City of Madison Transportation & Health Tool Indicators At the Planning Level

Submitted By:
Kirsten Brose, Daniel Handel, James Markosian,
Eli Miller, and Chelsea Morrison

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Executive Summary

In November of 2015, The U.S. Department of Transportation (DOT), in conjunction with the Center for Disease Control and Prevention (CDC), launched the Transportation and Health Tool (THT). The THT reveals how states and communities are performing relative to one another on a range of health-related transportation system indicators. There are 14 indicators included within the THT: alcohol-impaired fatalities, commute mode share, complete streets policy, housing and transportation affordability, land use mix, person-miles traveled by mode, physical activity from transportation, proximity to major roadways, public transit trips per capita, road traffic fatalities by mode, road traffic fatalities exposure rate, seat belt use, use of federal funding for bike and pedestrian facilities, and vehicle miles traveled per capita.

Since its release in 2015, the THT has provided states with information that can be used to identify disparities in their transportation systems that affect public health. However, the scale of the data presented in the THT is not useful for cities; cities require data at the neighborhood or district level. With this in mind, the following report outlines and details a method to scale the THT for a smaller region, enabling its use at a city level. Utilizing planning districts as the unit of analysis, this report focuses specifically on the transportation system in Madison, Wisconsin.

Data at the planning district level was obtained for ten of the indicators listed above. Due to time constraints and issues of data availability, four indicators from the list above were not included in this version of the THT. The omitted indicators include: person-miles traveled by mode, road traffic fatalities exposure rate, physical activity from transportation, and land-use mix. The final ten indicators were grouped into four categories that describe the transportation system’s impacts on public health: active living, safety, access to services, and indirect impacts.

Using geographic information systems (GIS) and the analytical hierarchy process (AHP), indicator data was sorted and weighted at the planning district level. The results reveal which planning districts are performing well and which are underperforming in each of the four categories. City officials can use these results to determine where efforts and funds need to be directed to improve the city's transportation system. Improvements to the transportation system in the four categories listed above, along with the indicators comprising those categories, could be an effective way to improve public health within the City of Madison.

Introduction

In November of 2015, the U.S. Department of Transportation (DOT), in conjunction with the Center for Disease Control and Prevention (CDC), launched the Transportation and Health Tool (THT). The THT reveals how states and communities are performing relative to one another on a range of transportation and health related indicators. There are 14 indicators included within the tool: alcohol-impaired fatalities, commute mode share, complete streets policy, housing and transportation affordability, land use mix, person-miles traveled by mode, physical activity from transportation, proximity to major roadways, public transit trips per capita, road traffic fatalities by mode, road traffic fatalities exposure rate, seat belt use, use of federal funding for bike and pedestrian facilities, and vehicle miles traveled per capita. These 14 indicators were selected from an original set of 190 potential candidates. An initial selection process narrowed the indicators from 190 down to 45 on the basis of physical activity, safety, air quality and access to goods and services. A panel of 48 participants selected the final 14 indicators through a two-day workshop.

The novel aspect of the tool lies in how indicator data from different localities are compiled into a single access point. This allows states and other localities to quickly view how they rank in transportation-driven health issues. Users have the ability to view data at the state, urbanized area, or metropolitan statistical area level as shown in Figure 1Figure 1.

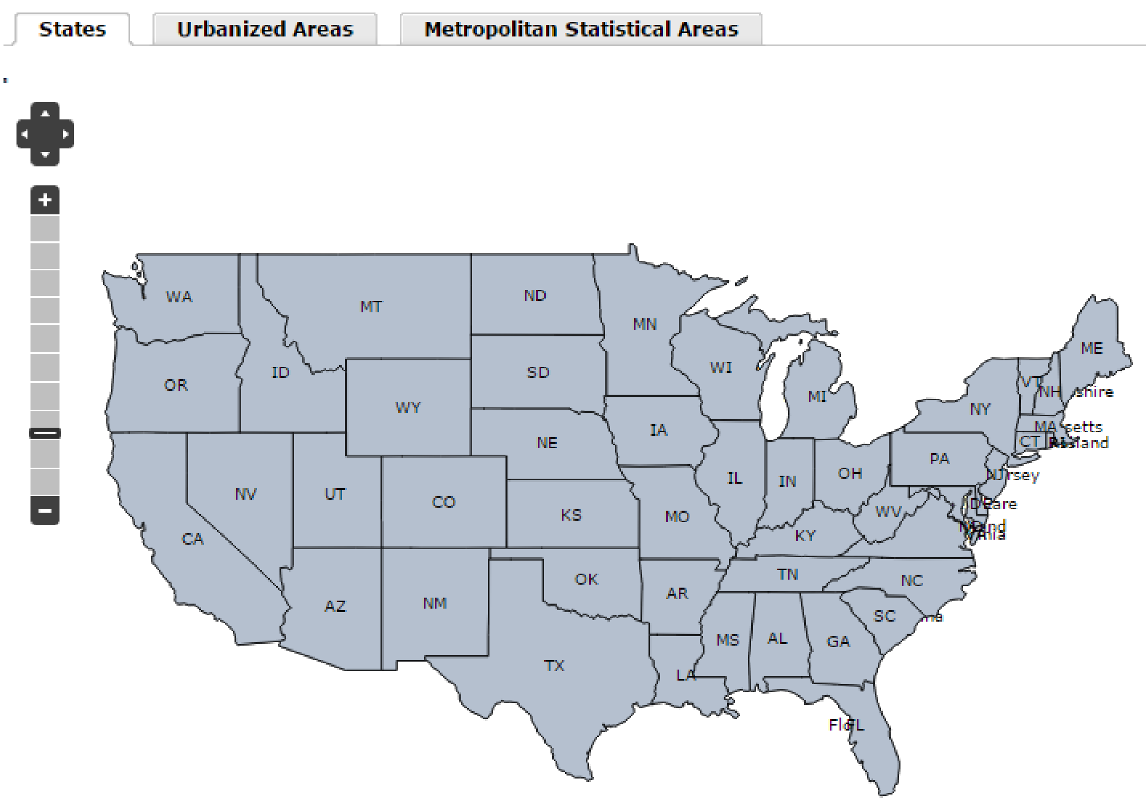

Figure 1: THT State Selection Screen

Upon selecting a location, the tool displays the associated indicator data. For each indicator, a raw score (Figure 2, "raw value") is presented along with a relative score (Figure 2, "score") that provides a comparison to other locations at the same scale. Some indicators are broken down into sub-indicators. For example, commute mode share is broken down into commute mode share by automobiles, transit, bikes, and walking. The bar graph distribution shown in Figure 2 shows the four commute mode share sub-indicators for Wisconsin. The state's auto mode share is 89.6 percent, ranking Wisconsin in the 39th percentile and the transit mode share is 1.8 percent, ranking in the 42nd percentile.

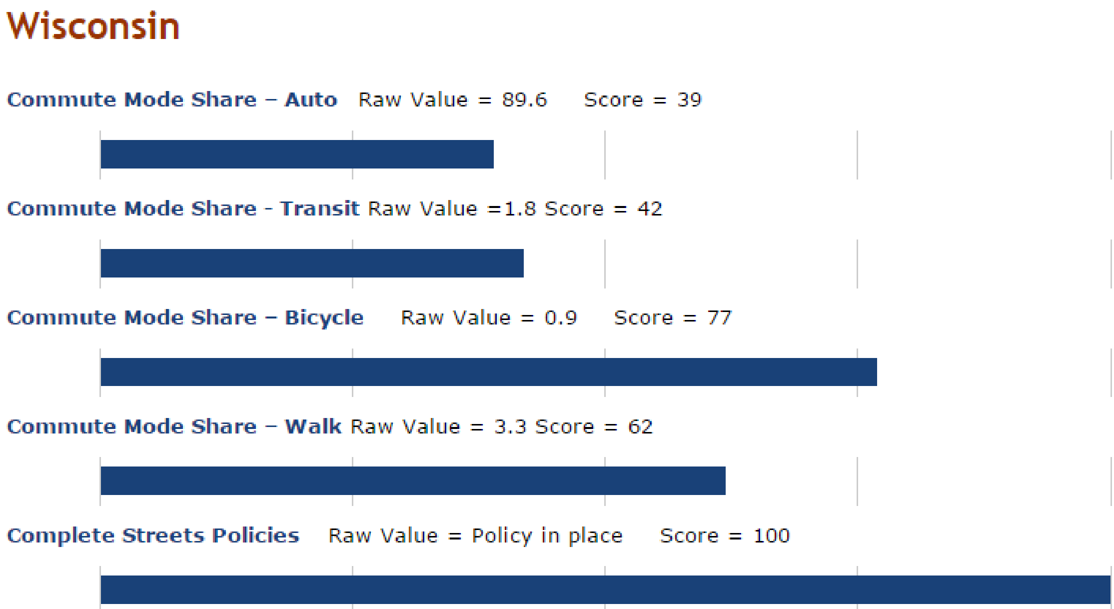

Figure 2: Wisconsin Breakdown of Indicator Data

The THT data set is useful when comparing large-scale areas such as states. However, this data is not particularly useful for cities, where policy makers require data at smaller scales. The City of Madison is divided into 62 planning districts for such decision-making purposes. At the request of the City of Madison, data for this project was collected at the planning district level (Figure 3).

Figure 3

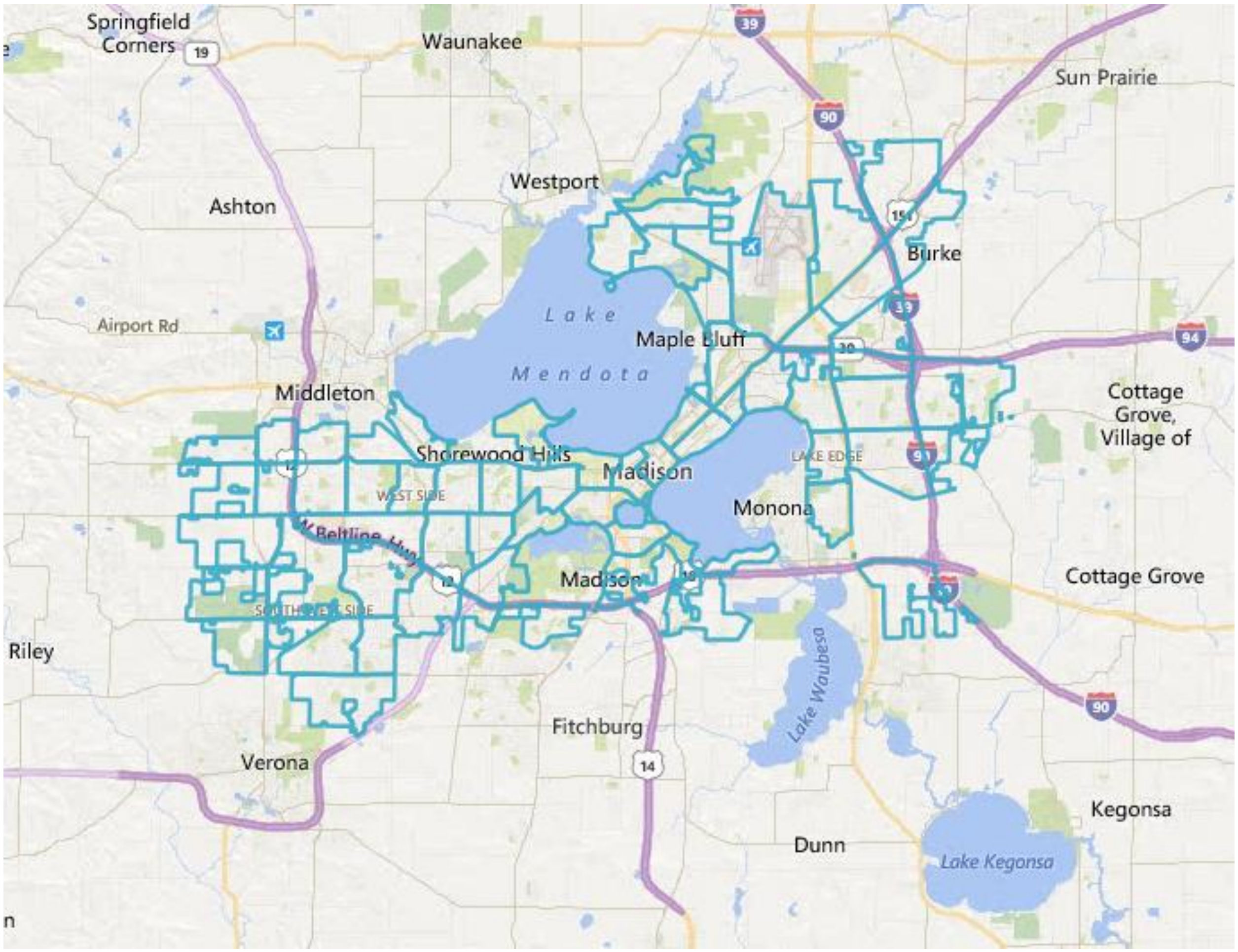

Figure 3: Madison Neighborhood Indicator Planning Districts

Problem Statement

The information contained within the THT allows users to compare their state performance against others. The broad geographic scale of the data is not useful for policy makers in the City of Madison. Rather, planning district level data is needed. The objective of this project is to display data at the planning district level for the 14 indicators used within the THT. However, due to time constraints and data availability, some variables were modified and/or omitted.

