



# **YOUNGSTOWN & WARREN** Disasters

Mapping Flood Susceptibility, Vulnerability, and Risk and Tree Canopy Coverage in Northern Ohio to Inform Stormwater Management and Flood Mitigation Efforts

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## **Study Area: Counties**

#### Study Area:

- Trumbull and Mahoning Counties, Ohio
- Climate: Humid continental warm
  summer
- Trumbull Population: 201K
- Mahoning Population: 226K

#### **Study Period:**

• January 2017 – December 2022



## **Study Area: Watershed**

#### Sub watersheds at the HUC 12 level:

- Encompass Trumbull and Mahoning counties study area
- Used for InVEST Model and Blue Spot Analysis



## Background









- Loss of steel jobs and deindustrialization
- Aging, declining population
- Removal of dams once used for steel factories



Image Credit: Courtney Boyle, Katherine of Chicago

## **Community Concerns and Goals**



## **Project Partners**

#### Environmental Collaborative of Ohio (ECO)



City of Warren, Water Pollution Control Department





Image Credit: Courtney Boyle

#### Eastgate Regional Council of Governments



Healthy Community Partnership Mahoning Valley





**Run** InVEST Urban Flood Mitigation Model to produce runoff and retention maps

2

**Compare** InVEST model outputs to Social Vulnerability Index and Blue Spot Model

3

**Map** tree canopy cover to understand the intersection of tree canopy equity and flood vulnerability

## **Satellites and Sensors**



Global Precipitation Measurement





**PlanetScope** 



## Methodology



### Methodology: InVEST Urban Flood Risk Mitigation



### Methodology: Flood Vulnerability



### Methodology: Blue Spot Model



## Methodology: Tree Canopy Cover



### InVEST Urban Flood Mitigation Model Results: Runoff and Retention Maps





### Land Use Land Cover



### InVEST Results: 2.47-inches of Rainfall





#### InVEST Results: 3.36-inches of Rainfall





### InVEST Results: 6.91-inches of Rainfall





## Flood Vulnerability Mapping Results



### **Results: Flood Vulnerability**



Social Vulnerability Index



## **Blue Spot Model Results**



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## **Tree Canopy Cover Results**



## **Results: Tree Canopy Cover**





### Conclusions

- Surface runoff is worst, and rainfall pools the most in the areas surrounding the cities of Youngstown and Warren due to the high levels of urban development and aging stormwater infrastructure
- Runoff retention is highest at the eastern and western boundaries of the watershed
- 20 census block groups surrounding the cities of Youngstown and Warren have the highest aggregate value of social vulnerability and surface runoff amount, putting these areas at the greatest vulnerability and risk during flood disasters
- Tree canopy cover is low within the center of both Youngstown and Warren where there are high impervious surfaces





#### **Errors & Uncertainties**

#### InVEST Model:

- Accounts for infiltration based on land and soil type but does not consider elevation gradient
- Applies uniform rainfall amount across study area
- Blue Spot:
  - > Spatial accuracy of the model is dependent on the quality of the input DEM
  - ▶ The model is unable to account for sewer systems

#### Tree Canopy:

- Misclassifications due to spatial and spectral resolution of the imagery
- Bivariate Social Vulnerability
  - Census block level, not specified to neighborhood level



### **Future Work**

- Explore the cost of potential economic damage through the InVEST building damage cost analysis optional output
  - Run InVEST using remotely sensed precipitation data
- Map past historical tree canopy cover and calculate percent tree canopy cover change
- Map riverine flooding using Sentinel-1 imagery and compare with FEMA maps and citizen reports





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Image Credit: Courtney Boyle

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### NASA Earth Observations: Precipitation

Spatially averaged, monthly aggregated precipitation in Trumbull and Mahoning Counties



