Meeting Pedestrian Demand in Topeka, KS: Sidewalk Construction and a Walkability Score

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This report uses data provided by the Topeka Planning and Development Division and the U.S. Census Bureau to analyze the 'Walkability' of Topeka, KS and assess where sidewalks need to be constructed in the city. This report aims to update Topeka's Pedestrian Master Plan by determining how well Topeka's current pedestrian infrastructure is meeting its pedestrian demand. Toole Design, a consulting company from Maryland, was hired to assess where the pedestrian demand is in Topeka. This report is a response to the consulting group's analysis and attempts to analyze to what extent Topeka is meeting pedestrian demand. The goal of this report is to determine priority areas for sidewalk construction and to use 3 different measures, population density, sidewalk length, and proximity to create a walkability score for each Census Block Group in the City of Topeka to decide where pedestrian infrastructure needs to be improved the most.
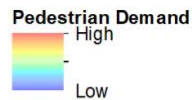
1.1 Toole Design Report

Toole Design was hired during the summer of 2019 to determine pedestrian demand in Topeka. The data layers they used and some of their methodology is available here:

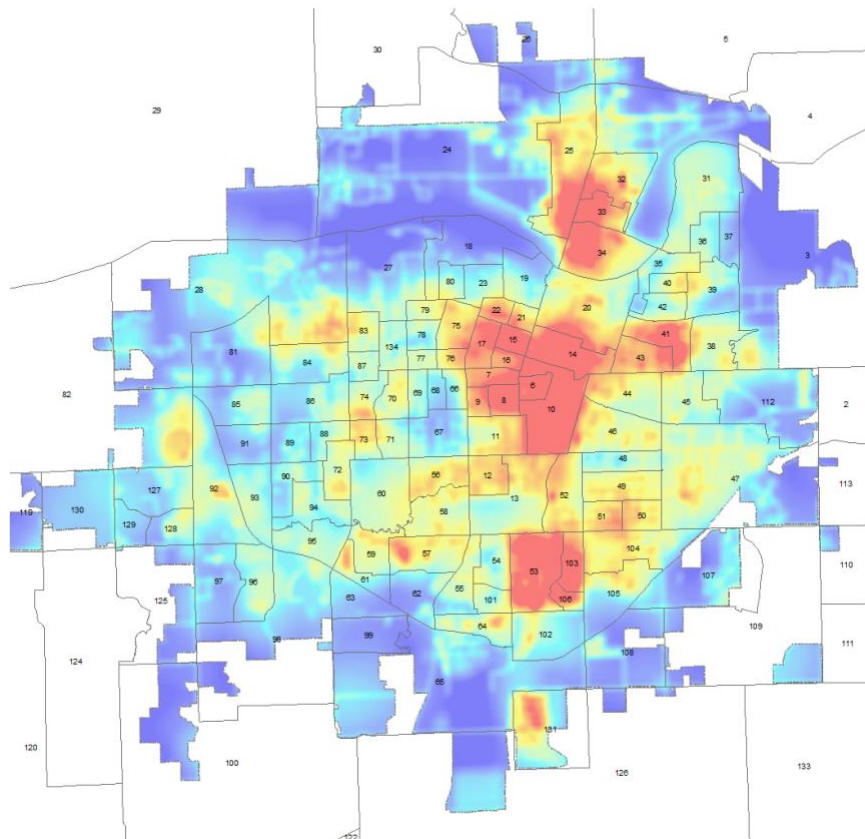F:\Departments\Planning\Chris_G_S2019\Toole_Design_heat_map

Figure 1- This map shows the pedestrian demand in Topeka. The red corresponds to areas with high pedestrian demand, and the blue corresponds with areas of low pedestrian demand.

The heat map was made by giving different priorities to different pedestrian features. The following layers were given the highest weight: Streets with no sidewalks, Parks, Bus Routes, and Schools. The following layers were given medium weight: Busy Streets, Neighborhoods, and Major Destinations. The following layers were given low weight: Community Centers, Commercial Parcels, and High Density Residential. Each layer was given a weight based on how many votes it received during a stakeholder committee meeting. See figure 2 for the priorities given to different pedestrian features of Topeka.

Layer	Weight	Vote
Streets with no Sidewalks	High	14
Parks	High	12
Bus Routes	High	10
Schools (all?)	High	9
Busy Streets	Medium	8
Neighborhoods (at risk, intensive care)	Medium	7
Major Destinations	Medium	6
Community Centers (inc. Senior Centers)	Low	5
Commercial Parcels (inc. Downtown)	Low	3
High Density Residential (4+ units)	Low	3

Figure 2- This chart shows the different weights of each layer and how many votes each layer received.

Additionally, the heat map was made by creating a buffer of varying distances around each point feature. The buffer distance was determined by what the Toole Design group saw as reasonable distances for people to want to walk to a destination. The figure below shows the buffer distance of each layer.

Feature	Weight	How it is Represented
Bus Routes	High	1/2 mile buffer
Neighborhoods (Intensive Care)	High	within polygons only
Parks & Trails	High	1/2 mile buffer
Schools (Elementary and Middle)	High	1/2 mile radius
Streets with no Sidewalks	High	500' buffer
Busy Streets (i.e. Arterials and Collectors)	Low	1/2 mile buffer
Commercial Parcels	Low	within polygons only

Community Centers (including Senior Centers)	Low	1/2 mile radius
High Density Residential Properties (4+ units)	Low	within polygons only
Major Destinations	Low	1/2 mile radius
Neighborhoods (At Risk)	Low	within polygons only

Figure 3- This chart shows the buffer distance used for each feature based on the farthest distance a pedestrian is likely to walk get to each destination

The exact methodology of how they used the weights and buffers is unknown because of Toole Design's failure to respond to our questions.