Indicator Selection

When developing the THT, the U.S. DOT and CDC gave careful consideration to which indicators would best represent the connections between transportation and health. Accordingly, we chose to use the 14 indicators already contained within the THT. However, not all THT indicators were applicable to this project at the planning district level due to availability and/or data scaling concerns.

Assumptions

We assumed that all data utilized is as accurate as possible. Additionally, time constraints did not allow for data to be collected for several of the 14 THT indicators at a more granular level. The limitations encountered in each indicator are further discussed below.

14 Indicators

The fourteen indicators were used as the starting point for the data collection process. These indicators were then grouped into four categories that were later used in the scoring process. The first category is active living. Active living is directly tied to the health of the community because an active lifestyle is healthier than a sedentary one. The second category was safety. This category included indicators related to traffic fatalities and prevention methods. A lower fatality rate is linked to a healthier community because fewer people are injured. The third category is access to services. Data indicates that communities with better access to services show better health due to the enhanced connectivity of the community. The final category was indirect impacts. This category reflects the health impacts of emissions and noise pollution from living near high-volume roadways. The indicators included in each category are summarized in Figure 4.

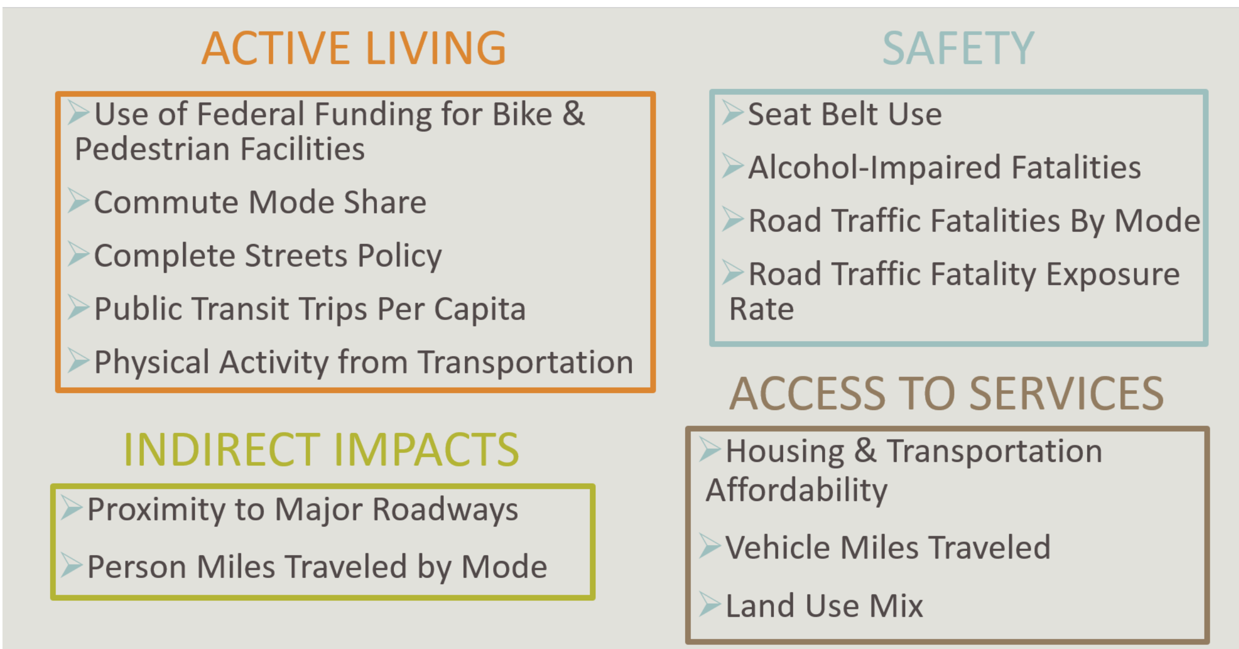

Figure 4: Four categorical breakdowns of the 14 indicators

Active Living

Use of Federal Funding for Bike and Pedestrian Efforts

THT Definition

This indicator, as defined by the THT, measures the percentage of federal transportation dollars that are invested in bike and pedestrian infrastructure projects. The problem encountered with this indicator is that different states report spending in different ways. Some states count funds that are exclusively dedicated to bike and pedestrian projects, such as trails, walkways, or street-widening for bike lanes. Other states report any project that includes bike and pedestrian enhancements, such as road reconstruction that includes widening for a bike lane.

Madison Planning District Definition

This indicator is defined as the proportion of City of Madison budget devoted to transportation projects involving bike and pedestrian improvements. Data was collected by analyzing the City's 2009-2013 Capital Improvements Budgets for all engineering projects then determining what percentage of each budget was devoted to bicycle or pedestrian efforts. This required some engineering judgement when determining the final percentages.

Why Indicator is Included

Greater accessibility to bike and pedestrian friendly travel networks promotes a more active lifestyle. It is important to create a safe and convenient system for all transportation users, not just automobile users. Allocation of funding also indicates the value placed on different user groups by the municipality. Higher levels of funding for bicycle and pedestrian facilities are indicative of a community that values not only automotive user groups, but all user groups when improving facilities. High performance in this indicator fosters a more inclusive and livable community.

Commute Mode Share

THT Definition

The THT defines commute mode share as the percentage of workers age 16 or greater who commute using one of four methods: private vehicle, public transportation, bicycle, or walking.

Madison Planning District Definition

Commute mode share will be assessed as either auto or non-auto trips, where non-auto trips will include transit, bicycle, or walking. The indicator will be displayed as the percentage of non-automobile trips across each planning district.

The U.S. Census Bureau's American Community Survey (ACS) contains information regarding the percentage of individuals who commute to work via automobile, transit, bicycle, or walking. (2) This information will be used to determine percent trips non-auto. The data will be displayed across the 62 planning districts to reveal commute mode share performance throughout the City of Madison.

Why Indicator is Included

Commute mode share is linked to how land use patterns allow individuals to travel to work. The data also reflects how close individuals live to their workplace. Mode share is also related to health. If vehicle share is high, vehicle emissions will be high. On the contrary, if vehicle share is low, more workers are engaging in physical activity by walking or biking to their workplace. Commuting via private vehicle has also been shown to increase levels of stress, adversely impacting the health of these commuters.

Complete Streets Policy

THT Definition

This indicator, as defined by the THT, reveals whether or not a given state or metropolitan area has adopted a complete streets policy.

Madison Planning District Definition
The same analysis will be implemented on the city level, concluding that the City of Madison has either implemented a complete streets policy or not.

Why Indicator is Included
A complete streets policy according to Smart Growth America and the National Complete Streets Coalition covers ten identified elements. (3) These elements include an overall vision of how the complete street design should look, specifying how all user types will be accommodated. The program is applied to both new projects and existing projects. For existing projects, the program directs the retrofitting of existing street connectivity and the implementation of new street connectivity throughout the network. A complete streets policy promotes a healthy lifestyle by creating a link between all transportation modes.

Public Transit Trips per Capita

THT Definition
The THT defines this indicator as the average number of public transit trips that residents take per year.

Madison Planning District Definition
The Housing and Transportation Affordability Initiative included modeled household annual transit trips. This data will be used in the place of public transit trips per capita.

Why Indicator is Included
The benefits of public transportation include reduced air pollution, improved safety, and higher physical activity levels. All of these benefits lead to improved health. Public transportation generates less pollution than single vehicle transportation due to carpooling. Transit also offers safer travel for its users. Public transportation has the lowest fatality rate compared with other modes of transportation. Lastly, cities with more robust public transportation systems also tend to be more walkable, leaving visitors and residents less dependent on vehicular travel. (4)

Physical Activity from Transportation

THT Definition
The THT defines physical activity from transportation as the percentage of all trips made by foot or bike that are at least ten minutes in duration.

Madison Planning District Definition
The City of Madison Active Living Index contains information regarding physical activity from transportation. This data was not attainable within the timeframe of the project therefore this indicator was omitted from our analysis.

Why Indicator is Included
This indicator supports positive health outcomes; sustained walking and biking are forms of physical activity. Physical activity is important in preventing both of the nation's number one and five top causes of death: heart disease and stroke. The American Heart Association recommends that adults receive at least 150 minutes of moderate exercise or 75 minutes of vigorous exercise per week. Accordingly, the average adult should aim for 30 minutes of sustained moderate physical activity at least 5 times a week.

It is important to remember that even some activity is better than none so any bit of physical activity achieved through transportation is a health benefit. (5)

Safety

Seat Belt Use

THT Definition

Seat belt use, as defined by the THT, is the percentage of drivers and front-seat passengers that wear their seat belts.

Madison Planning District Definition

The Wisconsin Department of Transportation conducts annual statewide observations surveys of seat belt use. In July of 2015, 85.8 percent of passenger vehicle occupants were using safety belts. (7) Although data for total seat belt compliance throughout the city is not available, this indicator will be supplemented with seat belt use from crash data. The crash reports include if the driver involved in a crash was properly restrained with safety belts. Because the use of a proper restraint is independent of the likelihood of being involved in a crash, this information is a sufficient substitute.

Why Indicator is Included

Wearing a seat belt reduces the risk of fatality when involved in a collision. Seat belt laws include both primary and secondary regulations. Primary regulations give officers the ability to ticket based exclusively on violating seat belt use laws. Secondary regulations do not permit citations based solely on seat belt violations. However, a driver who has been stopped for an alternative reason may be cited for not wearing a seatbelt.

Vehicle crashes are consistently a leading cause of death in the United States. Safety efforts have been directed towards reducing the potential for injury and death. Seat belt use has been shown to be the most effective method of achieving this goal.

Alcohol-Impaired Fatalities

THT Definition

The THT measures alcohol-impaired fatalities as the rate of fatal traffic incidents in which the driver was impaired by alcohol. Alcohol impairment is defined as having a blood alcohol concentration of 0.08 g/dL or greater.

Madison Planning Districts Definition

The number of alcohol-impaired fatalities will be assessed from 2009-2013 across the City of Madison. The University of Wisconsin-Madison Traffic Operations and Safety (TOPS) Laboratory houses a crash database that was used to determine alcohol-impaired fatalities throughout the City of Madison. Analysis of the data revealed the occurrence of only 27 total alcohol-impaired fatalities over the five-year timeframe. Because there are over twice as many planning districts as fatalities, it was not sensible to display data for this indicator at the planning district level. Therefore, this indicator will only be displayed at the city level.

Why Indicator is Included
This indicator is included because of the distinct correlation between alcohol impairment while driving and the negative health consequences that accompany an incident. According to the CDC, someone in the United States dies every 53 minutes in an alcohol related crash, costing more than 44 billion dollars annually. In 2014, 9,967 people were killed in alcohol related crashes accounting for 31 percent of all traffic-related deaths in the United States. (1) Alcohol impairs the driver's sense of vision, decision making capabilities, and reaction time putting them at great risk of harming themselves and other roadway travelers.

According to the Wisconsin Department of Transportation, alcohol related crashes cost the State of Wisconsin over 450 million dollars in 2012. This value was calculated using the 2011 National Safety Council estimates for fatality cost, injury cost, and property damage cost. (6)

Road Traffic Fatalities by Mode

THT Definition
The THT defines Road traffic fatalities by mode as the rate of fatalities from traffic collisions involving a driver or passenger of a moving or parked vehicle, a bicyclist, or a pedestrian.

Madison Planning District Definition
Due to the limited number of fatalities occurring from 2009 to 2013, this indicator will be supplemented with total road traffic crashes occurring between 2009 and 2013 for the City of Madison. The proportion of total crashes occurring within each planning district will be displayed.

Why Indicator is Included
Fatalities within a transportation system directly impact public health. Transportation-related fatalities also have significant economic implications According to the U.S. Department of Transportation the total cost of 2014 roadway fatalities was $871 billion, including $277 billion in economic costs and $594 billion in harm as a result of the fatality. According to the Wisconsin Department of Transportation, the total economic cost of roadway fatalities in 2013 was $786 million.

Rode Traffic Fatalities Exposure Rate

THT Definition
Similar to road traffic fatalities by mode, the THT defines exposure rate as the relative risk that a driver or passenger, bicyclist, or pedestrian may die in a traffic collision. This exposure rate is calculated using two other indicators: road traffic fatalities by mode divided by vehicle commute mode share.

Madison Planning District Definition
Due to the similarity of this indicator with the road traffic fatalities by mode indicator in addition to the minimal number of fatalities occurring throughout Madison from 2009 to 2013, this indicator was omitted from our analysis.

Why Indicator is Included
This indicator directly reflects the danger that a community member faces on a daily basis to access the services they need, commute to work, or just live their lives. If a person's home is located near a corridor

with a high rate of fatalities, they are more likely to be involved in a crash. Living near a high-fatality corridor may also increase user's stress during their commute and may restrict movements.

Access to Services

Housing and Transportation Affordability

THT Definition

The THT assesses housing and transportation affordability by analyzing the percentage of income the average household spends on both transportation needs and housing combined.

Madison Planning District Definition

The same definition is applied at the planning district level with data from the Housing and Transportation Affordability Initiative (AI). This information is public and can be downloaded for the city of interest. The indicator used in the AI is defined as the modeled housing and transportation costs as a percentage of income.

Why Indicator is Included

For most households, the combination of housing and transportation expenses makes up the largest portion of total expenses, contributing to approximately half of the total budget allocated. These costs are directly reflective of the overall accessibility and land use mix of the community.

