Changing Climate:
Flood & Landslide Susceptibility along the Ohio-Kentucky Border

DEVELOP

GROUNDWORK CHANGING PLACES CHANGING LIVES

GROUNDWORK Ohio River Valley

city of CINCINNATI ENVIRONMENT & SUSTAINABILITY

Green Umbrella REGIONAL SUSTAINABILITY ALLIANCE

NASA DEVELOP's Urban Development Team

Assessing Flooding and Landslide Susceptibility along the Ohio-Kentucky Border

Celeste Gambino
NASA DEVELOP
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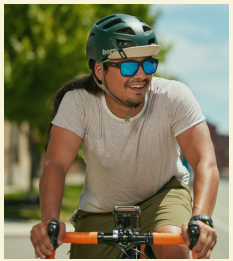
Fellow

GROUNDWORK Ohio River Valley

Green Umbrella Regional Sustainability Alliance

city of Cincinnati Environment & Sustainability



Tanner Yess
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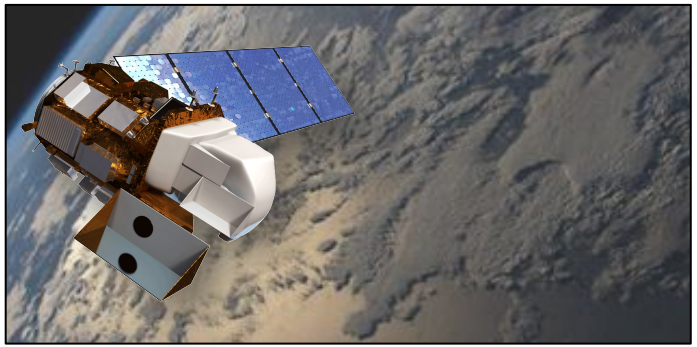
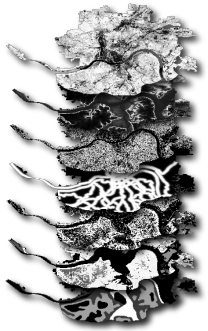
City of Cincinnati Office of Environment & Sustainability

Groundwork Ohio River Valley & NASA DEVELOP

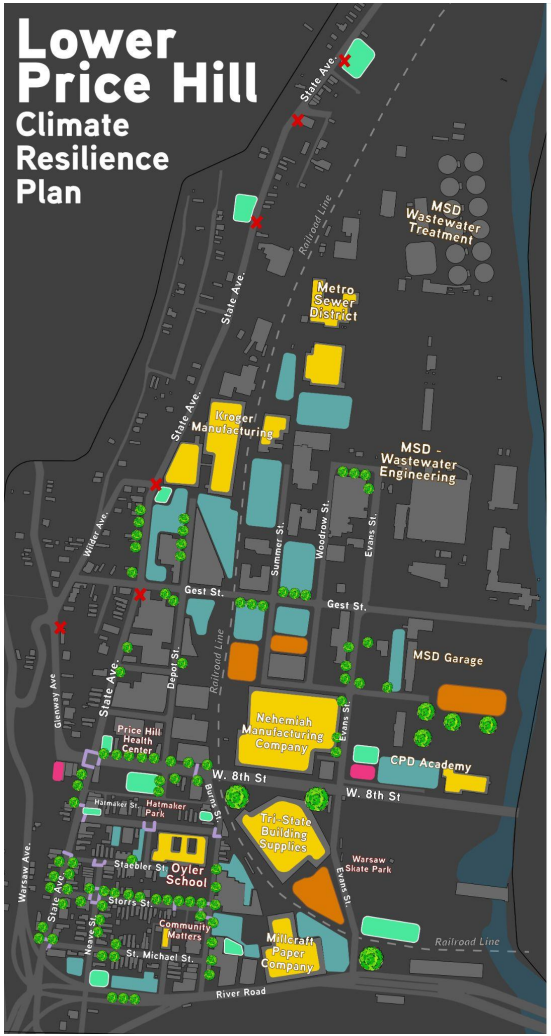
WHERE JUSTICE & THE ENVIRONMENT MEET.

- NASA DEVELOP
- Intro to Remote Sensing Virtual Summer Camp





Climate Safe Neighborhoods



GROUNDWORK Ohio River Valley

city of CINCINNATI ENVIRONMENT & SUSTAINABILITY

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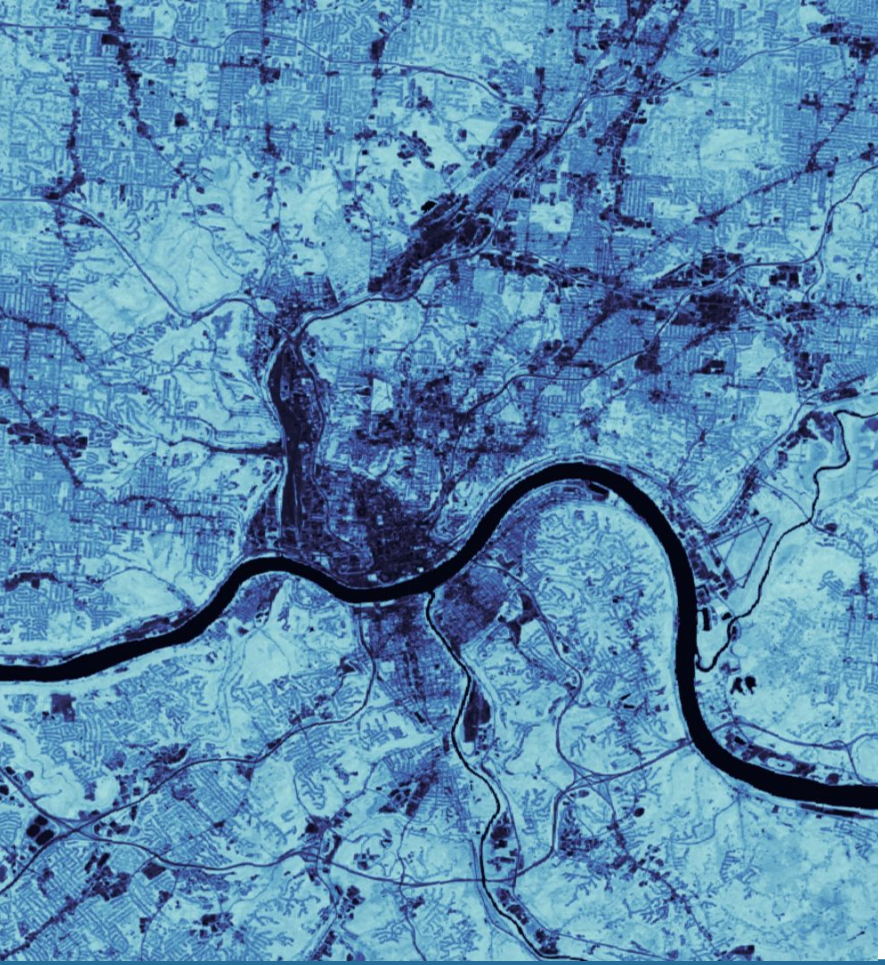


