

## Building Data for Climate Change Adaptation

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Filling data gaps and characterizing storm surge  
impacts for New York State

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Work funded by the New York State Energy &  
Research Development Authority (NYSERDA)

# CIESIN

Center for International Earth  
Science Information Network  
EARTH INSTITUTE | COLUMBIA UNIVERSITY

## Welcome

The Center for International Earth Science Information Network (CIESIN) is a center within the Earth Institute at Columbia University. CIESIN works at the intersection of the social, natural, and information sciences, and specializes in on-line data and information management, spatial data integration and training, and interdisciplinary research related to human interactions in the environment.

## Selected Blog Posts

### Addressing Climate Migration Within Borders Helps Countries Plan, Mitigate Effects

A new report is the first to focus on longer-term climate impacts on crop and water resources, and the ways in which they may influence internal migration.

[More Blog Posts](#)

## In the Spotlight

### Enhanced Population Mapping Tools Deliver Customized Demographic Estimates

The Population Estimation Service (PES) and associated Population Estimator mapping tool have recently been updated to provide users with the ability to visualize changes in total population over multiple decades together with basic demographic characteristics (age and sex) in the year 2010, for a user-defined geographic region. Version 3 of the Population Estimator enables users to draw a circle or polygon on a world map, which then produces a graph of estimated population for the years 2000, 2005, 2010, and 2015, and a projection to the year 2020. The Population Estimator also provides a "population pyramid" for the year 2010, with estimated population counts by five-year age groups for males and females. Users may save the graphs in selected image formats and download the tabular data for further analysis.

These detailed demographic estimates may be highly useful to those interested in assessing how different areas of the world vary in terms of their population growth between 2000 and 2020, and in comparing the relative shape and structure of their population pyramids. The data may be used to estimate important demographic characteristics such as the sex ratio, median age, dependency ratios, and the number of women of child-bearing age. Estimated totals for specific age groups (children under five



Non-profit research institute within Columbia University specializing in open source data production and applied research

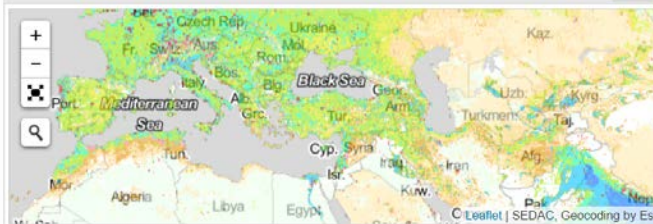
 SEDAC Map Viewer, v2

## GPWv4: Population Density - 2015



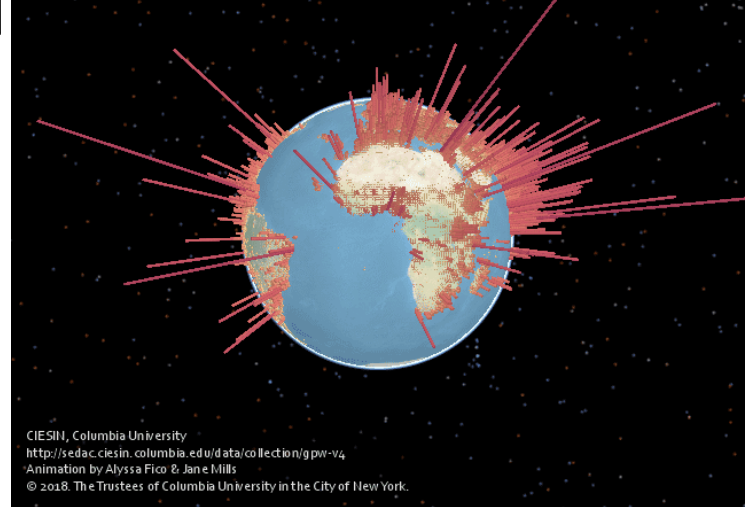
[Map Sync](#) | [Layer Sync](#) | [Legend](#) | [WMS](#) | [Download](#)

## Anthropogenic Biomes v2: 2000



Working to advance the understanding of human interactions in the environment

Population Density 2015, GPWv4.10



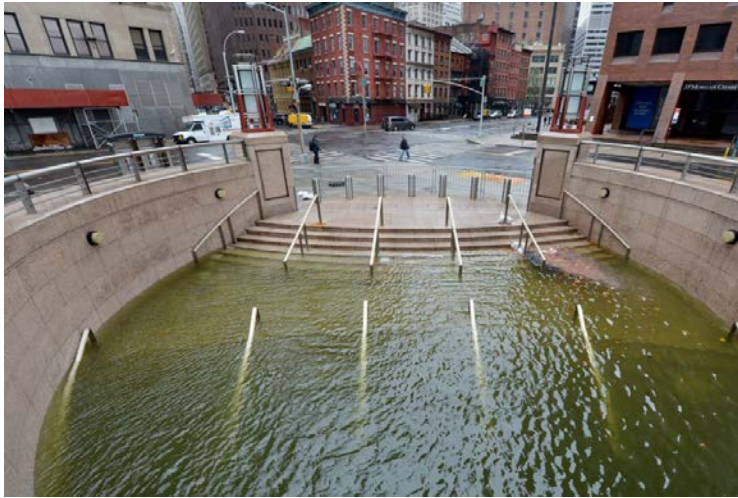
CIESIN, Columbia University  
<http://sedac.ciesin.columbia.edu/data/collection/gpw-v4>  
Animation by Alyssa Fico & Jane Mills  
© 2018. The Trustees of Columbia University in the City of New York.

While providing access to and enhancing the use of information worldwide

# October 2012

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New York State and the surrounding area were rocked by Superstorm Sandy



Were we prepared enough?

What could we do differently?

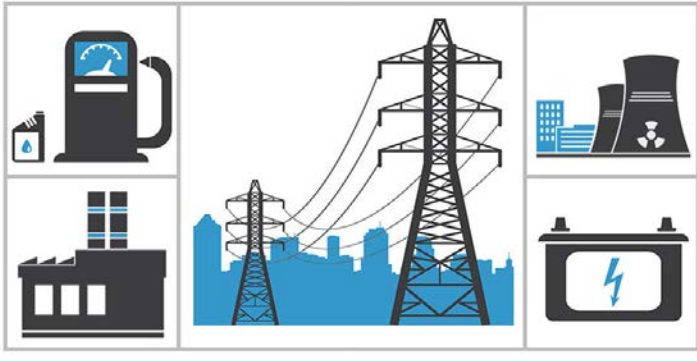
**What data do we need to prepare better for next time?**

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# Determining Data Gaps

Understanding where data gaps occur and subsequently filling those gaps leads to more effective and informed decision-making.