Vehicle Miles Traveled per Capita

THT Definition

This indicator is calculated by the THT as the total annual miles traveled by vehicle divided by the total population of a given area.

Madison Planning District Definition

Instead of per capita, this indicator will be represented by vehicle miles traveled per household this data is available through the Housing and Transportation Affordability Initiative. The data is defined as the modeled household annual vehicles miles traveled (VMT). The data will be analyzed at the planning district level.

Why Indicator is Included

A higher number of VMT relates to decreased air quality and lower overall health, as it is linked to a more sedentary lifestyle. Districts reporting higher VMT per household indicate regions that are reliant on private vehicles as the primary mode of transportation. This indicator is included to promote alternative non-vehicle forms of travel.

Land Use Mix

THT Definition

The THT defines land use mix as the diversity of eight different destination employment types throughout the metropolitan area. These eight different land use types include office, retail, industrial, service, entertainment, education, health, and the public sector.

Madison Planning District Definition

We were not able to obtain data to analyze this indicator at the city or planning district level. As a result, the land use mix indicator was omitted from this project.

Why Indicator is Included

Recent studies have concluded that residents from communities with higher density, greater connectivity, and greater land use mix have higher rates of walking and bicycling. Increased rates of walking and biking support positive health outcomes.

Indirect Impacts

Proximity to Major Roadways

THT Definition

Proximity to major roadways, as defined by the THT, is the percentage of people that live within 200 meters of high traffic roadways, where high traffic roadways are defined as those carrying over 125,000 vehicles per day.

Madison Planning District Definition

The Wisconsin Department of Transportation has counters located throughout the state to record volumes on major roadways, as shown in Figure 5. A preliminary analysis revealed that only 4 of the 62 planning districts contained high-volume roadways as defined by the THT. Therefor a second analysis was run Figure 1this time including State, U.S., or Interstate highways within Madison. The results of the second analysis revealed 43 planning districts within 200 meters of those highways.

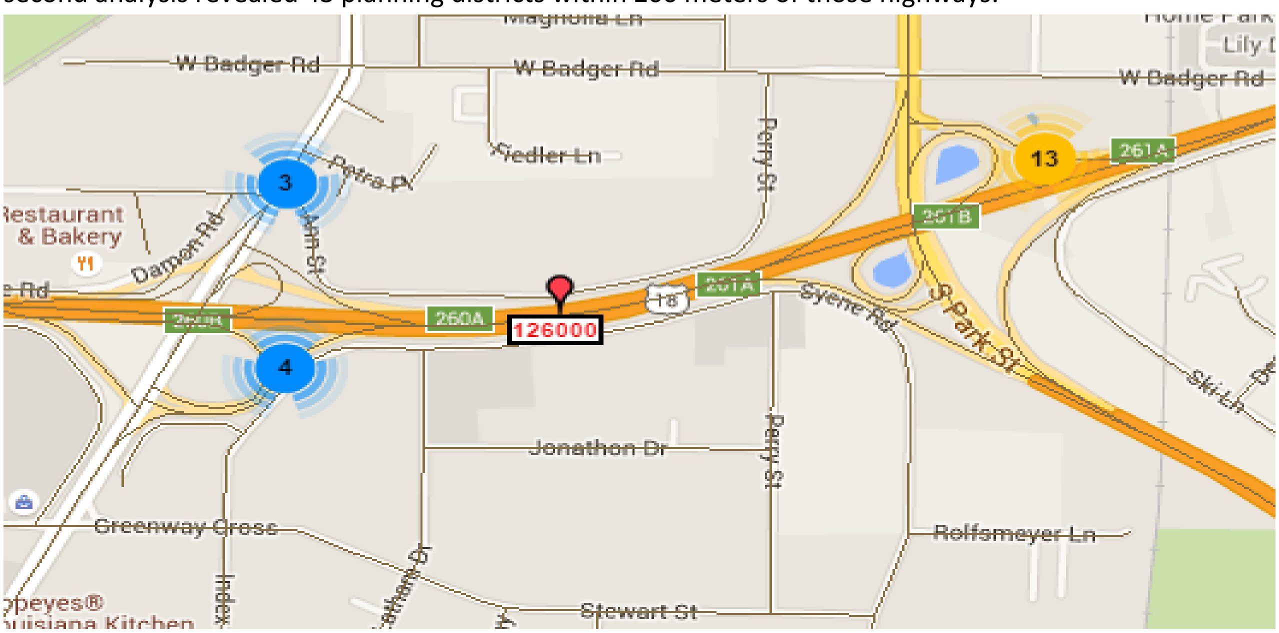

Figure 5: Screenshot of WisDOT traffic counts

Why Indicator is Included

According to the Center for Disease Control and Prevention more than 11 million people live within 200 meters of major roadways (greater than 125,000 VPD), exposing them to major noise and air pollution. Exposure to traffic-related pollution is linked to asthma and cardiovascular disease. (4)

Highways often act as barriers, cutting one neighborhood off from another as they are not designed for pedestrians or cyclists to cross easily. These consequences hinder active forms of transportation such as walking or biking and negatively impact health outcomes.

Person Miles Traveled by Mode

THT Definition

The THT defines person miles traveled by mode as the amount that the average person either walks or drives in a private vehicle in a given year.

Madison Planning District Definition

The City Active Living Index would be applicable in determining person miles traveled by mode. However, data was not attainable within the time frame of this project. Therefore, this indicator was omitted from our analysis.

Why Indicator is Included

This indicator examines the relationship between active transportation, such as walking and biking, and sedentary transportation, such as automobile use. Increasing active transportation promotes not only physical activity but also reduces emissions, congestion and travel costs that would otherwise be incurred by the automobile user. There is a reported 12 percent reduction in mortality associated with an active transportation lifestyle and an 11 percent reduction in risk of cardiovascular disease. (4)

Scoring

Raw data for each indicator will be converted to a score between 0 and 100. The data for each indicator has been assessed in such a way that a score closer to 100 represents better performance. The description of the scoring breakdown for each follows.

Active Living

Use of City Funding for Bike and Pedestrian Facilities

This indicator was examined at a city-wide level rather than at the planning district level. The City of Madison Capital Improvement Program was reviewed for the years 2009-2013, and construction projects under the "Engineering" subdivision were reviewed. The projects were divided into 3 categories: Roadway Only, On-Road Bicycle Facilities, and Bicycle/Pedestrian Only. The funding for on-road bicycle facilities was generally estimated as 10% bicycle funding for paved shoulders, with some adjustments made for unique features of a given project. For example, if there was a pedestrian/bicycle underpass constructed, the portion of bicycle funding increased, or if there was a grade separation required on the roadway, the bicycle portion decreased. Through this method, it was determined that a total of 11.4% construction funds were allocated to bicycles during this 5-year period. Individual years ranged from 5.6% - 18.4% bicycle funding. The scoring system was developed by setting a goal funding allocation of 12%. The score was determined by dividing the percent allocation by the goal of 12% to determine a score of 95% for every district in the city.

Commute Mode Share

Mode share as previously described was calculated based on "non-auto" versus auto trips, where non-auto includes those trips made by transit, biking, or walking. The range for non-auto trips for all planning districts was 2.46% to 77.9%. These values were calculated by subtracting percent auto trips from 100%. In order to assign each planning district a score, 2.46% was subtracted from the percent non-auto and then divided by the range. This method assigns the planning district with the highest percentage of non-auto usage a score of 100% and the planning district with the lowest percentage of non-auto trips a score of 0%.

Complete Streets Policy

The Complete streets policy is represented by a score of either 100% if the planning district has a policy in place, or a score of 0% if the planning district does not. Though the State of Wisconsin recently repealed its Complete Streets requirement, this policy has been in place in the City before it became a State requirement. We have found no data to indicate that repealing the State law will affect the local city-wide Complete Streets policy. Each district received a score of 100% for this indicator.

Public Transit Trips per Household

Scoring for public transit trips was based on achieving a goal trip use. The goal trip use of 260 annual trips per household equates to fifty percent of the total number of trips someone commuting to and from work daily would make in a given year. The score for each district was determined by dividing the reported transit trips per household by the goal of 260 transit trips, resulting in a range of scores from 0% to 88%.

Safety

Seat Belt Use

Seat belt use scoring was determined by the percentage of people who were reported wearing a seat belt when they were pulled over. There was extensive debate over the scoring of this item, since the ticket occurring within a planning district does not mean the individual lives in that district. However, without further data we were not able to devise another method for scoring seat belt use. The final scoring is reflective of the percentage of drivers involved in crashes who were reported using a restraint at the time of the crash.

Alcohol-Impaired Fatalities

Alcohol-impaired fatalities were assessed at the city-wide level. The City of Madison reported 27 fatalities from 2009 to 2013, which corresponds to a fatality rate of 0.0022 alcohol-related fatalities per City resident. For comparison, the average fatality rate for the State of Wisconsin for the same five-year period was 0.0038 alcohol-related fatalities per resident. This indicates that the City of Madison has an alcohol-impaired fatality rate of 0.58 times the statewide fatality rate. In order to give this indicator a score, a range of values needed to be created. The goal of any transportation agency is zero deaths on the roadway, indicating a perfect 100% score. To create the lower bound, the state with the highest alcohol related fatality rate was used. Texas has the nation's highest fatality rate of 0.012 alcohol-related fatalities per resident. To determine the score for Madison, the fatality rate of the city was divided by the range of 0.012. This value was subtracted from 1 so that higher scores would include cities with lower alcohol fatality rates. The resulting score of 82 was applied to each planning district in the City of Madison.

Proportion of Total Road Traffic Crashes

Scoring for this indicator was based on the percentage of total crashes that occurred in Madison from 2009 to 2013 in each planning district. The range for the 62 planning districts was 0.01 to 6.8 percent of total trips. To give each planning district a score 0.01% was subtracted from the percentage of crashes within each district and then divided by the range. This method assigns the planning district with the highest percentage of total crashes a score of 0% and the planning district with the lowest percentage of total crashes a score of 100%.

Access to Services

Housing and Transportation Affordability

The Housing and Transportation Affordability score was determined by comparing each planning district's spending percentage to the highest and lowest spending districts. The range of spending was from 23.7% to 67% of the household budget. A score was assigned to each planning district by normalizing the data across the range. This was accomplished by subtracting 23.7% from the percent each district spent on housing and transportation and then dividing by the range. This method assigns the planning district with the lowest percentage spent on housing and transportation a score of 100% and the planning district with the largest percentage spent on housing and transportation a score of 0%.

Vehicle Miles Traveled

The vehicle miles traveled (VMT) per household score was based on a range of 8,058 to 25,432 annual miles, the high and low bounds for Madison's 62 planning districts. A score was assigned to each planning district by normalizing the data across the range. This was accomplished by subtracting 8,058 from the annual miles traveled in each district and then dividing by the range. This method assigns the planning district with the highest reported VMT a score of 0% and the planning district with the lowest VMT a score of 100%.

Indirect Impacts

Proximity to Major Roadways

Scoring for proximity to major roadways was determined by creating 200-meter boundaries around every roadway classified as a U.S. or State Highway or Interstate within the City of Madison. Next, we determined the proportion of each planning district encompassed by one of these boundaries. The final score is the portion of a district that is farther than 200 meters from a major roadway. Districts with less mileage of major roadways received higher scores.

Data

Weighting the Indicators

In order to assign category and overall transportation system scores to each planning district, we needed to find a method to help roll-up indicator scores into category scores and category scores into an overall transportation and health score. This scenario is well suited for using the Analytical Hierarchy Process (AHP). AHP is an analytical method that can be used to set weights for individual components within a larger grouping (8). The process is a structured technique for organizing and analyzing complex decisions and provides a comprehensive and rational framework for assigning priority weights to the individual components that make up this tool.

In this case, the individual components were the ten indicators: Complete Streets, Mode Share, Percentage of Funds used for Bike/Pedestrian Features, Transit, Road Traffic Crashes, Alcohol Fatalities, Seat Belt Use, VMT per Household, Housing and Transportation Affordability, and Proximity to Major Roadways. These indicators were grouped into four main categories: Active Living, Safety, Access to Services, and Indirect Impacts. These four categories describe the transportation system and its impact to public health, as seen in Table 1. The indicators within each category can be viewed in Table 2 below. The four main categories describe the transportation system impact on public health. Likewise, all the indicators within each category describe the transportation system impact on that category, e.g. complete streets impacts active living or alcohol fatalities impacts safety.

Table 1: Global Categories

Global Categories
Active Living
Safety
Access to Services
Proximity to Major Roadways

Table 2: Categorical Breakdown of Indicators

Categorical Breakdown
Active Living
Complete Streets
Mode Share
Percentage of Funds for Bike/ Pedestrian Features
Transit
Safety
Road Traffic Crashes
Alcohol Fatalities
Seat Belt Use
Access to Services
VMT per Household
Housing and Transportation Affordability
Indirect Impacts
Proximity to Major Roadways

Using the AHP, weights were assigned to each indicator and category based on a set of pair-wise comparisons as shown in Table 3 through Table 6. These pair-wise comparisons define the dominance of the row item over the column item as they relate to a common criterion. The comparison matrices shown in Table 3 detail the row dominance over the column dominance in the pair-wise comparisons. The priority weight shown is the weight that each indicator holds in that category, found by taking the geometric mean of five expert comparisons. This method takes into account any variability in the opinions of the group. It is important to note that the indirect impacts category was composed only of the proximity to major roadways indicator. Because there was only one indicator in this category, no comparisons were made. Therefore, no comparison matrix is displayed for this category.