National Aeronautics and Space Administration

Cincinnati & Covington
Urban Development II

Assessing Flooding and Landslide Susceptibility along the Ohio-Kentucky Border

Paxton LaJoie, Edward Cronin, John Perrotti, Erin Shives, & Sophie Webster

Massachusetts – Boston | Summer 2021

DEVELOP

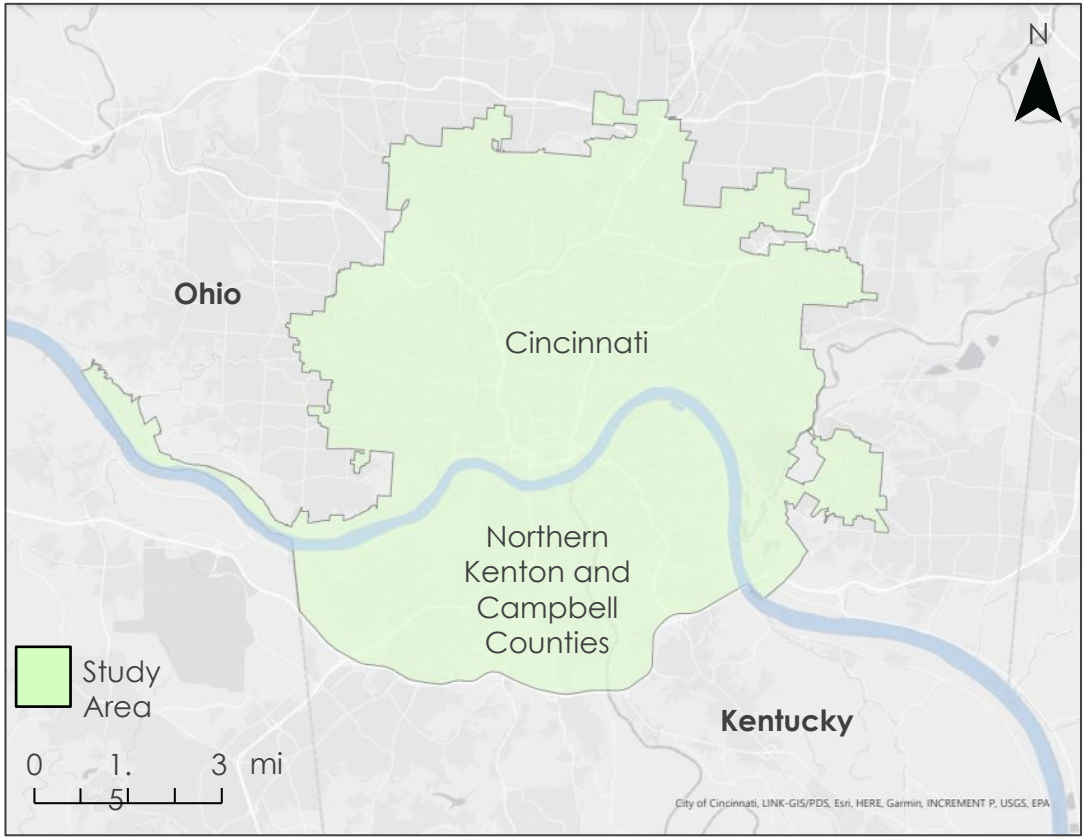
Project Overview

Study Area

- Cincinnati, Ohio & Northern Covington, Kentucky

Study Period

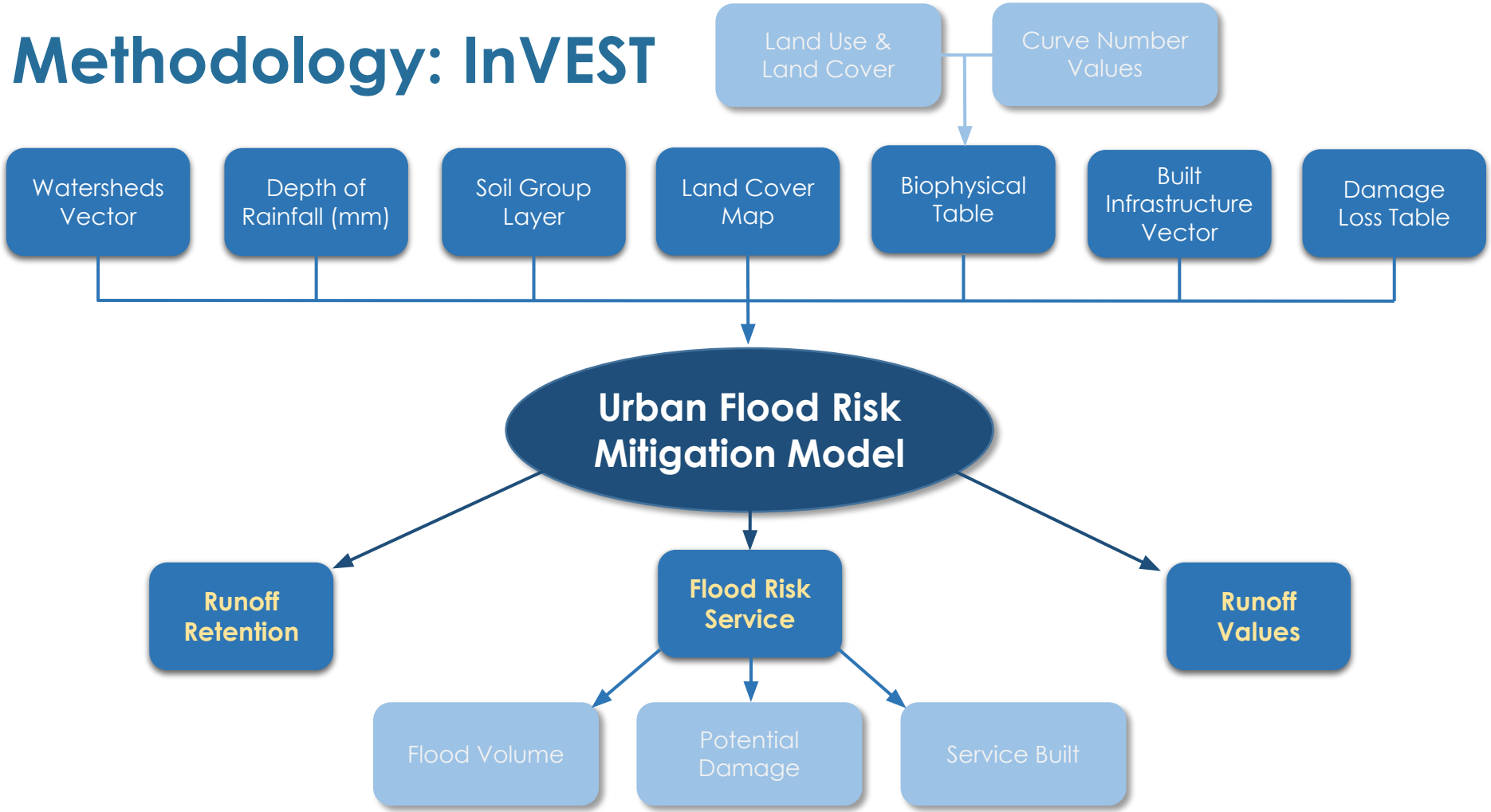
- 2004 – 2021



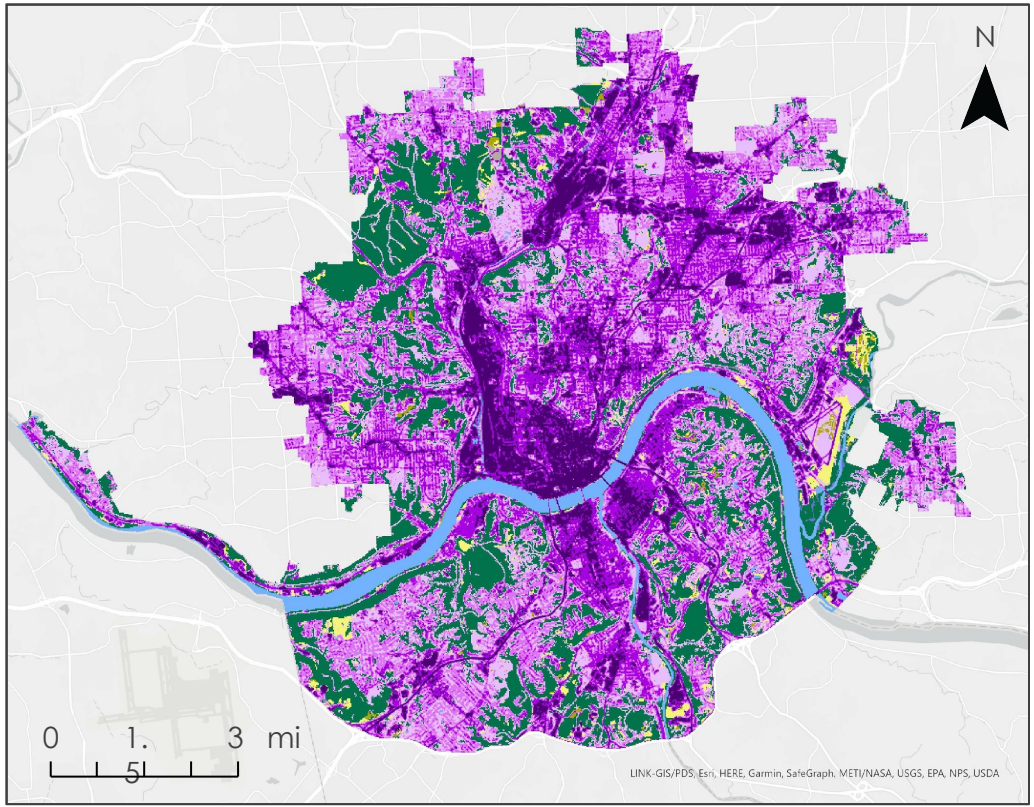
Project Objectives

1. Map stormwater runoff, runoff retention, and potential damage cost
2. Map landslide susceptibility and exposure
3. Create a standard operating procedure for future analysis

