Expanding Urban Tree Canopy as a Community Health Climate Adaptation Strategy

A Health Impact Assessment of the Ann Arbor Urban & Community Forest Management Plan

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Executive Summary

This Health Impact Assessment (HIA) examines the potential health and psychosocial benefits associated with targeting tree planting in residential areas of Ann Arbor, Michigan with lower tree canopy and populations vulnerable both directly to extreme heat events and to health conditions affected by heat and tree canopy. It is intended to inform the tree planting strategy of the City of Ann Arbor Urban Community Forestry Management Plan (AA-UCFMP), by recommending priority neighborhoods for tree plantings.

HIAs evaluate the potential health impacts of a project or policy and provide recommendations to increase positive health co-benefits and mitigate negative health impacts. Characteristics of HIAs include a broad definition of health; consideration of economic, social, or environmental health determinants; application to a broad set of policy sectors; involvement of affected stakeholders; explicit concerns about social justice; and a commitment to transparency.

This HIA used the methodology developed by the North American HIA Practice Standards Working Group. Project feasibility was determined in the screening step in consultation with City of Ann Arbor experts.

In June 2012, an Advisory Committee of community members, academic experts, and local government staff met to identify key health impacts to be considered in the HIA, stakeholders and decision makers who needed to be involved, and quantitative data resources to conduct the analysis. This scoping meeting generated a list of key health issues, subsequently narrowed to the six most important health outcomes besides heat stress that should be assessed: asthma, chronic obstructive pulmonary disease (COPD), diabetes, hypertension, mental distress, and obesity. Three priority intermediate impacts - defined as impacts of tree canopy change that indirectly affect health -were added: air pollution, physical activity and crime.

The HIA Project Workgroup conducted an assessment to identify low tree canopy neighborhoods in the City of Ann Arbor that were most highly vulnerable to heat stress and to the six health outcomes, where an increase in tree canopy could be the most beneficial to residents' health. This was done in six steps. First, residential areas of the city were determined using the City's land parcel use data. Second, low tree canopy areas were defined using data from the Midwest Urban Tree Canopy (UTC) Project. The City of Ann Arbor has an average tree canopy of 33%; therefore, residential areas with less than 30% tree canopy were defined as low tree canopy areas. Third, the Workgroup reviewed the scientific literature describing the relationship of each health outcome to heat, and independently to exposure to trees, tree canopy and green space. Fourth, the Workgroup examined prevalence data from the 2010 Washtenaw County Health Improvement Plan (HIP) survey and the most recent Michigan Behavioral Risk Factor Survey (BRFS) data available for each outcome, stratified by age, income, education and gender. The strata with the highest prevalence for a respective health outcome were identified as risk factors for that outcome. Fifth, a spatial assessment was conducted to determine where high risk populations are located within the City of Ann Arbor and where an

increase in tree canopy would be most beneficial to residents' health. Socioeconomic and demographic Census data were mapped by block group and those values were allocated to the residential areas located within each block group. Residential areas were defined as vulnerable to a health outcome based on the distribution in that area of demographic risk factors associated with that outcome, using threshold values for age, gender, education and household income that were linked to the highest prevalence for each health outcome. If a residential area has less than 30% tree canopy, and its population meets the threshold value for two or more risk factors for a priority health outcome, then that area was identified as highly vulnerable to both heat and that health outcome. Highly vulnerable residential areas were mapped.

The results of the assessment revealed *six neighborhoods* or areas that were vulnerable to three or more adverse health outcomes. These six neighborhoods were mapped. Each neighborhood appears to be characterized by a unique distribution of risk factors, suggesting that each has its own unique level of risk. Consideration of the intermediate factors did not add to this assessment.

The Workgroup recommends that The AA-UCFMP consider the six residential areas in the map on Figure 12 as priority areas for targeted tree planting. As there do not appear to be any compelling risk factors for one area over the other, we suggest they be ranked by population size, neighborhood receptiveness to tree planting and maintenance, or other factors which were not considered by this HIA. This analysis recognizes that there are both public and private sites available for tree planting. Expanding tree canopy on public sites is the priority. Further analysis at a neighborhood scale will better define the ratio of public and private trees that will provide the maximum benefit. Based on these analyses, strategies to incent planting on undercanopied private property should be developed.

I. Purpose and background

The purpose of this Health Impact Assessment (HIA) is to examine the potential health and psychosocial benefits associated with targeting tree planting opportunities in residential areas of Ann Arbor, Michigan, where there are both lower tree canopy and populations predicted to be most vulnerable to extreme heat events. The specific objective for this project was to identify low-tree canopy neighborhoods that were most vulnerable to adverse health outcomes associated with very hot weather because of the neighborhoods' high risk for selected health conditions. This HIA is intended to inform the tree planting strategy in the City of Ann Arbor Urban Community Forestry Management Plan (AA-UCFMP) beginning fiscal year 2014, which aims to plant 1,000 new trees per year, over several fiscal years, by recommending priority neighborhoods for tree plantings. The HIA was supported by the Michigan Climate and Health Adaptation Program (MICHAP), funded by a grant from the Centers for Disease Control & Prevention (CDC), Climate-Ready States and Cities Initiatives (CRSCI).

This section describes the reason for concern about extreme heat events and health in Michigan, the benefits of an urban forest as an extreme heat adaption strategy, the City of Ann Arbor and the AA-UCFMP, and the HIA methodology.

A. Extreme heat and health

Very hot weather that creates poor air quality is associated with exacerbation of chronic health conditions such as asthma and diabetes and with heat illness, a spectrum of disease going from mild heat cramps to life-threatening heat stroke. Lengthy or repeated heat waves increase risk as they may not allow people to recover. The adverse health effects of heat waves are of particular concern for the elderly and other vulnerable populations (e.g., the very young, the poor, and those whose health is already compromised).

According to the National Oceanic Atmospheric Administration, heat is the number one weather-related killer in the United States, resulting in hundreds of fatalities each year.[1] On average, excessive heat claims more lives each year than floods, lightning, tornadoes and hurricanes combined. In the 1980 heat wave, more than 1,250 people died in the U.S. In the 1995 Chicago heat wave, more than 700 deaths were attributed to heat. In August 2003, a record heat wave in Europe claimed an estimated 50,000 lives.

Over the course of this century, the number of hot days (exceeding 90^{o}F) annually is projected to increase with cities experiencing doubling or tripling of such days. Of greater concern is the projected 5- to 10-fold increase in extreme heat days (exceeding 97^{o}F).[2] Cities are particularly impacted because of the urban heat island effect. This effect is characterized by increased temperatures resulting from heat absorptive surfaces on dark buildings and pavements, which are ubiquitous in urban areas. The urban heat island affects not only local residents and ecosystems, but those in the surrounding area as well. As the climate becomes hotter, not only are there more frequent, longer lasting, extreme heat days, but there are also effects on

precipitation, frequency of storms and other severe weather. *Table 1 describes the scope of potential changes and impacts of weather projected for the Great Lakes Region as temperatures rise.*

Table 1: Impacts of Rising Temperatures on Weather in the Great Lakes Region[3]

Precipitation
- Projections of future precipitation vary widely. - Annual average precipitation will likely increase or remain nearly stable. - Winter and spring precipitation may increase more significantly. - Warmer temperatures will lead to less precipitation falling as snow, and more falling as rain. - Lake-effect precipitation may increase in some areas. - Ann Arbor precipitation has increased 25% when comparing 1951-1980 with 1981-2010[4]
Temperature
- Average temperature increased by 2.3°F (1.3°C) from 1968 to 2002 in the Great Lakes region. - By 2050, an average air temperature increase of 1.8 to 5.4°F (1 to 3°C) is projected. - By 2100, an average air temperature increase of 3.6 to 11.2°F (2 to 6.2°C) is projected. - Winter temperatures will likely experience a greater increase than the summer months.
Extreme Weather Events
- The frequency and intensity of severe storms has increased, and current models suggest that this trend will continue as the effects of climate change become more pronounced. - The frequency of 1% storms in Ann Arbor has increased by 43% when comparing 1951-1980 with 1981-2010[5]

B. Benefits of an Urban Forest as an Extreme Heat Adaption Strategy

Urban forests deliver a range of environmental, health, and social benefits. Shaded surfaces can be anywhere from 25°F to 45°F cooler than the peak temperatures of unshaded surfaces.[6] Trees cool communities, reduce heating and cooling costs, capture and remove air pollutants including CO_2 from the air (reviewed in[7]); strengthen quality of place and local economies, improve the quality of stormwater entering rivers and streams, reduce stormwater infrastructure costs, improve social connections, positively contribute to property value, improve pedestrian/recreation experiences, reduce mental fatigue, improve overall quality of life for residents, and provide habitat to support biodiversity.[8] Improving urban tree canopy can mitigate the adverse health effects of extreme heat events in a variety of ways.

Combating the urban heat island effect is particularly important in vulnerable neighborhoods where communities may not have sufficient resources to cope with its negative impact. Shading provided by increased canopy can protect residents from heat stress and reduce building cooling demands during the summer months. Reducing the need for air conditioning

not only decreases the urban heat island effect but also minimizes associated greenhouse gas emissions.

C. Background on the city of Ann Arbor and the AA-UCFMP

Ann Arbor is the sixth largest city in Michigan with a population of 113,934. It is located in east central Washtenaw County, 36 miles west of Detroit and about 40 miles north of the Ohio Border.[3] According to the 2010 U.S. Census, there were 45,634 households, and 21,704 families residing in the city. The racial makeup of the city's population was 73.0% White (70.4% non-Hispanic White), 7.7% Black or African American, 0.3% Native American, 14.4% Asian, and 1.0% from other races. Hispanic or Latino persons of any race made up 4.1% of the population.[9]

Ann Arbor's climate is mostly continental and is strongly influenced by the movement of high and low pressure systems across the continent. It is characterized by larger seasonal temperature ranges than areas closer to the Great Lakes which have moderated temperatures. While the day-to-day weather is highly variable, prolonged periods of hot, humid weather in the summer or extreme cold during the winter are relatively uncommon.[3] Summer temperatures can exceed 90 °F (32 °C), on average 10 days per summer, and winter temperatures can drop below 0°F (-18°C), doing so on average 4.6 nights per winter. Average monthly precipitation ranges from 2 to 4 inches (5 to 10 cm), with the heaviest occurring during the summer months. The highest recorded temperature was 105 °F (41 °C) on 24 July 1934.[1]

The city has a total area of 28.70 square miles, of which 27.83 square miles of it is land and 0.87 square miles is water, much of which is part of the Huron River.[10] The landscape of Ann Arbor consists of hills and valleys. Ann Arbor's "Tree Town" nickname stems from the dense forestation of its parks and residential areas. The city's street tree population is over 41,000 and there are approximately 5,000 vacant street tree planting locations. Ann Arbor has over 6,600 trees in mowed areas of parks and thousands in natural areas of parks. In recent years, the emerald ash borer has destroyed 10,000 ash trees.[11]

The City of Ann Arbor is responsible for managing an urban forest that contains over 40,000 street trees and 6,600 trees in the mowed areas of parks, which provide a cumulative value to Ann Arbor of $97 per tree annually, for a gross total of about $4.6 million, according to a report from the Davey Resource Group.[12] The value of the City's public trees was based on their ability to conserve and reduce energy, reduce carbon dioxide levels, improve air quality, mitigate storm water runoff, and provide other benefits associated with aesthetics, increased property values, and quality of life.

Development of Ann Arbor's first Urban & Community Forest Management Plan (AA-UCFMP) began in 2010. The AA-UCFMP provides a framework for effectively managing the city's urban forest. Members of the community participating in the planning process included residents, businesses, non-profits, institutions, commissions and city staff.

This multi-year, comprehensive planning effort has focused on engaging the public to help define a vision for Ann Arbor's urban forest and identify specific actions and policy wants and needs. The planning process involved establishing goals, developing plan options, selecting preferred options, drafting recommendations, and implementing actions. The AA-UCFMP outlines a wide range of recommendations and activities established during the planning process. The plan for tree canopy cover targets is based in part on land use category to ensure planting occurs throughout the city across all different land uses which build sustainability within the urban forest system and ensure trees are planted in the best locations.

By creating goals for each land use category (e.g., commercial, industrial, mixed use, office, public/institutional/transportation, utility, recreation/open space, residential, multi-family residential) the City can create customized plans to target each land use area and work towards achieving the individual goals. Currently, tree canopy cover in single-family residential areas in Ann Arbor is 40%. Ann Arbor has set a target of 60% canopy cover for these areas. A goal of 40% canopy cover has been set for multi-family residential areas, which currently average a canopy cover of 21%.

Associated with this plan is a multi-year plan for planting new trees on public (streets and parks) land. The City has identified 15,504 locations to plant trees. These locations are either vacant (without a tree), or the tree is in poor condition. The planting sites were ranked initially using four factors in order to prioritize planting selection. These factors were: ability to impact energy use from shade, surrounding tree canopy, surrounding impervious area, and size. Subsequently health of populations in residential areas was raised by city planners as an important consideration in prioritizing tree plantings. The HIA methodology was introduced as a tool to address this consideration.

D. The Health Impact Assessment Methodology

HIA is "a means of assessing the health impacts of policies, plans, and projects in diverse economic sectors using quantitative, qualitative and participatory techniques."[13] HIA is used to evaluate the potential health impacts of a project or policy, with the intent to provide recommendations to increase positive health co-benefits and to mitigate negative health impacts. HIA is explicitly concerned with vulnerable populations and includes analysis of a proposal's impacts on health inequities.

Characteristics of HIA include a broad definition of health: consideration of economic, social, or environmental health determinants; application to a broad set of policy sectors; involvement of affected stakeholders; explicit concerns about social justice; and a commitment to transparency.[14] Various HIAs have examined the impacts of plans or policies in the areas of transportation, land use, food and agriculture, climate adaptation, housing, education, and income, among others, on the health of individuals and communities. By exploring the relationship between policies and health, decision makers can better understand the broader impacts of their proposed actions, modify programs as needed, and prioritize investments.

An HIA generally consists of Six Steps:[15]

1. **Screening:** Determine whether an HIA is needed and likely to be useful.
2. **Scoping:** In consultation with stakeholders, develop a plan for the HIA, including the identification of potential health risks and benefits.
3. **Assessment:** Describe the baseline health of affected communities and assess the potential impacts of the decision.
4. **Recommendations:** Develop practical solutions that can be implemented within the political, economic or technical limitations of the project or policy being assessed.
5. **Reporting:** Disseminate the findings to decision makers, affected communities and other stakeholders.
6. **Monitoring:** Monitor the changes in health or health risk factors and evaluate the efficacy of the measures that are implemented and the HIA process as a whole.

The core objectives and the stages of HIA discussed above have provided the basis for the Ann Arbor Tree Canopy HIA. This report addresses steps one through five. Annual monitoring and review of program impacts is recommended.

II. The Ann Arbor Tree Canopy HIA

In August 2011, the Michigan Department of Community Health (MDCH) sponsored a state-wide two-day HIA training conducted by Human Impact Partners, a non-profit organization with expertise in HIA (http://www.humanimpact.org/). Urban planners from the City of Ann Arbor who attended the training described an upcoming City Council proposal that revolved around planting 1,000 trees per year and were interested in how an HIA could add value to their proposal. As an outcome to this discussion, MDCH agreed to work with the City of Ann Arbor to implement the HIA methodology to help prioritize tree plantings using health as a criterion. The specific objectives of the HIA were: 1) Identify adverse health outcomes associated with extreme heat events and benefits of tree canopy; 2) Identify vulnerable populations; 3) Determine spatial distributions of highly vulnerable populations in Ann Arbor in neighborhoods with low tree canopy; and 4) Develop recommendations to prioritize tree plantings in vulnerable neighborhoods. A goal of this HIA is to provide the city with a better understanding of how choices related to tree canopy impact the health and well-being of vulnerable residents living in low canopy neighborhoods; and to engage community members and stakeholders to understand what impacts health, and how to advocate for improving health.

A. Step 1 - Screening

The screening of the project was carried out through discussions with Jennifer Lucky, an HIA expert with Human Impact Partners and the City of Ann Arbor Systems Planning Unit. It was determined there was enough time to conduct an analysis to inform the decision and decision-makers, the HIA was feasible as MICHAP staff would take the lead and provide resources to complete the analysis, and the decision could affect environmental and social determinants that impact health outcomes. An HIA Project Workgroup, made up of primarily MICHAP staff would conduct the HIA.

B. Step 2 - Scoping

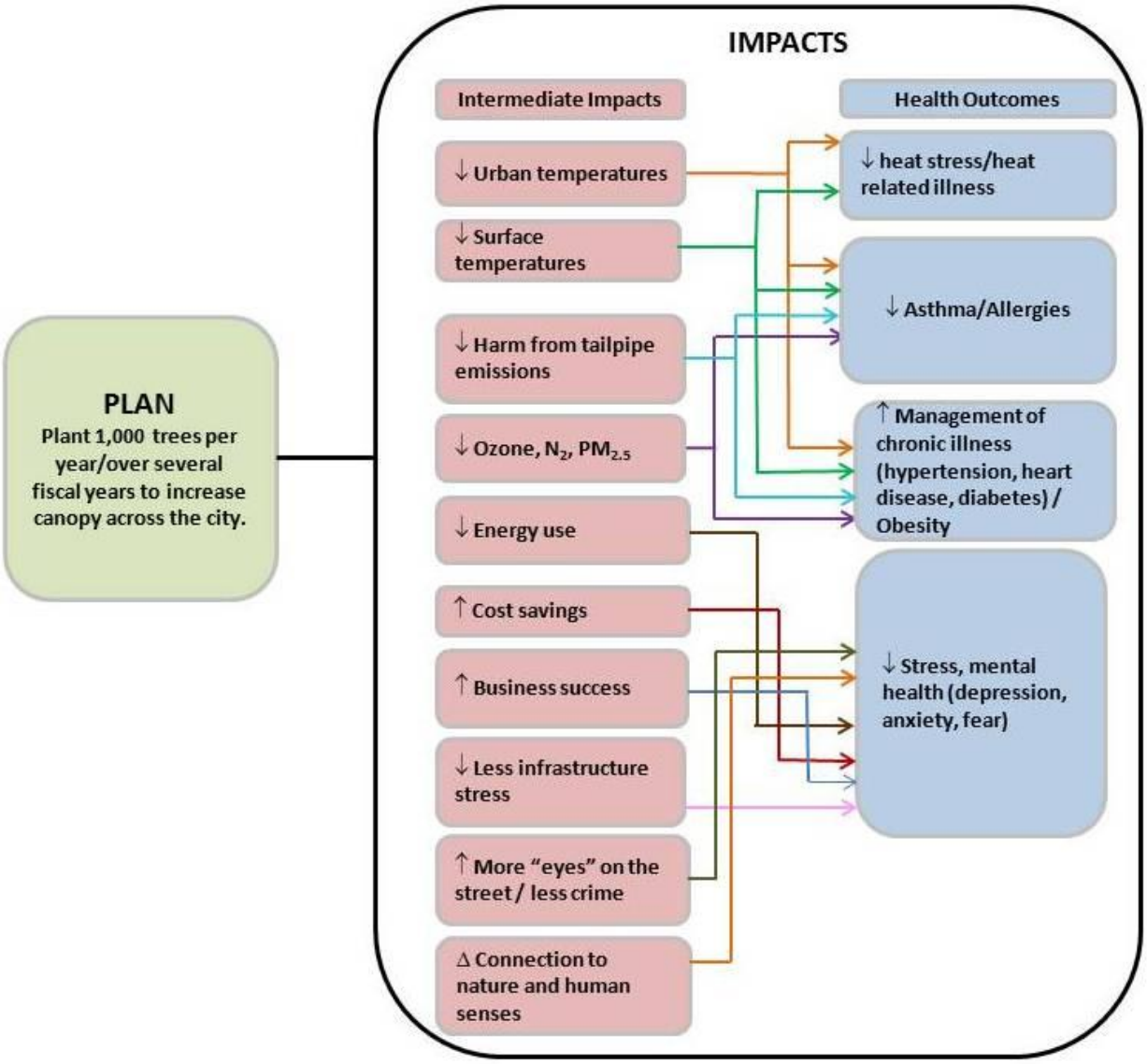
In May 2012, an Advisory Committee was formed to identify key health impacts that would be considered in the HIA, identify necessary stakeholders/decision makers who needed to be involved and to identify quantitative data resources to conduct the analysis. The Advisory Committee consisted of community members, academic experts, and local government staff.