Critical Infrastructure



Building Footprints



Flood Grids

## STEPS TO FILL GAPS:

1. Download data that already exists and create data where there is none
2. Clean and validate the data
3. Run the flood impact assessment
4. Visualize data and results in one place and make it publically available

# Critical Infrastructure

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Compiling locations of bridges, hospitals, and EMS stations in one location can lead to better planning during emergency situations

## STEPS

1. Collect local and national infrastructure datasets (fire stations, hospitals, schools etc.)
2. Standardize attribute tables

## CHALLENGES

- Multiple sources of data to pick from
  - Properly validating the data
- 



# Building Footprints

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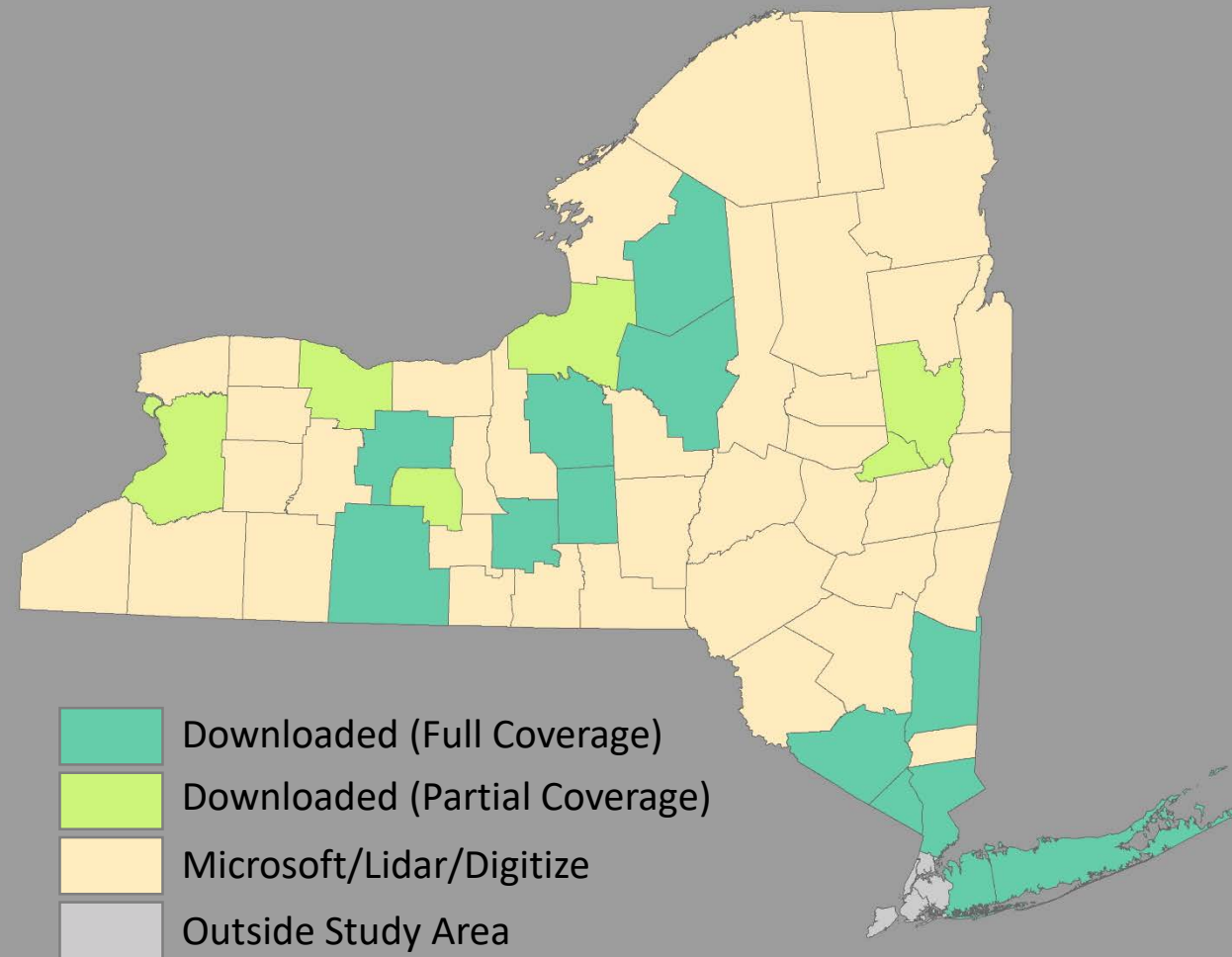
Creating a state-wide database of building footprints allows for a more detailed flood impact assessment

## STEPS

1. **Download local data sets**
2. Incorporate Microsoft data
3. Extract from LiDAR
4. Manually Digitize
5. Compile into a state-wide database

## CHALLENGES

- Some data sets are outdated or geographically incomplete





# Building Footprints

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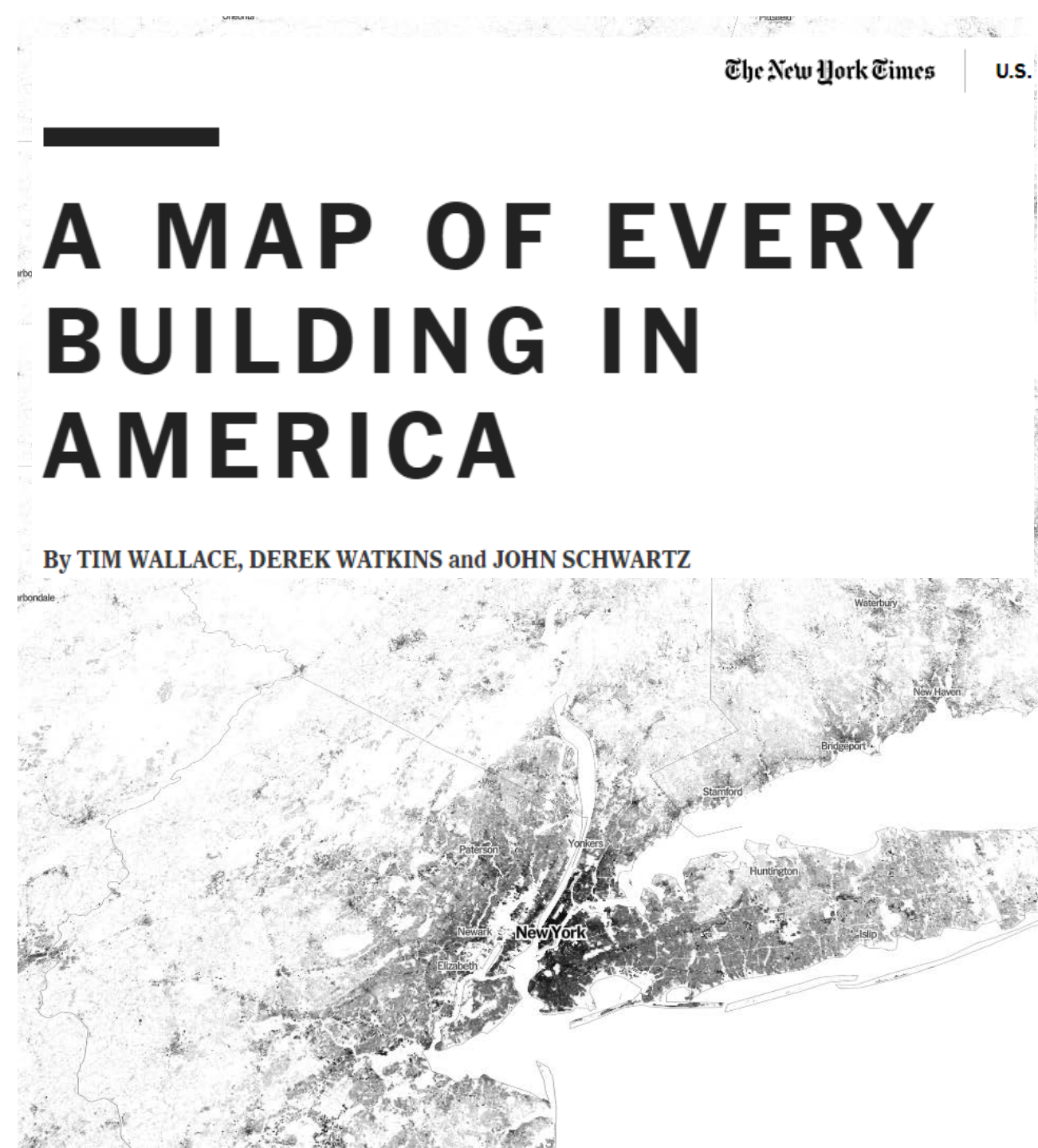
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## CHALLENGES

- Clusters buildings in urban area
  - Misses some buildings
  - Artifacts left over from national integration
- 