Methodology: InVEST

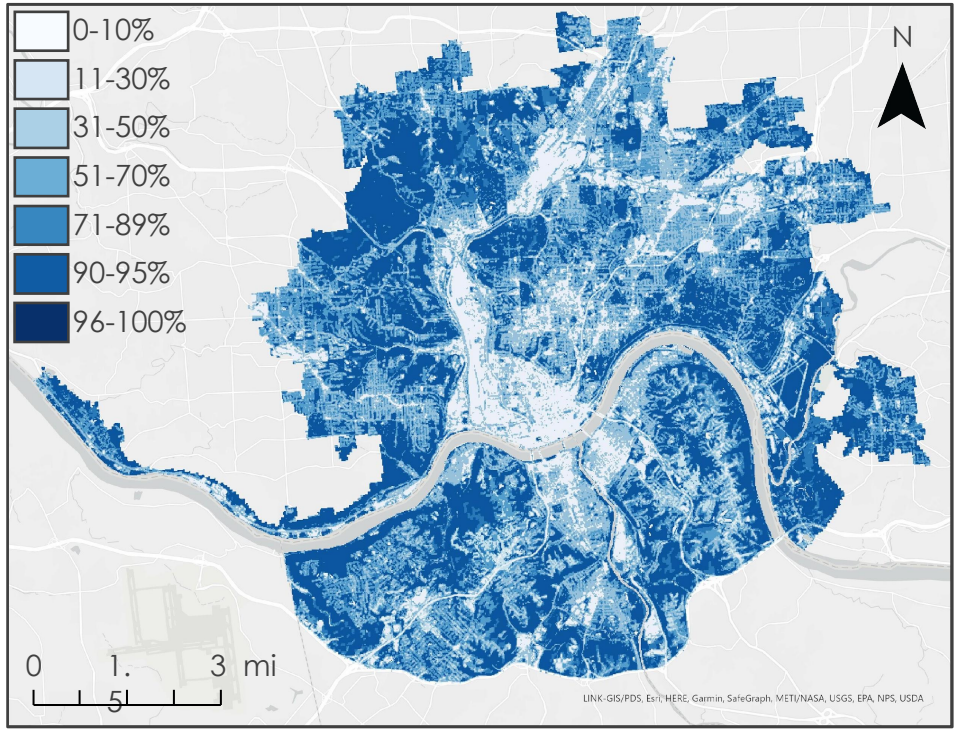


Land Use Land Cover

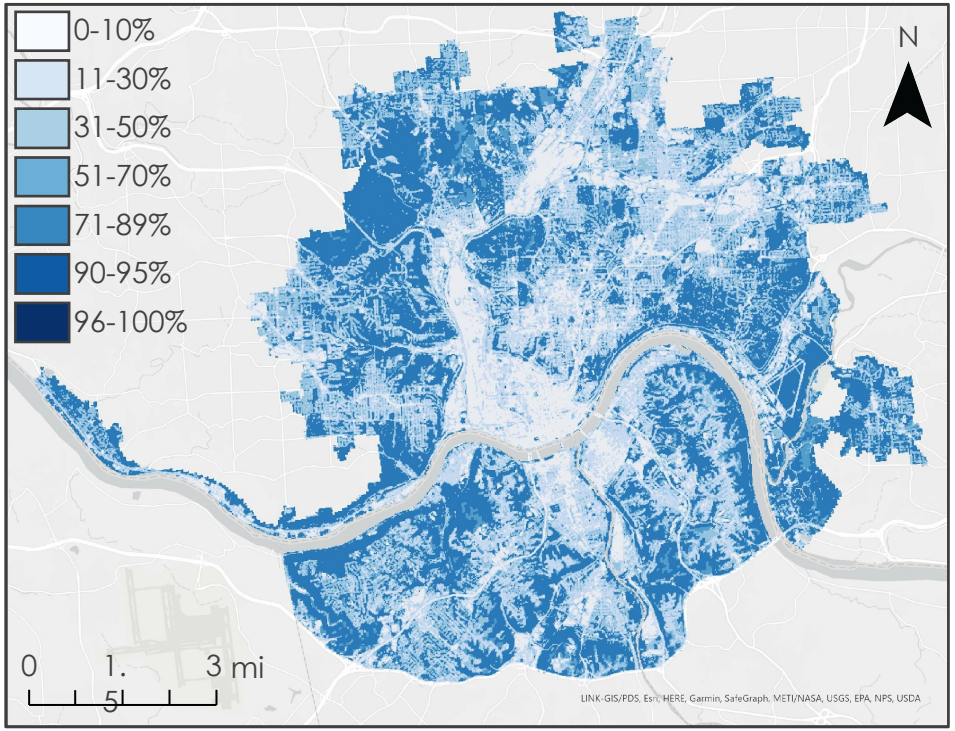


- Developed, Open Space < 20% impervious surface
- Developed, Low 20 – 49% impervious surface
- Developed, Medium 50 – 79% impervious surface
- Developed, High 80 – 100% impervious surface
- Open Water
- Wetlands
- Forest
- Shrub & Grassland
- Agriculture Fields
- Barren Land

