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GEOGRAPHY 578: GIS APPLICATIONS

SPRING 2017

UNIVERCITY BETTER PLACES TOGETHER

MONONA

June 9, 2017

Locating Unsafe Areas for Cyclists and Pedestrians in Monona, Wisconsin

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Objective

The city of Monona, in partnership with the UniverCity Alliance, hopes to identify unsafe areas within its city boundaries. The UniverCity Alliance is an initiative established by Monona to work in partnership with University of Wisconsin-Madison students to explore sustainable developments issues across four topics: Housing & Development, Community Media, Parks & Recreation, and Transportation. The objective of this project is to evaluate and identify unsafe areas within existing bike, pedestrian, and transit infrastructure. Unsafe areas shall be defined as those that pose risks to pedestrians and cyclists as determined by analyzing five variables: traffic speed, traffic volume, slope of the terrain, incidence of previously reported bicycle versus motor vehicle or pedestrian versus motor vehicle accidents, and absence of bike lanes or sidewalks.

Introduction

Background

The term “livable cities” is a relatively new concept in the arena of regional and urban planning referring to the general quality of life of a community’s residents. Several factors influence a community’s livability score including quality schools and healthcare facilities, safety and security, reliable and affordable public transportation, access to shopping, culture and recreation, and a physical environment conducive to walking and biking (AARP 2015). Walkable neighborhoods are highly desirable because of the benefits they offer. These benefits include reduced noise and traffic, increased physical health and wellbeing of residents, increased economic activity, higher home values, and increased community pride.

Study Area

The city of Monona, located in Dane County, Wisconsin, is a community of approximately 7900 residents. The community boasts over 330 acres of green space, including parks, woodlands, and wetlands. Uniquely located entirely within the city of Madison, Monona possesses a small-town charm combined with the luxury of urban services and amenities. Because of its unique geography, Monona faces challenges that other cities and towns of similar size likely do not have to consider. Because the City of Madison surrounds Monona, several of its main corridors serve to connect East Madison with the Isthmus. Thus, traffic volume on its main corridors is significantly increased. Recent redevelopment of one of the city's major traffic corridors, Monona Drive, has brought economic revitalization to the area. In its mission to provide and maintain a high standard of living to its residents, city planners hope to pinpoint unsafe areas in order to implement strategies for improved safety for future projects.

Figure 1: Study Area

Methodology

In order to identify and locate unsafe areas for pedestrians and bicyclists, first the definition of "unsafe" must be clearly defined. There are hundreds of factors that could amount to an unsafe environment for pedestrians and bicyclists, however for the scope of this project factors were filtered until five variables were selected. These variables include traffic speed, traffic volume, slope of the terrain, incidence of a previously recorded motor vehicle vs. pedestrian or motor vehicle vs. bicyclist accident, and absence of dedicated bike lanes or sidewalks. By combining these variables, an overall risk assessment can be used to locate areas which are unsafe for either pedestrians or bicyclists.

The factors that were chosen to be utilized in the analysis were among the most perceivably influential. Traffic speed was the first variable used. While some may argue that the roadway infrastructure is designed to accommodate the risk of speed, it can also be argued that if an accident is to occur, a higher speed would cause more harm and therefore be a higher risk to pedestrians and bicyclists. Traffic volume was the second factor used in the analysis. A higher level of traffic can increase the number of potential accidents given that with a higher level of traffic it can be more difficult to fully perceive one's surroundings. In other words, busy streets tend to lead to more difficult driving situations. The third variable that was analyzed was slope. This variable has two potential impacts on the risk for pedestrians and bicyclists. A high slope gradient at an intersection or crossroad could potentially lead to a visual obstruction increasing the risk for an accident. In addition, in a situation where road conditions are poor, a steep gradient could impede stopping distance. The fourth variable taken into consideration was the presence of a previous accident. This information was used to verify and further explore the areas which could have a high level of risk. The last variable to be integrated into the study was the presence of bike lanes for bicyclists or sidewalks for pedestrians. Without the appropriate infrastructure, there is a clear elevated risk for the pedestrians and bicyclists given they are forced to inhabit the same space as automobiles without any type of safety buffer separating them from traffic. This variable is also where the question of locating unsafe areas is divided into two sub questions; where unsafe areas exist for pedestrians and where unsafe areas exist for bicyclists. While some of these areas may overlap, many will be unique to the respective mode of transportation. Throughout the analysis, the first three variables will be the same for both sub questions; however, the presence of infrastructure and the presence of accidents will be specific to pedestrians or bicyclists.

In order to create a final product that would incorporate all of the factors into the final analysis, a scoring system was used to rank each variable. Each factor was treated as its own data layer that would then be combined with the other layers in the final analysis. For each factor a unique threshold was determined and the areas that did not meet or exceed that threshold were given a score of “0” (no risk) and the areas that did exceed it were given a score of “1” (potential risk). Once all the layers were classified with zeros and ones, they were overlaid and the values were added to calculate total risk given all the factors. The higher the total value of an area, the higher the risk for a pedestrian or bicyclist. These areas of high risk were further inspected and compared with the previous accidents layer. The following sections will detail the processes involved for creating the factor risk layers.

Traffic speed:

A roadway layer created by the City of Monona was the foundation for most of the layers that were generated in this project. This layer contained all of Monona's thoroughfares split into smaller segments, typically at every intersection. First, the layer was projected using a NAD83 UTM zone 16 projection, which also would be the projection used through the rest of the project. Because it is difficult to overlay lines when performing the final analysis, a 4.57-meter buffer, the approximate width of lane within a residential road, was then applied to all the line segments. This created polygons that could then be assigned a zero or one value and overlaid in the final steps of the project. Once the buffered roadway layer, which served as the base layer for most of the factors, was created, the traffic speed layer could then be generated. An exact copy of the roadway buffer layer was created to serve as the traffic speed layer.

Monona has a rather narrow range of speed limits for its roadways. The range extends between 25 mph for most of the residential areas to 30 - 40 mph on the more major thoroughfares. Because of this, there was a natural break in roadway classification between residential and major roads with regard to their speed limits and therefore the threshold for higher risk was set to 30 mph. Any roadway segment that had a speed limit greater than or equal to 30 mph was given a value of one and anything less a value of zero. The speed limits of each roadway segment were already accounted for in the data layer's attribute table and therefore identifying the segments that meet or exceed the threshold was an easy as a simple attribute query. Once the segments were identified, a new column was created in the attribute table labeled "Points" and the selected segments were given a value of 1. The selection was then inverted and the remaining segments were given a value of zero.

Figure 2: Speed Map

Traffic Volume:

Unlike traffic speed, traffic volume data was not included in the provided roadway data layer. Therefore, this information was obtained via the Wisconsin Department of Transportation's Interactive Highway Map. Approximately 30 data points measuring the estimate of typical daily traffic on a road segment for all days of the week, Sunday through Saturday, over the period of one year, were provided by the DOT's map and added to the buffered roadway attribute table under a new column labeled "Volume." A volume of 4000 was decided as the threshold based on a 2002 study by the State of Virginia Department of Transportation study defining this number as potentially problematic for residential neighborhoods and unsuitable for traffic calming measures. Any road segment greater than 4000 cars per day would be given a value of one and any segment under, a value of zero.

Figure 3: Volume Map

Coverage of traffic volume data is somewhat sparse for Monona so approximations were used on some segments that existed between data points but on the same street. Many streets lacked any traffic information, however they typically were residential areas which given the known data, all had a daily total under 2000 with most being around 1000 cars per day. With this evidence, it was assumed that the unknown values were most likely under the 4000 cars per day threshold. As for the major thoroughfares, one if not more data points were known and therefore were not subject to this assumption.

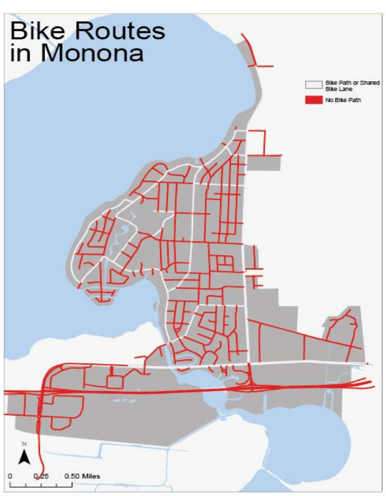

Figure 4: Established Bike Routes

Generating the traffic volume risk layer had similar steps to traffic speed layer. It started with creating a duplicate of the buffered roadway layer. Then the known and estimated data points were added to the attribute table for each of the roadway segments. Another column for points was created, all values exceeding the threshold were given a value of 1, and all unknown values and values under the threshold were given a value 0.

Presence of bike paths/sidewalks:

The next variable that was looked at was bike infrastructure. For this project, bike lanes, bike routes, and shared lanes were combined into one group. The presence of bike infrastructure was the only concern regarding the analysis. Once again, an exact copy of the roadway buffer layer was created and roadway segments that overlapped with the bike layer were selected. For this variable, the roadway segments that were selected were assigned a zero in the new points column in the attribute table instead of a one. This is because segments that had bike infrastructure present were considered safe. The selection was then inverted and the remaining segments were given a value of one.

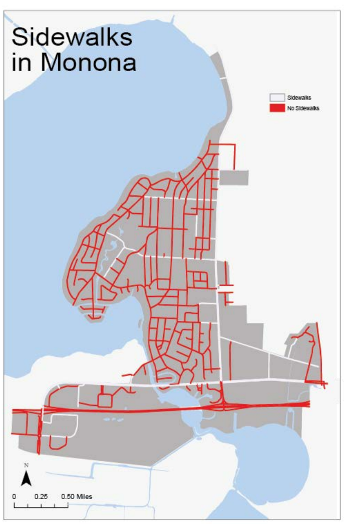

Figure 5: Sidewalks

Sidewalks were analyzed in the exact same fashion as the bike path variable. A copy of the roadway buffer layer was created and the roadway segments with at least one sidewalk adjacent to them were selected and given a value of 0 in the added points column in the attribute table. Unlike the bike path layer, there was no digitized sidewalk layer available, only a pdf of the existing sidewalks. In order to create the sidewalks layer, the pdf was georeferenced with the original Monona roadway layer using 10 control points. Once the pdf was properly aligned with roadway layer a new lines feature class was created and one by one the sidewalks segments were digitized and added to the layer.

Slope:

Although fairly flat, Monona still has some of topographic relief to contend with. Slopes can influence roadway safety in a few ways (as described earlier), so it is appropriate to analyze. The end goal was to find the steep slopes in Monona by using an existing topographic data layer. A threshold of 7%, or approximately 4 degrees, was established. Any value over the 7% threshold was assigned a value of 1 for high risk and below 7% a 0 for low risk. The threshold was decided after examining DOT standards (State of Florida Department of Transportation, 2013), where they recommend residential roads in flatter areas to be around a 7% grade.

A two-foot contour topographic data layer of Monona was used as the starting point of this analysis. A topo to raster tool then converted the contour map to a DEM. An output resolution of one meter was chosen as it seemed be a good balance of being high enough resolution yet not so high that it would take too long to calculate. The DEM was compared to the topographic map to make sure that it was accurate enough for the analysis. Once the DEM was created, a gradient tool was used to convert the elevation pixels to slope values. Again, the slopes were checked back to the Monona topographic map to verify the results. Once the slopes were verified, they were clipped to the boundaries of the roadway buffers. The clipped layer was then reclassified, where any slopes greater than 4 degrees or 7% (ArcMap indicates slopes in degrees, not percent grades) were given a value of one and under 7% a value of zero. The resulting data layer showed roadways that had a potentially dangerous slope.

Figure 6: Slope

Accidents:

The accidents layer had a different function than the rest of the variables. This layer did not contribute to the total risk score, rather it was used to validate areas that were rated as high risk in the final assessment as well as a tool to bring attention to areas that may not have been flagged as dangerous by the analysis that needed further inspection. The accident layers were divided up accordingly to their type; either they were in a list of vehicle-bicycle accidents or vehicle-pedestrian accidents. The accidents were provided from the City of Monona and given in the form of street addresses. To accommodate for this in ArcMap, they first needed to be geocoded into geographic coordinates. This was done using an online geocoding tool. The tool created points with latitude and longitudinal in a WGS84 GCS which then were geocoded as x and y data in a NAD83 UTM zone 16N projection and overlaid with their respective total risk maps as described in the next section.

Final steps:

The last step before the final analysis required all the risk factor layers to be converted to raster using the polygon to raster tool. Once the layers were converted to raster, pixel addition could be applied using the addition tool. For the pixel addition to function properly the pixels for every layer had to be the same size and align perfectly. When creating each raster layer the pixel size was set equal to the pixels generated in the slope layer (i.e. 1 x 1 meter). In addition, the snap to raster option was activated in the environment settings to ensure the pixels aligned properly. This resulted in the final two unsafe area maps, one for pedestrians and one for bicyclists, with the highest pixel values indicating areas of high risk. Finally, the geocoded previous accidents layers were overlaid the two final risk raster maps.

