

National Flood Risk Characterization Tool

Overview of Capabilities and Current Limitations



Overview of the *National Flood Risk Characterization Tool (NFRCT)*

- Map based viewer of relative flood risk around the U.S., with supporting reports for more detail
- Based on FEMA mapping of 1% and 0.2% chance events
- Three essential ingredients
 1. Innovative models to estimate flood depths and impacts
 2. Spatial overlay to aggregate results by watershed or county
 3. A fast, user-friendly interface for exploring results

Background & Purpose

- NFRCT Emerged from on-going Corps Contributions to FRM Study
1. Origin Purpose: Test the feasibility of identifying areas of relatively high flood risk using publically available, national-level data
 2. Re-purposed and modified to address Corps Watershed-Based Budgeting: New version of NFRCT allows flood risk metrics to be compared across HUC-8 (and larger) watersheds and is intended to support FRM budget decisions

Elements of Flood Risk in NFRCT

- NFRCT includes data on:
 - Hazard: flood depths across all NFHL floodzones
 - Consequences
 - Population exposure (current and future)
 - Asset exposure (residential, commercial, vehicles)
 - Asset damages (residential, commercial, vehicles)
 - Vulnerability (SoVI, exposure of critical facilities)

Input Data for NFRCT

- FEMA's NFHL
- USGS National Elevation Dataset
- National Watershed Boundary Dataset
- National Land Cover Dataset
- HAZUS asset inventories
- Census population and demographics
- Social Vulnerability Index
- USACE and HAZUS damage functions
- Population forecast

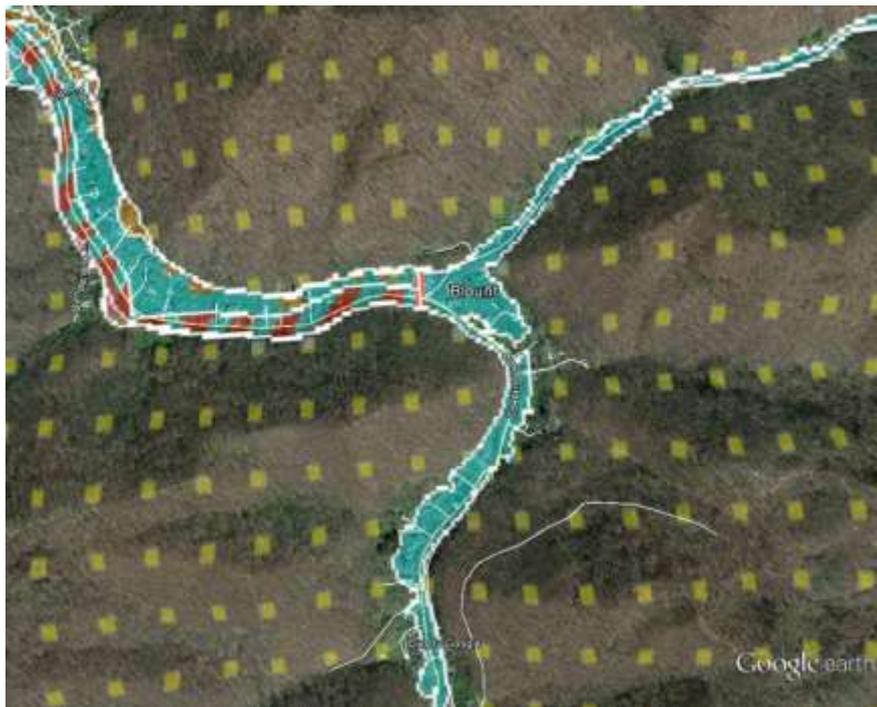
Estimating Flood Depths

1. Create polygons by intersecting NFHL Floodzones, HUC-8 watersheds and Census blocks
2. Perimeter of each floodzone is assumed to have zero depth
3. Sample perimeter points and use DEM to estimate elevation of flood surface
4. Sample interior points, elevation of water surface is estimated using a nearest-neighbor approach with perimeter elevations
5. Depths at interior points are computed as difference between water surface elevation from Step 4 and ground elevation from DEM
6. Identify each sampled point as urban or non-urban using National Land Cover Dataset
7. Compute distribution (percentiles) of depth for each area, separately for urban and non-urban