2   Sidewalks: Where are they now and where do they need to be built?

2.1.Background and methodology

The best place to improve pedestrian infrastructure is in the most populated areas that have minimal pedestrian infrastructure. Determining where people live in a city is hard to estimate because of privacy concerns. During the Census, the population is counted in units of varying sizes. Census blocks are the smallest unit; followed by Block Groups; followed by Census Tracts; followed by Counties.

Accuracy is important when deciding where to allocate city funds. Thus, knowing exactly where people live is crucial for optimizing city spending while reaching the most people. However, this can be difficult when the only population data available is in the form of block groups which, in Topeka, KS range from .088 square miles to 5.8 square miles. When considering distances to grocery stores and post schools, a ½ mile walk vs. a 2 mile walk makes a big difference.

Maptitude, a GIS software, seems to have a solution to this privacy vs. accuracy dilemma. Maptitude

allows a user to overlay any polygon over an area, and it will return the population inside the polygon no

matter if the polygon cuts through block group boundaries.

The program does not know where people are located inside block groups. Instead, Maptitude takes the

percentage that the polygon covers a block group and returns that percent of the population. Maptitude

assumes that all people that live in a block group are distributed evenly throughout the block group.

Figure 4 demonstrates how population within a block group is determined by Maptitude.
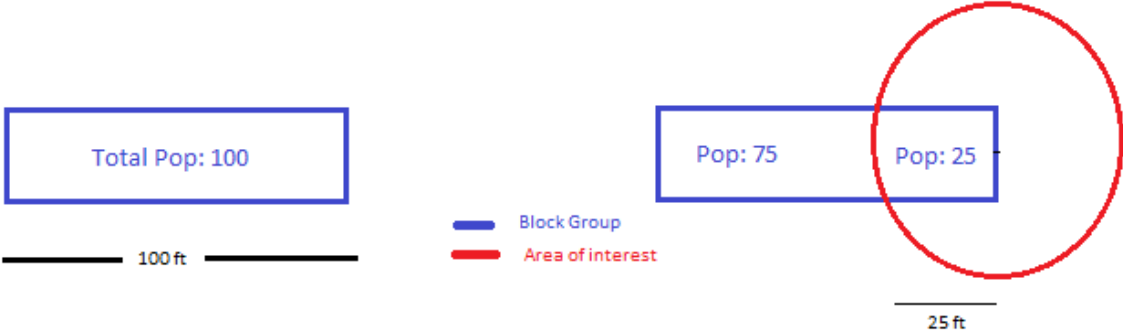

Figure 4- this diagram shows how the GIS software Maptitude allocates population inside a polygon

based on the percent area that it covers the Census Unit

2.2 Sidewalk GIS analysis results

Using the methodology mentioned above, it was determined that 88670.93 (or 72.3%) people in the City

of Topeka live 300 feet from a sidewalk. Citizens should be able to leave their house and walk to the

nearest Major Arterial road and arrive at a sidewalk. 300 feet was chosen because it is a little larger than

½ a city block. This allows those houses located in the middle of a block to be considered walkable since

they are relatively close to a major arterial (which should have a sidewalk). That translates to 72.3

percent of the population of the city of Topeka live 300 feet from a sidewalk. Figure 6 shows where the

population in the city is relative to the areas with sidewalks.
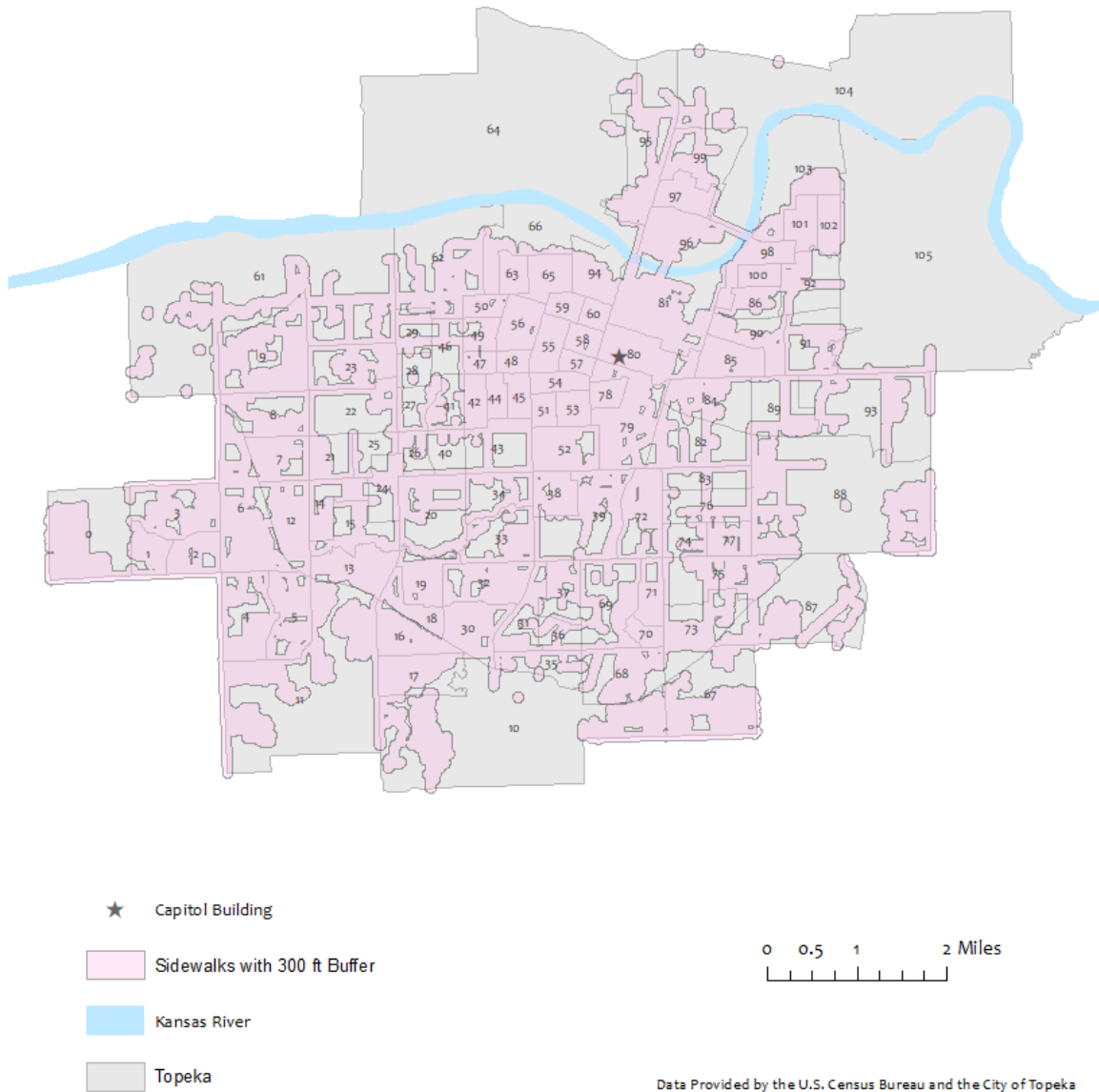
All Areas Within 300 Feet of a Sidewalk in Topeka, KS