In June 2012, the Project Workgroup convened the Advisory Committee to conduct the first scoping meeting. Advisory Committee members were provided with an introduction to the project, an overview of the HIA process, and the results of a mapping tree canopy analysis conducted by University of Michigan Urban Planning students, in which they evaluated the distribution of Ann Arbor's urban tree canopy with regard to vulnerable populations. The Project Workgroup determined the HIA would be focused on identifying health outcomes exacerbated by heat, because these health outcomes could be impacted by the cooling effects of increased tree canopy. In addition, there is well-documented literature and data that support urban forestry an adaptation strategy for reducing heat illness/stress.

Advisory Committee members then had a facilitated discussion about the potential health issues regarding tree canopy, the behaviors that contribute to those health issues, the policies that influence those behaviors, and possible data sources for the project. The group identified a variety of direct and intermediary impacts of increased tree canopy to improved health outcomes. These included such things as increased physical activity, improved air quality, decreased crime, and increased property values. These impacts may act at the individual level, the family level, or within the general physical and socio-economic environment.

Figure 1 summarizes this discussion linking the planting of 1,000 trees per year in the AA-UCFMP to its effects on environmental and social conditions related to identified health outcomes.

Figure 1: Pathway Diagram Linking Ann Arbor Urban & Community Forestry Management Plan Decision to Intermediate Impacts and to Health Outcomes



After the meeting, the Project Workgroup compiled a list of health issues generated at the scoping meeting and grouped them into seven categories: asthma/allergy, heat stress/heat-related illness, chronic diseases, low birth weight, substance abuse, mental distress, and obesity. A follow-up survey was sent to Advisory Committee members to rank the six most important health outcomes other than heat stress that should be assessed.

The Advisory Committee's survey responses narrowed the scope of the project, eliminating low birth weight and substance abuse as priority health outcomes. In addition, three priority intermediary impacts - defined as impacts of tree canopy change that affects health through social and environmental impacts-were added. These are listed in Table 2.

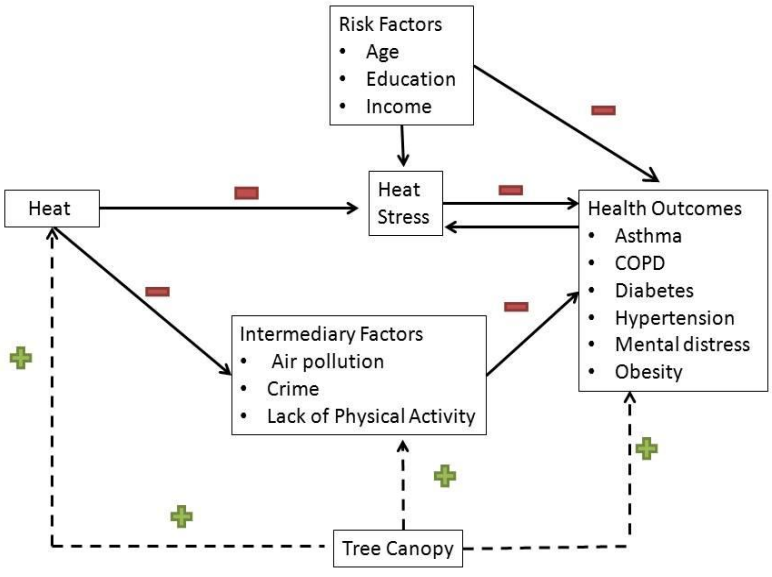
Table 2: Priority Health Outcomes and Intermediary Impacts

Health Outcomes	Intermediary Impacts
1. Asthma 2. Chronic Obstructive Pulmonary Disease 3. Diabetes 4. Hypertension 5. Mental Distress 6. Obesity	7. Air Pollution 8. Physical Activity 9. Crime

After the survey results were analyzed, the Project Workgroup developed a second causal Pathway Diagram (Figure 2) linking heat to tree canopy and the identified health outcomes and intermediary impacts, noting intervening population risk factors that would mediate the effects of heat and tree canopy. The Project Workgroup focused on the population risk factors of older age, low education level and low income, as they are reported to be the best predictors of poverty and in particular, vulnerability to heat stress.

The negative effects of heat on the health outcomes and on the intermediary factors are illustrated in Figure 2 by dark red lines going from heat to the health outcomes and from heat to the intermediary factors, respectively. The negative effects of the intermediary factors and the risk factors on the health outcomes are denoted by dark red lines going from them to the health outcomes. In contrast, the positive beneficial effects of tree canopy on heat, the intermediary factors, and the health outcomes are shown by light green lines. Thus increasing tree canopy would mitigate the adverse health effects of heat via several pathways. These relationships were further explored in the Assessment step.

Figure 2: Pathway Diagram Illustrating the Relationship of Heat, Tree Canopy and Population Risk Factors on the Priority Health Outcomes & Intermediary Factors



Scientific support for the strength of the association between increased tree canopy and improvements in the six identified health outcomes is summarized in Table 3. It summarizes the causal pathway for the association (whether directly related to lower temperatures or indirectly via intermediary effects), and indicates the quality and amount of supporting data from epidemiologic studies.

Table 3: Strength of the Relationship Between Tree Canopy and Adverse Health Outcomes

Health Outcome	Causal factors affecting improved health outcomes	Epidemiologic data quality/quantity
Asthma	-Indirectly through reduced air pollution and stress reduction	Good/moderate
COPD	·Directly via temperature reduction. -Indirectly via effect of tree canopy on air pollution	Good/Very sparse
Diabetes	·Indirectly via increased physical activity, weight reduction	Good/Sparse
Hypertension	·Directly via temperature reduction. -Indirect via physical activity, stress reduction.	Good/Sparse
Mental distress/stress	· Directly via temperature reduction. -Indirectly via physical activity	Good/Moderate
Obesity	·Indirect via physical activity	Very good/Very good

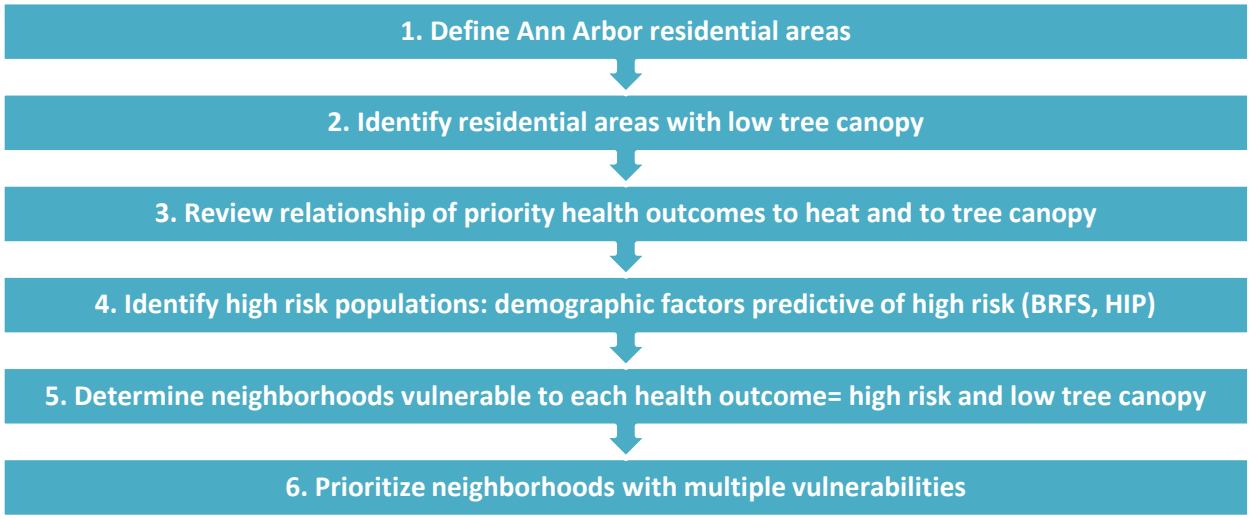
*There was insufficient information to evaluate the effects of crime on the health outcomes. Therefore, crime was not used to direct priority tree planting areas.

C. Step 3 – Assessment

The objective for the assessment portion of this HIA was to identify low-tree canopy neighborhoods in the City of Ann Arbor that could potentially be more vulnerable to heat stress and to the six adverse health outcomes associated with extremely hot weather previously

identified as high priority in the scoping phase (asthma, COPD, diabetes, hypertension, mental distress, and obesity). The Project Workgroup examined socioeconomic and demographic characteristics of residential areas with low tree canopy to determine which neighborhoods could be most vulnerable to extremely hot weather and, therefore, where an increase in tree canopy would be the most beneficial to residents' health. The diagram below illustrates the methodology used in this assessment.

Figure 3. Method for Assessing Heat Vulnerable Neighborhoods in Ann Arbor



1. Defining Residential Areas

This assessment is focused on the residents of Ann Arbor, so the Project Workgroup first needed to identify which areas in the city are residential. To do this, land parcel data containing information about the land use for each parcel was downloaded from the City of Ann Arbor's Data Catalog website.[16] Only the parcels of land identified as residential were used in this assessment; these residential parcels are referred to as "residential areas" throughout this document, and are used as an approximation of Ann Arbor neighborhoods.

2. Identifying Low Tree Canopy Areas

Tree canopy data for Ann Arbor was obtained from the Midwest Urban Tree Canopy (UTC) Project.[17] The City of Ann Arbor has an average overall tree canopy of about 33%. Therefore, for this assessment, residential areas with less than 30% tree canopy were defined as low tree canopy areas. The percent of tree canopy cover for each residential area was calculated by dividing the square feet of tree canopy found in that residential area parcel by the total area in square feet of that same parcel, and then multiplying by 100; i.e.:

$$\textit{Tree Canopy \%} = [\textit{canopy cover in parcel, ft.}^2 / \textit{total area of parcel, ft.}^2] \times 100$$

3. Review Literature on Relationship of Priority Health Outcomes to Heat and Tree Canopy

In the Scoping step, six priority health outcomes were identified by the Advisory Committee: asthma, COPD, diabetes, hypertension, mental distress, and obesity. Part of the Assessment step was a review of the literature to inform our understanding of the relationship of each

health outcome to exposure to heat, and independently to exposure to trees, tree canopy and green space. A summary of the findings follow; detailed descriptions are in Appendix A.

3a.Priority health outcomes and heat

Extreme heath events are known to be directly associated with an increase in heat-related mortality and morbidity (heat cramps, heat exhaustion and heatstroke). In addition, extreme heat events can increase population morbidity and mortality through the exacerbation of several chronic health conditions; and conversely, individuals with chronic diseases may be more susceptible to the adverse effects of heat.[18]

Respiratory diseases, including asthma and chronic obstructive pulmonary disease (COPD) are aggravated by factors known to increase when temperatures rise. An increase in asthma- and COPD-related hospitalizations due to inhaled smoke from wildfires and to higher levels of air pollutants, especially ozone and particulates, have been reported.[19,20] It is well documented that, because of behavioral issues and medications, individuals with mental illness are susceptible to the effects of extreme heat. Increases in anxiety and post traumatic distress disorder have followed heat waves.[21] Direct effects include an estimated 3.61-fold increase in risk (odds ratio = 3.61, 95% confidence interval, 1.3 - 9.8 for death during a heat wave for individuals with pre-existing psychiatric illness.[22] In addition, hospital admissions reportedly increase during heat waves for individuals with symptomatic mental disorders; dementia; mood disorders; neurotic, stress related disorders; and senility.[21]

The relationship between heat events and diabetes is less direct. It is known that Type 1 diabetes can be triggered by environmental toxins,[23] which are predicted to increase with increasing temperatures. An association between particulate air pollution and the development of diabetes has been reported.[24] Finally, people with diabetes experience excess mortality in on high air pollution days – often manifesting as deaths from heart attack of which diabetes is a major cause.[25]

Individuals over 60 years old, or who are obese, have cardiovascular disease, respiratory diseases (asthma, COPD) or diabetes mellitus (type 1) are more vulnerable to the effects of heat. These individuals are not able to adapt to changes in environmental conditions due to disease-related alterations in their physiology (reviewed in Kenny et al., 2010[26]).

3b.Priority health outcomes and tree canopy

The relationship of each priority health outcome to tree canopy or green space is briefly summarized here; for details including references, please see the review of each health outcome in Appendix A.

Green space is considered land that is partly or completely covered with grass, trees, shrubs, or other vegetation.[27] For purposes of this HIA, green space includes urban forest tree canopy.

Asthma: The effects of urban tree canopy on asthma are complex and include direct beneficial effects on asthma prevalence, potentially beneficial effects due to removal of air pollutants, and harmful effects due to tree pollen.

COPD: Individuals with myocardial infarction (MI), COPD, congestive heart failure (CHF) or diabetes are at higher risk of death when summer temperature increases; however, the proportion of green surface appears to significantly modify this association. It is possible that green space could lessen the symptoms of COPD and even reduce mortality.

Diabetes: There does not appear to be a direct link between Type 2 diabetes and green space. There are links between diabetes and lack of physical activity, which in turn is linked to lack of green space. Green space promotes physical activity and hence has the potential to reduce diabetes symptoms and prevalence.

Hypertension: Exercise by individuals at high risk for hypertension will reduce their rise in blood pressure over time. High quality green space was associated with lower systolic blood pressure and lower odds of hypertension. It was also found that walking in a natural environment reduced blood pressure while walking in an urban area produced the opposite result. Several studies have shown that just sitting in a room with a view of trees or similar green space reduced diastolic blood pressure. Neighborhoods with high quality green space provide the opportunity for spending more time outdoors which could lead to lower blood pressure.

Mental Distress: Although causality is complex, access to green space appears to be beneficial, possibly in conjunction with increased physical activity. A positive effect from visual exposure to green spaces on stress was found by a number of studies, and accessibility to green spaces may help reduce stress and benefit children with ADHD.

Obesity: Greening of urban areas by tree planting could indirectly help mitigate the obesity epidemic via increasing physical activity. A systematic review of 60 cross-sectional studies found the majority (68%) showed beneficial or weak associations between green space and weight or obesity-related factors, but findings were inconsistent and may be confounded by other factors such as socioeconomic status.

Intermediate Factors: **Air Pollution** has been linked with a number of chronic diseases including respiratory disease, high blood pressure, cardiovascular disease, chronic obstructive pulmonary disease (COPD), anxiety, and all-cause mortality. Urban vegetation plays a role in the formation and degradation of air pollutants in cities, both by directly removing pollutants from the air and indirectly by reducing air temperatures. Pollutants removed by urban trees and vegetation include ozone, particulates, nitric oxide, sulfur dioxide, carbon monoxide and carbon dioxide. Both gaseous and particulate air pollution has been linked to asthma development and exacerbations in many studies; while persons with COPD were at increased risk of death related to elevated ozone and PM_{10} particulate levels.

Regular **physical activity** has been shown to reduce morbidity and mortality by decreasing heart disease, diabetes, high blood pressure, colon cancer, feelings of depression/anxiety, and weight, while building and maintaining healthy bones, muscles, and joints. Physical activity is associated with proximity to green spaces, including trees and nature and proximity to parks.

This relationship may be modified by the quality of the green space and by demographics such as race, ethnicity, age and gender. Thus, physical activity is one pathway through which urban vegetation in the form of tree canopy could positively influence a variety of health outcomes.

Crime and fear of crime have historically been associated with green surroundings as bushes and underbrush may provide hiding places for criminals; but some studies found that living in greener buildings reduced aggression and violence, that significant reductions in all types of crime occurred among residents of houses with more greenery, and that vegetation/ greening was associated with reductions in gun assaults and vandalism. Evidence also suggests that exposure to natural environments may reduce feelings of anger, frustration and aggression, may enhance feelings of social safety, and may reduce rates of aggression and criminal activity.

4. Identify high risk populations: demographic factors predictive of high risk (BRFS, HIP)

Although all low tree canopy neighborhoods are potentially vulnerable to extreme heat and to heat stress, this assessment sought to identify the low tree canopy neighborhoods whose residents are at high risk for the priority health outcomes. As these outcomes are exacerbated by very hot weather, high risk neighborhoods would benefit greatly from an increase in tree canopy. To determine which risk factors best identify Ann Arbor populations at high risk to each of the six respective health outcomes (Asthma, COPD, Diabetes, Hypertension, Mental Distress, and Obesity), the Workgroup examined prevalence data from the 2010 Washtenaw County Health Improvement Plan (HIP) survey and the most recent Michigan Behavioral Risk Factor Survey (BRFS) data available for each outcome.

Prevalence for each outcome was stratified by available socioeconomic and demographic characteristics using the four selected risk factors (age, income, education and gender). Those socioeconomic and demographic strata with the highest prevalence for the respective health outcome were identified as risk factors for that outcome. For details on the determination of risk factors for each health outcome, see Appendix A.