# Building Footprints

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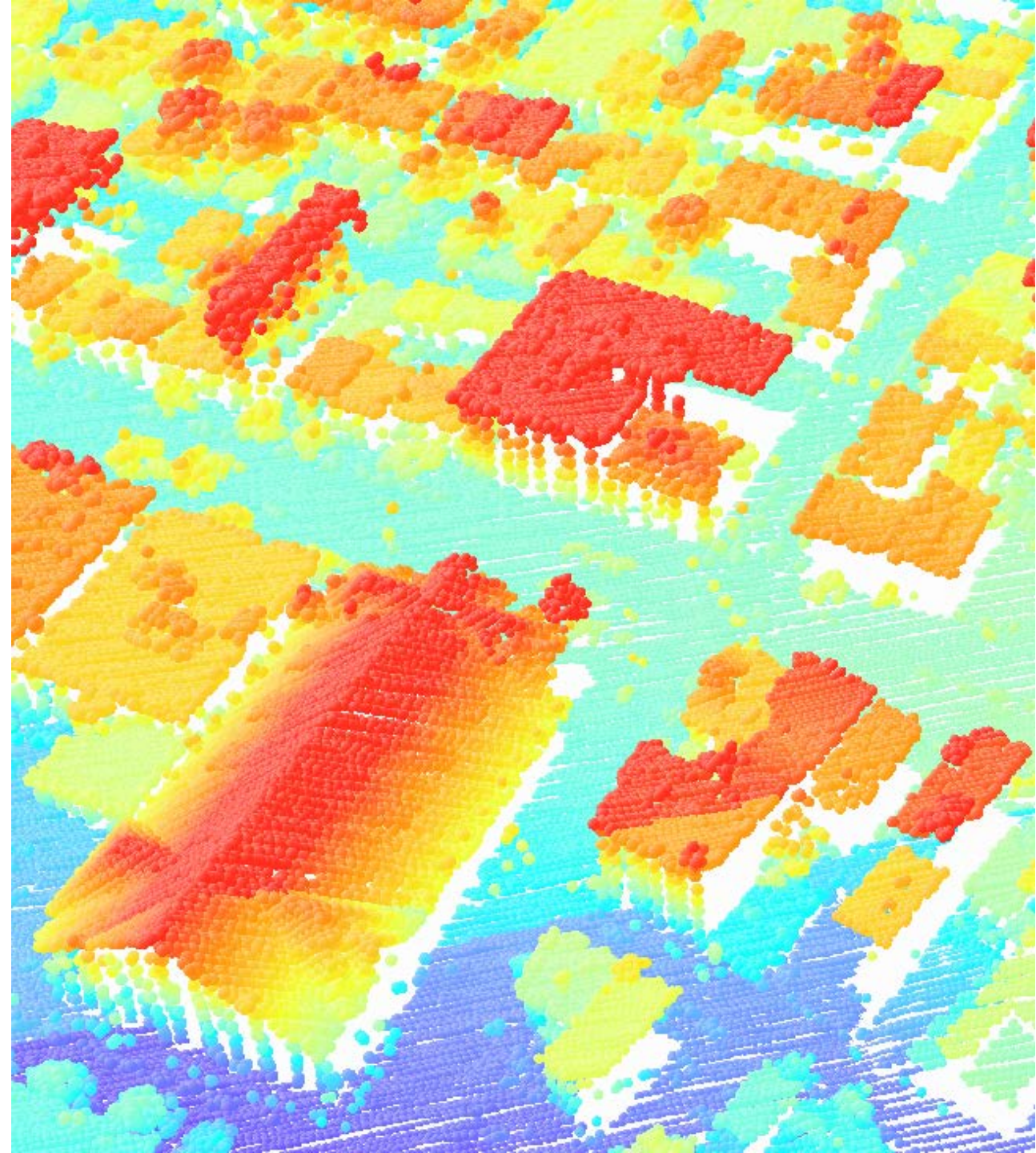
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## CHALLENGES

- Incomplete coverage
  - LiDAR point spacing from older data not adequate for building extraction
  - Requires some manual editing
- 





# Building Footprints

Creating a state-wide database of building footprints allows for a more detailed flood impact assessment

## STEPS

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4. **Manually Digitize**
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## CHALLENGES

- Time required for large scale digitizing
- Inconsistent detail in open-source imagery
- Creating consistent guidelines/best practices





# Flood Grids

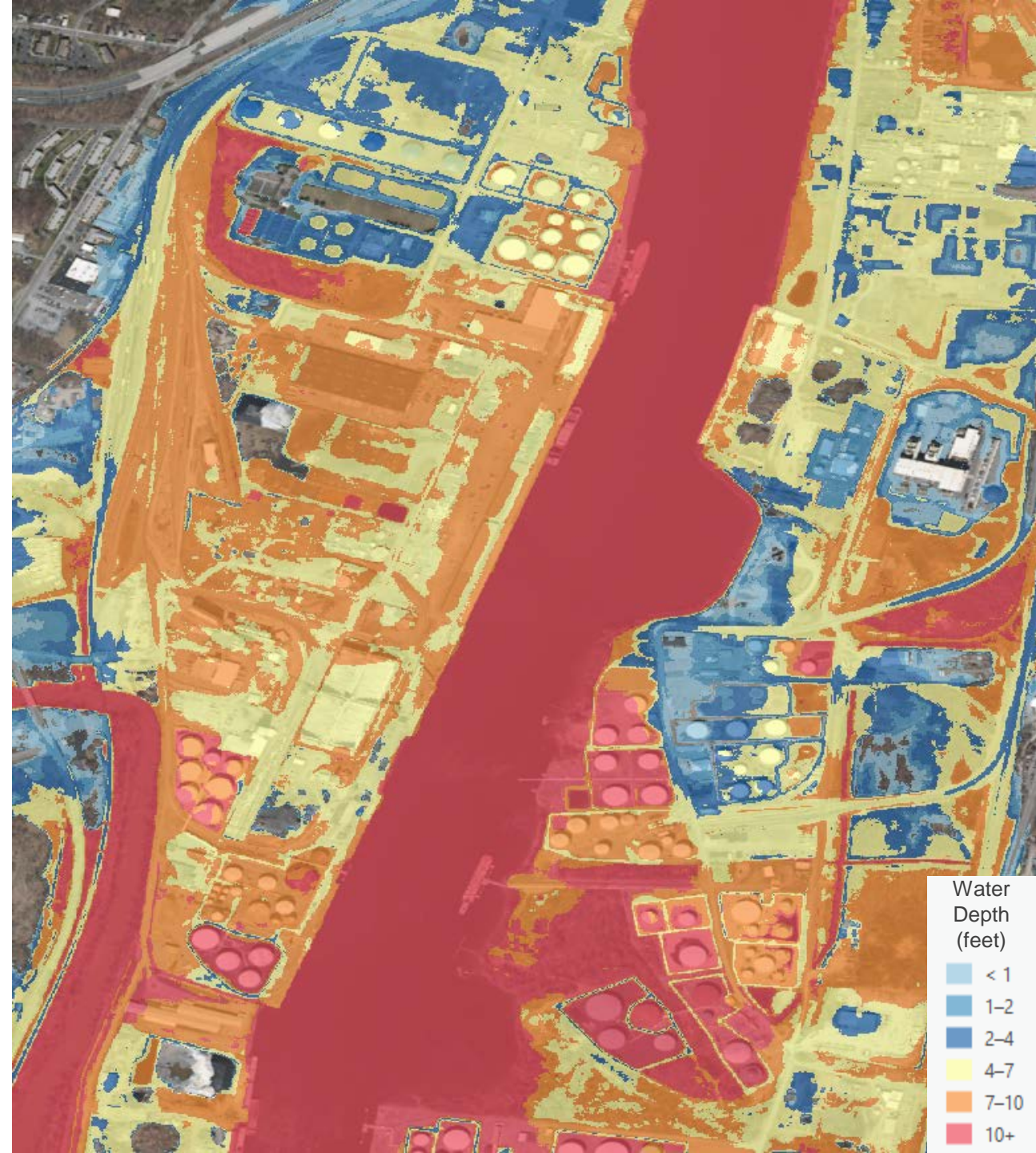
Creating a variety of flood scenarios allows for a range of possible results to be produced