Figure 7: Pedestrian Safety Analysis Map

Results and Discussion

Figure 8: Pedestrian Safety Analysis: Low Risk Area

The final total risk maps had scores between zero and four for both pedestrians and bicyclists. However, there were so few pixels with a score of four, for simplicity they were merged with the group of pixels that had a score of three. It should also be noted that no pedestrian or bicycle traffic is allowed on the Beltline and therefore is excluded from the analysis.

For the Pedestrian Safety Analysis Map, shown in figure 7, the roads with the highest risk were Monona Drive, Bridge Road, and Broadway. While these roads had sidewalks, they also had high traffic volume, high speed, and areas with a slope greater than 7%. All pedestrian accidents from 2010-2016 with the exception one occurred on one of these roads. Two thirds of the pedestrian accidents occurred Monona Drive, which has the highest volume of traffic ranging from about 18,000-20,000 cars per day within the city of Monona. Bridge Road and Broadway are the only ways to cross the Yahara River to access the southwestern portion of Monona as well as south Madison besides the Beltline.

Roads with the lowest risk include the western portion of Nichols Road, Healy Lane, Dean Avenue, and Femrite Drive. These roads have sidewalks on residential roads where speed, traffic volume, and slope aren't factors. Figure 8 highlights the portion of Nichols Road and Healy Lane which surround Winnequah Park and Nuestros Mundo Community School. Dean Avenue is one of the few residential roads in Monona that has sidewalks, making it safer for pedestrians as it also has low traffic volume, low speed, and no slope. This can be verified by the absence of any accidents along this roadway. One section of Schofield Street is an area that was ranked with as 0, yet an accident occurred in the area. While this seems contradictory, the accident was between a bicyclist and pedestrian as opposed to a pedestrian and a motor vehicle and therefore most of the risk factors do not apply in this situation. This accident is the only accident that occurred in an area with a risk of 0.

Figure 9: Bicycle Safety Map

Like the Pedestrian Safety Analysis Map, The Bicycle Safety Analysis Map, figure 9**,** also highlights Monona Drive, Broadway, and Bridge Road to the east of the Yahara River as roads with the most risk to bicyclists due to having high speed, high traffic volume, and areas with greater than 7% slope. Of the twenty-two bicycle accidents from 2010-2016, thirteen of which occurred on these roads.

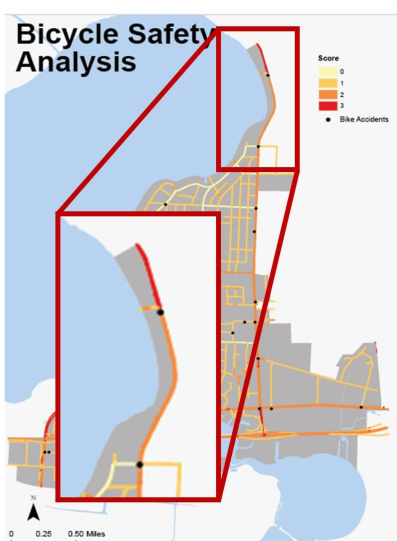

Figure 10: Bicycle Safely Map (detail)

Eight out of the twenty-two bicycle accidents occurred on Monona Drive, making it the road with highest accident rate of all the roads in our study area. In figure 10, the northernmost section of the road within Monona, is considered a risk of 3 because there are no bike lanes, and the area has high traffic volume and high

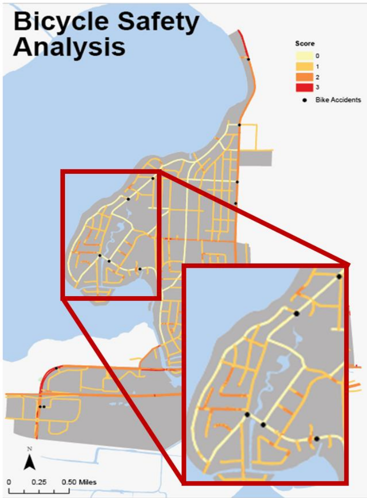

Figure 11: Bike Safety Map (detail)

speed. One of the accidents on Monona Drive occurred on the intersection where the bike lanes end.

The safest roads for bicyclists were Winnequah Road, Tonyawatha Trail, Winnequah Trail, Healy Road, Midmoor Road, and the eastern portions of Dean Avenue and Frost Woods Road because they have bike lanes, low traffic volume, and low speed with a slope less than 7%. However as shown in figure 11, five bicycle accidents have occurred along Winnequah Road. While Winnequah Road is designated as a bike route, no painted bike lanes exist and the bike route is only indicated by signage. Because of this there is an increased risk for bicyclists who use this thoroughfare for bike travel.

Conclusion

Speed and volume seem to have a greater impact on pedestrian and bicycle accidents on roadways than the other factors assessed. Even with the presence of sidewalks and bike lanes, most pedestrian and bicycle accidents happened on Monona Drive. There were fewer accidents for both pedestrians and bicyclists in residential areas that lacked sidewalks or any type of bike lanes compared to roads with high traffic volume and high speed. Winnequah Road and other roads considered to have bike paths but lacking painted bike lanes and clear signage could be improved upon. The presence of painted lanes markers in addition to signage would make motorists more aware of bicycles on the roadway.

Future considerations for safety analysis include considering obstructions including trees, shrubs, and center dividers on the roadways. Motorists, along with pedestrians and cyclists, could be safer if everyone has better visibility. Crosswalks could also be considered since they directly crosscut lanes of traffic and can put pedestrians at an even greater risk than walking along with or against the flow of traffic on the side of a road. The current signage on roadways is also an important factor to be considered for future study. Lastly, a more nuanced scoring system could be utilized to greater emphasize areas of risk. This more intricate scoring system could include intervals for point values as opposed to a binary zero and one scoring system, that way different traffic speeds and volumes could be more thoroughly analyzed. In addition, different types of bike lanes could have different scoring values to prevent overlooking dangerous areas such as Winnequah Road for bicyclists.

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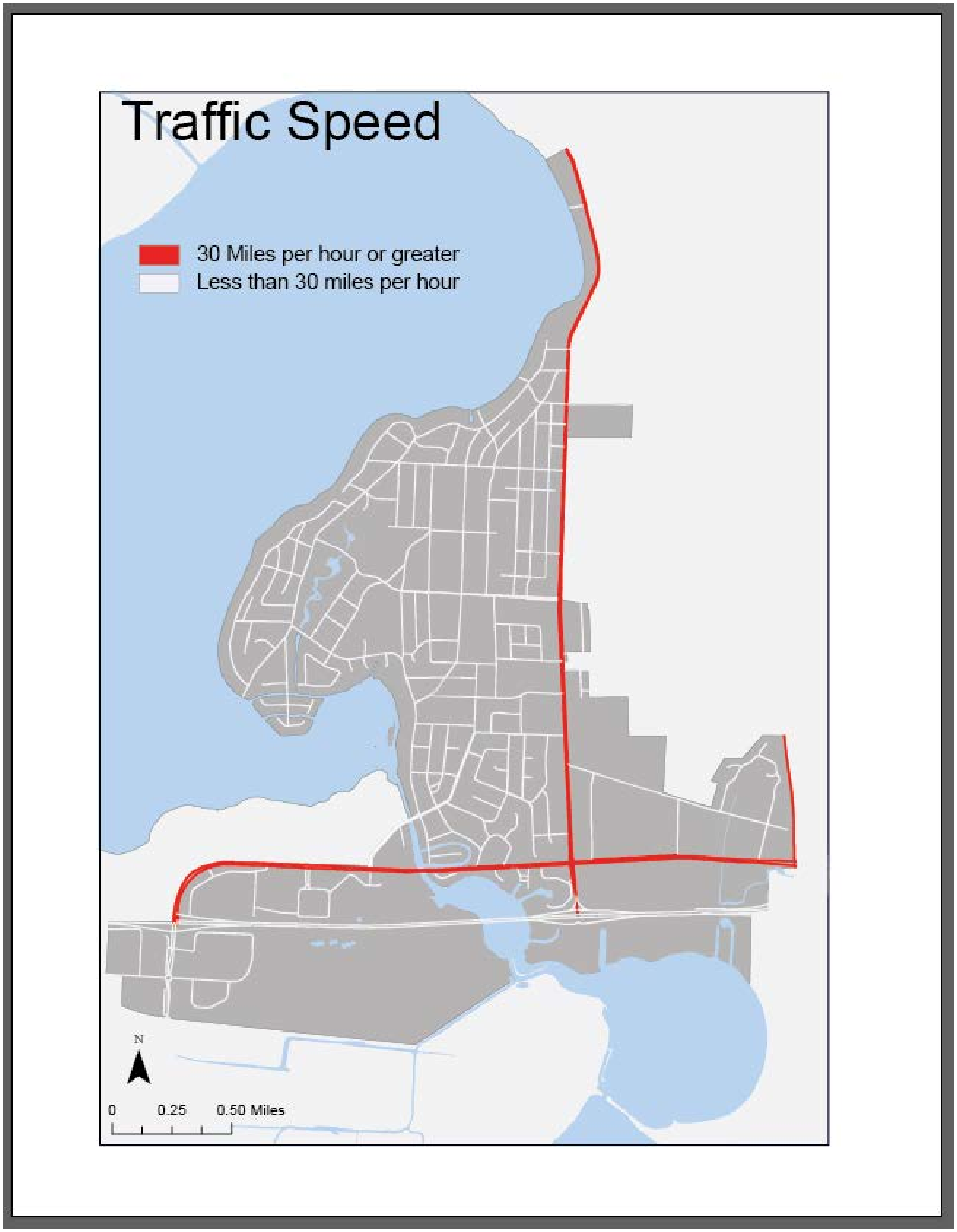
Appendix:



Traffic Speed
30 Miles per hour or greater
Less than 30 miles per hour
N
0
0.25
0.50 Miles


Traffic Volume
More than 4000 daily vehicles
Fewer than 4000 daily vehicles
N
0
0.25
0.50 Miles


Bike Routes in Monona
Bike Path or Shared Bike Lane
No Bike Path
N
0
0.25
0.50 Miles


Sidewalks
in Monona
Sidewalks
No Sidewalks
N
0
0.25
0.50 Miles


Road Grade
Scores
Road Grade Values
Slope >= 7%
Slope < 7%
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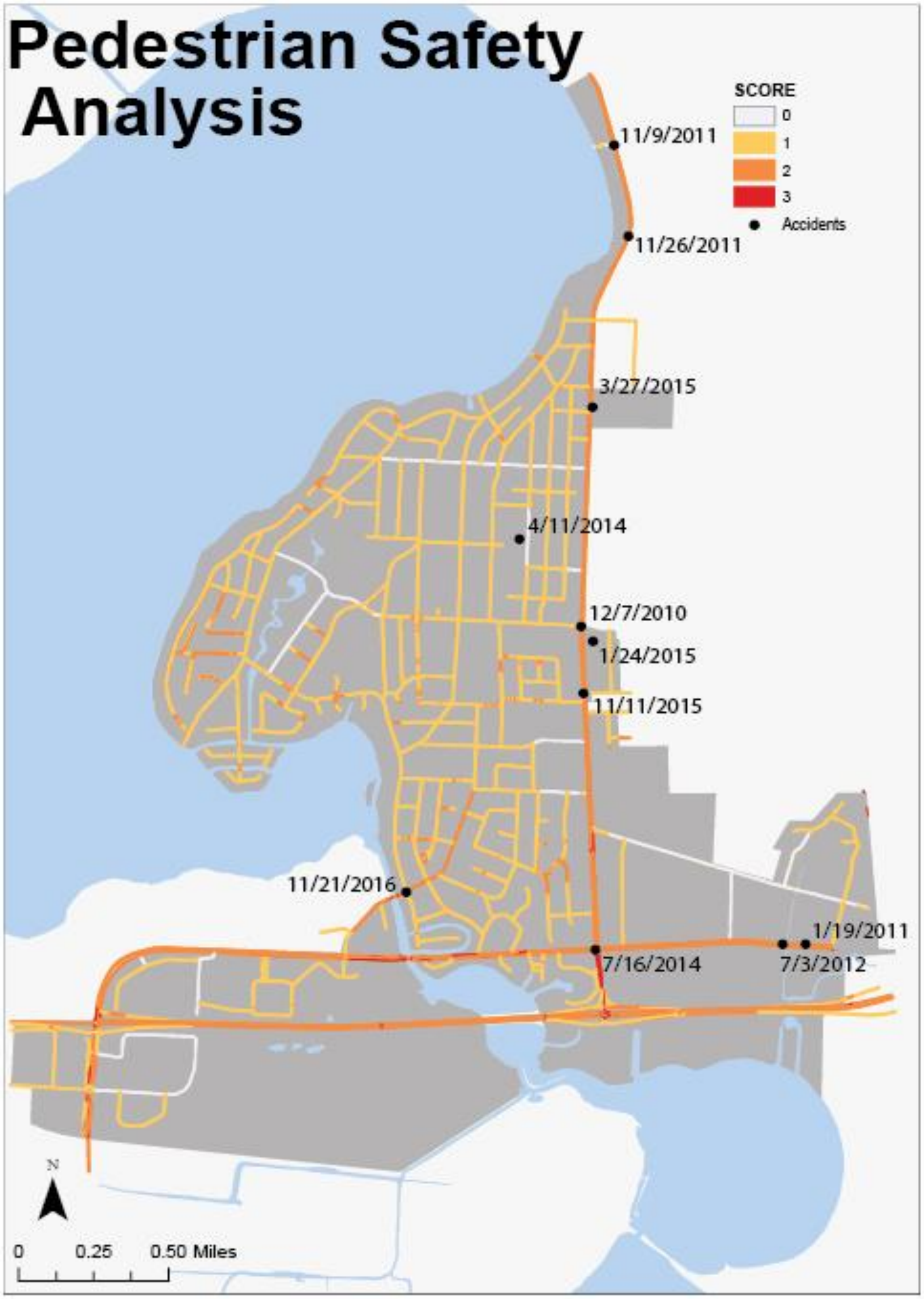
0
0.25
0.5 Miles