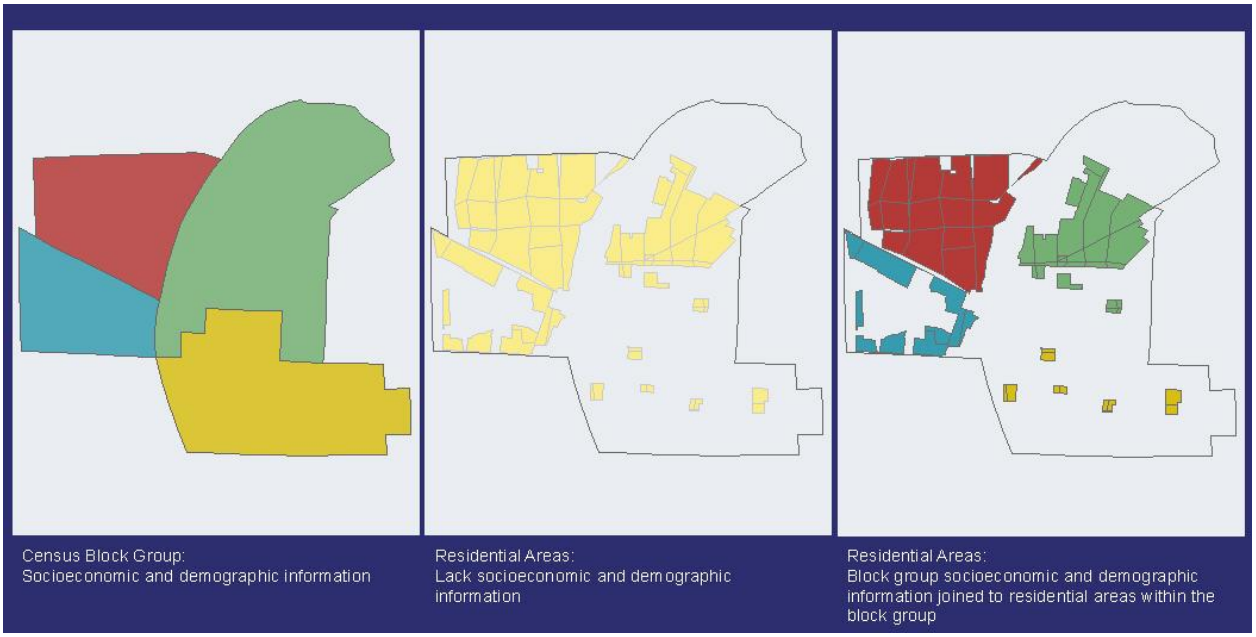
5. Determine Neighborhoods Vulnerable to Each Health Outcome

The residential areas in which these high risk populations reside could be especially vulnerable to adverse health outcomes associated with very hot weather; therefore, in order to determine where an increase in tree canopy would be the most beneficial to residents' health, a spatial assessment was conducted within the City of Ann Arbor.

5a. Map Socioeconomic and Demographic Data

To locate the residential areas that could be potentially vulnerable to each of the six adverse health outcomes, socioeconomic and demographic data for the City of Ann Arbor were obtained from the American Community Survey, ACS, 2005-2009, 5-year estimates at the block group level.[10] Socioeconomic and demographic data are not available for residential areas; therefore, block group data were allocated to the residential areas located within each of the block groups. Figure 4 offers a visualization of how this allocation was conducted.

Figure 4: Visualization of Census Block, Residential Parcels, and Spatially Joining the Data



5b. Define Vulnerable Neighborhoods

Residential areas were defined as vulnerable to a health outcome based on the distribution in that area of demographic risk factors associated with that outcome. This was done using threshold values for the socioeconomic and demographic variables that had the highest prevalence for each health outcome, as shown in Table 3. The threshold values for age, gender, and education were set based on one standard deviation higher from the mean of that variable for the City of Ann Arbor. If the median household income of a residential area fell within the high risk income stratum as listed in Table 3, that area met the threshold value for income.

If the population in the residential area met the threshold value for two or more of the potential risk factors for a given health outcome listed in Table 3, then that area became identified as vulnerable to that outcome. For example, if more than 14.65% of the population in a residential area is 65 years of age or older and the residential area has a median household income between $35,000 and $74,999 then it would be considered vulnerable to diabetes.

Table 3: Priority Health Outcomes, Demographic Variables Identified as Risk Factors, and the Threshold Values at which Residential Areas were Identified as Vulnerable.

Demographic Variables		Risk Factor Threshold Values (One Standard Deviation Higher than the Mean)
Diabetes:		
	18 to 24 years of age	40.07% of population or greater
	65 years of age or older	14.65% of population or greater
	Income $35,000 to $75,000	Median household income between $35,000 and $74,999
COPD:		
	65 years of age or older	14.65% of population or greater
	Income less than $35,000	Median household income less than $35,000
Hypertension:		
	65 years of age or older	14.65% of population or greater
	Income less than $35,000	Median household income less than $35,500
	High school education or less	15.27% of population or greater
Asthma:		
	18 to 34 years of age	14.17% of population or greater
	Income less than $35,000	Median household income less than $35,000
	High school education or less	15.27 % of population or greater
Mental Distress:		
	50 to 64 years of age	19.00% of the population or greater
	Female	53.21% of population of greater
	Income less than $35,000	Median household income less than $35,000
Obesity:		
	25 to 34 years of age	27.8% of population or greater
	65 years of age or older	14.65% of population or greater
	Income $35,000 to $75,000	Median household income between $35,000 and $74,999
	High school education or less	15.27 % of population or greater

5c. Identify Highly Vulnerable Residential Areas

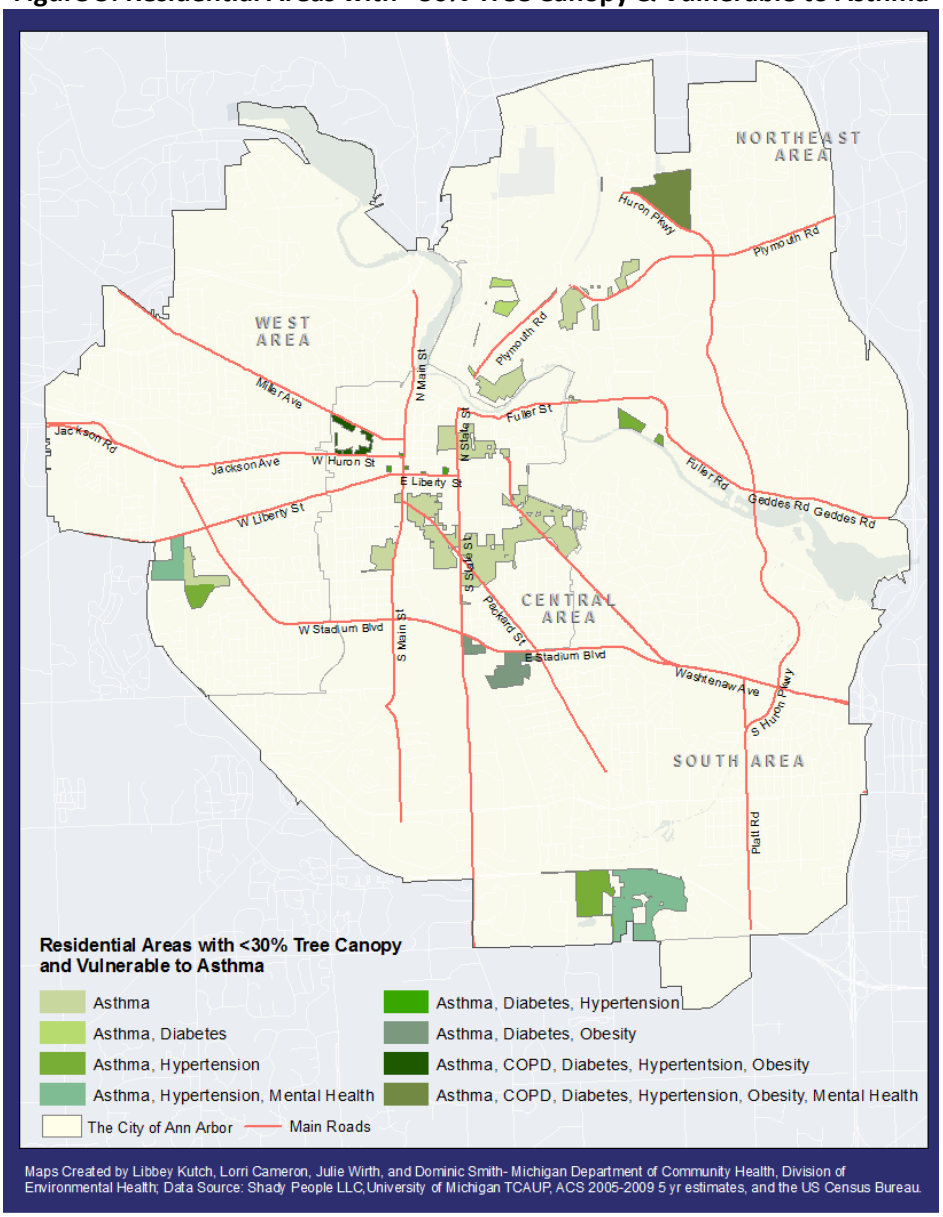
If a residential area has less than 30% tree canopy, and its population meets the threshold value for two or more risk factors for a priority health outcome, then that area was identified as

highly vulnerable to both heat and that health outcome. For example, a residential area that has low tree canopy, more than 14.65% of its population aged 65 years of age or older, and a median household income between $35,000 and $74,999 would be identified as highly vulnerable to diabetes.

The highly vulnerable residential areas for each priority health outcome are summarized in the following pages and map Figures 5 through 10.

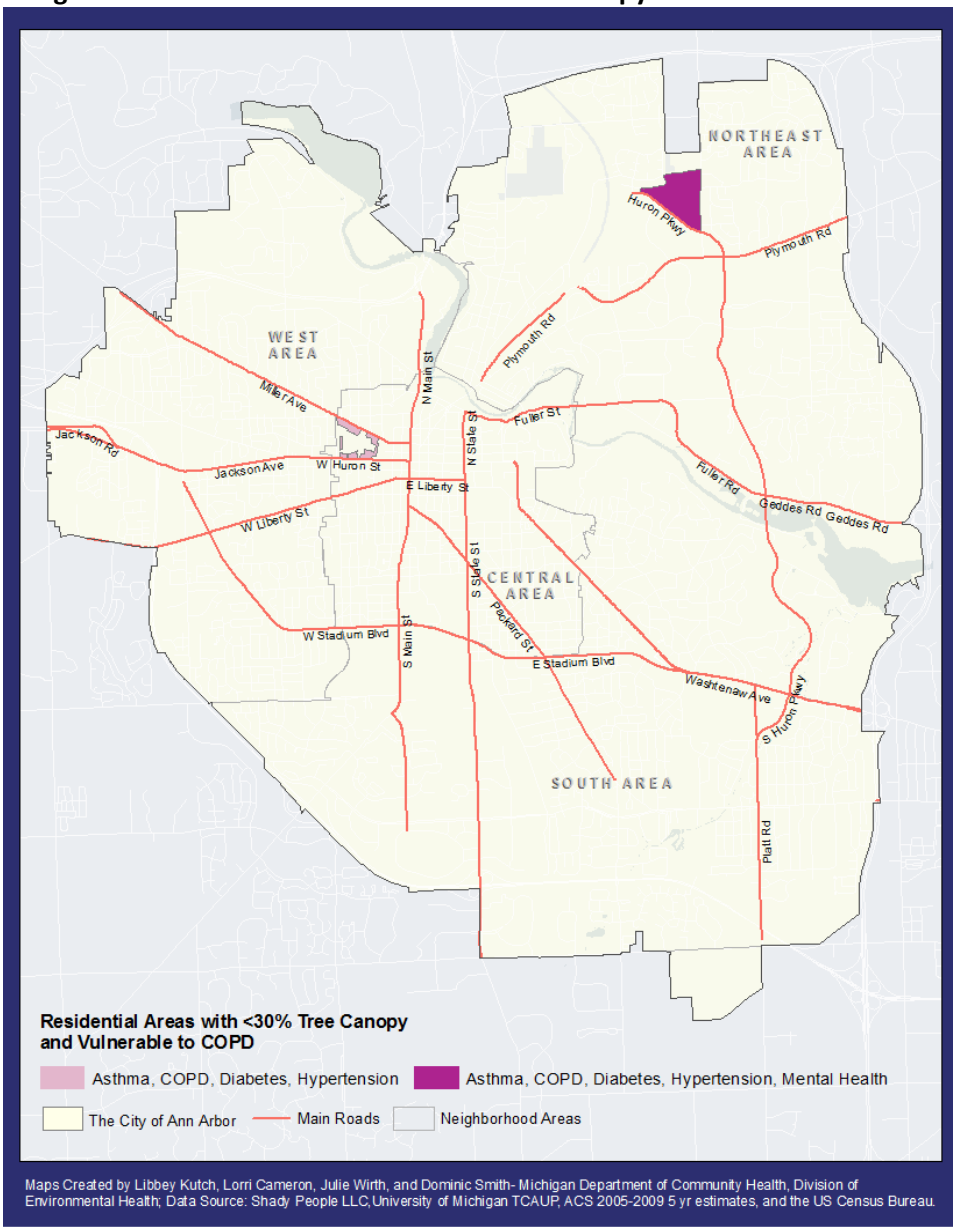
Asthma: The neighborhoods most vulnerable to asthma exacerbation whose population would benefit from selected tree planting to provide greater tree canopy have less than 30% tree canopy and at least two of the following characteristics: at least 14.17% of the residents are aged 18-24 years, and/or at least 15.27% have a high school education or less, and/or the median household income is less than $35,000 (Figure 5) The Central Area contains the most neighborhoods vulnerable to asthma alone, as well as neighborhoods vulnerable to asthma and hypertension, and to asthma, COPD, diabetes, and hypertension. The Northeast Area has neighborhoods vulnerable to asthma alone, to asthma and hypertension, to asthma and diabetes, and to asthma, COPD, diabetes and hypertension. The South Area has neighborhoods vulnerable to asthma and hypertension and to asthma, diabetes and obesity. The West Area has neighborhoods vulnerable to asthma and asthma and hypertension.

Figure 5: Residential Areas with <30% Tree Canopy & Vulnerable to Asthma



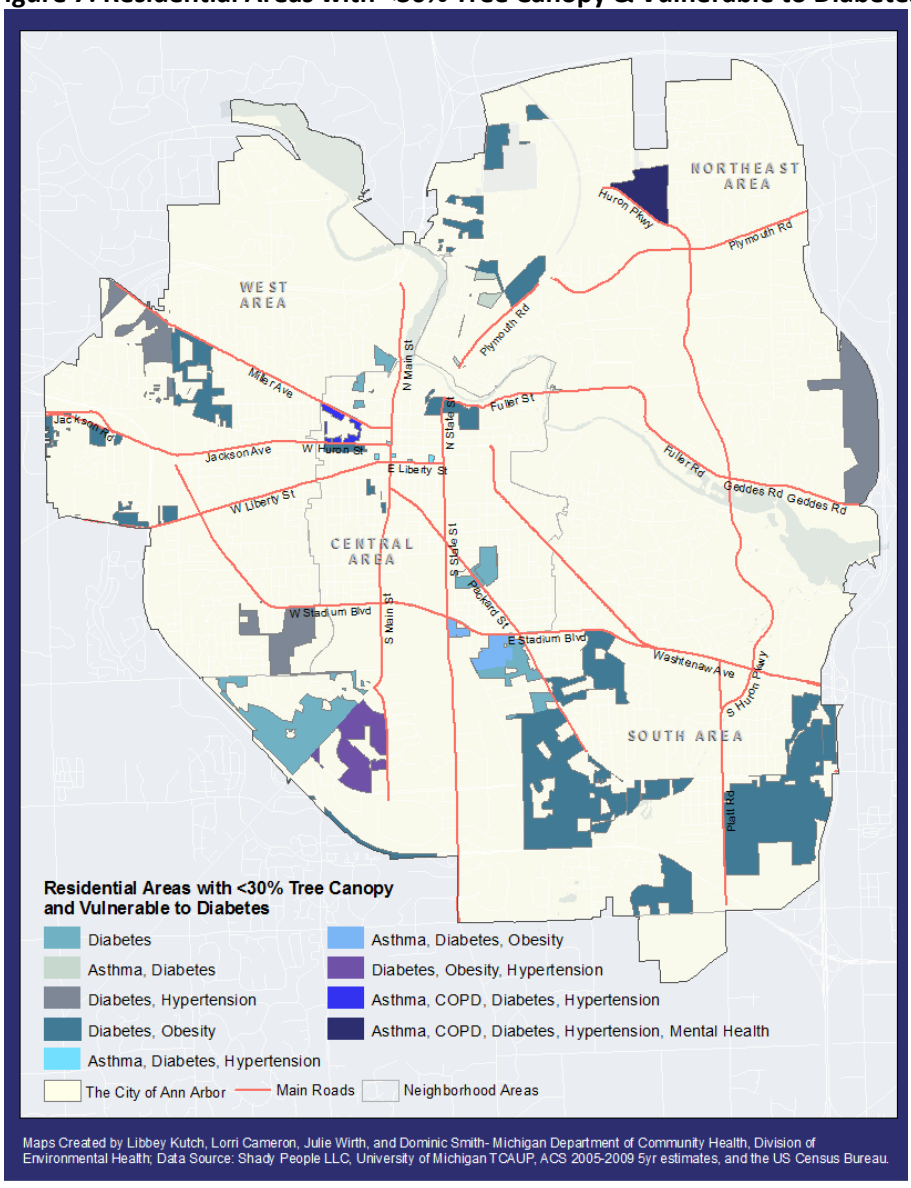
Chronic Obstructive Pulmonary Disease (COPD): Neighborhoods most vulnerable for COPD exacerbation whose residents would benefit from greater tree canopy have less than 30% tree canopy, at least 14.76% of residents aged 65 or older and a median household income less than $35,000 (Figure 6). Only two neighborhoods, one in the Northeast Area and one in the West Area, were vulnerable to COPD. These same neighborhoods were also vulnerable to asthma, diabetes, hypertension and obesity.

