

Climate Vulnerability Assessment

# Human Vulnerability

Humphrey School of Public Affairs

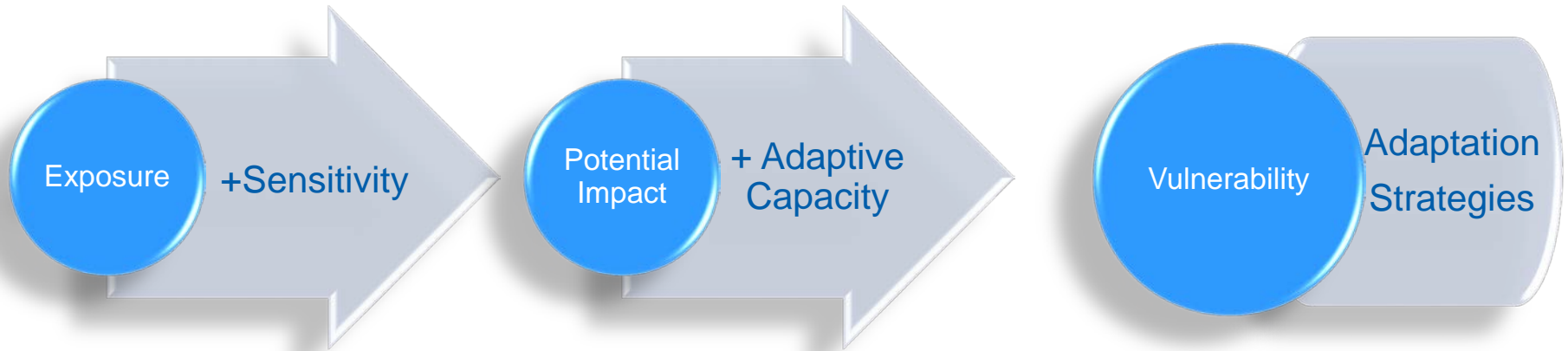
PA 8081 Capstone Spring 2017

Presented to: Metropolitan Council Land  
Use Advisory Committee

05/18/2017



# The Climate Vulnerability Assessment Process



## Climate impacts related to:

- **Flooding** - Floodways and Localized Flooding
- **Extreme Heat** - Urban Heat Island

# Climate Vulnerability Starts with People

*“THRIVE MSP 2040 is the vision for our region over the next 30 years.”  
– The Metropolitan Council*

Sustainability is one of five desired outcomes and “Building in Resilience” is one of seven core land use policies.

To address these items and align with *Thrive*, the Council must:

1. Respond to the effects of climate change in its planning and operational activities
2. Identify and address potential vulnerabilities in regional infrastructure
3. Provide related information and assistance to local communities