Pedestrian Safety
Analysis
SCORE
0
1
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Accidents
11/9/2011
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4/11/2014
12/7/2010
1/24/2015
11/11/2015
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Pedestrian Safety Analysis
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Bicycle Safety Analysis
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Bike Accidents
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3/28/2015
11/21/2011
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Bicycle Safety Analysis
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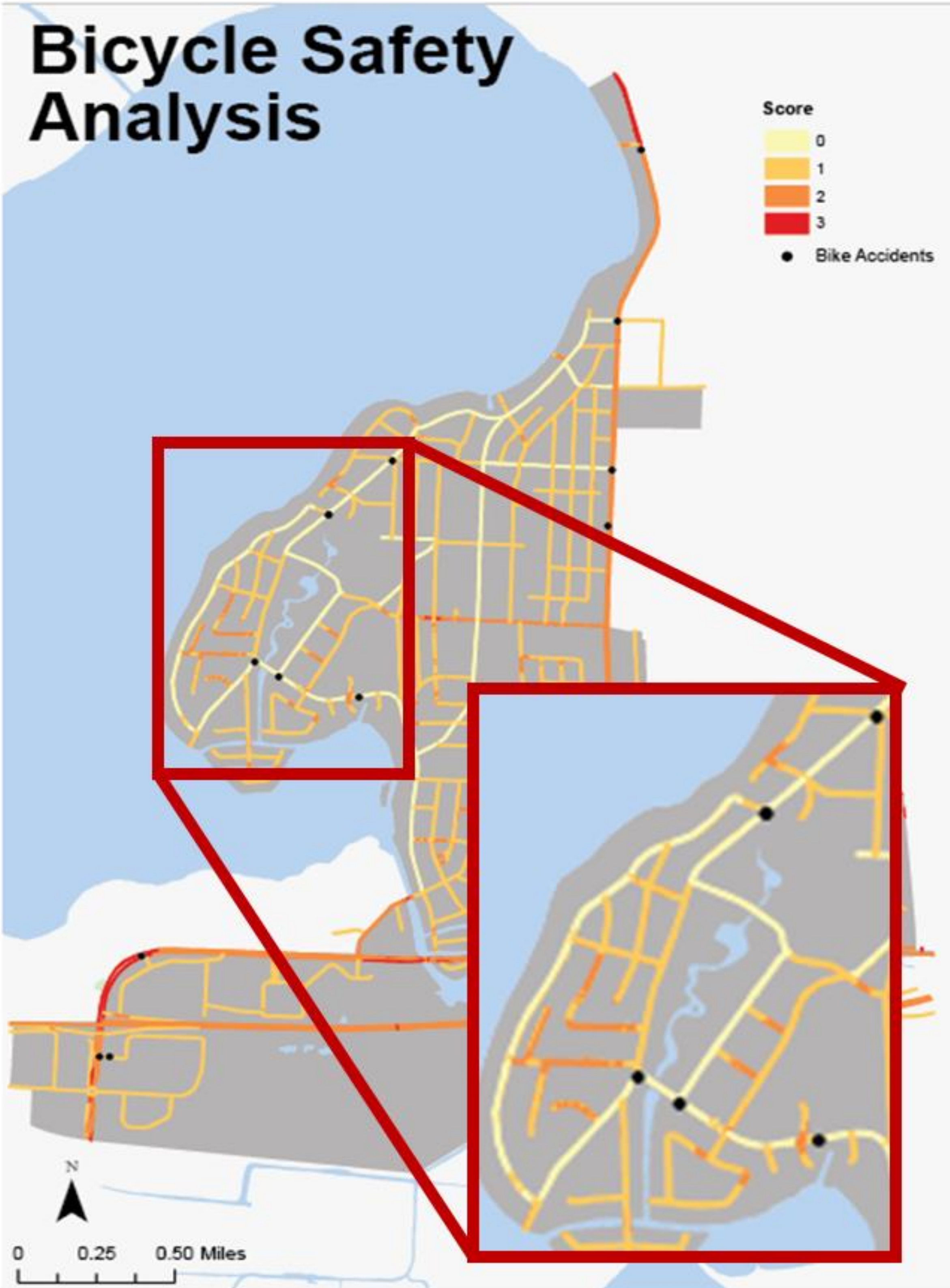

Bicycle Safety Analysis
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Identifying and Prioritizing Inefficiencies in Monona's Pedestrian Network

Geography 578

Final Report

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Objective

In the current City of Monona Comprehensive Plan, Monona plans to "create an environment conducive to pedestrians" and "provide safe and efficient access between neighborhoods, schools, employment and service centers, parks and shopping" (City of Monona Comprehensive Plan 2016). The city of Monona does not currently have enough sidewalk coverage to provide efficient pedestrian access to key destinations. Working through the UniverCity Alliance, the goal of this project was to analyze and prioritize network inefficiencies in pedestrian routes within the City of Monona and to use that data to recommend where additional sidewalks could be placed to increase the number of efficient pedestrian routes.

Introduction

Background

Pedestrians want the routes to their destinations to be short and low-stress. Generally, Americans are willing to walk 400 feet to ¼ mile to run an errand, and 10% of Americans are willing to walk ½ mile (Southworth 1997). The Wisconsin Guide to Pedestrians Best Practices data suggests people in Wisconsin will walk farther than that. It says that only 41% of walking trips in Wisconsin are less than 2 miles long, and the average walking trip in Wisconsin is 1.3 miles. Pedestrians are more likely to walk when they have a low-stress possibility, such as a sidewalk (Saelens and Handy 2008). Winters et al. found in a survey of bicyclists that although the bicyclists did detour from the shortest route to find lower stress routes, they wouldn't detour very far: 75% of routes were within 10% of the shortest route, and 90% were within 25% of the shortest route (Winters et al. 2010). We have not found a study in the literature that surveyed pedestrian detour ratios, and therefore are using the bicyclist survey to assume that if the low-stress pedestrian or bike route distance is more than 25% longer than the direct driving route, it won't be used.

Study area

In 2013 the City of Monona retained a consultant to assess the city's needs and to create a multi-year strategic plan for improvement. The city surveyed to its residents to gather information about their needs and aspirations. The results indicated, among other things, a lack of sidewalks, barriers to sidewalk use, and a lack of pedestrian accessibility to places around the city. Over 40% of participants mentioned environmental concerns having to do with the pedestrian or bike networks. Other residents indicated concerns about the networks for a variety of reasons ranging from safety to access to sparsely spread retail areas (Citizen Survey Results 2013). The city adopted a strategic plan to address the key issues illuminated by the survey, including improvements to pedestrian networks (Strategic Plan 2013).

We selected the City of Monona as our study area because of the community and government interest in evaluating and enhancing the connectivity of their pedestrian network. The area is small and contained, which makes the goals of the project attainable within our time frame.

Methodology

To find the greatest inefficiencies in Monona's pedestrian network, there were several definitions and parameters that had to be established. To calculate network efficiency, it was first necessary to know where people need to travel and where people begin these travels. Once these locations were defined, the next step was to determine if the shortest routes between them are efficient. The efficiency criteria had to be defined in the context of this project. Finally, once defined, the criteria needed to be applied to the data through a network analysis to produce a result. ArcGIS was used to complete all stages of this project.

The first step to solving this problem was to get a better sense of Monona's transportation network by establishing a base map and shape layer. A motorway layer was constructed from data provided by the UniverCity Alliance. The motor layer was selected because it is the most complete transportation network, and because it forms the baseline for most other transportation networks. The motor layer was clipped to the Monona city boundary to form the study area base map (Figure 1).

The next step was to create the pedestrian network data layer. Data was again provided through UniverCity Alliance. The data was checked using Google imagery and the shapefile was edited to reflect any necessary updates. The pedestrian shapefile was overlaid with the motor layer. A new attribute field was created in the motor layer to identify motor segments with associated sidewalks. The field was populated with a simple "yes" (presence of sidewalks) or "no" (absence of sidewalks). Since presence or absence was the only sidewalk data necessary, the original sidewalk layer was removed. Now a single layer, comprised of both the motor and

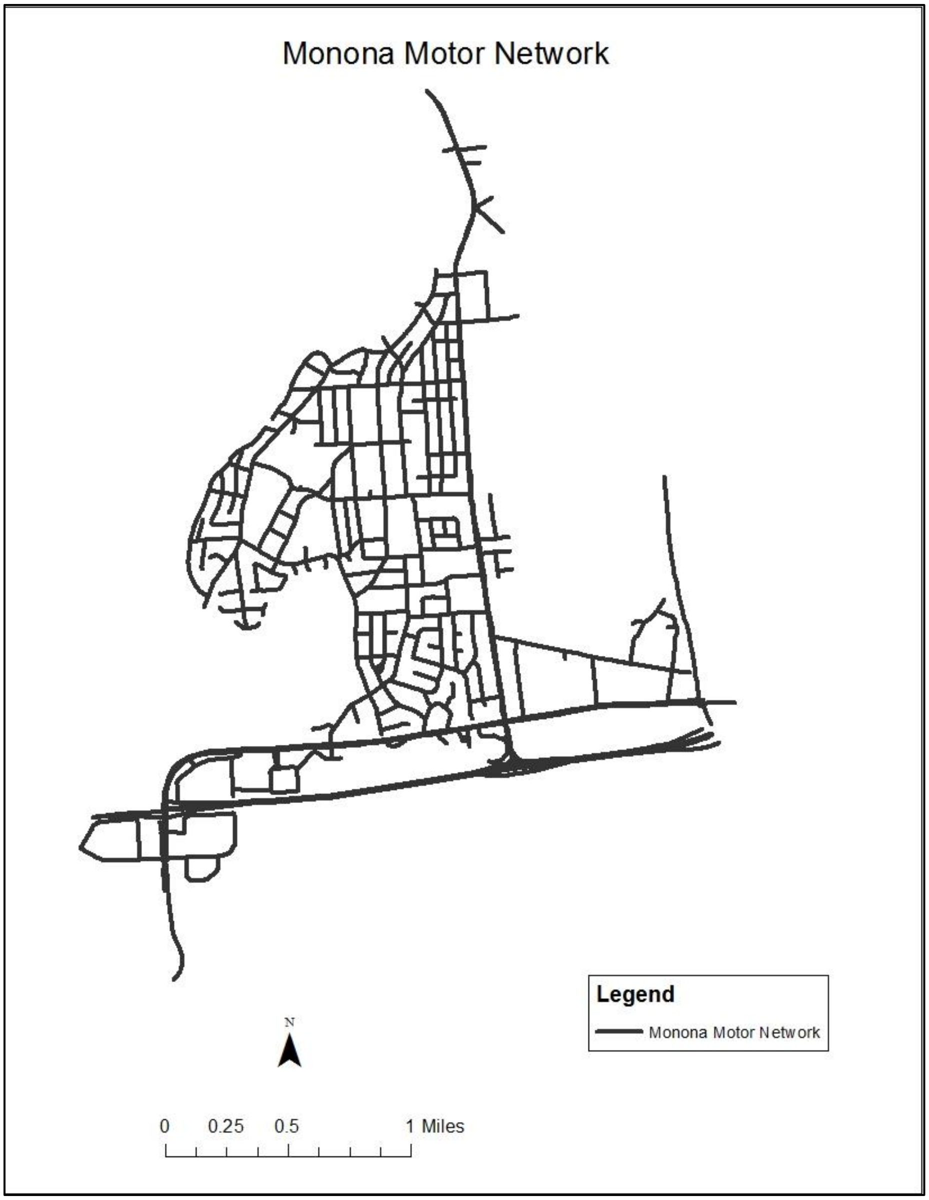

Figure 1: Map of Monona motor network.

pedestrian networks, formed the basemap. To perform a network analysis, data must be in specific formats. For this project, the data was all stored in a file geodatabase. The data also had to be formed into a single network dataset (Figure 2). The newly created multimodal (motor and pedestrian) network was used to create a network dataset. Once built, the network dataset allows the user to perform a number of network specific analyses. Once the network dataset was built, the problem of starting and ending points was addressed. A list of key destinations around Monona was created using a list from the UW-Madison Department of Urban and Regional

Figure 2: Map of Multimodal Network

Planning report, "Going for Silver: A Plan for the City of Monona to Reach Silver Status as a Bicycle Friendly Community with the League of American Bicyclists" (2016). In general, major government buildings, public parks and facilities, major shopping areas, and schools were chosen. An attempt was made to choose locations that were spread throughout Monona. This was meant to utilize more of the network. The addresses of these locations were used to place them on the base map. Because network locations need to be attached to the network for successful analysis, the key destinations were generalized and placed on the nearest network junction (intersection). These were renamed "Destinations" and added to the network dataset (Figure 3).