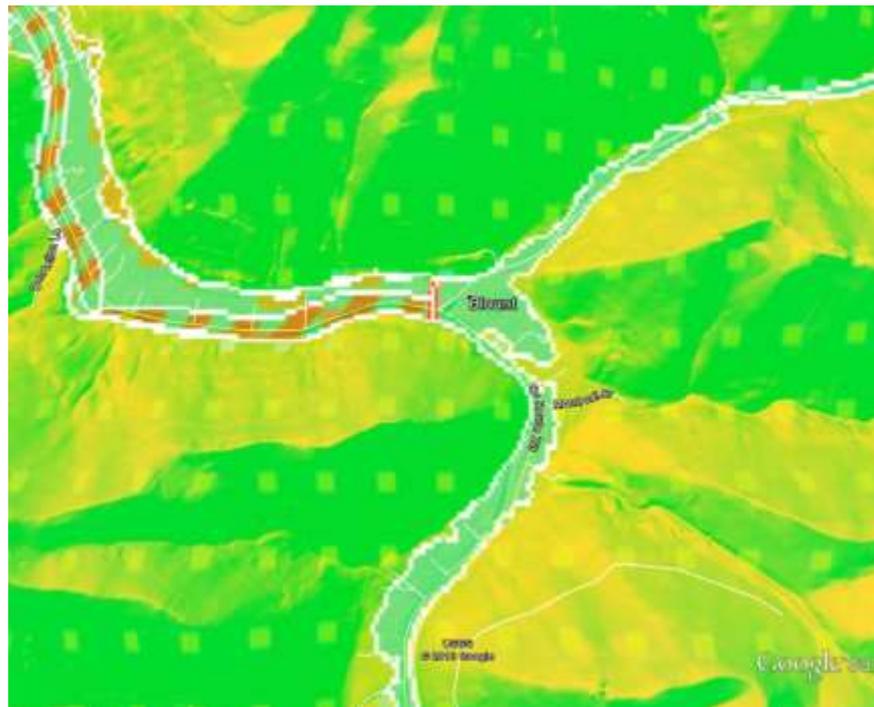
Key Innovation

- Using floodzone delineations and DEMs to estimate flood depth distributions across the nation