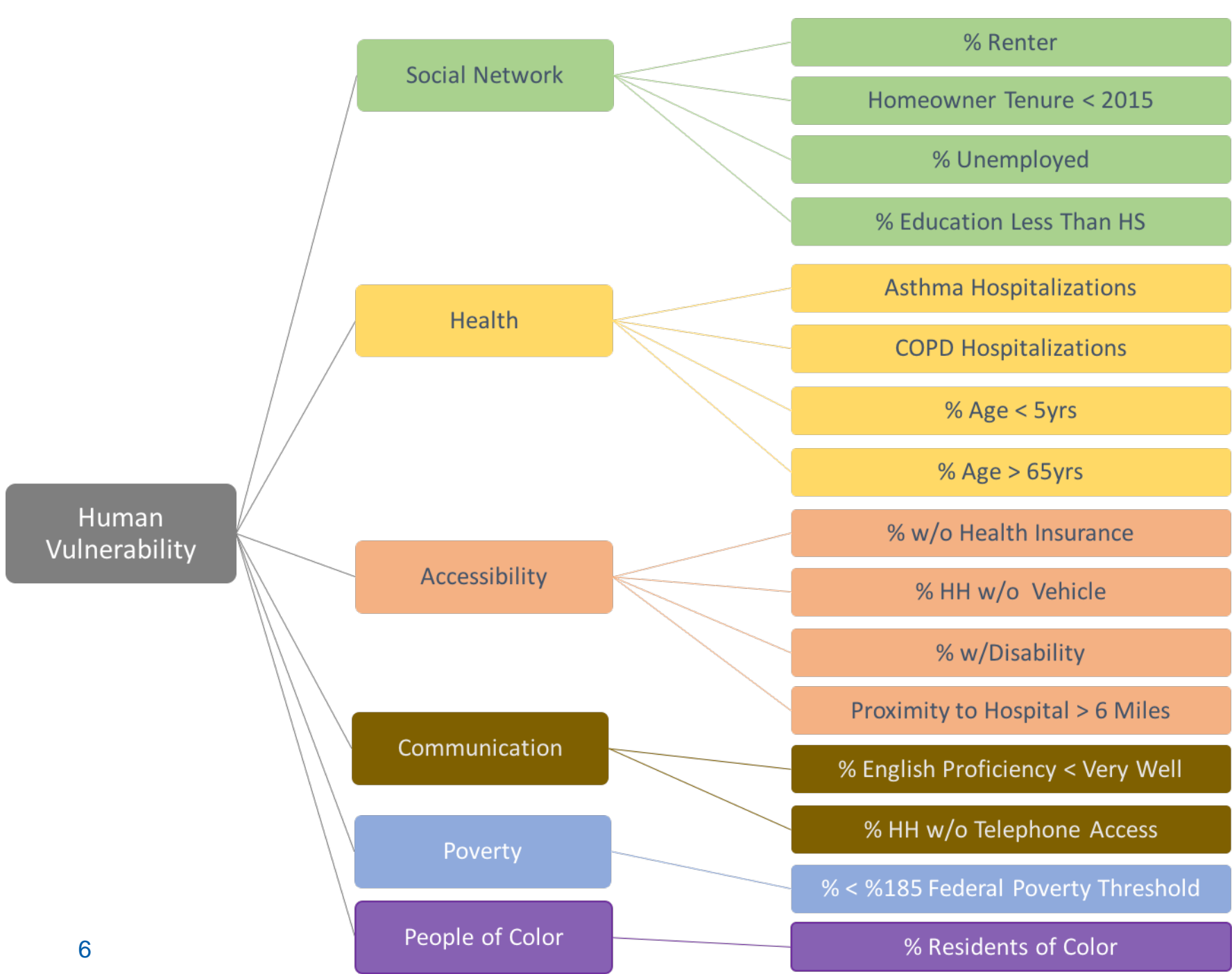
Our team completed the “people portion” of this assessment.

We have identified what human vulnerability means in our region when coupled with specific phenomena of flooding and extreme heat events.

# Objectives: Map Climate and Human Vulnerability

- Identify areas of climate vulnerability in relation to extreme heat and surface flooding
- Identify specific human vulnerabilities and analyze in terms of their relation to the areas of climate vulnerability to extreme heat and surface flooding

# Human Vulnerability Index



# Mapping Methodology

- Normalized all data to census tracts
- Calculated metro-wide average, standard deviation of each indicator
  - Above average/standard deviation = higher vulnerability
- Aggregated indicators based on concepts
  - Created common scale to avoid weighting based on number of indicators in concept
  - Higher scores = higher vulnerability
- Converted all aggregates, extreme heat, and surface flooding to rasters to calculate overall climate vulnerability
- Overlapped human and climate vulnerabilities

