Modernization Updates: Functional Enhancements
August 5, 2014

Upcoming Functional Enhancements:

1. Alignment of the Benefit Cost Analysis (BCA) and Hazus-MH Flood Model Coastal depth-damage functions
2. Study region aggregation by CID community
3. Dasymetric general building stock exposure distribution approach based on national land cover data

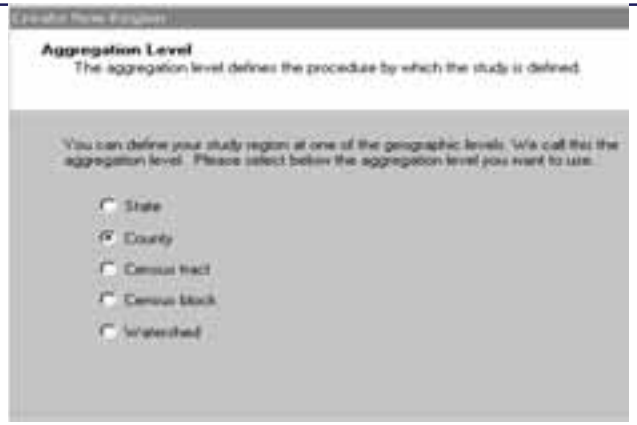
1. Benefit Cost Analysis (BCA) Alignment for Damage Functions

- Hazus currently provides an extensive Depth Damage Function (DDF) library that was initially used for the BCA tools modernization effort several years ago.
- Our BCA program within the Mitigation Directorate at FEMA is critically important in ensuring that our mitigation investments and sound and cost effective.
- This task will incorporate the latest additional DDFs from the BCA program recently developed for coastal flooding.
- This task enhances our alignment with FIMA programs and ensures Hazus loss projections can align with BCA benefit assessments.

2. Community-level Hazus-MH Study Region Aggregation

- Currently, the Hazus-MH study region aggregation is by
  - State
  - County
  - Census Tract
  - Census Block (flood), and
  - Watershed

- The proposed Hazus-MH study region aggregation will add
  - State
  - County
  - Census Tract
  - Census Block (flood), and
  - Watershed
  - Community