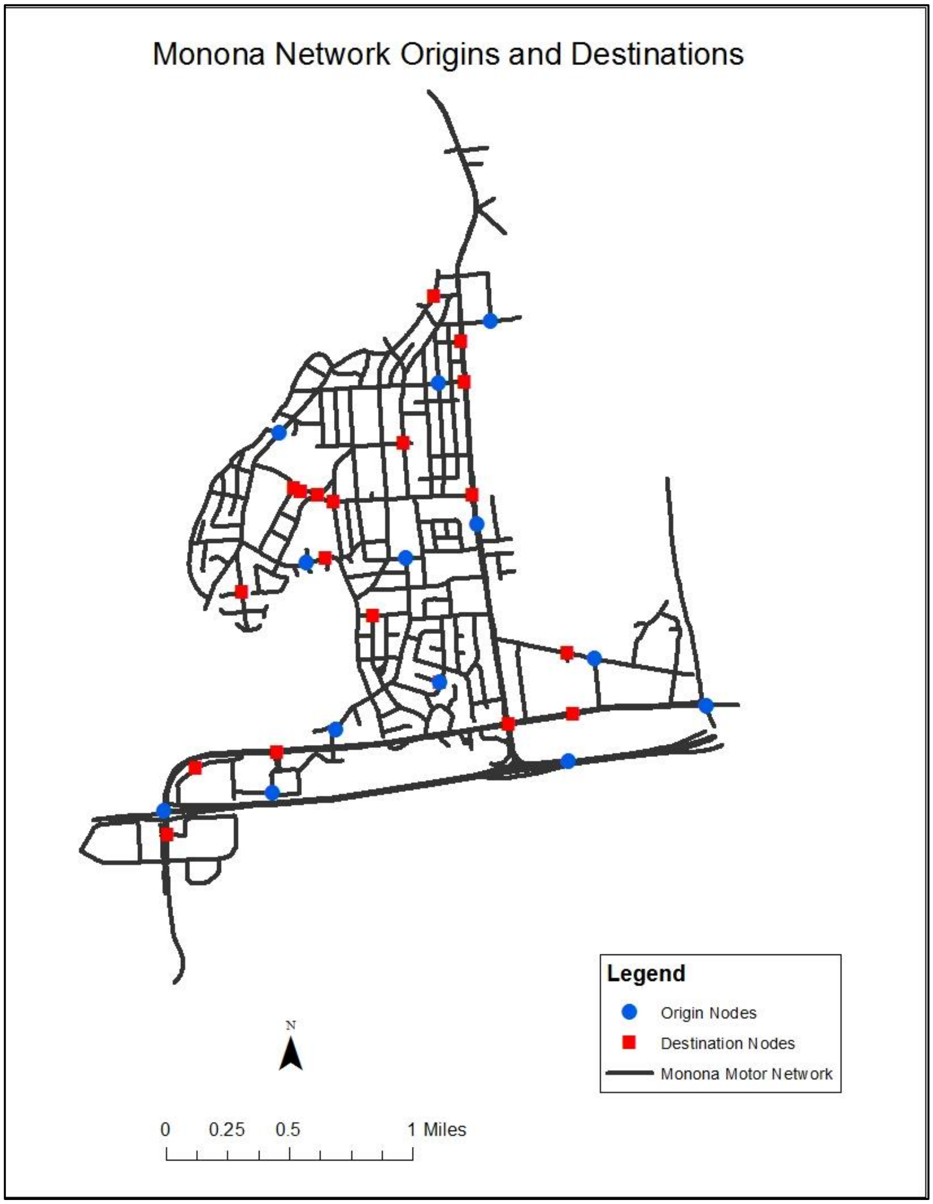

Figure 3: Map of Origins and Destinations

Defining starting points was more difficult. The goal was to approximate where people would start their trips, however this was not straight forward. Originally neighborhoods seemed like logical starting points. There were a few problems with using neighborhoods. First, determining where one neighborhood begins and one ends can be very subjective. Second, finding data on neighborhoods can be difficult. Third, people don't always travel directly from home. It was decided to use census block groups because they provide a relatively even spread of starting points around the city. To create points from polygons the centroids were calculated for each block group to approximate different starting points (Figure 4). Once again, the resulting points did not match exactly to the network so they were generalized and relocated to the nearest network junction. The points were renamed “Origins” and added to the network dataset (Figure 3).

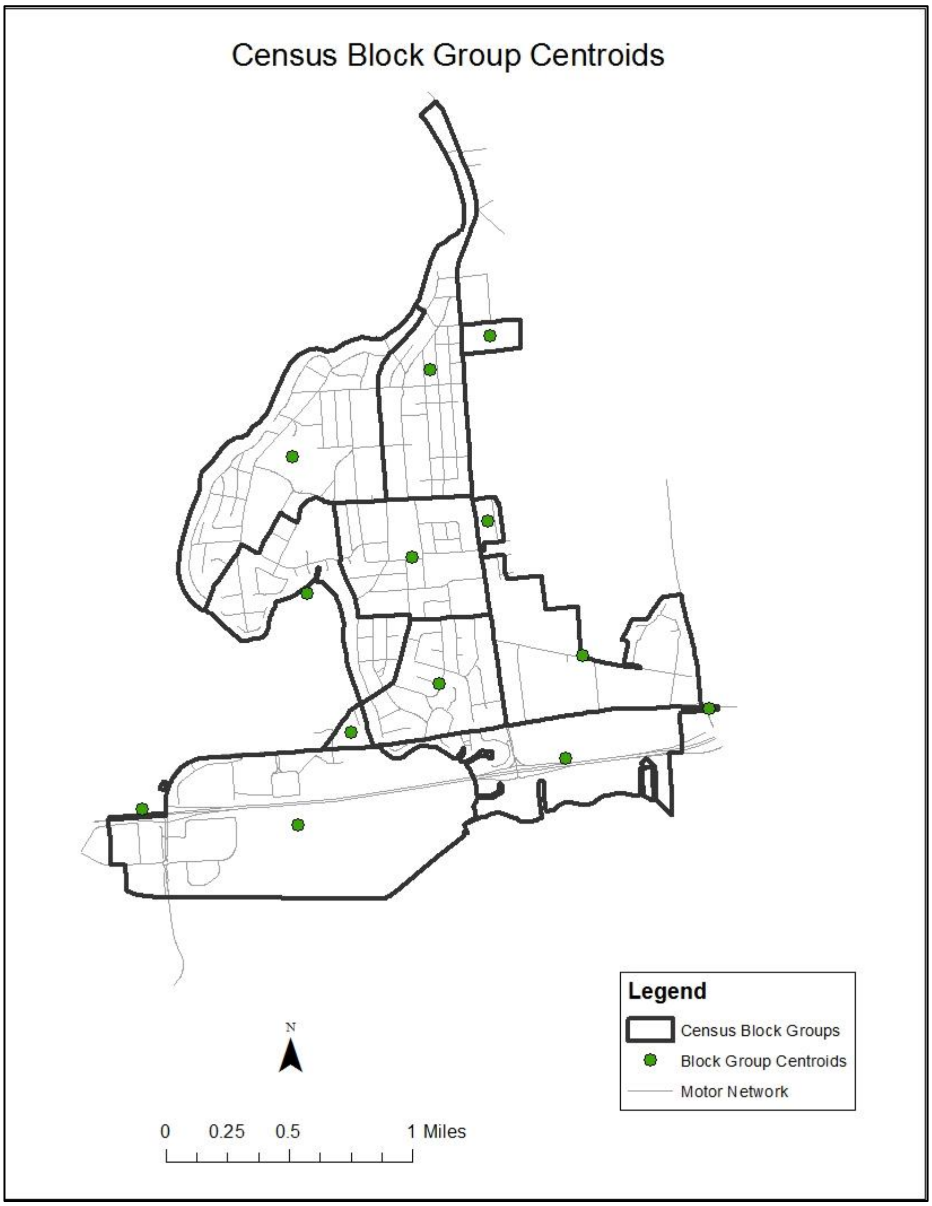

Figure 4: Map of Census Block Group Centroids

Once the network and network locations were set, the efficiency criteria needed to be determined. In other words, how would travel cost be assessed? Cost can be many different things depending on project goals. For example, "time," or how long it takes to travel a route on a network, could be the cost. For the purposes of this project the cost was "length," or how far people had to travel to get from origin to destination.

Using existing literature, it was determined that if pedestrian travel distance is more than 125% of the direct driving route, it is less likely to be used (Winter et al. 2010). It was also determined that if a route is considered "high-stress" it is less likely to be used (Mekuria and Furth 2012). For this analysis, high-stress was defined as network segments that lack sidewalks. To limit "high-stress" routes, the network was weighted to penalize segments that lack sidewalks. We used a scaled cost of "1.25 * Length" for segments without sidewalks to simulate "High-Stress" route avoidance. If people are generally willing to walk up to 125% further that the driving distance, it was reasoned that people would also walk 125% further to avoid high-stress routes by staying on sidewalks.

Once the network and efficiency criteria were set, the next step was to perform the network analysis. A shortest path analysis from each origin to each destination was conducted. The program used the network weights "length * 1" for segments with sidewalk and "length * 1.25" for segments without sidewalks, to find the shortest routes. For example, a 100 meter long segment with sidewalk would have a weighted length of 100 meters. A 100 meter segment without sidewalks would have a weighted length of 125 meters. This weighting penalizes the "high-stress" segment, making it potentially less costly to travel a greater spatial distance on a route with sidewalks. Since people will generally not go out of their way more than 25%, if there were no sidewalk routes under 125% of the high-stress route, the high stress route was still used as the shortest path. Locating these areas was the goal of the analysis. These areas represent locations where the addition of sidewalks would make the shortest path also a low stress path. The combination of short and low-stress is ideal for pedestrians. A table of results of this analysis can be found in Appendix A. A map was created which shows segments which are the shortest route but lack sidewalks (Figure 5).

The final step was to analyze how many times each of these segments was used during the analysis. This provided an idea of areas with potential high pedestrian traffic that also lacked sidewalks. The shortest path analysis produced 234 different routes between origins and destinations. These routes had significant overlap. To determine how often a segment was utilized by different routes, we created a new field with a default value of 0. Each time a line segment was used as part of a route the value was increased by 1. This was done for each of the

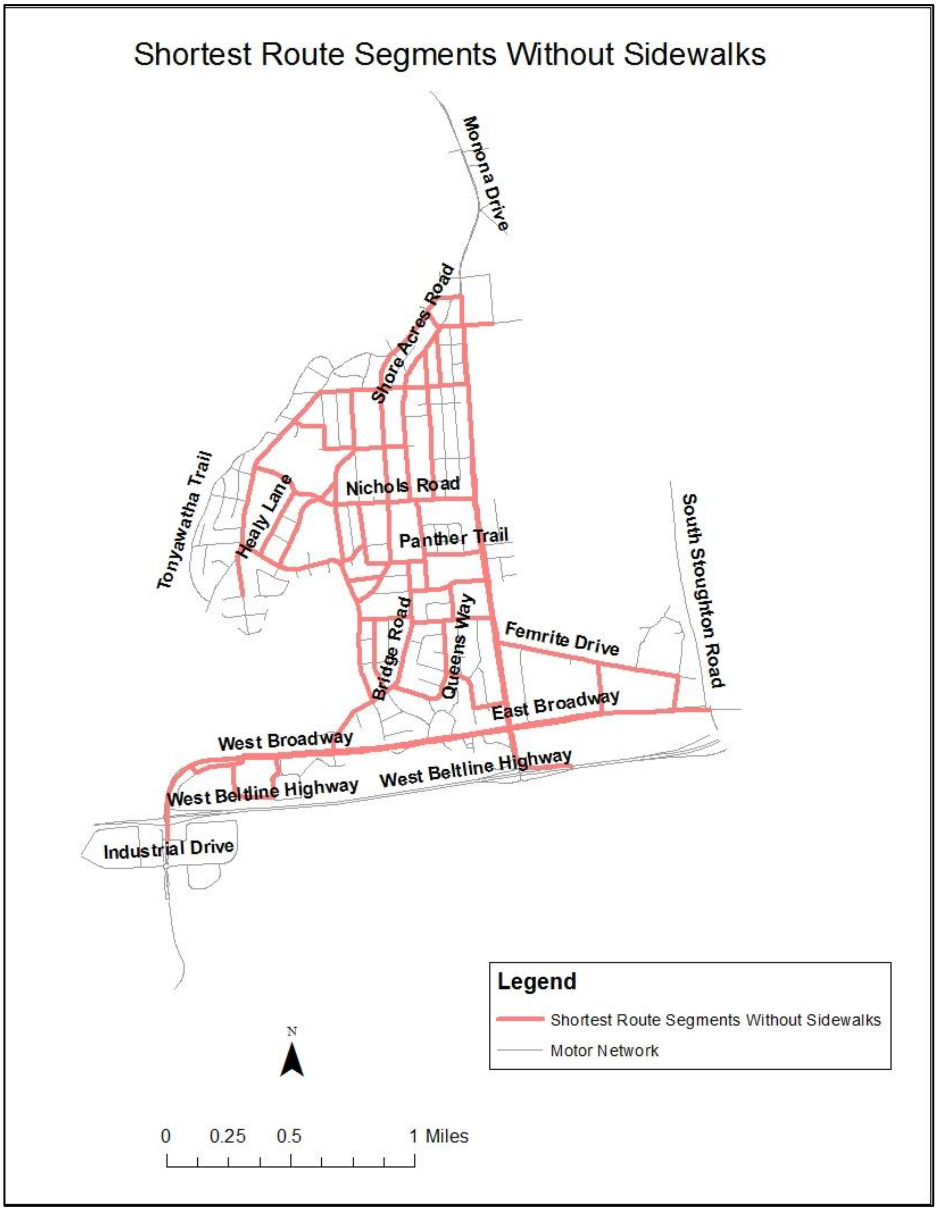

Figure 5: Map of route segments without sidewalks

234 routes. The top nine results are reported in Table 1 below. The complete table of results can be found in Appendix B. A map was created to illustrate the most used segments (Figure 6).