★ Capitol Building

Sidewalks with 300 ft Buffer

Kansas River

Topeka

0   0.5   1   2 Miles

Figure 5- This map shows all of the areas of Topeka that are within 300 feet of sidewalks
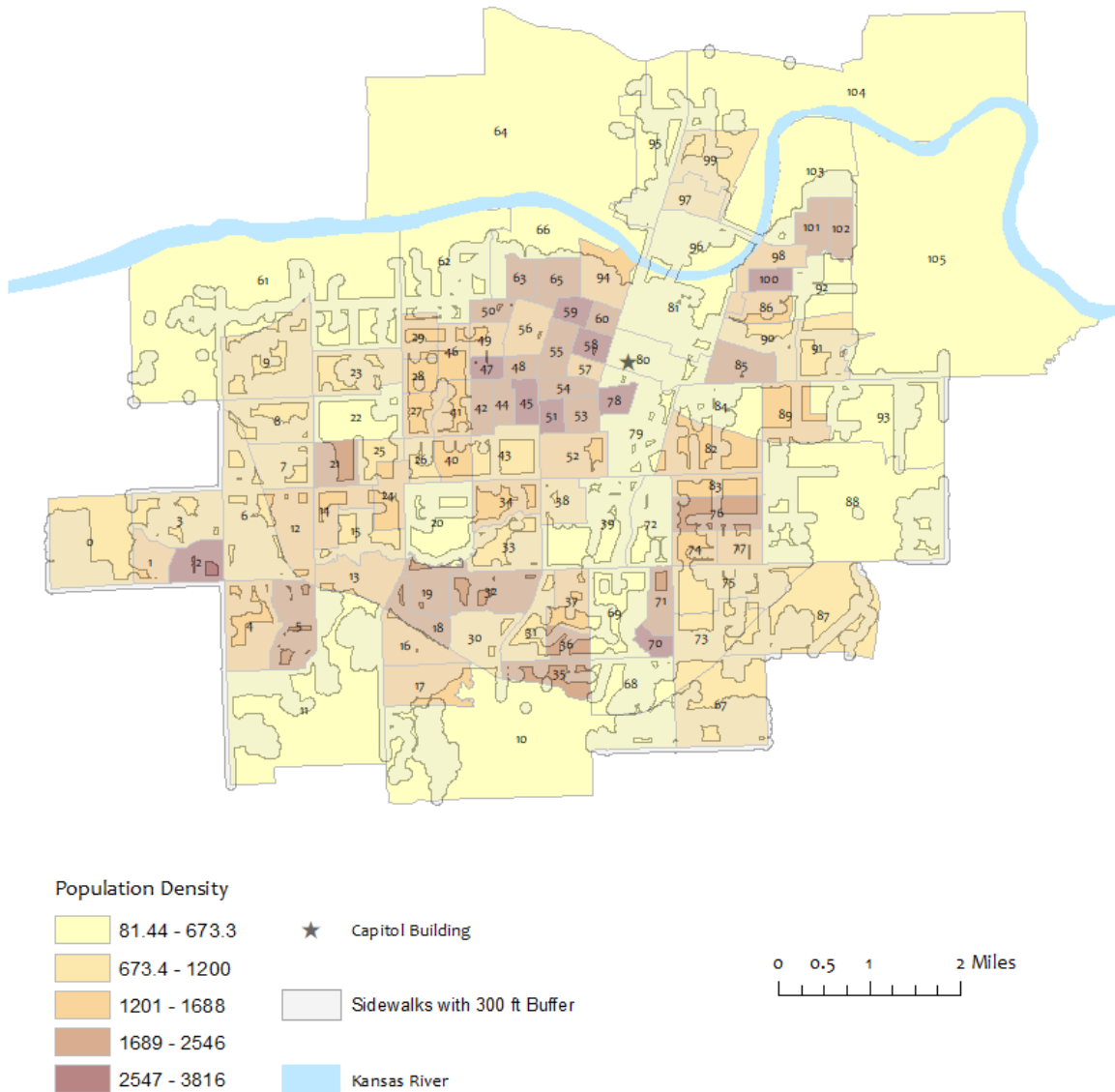
Figure 6- This map shows the areas of Topeka that are within 300 feet of sidewalks and the population
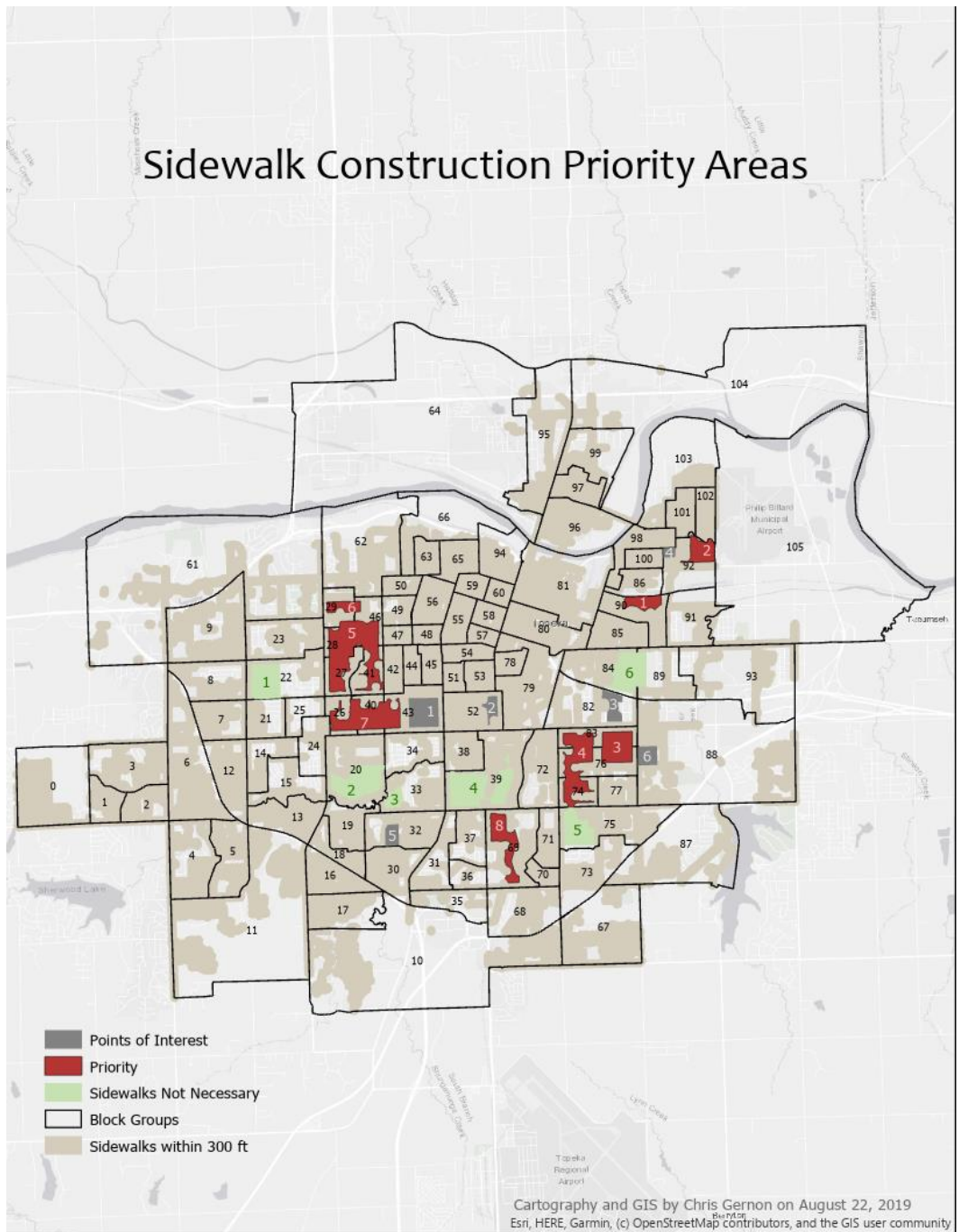
density of the city.

Figure 7- This map shows the areas of Topeka that should be prioritized when considering the construction of sidewalks and the walkability of the city. Additionally, it shows the areas of Topeka that do not require sidewalks from the city (golf courses, etc.). Lastly, it shows areas in Topeka that are points of interest (schools) when considering the construction of sidewalks.

Green- area not of concern

1- Mount Hope Cemetery

2- Shunga and Felker Park

3- Shunga and Felker Park

4- Topeka Country Club

5- Shunga Trail and Felker Park

6- Cemetery

Red- area of concern

1, 2- Neighborhoods around Chase Middle School

3, 4- Neighborhoods around Highland Park High School

5, 6- Neighborhood that lacks access to gage and services on gage—access to shunga and felker parks

7- 12th street, Equality House, Carlson Financial, Westboro neighborhood

8- Commercial location between Kansas Ave and Topeka Blvd. No sidewalks near.