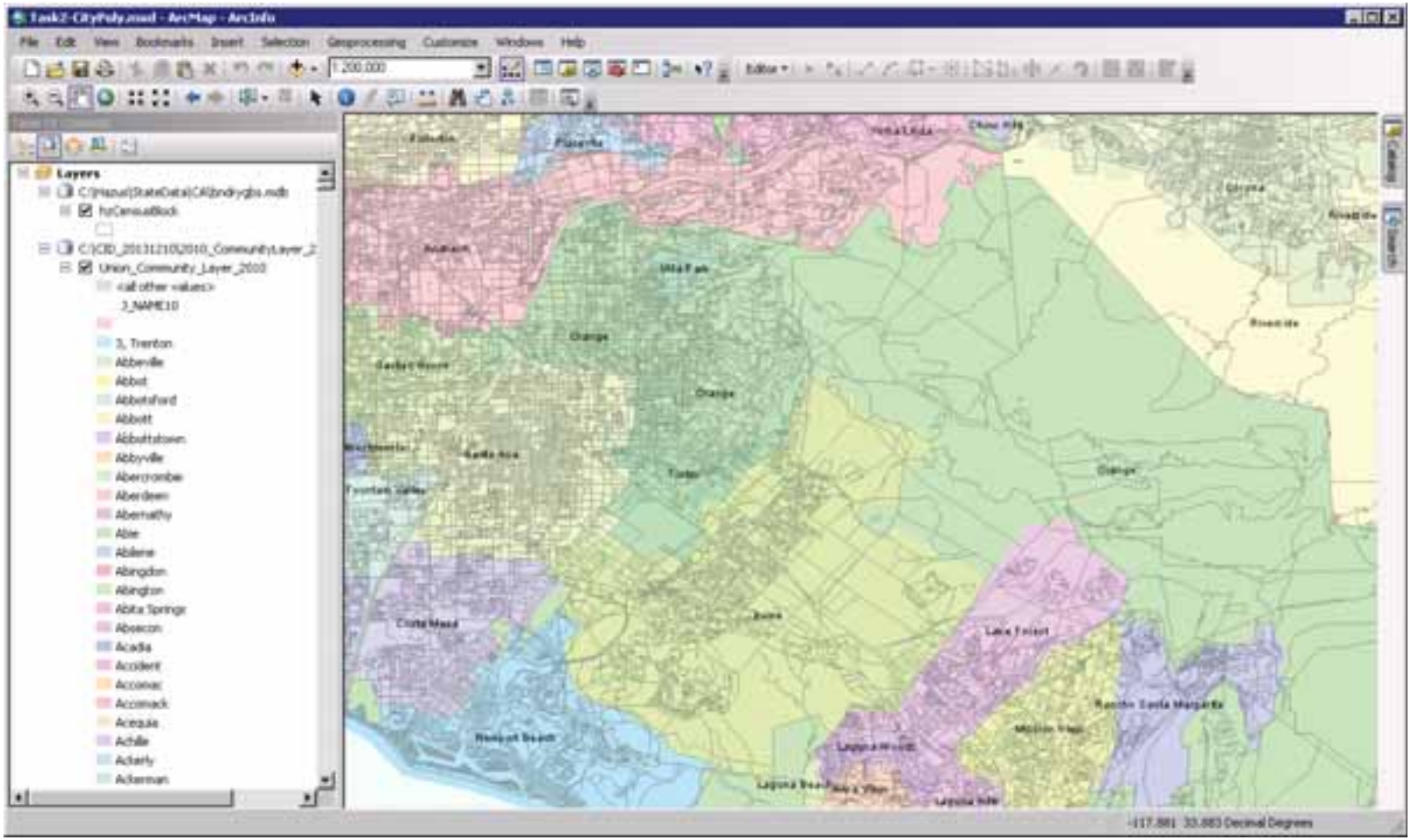


2. Community-level Hazus-MH Study Region Aggregation

- **Benefits:**

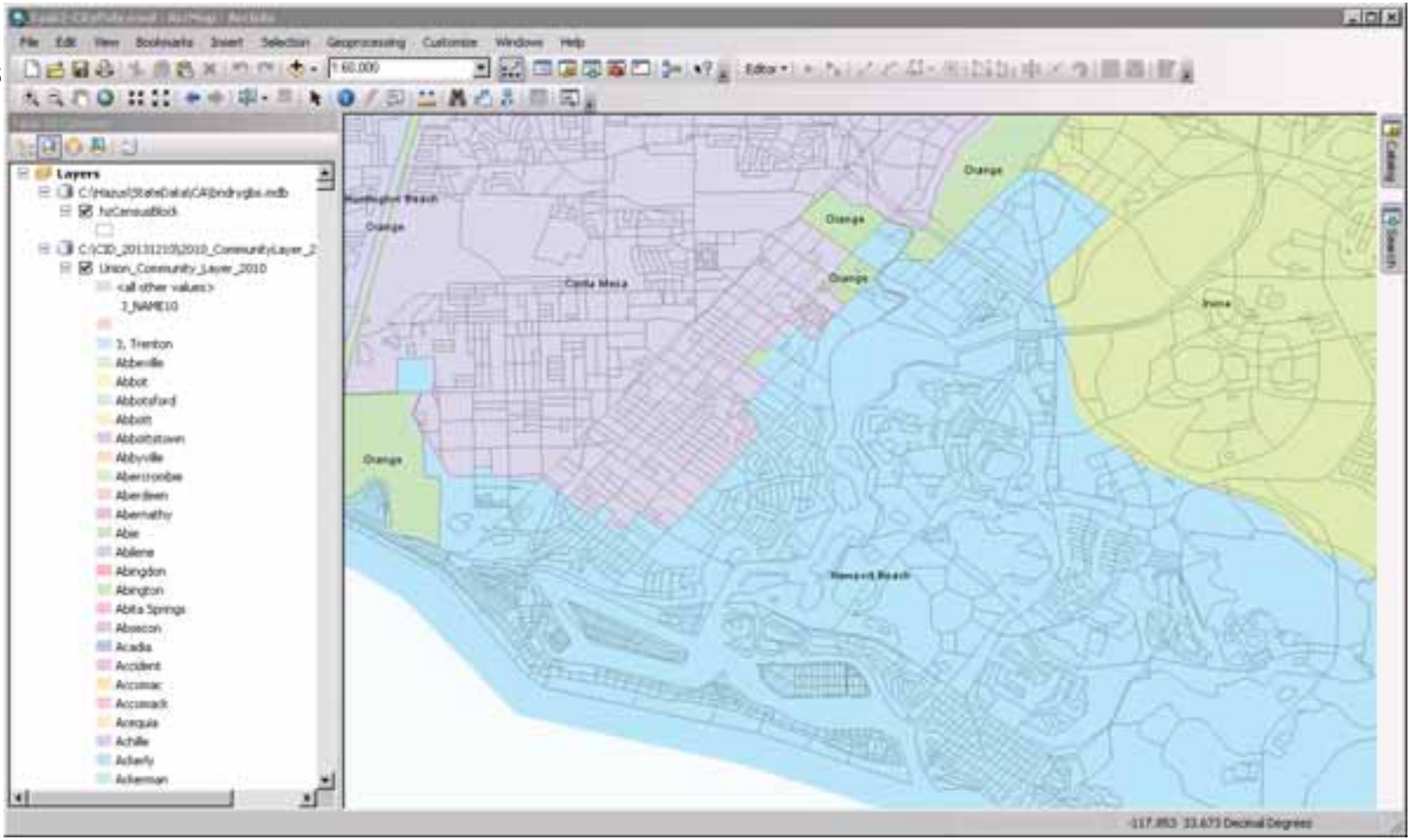
Aligned with

- FIMA programs
- NFIP communities
- Mitigation Plan completion and tracking database
- It will allow for jurisdiction analysis by city
- Non-incorporated county land
- tribal area



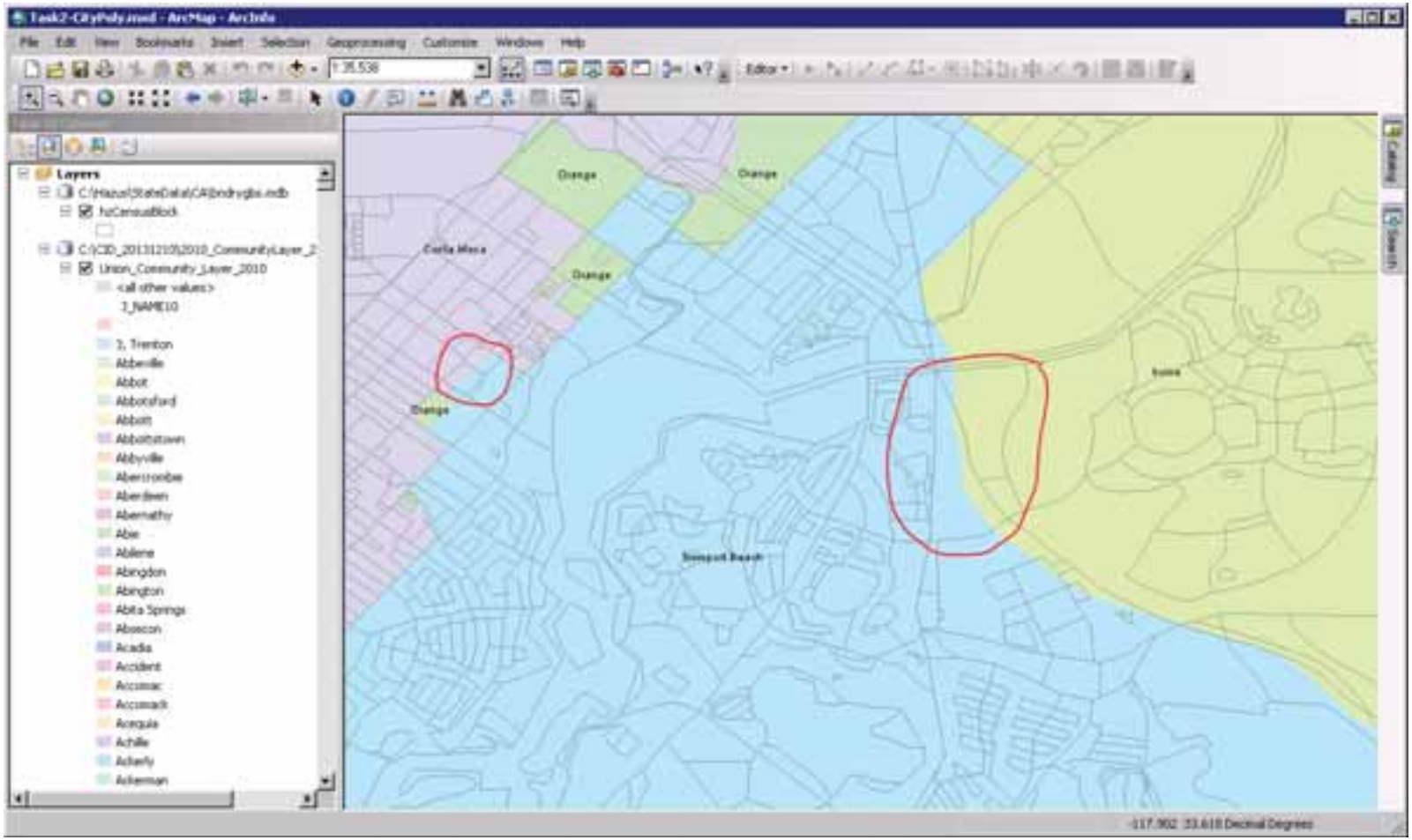
2. Community-level Hazus-MH Study Region Aggregation

- **Q: How?**
- **A:** pre-process Census Blocks (grey outline) that are completely contained in each CID community bounding polygon (in color)



2. Community-level Hazus-MH Study Region Aggregation

- **Challenge:** some city boundaries cut through CB, which is the smallest Hazus entity.
- City-County boundary – assign CB to city
- City-city boundary examples:
- Newport Beach and Costa Mesa
- Newport Beach and Irvine



3. Dasymetric GBS exposure distribution approach

- **Background**
- In the past several years the Hazus-MH Flood Model users have been avoiding the **General Building Stock (GBS)** analysis in favor of the **User-Defined Facility (UDF)** analysis
  - **Eliminate inherent inaccuracy** associated with the Hazus-MH Flood Model default Census Block (CB) **homogenous distribution**
  - **Increase** the flood risk assessment **location accuracy**

3. Dasymetric GBS exposure distribution approach

- **Why use dasymetric?**
  - Hazus-MH is in its **second decade of existence** and reaching the original paradigm's maturity.
  - Hazus-MH is facing the **new paradigm challenges**.
  - As the number of Hazus-MH users **continues to grow including internationally**, so do the types of uses.
  - In order to keep its relevance Hazus-MH **needs to evolve** and **answer to the increasing demands** of its users.
  - Hazus-MH can benefit from the latest trends in the use of dasymetric mapping approach **while keeping its methodology, code** and **data integrity.**
  - Great timing for the two spatial datasets converging on Hazus-MH –
    - **National Land Cover Dataset (NLCD) 2011** with a greatly improved Landsat quality became availabe in April
    - **Census 2010 TIGER and attribute data** just got updated for Hazus