Figure 6: Residential Areas with <30% Tree Canopy & Vulnerable to COPD



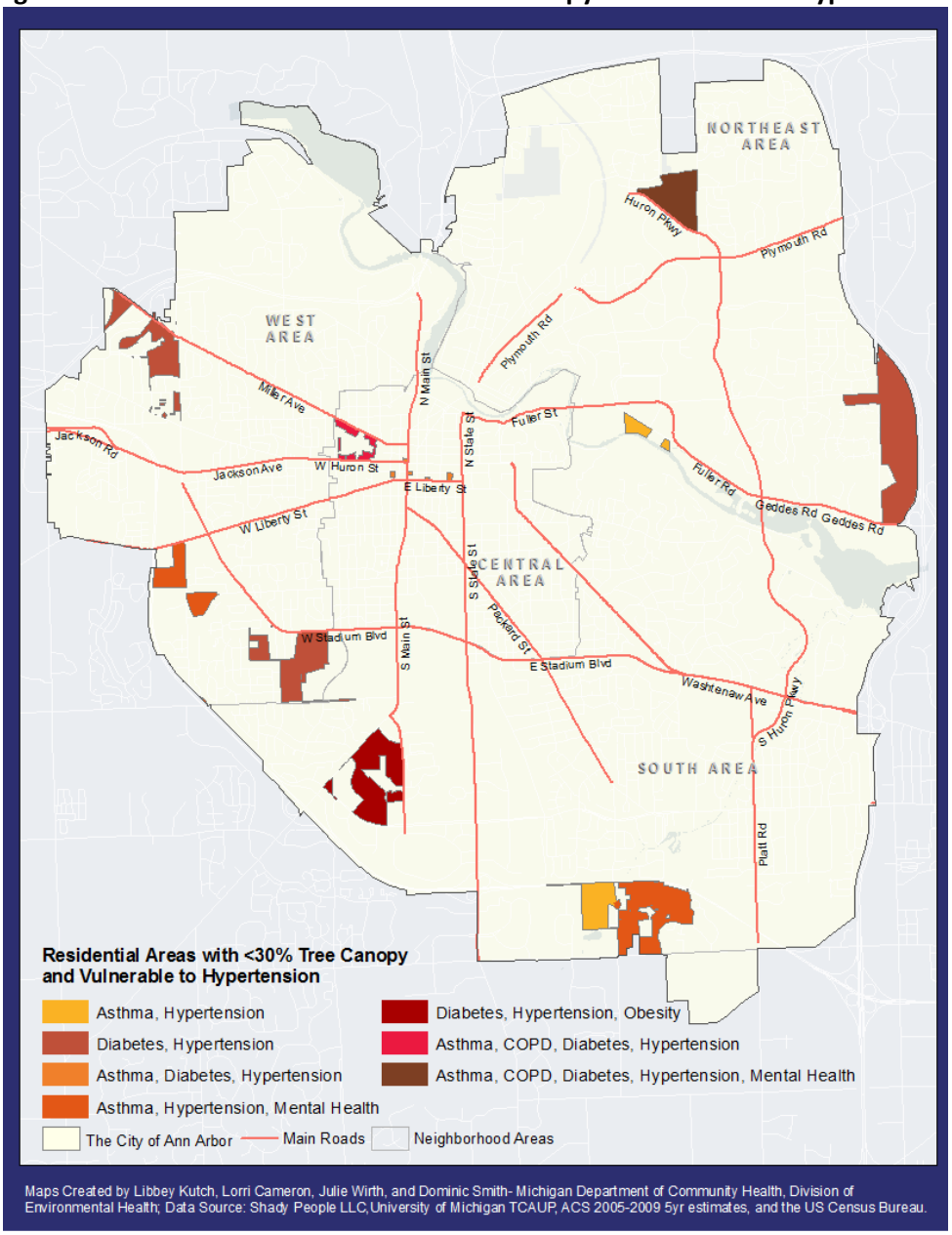
Diabetes: Individuals most vulnerable for diabetes who would most benefit from greater tree canopy reside in neighborhoods with less than 30% tree canopy and at least two of the following characteristics: at least 40.07% of the population is aged 18-24 years; and/or at least 14.65% is age 65 years or older; and/or the median household income is between $35,000 and $74,999 (Figure 7). The Central Area contains neighborhoods vulnerable to diabetes alone as well as to diabetes and obesity. The Northeast Area has neighborhoods vulnerable to diabetes and hypertension and to diabetes and obesity. The South Area has neighborhoods vulnerable to obesity alone, large areas vulnerable to diabetes and obesity and neighborhoods vulnerable to diabetes, hypertension and obesity. Several neighborhoods in the Northeast Area are vulnerable to diabetes and obesity as well.

Figure 7: Residential Areas with <30% Tree Canopy & Vulnerable to Diabetes



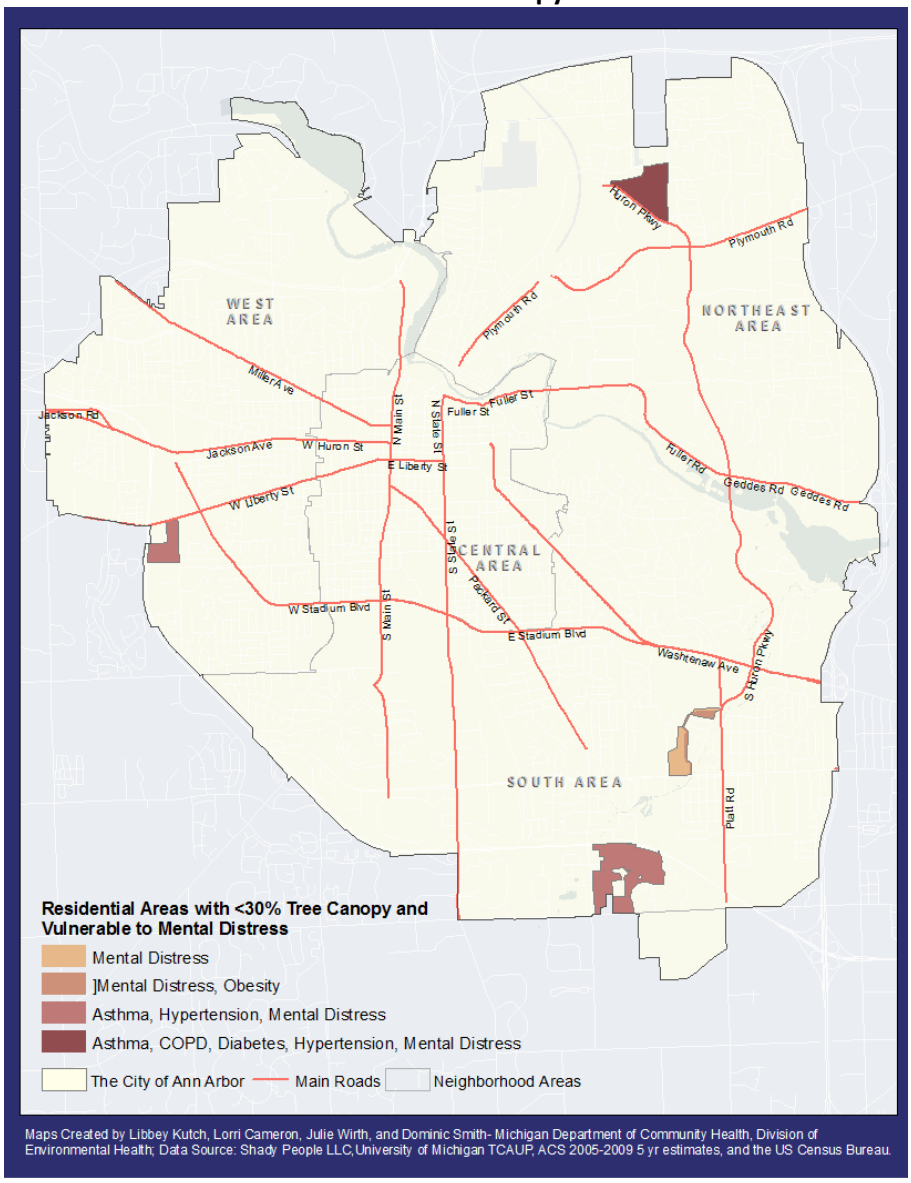
Hypertension: Neighborhoods most vulnerable for an increased risk of hypertension whose residents would benefit from greater tree canopy have less than 30% tree canopy and at least two of the following characteristics: at least 14.65% are aged 65 years and older; and/or 15.27% or more have a high school education or less; and/or the median household income less than $35,000 (Figure 8). The neighborhoods vulnerable for hypertension overlap with those vulnerable for asthma, COPD, diabetes and obesity. Please see those summaries and maps.

Figure 8: Residential Areas with <30% Tree Canopy & Vulnerable to Hypertension



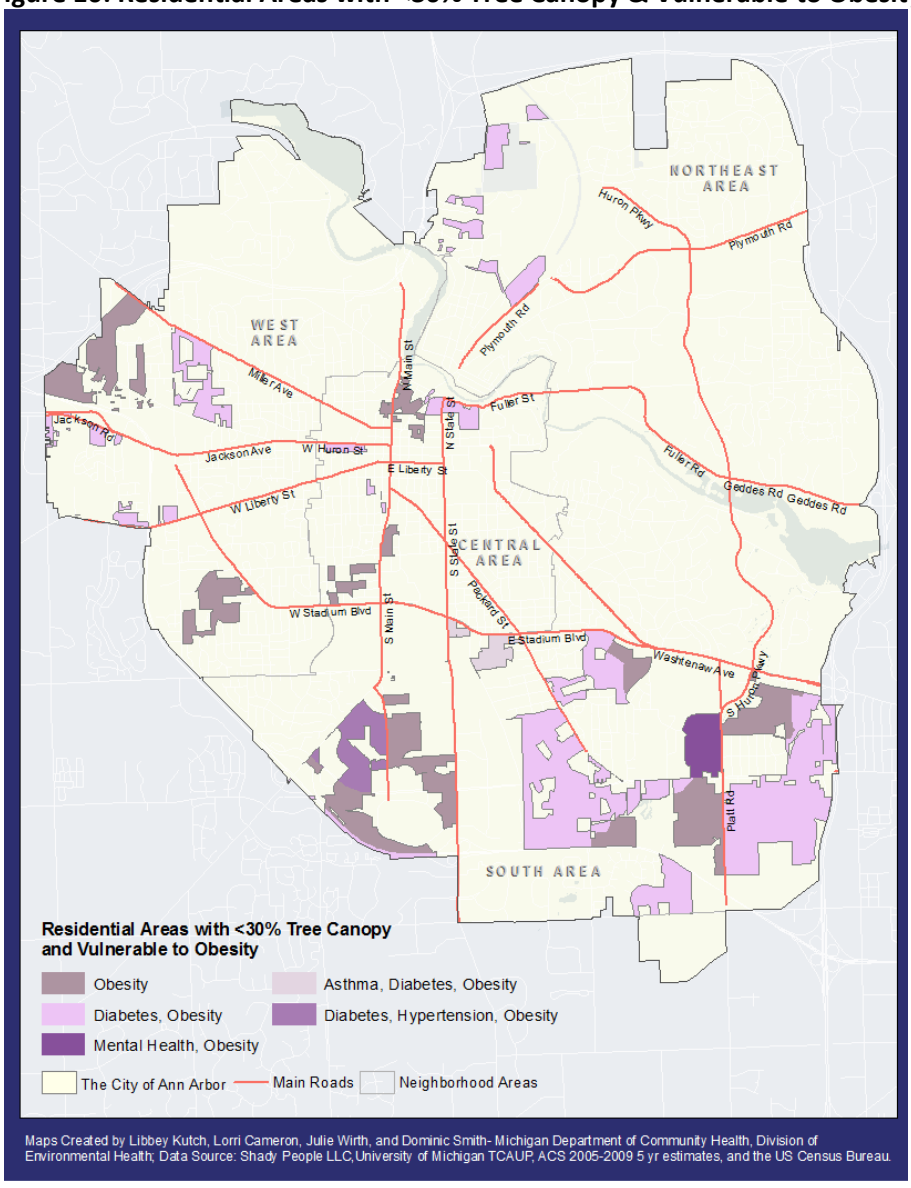
Mental Distress: Neighborhoods whose residents are most at risk for mental health problems and would benefit from increased tree canopy have less than 30% tree canopy and at least two of the following characteristics: at least 19% of residents are aged 50 to 60 years, and/or at least 53.21% are female, and/ or the median household hold income is less than $35,000 (Figure 9).Two small neighborhoods in the North Area were vulnerable to mental health problems, asthma, COPD, diabetes and hypertension. Neighborhoods in the South Area were vulnerable to mental health problems alone and to mental health problems and obesity. Two neighborhoods in that area were vulnerable to mental health problems, asthma and hypertension.

Figure 9: Residential Areas with <30% Tree Canopy & Vulnerable to Mental Distress



Obesity: The individuals most at risk for obesity who would benefit from greater tree canopy reside in neighborhoods with less than 30% tree canopy and at least two of the following characteristics: at least 27.8% of residents are age 25-34 years; and/or at least 14.65% are 65 years of age or older; and/or the median household income is between $35,000 and $74,999; and/or at least 15.27% of residents have a high school education or less (Figure 10). The Central Area contains several neighborhoods vulnerable to obesity alone and to obesity and diabetes. Northeast Area has neighborhoods vulnerable to both obesity and diabetes. Several neighborhoods in the South Area are vulnerable obesity alone, to obesity and diabetes, to obesity, asthma and diabetes and to obesity, diabetes and hypertension. The West Area has neighborhoods vulnerable to obesity alone, and to obesity and diabetes.

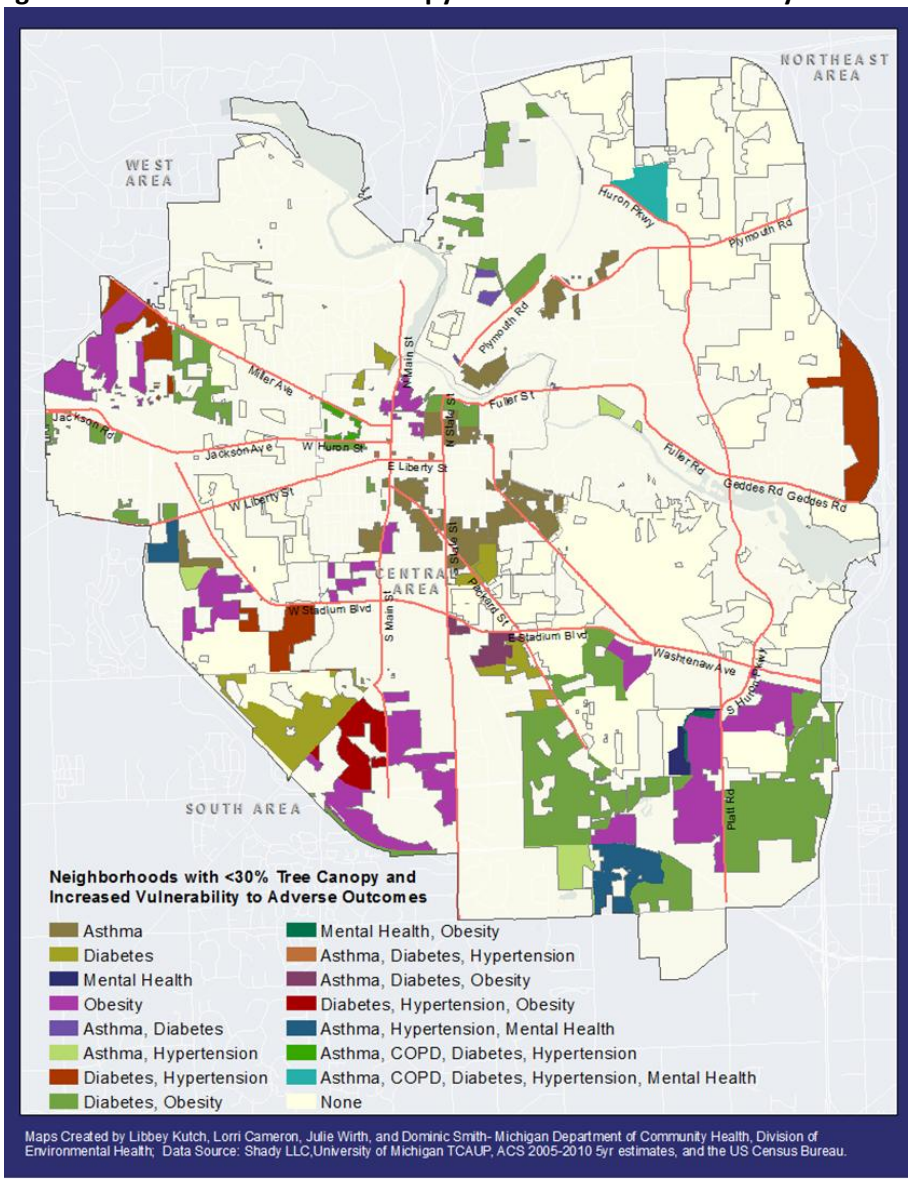
Figure 10: Residential Areas with <30% Tree Canopy & Vulnerable to Obesity



6. Prioritize neighborhoods with multiple vulnerabilities

In order to get an idea of the areas of Ann Arbor most at risk for all six priority health outcomes, the Project Workgroup put the vulnerable neighborhoods for all the health outcomes on one map (Figure 11). This map identified several neighborhoods at risk for all of the adverse health outcomes**.**

Figure 11: Neighborhoods with <30% Tree Canopy and Increased Vulnerability to Adverse Outcomes



To further assess the distribution of risk factors for neighborhoods vulnerable to multiple health outcomes, the Workgroup selected the six neighborhoods or areas that were vulnerable to three or more adverse health outcomes for more detailed characterization (see Figure 12 and Table 4 which lists the demographic risk factors and the percentages of individuals in the neighborhoods with those risk factors). Each neighborhood appears to be characterized by a set of unique percentages of risk factors. Scrutiny of these percentages does not reveal similar degrees of risk. For example, while all the neighborhoods have children less than 9 years old, the percentages vary from 4.6% to 15.8%. This suggests that each neighborhood has its own unique level of risk, at least regarding the selected risk factors.

Figure 12: Neighborhoods with <30% Tree Canopy & Increased Vulnerability to ≥3 Adverse Outcomes

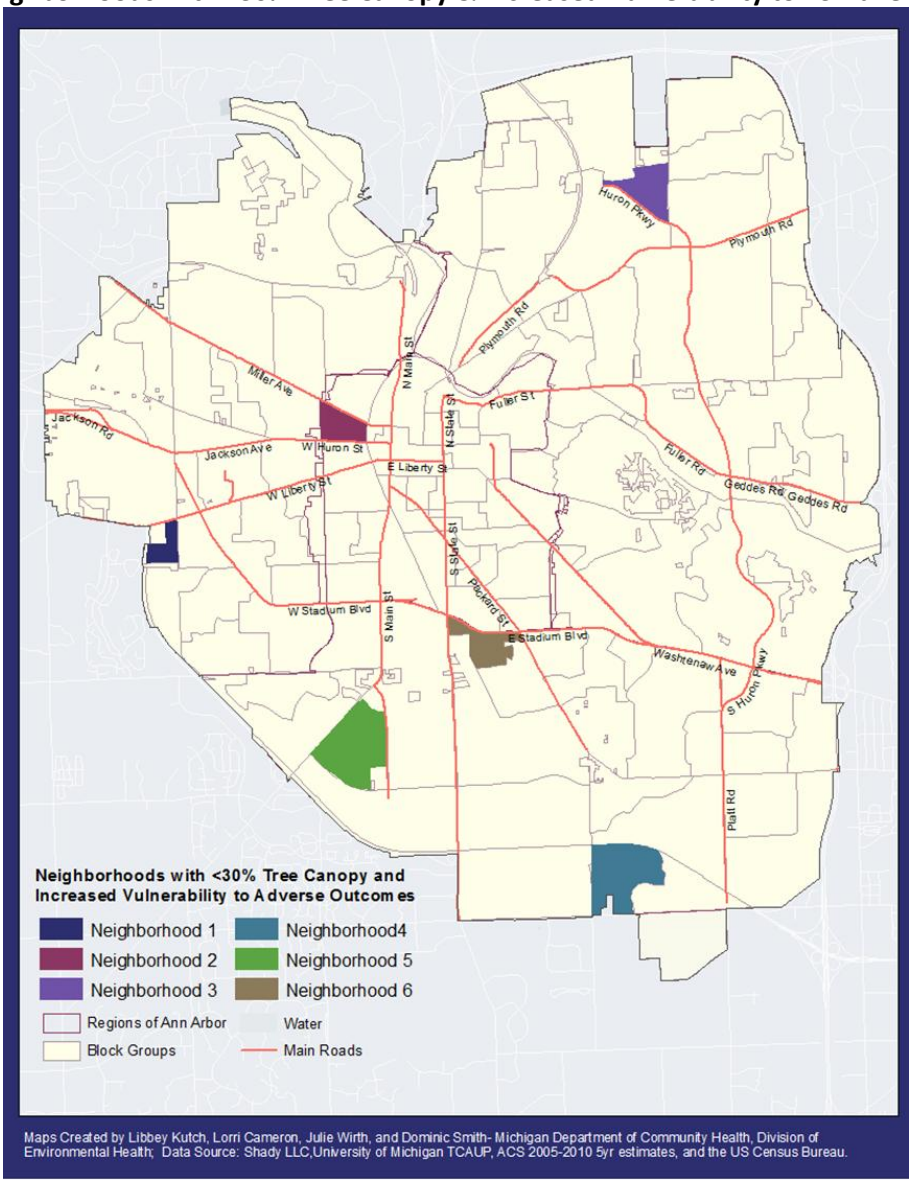


Table 4: Demographic Information for Neighborhoods at an Increased Vulnerability to Three or More of the Six Outcomes (Asthma, COPD, Diabetes, Hypertension, Obesity, and Mental Distress)