Grey- areas of interest

1- Washburn University

2- Expocentre

3- Park

4- Chase Middle School

5- Jardine Middle School

6- Highland Park High School

i. How was it determined these were areas of concern?

Satellite imagery from ArcPro and Google Maps were used to analyze areas with no sidewalks within 300 feet. The imagery was used to analyze why there may not be sidewalks in the area and whether or not there would be a reason to construct sidewalks in those locations. The presence of golf courses and train yards indicated sidewalks were not necessary. The presence of major shopping centers or schools nearby indicated the necessity of sidewalks. Figure 7 shows where sidewalks should be implemented and where there are currently no sidewalks.

Pedestrian Demand and Areas Within 300 ft of Sidewalks

Priority Block Groups
Block Group
Areas with Sidewalks Within 300 ft

Pedestrian Demand

High

Low

0   0.5   1   2 Miles

Cartography and GIS by Christopher Gernon on August 23, 2019
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
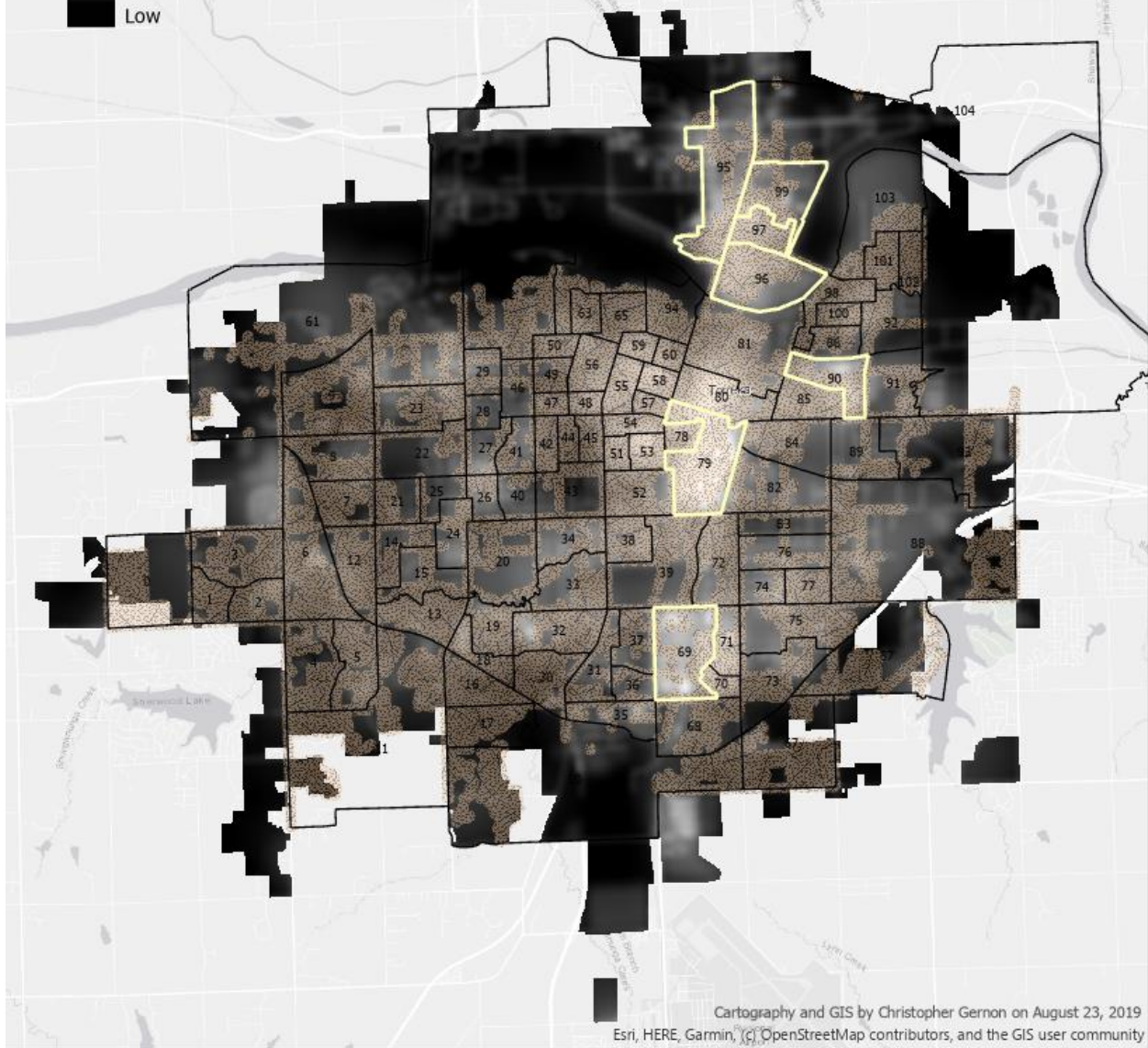
Figure 8- This map shows the areas within 300 feet of a sidewalk and the Pedestrian Demand in Topeka. Block Group 68 has the highest pedestrian demand and a low area of sidewalk. The Priority Block Groups emphasize the areas with high areas of pedestrian demand.

8 Walkability Score

a. Background

The pedestrian friendliness of a city does not depend on a single metric. While pedestrians need sidewalks to be able to walk, they also need to walk to a destination. Additionally, sidewalks are irrelevant if they are placed where the population is not. Sidewalk density, population density, and a proximity score are the three metrics used to create a walkability score for every block group in the city of Topeka. It is important to consider holistically how pedestrians interact with a city in order to assess how pedestrian friendly a city is.

b. Methodology and Results

i. Population Density (PD)

Why population Density?