3. Dasymetric GBS exposure distribution approach

- The Hazus-MH Flood Model **challenge-du-jour**:
  - **Q: How to adapt the original homogenous CB building exposure** and **content distribution** to only the built-up locations on the ground that are used in the GBS at the CB-level?
  - A: Use **dasymetric** CB exposure distribution
  - **Q: How to avoid the insurmountable UDF data maintenance task** while having a **improving** the spatial accuracy of the GBS exposure?
  - A: Use **dasymetric** model to intersect NLCD-TIGER polygons to filter out non-built-up areas
  - Q: How about migrating the dasymetric Census 2010 to newer state data?
  - A: Using a **dasymetric** model, preprocess and release the newer Census state data

3. Dasymetric GBS exposure distribution approach

- **History**
- At the March, 2011 Flood Committee meeting the idea of Hazus Flood shifting from uniform to dasymetric GBS exposure distribution was presented.
- In the NIBS "*Final IV&V Report*" report, Chapter 4, page 14, the Flood Committee recommends under **High Priority Tasks – Low Time and Cost to Accomplish** Recommendation #2 - to implement the **dasymetric distribution approach** in the Flood model.
- As a follow up, an August, 2012 "*Hazus-MH dasymetric exposure distribution approach*" white paper provided a detailed **description of the seamless integration of the dasymetric approach** in the Hazus Flood Model.
- Proof of Concept (POC) for the state of Rhode Island showing a **significant (40-50%) dasymetric loss estimate reduction as compared to the uniform exposure distribution**. This falls in line with the nationwide AAL assessment performed in 2009.
- At the June 17, 2013 Flood Committee teleconference discussing "*Five Hazus Flood Model Exposure Distribution Approaches*" the **dasymetric GBS exposure distribution was overwhelmingly favored** by the whole committee.

3. Dasymetric GBS exposure distribution approach

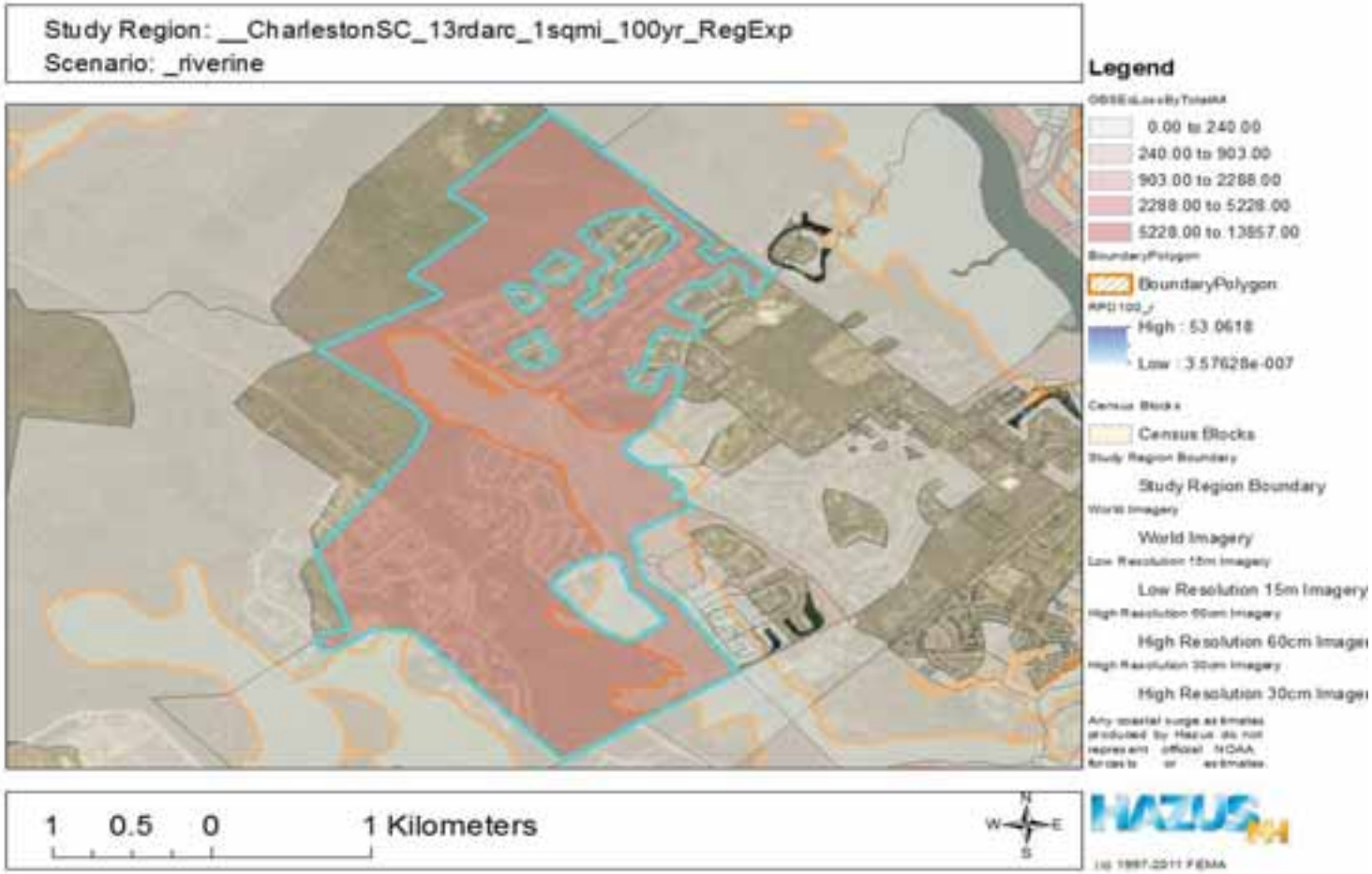
- Use of NLCD Land Use Land Cover (LULC)
- Suggested inclusion of NLCD 2011 LULC codes:
  - 21 – Developed, Open Space
  - 22 – Developed, Low Intensity
  - 23 – Developed, Medium Intensity
  - 24 – Developed, High Intensity
  - 81 – Pasture/Hay
  - 82 – Cultivated Crops
- Suggested exclusion of NLCD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