Neighborhood 1 **Area Acres: 32.00288935850**		**Neighborhood 2** **Area Acres: 50.8753008385**	
Percent Under 9	15.11%	Percent Under 9	04.57%
Percent 18 to 24	10.18%	Percent 18 to 24	08.62%
Percent 18 to 34	33.28%	Percent 18 to 34	28.72%
Percent 25 to 34	23.10%	Percent 25 to 34	20.10%
Percent 65 or Over	08.85%	Percent 65 or Over	20.63%
Percent w/ High School Ed or Less	25.44%	Percent w/ High School Ed or Less	19.38%
Percent Under 100% of Poverty	15.63%	Percent Under 100% of Poverty	30.76%
Percent Between 100% and 200% of Poverty	43.80%	Percent Between 100% and 200% of Poverty	32.64%
Median Household Income ($)	$30,573	Median Household Income ($)	$223,203
Neighborhood 3: **Area Acres: 69.63140442930**		**Neighborhood 4:** **Area Acres: 138.66462395**	
Percent Under 9	10.61%	Percent Under 9	15.81%
Percent 18 to 24	09.56%	Percent 18 to 24	08.59%
Percent 18 to 34	23.33%	Percent 18 to 34	28.95%
Percent 25 to 34	13.77%	Percent 25 to 34	20.36%
Percent 65 or Over	33.65%	Percent 65 or Over	06.35%
Percent w/ High School Ed or Less	24.26%	Percent w/ High School Ed or Less	38.45%
Percent Under 100% of Poverty	35.19%	Percent Under 100% of Poverty	19.57%
Percent Between 100% and 200% of Poverty	19.21%	Percent Between 100% and 200% of Poverty	28.98%
Median Household Income ($)	$16,510	Median Household Income ($)	$33,778
Neighborhood 5: **Area Acres: 155.12607011000**		**Neighborhood 6:** **Area Acres: 64.2436260271**	
Percent Under 9	06.60%	Percent Under 9	08.28%
Percent 18 to 24	07.54%	Percent 18 to 24	19.43%
Percent 18 to 34	28.21%	Percent 18 to 34	60.00%
Percent 25 to 34	20.67%	Percent 25 to 34	40.57%
Percent 65 or Over	35.24%	Percent 65 or Over	05.06%
Percent w/ High School Ed or Less	25.52%	Percent w/ High School Ed or Less	23.76%
Percent Under 100% of Poverty	26.26%	Percent Under 100% of Poverty	32.60%
Percent Between 100% and 200% of Poverty	08.22%	Percent Between 100% and 200% of Poverty	08.60%
Median Household Income ($)	$37,159	Median Household Income ($)	$43,068

7. Consider Intermediate Factors

No information was available on the distribution of air pollution in the City of Ann Arbor, so that factor was not considered in the identification of vulnerable residential areas.

To assess the distribution of physical activity in Ann Arbor in adults the Workgroup examined survey data on the opposite - that is lifetime prevalence of no leisure time physical activity; which was lower in the city of Ann Arbor (25.5%) than the rest of Washtenaw County (35%) or the State of Michigan (23.6%). Risk factors for lack of physical activity include: increasing age; being female or black; without health insurance; or with low household income (less than $35,000). Therefore the individuals least likely to participate in leisure time physical activity and who would benefit from selected tree planting to create greater tree canopy would be in neighborhoods that have a higher proportion of individuals who are female, black, elderly, uninsured, or with lower household income than the City average; however these residential areas were not mapped. See Appendix A for details.

The distribution of crime in Ann Arbor was mapped using 2011 data from the Michigan Incident Crime Reporting (MICR) system on each single crime occurrence, subdivided into violent crimes (assaults, batteries, robberies, and homicides); property crimes (thefts, vehicle thefts, burglaries, and arson); and total crimes. Ann Arbor had 225 violent crimes, 2,520 property crimes, and 6,300 total crimes. The map demonstrated that most crime was in the Central city Area, an area which corresponds with neighborhoods with low tree canopy. See details and map Figure 13 in Appendix A.

D. Step 4 – Recommendations to Ann Arbor

The Workgroup recommends that The AA-UCFMP consider the six residential areas in the map on Figure 12 as priority areas for targeted tree planting. As there do not appear to be any compelling risk factors for one area over the other, we suggest they be ranked by factors such as population size, neighborhood receptiveness to tree planting and maintenance, or other factors which were not considered by this HIA.

Appendix A: Data Review and Literature

I. Relationship between Tree Canopy and Asthma

Health Rationale: The effects of urban canopy or tree cover on asthma are complex and include beneficial effects on asthma prevalence, potentially beneficial effects due to removal of air pollutants, and harmful effects due to tree pollen. Lovasi and colleagues investigated the association between street tree density and childhood asthma prevalence and hospitalizations in New York City. After adjusting for possible confounders, asthma prevalence was estimated to be lower by 29% among children when the density of trees increased by 343 trees per km[28]. However, hospitalizations for childhood asthma did not show any association when adjusting for confounders. In urban areas in Canada, Dales and associates examined the relationship between daily hospitalizations for asthma and daily tree pollen grain concentrations for a range of tree types. They demonstrated a significant positive association between the majority of tree pollen grains and daily hospitalizations for asthma, with percent increases in daily asthma hospitalizations ranging from 2.16% to 2.63% for the most severe cases.[29] Air pollution has also been linked to asthma development and exacerbations[30,31] and tree canopy is reported to reduce air pollutants.[32] (See section on Air Pollutants)

Data Relevant to Asthma for the State of Michigan, Washtenaw County and the City of Ann Arbor (See Appendix B, Tables 1, 2, 3)

a. Survey: Michigan: BRFSS; Washtenaw County: HIP; Ann Arbor HIP

b. Hospital: Michigan: Healthcare Cost and Utilization Project (HCUP); Washtenaw County: MIDB

Adult Asthma: The Behavioral Risk Factor Survey System (BRFSS) survey data for Michigan provides prevalence information for adult self-reported lifetime and current asthma prevalence as a rate (percent), standard error (SE) and 95% confidence interval (CI); as a prevalence number and 95% confidence interval; and sample size. The prevalence for Michigan is 15.8%, SE 0.47, and CI 14.6-16.9; and prevalence number is 1,196,525, (1,104,142 – 1,288,908). Prevalence tables are also arranged by sex, age, race, race and ethnicity, education and income. A prevalence map of the USA divided into states with ordinal prevalence categories for adult, self-reported lifetime asthma prevalence is also provided. The Washtenaw County Health Improvement Plan (HIP) survey provides information on adult asthma (ever told had asthma and current asthma) for Washtenaw County for 2005 and 2010. The data for Washtenaw is further broken down by age, gender, race, household income, gender, education, health insurance, and employment. A table for Region is provided and this contains asthma prevalence only. Graphs of the data are also presented. The Michigan Inpatient Database (MIDB) survey provides the age-adjusted rates of asthma hospitalization for Michigan (~16 per 10,000) and Washtenaw County (13 per 10,000). Healthcare Cost and Utilization Project provides statistics on Michigan hospital discharges for asthma diagnosis by age, sex and race/ethnicity.

Childhood Asthma: The HIP survey provides information on asthma (ever told had asthma) broken down by age, gender, race, household income, gender, education, health insurance, and employment. The same types of information are also broken down for "child visited an emergency room in the last year." For both asthma metrics, there is a table for Region, one of which is Ann Arbor so prevalence of childhood asthma in Ann Arbor is provided.

Data from the above sources for 2010 indicate that for adults, lifetime prevalence of asthma:

1. In Ann Arbor is 21.7%, while that in Washtenaw County is 24% and Michigan is 15.8%. Thus asthma prevalence in Ann Arbor is slightly lower than in Washtenaw and higher than Michigan for adults.
2. In Washtenaw County is higher in those aged 18-34 years (26%-27.4%), in those with a high school education or less, and with a median household income of less than $35,000.
3. In Michigan is higher in females (17.8%), in multiracial individuals (34.2%), in those aged 18-24 years (20.9%), in non-high school grads (19.6%) and in those earning less than $15,000 (23.5%).

For children, lifetime prevalence of childhood asthma is associated with being male, 12-17 years old, and white.

4. Hospitalization for asthma occurred more frequently for those who are 0-4 and over 65 years old.
5. Asthma deaths occurred more frequently for those who are black.

Summary: Thus the individuals most vulnerable for asthma exacerbation who would benefit from selected tree planting to provide greater tree canopy would be in neighborhoods with less than 30% tree canopy that have a preponderance of individuals aged 18-24 years, or non-high school grad or earning less than $35,000.

II. Relationship between Tree Canopy and Chronic Obstructive Pulmonary Disease (COPD)

Health Rationale: COPD is a leading cause of death and illness worldwide. It is a disease characterized by airflow limitation that is not fully reversible and is both progressive and associated with abnormal inflammatory responses of the lungs to noxious particles or gases. This loss of lung function is due to both emphysema and chronic bronchitis, and is one of the most common lung diseases and the third leading cause of death in the USA.[33] The main risk factor for COPD is long term exposure to tobacco smoke, with occupational exposure to dusts and chemicals, age and genetics also contributing. Individuals with COPD have varying degrees of lung damage and experience shortness of breath, cough, and phlegm production. These symptoms can be exacerbated by higher (above 90^{o}F) temperatures. A large US multicenter study of older individuals who survived myocardial infarction (MI), COPD, congestive heart failure (CHF) or diabetes assessed the relationship between death from the illnesses and summer temperature variability.[34] The risk for mortality was significantly higher for all groups for a 1^{o}C increase in summer temperature (COPD hazard ratio 1.08, 95% confidence interval 1.02-1.14). Risk was greater for individuals 75 years or older compared to those younger than 75 years, for populations with a greater proportion below the poverty level, and for populations with an increasing proportion of blacks. Interestingly, for each 15% increase in green surface,

the hazard ratio for COPD decreased 0.98 (0.97-0.99). The proportion of green surface significantly modified the temperature variability-mortality association. Although the data is sparse, it is possible that green space could lessen the symptoms of COPD and possibly reduce mortality.

Health Data Relevant to COPD for the State of Michigan, and the City of Ann Arbor (See Appendix B, Table 4)
a. Survey: Michigan: BRFSS 2011 (COPD was not reported in the 2009 or 2010 BRFSS)
b. Hospital: Michigan: HCUP

COPD: The BRFSS provides Michigan 2011 demographic data for lifetime prevalence of COPD, emphysema and chronic bronchitis combined. The demographic data includes total prevalence and prevalence by age, gender, race/ethnicity, household income, health insurance and disability. HCUP has Michigan 2011 prevalence data for chronic pulmonary disease and bronchiectasis combined for total number of discharges and for in-hospital deaths. The hospital data is broken down by all hospital discharges, and by age, sex and race/ethnicity.

Data from the above sources for Michigan for 2010 - 2011 indicate that COPD prevalence:
1. Among Michigan adults (8.0%) was slightly higher than the US median (6.1%).
2. Was highest in individual 65 years or older.
3. Was highest in households with income less than $35,000.

There were 26,016 hospital discharges for COPD and bronchiectasis and 300 in-hospital deaths. Both the number of discharges and in-hospital deaths increased with age until 85+. The percent of discharges was slightly higher for females (56%) than for males (44%), while in-hospital deaths were slightly higher for males (156) than for females (144). Whites had a significantly higher percent of total discharges (69.8%) than blacks (13.3%) or Hispanics (0.26%). Whites also had a higher number of in-hospital deaths (220) than did blacks (31).

Summary: Thus the individuals most vulnerable for COPD exacerbation who would benefit from selected tree planting to provide greater tree canopy would be in neighborhoods with less than 30% tree canopy characterized by a high percentage of individuals 65 years old or households with a median income less than $35,000.

III. Relationship between Tree Canopy and Diabetes
Health Rationale: Diabetes affects 25.8 million people of all ages in the USA or 8.3 percent of the population and the incidence in increasing. Risk factors for type 2 diabetes include age, race, family history, hypertension and, especially, obesity (see summary for obesity) and a sedentary lifestyle.[35] While there does not appear to be a direct link between Type 2 diabetes and green space, there are links between diabetes and lack of physical activity, which in turn is linked to lack of green space (see summary on physical activity and green space). Treatment goals for type 2 diabetes include reduction in blood glucose concentrations and blood pressure, weight loss and modification of blood lipid levels.[36] Chronic exercise has been shown to stabilize plasma glucose in the acute phase and improve body composition, insulin resistance

and glycosylated hemoglobin levels in type 2 diabetics.[36] Further, structured exercise programs have had a statistically and clinically significant benefit on glycemic control, an effect not primarily mediated by weight reduction.[37] Green space promotes physical activity and hence has the potential to reduce diabetes symptoms and prevalence.

Types of data relevant to diabetes for the State of Michigan, Washtenaw County, and the City of Ann Arbor (See Appendix B, Tables 5, 6)
a. Survey: Michigan: BRFSS; Washtenaw County: HIP
b. Hospital: none

Adult Diabetes: The BRFSS report contains the following information regarding diabetes: prevalence as a rate (percent) and 95% confidence intervals. For Michigan in 2011 the prevalence of diabetes was 10% (9.3, 10.7). Demographic characteristics are available including age, gender, race/ethnicity, as well as household income, health insurance, and disability. The Washtenaw County Health Improvement Plan (HIP) survey report has the information on adult diabetes, including gestational diabetes, for years 2005 and 2010. The information can be displayed using the following categories: age, race, gender, education, household income, employment status, military service, health insurance, activity limitations, and region (Ann Arbor, Ypsilanti, Western Washtenaw, and the rest of the county). Bar charts are also displayed.

Data from the above sources for 2010-2011 indicate that lifetime prevalence of diabetes:
1. In Ann Arbor is 3.1%, in Washtenaw County is 4.2% and in Michigan is 10%. Therefore Ann Arbor it has a slightly lower prevalence than in Washtenaw County and a much lower prevalence than Michigan.
2. In Washtenaw County is highest in age group 18-24 (12%), lowest in age group 25-34 (0%) and then increases with age (10.7% for 75+ age group). Prevalence peaks at household income of $35,000-$74,999 and at education level of high school.
3. In Michigan has a similar pattern: increases in prevalence with age, is higher in males (10.2%), and in blacks (12.7%), and decreases with increasing income (7% for >$75,000 group).

Summary: Therefore the individuals most vulnerable for diabetes who would benefit from selected tree planting to create greater tree canopy would be in neighborhoods with less than 30% tree canopy that have a preponderance of individuals aged 18-24 years or 65 years old or older or individuals earning less than $35,000.

IV. Relationship between Tree Canopy and Hypertension
Health Rationale: Hypertension is present in epidemic proportions in adults of industrialized societies and is associated with a markedly increased risk of developing many types of cardiovascular problems.[38] High blood pressure has many risk factors, including age, race, gender, family history, stress and being overweight or obese, and not being physically active. The available evidence indicates that exercise training by individuals at high risk for developing hypertension will reduce the rise in blood pressure that occurs with time.[39] In a multiethnic study in Amsterdam on hypertension, high quality green space was associated with lower

systolic blood pressure and lower odds of hypertension.[40] It was also found that walking in a natural environment reduced blood pressure while walking in an urban area produced the opposite result[41]. Several studies have shown that just sitting in a room with a view of trees or similar green space reduced diastolic blood pressure while diastolic blood pressure of study participants who set in a windowless room increased.[41] Thus, it is likely that neighborhoods with high quality green space provide the opportunity for spending more time outdoors which could lead to lower blood pressure.

Types of Data Relevant to Hypertension for the State of Michigan, Washtenaw County, and the City of Ann Arbor (See Appendix B Tables 7, 8)
a. Survey: Michigan: BRFSS; Washtenaw County: HIP
b. Hospital: none

Adult Hypertension: The BRFSS report contains the following information regarding hypertension: prevalence as a rate (percent) and 95% confidence interval. For Michigan in 2011 the prevalence of hypertension was 34.2% l (32.9, 35.4). Information of demographic characteristics includes age, gender, race/ethnicity, as well as household income, health insurance, and activity limitations. The Washtenaw County Health Improvement Plan (HIP) survey report has information on adult hypertension, for years 2005 and 2010. The information can be displayed using the following categories: age, race, gender, education, household income, employment status, military service, health insurance, activity limitations, and region (Ann Arbor, Ypsilanti, Western Washtenaw, and the rest of the county). Bar charts are also displayed.

Data from the above sources for 2010-2011 indicate that lifetime prevalence of hypertension:
1. In Ann Arbor is 16.9%, in Washtenaw County is 21% and in Michigan is 34.2%. Therefore prevalence in Ann Arbor it is slightly lower than in Washtenaw County and much lower than in Michigan.
2. In Washtenaw County increases with age (54% for 65 and older age group). In addition it increases with a decrease in median household income (32.9% for $35,000 or less group), for those with a high school education or less (27.4% to 42.7%) or with a median household income less than $35,000 (32.9%).
3. In Michigan prevalence follows the same pattern: increases with age (67.7% for75+ age group), is slightly higher in females (22.1%) and in blacks (35.9%). In addition in it decreases with an increase of an income (13.9 for >$75,000 group).

Summary: The individuals most vulnerable for an increased risk of hypertension who would benefit from selected tree planting to create greater tree canopy would be in neighborhoods with less than 30% tree canopy with a majority of individuals who are 65 years and older, with a high school education or less or with a median household income less than $35,000.

V. Relationship between Tree Canopy & Mental Distress
Health Rationale: Poor mental health is a major issue worldwide and its prevalence is rising in many countries.[42] Neuropsychiatric disorders, mainly due to depression and other common

mental disorders, contribute about 14% of the global burden of diseases.[43] Causality is complex and most likely multifactorial with synergistic effects between person and place variables. Nature is suggested as one such positive place factor. A large Swedish study evaluating the effects of exposure to different types of green natural settings and physical activity found that risk for poor mental health increased in individuals who had access to serene places but were physically inactive and in those with no access to serene places and were not physically active compared to individual with access to serene places and who were physically active suggesting an interaction between green space and physical activity.[44] A study of 1,845 Australian adults found that those with higher degree of neighborhood greenness were in better mental health, compared with those who had just a little greenness.[45]

The most common mental distress diagnoses are stress related states (e.g. burnout, depression, anxiety) with the prevalence higher for women. There are different types of stress, all of which carry physical and mental health risks. Stress is also an important factor in mental illness because it can worsen symptoms and lead to relapses. A positive effect from visual exposure to green spaces on stress was found by a number of studies. In a study of 953 adults from nine Swedish cities a statistically significant relationship between the use of urban green areas and the stress was found.[46] Stress also decreased significantly (recovery ratio 87%) after visiting green spaces.[47] The more a person visited urban open green spaces, the less often he or she reported stress-related illnesses irrespective of sex, age, or socio-economic background.[48] Interestingly people who reported wishing to be outdoors in urban open green spaces also reported suffering from higher levels of stress more often. Both inner city and suburban residents reported the same interest in visiting urban open green spaces.