InVEST Results: Runoff Retention

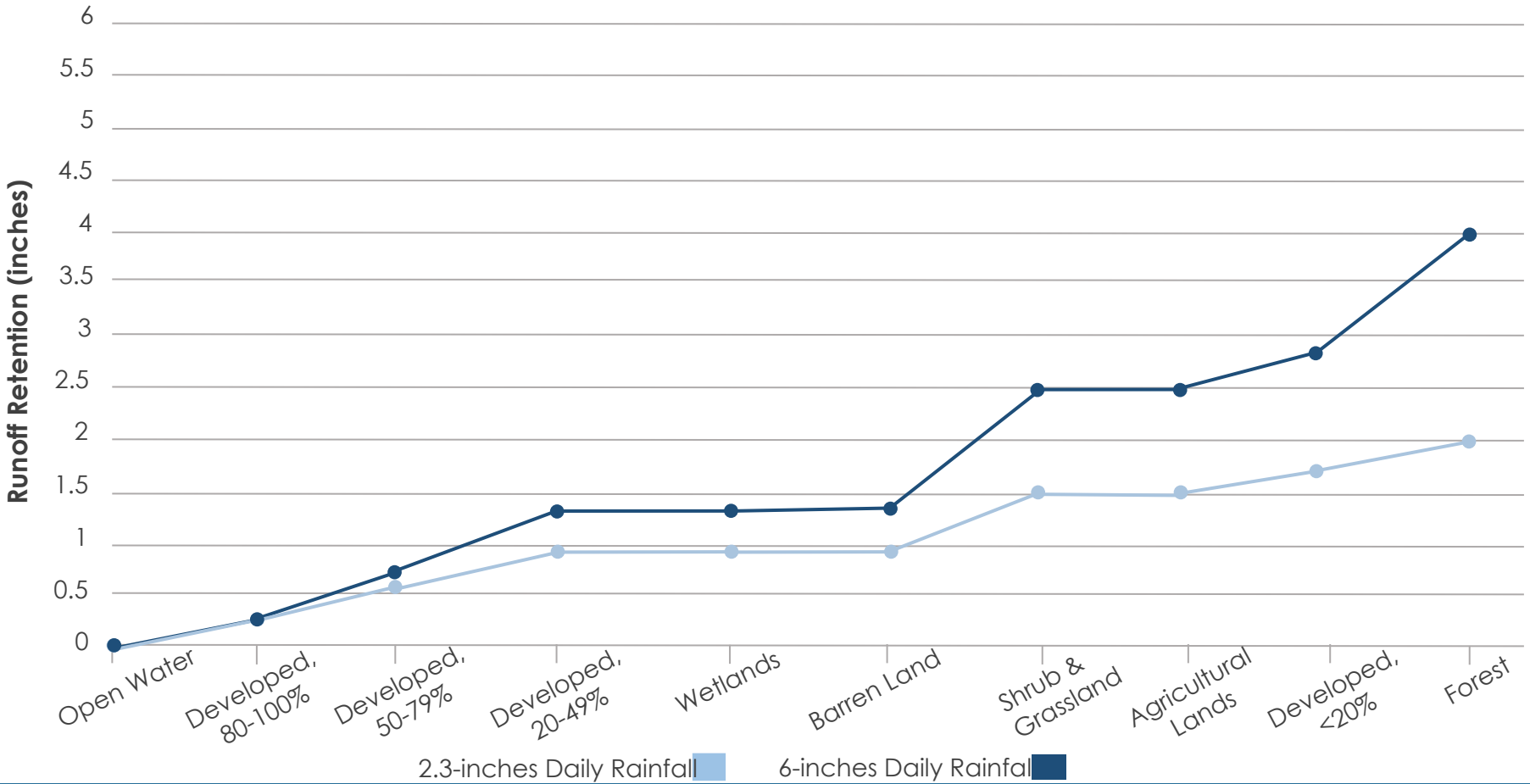


2.3-in/day Rainfall Event

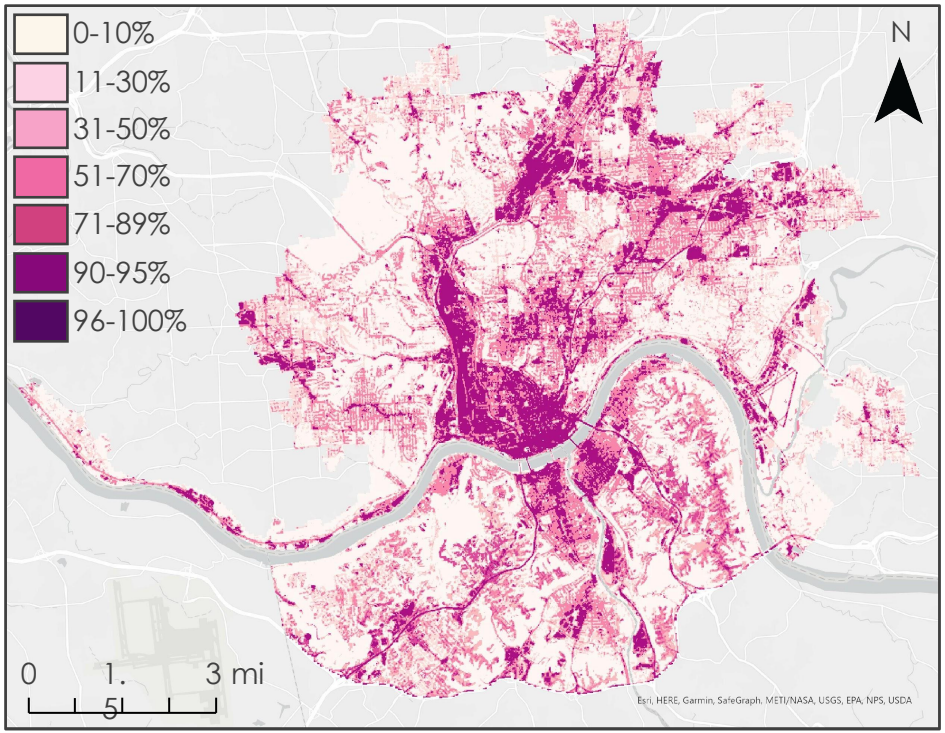


6-in/day Rainfall Event

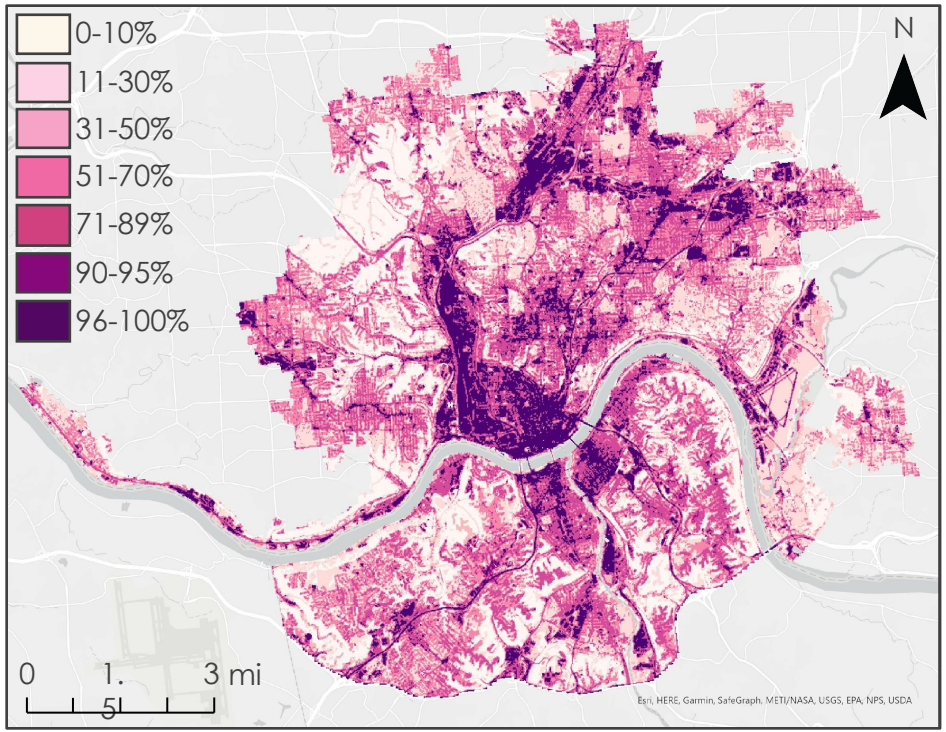
Runoff Retention per Landcover Class



InVEST Results: Runoff

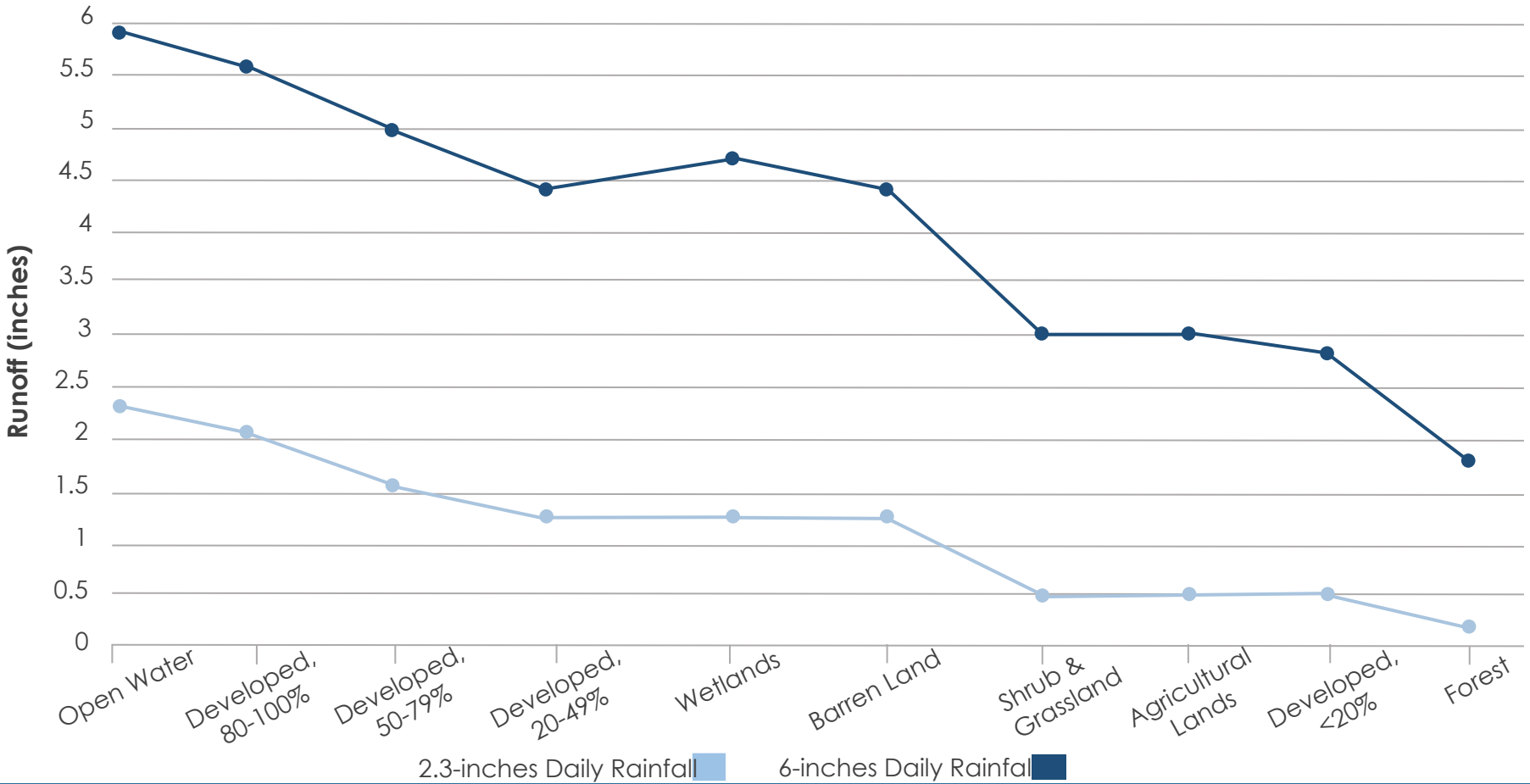


2.3-in/day Rainfall Event



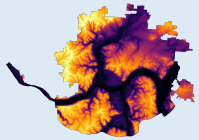
6-in/day Rainfall Event

Runoff per Landcover Class

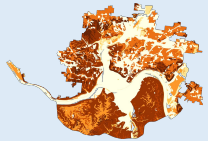


Methodology: Landslide Susceptibility Mapping

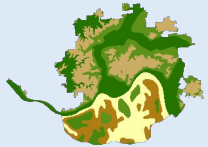
Determine Landslide Factors


Elevation

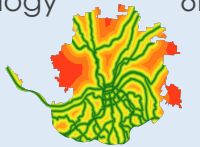

Slope


Clay %

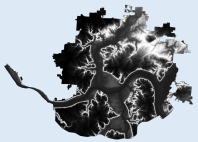

Roughness

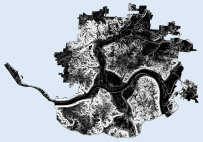

Lithology


δNDVI