NLCD Land Cover Classification Legend

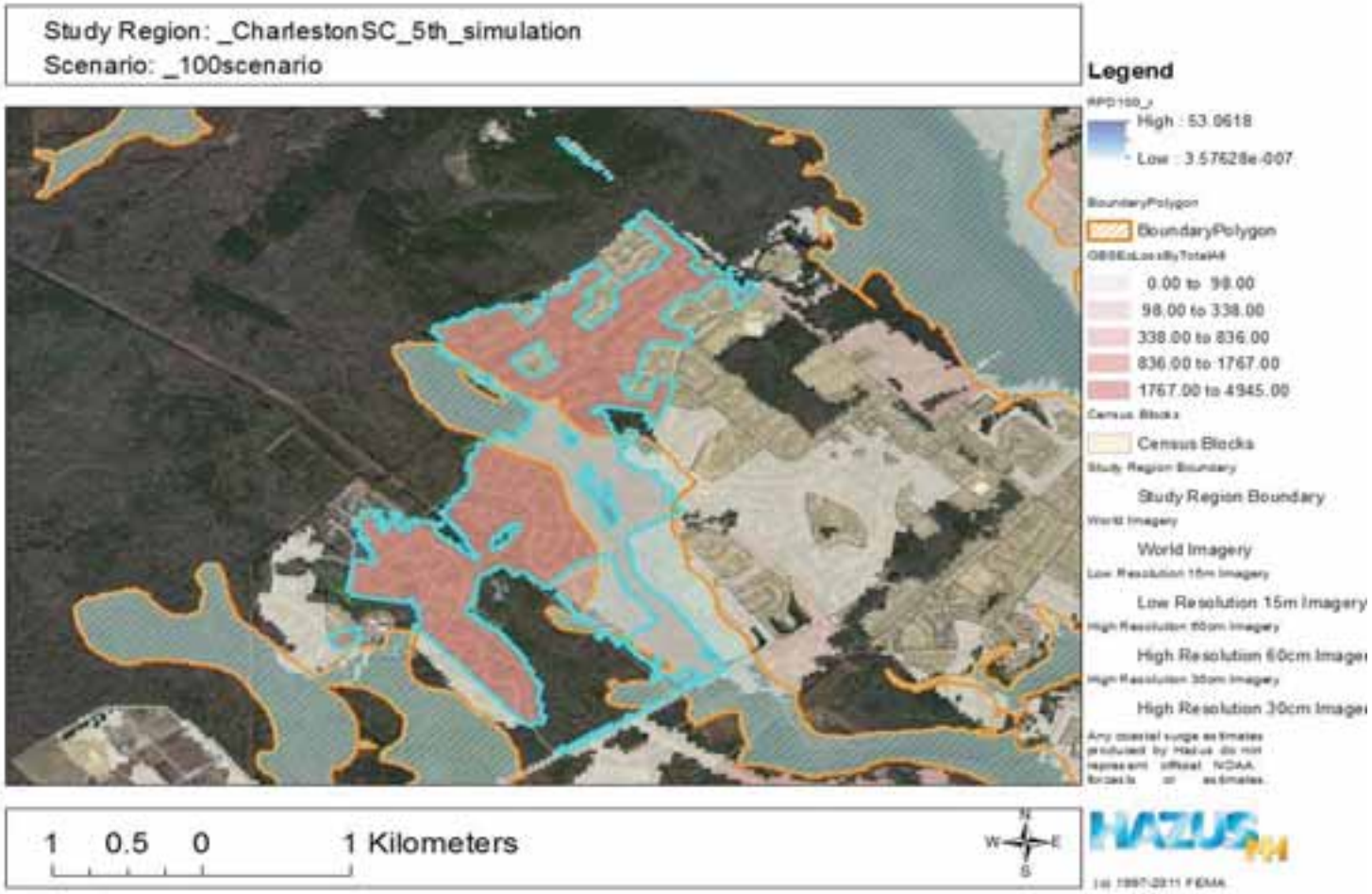
- 11 Open Water
- 12 Perennial Ice/ Snow
- 21 Developed, Open Space
- 22 Developed, Low Intensity
- 23 Developed, Medium Intensity
- 24 Developed, High Intensity
- 31 Barren Land (Rock/Sand/Clay)
- 41 Deciduous Forest
- 42 Evergreen Forest
- 43 Mixed Forest
- 51 Dwarf Scrub*
- 52 Shrub/Scrub
- 71 Grassland/Herbaceous
- 72 Sedge/Herbaceous*
- 73 Lichens*
- 74 Moss*
- 81 Pasture/Hay
- 82 Cultivated Crops
- 90 Woody Wetlands
- 95 Emergent Herbaceous Wetlands

* Alaska only

3. Dasymetric GBS exposure distribution approach – homogeneous results



3. Dasymetric GBS exposure distribution approach – dasymetric results



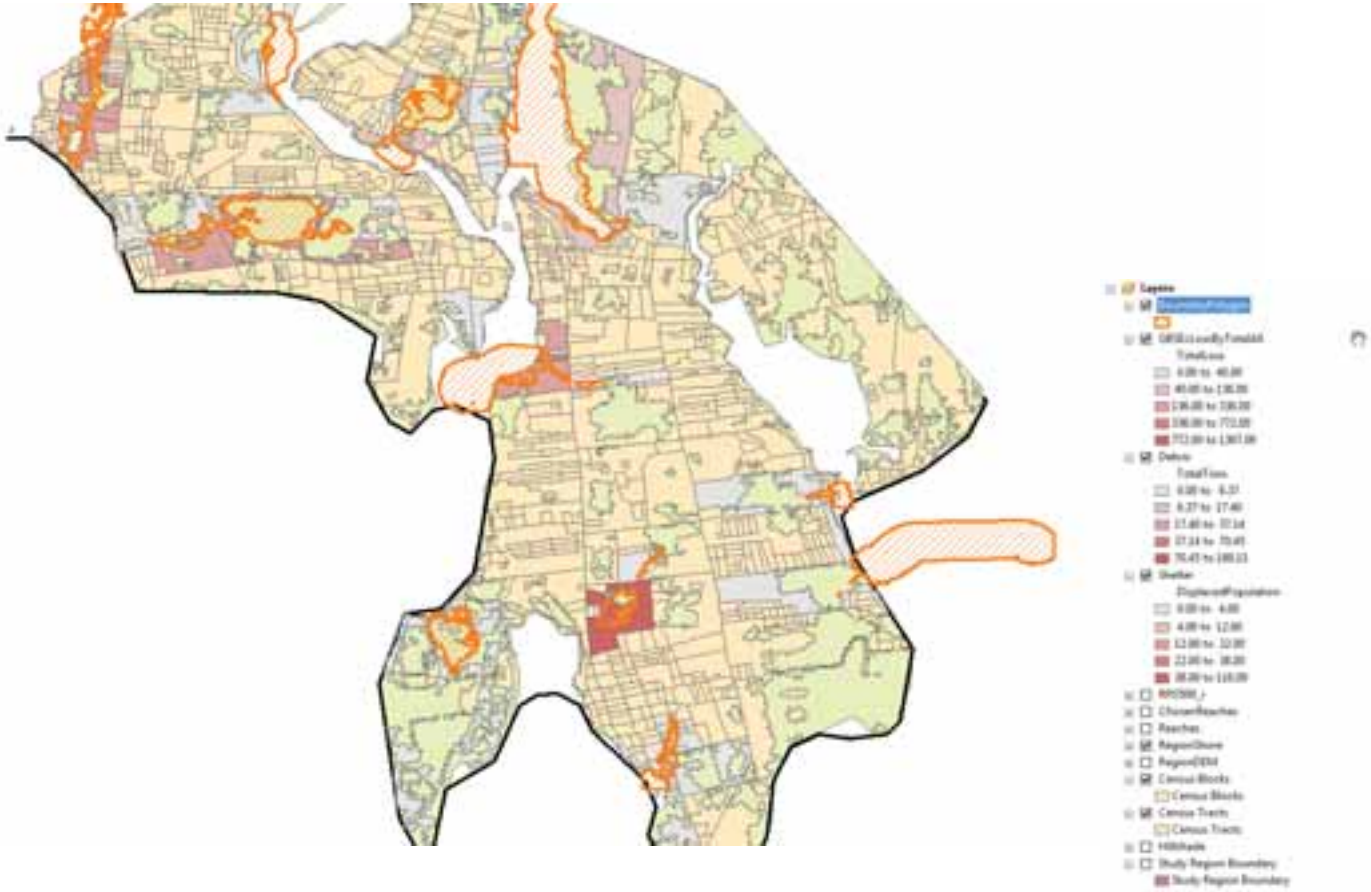
3. Dasymetric GBS exposure distribution approach – results comparison