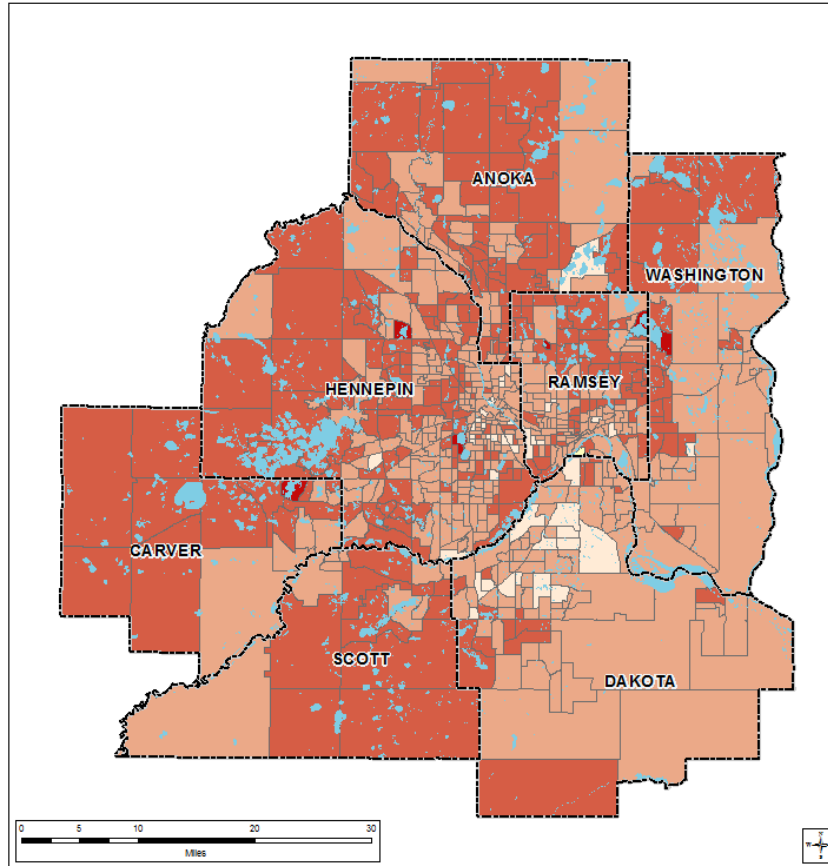
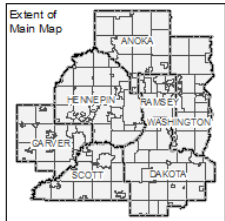
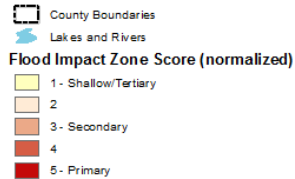


# Maps of Surface Flooding and Extreme Heat Events



# Four Counties Are Most Susceptible to Surface Flooding

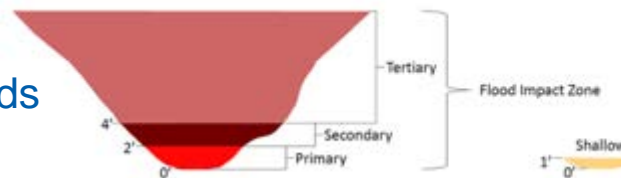
Climate Vulnerability Assessment  
Surface Flooding Index



Sources: 2015 ACS 5-year estimates, Heat Hazard Index, Flood Impact Zone Index

Map # 2

## Flood Hazards



Key Takeaways:

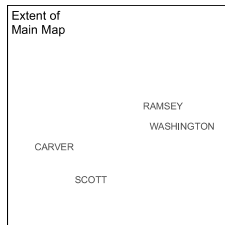
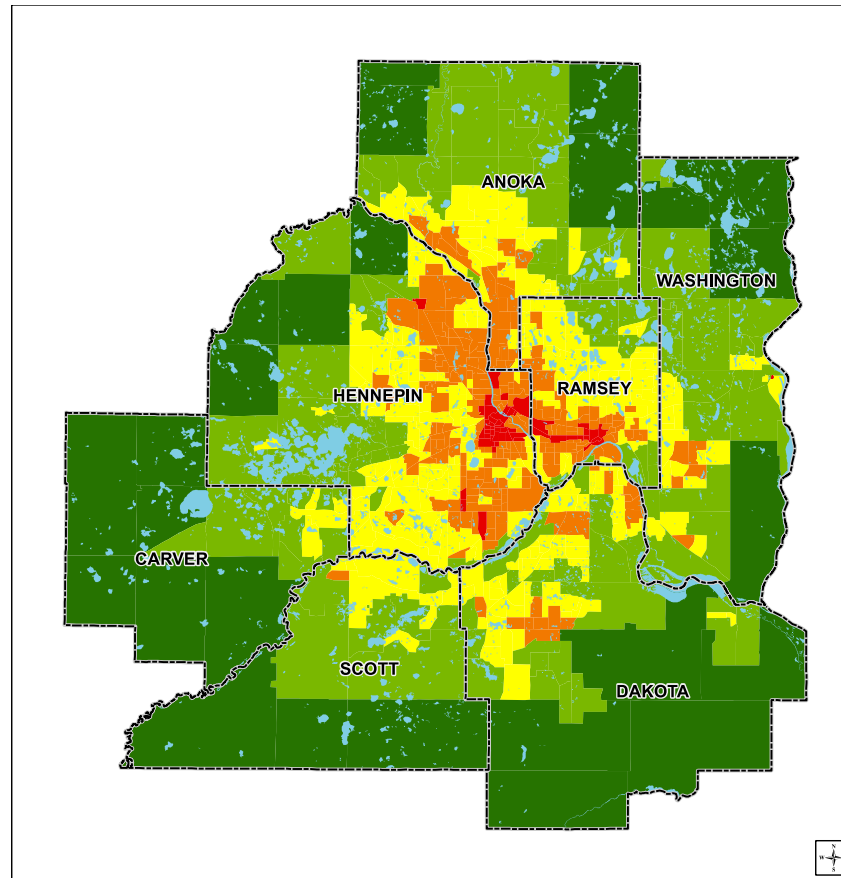
Flooding layer is a modification of Met Council's flood-map, created to better fit our level of analysis.

This map is showing the vulnerability with surface flooding levels ranging from 0'- 1'.

Counties most susceptible to surface flooding:

Anoka, Carver, Hennepin, Scott

# Three Counties Are Most Susceptible to Extreme Heat



## Key Takeaways:

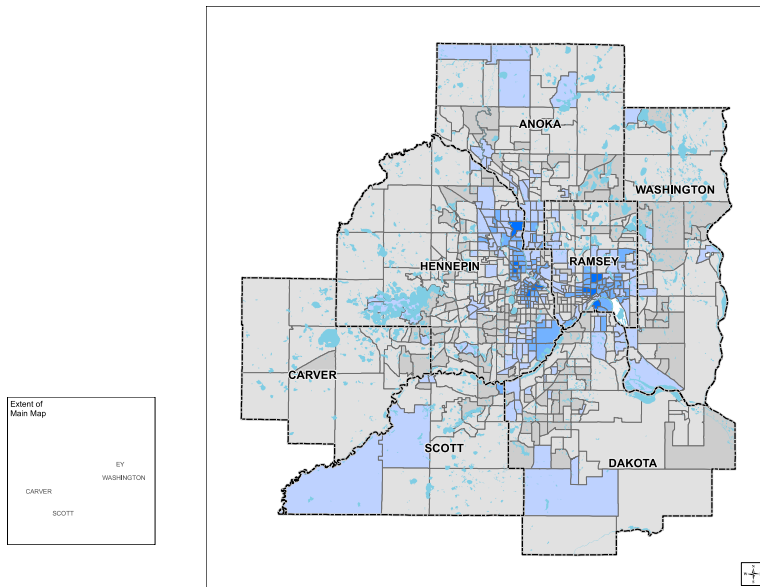
Heat layer measures land surface temperature on the third day of a regional heatwave at 11:59 am on July 22, 2016.

