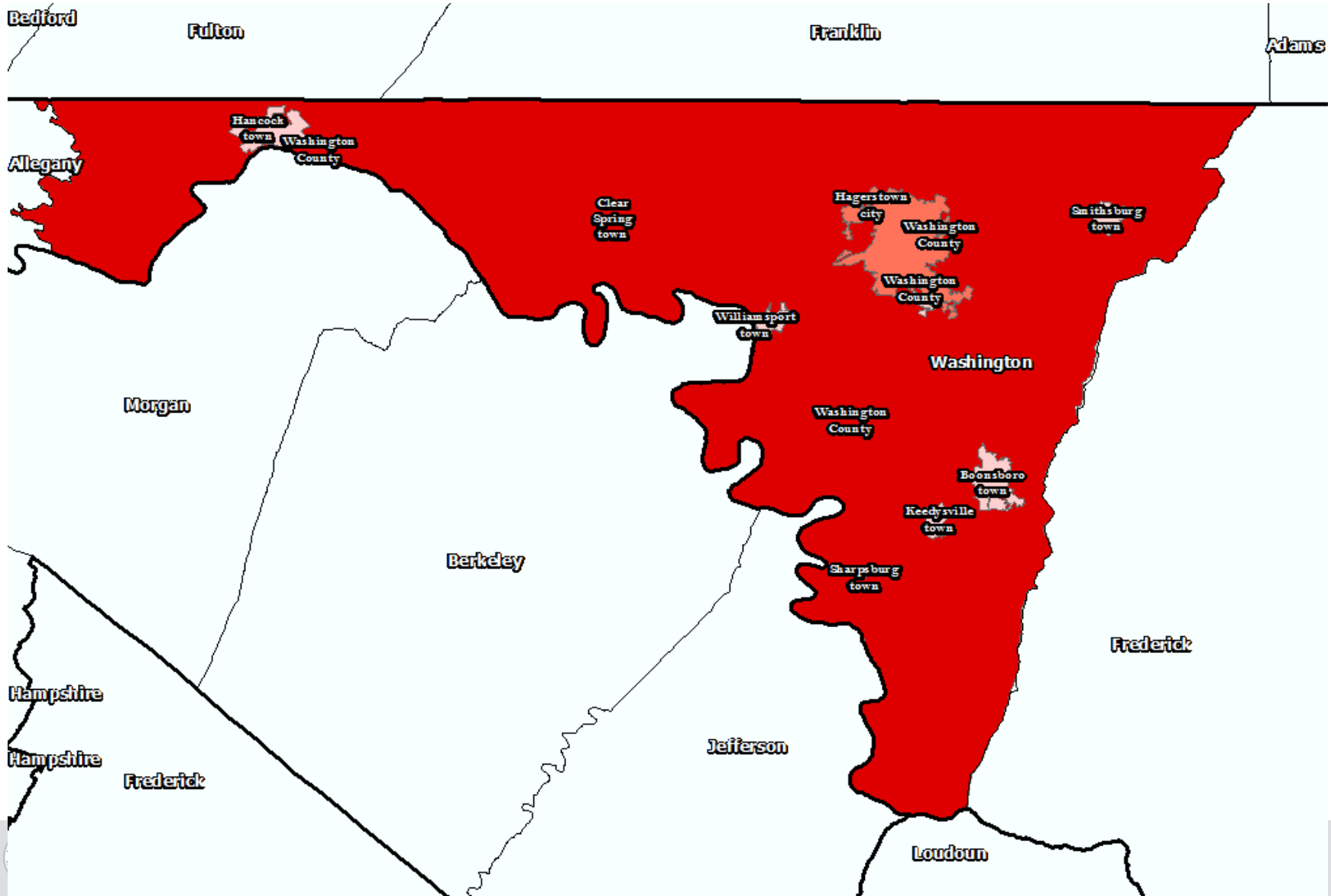
TEIF Demo


Bedford
Fulton
Franklin
Adams
Hancock town
Washington County
Allegany
Clear Spring town
Hagerstown city
Washington County
Smithsburg town
Washington County
Williamsport town
Washington
Morgan
Washington County
Boonsboro town
Keedysville town
Berkeley
Sharpsburg town
Frederick
Hampshire
Hampshire
Frederick
Jefferson
Loudoun

Questions and Contact Info

- **Tess Grubb – Risk MAP Project Monitor**
  - Therese.Grubb@fema.dhs.gov
- **Cynthia McCoy – Risk Analyst**
  - Cynthia.Mccoy@fema.dhs.gov
- **Mike McGeehin – RAMPP GIS Lead**
  - mmcgeehin@dewberry.com
- **Glenn Locke – Tetratech Regional Program Lead**
  - glenn.locke@tetratech.com