Table 3: Transportation Contributions to Public Health

Category	Active Living	Safety	Access to Services	Indirect Impacts	Priority Weight
Active Living	1.00	1.64	3.73	7.06	0.47
Safety	0.61	1.00	3.59	6.51	0.35
Access to Services	0.27	0.28	1.00	2.70	0.12
Indirect Impacts	0.14	0.15	0.37	1.00	0.06

Table 4: Indicators Contributing to Active Living

Category	Complete Streets	Mode Share	% of Funds for Bike/Ped Features	Transit	Priority Weight
Complete Streets	1.00	1.64	3.17	4.08	0.45
Mode Share	0.61	1.00	2.61	2.43	0.30
% of Funds for Bike/Ped Features	0.32	0.38	1.00	1.43	0.14
Transit	0.24	0.41	0.70	1.00	0.11

Table 5: Indicators Contributing to Safety

Category	Road Traffic Crashes	Alcohol Fatalities	Seat Belt Use	Priority Weight
Road Traffic Crashes	1.00	2.49	3.25	0.57
Alcohol Fatalities	0.40	1.00	2.17	0.28
Seat Belt Use	0.31	0.46	1.00	0.15

Table 6: Indicators Contributing to Access to Services

Category	**VMT per Household**	**Housing & Transportation Affordability**	**Priority Weights**
VMT per Household	1.00	2.77	0.74
Housing & Transportation Affordability	0.36	1.00	0.26

After each comparison was made and the geometric mean was calculated to produce the final weighting shown above, it was necessary to check for consistency among the comparisons. AHP provides a means for checking the consistency of the aggregated comparison matrices. A consistency ratio is developed using a random consistency index, seen in Table 7. Using this index, the consistency ratio becomes a function of the number of comparisons and the sum of the eigenvalues computed for each matrix. The eigenvalue is taken as the sum of the columns multiplied by the individual priority weight of each corresponding row. The eigenvalues should be relatively equal to the number of comparisons (n) in the n *x* n matrices.

Table 7: Random Index for Checking Consistency

n	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
RI	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.51

Consistency ratios less than 0.1 are acceptable, meaning that the comparisons are internally consistent and accurately reflect the views of all those involved in making the comparisons. The consistency ratios for this project can be viewed in Table 8. The data demonstrates that the comparisons made by the experts were well within the acceptable limit. It is important to note that while there were four comparison matrices, only three have consistency ratios. This is due to the trivial case of the 2 *x* 2 matric that made up the Access to Services category. There is no way to check for consistency with comparisons smaller than 3 *x* 3. Consistency in matrices smaller than 3x3 is ubiquitous: one feature must be more dominant than the other. Additionally, the proximity to major roadways indicator was grouped as its own contributor to public health and had no comparison matrix to check for consistency.

Table 8: Consistency in Comparisons

Comparison Matrix	**Transportation Contributions to Public Health**	**Active Living**	**Access to Services**
Consistency Ratio	0.02	0.01	0.03

Once the comparisons were checked for consistency, each indicator within each category had a priority weight. This priority weight is a local value, only weighting the indicator within the category, i.e. all indicators' local weights sum to 1.0 in each category. To apply these priority weights, shown in Table 9, to the rest of the planning districts, global weights were developed. The global weight is calculated by multiplying each indicator priority weight by the category priority weight. Based on this calculation, the global weights seen below in Table 10 are the weights used for applying the AHP results to the planning districts across all indicators.

Table 9: Category Contribution to Total Weighting

Category	Priority Weight
Active Living	0.47
Safety	0.35
Access to Services	0.12
Proximity to Major Roadways	0.06

Table 10: Global Weights of Each Indicator

Indicator	Global Weight
Complete Streets	0.212397
Mode Share	0.139029
% of Funds for Bike/Ped Features	0.064303
Transit	0.05114
Road Traffic Crashes	0.203223
Alcohol Fatalities	0.097545
Seat Belt Use	0.053468
VMT per Household	0.09094
Housing & Transportation Affordability	0.032784
Proximity to Major Roadways	0.06

Results and Analysis

Using the global weighting from the AHP, the scores from each planning district were updated based on the importance of the category as determined from the comparisons. Separate heat maps were created for the analysis of each category, as well as the total overall transportation and health score.

Active Living

The results from the active living analysis are displayed in Appendix C: Exhibit 1. This category was composed of 45% complete streets score, 30% mode share score, 14% bicycle and pedestrian funds, and 11% transit trips per household for each district. It is important to note that for this analysis, all districts were given the same score for both complete streets and bicycle and pedestrian funding categories. This means that 59% of the total score for each district will be held constant.

Overall, districts scored well in this category. The areas with the highest scores were located along the isthmus near the capitol square and campus areas. Scores tended to decrease as districts moved further away from this central area, with the lowest scores found in the Southeast and Gammon districts.

Safety

The results from the safety analysis are displayed in Appendix C: Exhibit 2. This category was composed of 57% road traffic crashes, 28% alcohol-impaired fatality, and 15% seat belt use scores. Traffic crashes were the most influential portion of this score, especially given that alcohol-impaired fatalities were analyzed at the city level with all districts receiving the same score. All districts scored relatively well (>90) on seat belt use, so the drastic variation in this map is mostly related to the disparity in crash rates across the city.

Standout districts for this category include Mineral Point and Near West. The Mineral Point district contains a long section of the Beltline Highway, much of which is currently being improved. These improvements will hopefully improve crash rates in the Mineral Point district. However, the areas around the West Towne mall and Odana Road also pose great risk to drivers. The Near West district also displayed a disproportionately high rate of crashes. This district contains a large section of University Avenue as well as many other high volume roadways with many access points. Efforts to decrease speeds in downtown areas would likely improve crash rates and improve access for non-vehicular traffic, as lower speeds are less intimidating to alternate modes of transportation.

Access to Services

The results for the access to services analysis are displayed in Appendix C: Exhibit 3. This category was composed of 74% vehicle miles traveled per household and 26% housing and transportation affordability scores. It is important to note that both of these indicators were normalized across their entire range, with some districts receiving a score of 0 and some receiving a score of 100. Also notable is that only 8 of the 62 planning districts received scores of over 50. This indicates that some districts within the city are performing well, but the distribution across districts is not ideal.

The highest score in this category was the University Campus district with a score of 100%. This result makes sense from the VMT standpoint, as students typically remain on campus much of the year. However, further study into housing and transportation affordability in this district is recommended. The low occurrence of fully-independent students may skew this data; as reported incomes may actually be those of student's parents rather than their personal income. The lowest scoring districts in the City were Midtown and University Ridge. Residents in these areas are likely to be very dependent on personal vehicles, as these more suburban-style neighborhoods were not designed with useful walks in mind.

Indirect Impacts

The results of the indirect impacts analysis are summarized in Appendix C: Exhibit 4. This category is composed solely of the proximity to major roadways indicator. The lowest scoring district for this category was East Washington, as it is sandwiched between major roadways on each side.

Transportation and Health

The final scoring comparison is displayed in Appendix D: Exhibit 1. This final score was composed of 47% active living, 35% safety, 12% access to services, and 6% indirect impact categorical scores. This translates to 21.2% complete streets, 13.9% mode share, 6.4% bicycle and pedestrian funding, 5.1% transit trips per household, 20.3% traffic crashes, 9.8% alcohol-impaired fatalities, 5.3% seat belt use, 9.1% vehicle miles traveled per household, 3.3% housing and transportation affordability, and 6% proximity to major roadway Indicator Scores.

Scores across the districts ranged from 59% in the Mineral Points district to 89% in Eagle Heights. In general, scores tended to decrease as districts move further away from the central isthmus/downtown area. However, the Mineral Points district stands out as a low-end outlier compared to its neighboring districts. The north side districts of Mendota, Cherokee, Gompers, and Warner Park also score well when compared to the score expected based on their distance from the isthmus area. A review of successful strategies in these districts is recommended for improving districts at similar distances from the isthmus along the southwest and southeast sides of the city.

Conclusions

We recommend that the City of Madison update and review this tool every five years to analyze how districts within the city are improving or deteriorating. This analysis will serve two main functions by both reviewing which areas are in most need of improvements and by analyzing the success/limitations of improvements that have been made over the previous five-year period. A periodic review of improvements is recommended so that the city can quickly adapt to how well different strategies are accepted and impact residents in that district.

The indicator data scores can be used to evaluate the performance of the sixty-two planning districts in Madison. This report highlights the underperforming and high-performing planning districts in Madison. The underperforming districts would benefit from increased attention and resources from the city, while the high-performing districts display exemplary performance. Ultimately, this level of analysis will be useful to the City of Madison when making budget allocation and planning decisions.