Population density is a measure of where people live in a city. Population Density was incorporated in the Walkability index for several reasons. First, high population density areas have destinations closer to each other compared to low population density areas, which makes it easier for people to walk to more places in a short period of time. Second, are more likely to walk if they think the area is safe, and people feel safer if there are more people around. Third, the higher the population density the easier it is to provide

transportation to more people in a smaller area.[1] Additionally, population and land area are two pieces of data that are readily available and accurate.

The population density map was made using data from the U.S. Census Bureau and the equation:

Density = number of people/ km^2 of land

Population Density for Topeka, KS by Census Block Group

Population Density
People per km^2

	81.44 - 673.3
	673.4 - 1200
	1201 - 1688
	1689 - 2546
	2546 - 3816

★ Capitol Building

Kansas River

Major Roads

0   0.5   1   2 Miles

Data Provided by the U.S. Census Bureau and the City of Topeka
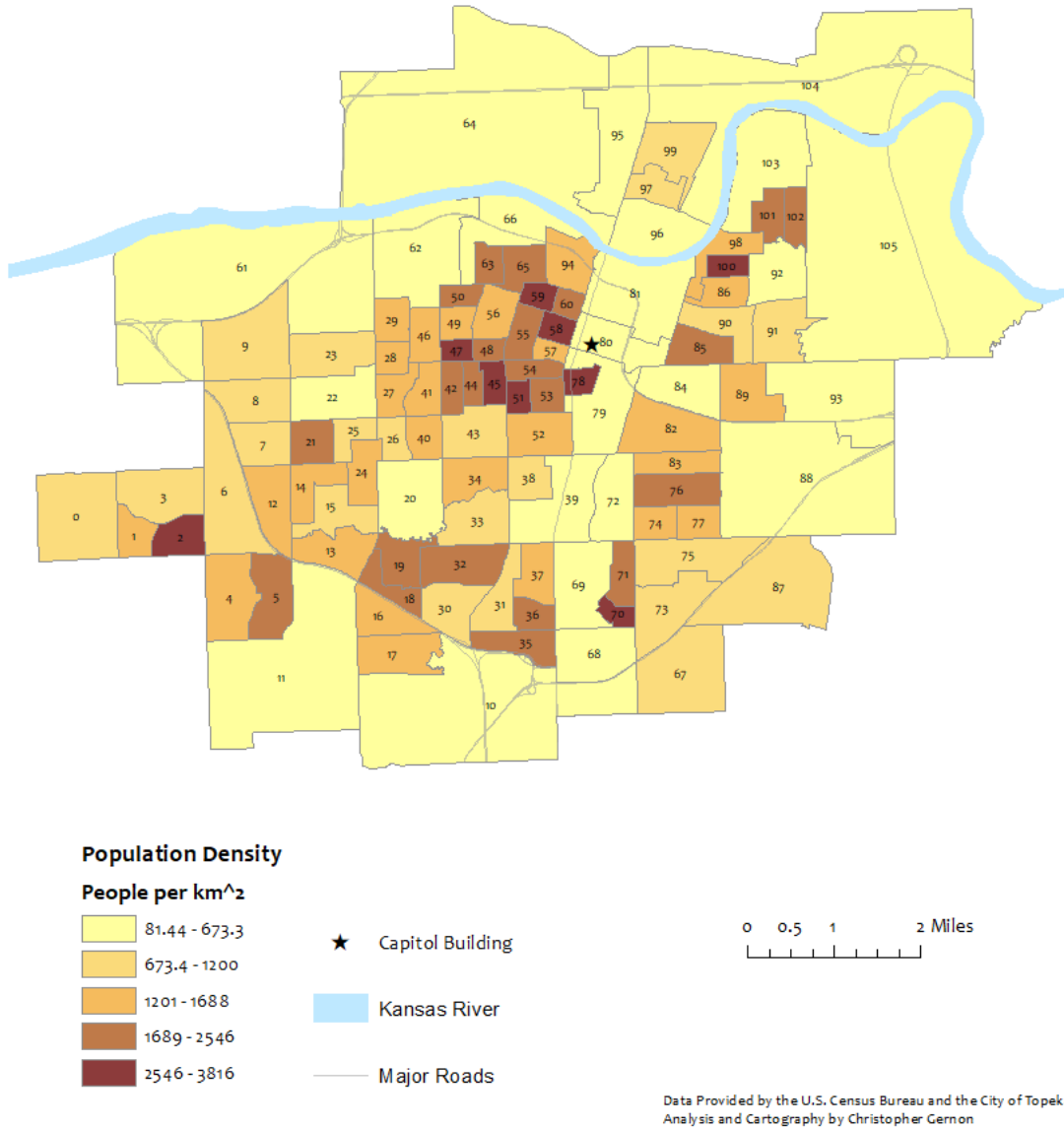Analysis and Cartography by Christopher Gernon

Figure 9- This map shows the population density in Topeka, KS. The population is most dense near the core of the city. However, there is an increase in population on the outskirts of the city. There is a corridor that runs through downtown that has a low population density.