Simulation	Total Loss	Building Loss	Contents Loss	Exposure	Cont Exposure	Total Exposure
Homogenous	$6,892	$4,107	$2,721	$327,528	$163,764	$491,292
Dasymetric	*$8,274*	*$4,945*	*$3,255*	*$327,528*	*$163,764*	*$491,292*

- In comparison the total losses increased from Homogenous distribution of $6.892 million to $8.274 million in the Dasymetric simulation, or **20.1% total loss increase** for this particular CB 450190026093031 in Charleston, SC

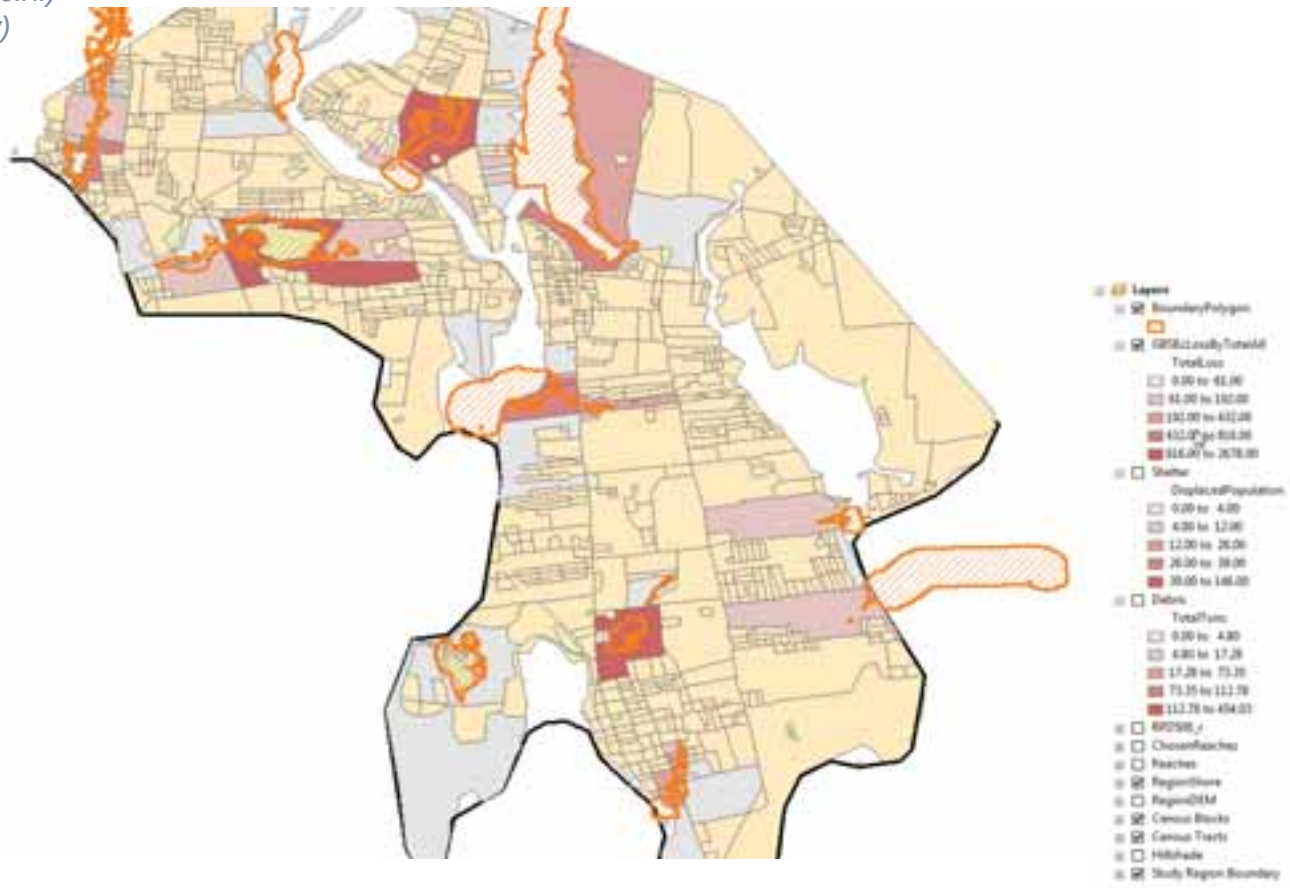
Direct Economic Loss for Buildings – Dasymetric distribution

Study Region: Bristol, RI (_BristolRI)
Scenario: Riverine only (rivOnly)
State Data: dassymetric
DELB Full Replacement:



Direct Economic Loss for Buildings – Homogeneous distribution

Study Region: Bristol, RI (_BristolRI)
Scenario: Riverine only (rivOnly)
State Data: homogeneous
DELB Full Replacement:



Direct Economic Loss for Buildings – Dasymetric distribution

Direct Economic Losses for Buildings

August 23, 2012

All values are in thousands of dollars

	Capital Stock Losses				Income Losses				
	Building Loss	Contents Loss	Inventory Loss	Building Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Rhode Island									
Bristol	2,814	2,754	26	0.50	4	1	5	0	5,604
Total	2,814	2,754	26	0.50	4	1	5	0	5,604
Scenario Total	2,814	2,754	26	0.50	4	1	5	0	5,604

Totals only reflect data for those census tracts /blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region: _BristolRI
Scenario: rivOnly
Return Period: 500

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Direct Economic Loss for Buildings – Homogeneous distribution

Direct Economic Losses for Buildings

August 23, 2012

All values are in thousands of dollars

	Capital Stock Losses				Income Losses				
	Building Loss	Contents Loss	Inventory Loss	Building Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Rhode Island									
Bristol	4,472	4,516	52	0.70	9	6	11	0	9,066
Total	4,472	4,516	52	0.70	9	6	11	0	9,066
Scenario Total	4,472	4,516	52	0.70	9	6	11	0	9,066

Totals only reflect data for those census tracts /blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