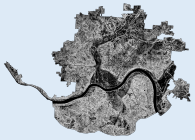

Distance to Roads

Rescale Factors


Elevation

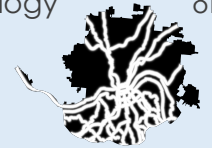

Slope


Clay %


Roughness

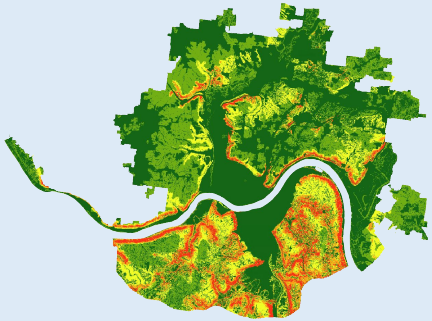

Lithology


δNDVI

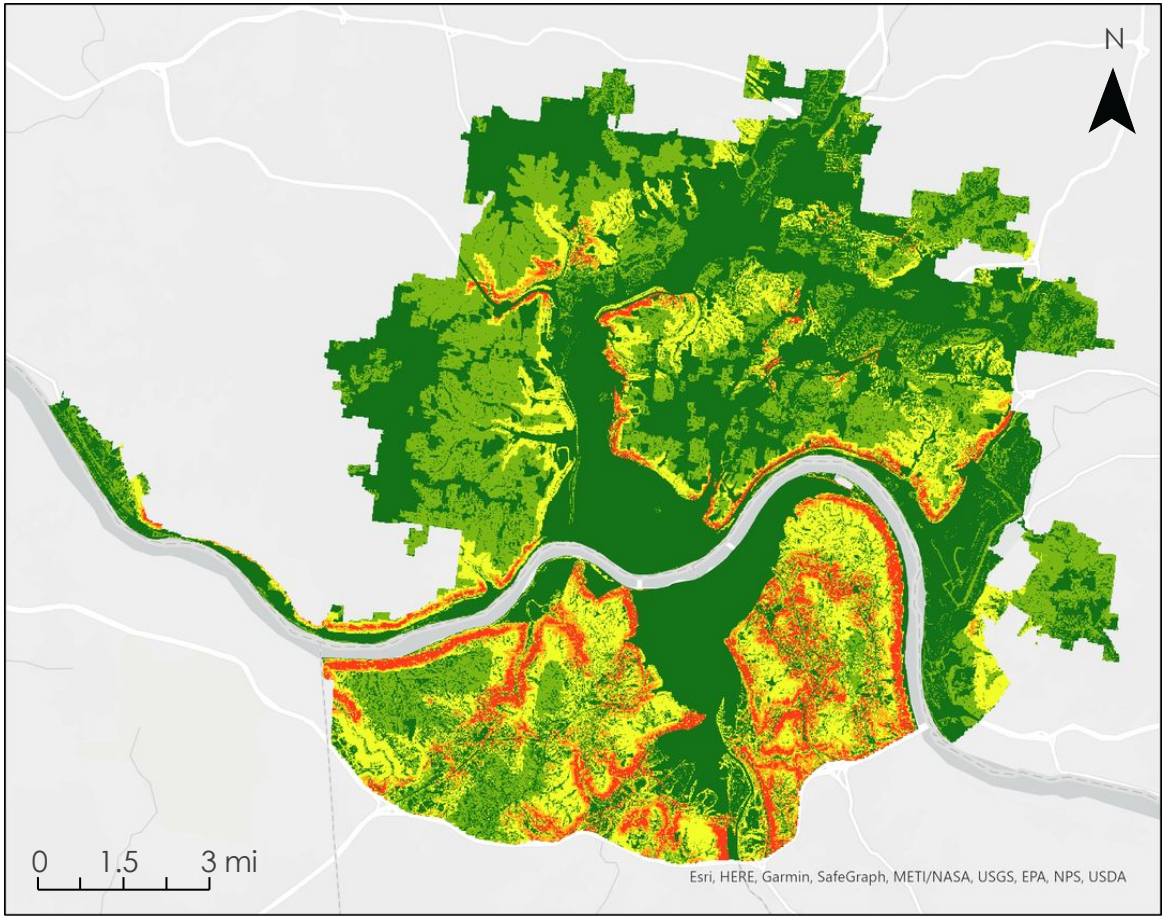

Distance to Roads

Overlay Factors

Final Susceptibility

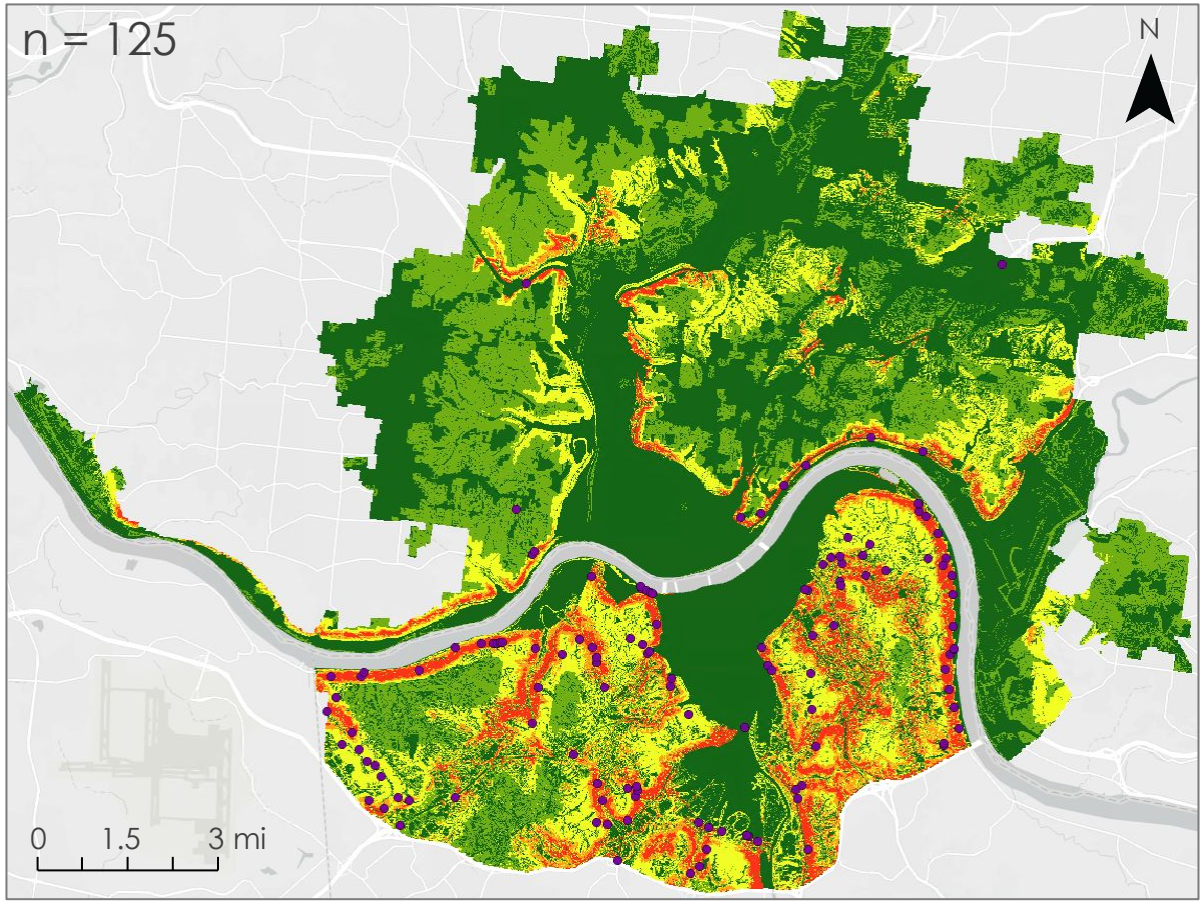


Results: Landslide Susceptibility Map



- Very High Susceptibility: 95-100%
- High Susceptibility: 90-95%
- Moderate Susceptibility: 75-90%
- Low Susceptibility: 50-75%
- Very Low Susceptibility: 0-50%

Validation: Landslide Occurrence



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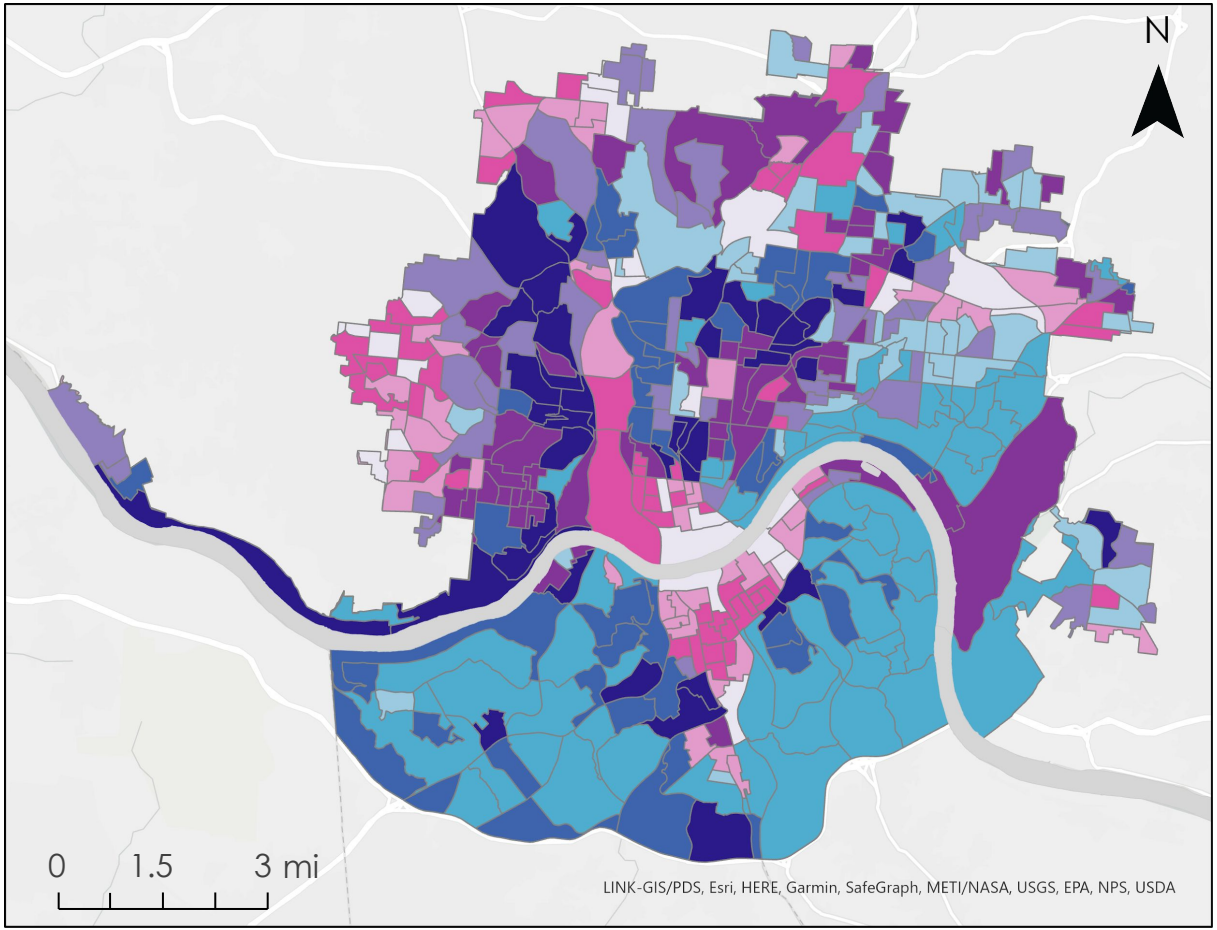
- Moderate Susceptibility: 75-90%
- Low Susceptibility: 50-75%
- Very Low Susceptibility: 0-50%
- Landslide Occurrence