ii. Sidewalk density

The presence of sidewalks is crucial for meeting pedestrian demand. Pedestrians require a surface on which to walk for both safety and comfort. Sidewalk density is a measure of how much of a block group is covered in sidewalk. It is important for the city to prioritize sidewalk construction in areas with more people and more services than in areas with less people and less need for sidewalks.
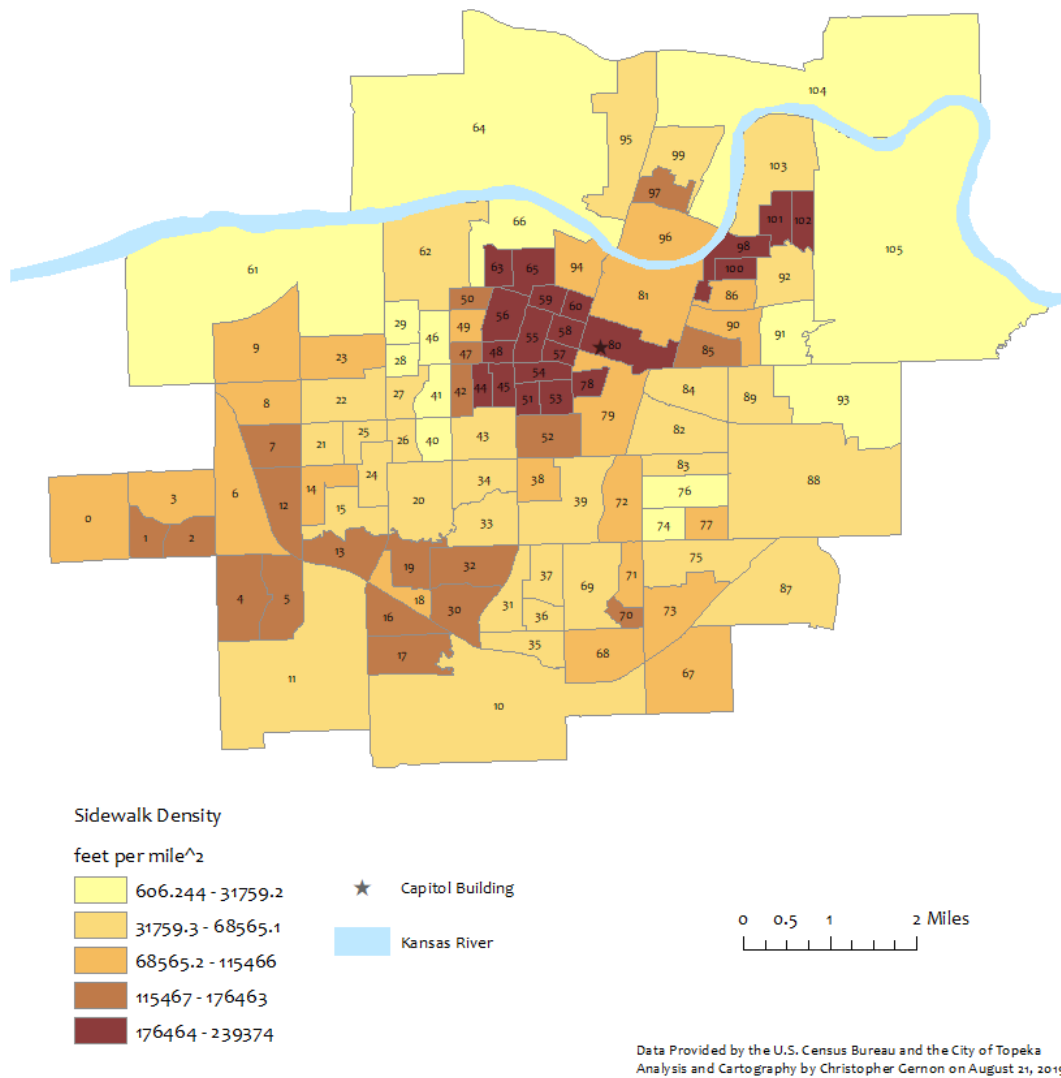
Density of Sidewalks in Topeka, KS by Block Group

Figure 10- This map shows the density of sidewalks in Topeka, Ks by Block Group. There density of sidwalks is highest in the core of the city. Then, there is an increase in sidewalks near the outskirts of the city. Sidewalk density was found by adding up the total number of feet of sidewalks in each block group and dividing by the area of the block group in sq miles.

iii. Proximity (P)

Why Proximity?

Proximity demonstrates the number and variety of destination within a distance of any location. Proximity is a major factor when determining walkability because 'too far away' is often perceived to be the biggest inhibitor to walkability.[2]

Destinations were determined by the likelihood that a person would decide to walk to the destination. The 6 different types of destinations were Schools, Post-Offices, Bus stops, Parks, Markets, and Points of Interest. The schools, Post-Offices, Bus stops, and Parks layers were all found in the Planning Department folder on the F drive. The Markets and Points of Interest were geocoded specifically for this analysis. Markets were defined as stores that were considered grocery stores or markets on Google. Points of interest were defined as popular tourist destinations in Topeka that people would be likely to want to visit. The table below shows the value given to each destination.

DESTINATION TYPE	SCORE	BUFFER DISTANCE (M)
SCHOOLS	3	400
POST OFFICE	2	700
BUS STOP	2	400
PARK	4	700
MARKET	3	800

Figure 11- This table shows the score given to each cell within the buffer distance of each pedestrian destination.

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[2] Ariffin, Raja Noriza Raja, and Rustam Khairi Zahari. "Perceptions of the Urban Walking Environments." Procedia - Social and Behavioral Sciences, vol. 105, 2013, pp. 589–597., doi:10.1016/j.sbspro.2013.11.062.

