Wisconsin Department of Health Services

# Milwaukee Heat Vulnerability Index

Wisconsin Department of Health Services
Bureau of Environmental and Occupational Health
Building Resilience Against Climate Effects (BRACE) Program
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## Acknowledgements

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## Introduction

Analysis of 60 years of weather trend data by the Wisconsin Initiative on Climate Change Impacts (WICCI) has indicated that Wisconsin has become warmer. In general, Wisconsin has experienced an increase in mean annual temperature of 1.5°F in the period from 1950 to 2006, with the greatest increase in average temperatures occurring during the winter months.[1] Across the Upper Midwest, temperatures were notably high in 2012.[2] Extreme heat is known to have negative impacts on human health in terms of morbidity[3] and mortality.[4,5] Many of the established risk factors for heat-related mortality disproportionately affect elderly populations, socially isolated individuals, and those with pre-existing chronic conditions such as cardiovascular disease.

Although limited in number, some studies have mapped heat vulnerability to identify potential areas of highest risk for public health interventions. Reid et al., created a national map of 10 heat vulnerability factors in the U.S.[6] San Francisco's Department of Public Health also created an index of heat vulnerability but used a different set of 21 variables in the index and focused on a much smaller geographic area, the City of San Francisco.[7] In addition to SFDPH, a number of studies have mapped heat vulnerability for specific metropolitan areas.[8,9,10]

Using the methodology developed by the San Francisco Department of Public Health (SFDPH), Wisconsin Building Resilience Against Climate Effects (BRACE) staff conducted a geo-spatial analysis of heat-related vulnerability in both Wisconsin as a whole and the greater Milwaukee urban area, though this report focused on the Milwaukee analysis. The project was completed with assistance from the Department of Health Services (DHS) Bureau of Information Technology Services (BITS) Geographic Information Systems (GIS) staff. This project used existing population and census data, natural and built environment data, and health factors data to create a heat vulnerability index (HVI) to identify areas of greatest risk for negative health impacts due to extreme heat. The maps can help identify high-risk neighborhoods and populations to receive targeted messaging related to heat events and additional resources during extreme heat events. The Wisconsin BRACE Program is collaborating with the City of Milwaukee Health Department and the Milwaukee Metropolitan Area Heat Task Force to develop planning and intervention strategies related to the HVI findings.

As far as we know, this is the first study to create a heat vulnerability index (HVI) for Milwaukee County.

## Methods

### *Data Sources*

Table 1 lists the variables, measures, data sources, geography, and years of the data included in the Milwaukee heat vulnerability index. Existing heat vulnerability studies were reviewed to inform the 16 data layers that were selected.[6,7] In addition to replicating data layers from these two studies and the statewide HVI of Wisconsin that the Wisconsin BRACE staff developed, this project added one dataset specific to Milwaukee. After compiling the datasets, the variables were organized into four categories: population density (1 variable), health factors (2 variables), demographic and socioeconomic factors (7 variables), and natural and built environment factors (6 variables).

**Population Density**

The population density category consists of a single variable: population per square mile, which was acquired from the U.S. Census. High settlement density has been associated with higher temperatures.[11]

**Health Factors**

The health factors consisted of a set of two variables:

- Percentage of population that visited an emergency department for heat stress
- Percentage of population that was admitted for psychiatric crisis services at a county psychiatric emergency room

Compared to the statewide Wisconsin HVI, there are fewer health factors included because the Behavioral Risk Factor Surveillance System (BRFSS) variables were not available at a sub-county level. The health factors were selected based on status as a risk factor for heat-related illness or death as well as data availability.

Studies have shown that some mental health medications and conditions[12,13] can increase the risk of heat-related illness or mortality. The psychiatric services variable in our HVI represents the percentage of the population that was admitted for psychiatric services at a county psychiatric emergency room. The psychiatric services data were obtained from Milwaukee County Behavioral Health Division.