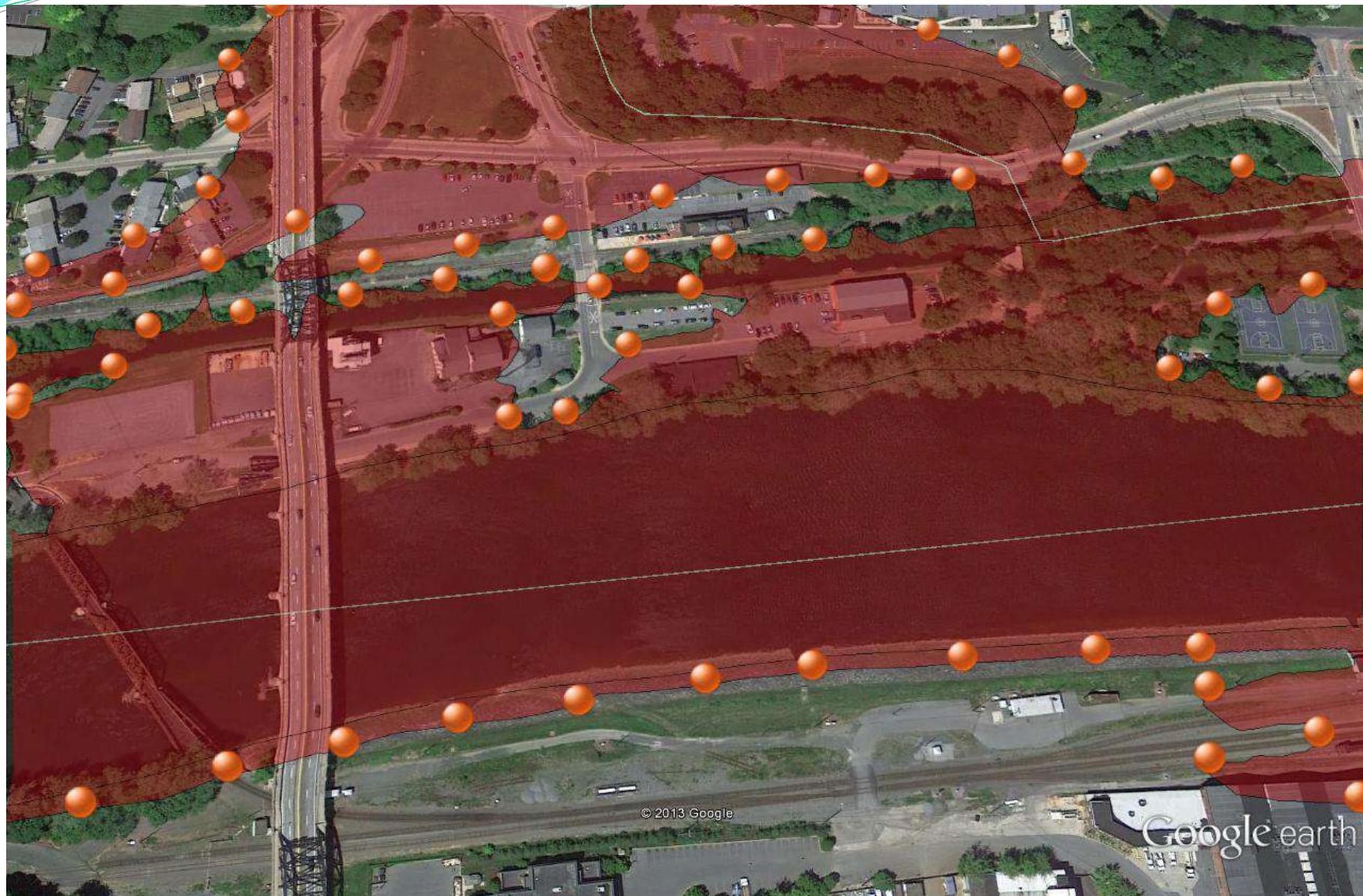
NFHL In Google Earth



NFHL & NED In Google Earth



NFHL 1% Zone, Sampled Perimeter Points



NFHL 1% Zone, Sampled Perimeter & Interior Points



Estimating Flood Depths

Important notes and caveats:

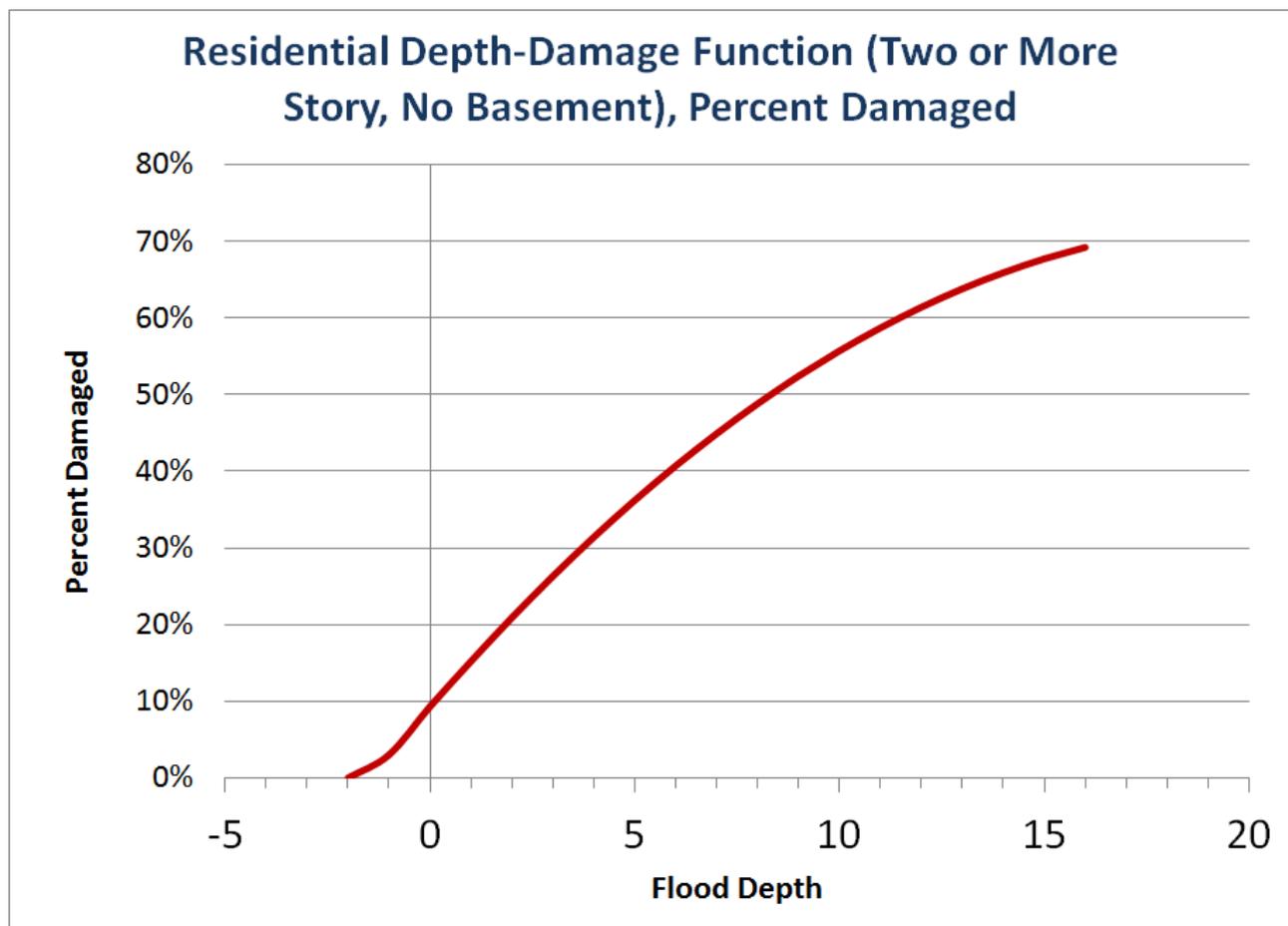
- NFHL includes only 1% annual chance and 0.2% annual chance events → A limited proxy for overall probability of flooding
- Does not address performance of infrastructure (e.g., probability and consequences of levee failure)
 - Areas with Accredited Levees are assumed low risk

Human and Asset Exposure

- General Building Stock Inventory (from HAZUS) and the Vehicle Location Estimation System (from HAZUS) are used to determine the number, type, and value of buildings and vehicles in each census block
- Census is used to determine population in Census blocks
- Assume population, structures and vehicles are evenly distributed throughout urban areas of Census blocks (using NLCD to ID urban)
- Exposure is proportional to the area overlapped by a floodzone
- E.g., if 25% of the urban portion of a Census block is overlapped by floodzone, then NFRCT assumes 25% of that block's population and assets would be exposed to the flood

Asset Damages

- The NFRCT applies USACE depth-damage functions



Asset Damages

- The NFRCT applies USACE depth-damage functions
- Building characteristics (# stories, first floor elevation, existence of basements) come from HAZUS and are based on regional building data
- Asset exposure data determines how many buildings are damaged and their value
- Total damage is calculated by using the depth distribution with the appropriate damage function
 - E.g., if 100 structures are exposed, 10 are assumed to be exposed to the 10th percentile depth and damages are calculated using that depth; 50 are exposed to the 50th percentile depth, and so on.
- Damages are calculated for each intersection area and aggregated by HUC-8 watersheds

Other Metrics

- Vulnerability
 - Estimates characteristics of exposed population: % over 65; % Non-White; % Living in Poverty; and Social Vulnerability Index
 - Exposure of emergency response facilities: police stations, fire stations, and hospitals
- Economic Activity
 - Total economic output of each watershed estimated based on county-level data from IMPLAN
- Future Population
 - Estimates of future population and employment growth are provided for each watershed (HUC-8) in order to distinguish areas of the country that are expected to experience relatively high growth over the next 25 years.