## STEPS

1. Create flood grids for various sea level rise and storm return scenarios for the Hudson River and Westchester coast of the Long Island Sound
2. Create state-wide 100- and 500- year flood grids for all inland and coastal areas

## CHALLENGES

- Methodology to produce accurate flood grids using available data





# Flood Grids

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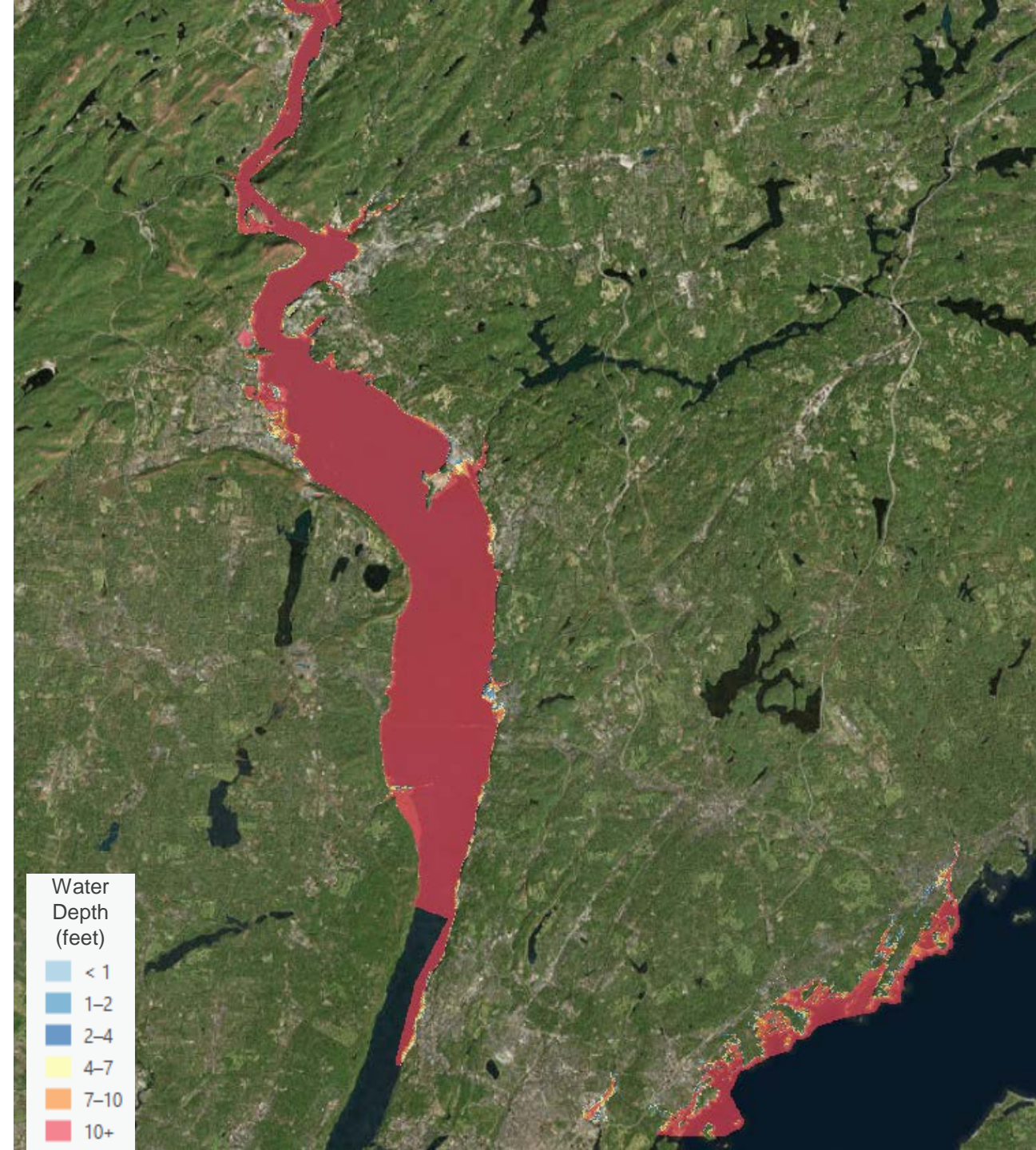
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- Bathtub methodology to produce flood grids using available data is somewhat simplistic



# Flood Grids

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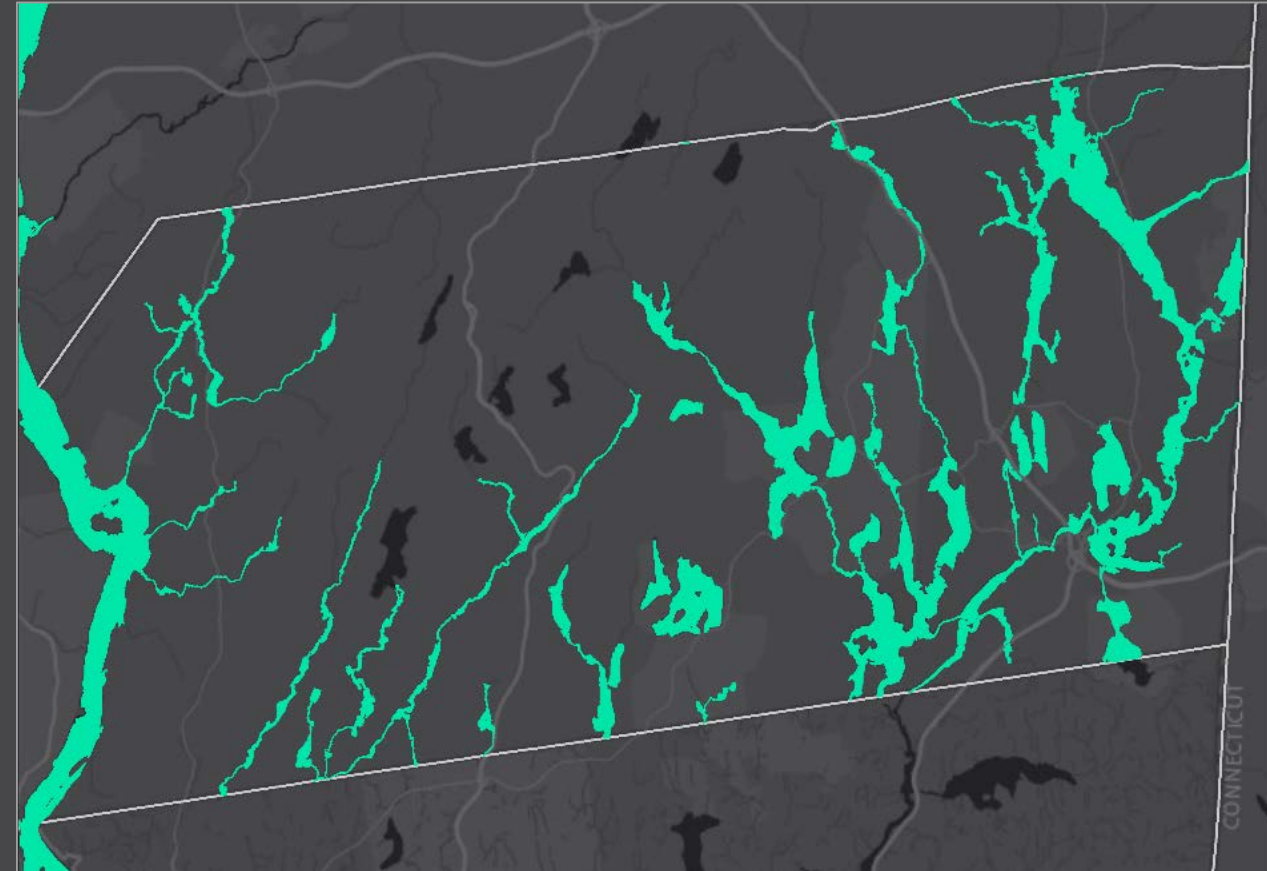
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FEMA 100-year floodplain