Methodology: Landslide Exposure Mapping

Results: Impoverished Population Exposure Map



Landslide Susceptibility

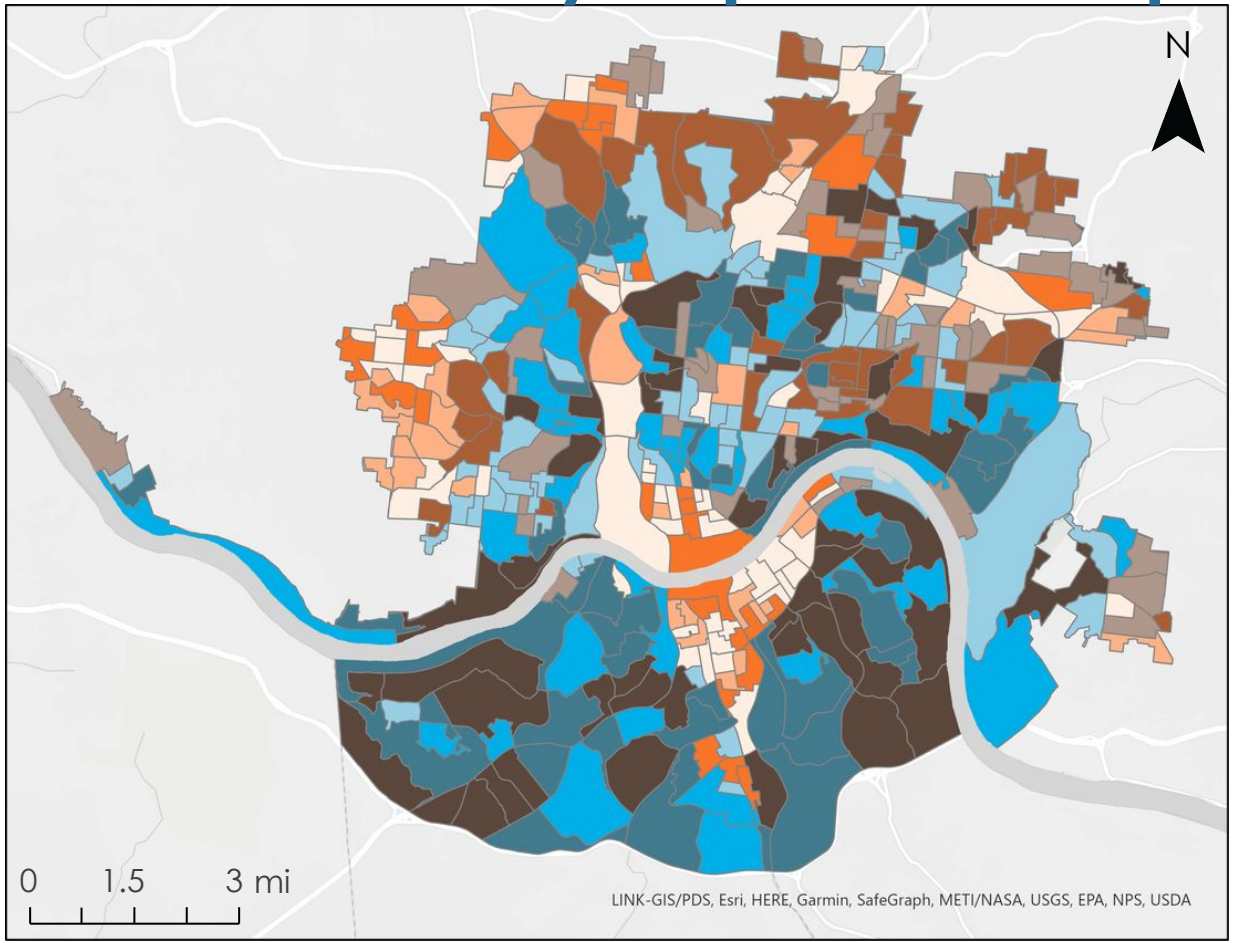
High

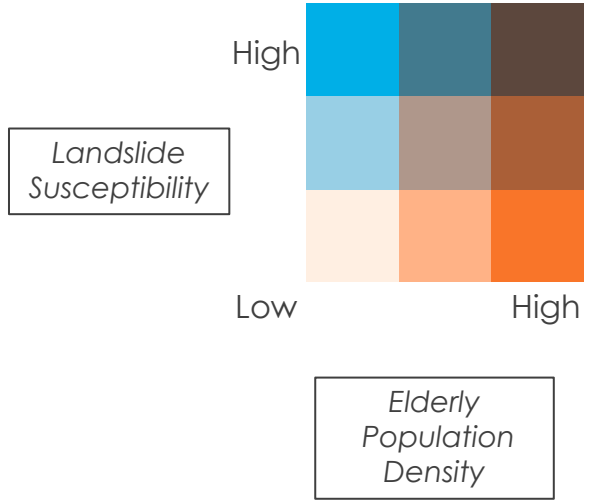
Low

High

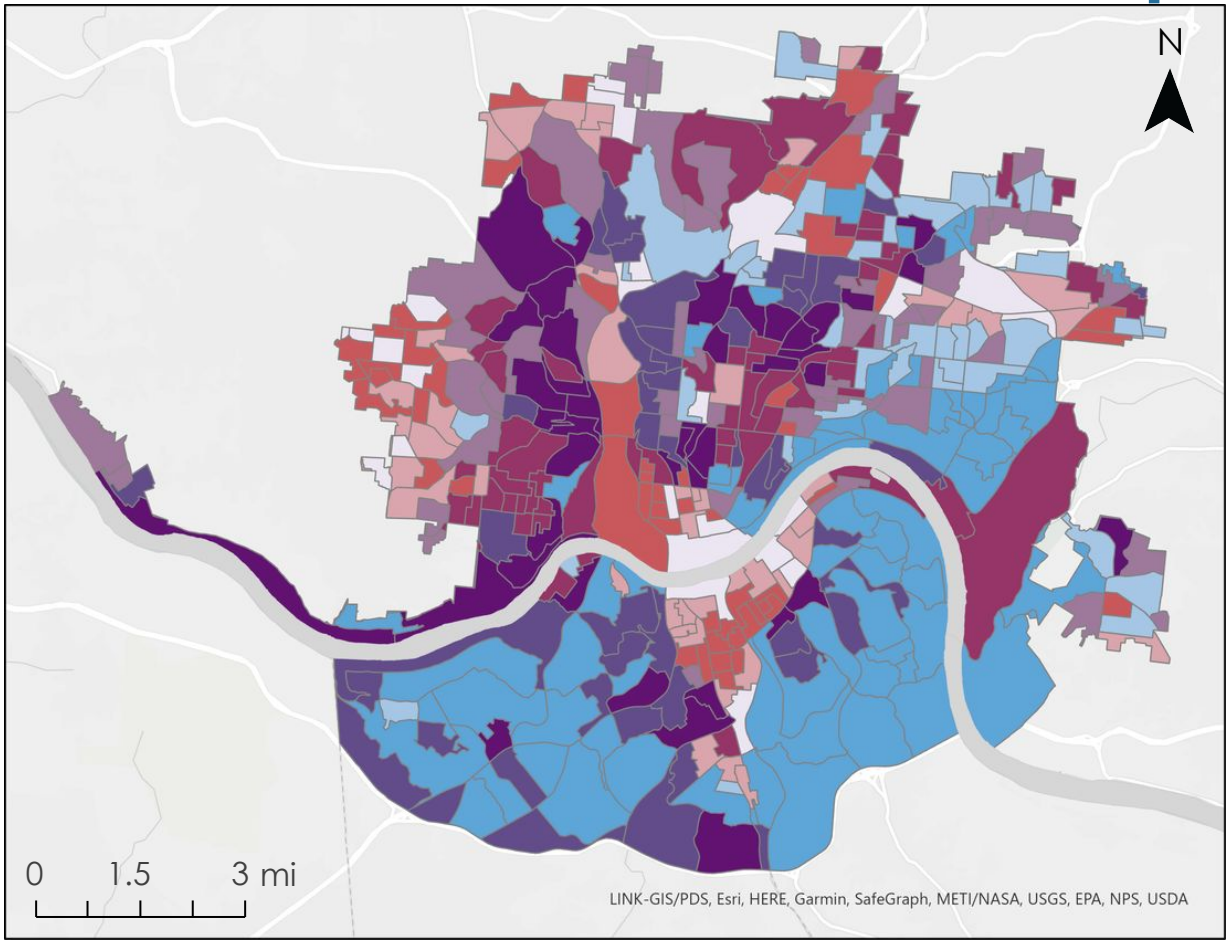
Impoverished Population Density

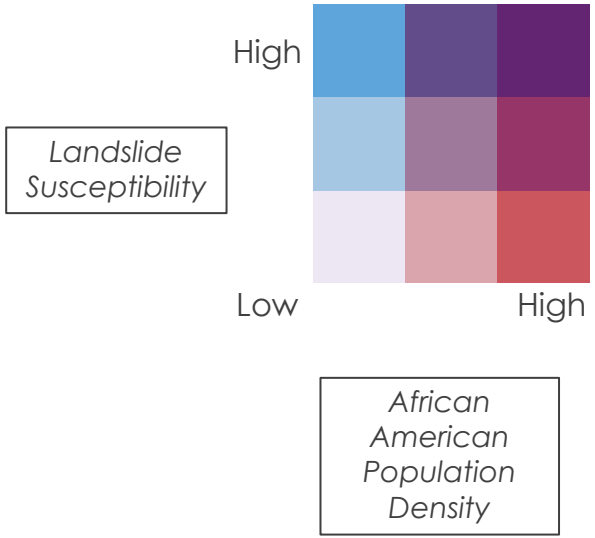
Results: Elderly Population Exposure Map