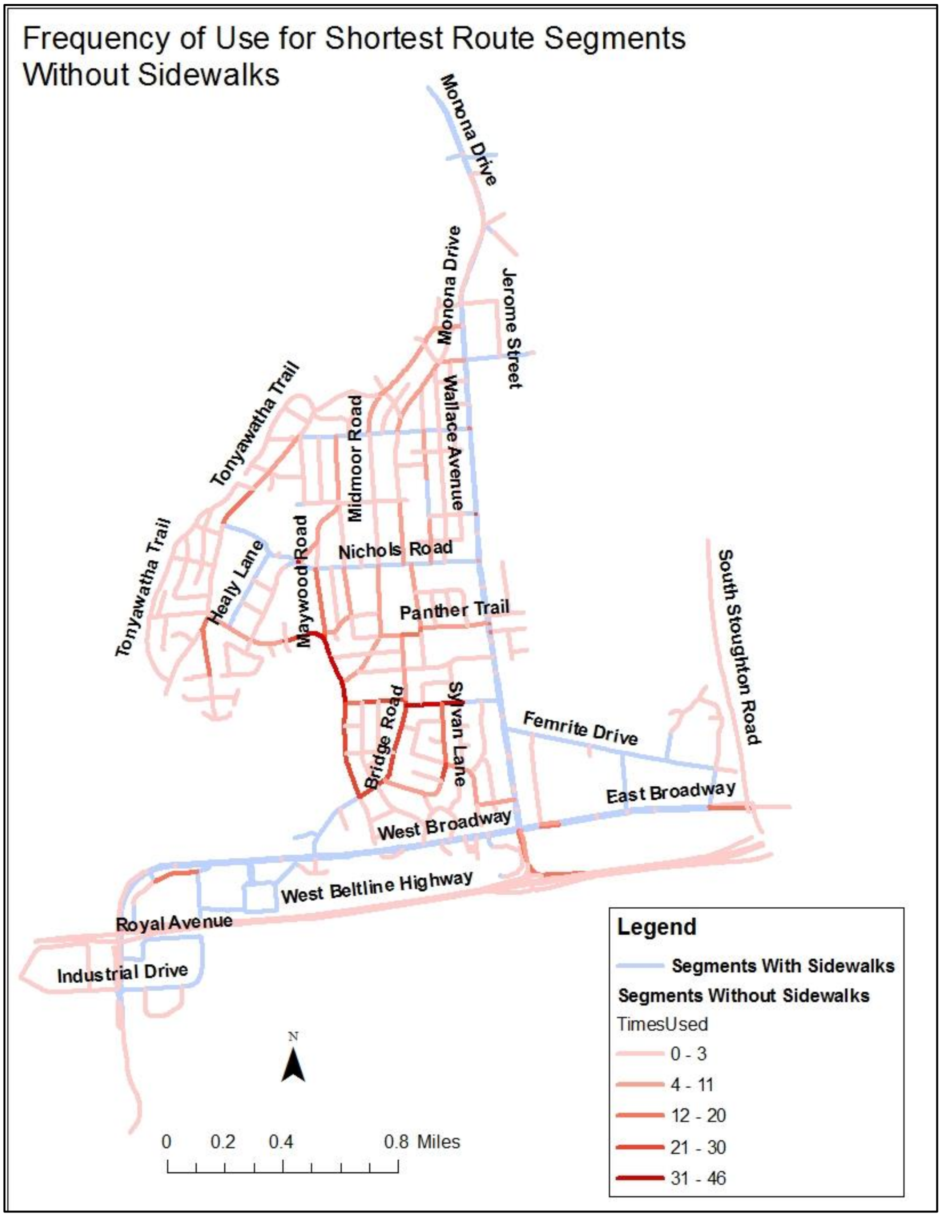

Figure 6: Map of frequency of use for shortest route segments without sidewalks

Results

The most used segment in the network was used 57 times. However, this segment had a sidewalk present. Since our goal was to identify inefficient areas, we focused on places without sidewalk. Figure 7 displays all the road segments that have no sidewalk or bike lanes that are used as a shortest route path. Since these roads have neither, they should be prioritized as important areas to look at. 136 of the 670 road segments fit the parameters of being used on the shortest route and having no sidewalk or bike path. That amounts to around 20% of the road

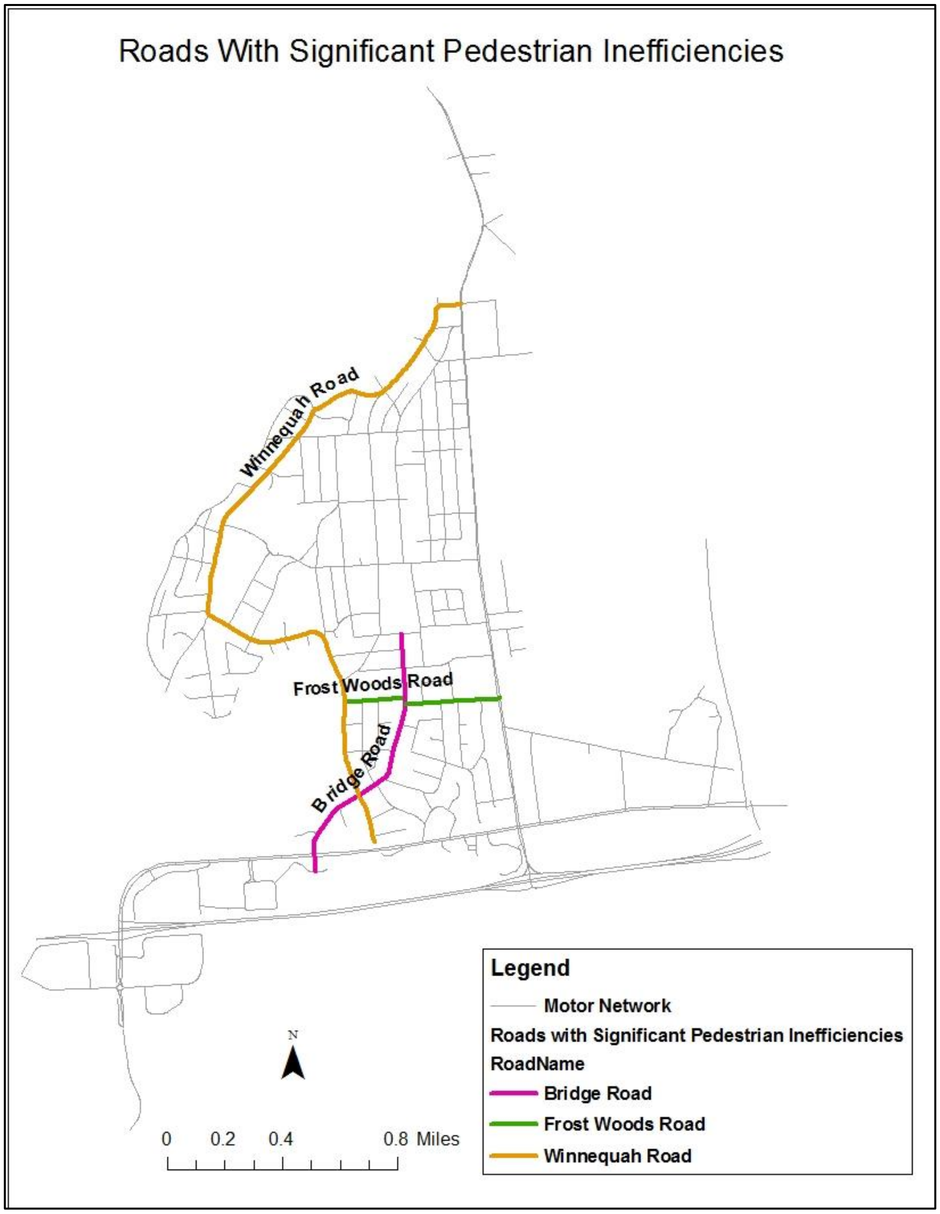

Figure 7: Map of roads with significant inefficiencies.

segments where pedestrians and bikers would most likely want to avoid when traveling. If given the option of an easier route and that route being less than 125% longer of the original route, pedestrians and bikers would opt to not use the paths without the sidewalk or bike path. The table is arranged by roads so continuous polylines can be identified. Most important, though, is the number of times the route is used going to every destination possible.

The top 9 most used segments formed two distinct, contiguous groups along two roads, Frost Woods and Winnequah (Table 1). Because there were over 600 individual segments in the network, it was very surprising and interesting for the top 9 to form two cohesive groups. Beyond the top 9 most used segments, Frost Woods and Winnequah road had more segments that were used often and had no sidewalk or bike route. Frost Woods has 8 segments total without sidewalk or a bike path and Winnequah has an astonishing 26 segments needing to be addressed. Another area of concern is Bridge Road. The most used segment of Bridge Road was used 30 times making it come in as the 11th most used road segment on the shortest route analysis. There is a total of 9 segments from Bridge Road that need to be addressed. Half of these segments are used 20 or more times to go to popular destinations.

Table 1: Top 9 Shortest Route Segments Used Without Sidewalks

Rank	Road Name	Times Used
1	Winnequah Road	46
2	Winnequah Road	42
3	Winnequah Road	39
4	Frost Woods Road	37
5	Frost Woods Road	36
6	Frost Woods Road	36
7	Frost Woods Road	36
8	Frost Woods Road	36
9	Winnequah Road	34

Another interesting thing to look at are intersections. There are three intersections that are used during the shortest route analysis that don’t have a crosswalk. They are Monona Drive where it intersects West Dean Avenue, Saint Teresa Terrace, and Nichols Road. Simply painting a crosswalk in these spots could have a large impact on the shortest route. Adding sidewalks to these sections would decrease the cost by 25%, making them more efficient for pedestrian travel. Since these are also the most used segments, the improvement would impact a greater number of pedestrian trips.

Conclusion

Based on this analysis, adding sidewalks to the identified sections of Winnequah, Frost Woods, and Bridge Roads should be beneficial to pedestrian travel efficiency in Monona. Adding sidewalks to these sections would decrease the cost of travel by 25%, making them more efficient for pedestrian travel. Since these are also the most used segments, the improvement should impact a greater number of pedestrian trips.

Future research and analysis should focus on the multitude of other factors which affect pedestrian travel. The integration of public transportation into this analysis could create a more realistic model by incorporating bus routes and stops that people use to augment walking trips. Combining the results of safety related analysis could shed more light on other factors affecting stress and might provide useful insights that could affect how networks are weighted in this type of network analysis. Future work could also expand the number of origins and destinations to incorporate more of the network in the analysis. The final, and important aspect of this project that could be addressed in the future is the determination of route origins, or starting points. Using population density data might simulate neighborhood or residential areas better. Without knowing where people are starting a trip it is difficult to know which route they will travel.