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Appendix

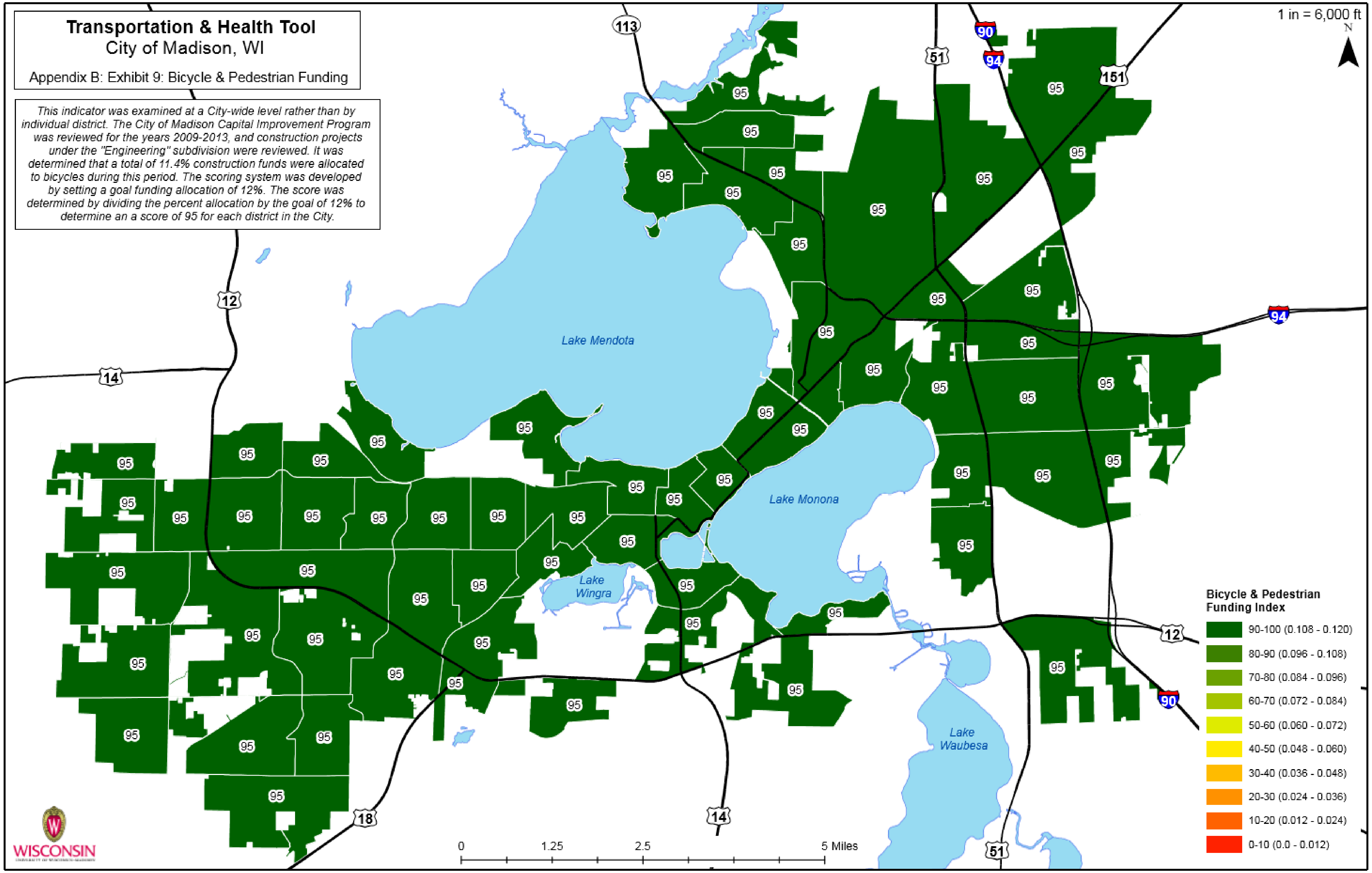

Figure 6: Use of State Funding for Bike and Pedestrian Projects

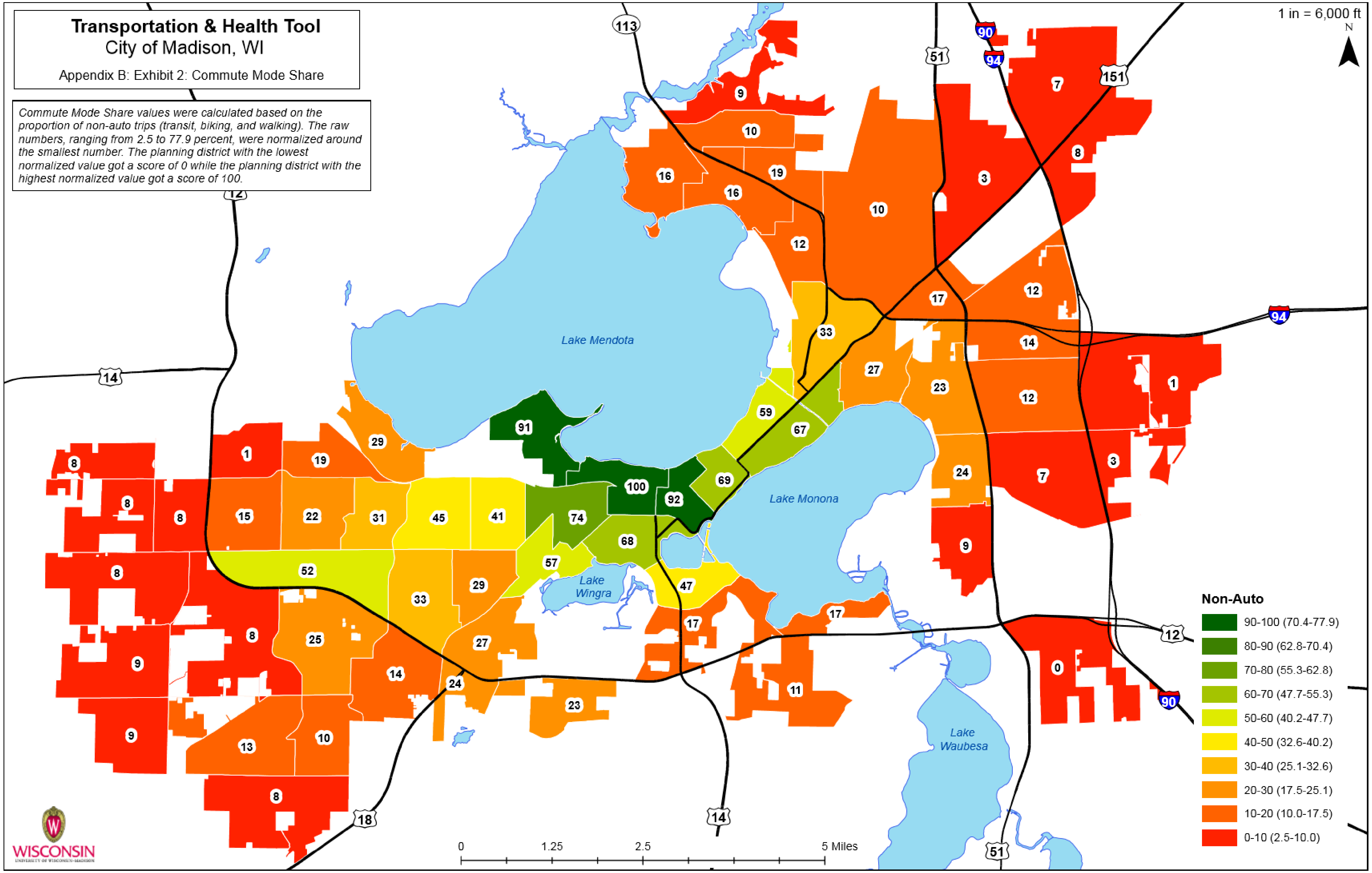

Figure 7: Commute Mode Share

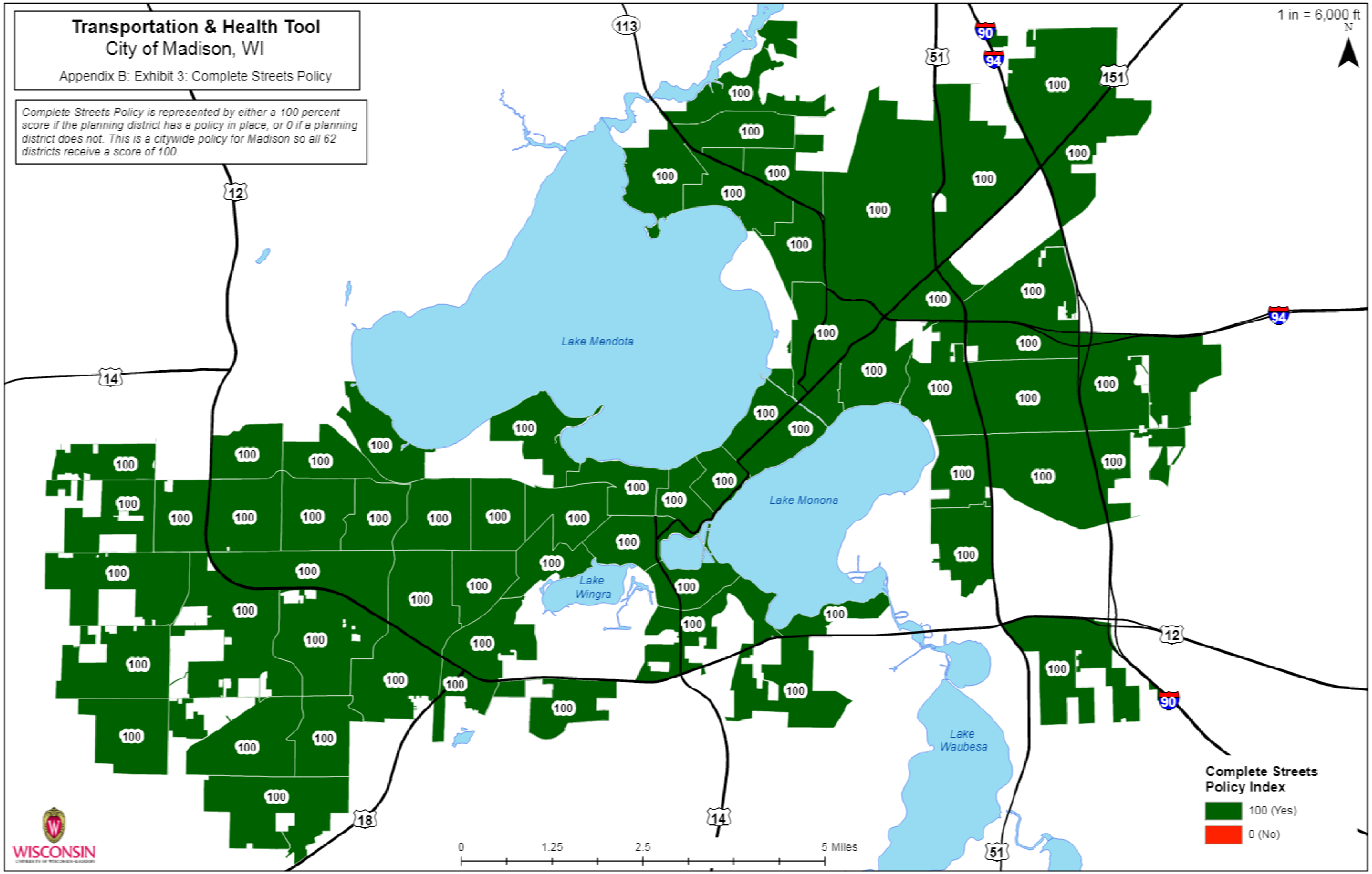

Figure 8: Complete Streets Policy