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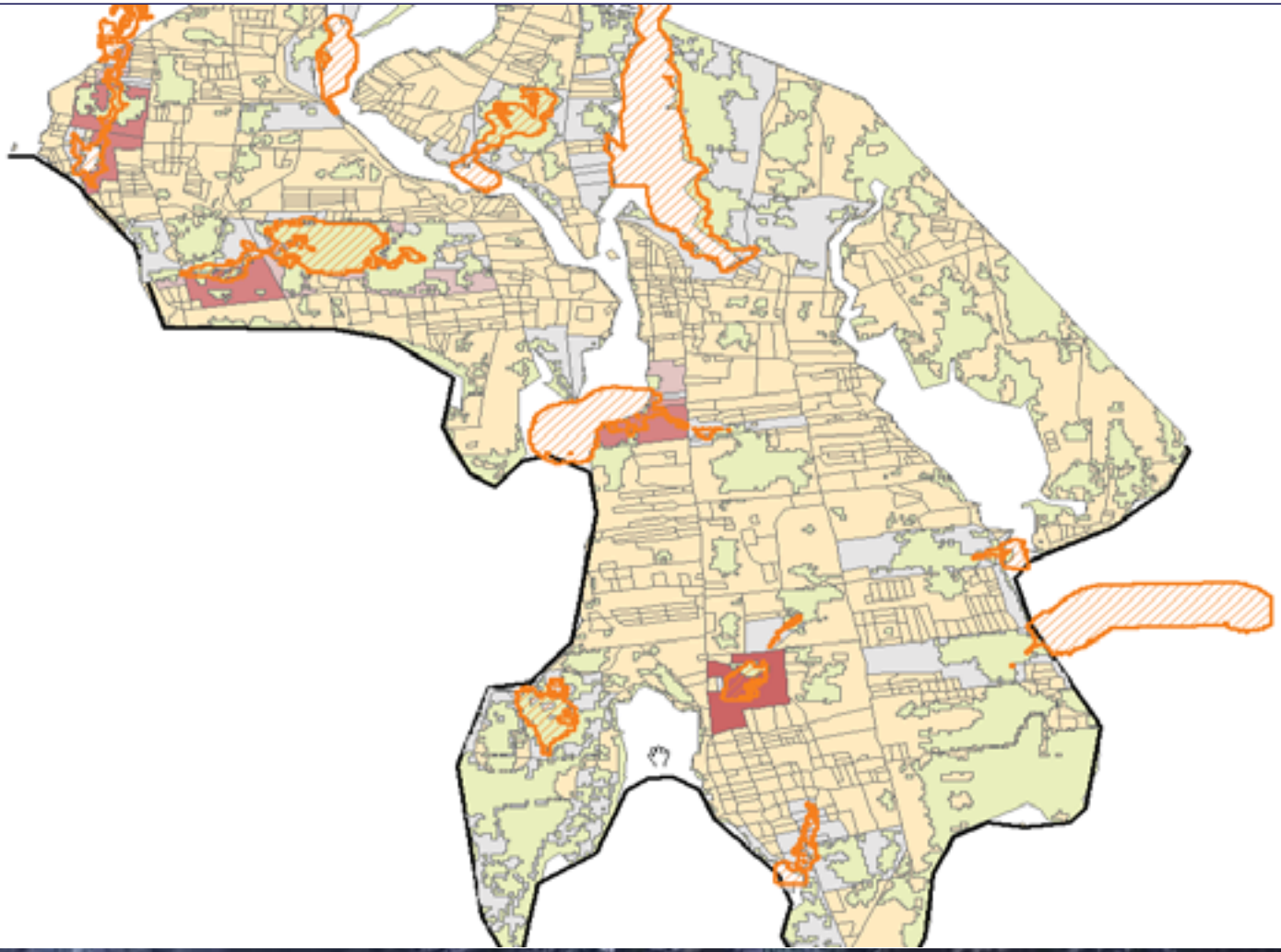
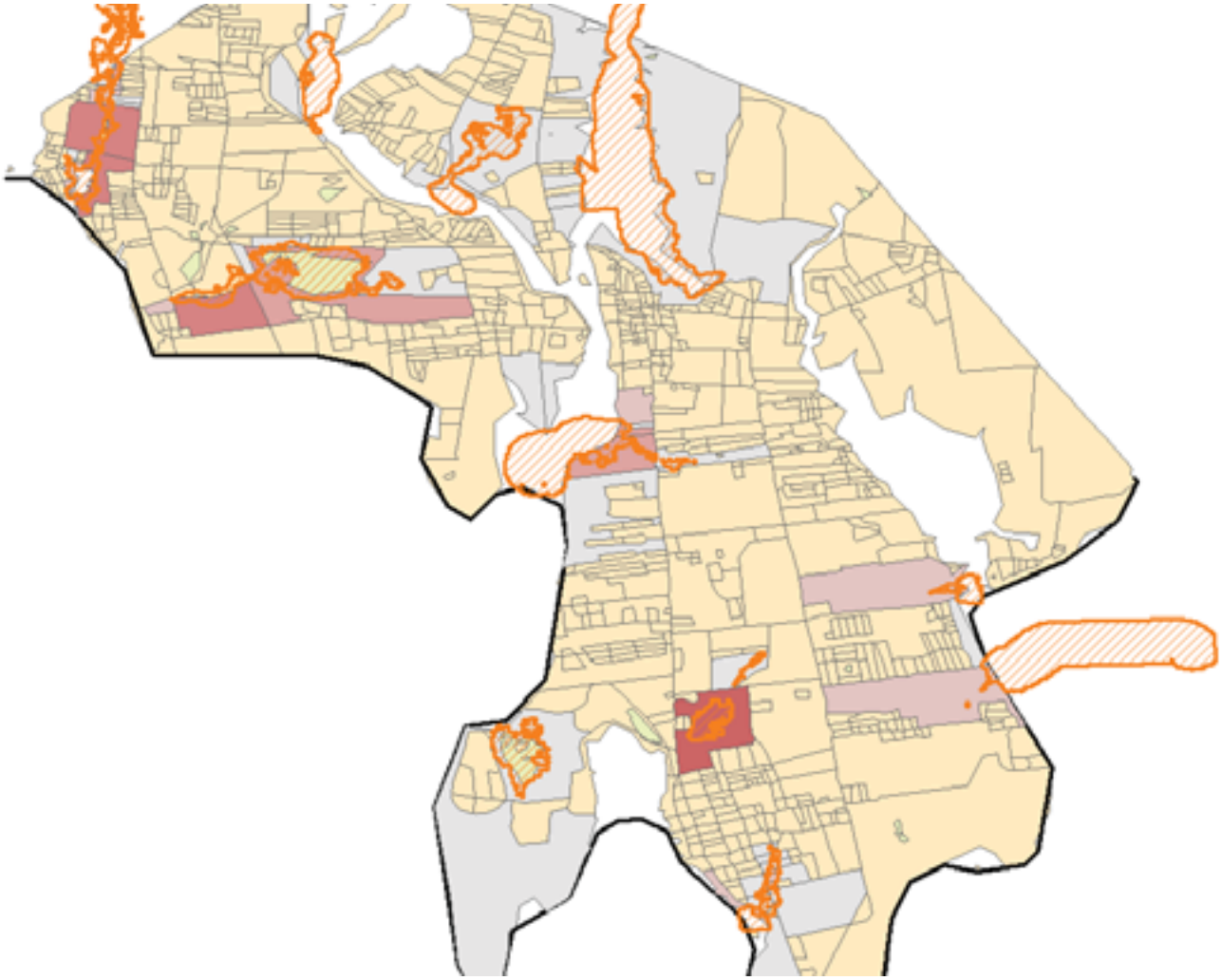
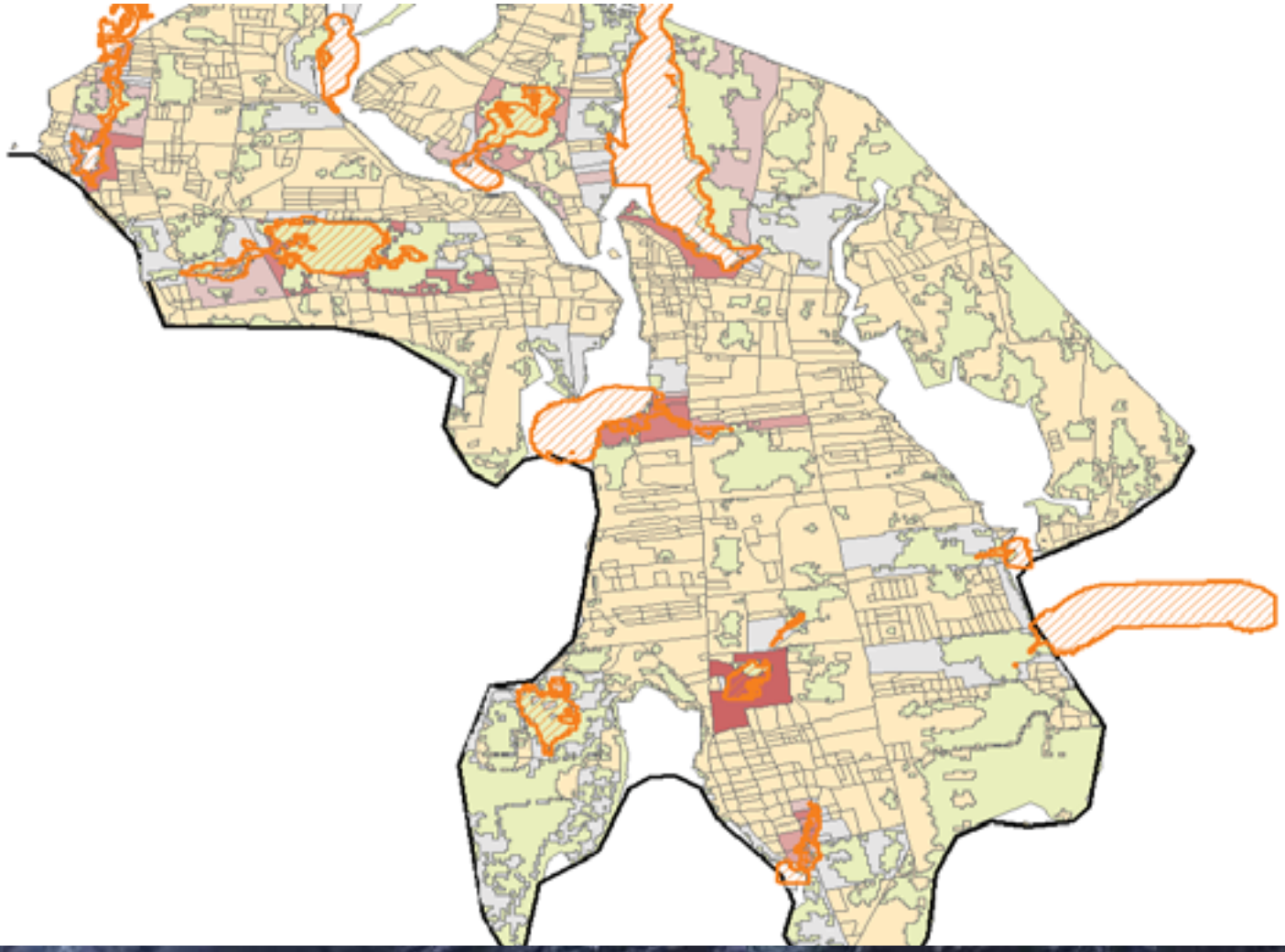
Debris – Dasymetric distribution