1 – Turn the extent into points



# Flood Grids

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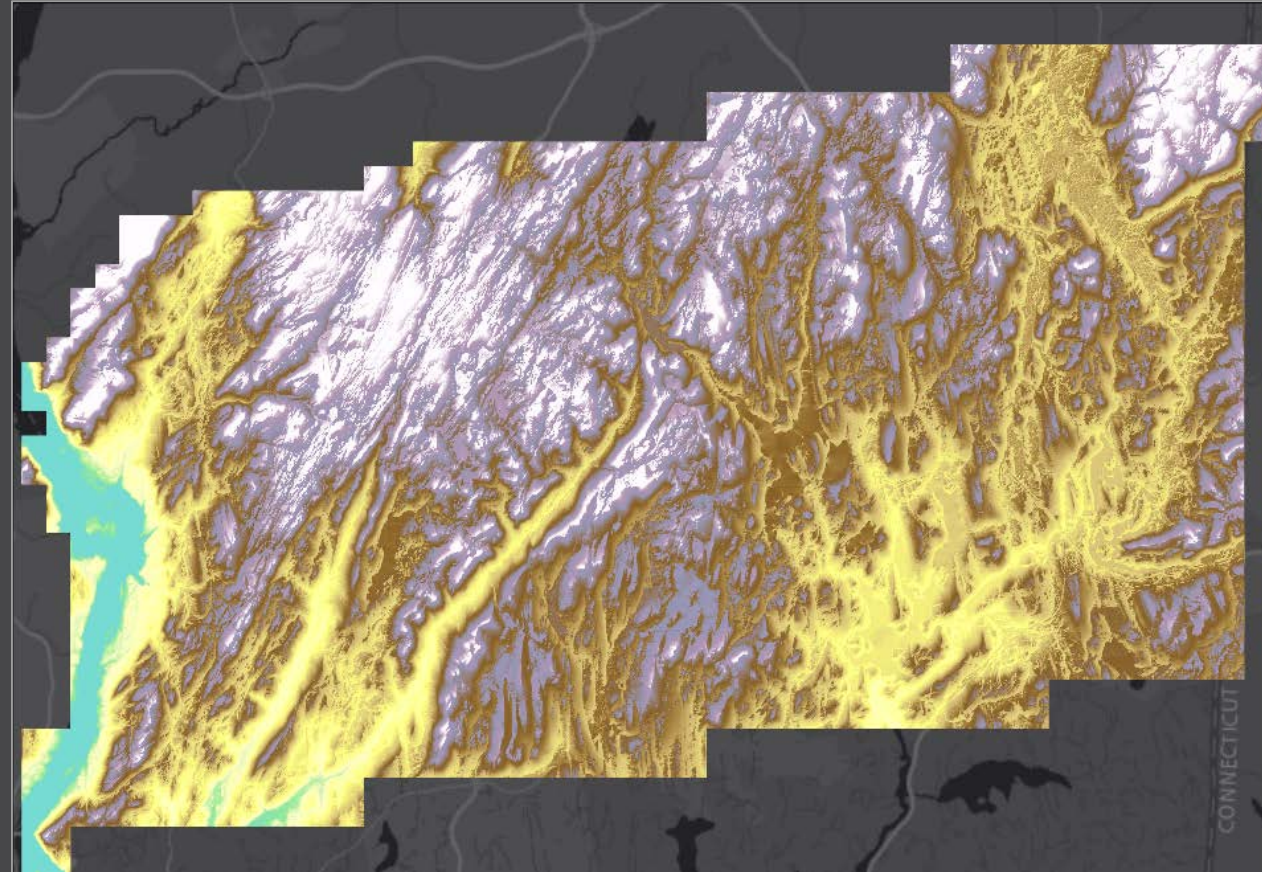
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NYS 2 meter DEM



2 – Extract the elevation at the points

# Flood Grids

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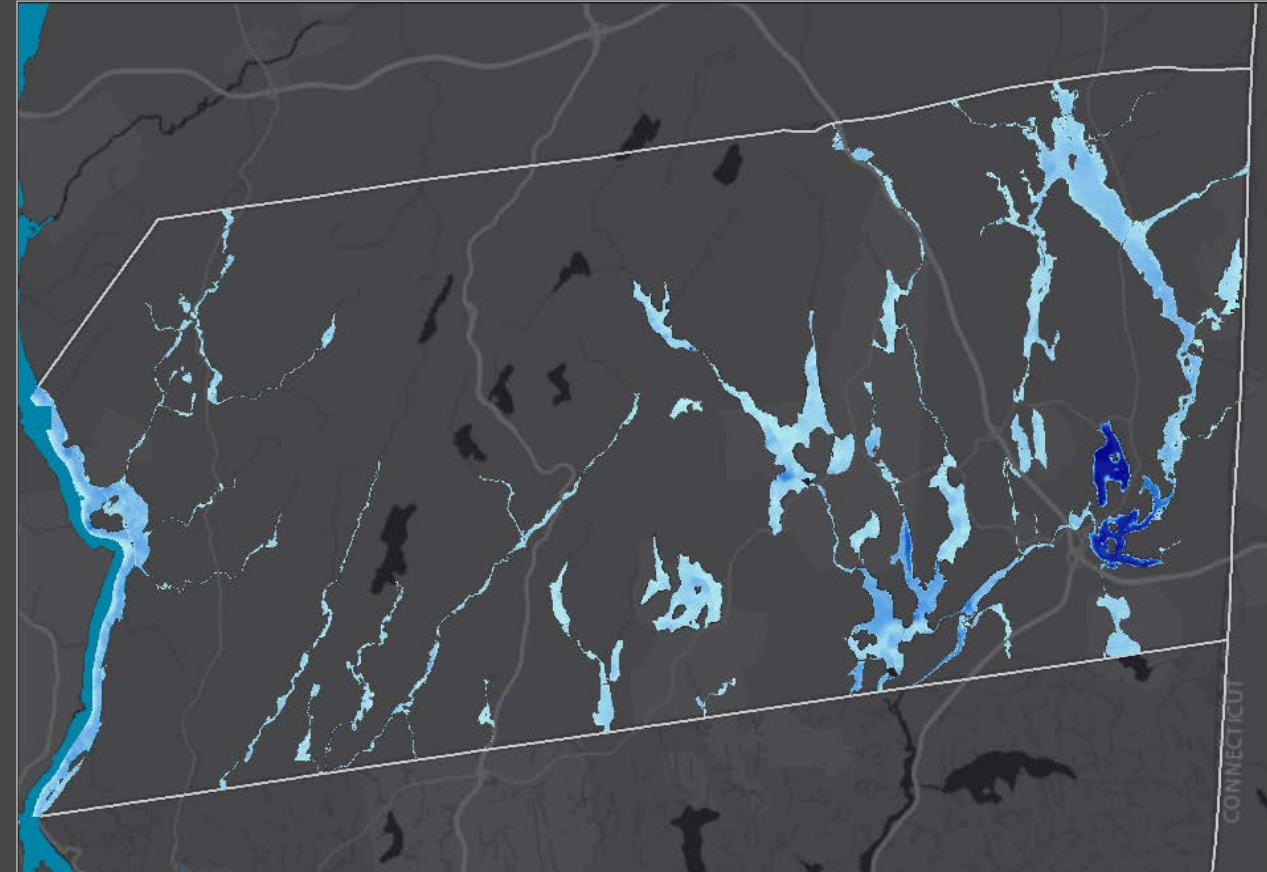
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CIESIN 100 year flood grid