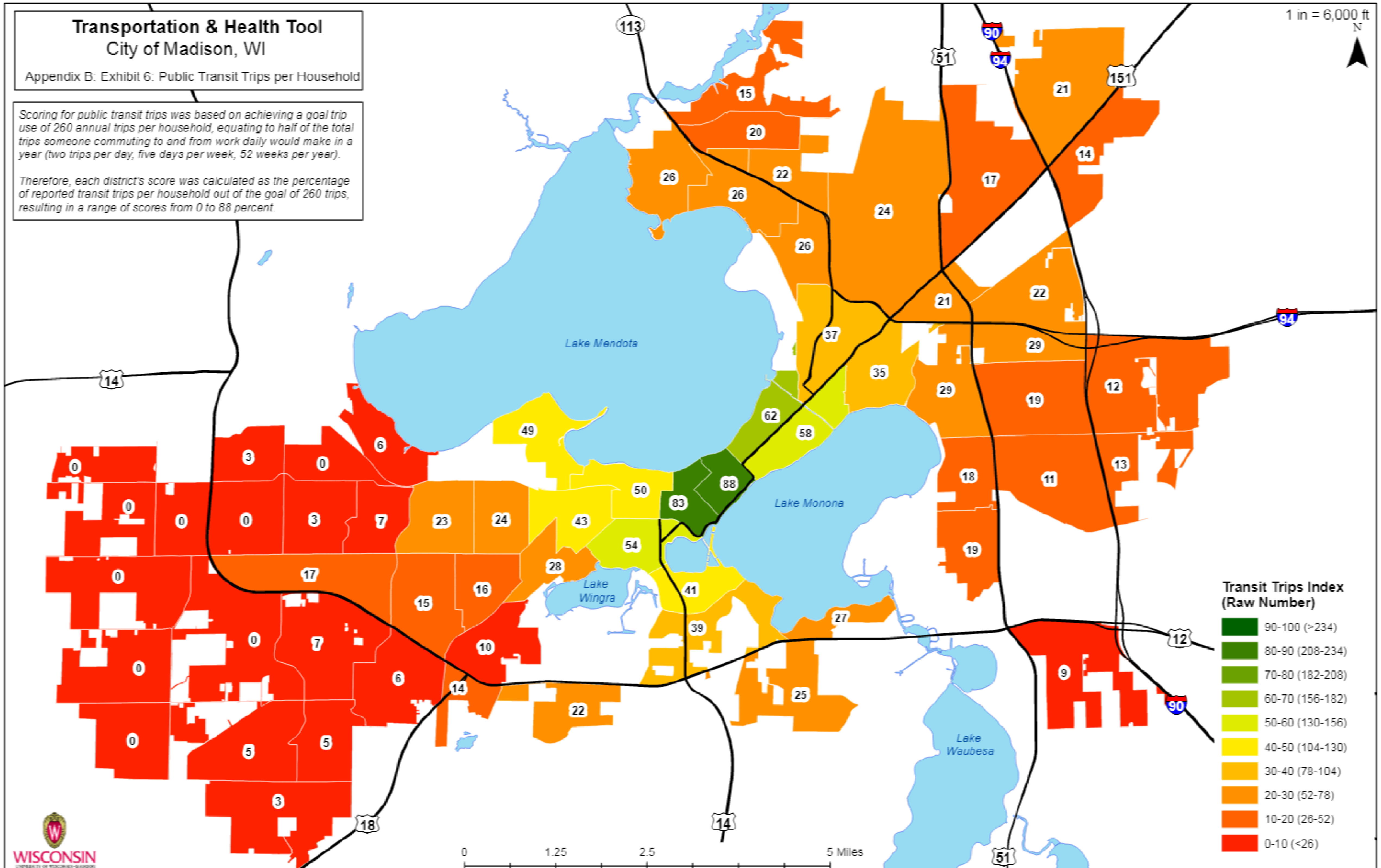

Figure 9: Public Transit Trips per Household

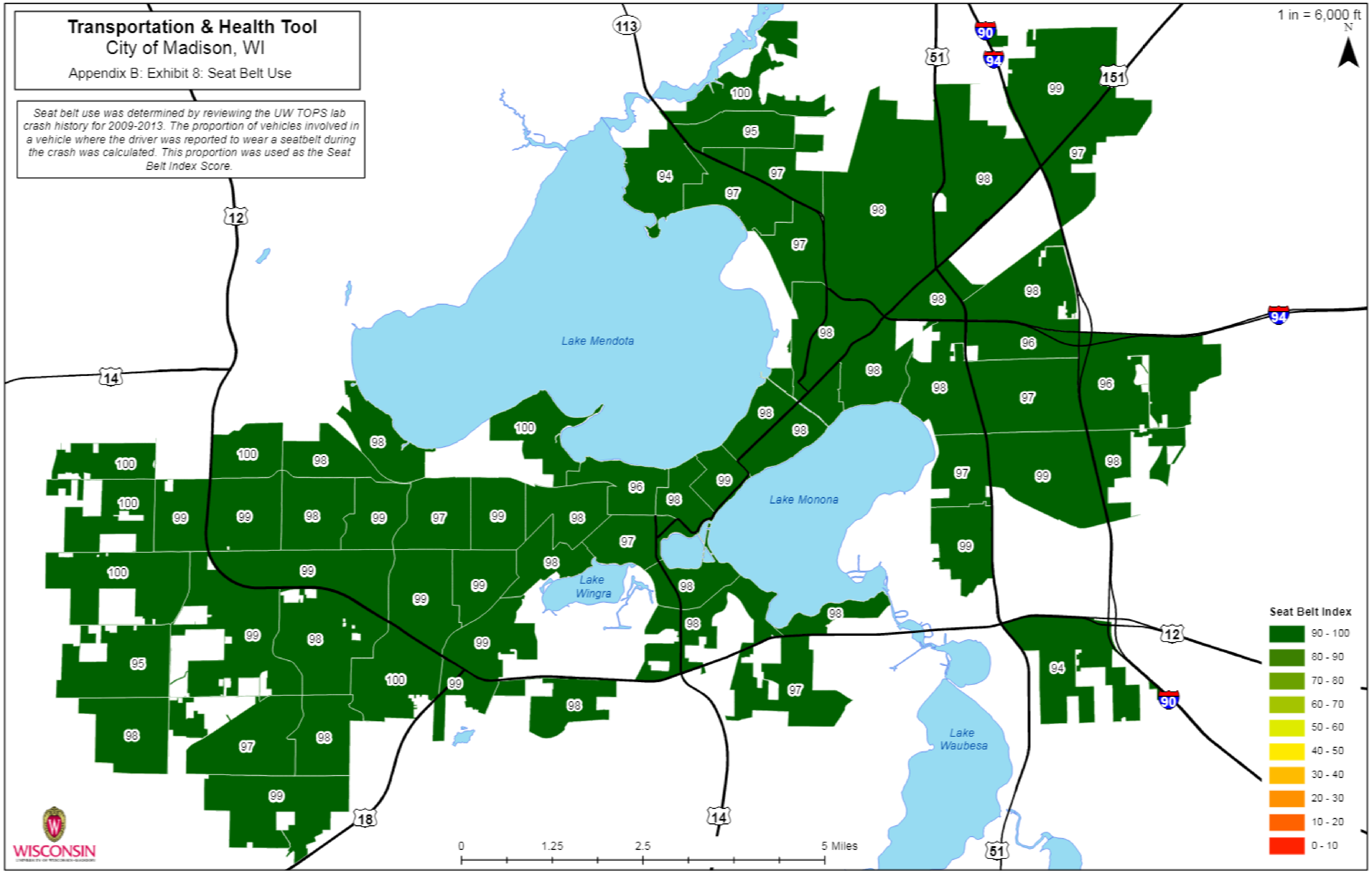

Figure 10: Seat Belt Use

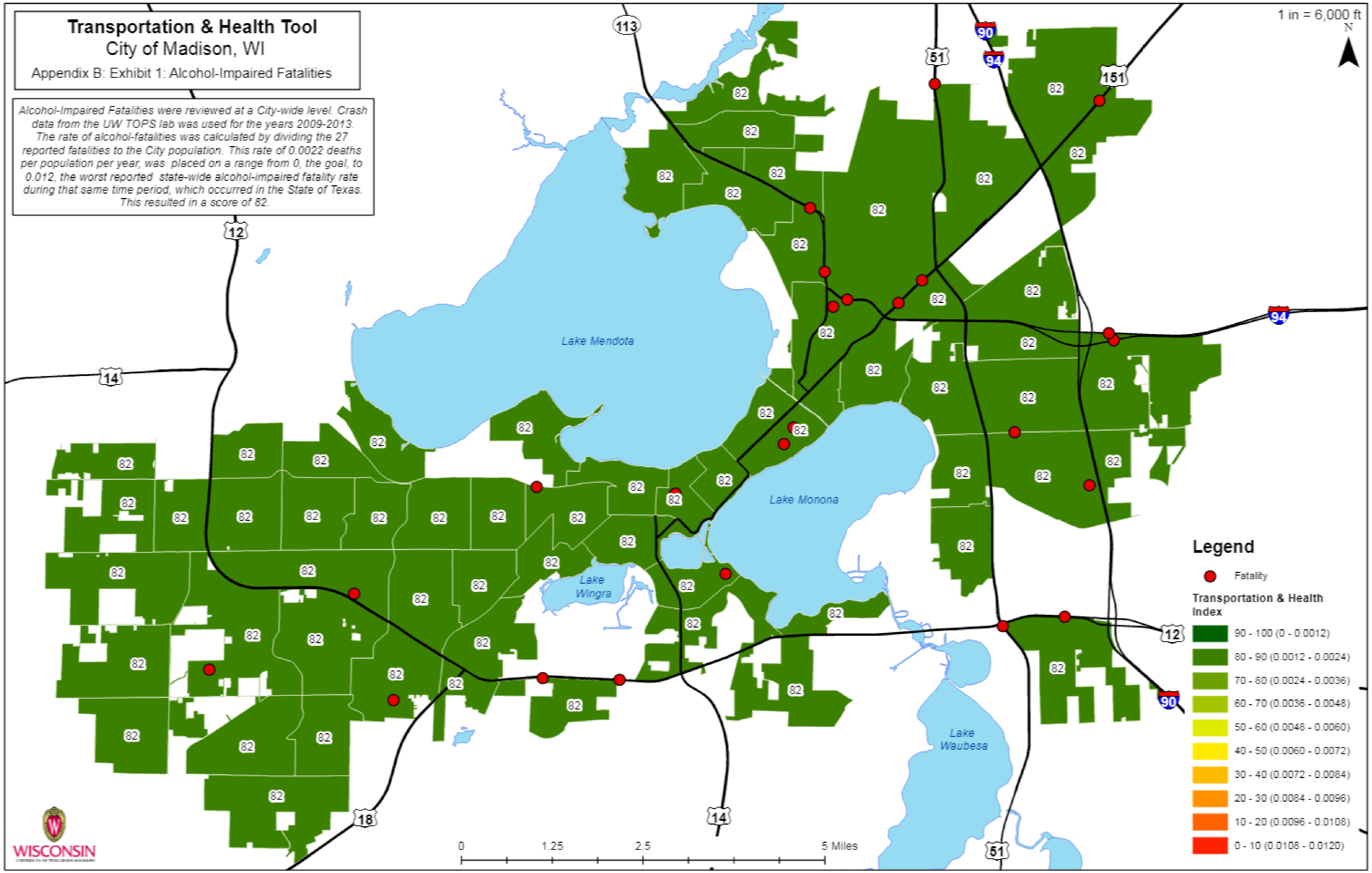

Figure 11: Alcohol Impaired Fatalities

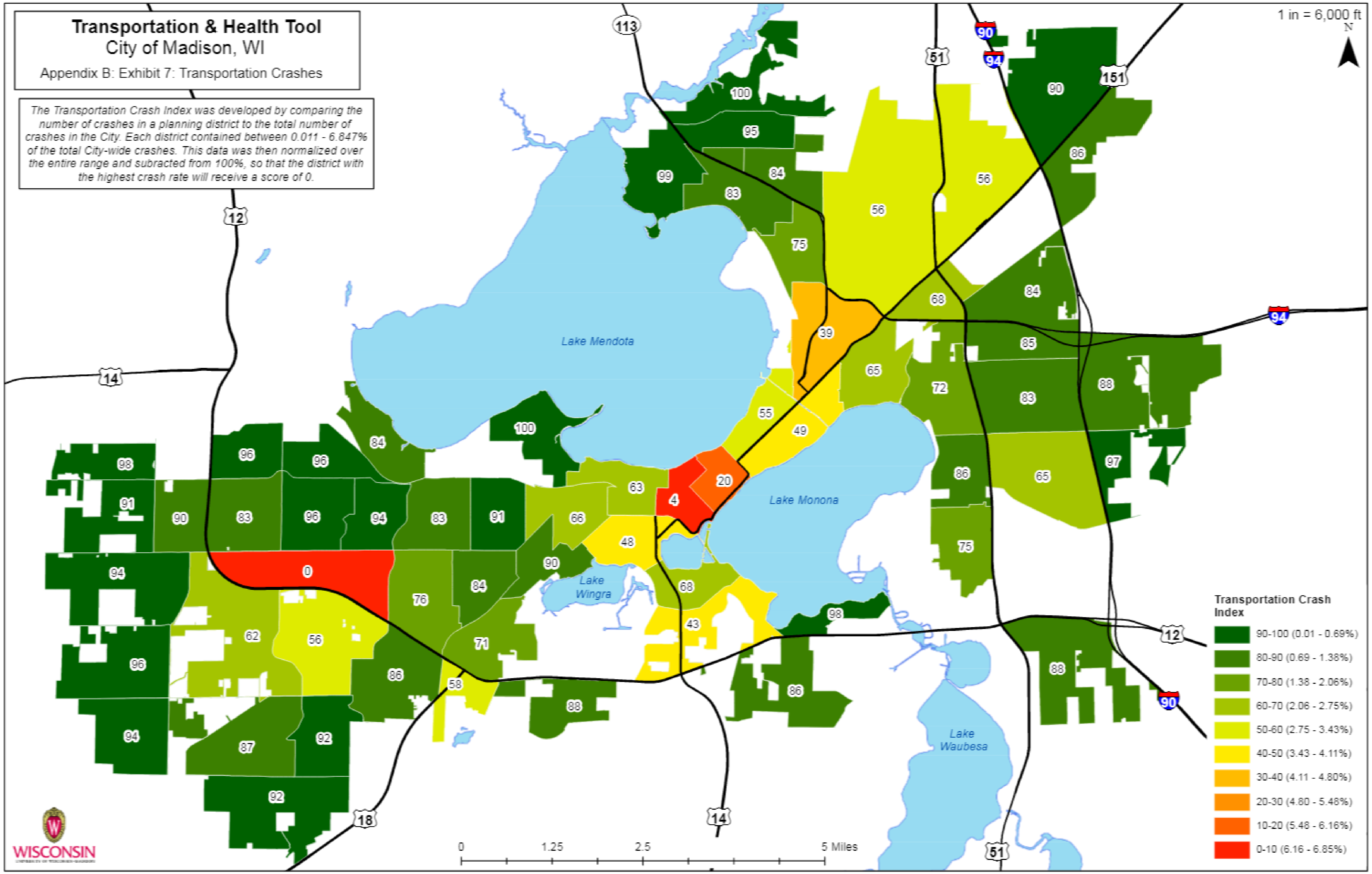

Figure 12: Proportion of Traffic Crashes