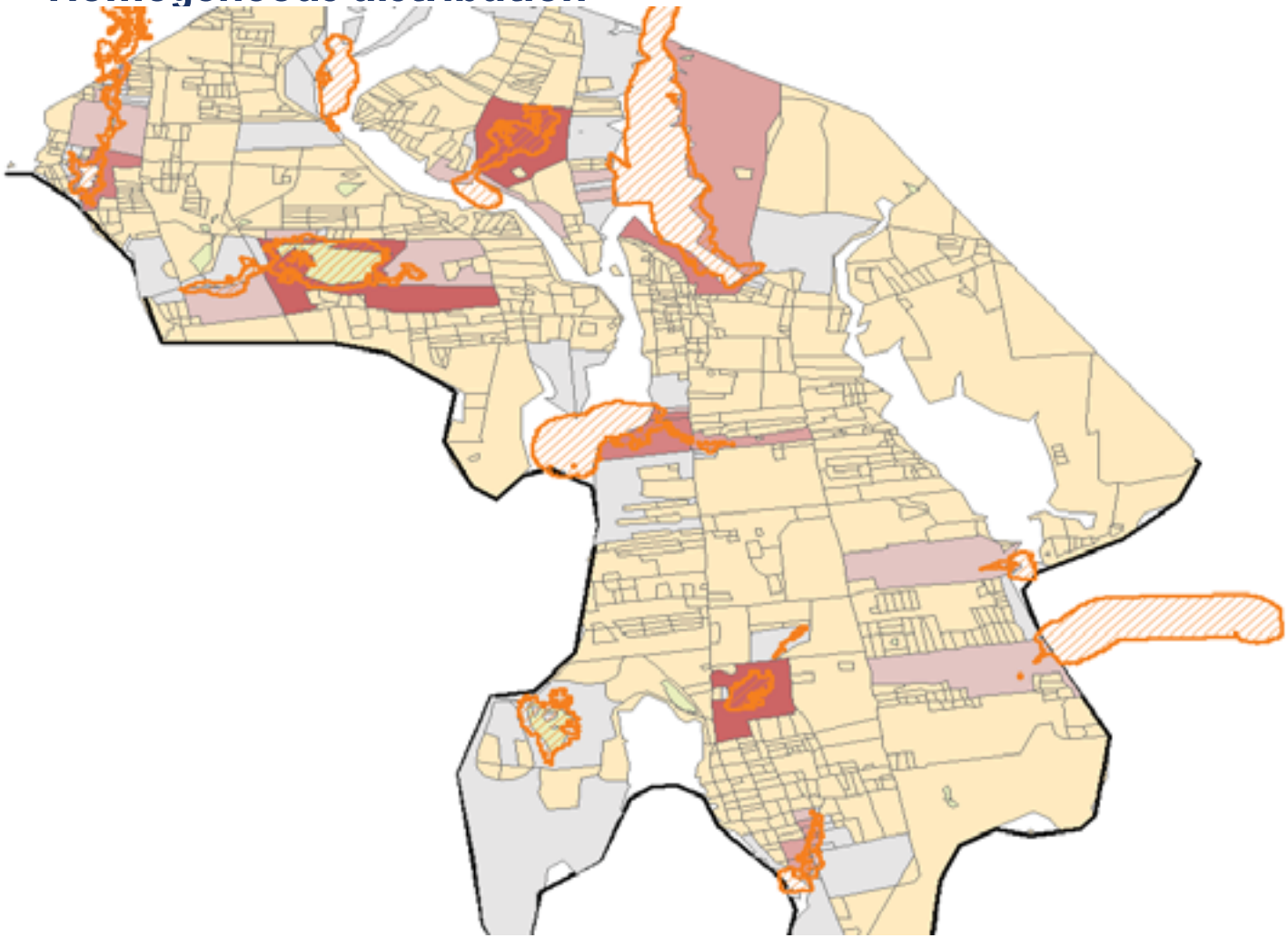
Debris – Homogeneous distribution



Shelter – Dasymetric distribution



Shelter – Homogeneous distribution



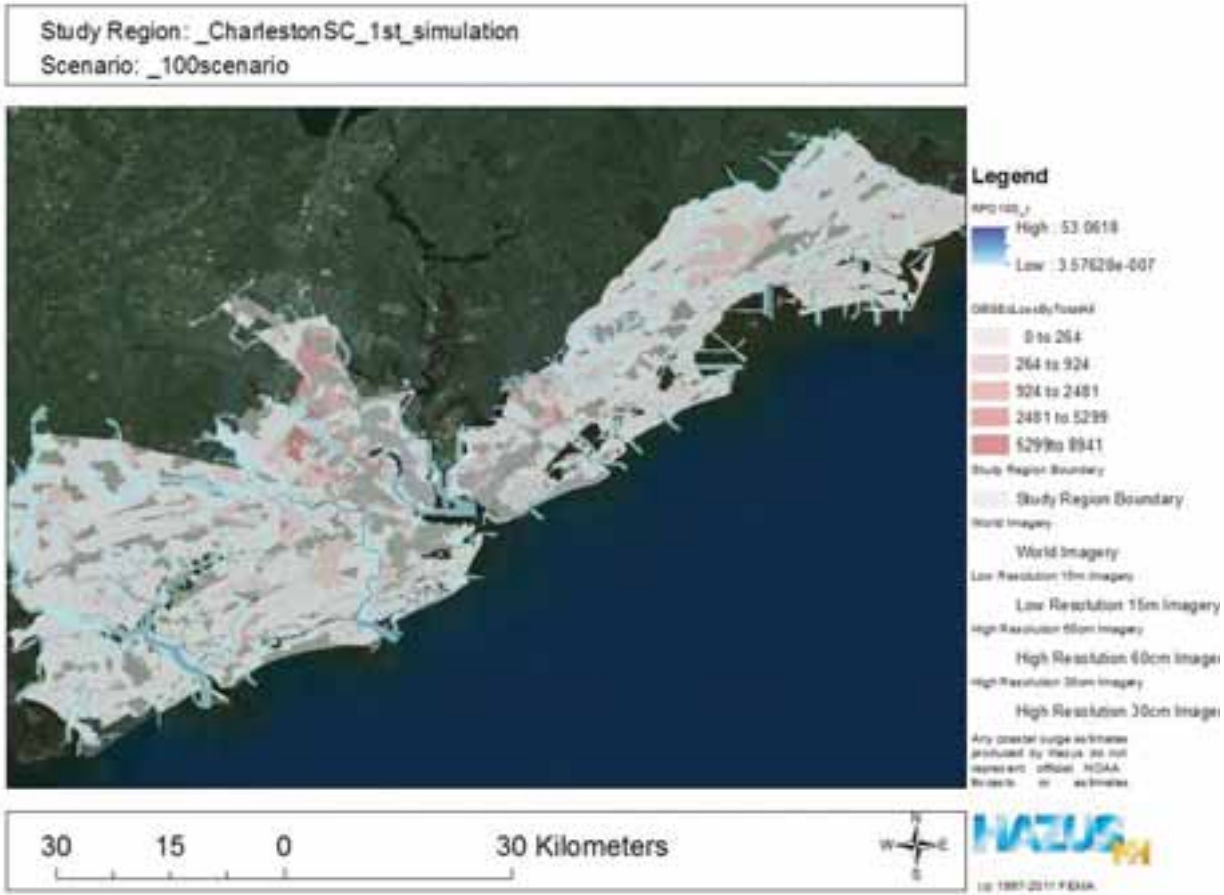
3. Dasymetric GBS exposure distribution approach – to do list

- Committee members were in favor of **sample size increase**
- ...use of FEMA **regulatory depth grids** instead of generic Level 1 approximation
- ...**research** and **use weighting factors** between built-up environment

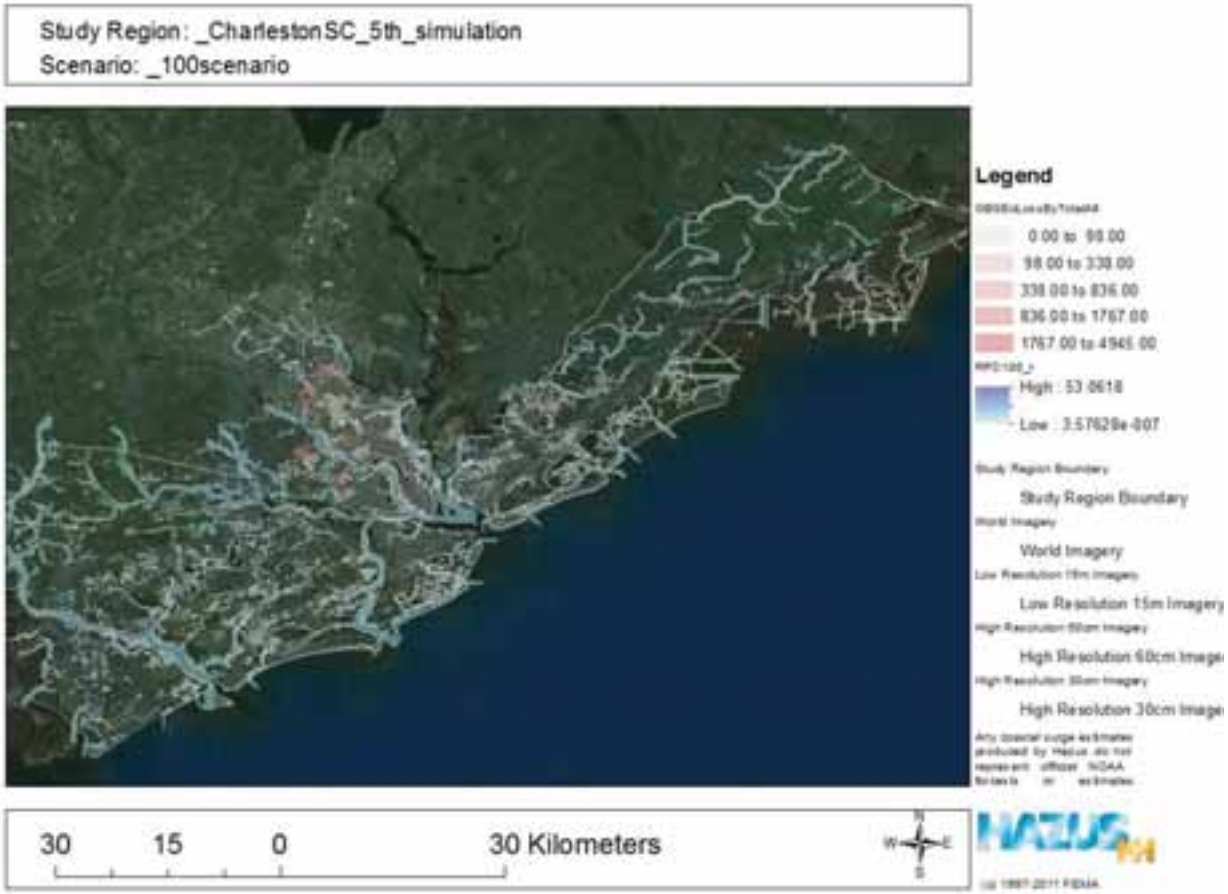
LULC Description	Weight Factor
High Intensity Developed	4.0
Medium Intensity Developed	2.0
Low Intensity Developed	1.0
Open Developed	0.5

- ...use of any **other remote sensing products** to easily and acurately determine the built-up environment, in lieu of the 30m NLCD 2006, which is based primarily on the unsupervised classification of Landsat Enhanced Thematic Mapper+ (ETM+) circa 2006 satellite data
- The white paper "Hazus-MH dasymetric exposure distribution approach" is available at: ***https://dl.dropboxusercontent.com/u/8245789/Hazus-MHDasymetricExposureDistributionApproach.pdf***

Charleston, SC – Uniform distribution



Charleston, SC – Dasymetric distribution



Charleston, SC – Uniform vs Dasymetric distribution

The Level 1 Hazus Flood dasymetric analysis with 2012 property data replacing Census 2000 data was performed to the expected conservative limits for the riverine 100 year dasymetric with loss of a little over 50% of the uniform distribution exposure analysis losses.

Simulation	Total Loss	Building Loss	Contents Loss
#1 Uniform	$251,006	$153,448	$96,188
#5 Dasymetric	*$134,360*	*$82,092*	*$51,497*
	Total Exposure	**Bldg Exposure**	**Cont Exposure**
#1 Uniform	$46,041,243	$30,695,321	$15,345,922
#5 Dasymetric	*$46,041,243*	*$30,695,321*	*$15,345,922*
	Total Ratio	**Building Ratio**	**Contents Ratio**
#1 Uniform	0.55%	0.50%	0.63%
#5 Dasymetric	*0.29%*	*0.27%*	*0.34%*

Q&A

- For additional questions
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