Structure the Data

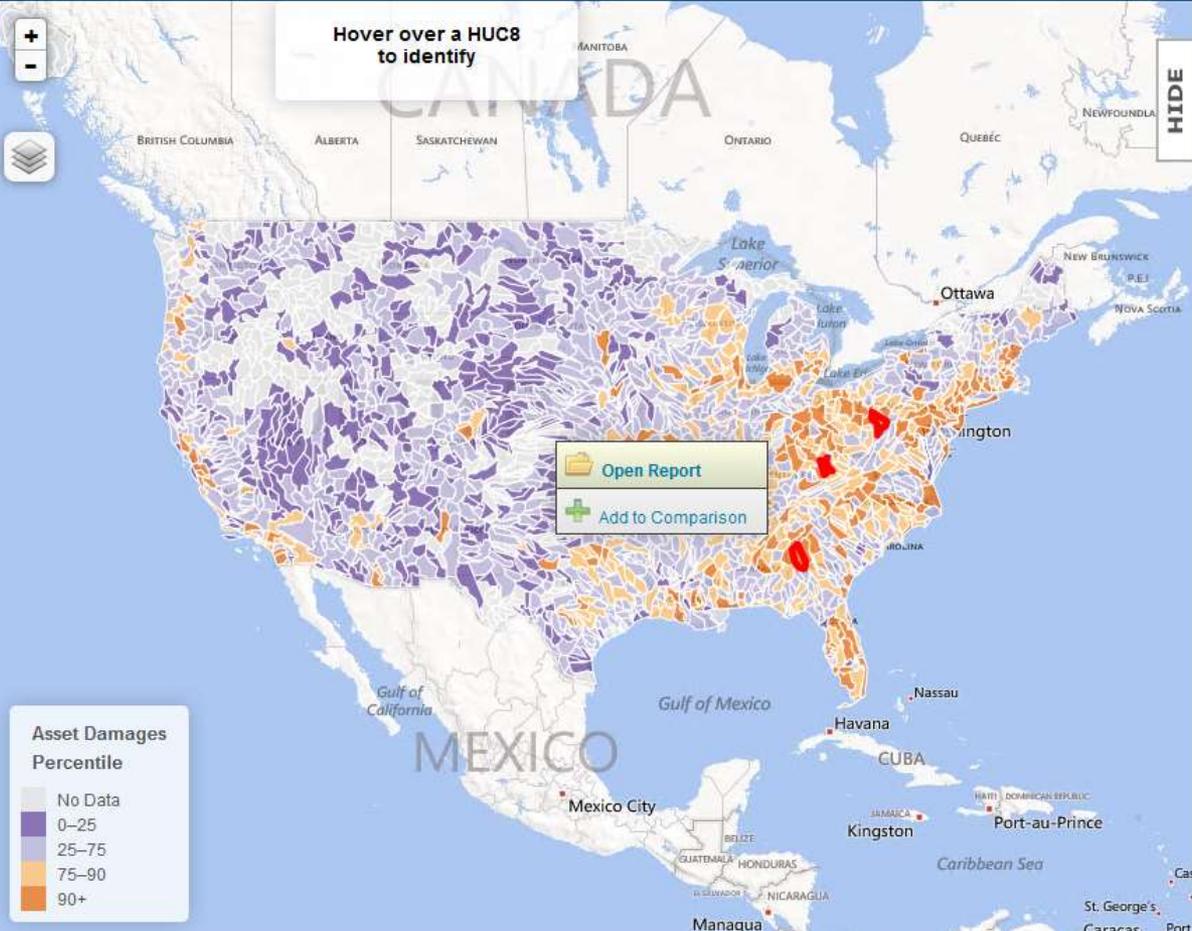
- All outputs are calculated to construct database of each of metric by HUC-8 (and larger) watersheds
- Nothing is calculated live online
- Most calculations are done Delphi and SAS, some ArcGIS
- Interface pulls from that database

