Who Bears the Burden?

Measuring Risk & Resiliency in Medford, Massachusetts

Photo by Wellington Rodrigues/Unsplash.com

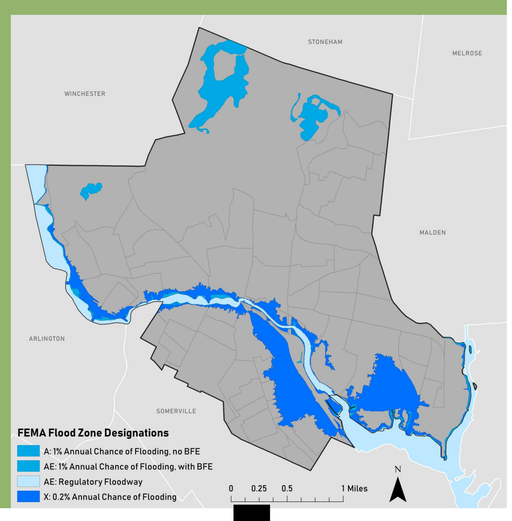
Background & Questions

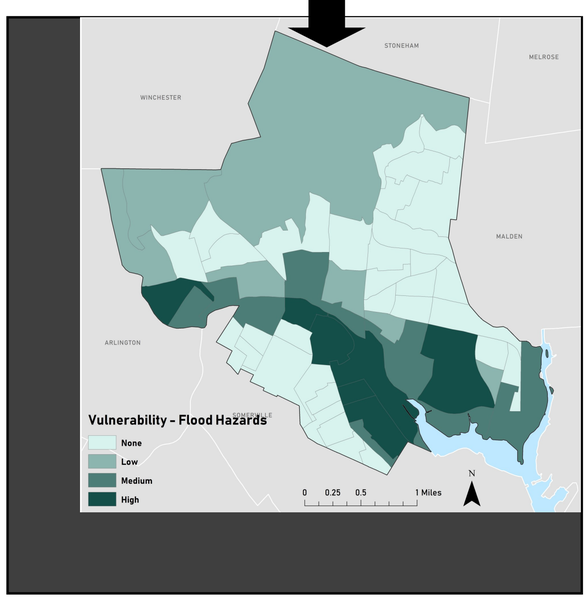
Of the myriad of current and anticipated transformations of our environment resulting from climate change, the projections of increased precipitation within northern regions of the United States, more frequent and intense extreme precipitation events across many regions of the country, as well as the increased intensity, frequency, and duration of North Atlantic hurricanes[1] have received much attention as of late. New England is taking note, and in particular, the Boston metropolitan region is undertaking substantial efforts to assess, mitigate, and plan for the future of communities as it relates to potential climate change impacts .

As such, the city of Medford, Massachusetts, is currently preparing a climate vulnerability assessment, a component of which will address urban flooding and extreme weather impacts[2]. Factors that affect the ability of communities to adapt or respond to adverse conditions ("resilience") can include social vulnerability (i.e. measures of age demographics, low-income populations, communities characterized by English language isolation, etc.) and neighborhood connectivity (i.e. access to transit, access to community resources)[3,4]. Accordingly, this investigation seeks to use risk mapping and vulnerability analysis to address specific questions related to flood hazard mitigation in Medford, Massachusetts:

- Which areas in Medford have the highest combined risk when considering flooding hazards, social vulnerability, and gaps in public transit access?
- What is the nature of the vulnerabilities in areas of high risk?