Counties most susceptible to extreme heat:

Anoka, Hennepin, Ramsey

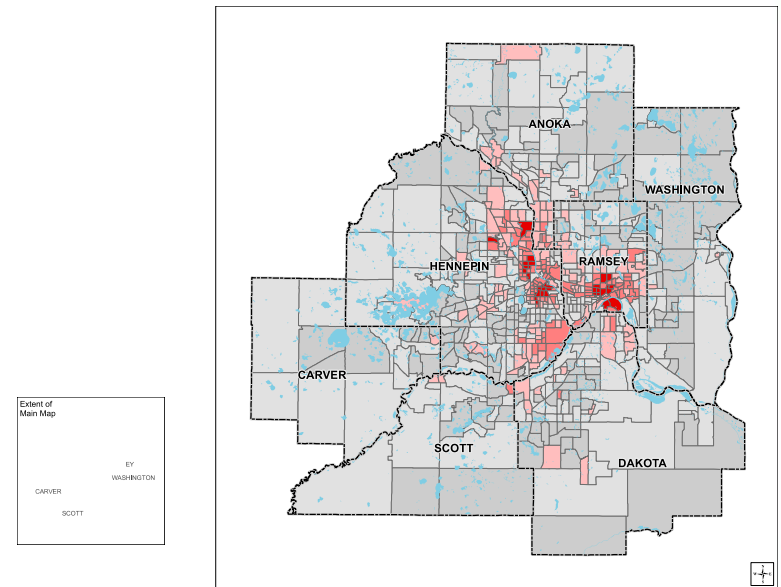
# Mapping Human Vulnerability with Surface Flooding and Extreme Heat

# Aggregate Maps of Human Vulnerability with Surface Flooding and Extreme Heat



## Key Takeaway:

While base flooding map strictly shows areas of surface flooding, the aggregate map shows where flooding strongly overlaps with human vulnerability.

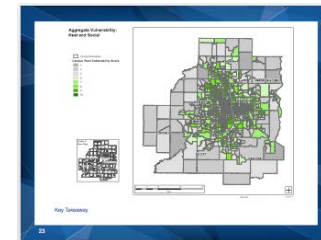
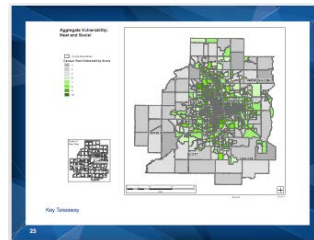
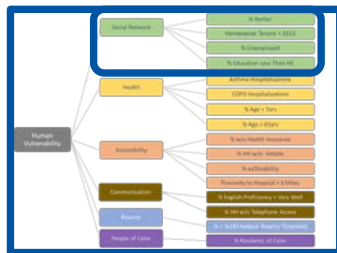


## Key Takeaway:

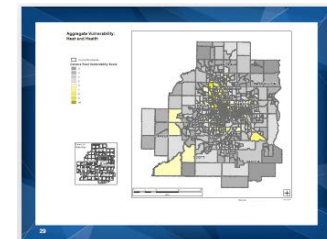
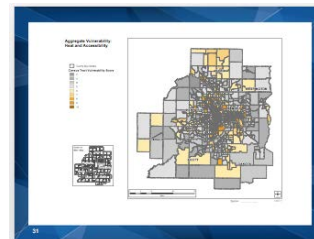
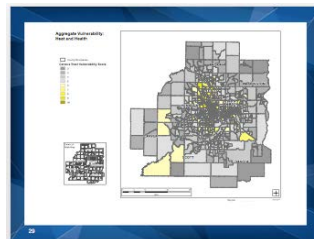
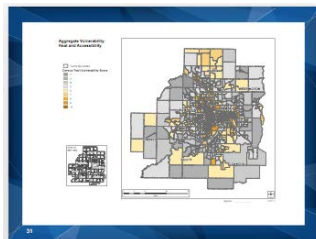
There is strong correlation between areas of extreme heat and human vulnerability – particularly in urban areas.