NFRCT Interface



National Flood Risk Characterization Tool

Hover over a HUC8 to identify



Asset Damages Percentile

- No Data
- 0-25
- 25-75
- 75-90
- 90+

ANALYSIS OPTIONS

Unit of Analysis: HUC-8

Map Metric: Asset Damages

Filter by: Raw Metric | Percentile

Asset Damages: \$0 - \$9.4b

Economic Activity: \$16 - \$728.3m

Current Pop. Exposure: 0 - 629,261

Future Pop. Exposure: 0 - 810,056

Asset Exposure: \$0 - \$71.9b

Apply Filters

COMPARISON REPORT

Select up to 4 regions on the map for comparison.

Upper Flint X Youghiogheny X

Lower Levisa X (choose region)

Compare

NFRCT Interface – Filtering watersheds

National Flood Risk Characterization Tool

Hover over a HUC8 to identify

Asset Damages Percentile

- No Data
- 0-25
- 25-75
- 75-90
- 90+

ANALYSIS OPTIONS

Unit of Analysis: HUC-8

Map Metric: Asset Damages

Filter by: Raw Metric | Percentile

Asset Damages: \$375m - \$5.3b

Economic Activity: \$16 - \$728.3m

Current Pop. Exposure: 0 - 629,261

Future Pop. Exposure: 0 - 810,056

Asset Exposure: \$0 - \$71.9b

Apply Filters

COMPARISON REPORT

Select up to 4 regions on the map for comparison.

(choose region) (choose region)

(choose region) (choose region)

Compare

Comparing Flood Risk Metrics Across Watersheds

- User can select up to 4 watersheds to compare across all flood metrics

COMPARISON REPORT

Comparison Report for: Altamaha - Santee - Yazoo - Southern Florida

Summary | Asset Damages | Inundation | Population Exposure | Asset Exposure | Vulnerability | FRM Projects | Future