Flood Hazards





Social Vulnerability

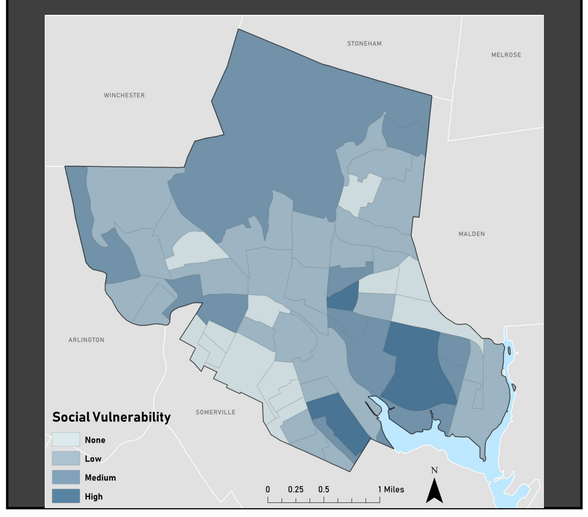
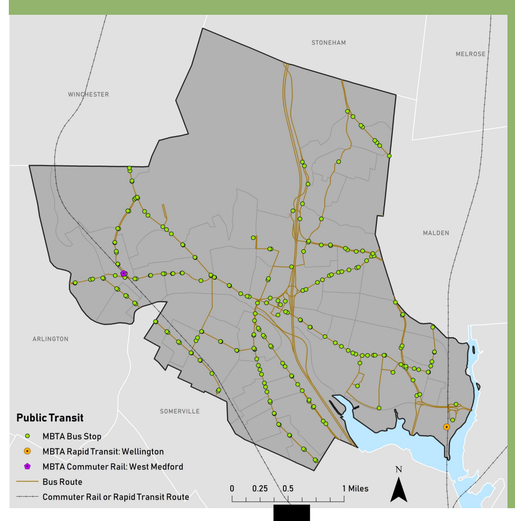
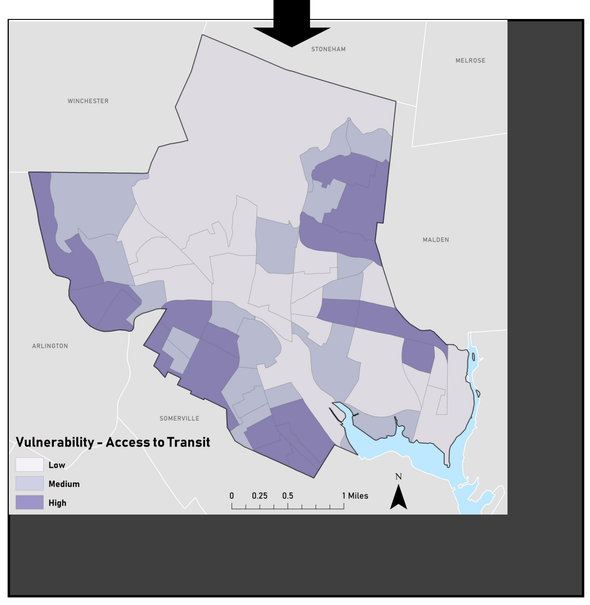


Image: pixabay.com Image: svgsilh.com

Access to Public Transit





Methods & Risk Factors

Three factors were included as part of the risk analysis:

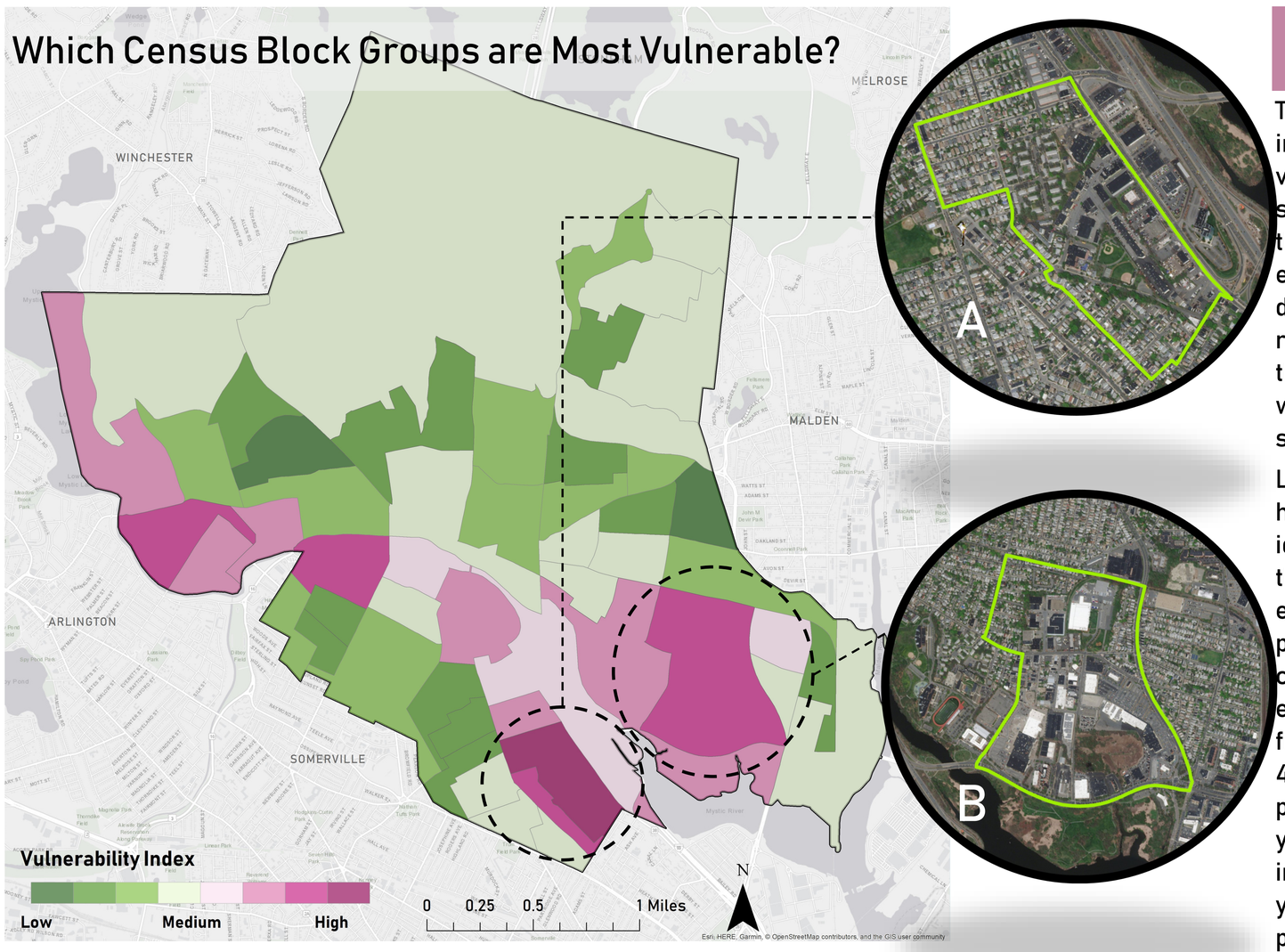
(1)Flood hazards: The 100- and 500-year floodplain data was utilized from the FEMA National Flood Hazard Layer (NFHL), effective 2017. Spatial Analyst/Zonal commands were used to tabulate the total area of the 100- and 500-year floodplain per Census 2010 Block Group (BG). Percent area affected per BG was computed via Field Calculator, and a vulnerability ranking was assigned.