A number of studies examined the impact of green spaces on attention-deficit-hyperactivity-disorder (ADHD) symptoms. In a cross-sectional, internet-based survey, which studied 452 children 5-18 years of age with ADHD, green outdoor spaces appeared to reduce ADHD symptoms in children across a wide range of individual, residential, and case characteristics.[49] Children with ADHD concentrated better after walk in a park rather than after a walk downtown or in a neighborhood.[50] Thus, accessibility to green spaces may help reduce stress and benefit children with ADHD.

Data Relevant to Mental Distress for the State of Michigan, Washtenaw County, and the City of Ann Arbor (See Appendix B Tables 9, 10)
a. Survey: Michigan: BRFSS, YRBS; Washtenaw County: HIP
b. Hospital: none

Adult Mental Distress: The BRFSS report contains the following information regarding adult depression: prevalence as a rate (percent) and 95% confidence interval. For Michigan in year 2011 the prevalence of depression was 20.6% with confidence interval (19.5, 21.8). The prevalence table contains certain demographic characteristics: age, gender, race/ethnicity, as well as household income, health insurance, and activity limitations. The Washtenaw County Health Improvement Plan (HIP) survey report has information on the prevalence of use of services for mental health problems, anxiety or depression, for years 2005 and 2010. The

information can be displayed using the following categories: age, race, gender, education, household income, employment status, military service, health insurance, activity limitations, and region (Ann Arbor, Ypsilanti, Western Washtenaw, and the rest of the county). Bar charts are also displayed.

Childhood Mental Distress: The YRBS report provides prevalence as a rate (percent) and 95% confidence interval, separated by gender as well as total, for the following categories corresponding to mental distress: high school students who felt sad or hopeless, high school students who seriously considered attempting suicide and who made a plan about how they would attempt suicide, and high school students who attempted suicide and whose suicide attempt resulted in an injury, poisoning, or overdose that had to be treated by the doctor or nurse. This information is provided mostly for the states, but in some cases for the selected large cities.

Data from the above sources for 2010-2011 indicate that for adult's lifetime prevalence of mental health problems:

1. In Ann Arbor is 21.6%, in Washtenaw County is 13.5% and in Michigan is 20.6%. Therefore Washtenaw County has the lowest prevalence, followed Michigan and then Ann Arbor.
2. In Washtenaw County is the highest among middle-aged (20.1% for 50-64 year old group) and in those with low household income (19.3% for <$35,000).
3. In Michigan poor mental health decreases with increasing age, education and household income. It's higher in females and there is no difference for race, but Hispanics are slightly higher than non-Hispanics.
4. For children prevalence of poor mental health among high-school students in Michigan is as follows: those who felt sad or hopeless: 26.0%, those who seriously considered attempting suicide: 12.8%, those who attempted suicide: 8.1% and those who had to be treated by a medical professional as a result of their suicide attempt: 2.7%.

Summary: Therefore the individuals most at risk for mental health problems who would benefit from selected tree planting to create greater tree canopy would be in neighborhoods with less than 30% tree canopy that have a majority of individuals who are 50 to 60 years old or in a household hold earning less than $35,000.

VI. Relationship between Tree Canopy and Obesity

Health rationale: Obesity is a major cause of morbidity and mortality in the United States (reviewed in[51]). Each year, an estimated 300,000 US adults die of causes related to obesity, and obesity generates immense health care costs. Evidence from several studies indicates an association between obesity and weight and diabetes, with diabetes being a risk factor for obesity and vice versa. In addition to diabetes, risk factors for obesity include genetics, poor dietary habits, family lifestyle, pregnancy, lack of sleep, age, socioeconomic status and lack of exercise. Greening of urban areas by tree planting could indirectly help mitigate the obesity epidemic via increasing physical activity (see summary on physical activity and green space). Several studies have found positive effects of green space on development of obesity. A study looking at 3,831 children 3-16 years old found that higher greenness was associated with lower

risk of an increase in a measure of body mass index (BMI) over a 2 year period (OR=0.87, 95% CI=0.79, 0.97).[52] Another study by the same authors found that increased neighborhood vegetation was inversely associated with being overweight among 7,334 children 3-18 years of age, but only if they resided in a higher population density region.[53] Children living in areas with parks within 500m of their homes and/or recreation programs within 10 km of their homes had lower BMIs at age 18, compared to those who did not.[54] Regarding adults, a study investigating 6,919 adults residing in eight different European cities found the likelihood of being overweight and obese was about 40% less for the people whose residential environment contained a higher level of greenery.[55] In a study of 953 adults from nine Swedish cities, access to a garden or short distances to green areas from dwellings were associated with lower likelihood of obesity.[56] A systematic review of 60 cross-sectional studies examined the association between green space and weight status of both children and adults.[57] A majority (68%) of the studies found beneficial or weak associations between green space and weight or obesity-related factors, but findings were inconsistent and mixed across the studies. The inconsistency in these findings may be accounted for by large-range factors, such as socioeconomic status, which affect weight status, and potential time-lags between exposure and changes in body weight.

Types of data relevant to obesity for the State of Michigan, Washtenaw County, and the City of Ann Arbor (See Appendix B, Tables 11, 12)
a. Survey: Michigan: BRFSS, YRBS; Washtenaw County: HIP
b. Hospital: none

Adult Obesity: The BRFSS report contains the following information regarding obesity: prevalence as a rate (percent) and 95% confidence intervals. For Michigan in 2011 the prevalence of obesity was 31.3% with a confidence interval (30.0, 31.6). The report contains certain demographic characteristics: age, gender, race/ethnicity, as well as household income, health insurance, and activity limitations. The Washtenaw County Health Improvement Plan (HIP) survey has information on adult obesity for years 2005 and 2010. The prevalence for Washtenaw County is 25.8%. The information can be displayed using the following categories: age, race, gender, education, household income, employment status, military service, health insurance, activity limitations, and region (Ann Arbor, Ypsilanti, Western Washtenaw, and the rest of the county). Bar charts are also displayed.

Childhood Obesity: The YRBS report provides prevalence as a rate (percent) and 95% confidence intervals, separated by gender as well as total, for high school students who were obese or were overweight. For Michigan in year 2011 the prevalence of obesity was 12.1% with confidence interval (10.6, 13.8). The HIP survey has information on childhood obesity, for years 2005 and 2010. The information can be stratified by age, race, gender, education, household income, health insurance, activity limitations, and region (Ann Arbor, Ypsilanti, Western Washtenaw, and the rest of the county). Bar charts are also displayed.

Data from the above sources for 2010-2011 indicate that for adult's lifetime prevalence of obesity:
1. In Ann Arbor is 17.6%, in Washtenaw County is 25.8% and in Michigan is 31.1%. Therefore the prevalence of obesity in Ann Arbor it is slightly lower than in Washtenaw County and much lower than in Michigan.
2. In Washtenaw County higher prevalence of obesity is in 25-34 years old adults (35.3%) and in those 65 years or older (33.7%). It is and in those with the medium household income (30.6% for $35,000-$74,999 group) and in those with high school education or less (31.7%).
3. In Michigan the prevalence of obesity increases with age until 55-64 years old and then decreases in older adults. It is also it is higher in males (31.9%), in blacks (41.0%), and also in those with low household income (36.6% for <$20,000 group).
For children lifetime prevalence of obesity in Michigan is 12.1%. Washtenaw County reported 7.9% of children aged 2-17 were overweight, but did not provide a value for obese children. However they report that 11.8% of children 6-17 years old are overweight/obese - at risk.

Summary: The individuals most at risk for obesity who would benefit from selected tree planting to create greater tree canopy would be in neighborhoods that have less than 30% tree canopy and a majority of individuals who are aged 25-34 years old or 65 years old or greater, with a median household income of $35,000 to $75,000 or having a high school education or less.

VII. Relationship between Tree Canopy and Air Pollution
Air pollution is a major environmental concern in most major cities across the world. The American Lung Association highlighted scientific evidence linking air pollutants with stroke, respiratory symptoms, preterm birth, preeclampsia, infant pneumonia mortality, all-cause mortality, migraines, reduced longevity, high blood pressure, decreased cognitive function, cardiovascular disease, lung cancer, chronic obstructive pulmonary disease (COPD), bronchitis, birth defects, arthritis, and anxiety.[58]

An important focus of research aimed at reducing air pollutant levels has involved the role of urban vegetation in the formation and degradation of air pollutants in cities. Urban trees and shrubs have the ability to remove significant amounts of air pollutants and consequently improve environmental quality and human health (reviewed in[59,60]). Trees remove gaseous air pollution primarily by uptake via leaf stomata, though some gases are removed by the plant surface. Once inside the leaf, gases diffuse into intercellular spaces and may be absorbed by water films to form acids or react with inner-leaf surfaces. Trees also remove pollution by intercepting airborne particles. Some particles can be absorbed into the tree, though most particles that are intercepted are retained on the plant surface. The intercepted particle often is resuspended to the atmosphere, washed off by rain, or dropped to the ground with leaf and twig fall. Urban trees can also improve air quality by reducing air temperatures (via transpiration and reducing building energy and consequent power plant emissions (e.g. temperature reductions; tree shade). A recent systematic quantitative review of 115 published papers on the benefits and costs of urban trees across cities in different climate zones

concluded that trees provided economic, social, health, visual and aesthetic benefits.[5] Identified ecosystem services included carbon sequestration, air quality improvement, storm water attenuation, and energy conservation.

Several studies have estimated the amount of pollutants removed by urban trees and greenery and the subsequent cost savings. Nowak et al, modeled the association between trees, including large shrubs, and annual air pollution removal in 55 U.S cities[59]. They found that urban trees removed large amounts of air pollution that consequently improved urban air quality. Pollution removal (ozone, particulate matter 10 microns, nitric oxide, sulfur dioxide and carbon monoxide) varied among cities with total annual air pollution removal by US urban trees estimated at 711,000 metric tons ($3.8 billion value). Using another model air pollutant uptake by Sacramento's urban forest was estimated to be approximately 1,457 metric tons annually, at an implied value of US$28.7 million.[61] The growing season daily uptake for ozone was approximately 2.4 metric tons per day, while PM10 uptake was slightly greater, at 2.7 metric tons per day. Daily uptake of nitrogen dioxide, and particulate matter represented 1 % to 2% of anthropogenic emissions for the county. A study in Beijing China estimated that trees in the central Beijing removed 1261.4 tons of pollutants from the air in 2002.[62] The air pollutant that was most reduced was PM10 with 772 tons removed. The carbon dioxide stored in biomass form by the urban forest was approximately 0.2 million tons.

Air Pollution and Asthma: Air pollution has been linked to asthma development and exacerbations in many studies.[63,64] Attention has focused on gaseous pollutants, such as ozone and nitrogen dioxide (NO_2), and particulate matter (PM), generated by car traffic and industry. Increased air levels of ozone ($O_{2)}$ and nitrogen dioxide (NO_2) have been associated with increased respiratory morbidity and with hospital admissions for asthma in the case of both children and adults.[65,66]

People who are at the highest risk of being affected by ozone include people with asthma or lung disease because they will feel the effects of ozone sooner and at lower ozone levels than less-sensitive people.[67] Children who spend a lot of time outdoors playing sports are at risk of developing asthma in high ozone areas.[68] Asthma in children may also be aggravated when they breathe in outdoor ozone. Pediatric asthma is an important and growing public health problem known to be associated with air pollutants. On days with higher ambient air pollution, emergency rooms see more cases of asthma in the pediatric and elderly populations.[69] Being exposed to ozone for short periods of time over many years may cause children to have more breathing problems as adults. Older adults are also at risk because they are more likely to have heart or lung disease, as well as active people of all ages who exercise or work hard outside because they are in contact with ozone more than people who spend more time indoors. Heavy smokers had an increased relative risk of emergency department visits for asthma compared to comparable nonsmoking asthmatics in response to increases in 2-day lagged ozone levels.[70] Finally infants are at risk because their lungs continue to develop after birth and can be impacted by air pollutants.

Many studies indicate that air pollutants can aggravate asthma. For example, ozone and particulate matter decreased lung function, triggered exacerbations of asthma, and increased rates of hospitalization for asthma.[71] Exposure of individuals with mild or moderate asthma to road side traffic lead to decreases in lung function.[72] Whether air pollution also contributes to the initial development of asthma remain unclear.[73] However, a large study of 2725 never-smokers found that the incidence of asthma was associated with a change in traffic related particulate matter 10 microns in diameter (TPM 10). The hazard ratio was 1.30 (CI 95% CI 1.05 to 1.61) per 1 microg/m^3 change in TPM 10.[74] Additionally a recent review of the literature supported the associations between long-term exposure to traffic-related pollutants and newly developed asthma sensitization in children.[75]

Air pollution and COPD: A large cohort study on the effect of exposure to PM_{10} on persons discharged alive following a hospital admission for COPD found that those discharged had substantial mortality risk associated with exposure to PM_{10}.[76] The mortality hazard ratio for each 10 μg/m^3 increase of PM_{10} was 1.22 (95% CI: 1.17-1.27) for the year of death and up to 3 years previously. Ozone exposure, also investigated in the same COPD cohort, resulted in an increase in the mortality hazard ratio of 1.7 (95% CI; 1.04-1.09) for each 5 ppb increase in seasonal ozone.[77]

VII Relationship between Tree Canopy and Crime

Health Rationale: Historically green surroundings have often been associated with fear of crime and crime itself as bushes and underbrush may provide hiding places for criminals. Other studies found that living in greener buildings reduced aggression and violence.[78] Some studies have examined the association between crime and greenery. A study divided crime incidents into three categories: violent crime (assaults, batteries, robberies, and homicides), property crime (simple thefts, vehicle thefts, burglaries, and arson), and total crime (all crimes reported). A significant reduction in all types of crime occurred among residents of houses with more greenery.[79] In a study examining the association between crime and vegetation, greening was associated with a consistent reduction in gun assaults in all sections of the city and a consistent reduction in vandalism in one part of the city.[80] Evidence also suggests that exposure to natural environments may reduce feelings of anger, frustration and aggression.[78] In turn, this may enhance feelings of social safety, and even reduce actual rates of aggressive behavior and criminal activity.[79]

Types of data relevant to crime for the State of Michigan, Washtenaw County, and the City of Ann Arbor (See Appendix B, Tables 13, 14, 15)

a. Survey: Michigan, Washtenaw County, Ann Arbor: MICR

b. Hospital: none

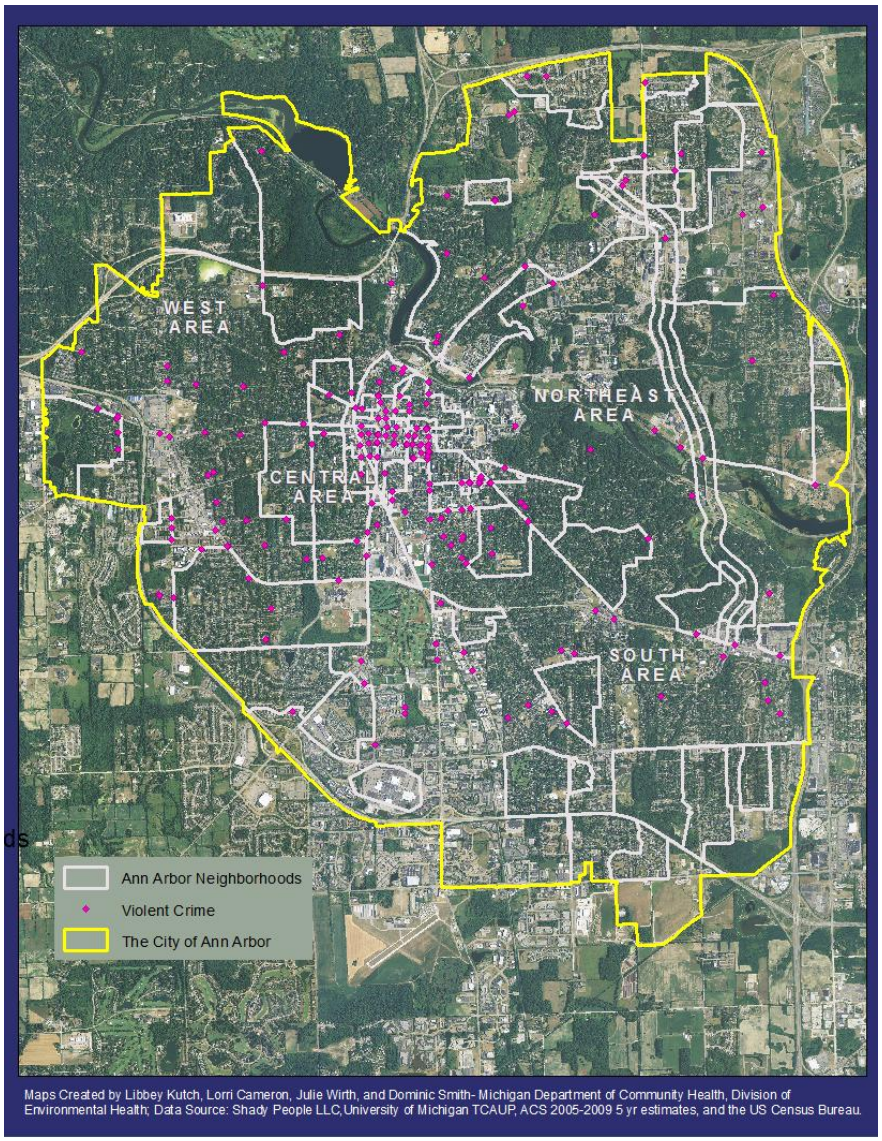
Summary of Crime Data: Michigan Incident Crime Reporting (MICR) is Michigan's incident-based reporting system in which data is collected on each single crime occurrence. The MICR system was established and certified by the FBI in 1994 and is Michigan's equivalent of the National Incident Based Reporting System (NIBRS). MICR captures a standard set of data elements as required by the FBI. In addition data elements concerning crimes passed into law

by the Michigan legislature and information concerning hate crime, domestic violence, and law enforcement officers assaulted or killed in Michigan are recorded. All law enforcement agencies are required to submit offense, arrest, and such other information relating to the method, frequency, cause, and prevention of crime at least once a month to the Michigan State Police for MICR. MICR provides detailed information on various types of crimes statewide, countywide, and citywide, as well as corresponding graphical displays.

Data from above source for 2011 defined by us as violent crimes as those including assaults, batteries, robberies, and homicides; property crimes as thefts, vehicle thefts, burglaries, and arson; and total crimes as both violent and property crimes and all other existing types of crime. For...
1. Ann Arbor the number of violent crimes was 225, property crimes 2,520 and total crimes 6,300.
2. Washtenaw County the number of violent crimes was 950, property crimes was 8,218 and total crimes 24,182.
3. Michigan the number of violent crimes was 43,983, property crimes 257,979, and total crimes 610,924.