Heat stress is considered a condition along a spectrum of heat-related conditions, which increase in severity from heat exhaustion to heat stroke and death. The definition of heat stress cases for the indicator were those cases seen in an emergency department in summer months (May-September) with any of the following ICD-9 codes as a principal diagnosis, injury cause, or other diagnosis: 992.0, 992.1, 992.3, 992.4, 992.5, 992.6, 992.7, 992.8, 992.9, E900.0, E900.9. The heat stress data came from the Wisconsin Hospital Patient Data System.

**Demographic and Socioeconomic Factors**

Older adults[14] and very young children[15] are at increased risk for heat-related morbidity and mortality. In this context, percentage of the population aged 0-4 and percentage of the population aged 85+ were included in the index as two distinct variables.

The percentage of households in poverty was included as a data layer since low-income status is associated with increased susceptibility to extreme heat.[16] The impoverished are less likely to afford air conditioning, a strong protective factor.[13,16] Minority populations[17] and subjects with a high school diploma or less[18] have also been shown to have elevated vulnerability to heat, so this HVI included the percentage of the population identifying as “non-white,” and the percentage with less than a high school education, as variables in the analysis.

Social isolation has been found to be a risk factor for heat-related mortality,[5,16] so the percentage of population living alone was included as an indicator of this source of vulnerability.

All of the demographic and socioeconomic variables in the index were obtained from the American Community Survey (ACS), conducted by the U.S. Census Bureau.

**Natural and Built Environment Factors**

Extremely hot temperatures are associated with higher mortality.[19] SFDPH used a day of surface temperature measurements in both May and September to represent conditions in spring and summer in its HVI.[7] We altered this methodology slightly to reflect conditions during a heat wave: air surface temperature on July 6, 2012, was included as an indicator because this day was during a heat wave in the hottest year on record for the contiguous United States. The temperature data were acquired from the PRISM (Parameter-elevation Regressions on Independent Slopes Model) climate mapping system.

Air pollutants such as ozone have been associated with higher temperatures and increased daily mortality,[20] even at low concentrations of the pollutant.[21] Though the effects of climate on air pollutants such as particulate matter are not well understood, there is some evidence that particulate matter ($PM_{10}$) interacts with temperature to have a large effect on mortality on hot days.[22] Assuming a similar temperature-air pollution interaction with fine particulate matter ($PM_{2.5}$), we used $PM_{2.5}$ as a variable in the index because exposure to this air pollutant is associated with respiratory and cardiovascular diseases,[23] including asthma, chronic obstructive pulmonary disease, and cardiac dysrhythmias, and increased school and work absences, emergency department visits, and hospital admissions.[24] Airborne particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$) poses a health risk because the small size of the particles (approximately 1/30$^{th}$ the average width of a human hair) allows them to lodge deeply into the lungs.[25] The recently released International Panel on Climate Change (IPCC) Working Group II report considers the health risks caused by synergistic effects of extreme heat and degraded air to be a significant vulnerability, especially with an aging population and the global shift to urbanization.[26] For this heat vulnerability study, air quality data from the Environmental Protection Agency (EPA) from July 2012 was included to reflect ambient air conditions during a heat wave.

Access to transportation can reduce one's risk of heat-related mortality.[5] Therefore, households without a vehicle were included as an indicator representative of a population that may not have consistent access to transportation. These data were acquired from the ACS of the U.S. Census.

Studies have shown that people in neighborhoods with less green space are at higher risk of heat-related health outcomes.[27] Increased green space can help reduce the urban heat island effect. This study captured urban areas spatially by creating an indicator of developed land cover, which includes areas of medium and high intensity classification, according to the National Land Cover Database (NLCD).

As noted above, older adult populations are at particular risk for heat-related health outcomes; nursing home populations represent a vulnerable subgroup of this population.[28] We obtained nursing home bed count data from the Wisconsin Division of Long Term Care to include in this HVI.