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Appendix A: Shortest Routes Between Origins and Destinations

Route (Origin - Destination)	Total Weighted Length (m)
Block Group 1 - Wal-Mart	190.28
Block Group 1 - South Towne Shopping Center	491.22
Block Group 1 - WPS	1035.98
Block Group 1 - Bridge Road Park	2635.28
Block Group 1 - PicknSave	2652.04
Block Group 1 - Frost Woods Park	2692.11
Block Group 1 - Ahuska Park	3132.69
Block Group 1 - Maywood Park	3253.51
Block Group 1 - Nuestro Mundo School	3648.88
Block Group 1 - Roselawn Memorial Park (Cemetery)	3761.78
Block Group 1 - Public Library	3771.70
Block Group 1 - Community Center	3944.87
Block Group 1 - Nichols Elementary School	4169.04
Block Group 1 - Immaculate Heart of Mary School	4373.50
Block Group 1 - Oneida Park	4497.46
Block Group 1 - Monona Municipal Golf Course	4969.19
Block Group 1 - Monona Grove High School	5249.94
Block Group 1 - Stone Bridge Park	5669.37
Block Group 2 - Monona Grove High School	331.77
Block Group 2 - Monona Municipal Golf Course	613.58
Block Group 2 - Stone Bridge Park	629.25
Block Group 2 - Nichols Elementary School	1398.44
Block Group 2 - Immaculate Heart of Mary School	1521.47
Block Group 2 - Nuestro Mundo School	2360.99
Block Group 2 - Public Library	2447.53
Block Group 2 - Community Center	2620.70
Block Group 2 - Roselawn Memorial Park (Cemetery)	2909.67
Block Group 2 - Maywood Park	2973.20
Block Group 2 - PicknSave	3007.75
Block Group 2 - Bridge Road Park	3182.88
Block Group 2 - Frost Woods Park	3186.03
Block Group 2 - Ahuska Park	3488.41
Block Group 2 - Oneida Park	3607.41
Block Group 2 - WPS	4531.84
Block Group 2 - South Towne Shopping Center	5197.63
Block Group 2 - Wal-Mart	5710.04
Block Group 3 - Roselawn Memorial Park (Cemetery)	195.57
Block Group 3 - Ahuska Park	546.42
Block Group 3 - PicknSave	1025.02
Block Group 3 - Nichols Elementary School	1724.32
Block Group 3 - Bridge Road Park	1843.08
Block Group 3 - Frost Woods Park	1899.70
Block Group 3 - Monona Municipal Golf Course	2506.96
Block Group 3 - WPS	2639.74
Block Group 3 - Immaculate Heart of Mary School	2642.95

Block Group 3 - Maywood Park	2668.47
Block Group 3 - Nuestro Mundo School	2686.87
Block Group 3 - Monona Grove High School	2787.70
Block Group 3 - Public Library	2809.69
Block Group 3 - Community Center	2982.87
Block Group 3 - South Towne Shopping Center	3305.54
Block Group 3 - Stone Bridge Park	3329.86
Block Group 3 - Wal-Mart	3817.95
Block Group 3 - Oneida Park	3912.42
Block Group 4 - WPS	304.44
Block Group 4 - South Towne Shopping Center	821.25
Block Group 4 - Wal-Mart	1455.03
Block Group 4 - Bridge Road Park	1904.08
Block Group 4 - PicknSave	1920.49
Block Group 4 - Frost Woods Park	1960.91
Block Group 4 - Ahuska Park	2401.15
Block Group 4 - Maywood Park	2522.32
Block Group 4 - Nuestro Mundo School	2917.68
Block Group 4 - Roselawn Memorial Park (Cemetery)	3030.58
Block Group 4 - Public Library	3040.50
Block Group 4 - Community Center	3213.67
Block Group 4 - Nichols Elementary School	3437.84
Block Group 4 - Immaculate Heart of Mary School	3642.30
Block Group 4 - Oneida Park	3766.26
Block Group 4 - Monona Municipal Golf Course	4238.00
Block Group 4 - Monona Grove High School	4518.74
Block Group 4 - Stone Bridge Park	4938.17
Block Group 5 - Nichols Elementary School	224.01
Block Group 5 - Monona Municipal Golf Course	1005.19
Block Group 5 - Immaculate Heart of Mary School	1142.64
Block Group 5 - Nuestro Mundo School	1186.56
Block Group 5 - Monona Grove High School	1285.94
Block Group 5 - Roselawn Memorial Park (Cemetery)	1306.19
Block Group 5 - Public Library	1309.39
Block Group 5 - PicknSave	1404.28
Block Group 5 - Community Center	1482.56
Block Group 5 - Bridge Road Park	1580.74
Block Group 5 - Frost Woods Park	1583.89
Block Group 5 - Maywood Park	1736.83
Block Group 5 - Stone Bridge Park	1828.09
Block Group 5 - Ahuska Park	1884.94
Block Group 5 - Oneida Park	2606.73
Block Group 5 - WPS	2929.70
Block Group 5 - South Towne Shopping Center	3595.50
Block Group 5 - Wal-Mart	4107.90
Block Group 6 - Frost Woods Park	792.75
Block Group 6 - Maywood Park	874.68
Block Group 6 - Nuestro Mundo School	1040.87

Block Group 6 - Nichols Elementary School	1065.85
Block Group 6 - Public Library	1163.69
Block Group 6 - Immaculate Heart of Mary School	1194.59
Block Group 6 - Community Center	1336.87
Block Group 6 - Bridge Road Park	1369.76
Block Group 6 - Roselawn Memorial Park (Cemetery)	1842.48
Block Group 6 - Monona Municipal Golf Course	1866.00
Block Group 6 - PicknSave	1940.56
Block Group 6 - Oneida Park	2118.63
Block Group 6 - Monona Grove High School	2146.75
Block Group 6 - WPS	2190.20
Block Group 6 - Ahuska Park	2421.22
Block Group 6 - Stone Bridge Park	2581.51
Block Group 6 - South Towne Shopping Center	2855.99
Block Group 6 - Wal-Mart	3368.40
Block Group 7 - WPS	520.88
Block Group 7 - Bridge Road Park	1078.76
Block Group 7 - Frost Woods Park	1135.58
Block Group 7 - South Towne Shopping Center	1186.68
Block Group 7 - PicknSave	1363.30
Block Group 7 - Maywood Park	1696.99
Block Group 7 - Wal-Mart	1699.08
Block Group 7 - Ahuska Park	1843.96
Block Group 7 - Nuestro Mundo School	2092.35
Block Group 7 - Public Library	2215.17
Block Group 7 - Community Center	2388.35
Block Group 7 - Roselawn Memorial Park (Cemetery)	2446.99
Block Group 7 - Nichols Elementary School	2612.52
Block Group 7 - Immaculate Heart of Mary School	2816.98
Block Group 7 - Oneida Park	2940.94
Block Group 7 - Monona Municipal Golf Course	3412.67
Block Group 7 - Monona Grove High School	3693.42
Block Group 7 - Stone Bridge Park	4112.84
Block Group 8 - PicknSave	766.98
Block Group 8 - Ahuska Park	1247.63
Block Group 8 - Bridge Road Park	1806.58
Block Group 8 - Roselawn Memorial Park (Cemetery)	1880.82
Block Group 8 - WPS	2370.43
Block Group 8 - Nichols Elementary School	2385.59
Block Group 8 - Frost Woods Park	2560.73
Block Group 8 - South Towne Shopping Center	3036.57
Block Group 8 - Monona Municipal Golf Course	3176.44
Block Group 8 - Immaculate Heart of Mary School	3304.23
Block Group 8 - Maywood Park	3329.51
Block Group 8 - Nuestro Mundo School	3348.15
Block Group 8 - Monona Grove High School	3457.19
Block Group 8 - Public Library	3470.97
Block Group 8 - Wal-Mart	3548.97

Block Group 8 - Community Center	3644.15
Block Group 8 - Stone Bridge Park	3999.35
Block Group 8 - Oneida Park	4573.45
Block Group 9 - Ahuska Park	994.49
Block Group 9 - Roselawn Memorial Park (Cemetery)	1326.46
Block Group 9 - PicknSave	1475.14
Block Group 9 - Bridge Road Park	2525.20
Block Group 9 - Nichols Elementary School	2855.20
Block Group 9 - Frost Woods Park	3030.58
Block Group 9 - WPS	3091.19
Block Group 9 - Monona Municipal Golf Course	3637.84
Block Group 9 - South Towne Shopping Center	3757.33
Block Group 9 - Immaculate Heart of Mary School	3773.84
Block Group 9 - Maywood Park	3799.36
Block Group 9 - Nuestro Mundo School	3817.76
Block Group 9 - Monona Grove High School	3918.59
Block Group 9 - Public Library	3940.58
Block Group 9 - Community Center	4113.75
Block Group 9 - Wal-Mart	4269.74
Block Group 9 - Stone Bridge Park	4460.74
Block Group 9 - Oneida Park	5043.30
Block Group 10 - Monona Municipal Golf Course	180.11
Block Group 10 - Monona Grove High School	461.92
Block Group 10 - Immaculate Heart of Mary School	751.76
Block Group 10 - Stone Bridge Park	838.50
Block Group 10 - Nichols Elementary School	980.26
Block Group 10 - Nuestro Mundo School	1664.08
Block Group 10 - Public Library	1677.81
Block Group 10 - Community Center	1850.99
Block Group 10 - Maywood Park	2301.09
Block Group 10 - Roselawn Memorial Park (Cemetery)	2491.49
Block Group 10 - Frost Woods Park	2583.58
Block Group 10 - PicknSave	2589.58
Block Group 10 - Bridge Road Park	2764.71
Block Group 10 - Oneida Park	2837.70
Block Group 10 - Ahuska Park	3070.24
Block Group 10 - WPS	3985.73
Block Group 10 - South Towne Shopping Center	4651.52
Block Group 10 - Wal-Mart	5163.93
Block Group 11 - Community Center	693.96
Block Group 11 - Public Library	867.13
Block Group 11 - Nuestro Mundo School	989.95
Block Group 11 - Immaculate Heart of Mary School	1355.83
Block Group 11 - Oneida Park	1497.64
Block Group 11 - Monona Municipal Golf Course	1520.18
Block Group 11 - Maywood Park	1642.94
Block Group 11 - Monona Grove High School	1801.99
Block Group 11 - Stone Bridge Park	1867.05

Block Group 11 - Nichols Elementary School	1952.51
Block Group 11 - Frost Woods Park	2154.09
Block Group 11 - Bridge Road Park	3370.59
Block Group 11 - Roselawn Memorial Park (Cemetery)	3481.25
Block Group 11 - PicknSave	3579.34
Block Group 11 - WPS	3603.18
Block Group 11 - Ahuska Park	4059.99
Block Group 11 - South Towne Shopping Center	4268.98
Block Group 11 - Wal-Mart	4781.39
Block Group 12 - Bridge Road Park	0.00
Block Group 12 - PicknSave	1050.05
Block Group 12 - Frost Woods Park	1216.51
Block Group 12 - Ahuska Park	1530.71
Block Group 12 - WPS	1599.64
Block Group 12 - Roselawn Memorial Park (Cemetery)	1647.51
Block Group 12 - Nichols Elementary School	1784.45
Block Group 12 - Maywood Park	1985.28
Block Group 12 - South Towne Shopping Center	2265.44
Block Group 12 - Nuestro Mundo School	2380.64
Block Group 12 - Immaculate Heart of Mary School	2467.54
Block Group 12 - Public Library	2503.46
Block Group 12 - Monona Municipal Golf Course	2584.60
Block Group 12 - Community Center	2676.64
Block Group 12 - Wal-Mart	2777.84
Block Group 12 - Monona Grove High School	2865.35
Block Group 12 - Oneida Park	3229.23
Block Group 12 - Stone Bridge Park	3407.50
Block Group 13 - Maywood Park	176.72
Block Group 13 - Nuestro Mundo School	829.71
Block Group 13 - Public Library	938.78
Block Group 13 - Frost Woods Park	945.49
Block Group 13 - Community Center	949.15
Block Group 13 - Oneida Park	1067.23
Block Group 13 - Nichols Elementary School	1751.48
Block Group 13 - Immaculate Heart of Mary School	1782.98
Block Group 13 - Bridge Road Park	2162.00
Block Group 13 - WPS	2394.59
Block Group 13 - Monona Municipal Golf Course	2551.63
Block Group 13 - Roselawn Memorial Park (Cemetery)	2649.61
Block Group 13 - PicknSave	2747.70
Block Group 13 - Monona Grove High School	2832.38
Block Group 13 - Stone Bridge Park	3020.79
Block Group 13 - South Towne Shopping Center	3060.39
Block Group 13 - Ahuska Park	3228.36
Block Group 13 - Wal-Mart	3572.79

Appendix B: Shortest Route Segment Use in Order of Frequency

Street Name	Sidewalk Present?	Bike Lane/Path Present?	Segment Length (m)	Number of Times Used in Shortest Path Analysis
Bridge Road	yes	no	186	57
Bridge Road	yes	no	283	57
Bridge Road	yes	no	166	51
Winnequah Road	no	no	173	46
Monona Drive	yes	yes	60	46
Monona Drive	yes	yes	72	46
Monona Drive	yes	yes	90	46
Monona Drive	yes	yes	76	45
Monona Drive	yes	yes	140	45
Monona Drive	yes	yes	103	45
Monona Drive	yes	yes	72	45
Monona Drive	yes	yes	127	45
Winnequah Road	no	no	168	42
Unknown	yes	yes	695	41
Monona Drive	yes	no	35	40
Monona Drive	yes	yes	184	40
Monona Drive	yes	yes	75	40
Winnequah Road	no	no	220	39
Frost Woods Road	no	no	102	37
Frost Woods Road	no	no	32	36
Frost Woods Road	no	no	138	36
Frost Woods Road	no	no	151	36
Frost Woods Road	yes	no	141	36
Frost Woods Road	yes	no	147	36
Frost Woods Road	no	no	41	36
Femrite Drive	yes	no	466	34
Femrite Drive	yes	no	228	34
Winnequah Road	no	no	141	34
Nichols Road	no	no	8	34
Monona Drive	yes	yes	138	34
Monona Drive	yes	yes	129	34
Monona Drive	yes	yes	84	34
Nichols Road	yes	no	162	32
West Broadway	yes	yes	254	32
West Broadway	yes	yes	273	32
West Broadway	yes	no	89	31
West Broadway	yes	no	185	31
West Broadway Frontage Road	yes	no	19	31
Unknown	yes	no	333	31