3 – Interpolate and subtract DEM



# Impact Assessment

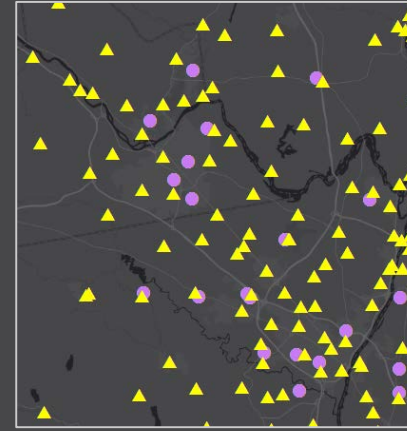
Once all the data is compiled, a comprehensive and detailed flood impact assessment is produced

## STEPS

1. **Attach critical infrastructure, Hazus provided attributes, and tax parcel information to building footprints**
2. Assign flood depth value to each building footprint
3. Apply modified depth-damage function from Hazus model
4. Aggregate financial damages to the municipality level

## CHALLENGES

Still includes assumptions from Hazus model (first floor elevation)



Critical Infrastructure

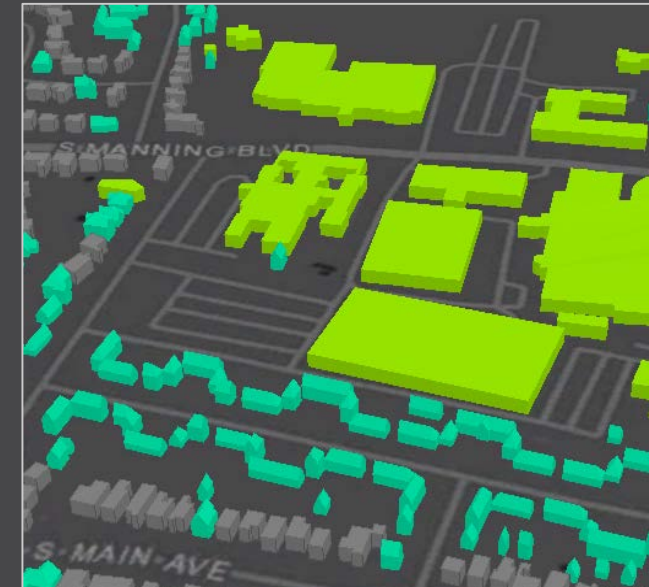


Tax Parcels



Hazus

Building Footprints



# Impact Assessment

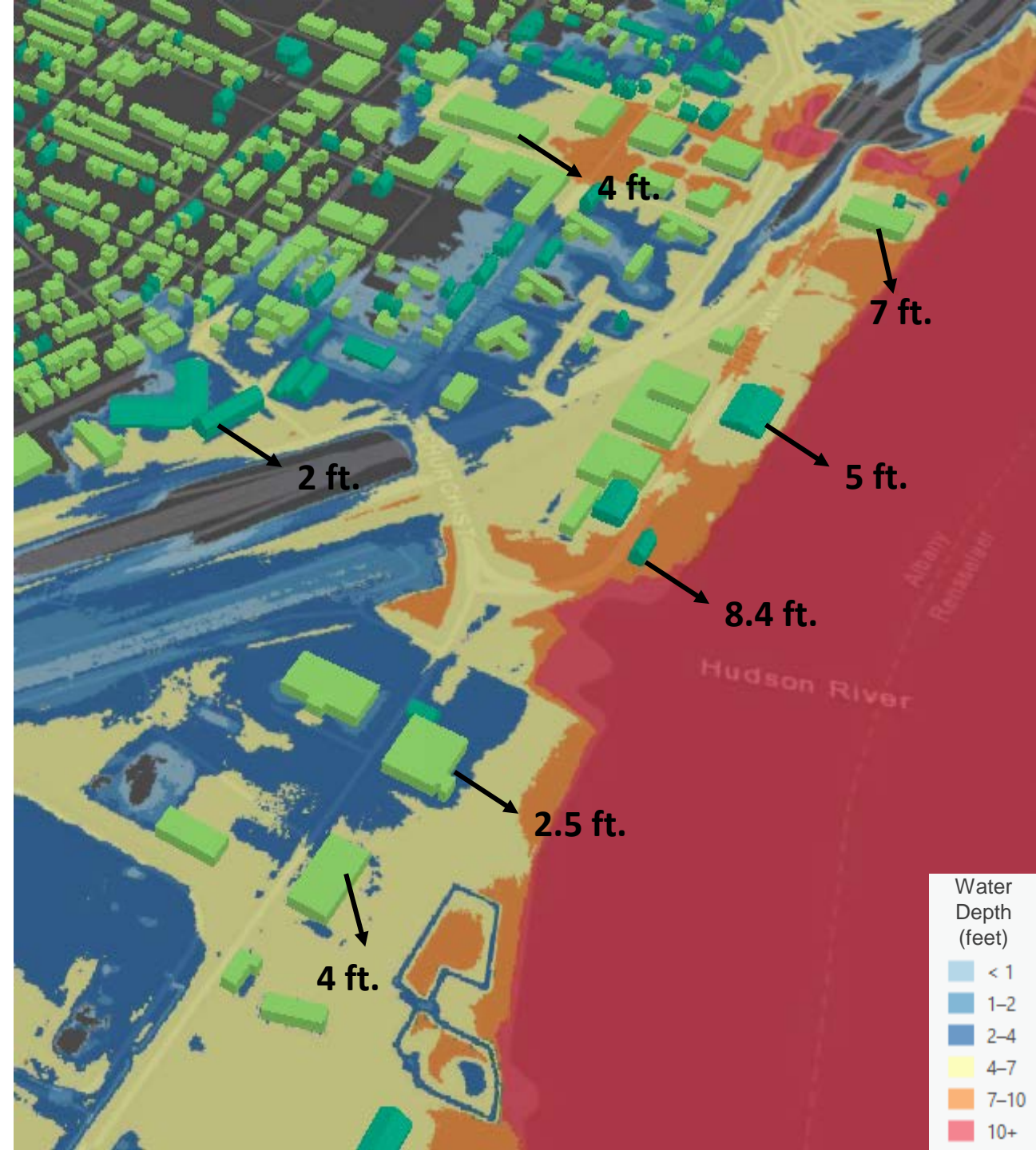
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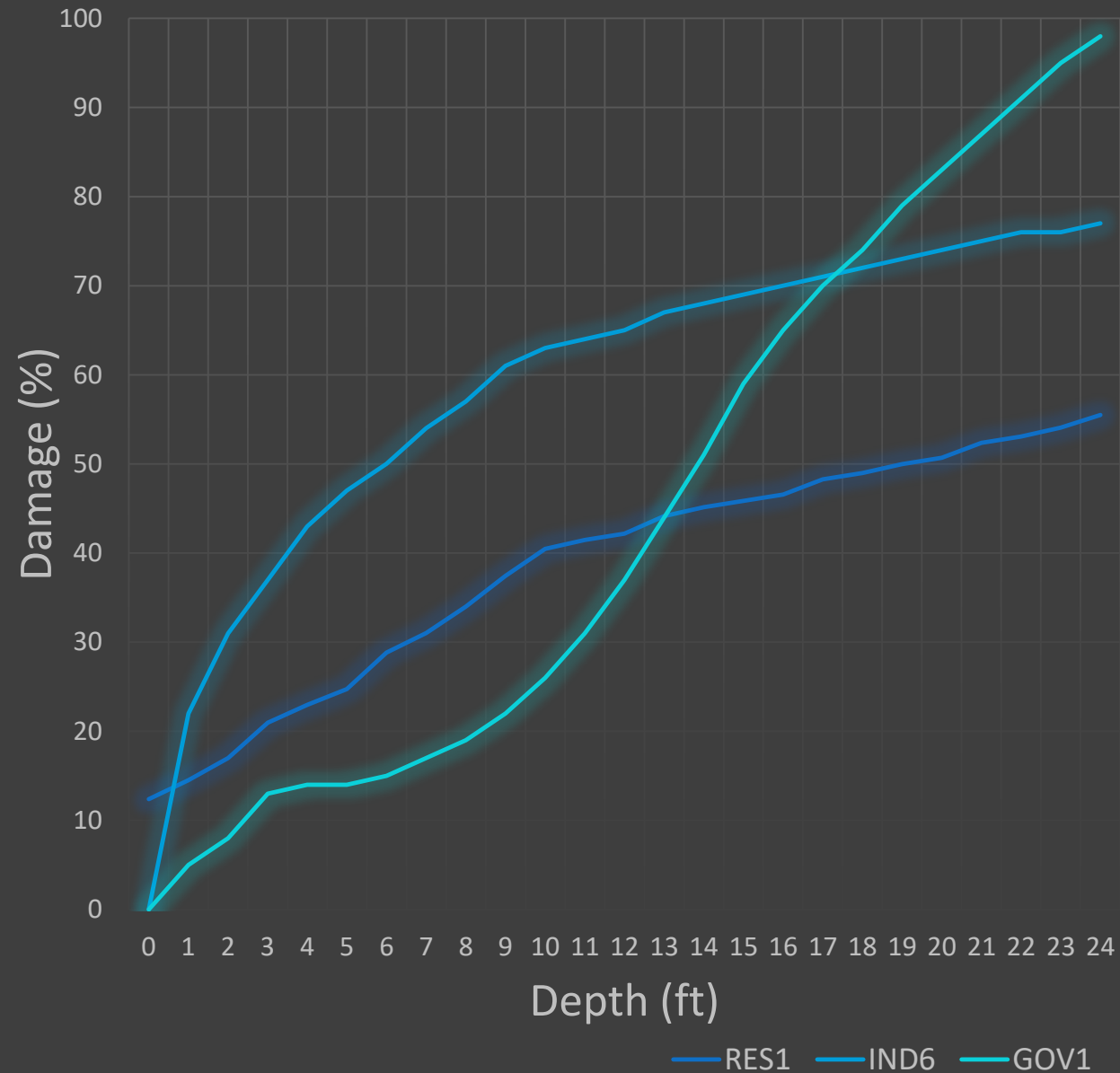
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Damage = % Damage x Value