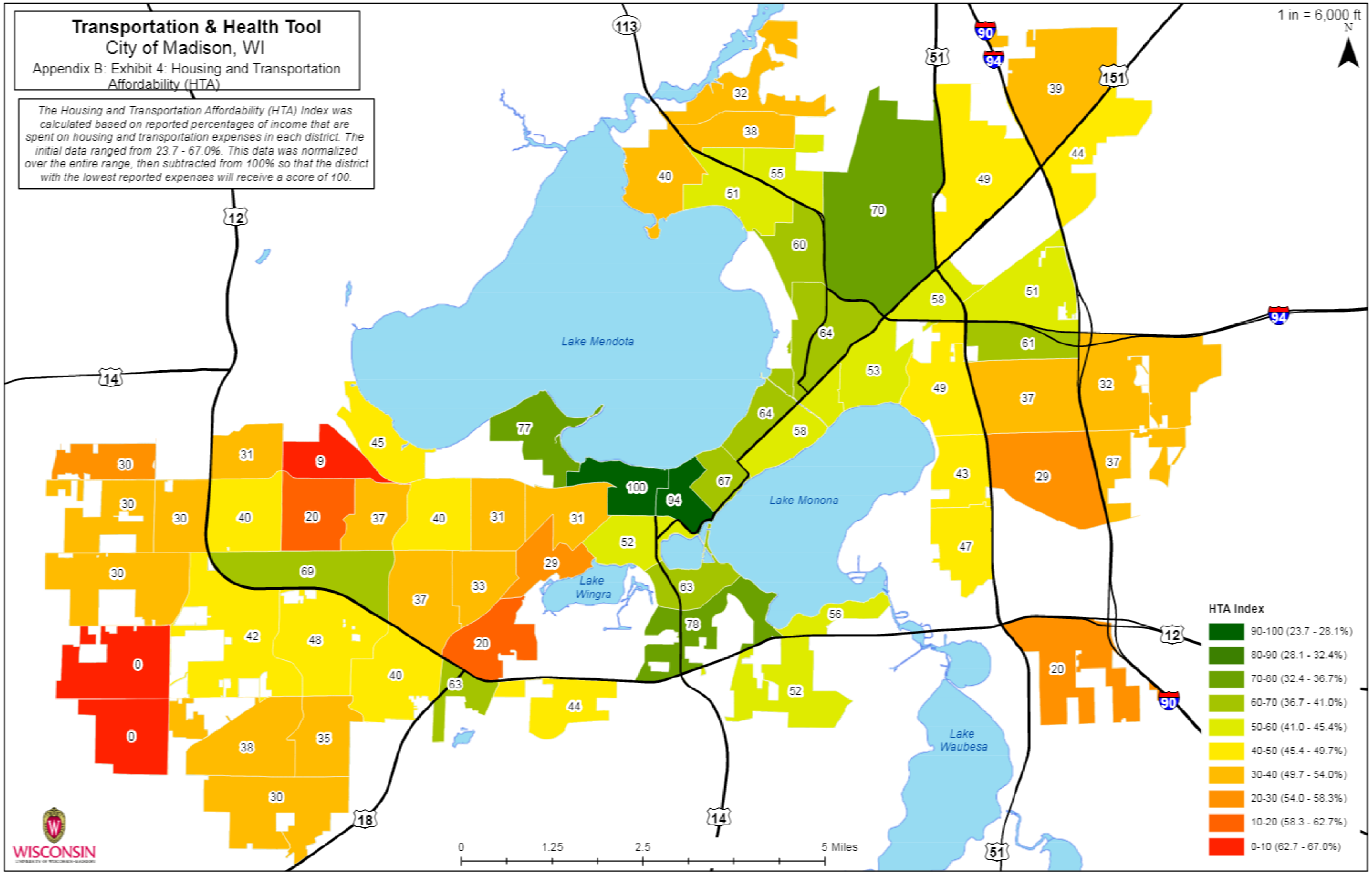

Figure 13: Housing and Transportation Affordability

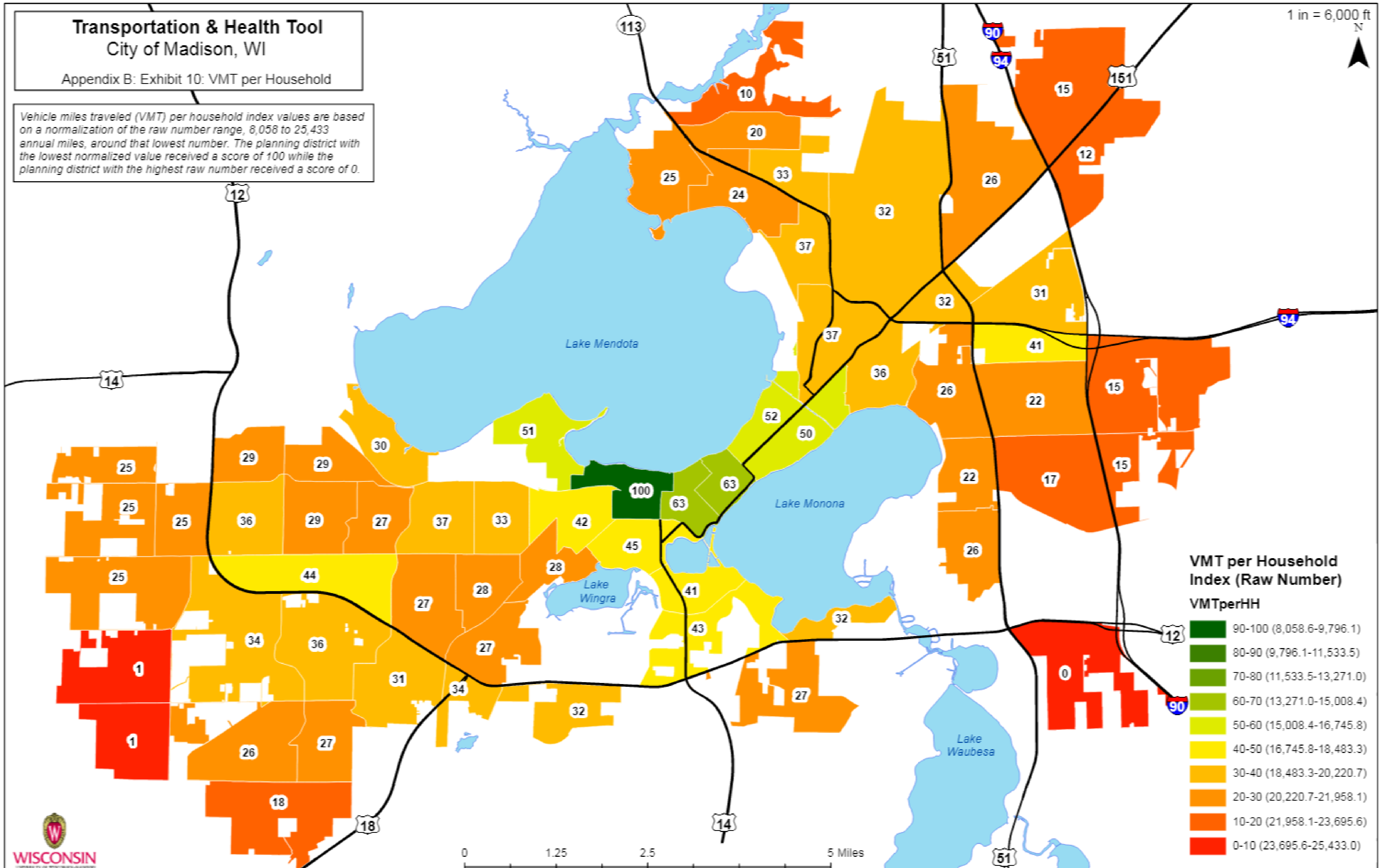

Figure 14: Vehicle Miles Traveled per Household

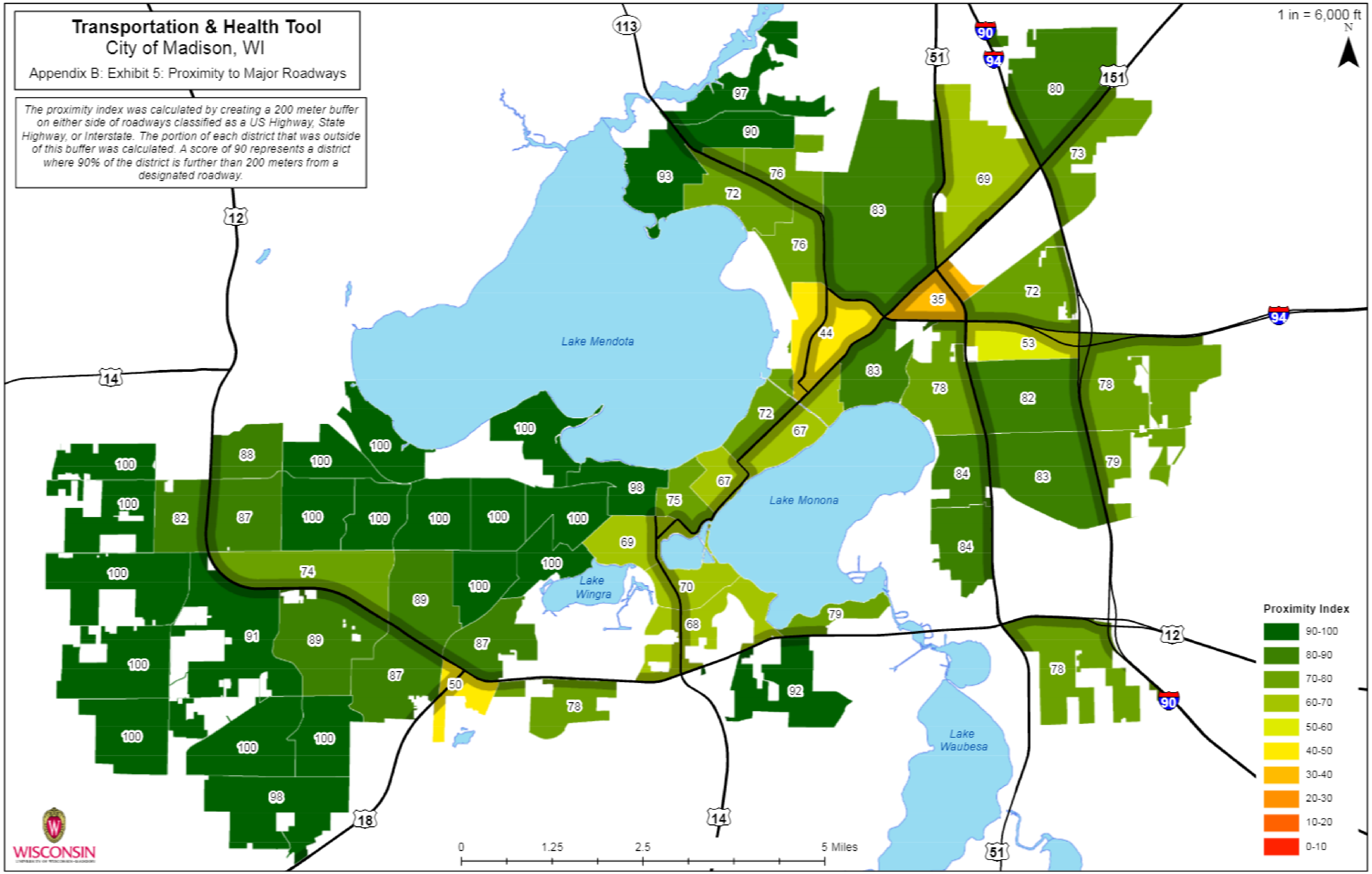

Figure 15: Proximity to Major Roadways

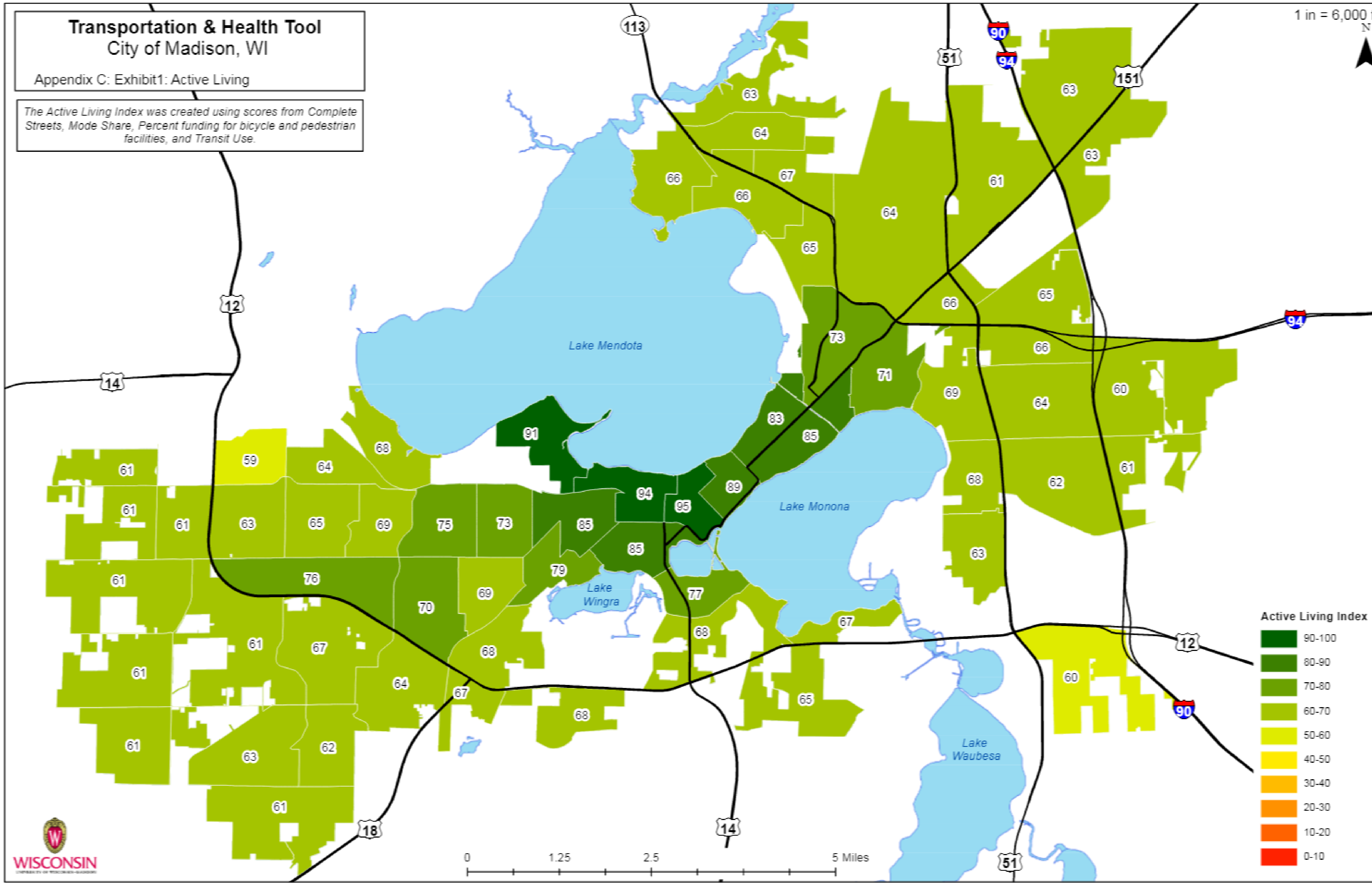