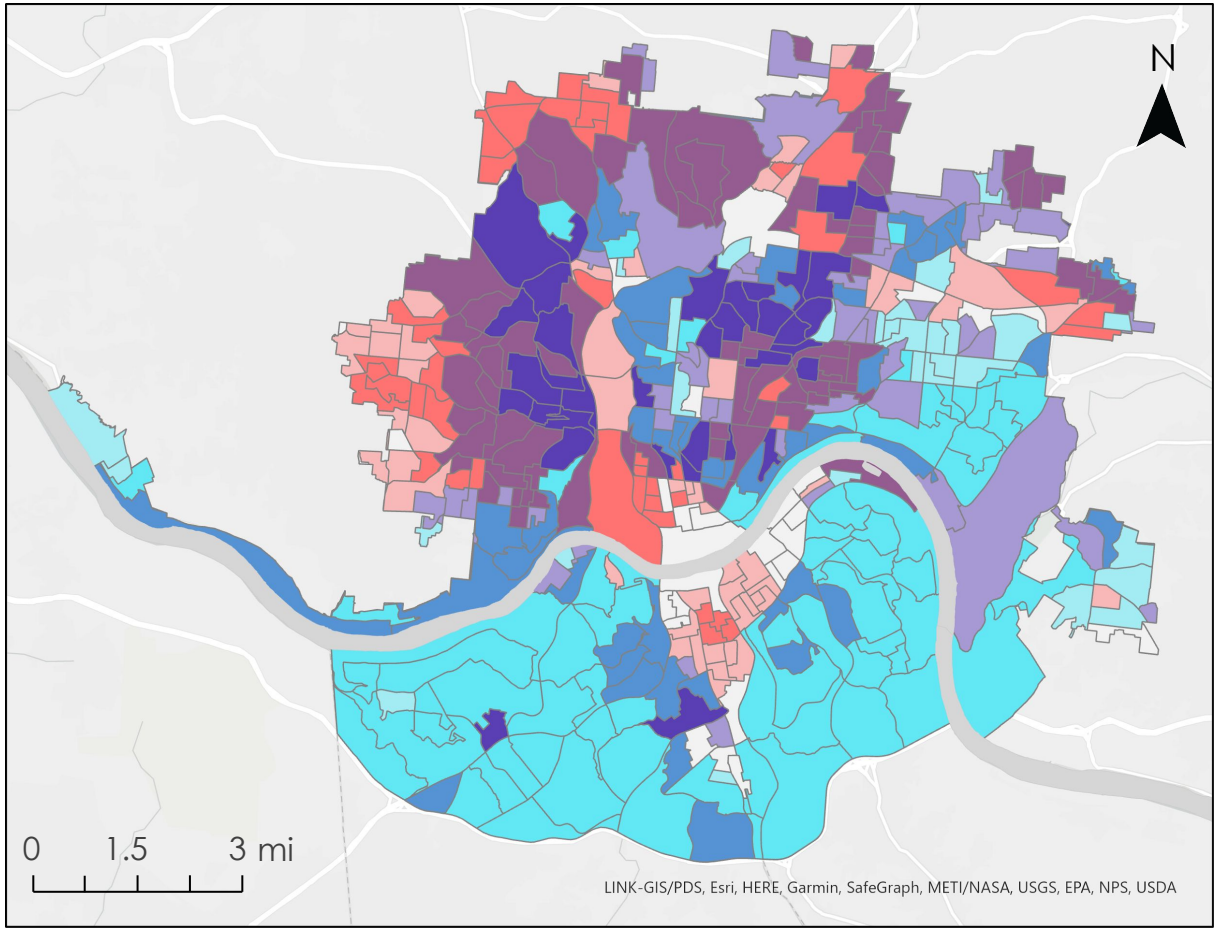


Results: African American Exposure Map





Results: Combined Landslide Exposure Map



Landslide Susceptibility

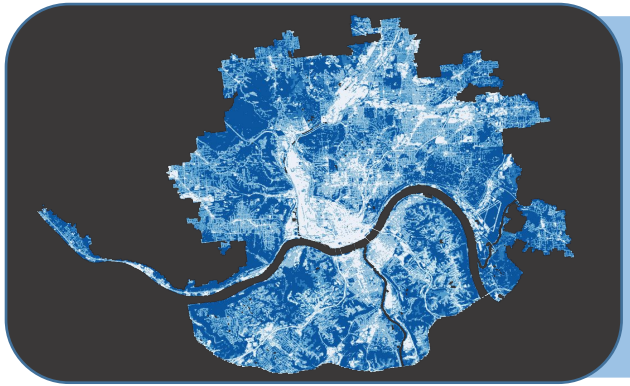
High

Low

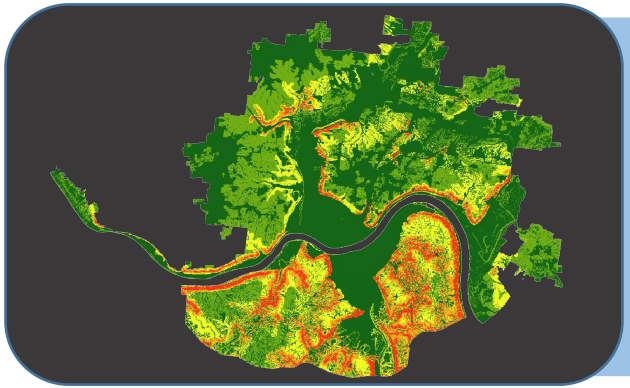
High

Vulnerable Groups Population Density

Conclusions



- In storms affecting the area, highly urbanized land cover types retained barely 10% of rainfall, while forested areas retained up to 90%
- The Downtown Cincinnati, Queensgate, and Over-the-Rhine neighborhoods retained the least amount of rainfall, between 10 – 15%



- Slope was the most predictive variable in assessing landslide susceptibility
- Slopes near major highways, such as US 50 and KY 8, were found to have very high landslide susceptibility
- The area around Avondale, along with North and South Fairmont had the highest determined landslide exposure

Uncertainties and Limitations

InVEST Inputs

- Rainfall estimates
- Watershed limits

Landslide Inventory

- Completeness
- Location accuracy

Susceptibility Factors

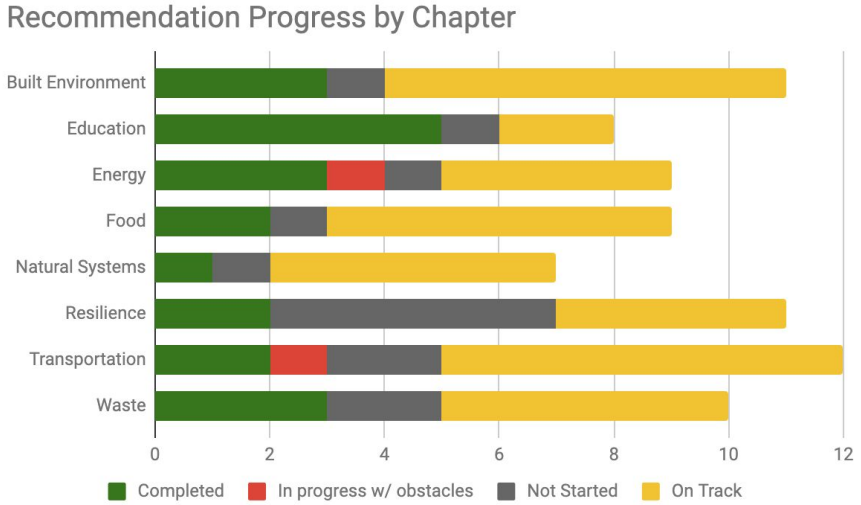
- Rock strength
- Vegetation cover

Image Credit: Vectors Market, Claudia Revalina, Gan Khoon Lay

City of Cincinnati Sustainability Road Map:

2018 Green Cincinnati Plan – 80 Recommendations to achieve 80% reduction by 2050

- 3rd iteration
- 30 public meetings
- 1400 public comments



Green Cincinnati
BUILDING A SUSTAINABLE AND EQUITABLE CITY

Department of Transportation

Sunset Ave.

- $302,514

Eberon Ave

- $728,240

Department of Transportation

Columbia Parkway Before and After

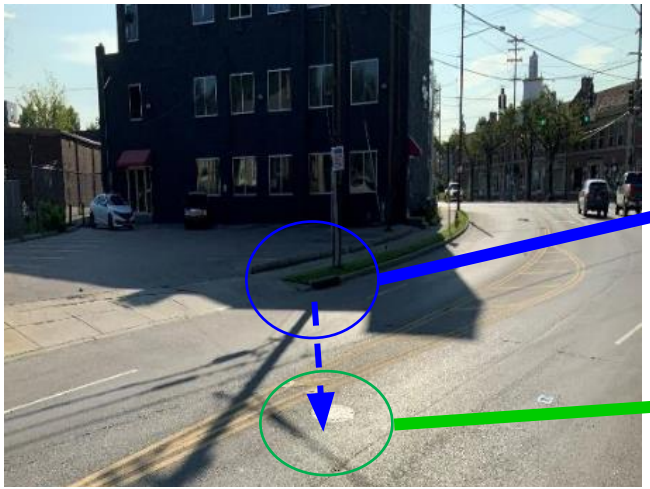
What is the difference between SMU and MSD asset responsibility ?

SMU

- Public SW inlets
- Pipe connection to MSD sewers
- Stormwater sewers
- Erosion control
- Flood control (public areas)

MSD

- Sanitary and combined sewers
- Verified sewer backups in homes/building
- Green Infrastructure for CSO control
- Treatment of wastewater



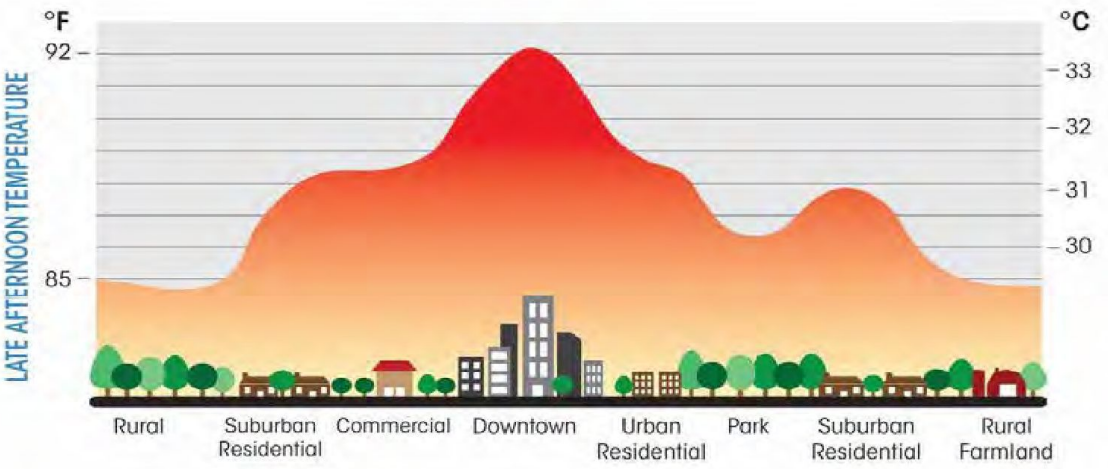
Improved Coordinated Site Reviews

In 2016, The City combined the review and inspection process into one process.