% Damage = f(flood depth, occupancy class)

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County	Municipality	Return Period (years)	Building and Contents loss (\$)	Number of buildings damaged
Dutchess	Fishkill	100	3,803,235	93
Dutchess	Fishkill	500	9,679,156	367
Dutchess	Pleasant Valley	100	1,590,441	93
Dutchess	Pleasant Valley	500	10,912,804	276

Damages are aggregated to the municipality level and are attached to the buildings as FEMA loss categories



# Impact Assessment

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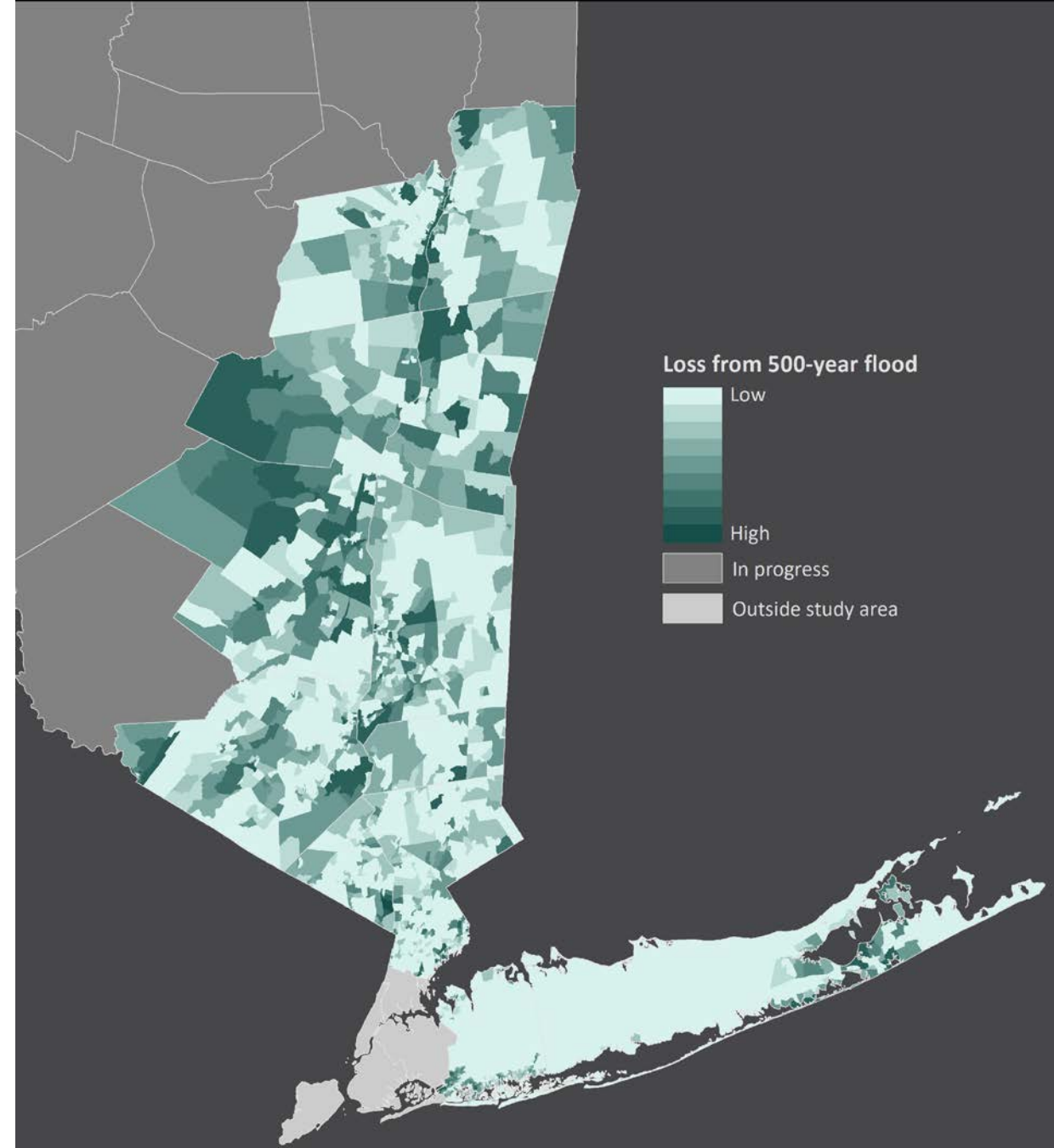
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# Publishing the Results