***Analysis***

Census block groups were used for spatial analysis due to the availability of demographic and household characteristics at that level of geography. They also provided a way to compare vulnerability within local jurisdictional boundaries. Several analyses were utilized to extrapolate and calculate environmental data variables for each census block group. Land cover raster data were converted to vector and measured by the percent coverage of the developed land classification. Air quality data values were assigned to block groups from the monitoring stations based on a nearest neighbor analysis. Nursing home bed counts were applied to the block groups in which the facility was physically located.

The range of data for each variable was standardized using z-score methodology. The z-scores were calculated so that increasing values correspond to increasing vulnerability. The z-score values for all variables were summed to create the vulnerability index score, under the assumption that each variable has an equal impact on overall vulnerability. The index scores were categorized into quantiles for data display and presentation purposes.

To transform the data into a visually appealing map, the summary z-score values were categorized into quantiles. The top 20% quantile represents the geographic areas with "high" heat vulnerability risk based on the analyzed variables. Likewise, the bottom 20% quantile represents the areas of "low" heat vulnerability risk. The three middle quantiles are representative of "moderate high" heat vulnerability, "moderate" heat vulnerability, and "moderate low" heat vulnerability. The geographic areas represented by the index are at the census block level. The color scheme of the map corresponds to the risk values, with the dark and light purple representing the "high" and "moderate high" heat vulnerability areas, light gray representing the "moderate" areas, and yellow and gold representing the "moderate low" and "low" heat vulnerability census blocks. State parks and forests (green color scheme) and larger bodies of water (blue) are also represented. County boundaries, larger cities, and major highways are included to aid in referencing location.

The Milwaukee Heat Vulnerability Index Map is displayed in Appendix A.

**Table 1.** Variables included in the Milwaukee heat vulnerability index

| Variable | Measure | Year | Data Source | Geography |
|---|---|---|---|---|
| Population Density | | | | |
| Population density | Population per square mile | 2011 | U.S. Census | Block group |
| Health Factors | | | | |
| Heat stress | Percentage of population that visited an emergency department for heat stress | 2002-2012 | Wisconsin Department of Health Services (DHS) | Zip Code Tabulation Area (ZCTA) |
| Psychiatric services | Percentage of population that was admitted for psychiatric crisis services at county psychiatric emergency room | 2013 | Milwaukee County Behavioral Health Division (BHD) | ZCTA |
| Demographic and Socioeconomic Factors | | | | |
| Poverty | Percentage of households in poverty | 2007-2011 | U.S. Census, American Community Survey (ACS) | Block group |
| Age 0-4 | Percentage of population aged 0-4 | 2007-2011 | U.S. Census (ACS) | Block group |
| Age 85+ | Percentage of population aged 85+ | 2007-2011 | U.S. Census (ACS) | Block group |
| Age 65+ living alone | Percentage of population 65+ living alone | 2007-2011 | U.S. Census (ACS) | Block group |
| Living alone | Percentage of population living alone | 2007-2011 | U.S. Census (ACS) | Block group |
| Non-white | Percentage of non-white population | 2007-2011 | U.S. Census (ACS) | Block group |
| Less than high school education | Percentage of population with less than high school education | 2007-2011 | U.S. Census (ACS) | Block group |
| Natural and Built Environment | | | | |
| Air surface temperature | July 6, 2012, air temperature | 2012 | Parameter-elevation Regressions on Independent Slopes Model (PRISM) | Raster, 4 k resolution |
| Air quality, $PM_{2.5}$ | July 2012, average $PM_{2.5}$ concentration ($ug/m^3$) | 2012 | Environmental Protection Agency (EPA) Air Quality Index (AQI) | Lat/long (extrapolated) |
| Air quality, ozone | July 2012, maximum recorded ozone level (ppb) | 2012 | EPA AQI | Lat/long (extrapolated) |
| Households without vehicle | Percentage of households without a vehicle | 2007-2011 | U.S. Census (ACS) | Block group |
| Developed land cover | Medium and high intensity classification | 2006 | National Land Cover Database (NLCD) | Raster, 30 m resolution |
| Nursing home | Nursing home bed count | 2013 | Division of Long Term Care | Lat/long |

## Results

The largest area of high heat vulnerability identified in the Milwaukee HVI map is the inner core of the City of Milwaukee. Areas of low heat vulnerability include the shoreline of Lake Michigan as well as the southern region of Milwaukee County.