Figure 16: Active Living

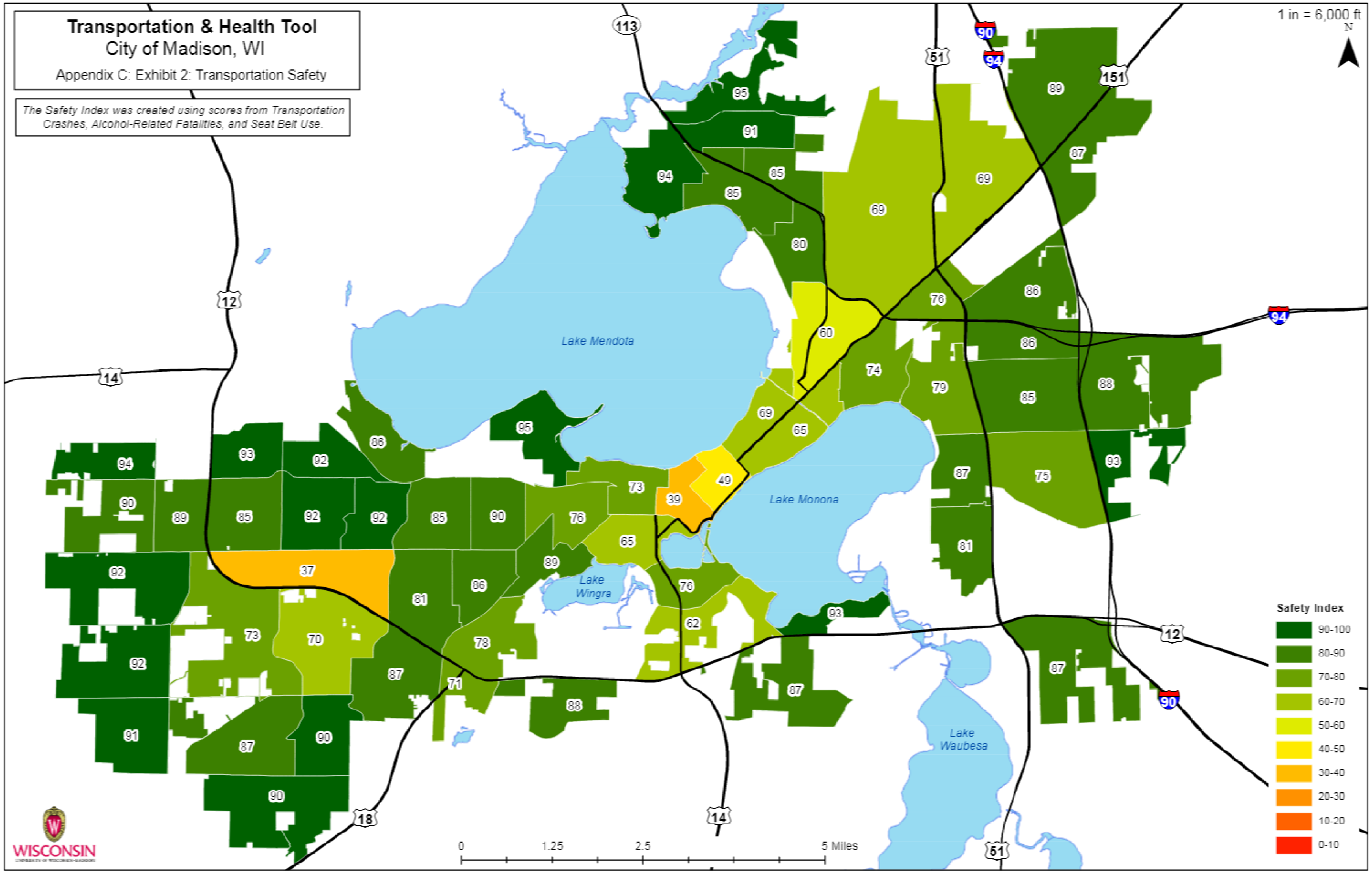

Figure 17: Safety

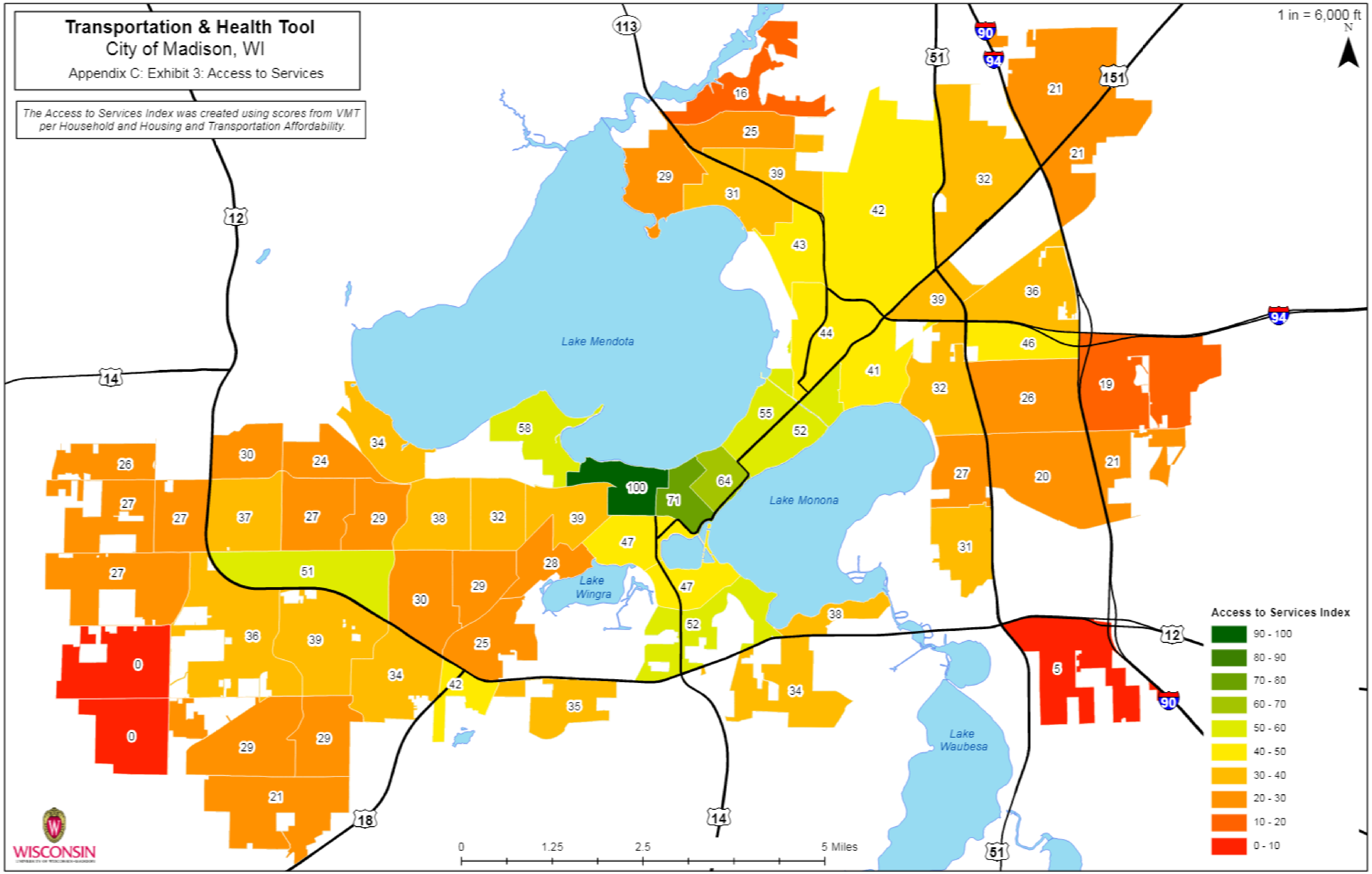

Figure 18: Access to Services

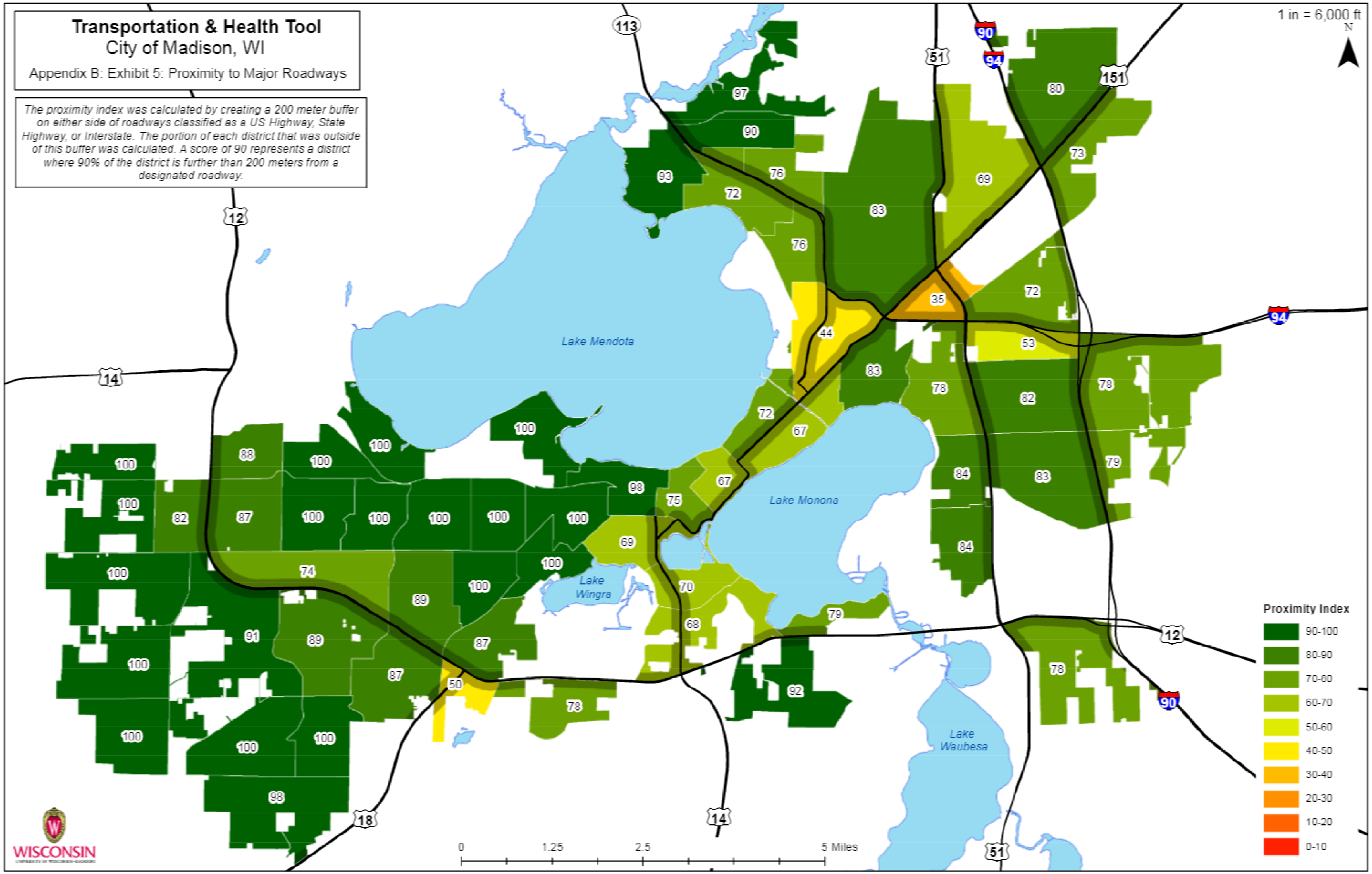

Figure 19: Indirect Impacts

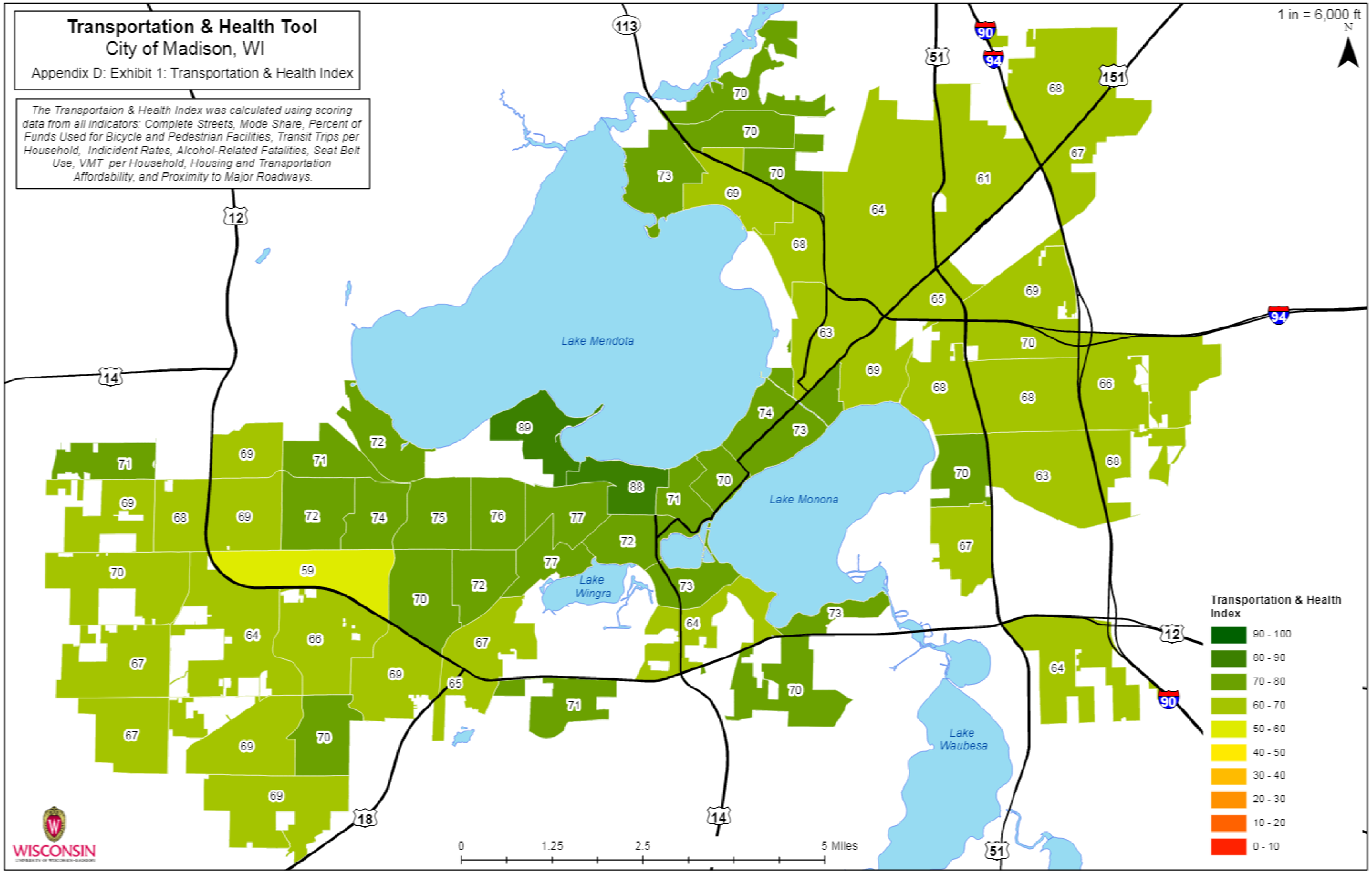

Figure 20: Final Planning District Scores