Unknown	yes	no	254	31
Nichols Road	yes	no	64	30
Bridge Road	no	no	160	30
Nichols Road	yes	no	158	30
West Broadway	yes	no	60	29
West Broadway	yes	no	387	29
West Broadway	yes	no	107	29
Nichols Road	yes	no	205	28
Bridge Road	no	no	89	27
Winnequah Road	no	no	373	27
West Broadway	yes	yes	128	27
Winnequah Road	no	no	193	27
Winnequah Road	no	no	218	27
Bridge Road	no	no	58	27
West Broadway	yes	yes	271	27
West Broadway	yes	no	37	27
West Broadway	yes	no	60	27
Monona Drive	yes	yes	137	27
Monona Drive	yes	yes	130	27
Monona Drive	yes	yes	85	27
Nichols Road	yes	no	110	26
Nichols Road	yes	no	270	26
Maywood Road	no	no	46	26
Monona Drive	yes	yes	107	26
Monona Drive	yes	yes	81	26
Unknown	yes	yes	198	26
Femrite Drive	yes	no	267	25
Nichols Road	yes	no	237	24
Nichols Road	yes	no	138	24
Monona Drive	yes	yes	34	24
Nichols Road	yes	no	138	24
Monona Drive	yes	yes	184	24
Monona Drive	yes	yes	74	24
Frost Woods Road	no	no	131	23
Frost Woods Road	no	no	219	23
Winnequah Road	no	no	178	23
Winnequah Road	no	no	16	23
Sylvan Lane	no	no	144	23
Saint Teresa Terrace	yes	no	5	23
Saint Teresa Terrace	no	no	5	23
Monona Drive	yes	yes	218	23
Monona Drive	yes	yes	162	23
Bridge Road	yes	no	20	22

Bridge Road	no	no	234	21
Bridge Road	no	no	227	21
Bridge Road	no	no	167	21
Nichols Road	yes	no	113	21
Nichols Road	yes	no	116	21
Maywood Road	no	no	529	20
Monona Drive	yes	yes	20	20
East Coldspring Avenue	yes	no	277	19
Frost Woods Road	no	no	141	19
Sylvan Lane	no	no	180	19
Sylvan Lane	no	no	136	19
Sylvan Lane	no	no	176	19
Monona Drive	yes	yes	239	19
Monona Drive	yes	yes	138	19
Monona Drive	yes	yes	146	19
Monona Drive	yes	yes	91	19
Monona Drive	yes	yes	168	19
West Beltline Highway	no	no	181	18
East Broadway	no	yes	43	18
East Broadway	no	yes	306	18
West Beltline Highway	no	no	10	18
West Beltline Highway	no	no	403	18
West Beltline Highway	no	no	16	18
Monona Drive	yes	yes	128	18
Monona Drive	yes	yes	72	18
Monona Drive	yes	yes	68	18
Monona Drive	yes	yes	59	18
Monona Drive	no	yes	5	18
Monona Drive	no	yes	3	18
Monona Drive	yes	yes	73	18
Monona Drive	yes	yes	91	18
Unknown	yes	yes	218	18
Unknown	yes	yes	162	18
Winnequah Road	no	no	386	16
Unnamed	yes	no	212	16
East Broadway	yes	yes	164	16
Owen Road	yes	no	15	16
East Broadway	yes	yes	311	16
East Broadway	no	yes	145	16
WPS Drive	yes	no	161	16
WPS Drive	yes	no	43	16
Monona Drive	yes	yes	130	16
Monona Drive	yes	yes	66	16

West Dean Avenue	no	no	9	15
West Broadway Frontage Road	no	no	363	13
Nichols Road	yes	no	467	13
West Broadway	yes	no	20	13
Winnequah Trail	no	no	123	13
Pheasant Hill Road	no	no	49	13
Tecumseh Avenue	no	no	376	13
Lofty Avenue	yes	no	10	13
South Towne Drive	yes	no	68	13
South Towne Drive	yes	no	140	13
West Dean Avenue	yes	no	126	12
Monona Drive	no	no	133	12
Copps Avenue	no	no	21	12
West Broadway	yes	yes	245	12
West Broadway	yes	yes	194	12
West Broadway	yes	yes	114	12
West Broadway	yes	yes	74	12
West Broadway	yes	yes	326	12
Monona Drive	no	no	123	12
Panther Trail	no	no	164	12
Femrite Drive	yes	no	364	12
Copps Avenue	yes	no	312	12
Femrite Drive	yes	no	407	12
Monona Drive	yes	yes	147	12
Monona Drive	yes	yes	90	12
West Dean Avenue	yes	no	165	11
West Dean Avenue	yes	no	110	11
Winnequah Road	no	no	155	11
Winnequah Road	no	no	123	11
Frost Woods Road	yes	no	15	11
West Broadway Frontage Road	yes	no	123	11
Monona Drive	yes	yes	99	11
Monona Drive	yes	yes	98	11
Shore Acres Road	no	no	521	10
Winnequah Road	no	no	210	10
West Broadway	yes	yes	256	10
West Broadway	yes	yes	51	10
West Broadway	yes	yes	403	10
Winnequah Road	no	no	182	10
Midmoor Road	no	no	153	10
Bridge Road	no	no	238	10
East Coldspring Avenue	yes	no	10	10
West Dean Avenue	yes	no	108	9

West Dean Avenue	yes	no	124	9
West Dean Avenue	yes	no	125	9
West Dean Avenue	yes	no	121	9
West Broadway	yes	yes	10	9
East Broadway	yes	no	9	9
McKenna Road	no	no	402	9
Monona Drive	yes	yes	20	9
West Broadway	yes	no	53	8
West Broadway	yes	no	396	8
West Broadway	yes	no	258	8
Bridge Road	no	no	126	8
Bridge Road	no	no	154	8
Monona Drive	yes	yes	103	8
Monona Drive	yes	yes	205	8
Monona Drive	yes	yes	141	8
Monona Drive	yes	yes	172	8
Midmoor Road	no	no	393	7
West Dean Avenue	yes	no	212	7
Panther Trail	no	no	251	7
Panther Trail	no	no	163	7
McKenna Road	no	no	15	7
Winnequah Road	no	no	27	7
Owen Road	no	no	160	7
Midmoor Road	no	no	182	7
East Broadway	yes	yes	251	7
West Broadway	yes	yes	333	7
Midmoor Road	no	no	183	7
Panther Trail	no	no	128	7
Winnequah Road	no	no	124	7
Sylvan Lane	no	no	204	6
Winnequah Road	no	no	189	6
Kelly Place	no	no	77	6
Kelly Place	no	no	116	6
Maywood Road	no	no	371	6
McKenna Road	no	no	536	6
Schofield Street	no	no	170	6
Schofield Street	no	no	103	6
Schofield Street	yes	no	306	6
Schofield Street	no	no	164	6
Schofield Street	no	no	173	6
Pheasant Hill Road	no	no	236	6
West Broadway	yes	no	245	6
West Broadway	yes	no	194	6

Pheasant Hill Road	no	no	289	6
Kelly Place	no	no	72	6
Ford Street	no	no	353	6
West Broadway	yes	no	114	6
West Broadway	yes	no	227	6
West Broadway	yes	no	173	6
East Broadway	yes	yes	229	6
Monona Drive	no	no	255	6
Monona Drive	yes	no	14	6
Panther Trail	no	no	171	6
Nichols Road	no	no	5	6
Pflaum Road	yes	no	9	6
Parkway Drive	no	no	70	6
Shore Acres Road	no	no	71	6
Parkway Drive	no	no	166	6
East Broadway	yes	yes	443	6
Schofield Street	yes	no	46	6
Schofield Street	no	no	110	6
Monona Drive	yes	yes	280	6
Midmoor Road	no	no	341	5
West Dean Avenue	no	no	18	5
West Dean Avenue	yes	no	140	5
West Dean Avenue	yes	no	139	5
Winnequah Road	no	no	360	5
Shore Acres Road	no	no	196	5
Edna Taylor Parkway	yes	no	473	5
Winnequah Road	no	no	42	5
Winnequah Road	no	no	501	5
Shore Acres Road	no	no	125	4
Shore Acres Road	no	no	288	4
Schluter Road	no	no	232	4
East Broadway	yes	no	165	4
West Coldspring Avenue	no	no	122	4
Woody Lane	no	no	57	4
Woody Lane	no	no	144	4
Woody Lane	no	no	62	4
Kings Row	no	no	167	4
Kings Row	no	no	135	4
West Gate Road	no	no	223	4
East Broadway	yes	no	311	4
East Broadway	no	no	145	4
East Broadway	yes	no	252	4
West Coldspring Avenue	no	no	82	4

Monona Drive	yes	yes	198	4
Monona Drive	yes	yes	108	4
Monona Drive	yes	yes	81	4
Midmoor Road	no	no	521	3
Winnequah Road	no	no	76	3
Winnequah Road	no	no	257	3
Midmoor Road	no	no	551	3
Winnequah Road	no	no	250	3
Winnequah Road	no	no	140	3
Midwood Avenue	no	no	127	3
Moygara Road	no	no	325	3
Midwood Avenue	no	no	121	3
Midwood Avenue	no	no	193	3
Midwood Avenue	no	no	218	3
Kings Row	yes	no	16	3
Monona Drive	yes	no	16	3
Winnequah Road	no	no	34	3
West Broadway	yes	no	10	3
East Broadway	yes	no	9	3
Midwood Avenue	no	no	49	3
McKenna Road	no	no	175	3
Panther Trail	no	no	209	3
Owen Road	no	no	218	3
Gisholt Drive	yes	no	301	2
Healy Lane	yes	no	234	2
Maywood Road	no	no	226	2
Healy Lane	yes	no	198	2
Shore Acres Road	no	no	277	2
Shore Acres Road	no	no	277	2
Healy Lane	yes	no	258	2
Interlake Drive	yes	no	18	2
Engel Street	yes	no	368	2
Owen Road	no	no	165	2
Owen Road	no	no	354	2
West Coldspring Avenue	no	no	198	2
Frazier Avenue	yes	no	85	2
Progressive Lane	no	no	275	1
Progressive Lane	no	no	12	1
Wallace Avenue	no	no	386	1
Schofield Street	no	no	347	1
Rothman Place	no	no	229	1
Schluter Road	no	no	200	1
Schluter Road	no	no	230	1

Greenway Road	no	no	139	1
Wallace Avenue	no	no	114	1
Greenway Road	no	no	141	1
Greenway Road	no	no	278	1
Greenway Road	no	no	204	1
Edna Taylor Parkway	no	no	19	1
Schluter Road	no	no	236	1
Anthony Place	no	no	162	1
Anthony Place	no	no	160	1
Pheasant Hill Road	no	no	282	1
Schluter Road	yes	no	106	1
Columbia Circle	no	no	88	0
Woody Lane	no	no	292	0
Goucher Lane	no	no	157	0
Ela Terrace	no	no	126	0
Industrial Drive	no	no	140	0
Ford Street	no	no	148	0
Ridgewood Avenue	no	no	101	0
Wyldhaven Avenue	no	no	99	0
Ridgewood Avenue	no	no	76	0
Nishishin Northeast	no	no	53	0
Nishishin Northeast	no	no	65	0
Graham Avenue	no	no	133	0
Wallace Avenue	no	no	177	0
Winnequah Place	no	no	150	0
Kilgust Road	no	no	662	0
Winnequah Road	no	no	155	0
West Dean Avenue	no	no	253	0
Industrial Drive	yes	no	180	0
Oak Court	no	no	265	0
South Towne Drive	yes	no	32	0
Royal Avenue	no	no	42	0
West Beltline Highway	no	no	574	0
Winnequah Road	no	no	76	0
West Beltline Highway	no	no	631	0
Tonyawatha Trail	no	no	249	0
West Beltline Highway	no	no	572	0
Progressive Lane	no	no	153	0
Engel Street	yes	no	220	0
Lofty Avenue	no	no	126	0
West Broadway Frontage Road	no	no	153	0
Tonyawatha Trail	no	no	87	0
Lofty Avenue	no	no	121	0