In order to help identify the underlying factors contributing to an area's vulnerability index score, additional, independent analysis of each of the four categories of the index was completed. Again, data for the HVI were organized into four topical categories: population density, health factors, demographic and socioeconomic factors, and natural and built environment factors. Each category was mapped (Appendix B), following the same process as described in the Methods. The health factors and demographic/socioeconomic maps display the most spatial variation in heat vulnerability in Milwaukee County. However, all four of the factor categories indicate areas of high and moderately high heat vulnerability.

## Discussion

### *Strengths*

By mapping at a census block level, the heat vulnerability index may be used to identify areas where the residents are most vulnerable to heat-related health outcomes. Adaptation and prevention strategies may then be targeted to those at-risk areas. Specific messages may be targeted to the residents within those communities, and existing social support networks may be used to assist with identifying and protecting vulnerable neighbors. County and municipal agencies, such as the Milwaukee Metropolitan Area Heat Task Force, may use the HVI maps to ensure that resources are provided in the areas deemed most vulnerable and that protective strategies, such as cooling shelters, are located where they are most needed. In preparation for the 2014 summer heat season, the Milwaukee Metropolitan Area Heat Task Force included the Milwaukee HVI in its Excessive Heat Event Coordination Plan.

By analyzing the component factors within the HVI, factors that are driving increased vulnerability become clearer. It appears that socioeconomic factors and health factors increase vulnerability. Ethnic diversity and lower incomes are especially indicative of higher heat risk, as evidenced by the high rankings in the Milwaukee central city and high traffic corridors leading away from the central city. Traditionally, these have been areas with large non-white populations and lower household income levels. Conversely, areas along the Lake Michigan shoreline and the smaller suburban municipalities around the City of Milwaukee are areas with higher annual incomes, newer housing, and a small non-white population. In addition, there may be some evidence of a cooling effect along the lakeshore.

### *Limitations*

While the analysis conducted in this study did not weight the variables, additional studies using similar methods may wish to consider this option. A literature review completed during this project was not able to identify a strong methodology or argument for effectively weighting variables, so the weighting option was rejected. However, as noted above, the health and demographic/socioeconomic variables appear to play a large role in determining vulnerability to heat-related outcomes. Additional review of new and future HVI studies may further clarify weighting methods in future analyses.

This study did not run a regression analysis to attempt to determine which variables contributed to the most variability. Again, future heat vulnerability indices may consider this analysis to further clarify the driving forces behind increased vulnerability.

Our analysis was limited by data availability; for example, air conditioning is a known protective factor for heat-related mortality but we did not have access to these data. Another potential limitation is the differing levels of geography of the variables. Because many of the health factors from the statewide HVI study were at the county level, they had to be removed for the Milwaukee HVI study, thereby limiting the number of health-related risk factors incorporated into the index.

Anyone using this Milwaukee Heat Vulnerability Index as a tool for prevention and preparedness planning must be aware that it is a relative index, and does not measure or indicate absolute vulnerability. However, as a visual representation of potential heat vulnerability, it provides a useful and engaging way to transfer climate and extreme knowledge to both professionals and the general population.

## Recommendations

The interactions of climate and extreme weather events may lead to many significant public health effects. The ability of municipal agencies to identify, plan for, and respond to these events will lead to increased resiliency within Milwaukee County. Adaptation strategies must be aligned with current scientific knowledge, and information must be shared with key stakeholders and partners. The transfer of this knowledge in a meaningful way will prepare residents to adapt and cope with expected events and conditions.