Flood Event Chance: 1% Riverine 1% Coastal 0.2% Riverine

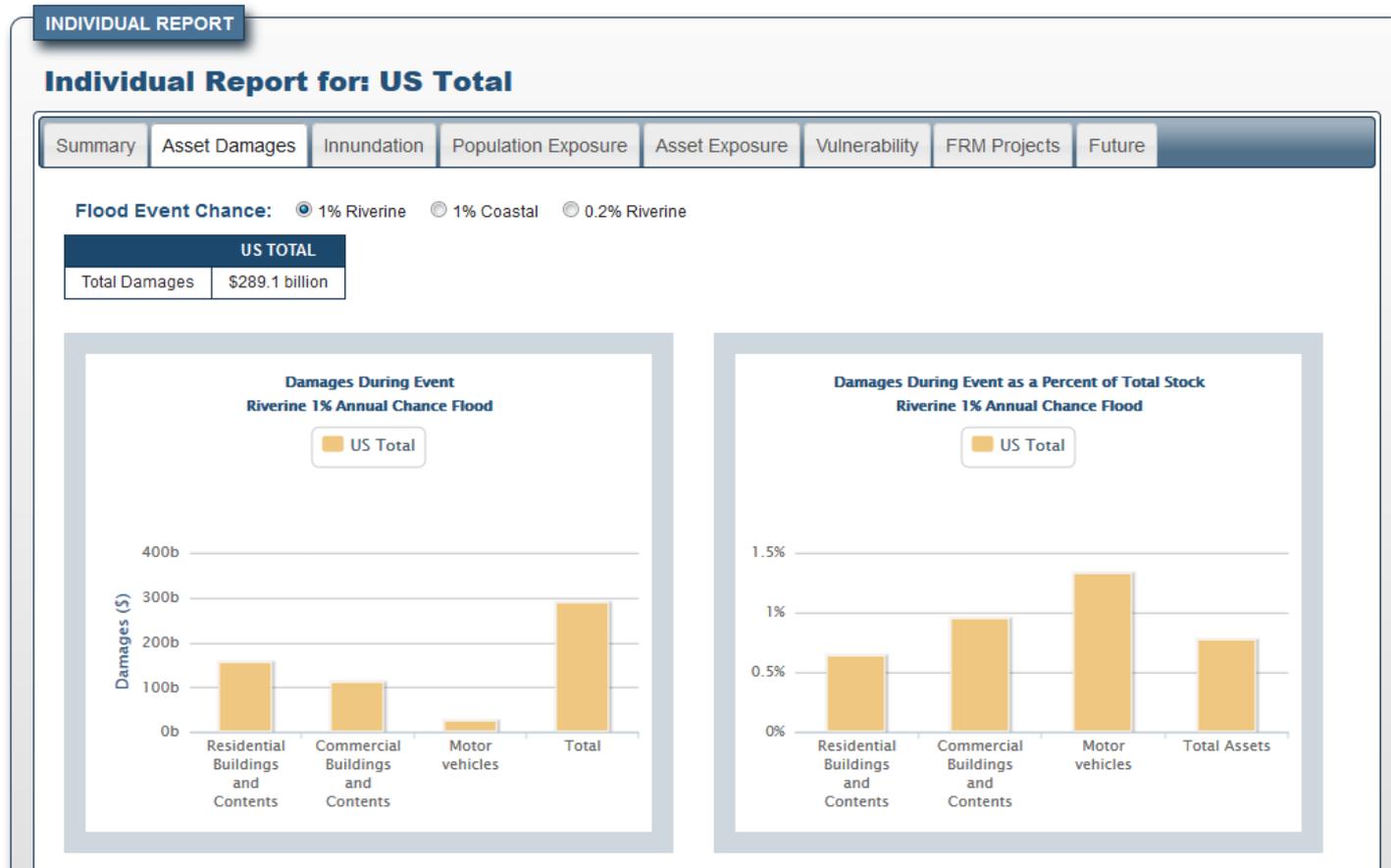
EXPOSURE TO FLOOD EVENT	ALTAMAHA	SANTEE	YAZOO	SOUTHERN FLORIDA	HUC6 AVERAGE
Population Exposed	158,901	154,385	56,913	952,382	35,643
Total Damages	\$3.7 billion	\$4.3 billion	\$1.1 billion	\$12.6 billion	\$833.2 million
Police Stations Exposed (#)	2	3	3	41	4
Fire Stations Exposed (#)	3	9	5	19	5
Hospitals Exposed (#)	1	1	1	16	1
Percent Population in Poverty	0.82%	0.51%	2.56%	1.92%	0.78%
Percent Minority Population	2.65%	1.11%	4.93%	2.9%	1.29%
Percent Elderly Population	0.52%	0.47%	1.2%	2.71%	0.69%
VALUE IN WATERSHED					
Economic Output	\$98.5 billion	\$164.7 billion	\$15.3 billion	\$277.2 billion	\$38.3 billion
Pop. Growth Rate (%)	1.9%	1.4%	0.8%	1.6%	1%

Color Key: National Percentile

0	25	75	90
---	----	----	----

National-Level Output

- The NFRCT also provides a National Level Report of flood risk metrics.



Limitations

- Hazard Data: NFHL 1% and 0.2% annual chance flood zones are a limited proxy for overall flood risk
- No method to address infrastructure performance and impact on risk (e.g., levee reliability and impact on failure)
- Uses a spatial overlay approach with datasets that come in varying levels of spatial resolutions (e.g., Census blocks, counties), and assumes equal distribution in urban areas. Therefore, results appropriate for large areas and regional comparison, not valid for small areas or specific locations.

Current Plans and Opportunities

- Current work
 - Integrate with Corps FRM budget information to support program management
 - Validate with other data
 - Add NOAA Sea Level Rise scenarios (Abt R&D Project)
- Other opportunities
 - Integrate levee and/or dam safety program outputs
 - Add more flood events (from state work) to better reflect full range of risk