Rothman Place	no	no	310	0
West Beltline Highway	no	no	2346	0
Winnequah Road	no	no	185	0
West Beltline Highway	no	no	2298	0
Oak Court	no	no	198	0
West Beltline Highway	no	no	416	0
Winnequah Road	no	no	379	0
West Beltline Highway	no	no	422	0
Arrowhead Drive	no	no	171	0
Vogts Lane	no	no	80	0
Monona Drive	no	no	127	0
Tonyawatha Trail	no	no	437	0
Tonyawatha Trail	no	no	192	0
Winnequah Trail	no	no	108	0
West Beltline Highway	no	no	158	0
West Beltline Highway	no	no	353	0
Tonyawatha Trail	no	no	118	0
West Beltline Highway	no	no	425	0
Vogts Lane	no	no	144	0
West Beltline Highway	no	no	530	0
Tonyawatha Trail	no	no	204	0
South Stoughton Road	no	no	186	0
Mesa Road	no	no	202	0
West Beltline Highway	no	no	239	0
Wyldhaven Avenue	no	no	126	0
West Beltline Highway	no	no	424	0
Arrowhead Drive	no	no	276	0
Royal Avenue	yes	no	780	0
Wyldhaven Avenue	no	no	125	0
Gisholt Drive	yes	no	402	0
West Broadway Frontage Road	no	no	260	0
Gisholt Drive	yes	no	71	0
Arrowhead Drive	no	no	181	0
McKenna Road	no	no	521	0
Raywood Road	no	no	242	0
Ela Terrace	no	no	125	0
Woodstock Circle	no	no	124	0
Queens Way	no	no	473	0
Unnamed	yes	no	465	0
Falcon Circle	no	no	135	0
Bartels Street	no	no	292	0
Unnamed	yes	no	163	0
Brandt Place	no	no	164	0

West Beltline Highway	no	no	514	0
West Beltline Highway	no	no	324	0
Flamingo Road	no	no	469	0
Navajo Trail	no	no	189	0
Winnequah Road	no	no	215	0
Midwood Avenue	no	no	243	0
Metropolitan Lane	no	no	176	0
Lake Point Drive	yes	no	210	0
Bridge Road	no	no	124	0
Admiral Drive	no	no	424	0
Tonyawatha Trail	no	no	351	0
Winnequah Road	no	no	36	0
Tonyawatha Trail	no	no	291	0
Saint Teresa Terrace	no	no	126	0
Gordon Avenue	no	no	524	0
Saint Teresa Terrace	no	no	126	0
Schultz Place	no	no	235	0
Outlook Street	no	no	122	0
Lamboley Avenue	no	no	240	0
Greenway Road	yes	no	62	0
Roigan Terrace	no	no	536	0
Wallace Avenue	no	no	521	0
Saint Teresa Terrace	yes	no	89	0
Wallace Avenue	no	no	208	0
Starry Avenue	no	no	106	0
Starry Avenue	no	no	124	0
Starry Avenue	no	no	126	0
Gordon Avenue	no	no	185	0
Springhaven Avenue	no	no	122	0
Outlook Street	no	no	139	0
Outlook Street	no	no	126	0
Gordon Avenue	no	no	203	0
Valorie Lane	no	no	124	0
Valorie Lane	no	no	127	0
Valorie Lane	no	no	112	0
Gordon Avenue	no	no	200	0
Gordon Avenue	no	no	171	0
Clear Spring Court	no	no	319	0
Waterman Way	no	no	245	0
Wallace Avenue	no	no	170	0
Tompkins Drive	no	no	140	0
Waterman Way	no	no	109	0
Copps Avenue	no	no	241	0

Greenway Road	no	no	68	0
Pocahontas Drive	no	no	119	0
Bjelde Lane	no	no	177	0
South Stoughton Road	no	no	1107	0
East Broadway	no	no	298	0
Atwood Avenue	yes	no	117	0
Atwood Avenue	yes	no	135	0
Ferchland Place	yes	no	124	0
Roselawn Avenue	no	no	734	0
Atwood Avenue	yes	no	371	0
West Beltline Highway	no	no	313	0
Stone Terrace	no	no	125	0
West Beltline Highway	no	no	567	0
River Place	no	no	214	0
River Place	no	no	19	0
Winnequah Trail	no	no	118	0
West Beltline Highway	no	no	517	0
Sleepy Lagoon Drive	no	no	50	0
Sleepy Lagoon Drive	no	no	19	0
Brandt Place	no	no	126	0
East Coldspring Avenue	yes	no	247	0
Goucher Lane	no	no	128	0
Jerome Street	no	no	457	0
Southern Circle	no	no	260	0
East Winnequah Road	no	no	281	0
Falcon Circle	no	no	139	0
Baskerville Avenue	no	no	75	0
East Gate Road	no	no	65	0
Squaw Circle	no	no	109	0
Monona Ridge	no	no	212	0
Winnequah Trail	no	no	378	0
Unnamed	no	no	9	0
Tonyawatha Trail	no	no	523	0
Gateway Green	no	no	197	0
Baskerville Avenue	no	no	65	0
Tonyawatha Trail	no	no	593	0
Jeffrey Circle	no	no	63	0
Thunderbird Lane	no	no	276	0
South Stoughton Road	no	no	6	0
Dellwood Circle	no	no	95	0
East Broadway	no	no	17	0
Mathys Road	no	no	315	0
Shato Lane	no	no	181	0

Mesa Road	no	no	284	0
Tompkins Drive	no	no	75	0
Unnamed	no	no	19	0
Baskerville Avenue	no	no	334	0
Birch Haven Circle	no	no	64	0
Tecumseh Avenue	no	no	182	0
Monona Drive	yes	no	371	0
Nishishin Trail	no	no	192	0
Tecumseh Avenue	no	no	178	0
Olbrich Avenue	yes	no	9	0
Nishishin Trail	no	no	249	0
Monona Drive	yes	no	133	0
Ferchland Place	no	no	8	0
Birch Haven Circle	no	no	1148	0
Falcon Circle	yes	no	19	0
Falcon Circle	no	no	255	0
Cove Circle	no	no	102	0
Sethne Court	no	no	117	0
Woodridge Road	no	no	135	0
Henuah Circle	no	no	66	0
Falcon Circle	no	no	142	0
Gateway Green	no	no	161	0
Kristi Circle	no	no	65	0
Gateway Green	no	no	189	0
Interlake Drive	no	no	213	0
Monona Drive	no	no	17	0
Queens Way	no	no	153	0
South Stoughton Road	no	no	1054	0
Midland Lane	no	no	245	0
South Stoughton Road	no	no	29	0
South Stoughton Road	no	no	26	0
South Stoughton Road	no	no	33	0
Femrite Drive	yes	no	16	0
Greenwood Street	no	no	147	0
South Stoughton Road	no	no	38	0
Greenwood Street	no	no	105	0
Monona Drive	no	no	40	0
Greenwood Street	no	no	135	0
West Broadway Frontage Road	no	no	92	0
East Gate Road	no	no	390	0
Bartels Street	no	no	227	0
Cardinal Crescent	no	no	404	0
West Gate Road	no	no	176	0

Pirate Island Road	no	no	269	0
Sleepy Lagoon Drive	no	no	25	0
Industrial Drive	no	no	134	0
Monona Drive	no	no	39	0
West Beltline Highway	no	no	96	0
West Beltline Highway	no	no	70	0
Pocahontas Drive	no	no	146	0
Monona Drive	no	no	16	0
Joyce Road	no	no	193	0
Interlake Drive	no	no	128	0
River Place	no	no	329	0
River Place	no	no	50	0
Roselawn Avenue	no	no	19	0
Kelly Place	no	no	237	0
Unknown	no	no	62	0
West Coldspring Avenue	no	no	88	0
South Towne Road	no	no	869	0
Unknown	no	no	12	0
Unknown	no	no	10	0
Unknown	no	no	16	0
Unknown	no	no	11	0
Frazier Avenue	yes	no	20	0
Unnamed	no	no	19	0
Unnamed	no	no	19	0
East Broadway	yes	no	230	0
Unnamed	no	no	19	0
Unnamed	no	no	13	0
Monona Drive	no	no	14	0
Panther Trail	yes	no	14	0
West Beltline Highway	no	no	498	0
Monona Drive	no	no	43	0
Labelle Lane	no	no	254	0
Monona Drive	no	no	37	0
Stone Terrace	no	no	119	0
Starry Avenue	no	no	51	0
Acacia Lane	no	no	171	0
Shato Lane	yes	no	3	0
Shato Lane	yes	no	14	0
Unnamed	yes	no	83	0
Shato Lane	yes	no	218	0
WPS Drive	yes	no	23	0
Ridgewood Avenue	no	no	127	0
Monona Drive	no	no	14	0

West Beltline Highway	no	no	522	0
WPS Drive	yes	no	145	0
Monona Drive	no	no	22	0
West Beltline Highway	no	no	575	0
West Beltline Highway	no	no	521	0
West Beltline Highway	no	no	495	0
Labelle Lane	no	no	191	0
Monona Drive	no	no	15	0
Cottage Grove Road	yes	no	270	0
West Beltline Highway	no	no	148	0
Moygara Road	no	no	257	0
Davidson Street	no	no	130	0
West Beltline Highway	no	no	147	0
Winnequah Road	no	no	49	0
Buckeye Road	no	no	272	0
Lake Edge Boulevard	no	no	191	0
Ridgewood Avenue	no	no	194	0
Ridgewood Avenue	no	no	218	0
Graham Avenue	no	no	126	0
Gordon Avenue	no	no	169	0
Monona Drive	no	no	5	0
Graham Avenue	no	no	133	0
Sioux Trail	no	no	204	0
Shore Acres Road	no	no	307	0
Monona Drive	no	no	5	0
Neponset Trail	no	no	206	0
Winn Drive	no	no	71	0
Tompkins Drive	no	no	66	0
Winnequah Road	no	no	138	0
Winnequah Road	no	no	140	0
Crestview Drive	no	no	137	0
Winnequah Road	no	no	187	0
Asher Circle	no	no	115	0
Bjelde Lane	no	no	56	0
Monona Pass	no	no	163	0
Owen Road	no	no	371	0
Stone Terrace	no	no	128	0
East Broadway	yes	no	445	0
Femrite Drive	no	no	169	0
Copps Avenue	no	no	433	0
Royal Avenue	no	no	396	0
Springhaven Avenue	no	no	4	0
Springhaven Avenue	no	no	6	0

Parkway Drive	no	no	7	0
Parkway Drive	no	no	3	0
Industrial Drive	no	no	319	0
Tompkins Drive	yes	no	14	0
Royal Avenue	no	no	270	0
Monona Drive	no	no	15	0
Monona Drive	yes	no	15	0
Mangrove Lane	no	no	382	0
West Beltline Highway	no	no	640	0
West Beltline Highway	no	no	26	0
West Beltline Highway	no	no	26	0
South Towne Drive	no	no	68	0
East Broadway	no	yes	295	0
West Broadway	no	no	20	0
West Beltline Highway	no	no	532	0
West Beltline Highway	no	no	531	0
South Towne Drive	no	no	135	0
Royal Avenue	no	no	17	0
Unknown	no	no	208	0
Raywood Road	no	no	106	0
Raywood Road	no	no	222	0
Unknown	no	no	61	0
South Towne Drive	no	no	236	0
Unknown	no	no	76	0
Industrial Drive	yes	no	33	0
Industrial Drive	no	no	216	0
South Towne Drive	yes	no	26	0
South Towne Drive	no	no	18	0
South Towne Drive	no	no	209	0
Industrial Drive	yes	no	105	0
Industrial Drive	yes	no	298	0
Unknown	no	no	37	0
Unknown	no	no	78	0
Acacia Lane	no	no	125	0
Acacia Lane	no	no	14	0
South Towne Drive	yes	no	92	0
Industrial Drive	yes	no	17	0
West Broadway Frontage Road	yes	no	150	0
West Broadway Frontage Road	yes	no	57	0
WPS Drive	yes	no	45	0
River Place	yes	no	27	0
River Place	yes	no	105	0
Unknown	no	no	585	0

Unknown	yes	no	236	0
Unknown	yes	no	271	0
Shato Lane	no	no	188	0
Saint Teresa Terrace	no	no	33	0
East Coldspring Avenue	no	no	35	0
Winnequah Road	yes	no	6	0
Winnequah Road	yes	no	43	0
Buckeye Road	yes	no	88	0
Davidson Street	yes	no	26	0
Monona Drive	yes	yes	173	0
Monona Drive	yes	yes	694	0
Monona Drive	yes	yes	168	0
Monona Drive	yes	yes	152	0
Monona Drive	yes	yes	427	0
Monona Drive	yes	yes	45	0
Monona Drive	yes	yes	625	0
Monona Drive	yes	yes	280	0
Monona Drive	yes	yes	176	0
Atwood Avenue	yes	yes	23	0
Industrial Drive	yes	no	37	0
South Towne Drive	yes	yes	203	0
South Towne Drive	yes	yes	17	0
South Towne Drive	yes	yes	295	0
Industrial Drive	yes	yes	26	0
Unknown	no	yes	4	0
Unknown	no	yes	6	0
Unknown	no	yes	1095	0
Monona Drive	yes	yes	24	0
Monona Drive	yes	yes	152	0

ABOUT THE UNIVERCITY YEAR

UniverCity Year is a year-long partnership between UW-Madison and one community in Wisconsin. The community partner identifies sustainability and livability projects that would benefit from UW-Madison expertise. Faculty from across the university incorporate these projects into their courses with graduate students and upper-level undergraduate students. UniverCity Year staff provide administrative support to faculty, students and the partner community to ensure the collaboration's success. The result is on-the-ground impact and momentum for a community working toward a more sustainable and livable future.

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UNIVERCITY BETTER PLACES TOGETHER