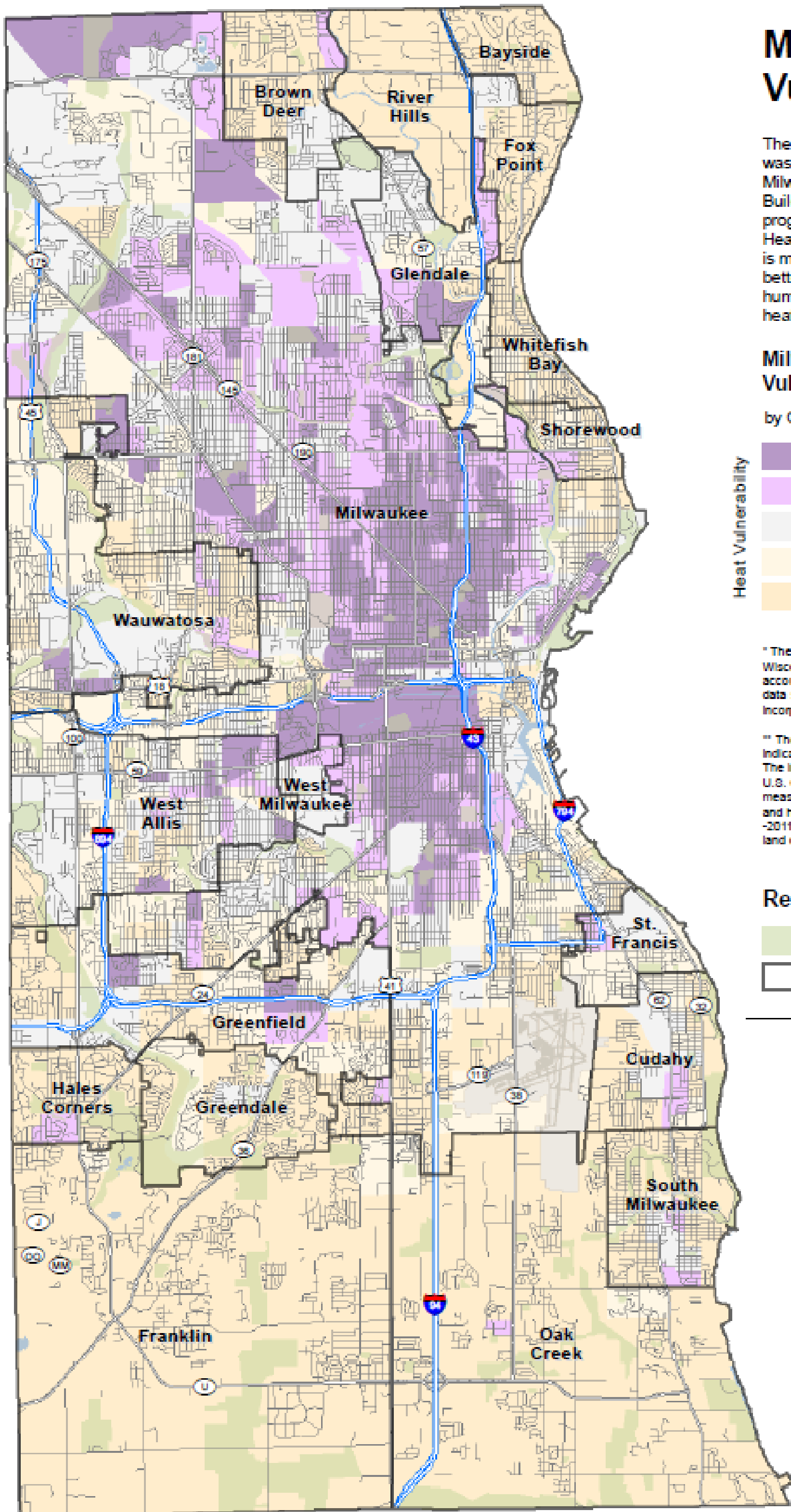
Statistical analysis of the factors contained in this Milwaukee Heat Vulnerability Index, such as factor analysis and multivariate regression, may lead to a better understanding of the risk factors, and may identify gaps in our existing support structures. Social factors in this HVI clearly indicate that ethnicity, social disparity, and low income play a part in poor health outcomes. Similarly, population density and lack of green space contribute to increased vulnerability. Planning efforts at the local level, which are flexible and built upon partnerships with faith organizations, neighborhood associations, civic organizations, and at-risk population service providers, will be necessary to reduce heat-related health outcomes, eliminate the drivers of high vulnerability, and initiate and build local environmental strategies to reduce the impact of extreme heat on Milwaukee County residents and visitors.