# Aggregates and Small Multiples Created for Each Concept Area

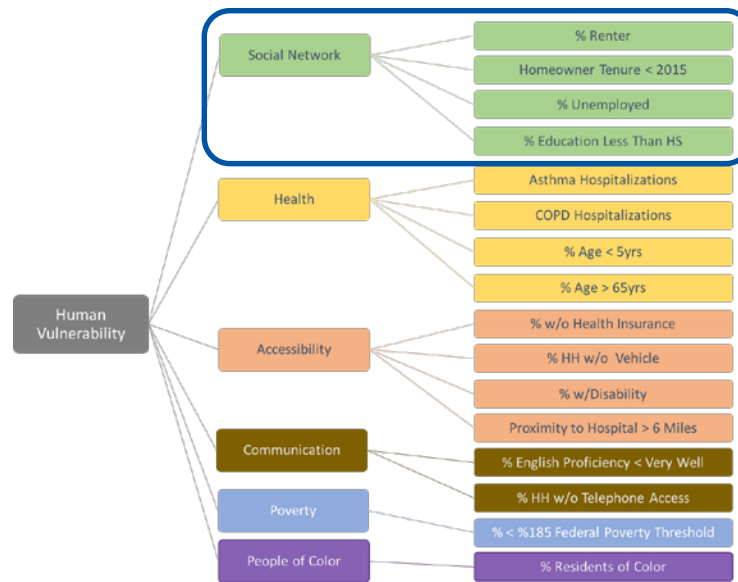
- Map for aggregate human vulnerability concepts overlaid with heat and flood



- Small Multiples – One slide/map per vulnerability indicator with heat and flood

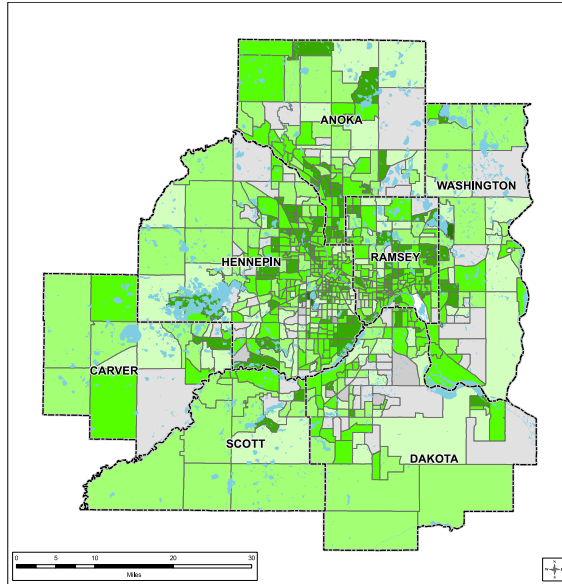


- Analysis - Key takeaways noted for each concept area as well as county-by-county analysis of each indicator and each concept area.



# Aggregate Maps of Larger Concept with Surface Flooding and Extreme Heat

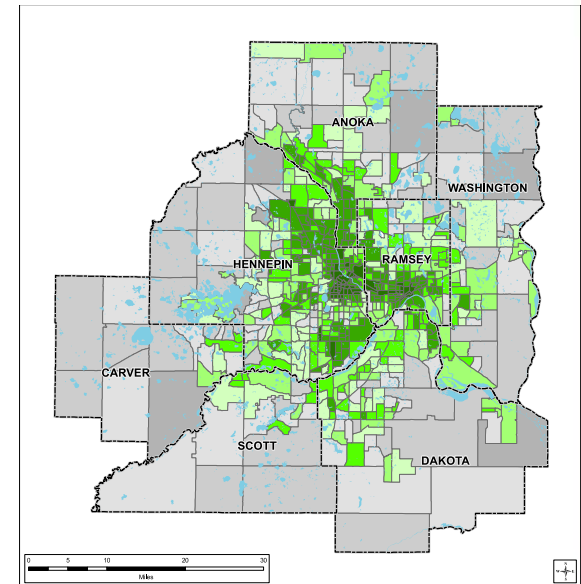
Climate Vulnerability Assessment  
**Aggregate:**  
Flooding and Social Network