- The Coordinated Site Review process was created to help developers identify any regulatory conditions that may affect their project, including stormwater management.
- The goal of Coordinated Site Review is to give developers written feedback from all departments involved in the site plan and stormwater management approval process.
- By giving this feedback early on, the applicant will be able to change minor or major details before applying for the necessary permits.

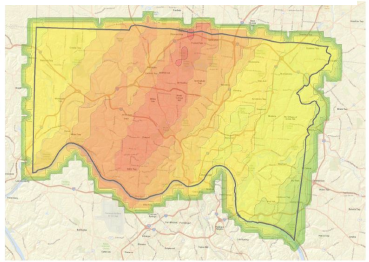
B&I works closely with SMU and MSD evaluating each project for system capacity. Reviews and inspections are performed for grade changes that impact drainage patterns and adjoining properties.

We are seeing impacts now

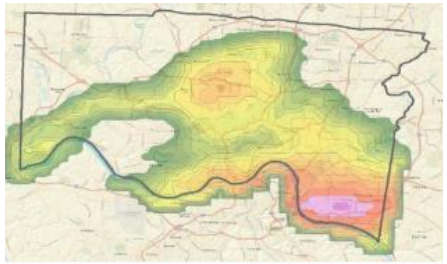


Hamilton Co. has seen 9, 100-Year or 1% Storms in the last 10 years

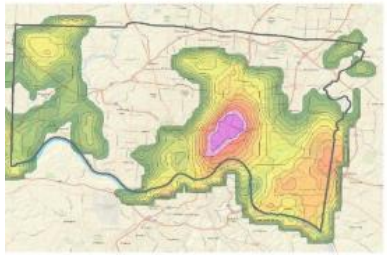
September 25, 2011



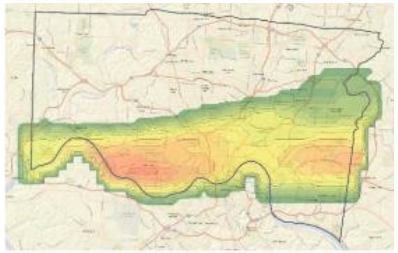
July 27, 2016



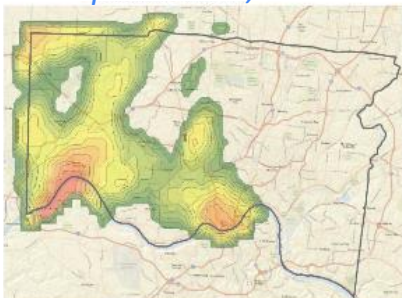
August 28, 2016



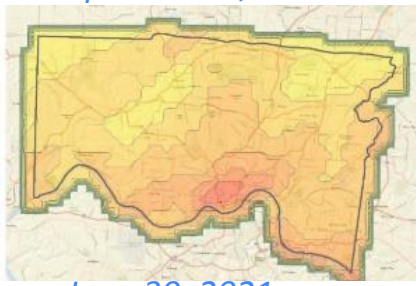
April 16, 2017



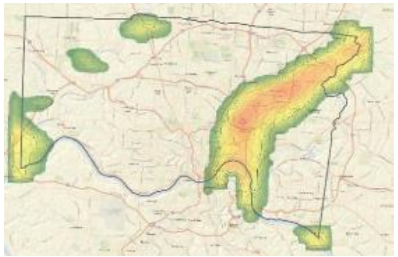
September 5, 2018



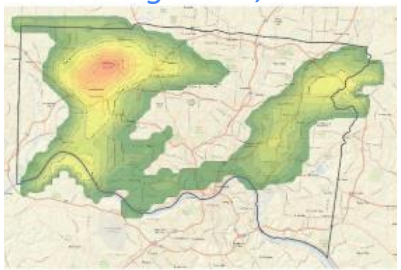
September 7, 2018



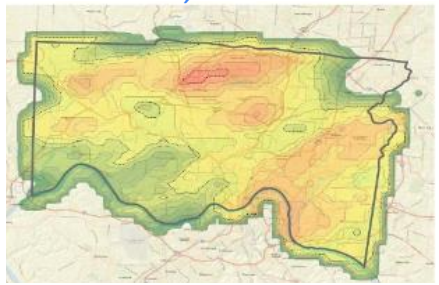
July 30, 2019



August 20, 2019



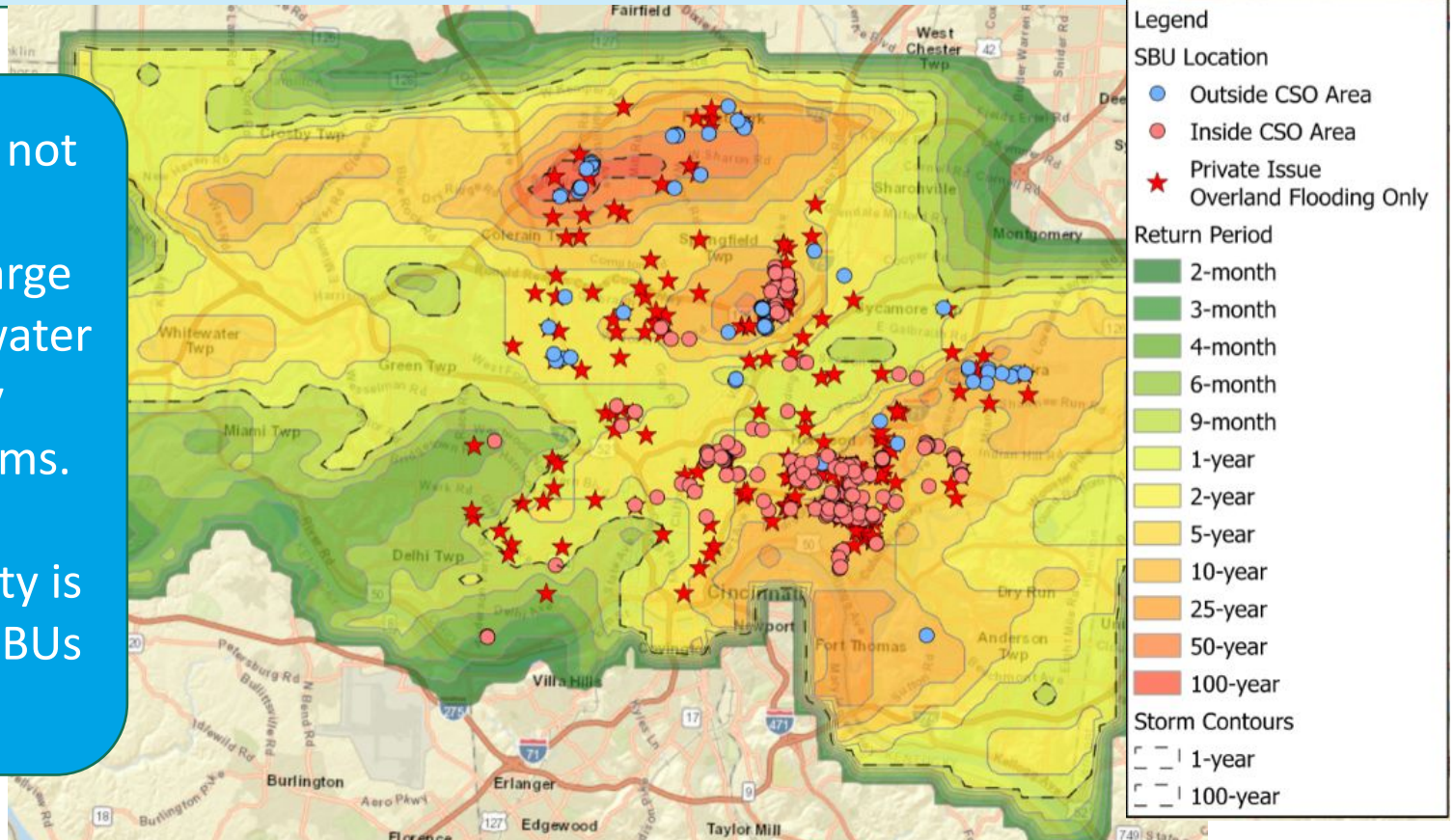
June 30, 2021



Extreme Weather
June 30 – July 1, 2021

Sewers were not designed to convey the large volumes of water generated by extreme storms.

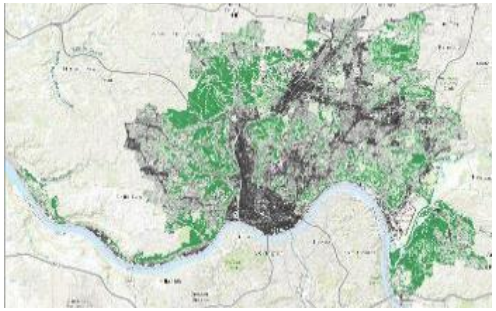
When capacity is exceeded – SBUs may result.



What Will We Need to Do?

Reduce Cincinnati's carbon footprint

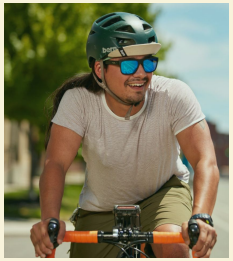
Gather data and analyze risk



Engage the public

Do things differently

Look to the future



Tanner Yess
Co-Executive Director,
Groundwork
Ohio River Valley

Panel Discussion

- Please ask questions in the “Q&A”
- Identify who your question is for if for a specific person

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Sarah Morgan
GIS Manager,
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GROUNDWORK
CHANGING PLACES
CHANGING LIVES
GROUNDWORK
Ohio River Valley

Green Umbrella
REGIONAL SUSTAINABILITY ALLIANCE

city of
CINCINNATI
ENVIRONMENT &
SUSTAINABILITY