## References


1. Wisconsin Initiative on Climate Change Impacts (WICCI). Wisconsin's changing climate: impacts and adaptation. Nelson Institute for Environmental Studies, University of Wisconsin and Wisconsin Department of Natural Resources. 2011. Available at: http://www.wicci.wisc.edu/report/2011_WICCI-Report.pdf. Accessed October 30, 2013.
2. National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center (NCDC). Summary Information. http://www.ncdc.noaa.gov/extremes/cei/graph/en/cei/01-12. Accessed Nov 3, 2014.
3. Li BL, Sain S, Mearns LO, et al. The impacts of extreme heat on morbidity in Milwaukee, Wisconsin. *Climatic Change*. 2012;110(3-4):959-976.
4. Centers for Disease Control and Prevention. Heat-related deaths after an extreme heat event—four states, 2012, and United States, 1999-2009. *MMWR Morb Mortal Wkly Rep.* 2013;62(22):433-436.
5. Semenza JC, Rubin CH, Falter KH, et al. Heat-related deaths during the July 1995 heat wave in Chicago. *N Engl J Med.* 1996;335(2):84-90.
6. Reid CE, O'Neill MS, Gronlund CJ, et al. Mapping community determinants of heat vulnerability. *Environ Health Perspect.* 2009;117(11):1730-1736.
7. San Francisco Department of Public Health. Understanding the risk: an assessment of San Francisco's vulnerability to extreme heat events. 2013. http://www.sfphes.org/component/jdownloads/finish/42/269 Accessed March 14, 2014.
8. Vescovi L, Rebetez M, Rong F. Assessing public health risk due to extremely high temperature events: climate and social parameters. *Clim Res.* 2005;30:71-78.
9. Rinner C, Patychuk D, Bassil K, Nasr S, Gower S, Campbell M. The role of maps in neighborhood-level heat vulnerability assessment for the city of Toronto. *Cartography and Geographic Information Science.* 2010;37(1):31-44.
10. Chow WTL, Chuang W, Gober P. Vulnerability to extreme heat in metropolitan Phoenix: spatial, temporal, and demographic dimensions. *The Professional Geographer.* 2012;64(2):286-302.
11. Harlan SL, Brazel AJ, Prashad L, Stefanov WL, Larsen L. Neighborhood microclimates and vulnerability to heat stress. *Soc Sci Med.* 2006;63(11):2847-2863.
12. Batscha CL. Heat stroke: keeping your clients cool in the summer. *J Psychosoc Nurs Ment Health Serv.* 1997;35(7):12-17.
13. Kaiser R, Rubin CH, Henderson AK, et al. Heat-related death and mental illness during the 1999 Cincinnati heat wave. *Am J Forensic Med Pathol.* 2001;22(3):303-307.
14. Conti S, Meli P, Minelli G, et al. Epidemiologic study of mortality during the summer 2003 heat wave in Italy. *Environ Res.* 98(3):390-399.
15. Waters TA. Heat illness: tips for recognition and treatment. *Clev Clin J Med.* 2001;68(8):685-687.
16. Naughton MP, Henderson A, Mirabelli MC, et al. Heat-related mortality during a 1999 heat wave in Chicago. *Am J Prev Med*. 2002;22(4):221-227.
17. Uejio CK, Wilhelmi OV, Golden JS, Mills DM, Gulino SP, Samenow JP. Intra-urban societal vulnerability to extreme heat: the role of heat exposure and the built environment, socioeconomics, and neighborhood stability. *Health Place*. 2011;17(2):498-507.