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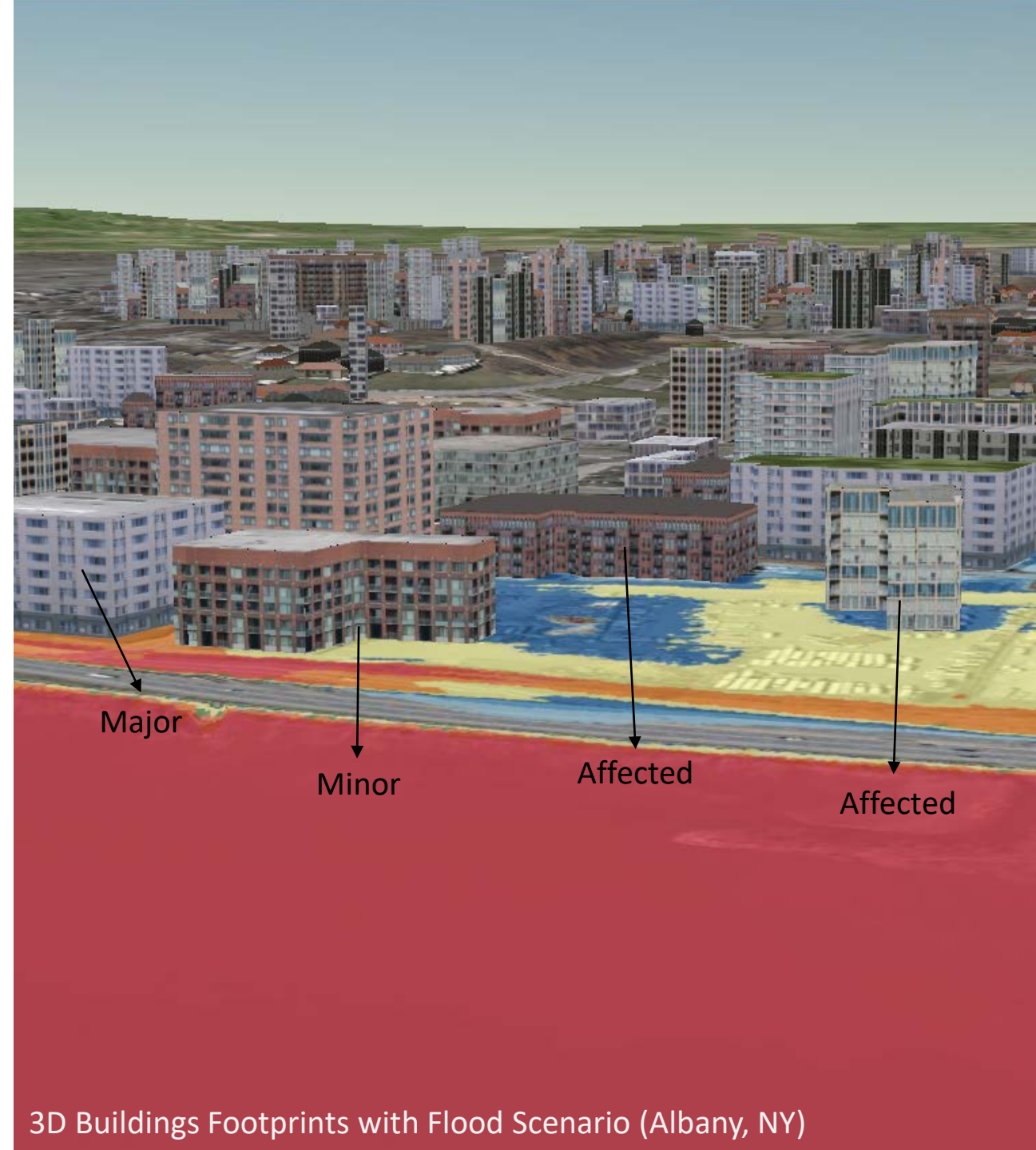
The building footprints, flood scenarios, and flood impact results will be published and available for download

## STEPS

1. Data documentation
2. Publication of web services (ArcGIS Server / OGC services)

## CHALLENGES

Data volume for publishing



3D Buildings Footprints with Flood Scenario (Albany, NY)



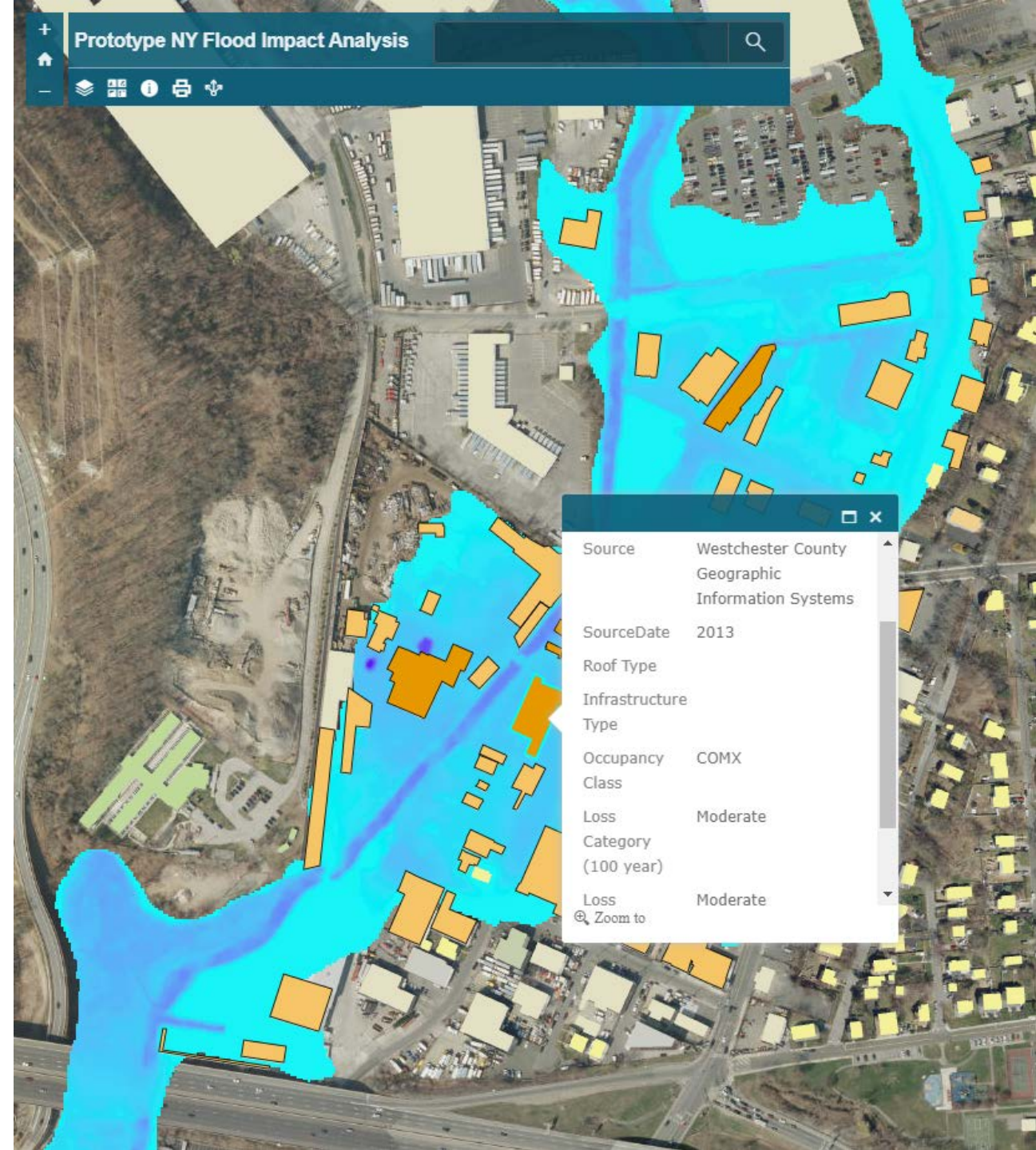
# Questions?

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gyetman@ciesin.columbia.edu

Work funded by the New York State  
Energy & Research Development  
Authority (NYSERDA)

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# Prototype Application

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Release Pending

- [ArcGIS Online](#)