Summary: The individuals most vulnerable for an increased risk of crime who would benefit from selected tree planting to create greater tree canopy would be in neighborhoods with low tree canopy. Crime vulnerability mapping based on the above risk factor (See map in Figure 11).The neighborhoods most vulnerable to crime are in the Central Area.

Figure 13: Locations of Violent Crimes Reported Between July 2012 and December 2012 and Selected Neighborhood locations



VIII. Physical Activity and Green Space

Literature Summary: Regular physical activity has been shown to reduce morbidity and mortality by decreasing heart disease, diabetes, high blood pressure, colon cancer, feelings of depression/anxiety, and weight, while building and maintaining healthy bones, muscles, and joints.[81] Physical activity is associated with proximity to green spaces, including trees and nature.[82] Leisure-time physical activity can be conducted in a variety of community environments, such as local parks, which are often accessible to citizens at low or no cost.[83] There is increasing evidence that use of parks has a positive relationship with individual health [83], in part because park users are frequently physically active during park visits.[84] A European-wide study determined that adults living in the highest quintile of greenery were three time more likely to report they were physically active (OR 3.32, 2.46-4.50).[85] Lachowycz and Jones[86]

conducted a systematic review of 50 cross-sectional studies examining the relationship between green space and physical activity. These studies were conducted in USA, England, Australia, the Netherlands, Canada, New Zealand, Portugal, Sweden, and Europe-wide. Twenty studies reported a positive association between green space and physical activity, including six among children/teenagers and fourteen among adults. Other studies found the quality of the green space (attractiveness, size, amount of shaded area) modified the relationship between green space and physical activity.[87,88] Finally, several studies reported that the perceived health benefits of and participation in physical activity differed by race, ethnicity, age and gender.[88,89,90] Thus, physical activity is one pathway through which urban vegetation in the form of tree canopy could positively influence a variety of health outcomes.

Types of data relevant to physical activity for the State of Michigan, Washtenaw County, and the City of Ann Arbor (See Appendix B, Tables 16 and 17)
a. Survey: Michigan: BRFSS, YRBS; Washtenaw County: HIP
b. Hospital: none

Summary of Adult Physical Activity: The BRFSS report contains the following information regarding physical activity: prevalence as a rate (percent) and 95% confidence interval of absence of leisure-time physical activity. For Michigan in year 2011 the prevalence of absence of leisure-time physical activity was 23.6% with confidence interval (22.4, 24.8). The prevalence table contains certain demographic characteristics: age, gender, race/ethnicity, as well as household income, health insurance, and activity limitations. The Washtenaw County Health Improvement Plan (HIP) survey report has information is displayed using the following categories: age, race, gender, education, household income, employment status, military service, health insurance, activity limitations, and region (Ann Arbor, Ypsilanti, Western Washtenaw, and the rest of the county). Bar charts are also displayed.

Childhood Physical Activity: The YRBS report provides prevalence as a rate (percent) and 95% confidence interval, grouped by gender as well as total, for high school students who were physically active for at least 60 minutes a day for 7 days. For Michigan in year 2011 the prevalence of physical activity was 27.0% with confidence interval (24.4, 29.7). The Washtenaw County Health Improvement Plan (HIP) survey report has the information on childhood physical activity, for years 2005 and 2010. The information can be displayed using the following categories: age, race, gender, education, household income, health insurance, activity limitations, and region (Ann Arbor, Ypsilanti, Western Washtenaw, and the rest of the county). Bar charts are also displayed.

Data from the above sources for 2010-2011 indicate that for adult's lifetime prevalence of no leisure time physical activity:

1. In Ann Arbor is 25.5%, in Washtenaw County is 35% and in Michigan is 23.6%. Therefore Ann Arbor is much lower than Washtenaw County and slightly higher than in Michigan.
2. In Washtenaw County increases with age (47.9% for 75+ age group), is higher in females (52.5%), in blacks (63.7%), in those without health insurance (64.5%), and it also increases with decreasing income (45.1% in <$35,000 group).

3. In Michigan follows pretty much the same pattern: increases with age (34.3% for 75+ age group), is higher in females (25%), and in blacks (30.1%). However it also increases in those without health insurance (35.5%). In addition in Michigan it increases with decreasing income (32.4% for <$35,000 group).

For children the lifetime prevalence of exercising at least 60 minutes 7 days a week:
1. In Ann Arbor is 44.4%.
2. In Washtenaw County is 60%.
3. In Michigan is 22.4%.

Summary: Therefore the individuals most likely to participate in no leisure time physical activity and who would benefit from selected tree planting to create greater tree canopy would be in neighborhoods that have a majority of individuals who are female, black, elderly, uninsured, or with low household income.

Appendix B: Data Tables for Health Outcome Demographic Risk Factors & Figure

Table 1: Asthma
Source: Washtenaw County Health Improvement Plan Survey (HIP)

Washtenaw HIP Survey 2010: Adult Ever Told Had Asthma		Washtenaw HIP Survey 2010: Child Ever Told Had Asthma	
Demographic Characteristics	**%**	**Demographic Characteristics**	**%**
Told had asthma	15.8	**Told had asthma**	9.9
Age		**Age**	
18-24	26	**0-5**	2.2
25-34	27.6	**6-11**	13.1
35-49	20.4	**12-17**	13.8
50-64	9		
65-74	15.1		
75+	21		
Gender		**Gender**	
Male	21.3	**Male**	13.6
Female	17.8	**Female**	6
Race/Ethnicity		**Race/Ethnicity**	
White non-Hispanic	16.6	**White non-Hispanic**	9.3
Black non-Hispanic	36.5	**Black non-Hispanic**	7.5
Asian	21%		
Household Income		**Household Income**	
<$35,000	23.3	**<$35,000**	12.2
$35,000-$74,999	14.3	**$35,000-$74,999**	6
$<75,000	24.2	**$<75,000**	11.6
Education		**Education**	
<High school	25.5	**<High school**	0
High School	12.6	**High School**	9.2
Some College	20.8	**Some College**	13.3
College Grad	20.7	**College Grad**	9.2

Table 2: Child Asthma

Source: Michigan Behavioral Risk Factor Survey (BRFS) 2010

Demographic Characteristics	Lifetime Asthma [a]		Current Asthma [b]	
	%	95% Confidence Interval	%	95% Confidence Interval
Total	**14.4**	**(12.4-16.6)**	**11.1**	**(9.3-13.1)**
Age				
0 – 4	12.0	(8.1-17.6)	10.4	(6.7-15.7)
5 – 9	15.2	(11.3-20.0)	11.6	(8.5-15.7)
10 – 14	12.1	(9.2-15.7)	9.0	(6.4-12.5)
15 – 17	19.7	(16.0-24.1)	14.3	(11.0-18.2)
Gender				
Male	16.0	(13.1-19.2)	12.2	(9.7-15.3)
Female	12.8	(10.2-15.9))	9.9	(7.7-12.7)
Race/Ethnicity				
White non-Hispanic	13.1	(11.1-15.3)	9.9	(8.1-11.9)
Black non-Hispanic	16.3	(11.0-23.5)	14.0	(9.1-21.0)
Other non-Hispanic	12.6	(5.0-28.4)	4.5	(1.5-12.8)
Hispanic	20.8	(11.9-33.7)	17.2	(9.7-28.7)
Respondent Education				
< High School	20.7	(10.5-36.7)	19.0	(9.1-35.5)
High School Grad	11.6	(8.2-16.2)	10.7	7.4-15.2
Some College	18.0	(14.0-22.7)	13.2	10.0-17.3
College Grad	12.4	(9.9-15.4)	8.7	6.6-11.5
Household Income				
< $20,000	15.2	(10.1-22.4)	14.3	(9.3-21.5)
$20,000 - $34,999	19.5	(14.0-26.8)	16.2	(11.2-22.9))
$35,000 - $49,999	16.2	(10.7-23.6)	11.8	(7.3-18.4)
$50,000 – 74,999	11.6	(7.7-17.1)	7.0	(4.6-10.6)
≥ $75,000	12.6	(9.9-15.9)	9.1	(6.8-12.1)

[a] The proportion who reported that they were ever told by a doctor, nurse, or other health care professional that they had asthma.

[b] Among all respondents, the proportion who reported that they still had asthma

Table 3: Adult Asthma

Source: Michigan BRFS 2010

Demographic Characteristics	Lifetime Asthma [a] %	Lifetime Asthma [a] 95% Confidence Interval	Current Asthma [b] %	Current Asthma [b] 95% Confidence Interval
Total	**15.8**	**(14.6-16.9)**	**10.5**	**(9.6-11.4)**
Age				
18 – 24	20.9	(16.2-26.5)	12.6	(9.0-17.4)
25 – 34	17.8	(14.1-22.1)	11.5	(8.8-14.9)
35 – 44	17.7	(15.0-20.7)	11.4	(9.3-13.9)
45 – 54	12.9	(11.2-14.9)	9.2	(7.8-10.9)
55 – 64	14.3	(12.7-16.1)	9.4	(8.1-10.9)
65 – 74	13.2	(11.4-15.1)	9.5	(8.0-11.3)
75+	12.1	(10.4-14.1)	9.0	(7.5-10.8)
Gender				
Male	13.6	(12.0-15.4)	8.2	(7.0-9.6)
Female	17.8	(16.3-19.4)	12.6	(11.3-14.0)
Race/Ethnicity				
White non-Hispanic	14.9	(13.7-16.2)	10.0	(9.0-11.0)
Black non-Hispanic	19.8	(16.2-24.0)	11.1	(8.7-14.1)
Other non-Hispanic	18.5	(13.5-24.8)	14.3	(9.9-20.3)
Hispanic	15.5	(9.1-25.3)	10.8	(5.5-20.3)
Respondent Education				
< High School	19.6	(15.1-25.1)	15.2	(11.2-20.4)
High School Grad	15.4	(13.3-17.7)	9.6	(8.0-11.4)
Some College	17.5	(15.4-19.9)	11.2	(9.6-13.1)
College Grad	13.7	(12.1-15.5)	9.6	(8.2-11.2)
Household Income				
< $20,000	21.6	(18.3-25.1)	17.0	(14.1-20.4)
$20,000 - $34,999	17.4	(14.7-20.4)	11.9	(9.7-14.4)
$35,000 - $49,999	15.4	(12.5-18.9)	10.0	(7.9-12.5)
$50,000 – 74,999	14.0	(11.3-17.2)	9.1	(6.9-12.0)
≥ $75,000	12.8	(10.9-15.0)	7.3	(6.0-8.8)

[a] The proportion who reported that they were ever told by a doctor, nurse, or other health care professional that they had asthma.

[b] Among all respondents, the proportion who reported that they still had asthma

From Michigan HCUP:

Table 4: Outcomes by Patient and Hospital Characteristics for 127 Chronic Obstructive Pulmonary Disease (COPD) and Bronchiectasis

Source: Michigan Heathcare Cost and Utilization Project (HCUP)

	Ever Told COPD, Emphysema, or Chronic Bronchitis [a]	
Demographic Characteristics	**%**	**95% Confidence Interval**
Total	**8.0**	**(7.3-8.7)**
Age		
18 – 24	2.3	(1.2-4.2)
25 – 34	3.6	(2.3-5.7)
35 – 44	5.2	(3.8-7.1)
45 – 54	9.0	(7.3-11.0)
55 – 64	11.1	(9.4-13.1)
65 – 74	14.8	(12.6-17.4)
75+	14.2	(11.8-17.0)
Gender		
Male	6.8	(5.8-7.9)
Female	9.1	(8.1-10.2)
Race/Ethnicity		
White non-Hispanic	7.9	(7.2-8.8)
Black non-Hispanic	9.9	(7.6-12.7)
Other non-Hispanic	7.1	(4.9-10.1)
Hispanic	3.7	(1.9-7.4)
Household Income		
< $20,000	13.0	(11.0-15.2)
$20,000 - $34,999	10.2	(8.7-12.0)
$35,000 - $49,999	7.2	(5.6-9.2)
$50,000 – 74,999	6.1	(4.5-8.2)
≥ $75,000	32	(2.2-4.5)
Health Insurance		
Insured	8.2	(7.5-9.1)
Uninsured	6.8	(5.2-9.0)
Disability		
Disabled	17.7	(15.9-19.7)
Not Disables	4.2	(3.6-4.9)

[a] Among all adults, the proportion who reported ever being told by a doctor that they had chronic obstructive pulmonary disease (COPD), emphysema or chronic bronchitis.

Data for Outcomes by Patient and Hospital Characteristics for 127 Chronic Obstructive Pulmonary Disease (COPD) and Bronchiectasis Continued...

Demographics	Number of discharges	In-hospital deaths
Total discharges	26,016 (100.00%)	300 (1.15%)
Age group		
<1	*	*
1-17	36 (0.14%)	*
18-44	734 (2.82%)	*
45-64	9,077 (34.89%)	51 (0.56%)
65-84	13,620 (52.35%)	202 (1.48%)
85+	2,543 (9.77%)	45 (1.77%)
Missing	*	*
Sex		
Male	11,464 (44.07%)	156 (1.36%)
Female	14,552 (55.93%)	144 (0.99%)
Race/ethnicity		
White	18,159 (69.80%)	220 (1.21%)
Black	3,465 (13.32%)	31 (0.89%)
Hispanic	67 (0.26%)	*
Asian/Pacific Islander	30 (0.12%)	*
Native American	35 (0.13%)	*
Other	170 (0.65%)	*
Missing	4,090 (15.72%)	46 (1.12%)

Table 5: Diabetes

Source: Washtenaw HIP Survey

****Survey Question on Washtenaw County HIP Survey 2010: Have you ever been told by a doctor that you have diabetes?***

Ever Told Were Diabetic* Demographic Characteristics	%
Diabetic	4.20
Age	
18-24	12.2
25-34	0
35-49	4.9
50-64	6.7
65-74	8.7
75+	10.7
Gender	
Male	5.4
Female	3
Race/Ethnicity	
White non-Hispanic	3.8
Black non-Hispanic	7.3
Asian	1.7
Household Income	
<$35,00	5.5
$35,000-$74,999	6.4
>$75,000	2.7
Education	
<High school	3.7
High School	8.3
Some College	1.9
College Grad	4

Table 6: Diabetes

Source: Michigan BRFS 2010

Demographic Characteristics	Ever Told Diabetes [a] %	95% Confidence Interval
Total	**10.1**	**(9.4-10.9)**
Age		
18 - 24	0.7	(0.2-2.2)
25 - 34	3.9	(2.0-7.6)
35 - 44	5.8	(4.2-7.9)
45 - 54	9.8	(8.3-11.6)
55 - 64	16.6	(14.8-18.5)
65 - 74	21.5	(19.3-23.8)
75 +	20.8	(18.5-23.4)
Gender		
Male	11.4	(10.1-12.7)
Female	9.0	(8.1-9.9)
Race/Ethnicity		
White non-Hispanic	9.2	(8.4-10.0)
Black non-Hispanic	15.9	(13.3-19.0)
Other non-Hispanic	11.3	(7.8-16.0)
Hispanic	9.2	(5.5-15.2)
Education		
< High school	11.2	(8.8-14.3)
High school grad	13.0	(11.5-14.6)
Some college	10.8	(9.3-12.5)
College grad	6.8	(5.9-7.9)
Household Income		
< $20,000	15.3	(12.9-17.9)
$20,000 - $34,999	12.9	(11.1-15.0)
$35,000 - $49,999	10.8	(9.1-12.8)
$50,000 - $74,999	8.5	(6.9-10.4)
≥ $75,000	6.2	(4.8-7.9)

[a] The proportion who reported that they were ever told by a doctor that they have diabetes. Adults who had been told they have prediabetes and women who had diabetes only during pregnancy were classified as not having been diagnosed.

Table 7: Hypertension

Survey Question on Washtenaw County HIP Survey 2010: Have you ever been told by a health professional that you have high blood pressure?

Demographic Characteristics	%
Ever told	21.0
Age	
18-24	4.4
25-34	8.7
35-49	14.2
50-64	31.2
65-74	53.8
75+	77.7
Male	19.9
Female	22.0
Race/Ethnicity	
White non-Hispanic	20.2
Black non-Hispanic	35.9
Asian	7.1
Household Income	
<$35,00	32.9
$35,000-$74,999	20.4
>$75,000	13.9
Education	
<High school	42.7
High School	27.4
Some College	13.1
College Grad	22.3

Table 8: Lifetime Prevalence of High Blood Pressure

Source: Michigan BRFS 2011

	Ever Told HBP[a]	
Demographic Characteristics	**%**	**95% Confidence Interval**
Total	**34.2**	**(32.9-35.4)**
Age		
18 - 24	7.1	(5.0-10.2)
25 - 34	15.9	(13.2-19.1)
35 - 44	21.6	(18.7-24.8)
45 - 54	36.3	(33.4-39.3)
55 - 64	50.3	(47.5-53.0)
65 - 74	61.7	(58.5-64.8)
75 +	67.7	(64.3-71.0)
Gender		
Male	35.8	(33.9-37.8)
Female	32.6	(31.0-34.3)
Race/Ethnicity		
White non-Hispanic	33.9	(32.6-35.4)
Black non-Hispanic	41.0	(37.0-45.1)
Other non-Hispanic	24.4	(19.5-30.1)
Hispanic	26.4	(19.7-34.3)
Household Income		
< $20,000	40.9	(37.5-44.3)
$20,000 - $34,999	38.5	(35.7-41.4)
$35,000 - $49,999	34.6	(31.4-38.0)
$50,000 - $74,999	33.7	(30.4-37.1)
≥ $75,000	26.1	(23.7-28.7)
Health Insurance		
Insured	35.6	(34.2-37.0)
Uninsured	26.4	(23.2-29.9)
Disability		
Disabled	51.5	(48.9-54.1)
Not disabled	27.4	(26.0-28.9)

[a] Among all adults, the proportion who reported that they were ever told by a doctor that they had high blood pressure (HBP). Women who had HBP only during pregnancy and adults who were borderline hypertensive were considered to not have been diagnosed.