18. Medina-Ramon M, Zanobetti A, Cavanagh DP, Schwartz J. Extreme temperatures and mortality: assessing effect modification by personal characteristics and specific cause of death in a multi-city case-only analysis. *Environ Health Perspect.*2006;114(9):1331-1336.
19. Curriero FC, Heiner KS, Samet JM, et al. Temperature and mortality in 11 cities of the eastern United States. *Am J Epidemiol*. 155(1):80-87.
20. Ren C, Williams GM, Morawska L, Mengersen K, Tong S. Ozone modifies associations between temperature and cardiovascular mortality: analysis of the NMMAPS data. *Occup Environ Med.* 2008;65(4):255-260.
21. Vedal S, Brauer M, White R, Petkau J. Air pollution and daily mortality in a city with low levels of pollution. *Environ Health Perspect.* 2003;111(1):45-52.
22. Roberts S. Interactions between particulate air pollution and temperature in air pollution mortality time series studies. *Environ Res.* 2004;96(3):328-337.
23. Dominici F, Peng RD, Bell ML, et al. Fine particulate air pollution and hospital admission for cardiovascular and respiratory diseases. *JAMA.* 2006;295(10):1127-1134.
24. Centers for Disease Control and Prevention (CDC). Air Quality and Respiratory Disease. http://www.cdc.gov/climateandhealth/effects/airquality.htm. Accessed July 8, 2014.
25. U.S. Environmental Protection Agency (EPA). Fine Particle ($PM_{2.5}$) Designations: Frequent Questions. http://www.epa.gov/pmdesignations/faq.htm. Accessed July 8, 2014.
26. IPCC, 2014: Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability.Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea,.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken,P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 19.
27. Tan J, Zheng Y, Song G, Kalkstein LS, et al. Heat wave impacts on mortality in Shanghai, 1998 and 2003. *Int J Biometeorol.* 2007;51(3):193-200.
28. Klenk J, Becker C, Rapp K. Heat-related mortality in residents of nursing homes. *Age and Ageing.* 2010;39(2):245-252.

**Appendix A**




# Milwaukee Heat Vulnerability Index

The Milwaukee Heat Vulnerability* analysis was created in partnership with the City of Milwaukee Public Health Department and the Building Resilience Against Climate Effects program within the Wisconsin Department of Health Services. The data displayed in the map is meant to serve as an informational tool to better understand the spatial distribution of human populations most vulnerable to extreme heat related events.

## Milwaukee County Vulnerability (quantiles)

by Census Block Group

Heat Vulnerability

- High (top 20%)
- Moderate High
- Moderate
- Moderate Low
- Low (bottom 20%)

* The Milwaukee County Heat Vulnerability Index is based on the Wisconsin Heat Vulnerability Index** with slight alterations to account for risk factors specific to Milwaukee County. Additional data sets were made available for the Milwaukee study area and incorporated into the analysis.

** The Wisconsin Heat Vulnerability Index is based on multiple indicators associated with risk for heat related illness and mortality. The index analysis was created as a measure of vulnerability by U.S. Census block groups during an extreme heat event. The measure includes: health behaviors and outcomes, demographic and household characteristics (American Community Survey 2007 -2011), environmental exposure factors (air quality, temperature, land cover) and population density (U.S. Census).