Map # 30

Notable Counties – Hennepin, Scott

Climate Vulnerability Assessment  
**Aggregate:**  
Heat and Social Network

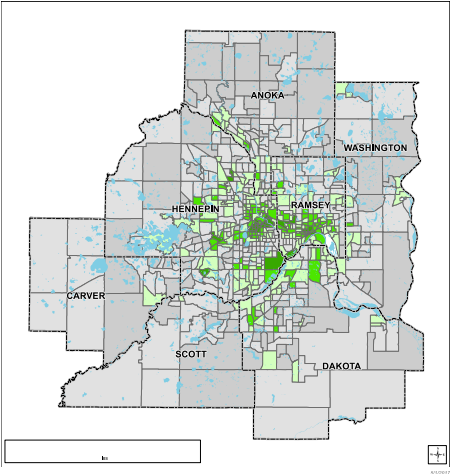


Map # 24

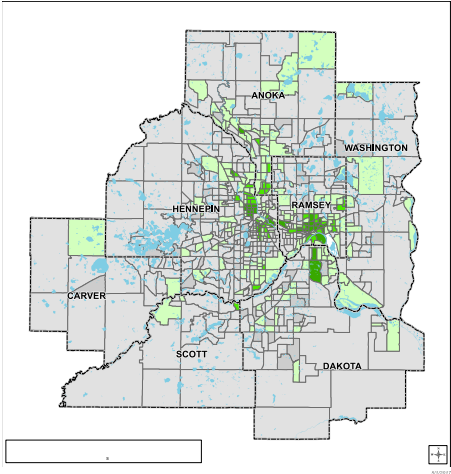
Notable Counties - Anoka, Hennepin, Ramsey

# Small Multiples – One Slide/Map Per Indicator

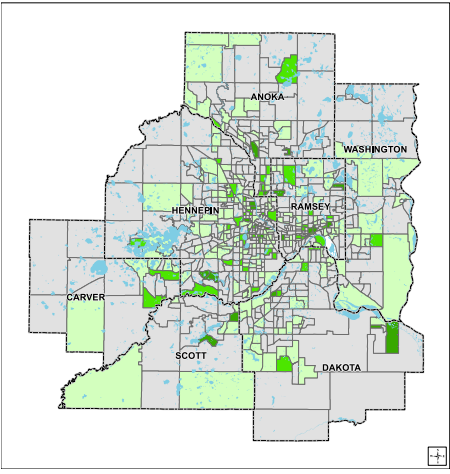
Social:  
Renter-occupied households



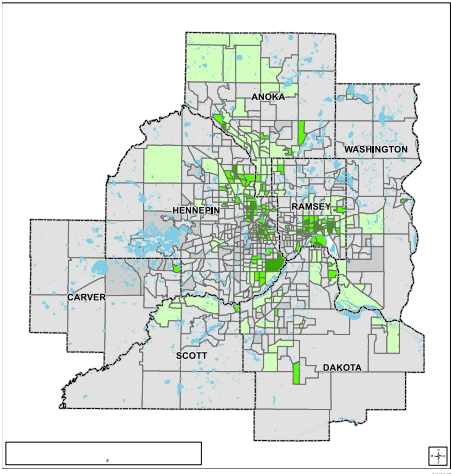
Social:  
Unemployment



meowner Tenure

















Social:  
Education





# Key Takeaways for the Social Network Vulnerability Concept at the County-by-County Level

- Anoka's unemployed and H.S. education populations are vulnerable to heat on the southwestern edge
- Hennepin's vulnerable populations of renters and persons with less than a H.S. education are vulnerable to both heat and flood.
- Ramsey's social networks are the most vulnerable to heat overall
- Scott has some vulnerability for tenure < 2015 & less than high school education

Social	Anoka	Carver	Dakota	Hennepin	Ramsey	Scott	Washington
unemployed							
renter							
tenure < 2015							
less than high school							

# Strategies and Next Steps

# Relevant Adaption and Mitigation Strategies Derived from the Literature

- Notable Smart Solutions
  - Tree and Landscape Ordinances
  - Stormwater Management
- Policy Strategies at Multiple Scales
  - Metropolitan Council, Counties, and Municipalities
  - Counties and Municipalities
  - Municipalities