(2) Social vulnerability: Environmental Justice (EJ) population criteria were considered per BG, to include English language isolation, percent minority population, and household income. Percent of total population per BG was also evaluated for persons 65 years and older and persons 5 years and younger. A vulnerability rating was computed via Field Calculator according to the number of social vulnerability conditions met.

(3) Gaps in public transit access: MBTA bus, rapid transit, and commuter rail routes were included to identify how many routes service each BG. A series of spatial joins were used, before normalizing the number of routes by the total population per BG. A vulnerability ranking was assigned accordingly.

Using the Field Calculator, a cumulative vulnerability index was computed by summing the ratings from the above-mentioned three categories. A total vulnerability rating resulted per BG, ranging from 0 (lowest risk) to 11 (highest risk).

Which Census Block Groups are Most Vulnerable?



Results & Locations with High Vulnerability

The cumulative vulnerability index suggests that the most vulnerable areas are not surprisingly those which border the banks of the Mystic River. It is evident, however, that the demographics and transit resources within the BGs along this corridor are not uniform, warranting a closer look at select sites:

Location A—The BG with the highest rating (9 out of 11) was identified in South Medford, with the Mystic River situated to the east-northeast. The BG consists primarily of residential and commercial uses, with an elementary school. Beyond the flood hazards (approximately 45% of the area of the BG may potentially be affected by a 500-year event), the demographics indicate a high population of youth, as well as a high percentage of low-income households, and over 25% minority population. At the same time, this area also demonstrated one of the lowest rates of public transit resources per capita.

Factors		Location A	Location B
Flood Hazards	Risk Rating	3 out of 3	3 out of 3
	Percent Area Potentially Affected	45%	46%
Social Vulnerability	Risk Rating	3 out of 5	3 out of 5
	Criteria Met	• Minority • Income • Population <5 years old	• Minority • Population <5 years old • Population >65 years
Transit Gaps	Risk Rating	3 out of 3	1 out of 3
	Routes Per Capita	0.007	0.026

Location B— In contrast, Location B is dominated by commercial use, with lesser residential areas. This area is well-served by public transit, however, flood hazards may potentially be substantial, and high percentages of minority populations, as well as elderly and youth, are present.

These findings display the unique challenges facing each neighborhood in Medford. The index can guide a prioritization process, and facilitate the identification of appropriate strategies/interventions for future resilience planning.

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Data Sources: MassGIS, 2010 U.S. Census, ESRI, Tufts GIS
Projection/Coordinate System: Lambert Conformal Conic/ NAD 1983 State Plane Massachusetts Mainland FIPS 2001 (meter)

REFERENCES:

1 Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, et al. 2014. "Ch. 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment." U.S. Global Change Research Program. https://doi.org/10.7930/J0KW5CXT.

2 Willson, Miranda. 2018. "Climate Ready Medford: City Assesses Local Climate Change Impacts." *Medford Transcript*, February 2, 2018. http://medford.wickedlocal.com/news/20180202/climate-ready-medford-city-assesses-local-climate-change-impacts

3 Climate Ready Boston. 2017. "Climate Vulnerability Assessment." In *Climate Ready Boston*– Citywide Report. City of Boston. Accessed November 19, 2018. https://www.boston.gov/sites/default/files/imce-uploads/2017-01/crb_-_focus_area_va.pdf

4 Douglas, Ellen, Paul Kirshen, Michael Paolisso, Chris Watson, Jack Wiggin, Ashley Enrici, and Matthias Ruth. 2012. "Coastal Flooding, Climate Change and Environmental Justice: Identifying Obstacles and Incentives for Adaptation in Two Metropolitan Boston Massachusetts Communities." *Mitigation & Adaptation Strategies for Global Change* 17 (5): 537–62. https://doi.org/10.1007/s11027-011-9340-8