## Reference Data

- Park / Forest
- Water
- Municipal Boundary

Think Health Act Now! City of Milwaukee Health Department

Map created by the Bureau of Information Technology Services in cooperation with the BRACE Program, Bureau of Environmental & Occupational Health, Division of Public Health, Department of Health Services, State of Wisconsin - May 2014

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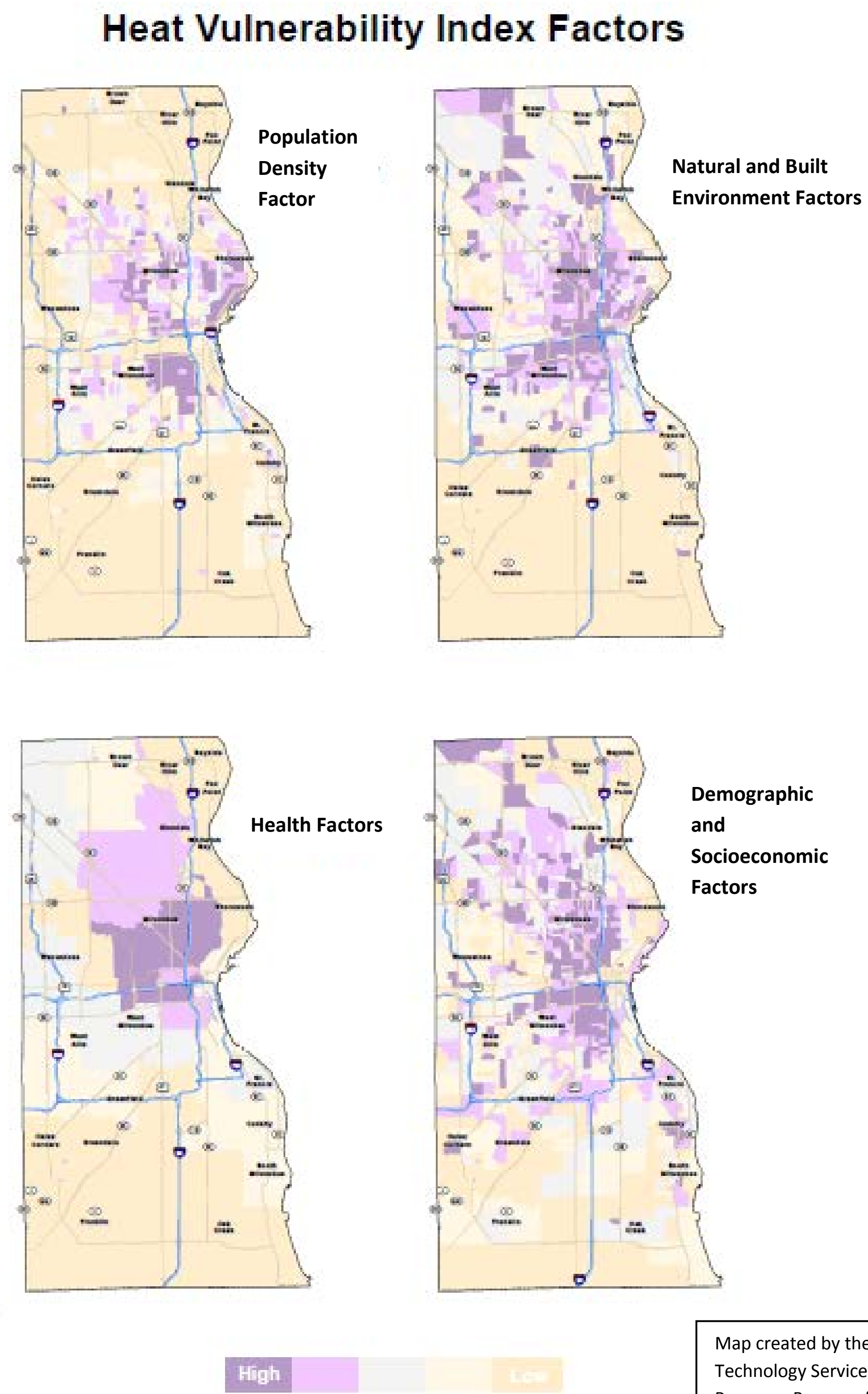
0 2 Miles

**Appendix B   Milwaukee Heat Vulnerability Index Factor Categories**




Map created by the Bureau of Information Technology Services in cooperation with the BRACE Program, Bureau of Environmental and Occupational Health, Division of Public Health, Department of Health Services, State of Wisconsin - May 2014