Figure 1: Ever Told High Blood Pressure by Local Health Department Region
Source: 2007-2009 Michigan BRFS

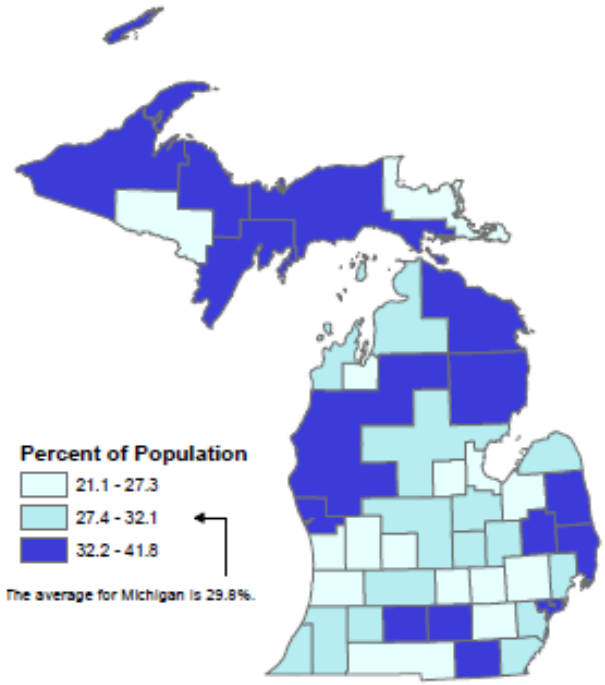


Table 9: Mental Health Problems
Source: Washtenaw HIP Survey

****Survey Question on Washtenaw County HIP Survey 2010: Are you currently being seen by a doctor, psychiatrist, or social worker for any mental health related problems?***

Demographic Characteristics	%
Seeing Someone	13.5%
Age	
18-24	12.9
25-34	16.4
35-49	10.1
50-64	20.1
65-74	10.3
75+	2.1
Male	11.2
Female	15.8
Race/Ethnicity	
White non-Hispanic	16.4
Black non-Hispanic	4.2
Asian	0
Household Income	
<$35,00	19.3
$35,000-$74,999	4.4
>$75,000	16.2
Education	
<High school	16
High School	3.1
Some College	17.6
College Grad	14.6

Table 10: Lifetime Prevalence of Depression

Source: Michigan BRFS 2011

	Ever Told Depression[a]	
Demographic Characteristics	**%**	**95% Confidence Interval**
Total	**20.6**	**(19.5-21.8)**
Age		
18 - 24	19.4	(15.6-24.0)
25 - 34	21.2	(18.0-24.8)
35 - 44	22.4	(19.4-25.7)
45 - 54	23.7	(21.1-26.4)
55 - 64	22.9	(20.7-25.3)
65 - 74	16.4	(14.2-18.8)
75 +	11.4	(9.1-14.1)
Gender		
Male	15.4	(13.8-17.0)
Female	25.6	(24.0-27.3)
Race/Ethnicity		
White non-Hispanic	21.5	(20.2-22.8)
Black non-Hispanic	14.9	(12.2-18.0)
Other non-Hispanic	20.9	(15.4-27.7)
Hispanic	23.0	(16.2-31.5)
Household Income		
< $20,000	30.1	(27.0-33.4)
$20,000 - $34,999	23.1	(20.5-26.0)
$35,000 - $49,999	19.1	(16.5-22.1)
$50,000 - $74,999	16.3	(13.7-19.2)
≥ $75,000	15.1	(13.1-17.4)
Health Insurance		
Insured	20.5	(19.3-21.8)
Uninsured	22.1	(19.0-25.6)

Table 11: Obesity

Source: Washtenaw HIP Survey

****Survey Question on Washtenaw County HIP Survey 2010: BMI Calculated from self-report height and weight.***

Weight Status: Obese (BMI ≥30)

Demographic Characteristics	%
Obese	17.6
Age	
18-24	6.4
25-34	35.3
35-49	32.4
50-64	29.8
65-74	33.7
75+	20.5
Gender	
Male	27.7
Female	23.8
Race/Ethnicity	
White non-Hispanic	27
Black non-Hispanic	28
Asian	9
Household Income	
<$35,00	26
$35,000-$74,999	30.6
>$75,000	26.3
Education	
<High school	15.8
High School	31.7
Some College	26.6
College Grad	24.2

Table 12: Lifetime Prevalence of Adult Obesity

Source: Michigan 2011 BRFS

	Obese[a]	
Demographic Characteristics	**%**	**95% Confidence Interval**
Total	**31.3**	**(30.0-32.6)**
Age		
18 - 24	17.3	(13.8-21.5)
25 - 34	31.3	(27.6-35.2)
35 - 44	33.3	(29.9-37.0)
45 - 54	34.7	(31.8-37.7)
55 - 64	38.0	(35.3-40.7)
65 - 74	34.0	(31.0-37.2)
75 +	24.2	(21.0-27.8)
Gender		
Male	31.9	(29.9-33.9)
Female	30.7	(28.9-32.4)
Race/Ethnicity		
White non-Hispanic	29.7	(28.3-31.2)
Black non-Hispanic	41.0	(36.9-45.2)
Other non-Hispanic	24.8	(19.2-31.4)
Hispanic	36.7	(28.7-45.4)
Household Income		
< $20,000	36.6	(33.3-40.1)
$20,000 - $34,999	32.4	(29.5-35.3)
$35,000 - $49,999	28.6	(25.4-32.0)
$50,000 - $74,999	32.6	(29.2-36.2)
≥ $75,000	28.2	(25.6-31.0)
Health Insurance		
Insured	30.6	(29.3-32.1)
Uninsured	34.8	(31.1-38.8)
Disability		
Disabled	42.3	(39.7-45.0)
Not disabled	27.1	(25.6-28.7)

Note: BMI, body mass index, is defined as weight (in kilograms) divided by height (in meters) squared [weight in kg/(height in meters)^2]. Weight and height were self-reported. Pregnant women were excluded.

[a] Among all adults, the proportion of respondents whose BMI was greater than or equal to 30.0

Table 13: Crime (Total Index Offenses Statewide)
Source: Michigan Incident Crime Reporting (MICR)

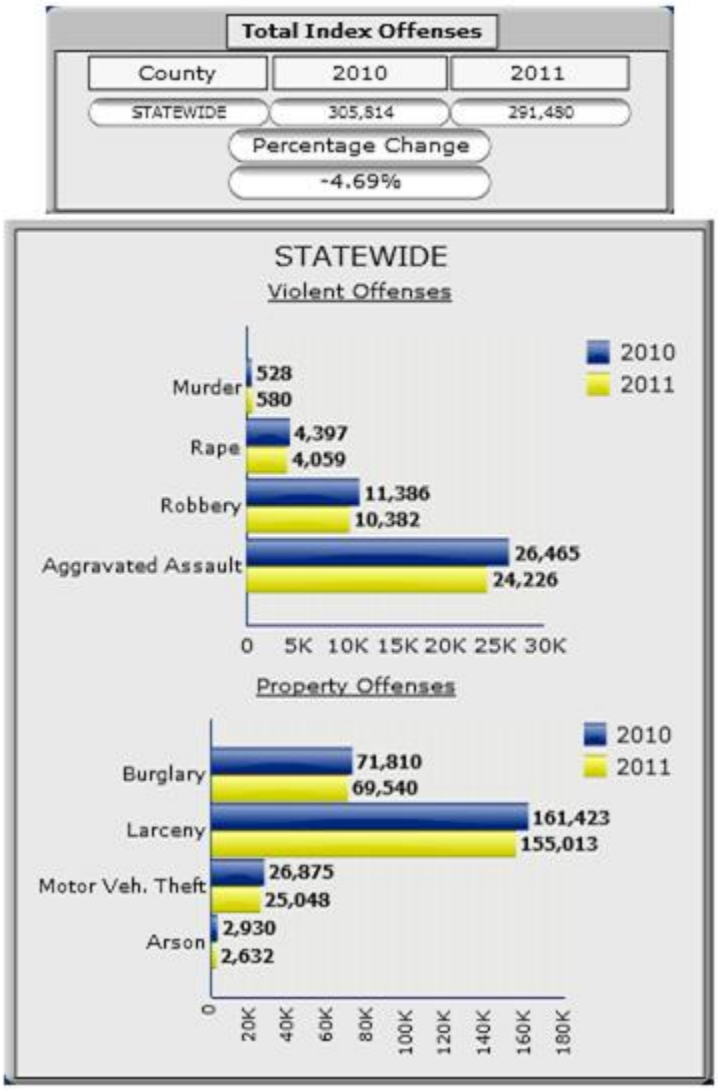


Table 14: Crime (Total Index Offenses Washtenaw County)

Source: Michigan Incident Crime Reporting (MICR)

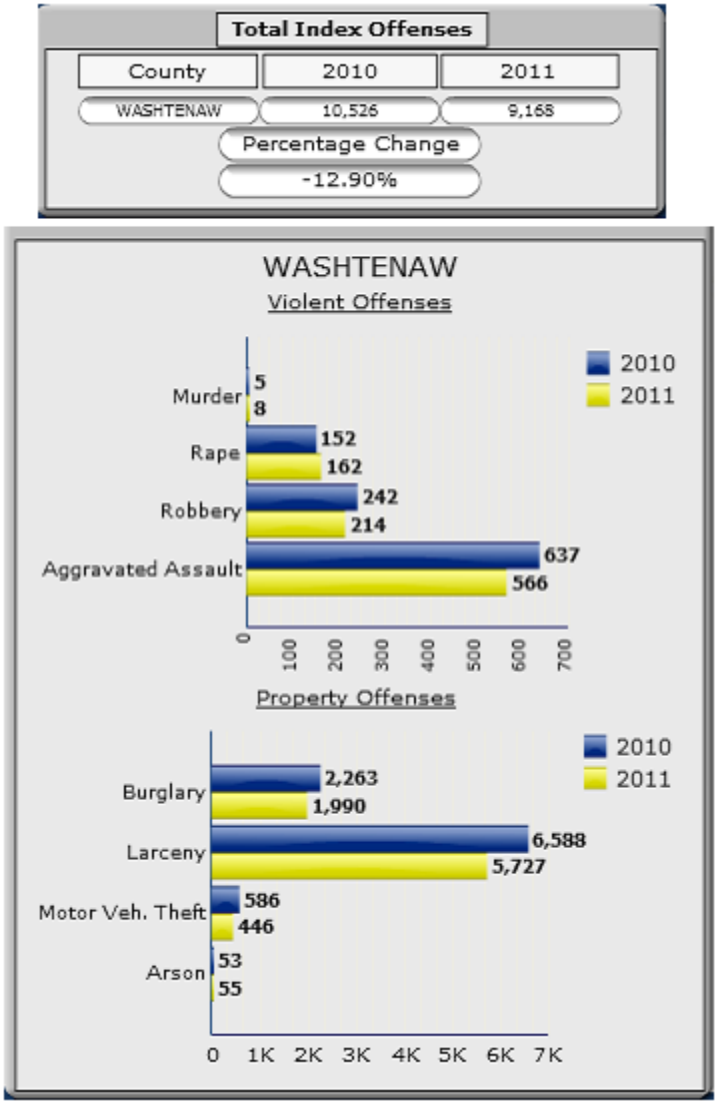
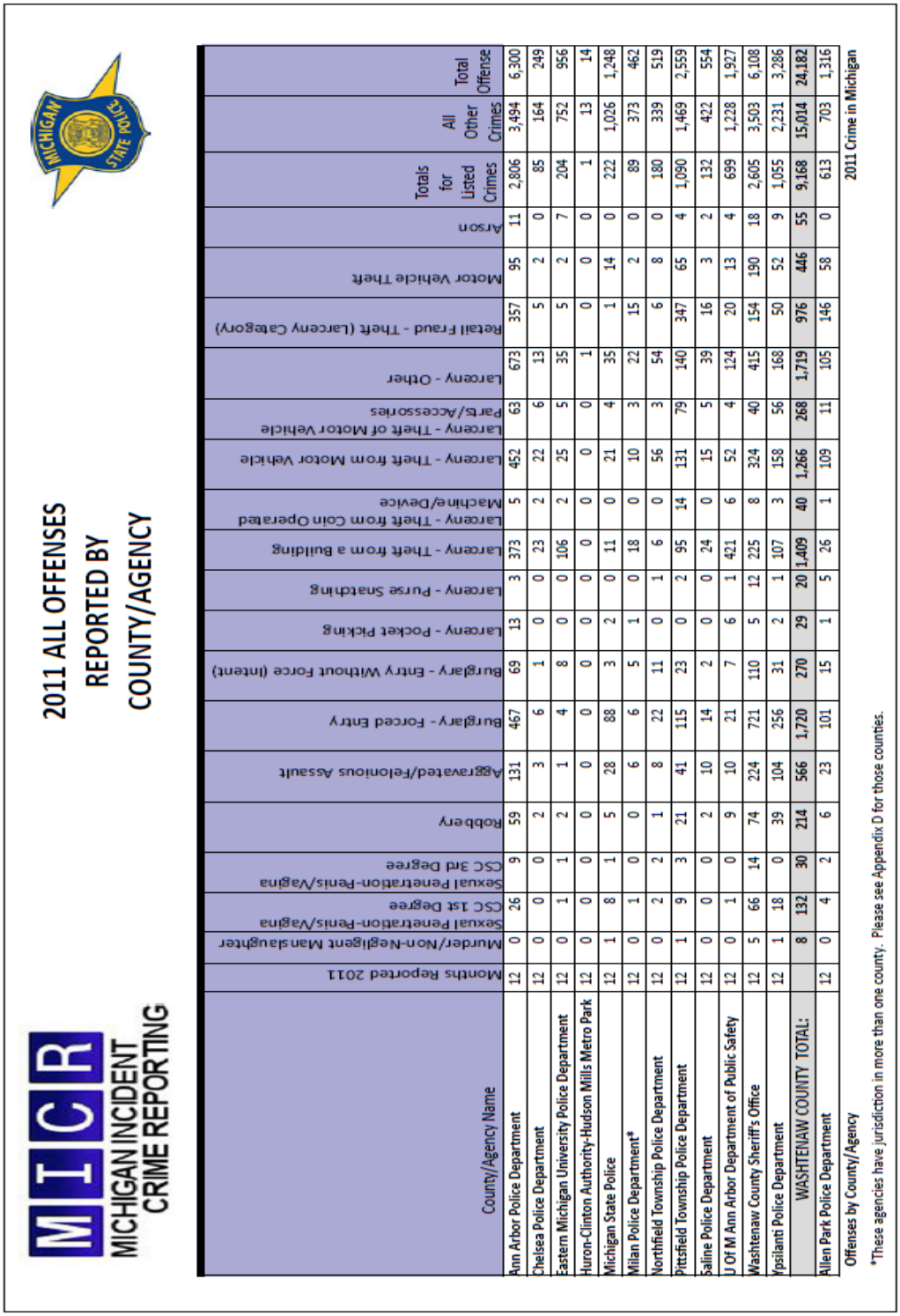


Table 15: Crime (All Offenses Report by County/Agency)

Source: Michigan Incident Crime Reporting (MICR)



MICR
MICHIGAN INCIDENT CRIME REPORTING

2011 ALL OFFENSES REPORTED BY COUNTY/AGENCY

County/Agency Name	Months Reported 2011	Murder/Non-Negligent Manslaughter	Sexual Penetration-Penis/Vagina CSC 1st Degree	Sexual Penetration-Penis/Vagina CSC 3rd Degree	Robbery	Aggravated/Felonious Assault	Burglary - Forced Entry	Burglary - Entry Without Force (Intent)	Larceny - Pocket Picking	Larceny - Purse Snatching	Larceny - Theft from a Building	Larceny - Theft from Coin Operated Machine/Device	Larceny - Theft from Motor Vehicle	Larceny - Theft of Motor Vehicle Parts/Accessories	Larceny - Other	Retail Fraud - Theft (Larceny Category)	Motor Vehicle Theft	Arson	Totals for Listed Crimes	All Other Crimes	Total Offense
Ann Arbor Police Department	12	0	26	9	59	131	467	69	13	3	373	5	452	63	673	357	95	11	2,806	3,494	6,300
Chelsea Police Department	12	0	0	0	2	3	6	1	0	0	23	2	22	6	13	5	2	0	85	164	249
Eastern Michigan University Police Department	12	0	1	1	2	1	4	8	0	0	106	2	25	5	35	5	2	7	204	752	956
Huron-Clinton Authority-Hudson Mills Metro Park	12	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	13	14
Michigan State Police	12	1	8	1	5	28	88	3	2	0	11	0	21	4	35	1	14	0	222	1,026	1,248
Milan Police Department*	12	0	1	0	0	6	6	5	1	0	18	0	10	3	22	15	2	0	89	373	462
Northfield Township Police Department	12	0	2	2	1	8	22	11	0	1	6	0	56	3	54	6	8	0	180	339	519
Pittsfield Township Police Department	12	1	9	3	21	41	115	23	0	2	95	14	131	79	140	347	65	4	1,090	1,469	2,559
Saline Police Department	12	0	0	0	2	10	14	2	0	0	24	0	15	5	39	16	3	2	132	422	554
U Of M Ann Arbor Department of Public Safety	12	0	1	0	9	10	21	7	6	1	421	6	52	4	124	20	13	4	699	1,228	1,927
Washtenaw County Sheriff's Office	12	5	66	14	74	224	721	110	5	12	225	8	324	40	415	154	190	18	2,605	3,503	6,108
Ypsilanti Police Department	12	1	18	0	39	104	256	31	2	1	107	3	158	56	168	50	52	9	1,055	2,231	3,286
WASHTENAW COUNTY TOTAL:		8	132	30	214	566	1,720	270	29	20	1,409	40	1,266	268	1,719	976	446	55	9,168	15,014	24,182
Allen Park Police Department	12	0	4	2	6	23	101	15	1	5	26	1	109	11	105	146	58	0	613	703	1,316

Offenses by County/Agency

*These agencies have jurisdiction in more than one county. Please see Appendix D for those counties.

2011 Crime in Michigan

Table 16: Lifetime Prevalence of No Leisure-time Physical Activity for Michigan
Source: 2010 BRFSS

Demographic Characteristics	No Leisure-Time Physical Activity[a] %	95% Confidence Interval
Total	**23.6**	**(22.4-24.8)**
Age		
18 - 24	15.8	(12.4-19.9)
25 - 34	16.9	(14.1-20.0)
35 - 44	21.4	(18.5-24.7)
45 - 54	27.0	(24.2-29.9)
55 - 64	25.5	(23.1-28.1)
65 - 74	28.6	(25.6-31.7)
75 +	34.4	(30.8-38.1)
Gender		
Male	22.1	(20.3-23.9)
Female	25.0	(23.4-26.6)
Race/Ethnicity		
White non-Hispanic	22.2	(20.9-23.5)
Black non-Hispanic	30.1	(26.3-34.2)
Other non-Hispanic	24.5	(18.5-31.6)
Hispanic	28.9	(21.6-37.5)
Household Income		
< $20,000	32.4	(29.2-35.9)
$20,000 - $34,999	29.0	(26.3-31.9)
$35,000 - $49,999	19.5	(16.9-22.5)
$50,000 - $74,999	18.6	(16.0-21.5)
≥ $75,000	15.8	(13.7-18.2)
Health Insurance		
Insured	22.9	(21.7-24.2)
Uninsured	27.2	(23.9-30.9)
Disability		
Disabled	34.5	(32.1-36.9)
Not disabled	19.5	(18.1-20.8)

[a] Among all adults, the proportion who reported not participating in any leisure-time physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise during the past month.

Table 17:
Source: Washtenaw County HIP Survey

****Survey Questions on Washtenaw County HIP Survey 2010: During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?***

Demographic Characteristics	%
Some activity	24.70%
Age	
18-24	21.4
25-34	21.3
35-49	29.8
50-64	22.2
65-74	27.8
75+	42
Male	23.9
Female	25.5
Race/Ethnicity	
White non-Hispanic	23.5
Black non-Hispanic	28.1
Asian	23.4
Household Income	
<$35,00	40.3
$35,000-$74,999	20.4
>$75,000	13.2
Education	
<High school	65.2
High School	30.2
Some College	26.2
College Grad	16.3

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