# Key Takeaways Derived from Analysis of Maps and Data

- Zones of transition offer opportunity
  - For heat – high albedo/cool pavement
  - For flooding- preserve good soils and avoid impervious surfaces
- Spatial heterogeneity in sub-populations (elderly, particular ethnic/cultural groups, etc.) require careful study to develop culture-specific interventions
- One advantage of our model is that it is replicable
  - Any other variable – especially from the ACS – can be scaled to fit the calculations used in this report

# Ideas for Sustaining the Learning

- Perform in-depth county and municipality analysis
- Use spatial data to evaluate policy in the future
- Create online climate action database for metro area
- Develop Culture and Risk “Framework” following IFRC World Disaster Report guidelines
  - Changing demographics present strong argument for considering culture in both policy making and in advising organizations tasked with implementation.

*“The one thing that is certain is that we will have less sustained impact if we do not adequately take account of people’s cultures, beliefs and attitudes in relation to risk. With climate change leading to damaged livelihoods, and therefore more vulnerability, and making hazards more extreme and/or frequent, we have to get this right.”*

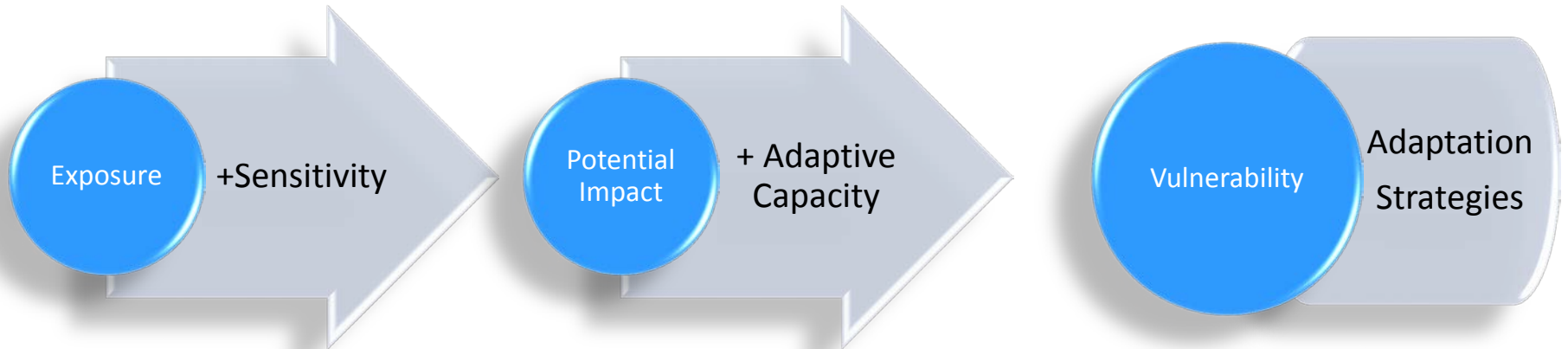
*-- IFRC. 2014. “World Disaster Report - Focus on culture and risk”*



# Humphrey School Capstone Team

- Vincent Ferguson – MURP
  - [fergu229@umn.edu](mailto:fergu229@umn.edu)
- Sadie Gannett – MURP/MPH
  - [gann0035@umn.edu](mailto:gann0035@umn.edu)
- Emilie Hitch – MPA
  - [hitc0017@umn.edu](mailto:hitc0017@umn.edu)
- Sarah Strain – MURP
  - [strai063@umn.edu](mailto:strai063@umn.edu)

# Next Steps



- **Finalize Report and Local Planning Handbook tools/strategies**
  - End of Summer, Early Autumn 2017
- **Social Vulnerability Assessment**
  - End of Summer, Early Autumn 2017
- **Rollout and CVA training**

Any Questions?

**THANKS!**

**Project Manager:**

**Eric Wojchik**

Local Planning Assistance

651-602-1330

[eric.wojchik@metc.state.mn.us](mailto:eric.wojchik@metc.state.mn.us)

5/18/17

Presenting To: Metropolitan Council Land  
Use Advisory Committee