All Parks were converted from polygons to points. If the park was smaller than 20 acres, the centroid of each park was used as the location for the park. If the park was bigger than 20 acres, the satellite image of the park was analyzed and a point was placed at each walking entrance to the park. Using a GIS, a score was calculated for each Census Block by first creating a buffer around each point (table 1). Each buffer polygon was rasterized and given a weight to go in each cell (table 1). Using the cell statistics tool in ArcPro, each raster layer was joined together and their values summed. Thus, each raster cell has a value of 2-14. Next, the zonal statistics tool was used to find the mean Value of each cell in each block group.

Proximity Score in Topeka, KS by Block Group

Proximity Score

- 2.82 - 4.92
- 4.93 - 6.35
- 6.36 - 7.64
- 7.65 - 9.33
- 9.34 - 11.4

★ Capitol Building

Kansas River

0   0.5   1   2 Miles

Data Provided by the U.S. Census Bureau and the City of Topeka
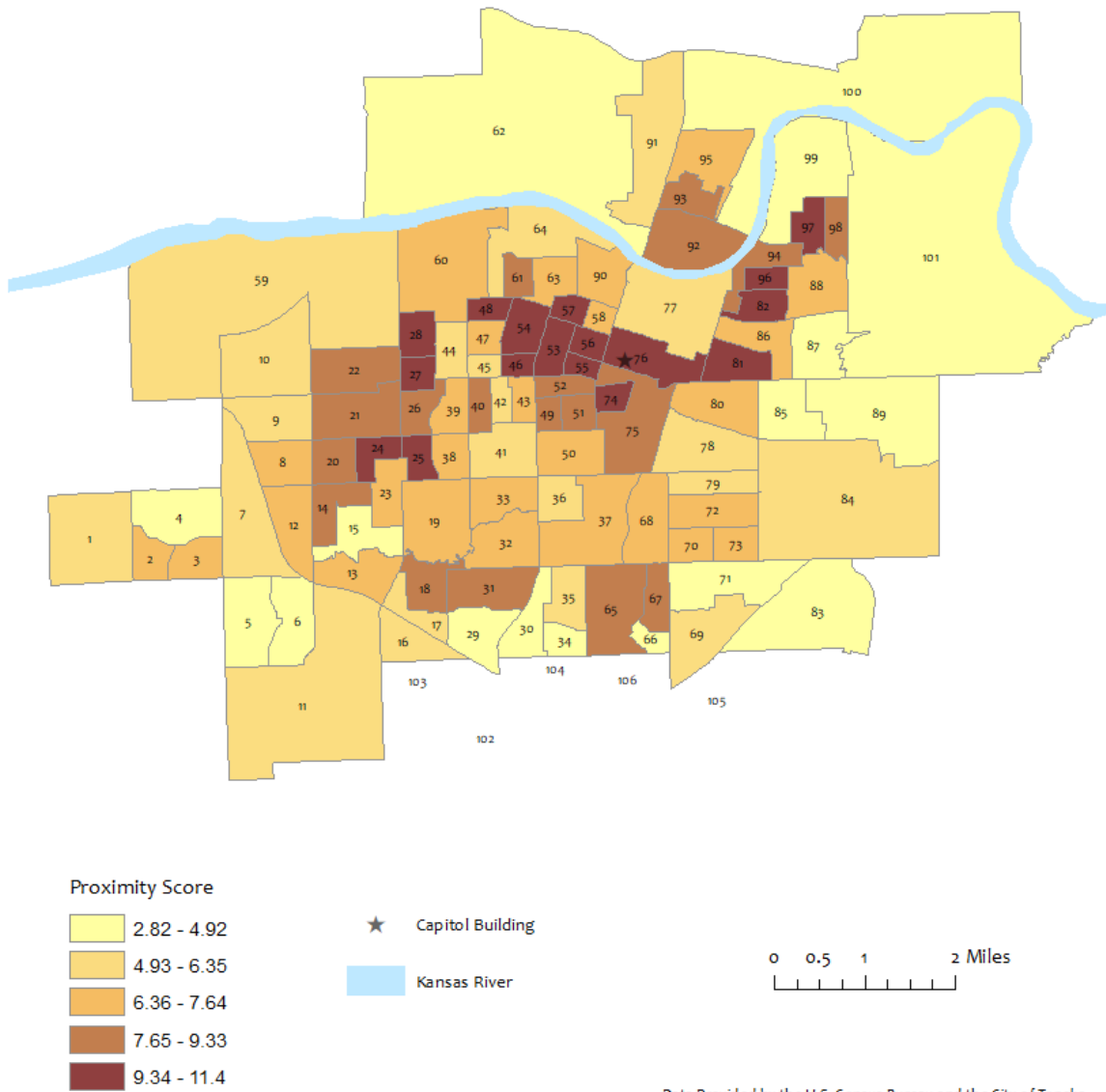Analysis and Cartography by Christopher Gernon on August 21, 2019

Figure 12- This map shows the proximity score of each Block Group in Topeka, KS. The highest cluster of high scores is found in the core of the city and in a ring outside the core of the city. 77 does not have a high score because the majority of its land area is taken up by a train yard.

c. Walkability Index

The Walkability Index of each Census Block Group was found by converting the calculated population density, sidewalk density, and the proximity to a z-score for each Block Group and adding the values together. The equation to calculate the Walkability Index is:

WI = PD + 2(SD) + P

The sidewalk density Z-score was doubled when calculating the WI because the presence of a sidewalk is twice as important as the population density and proximity score when considering pedestrian friendliness in Topeka, KS.

Why Z-Score?

Z-scores measure the variability of data. They reveal how typical a score is with 0 being the most typical score. Adding the Z-score's of the different values creates an understanding of how walkable a Census Block Group is compared to all other Block Groups included in the analysis.
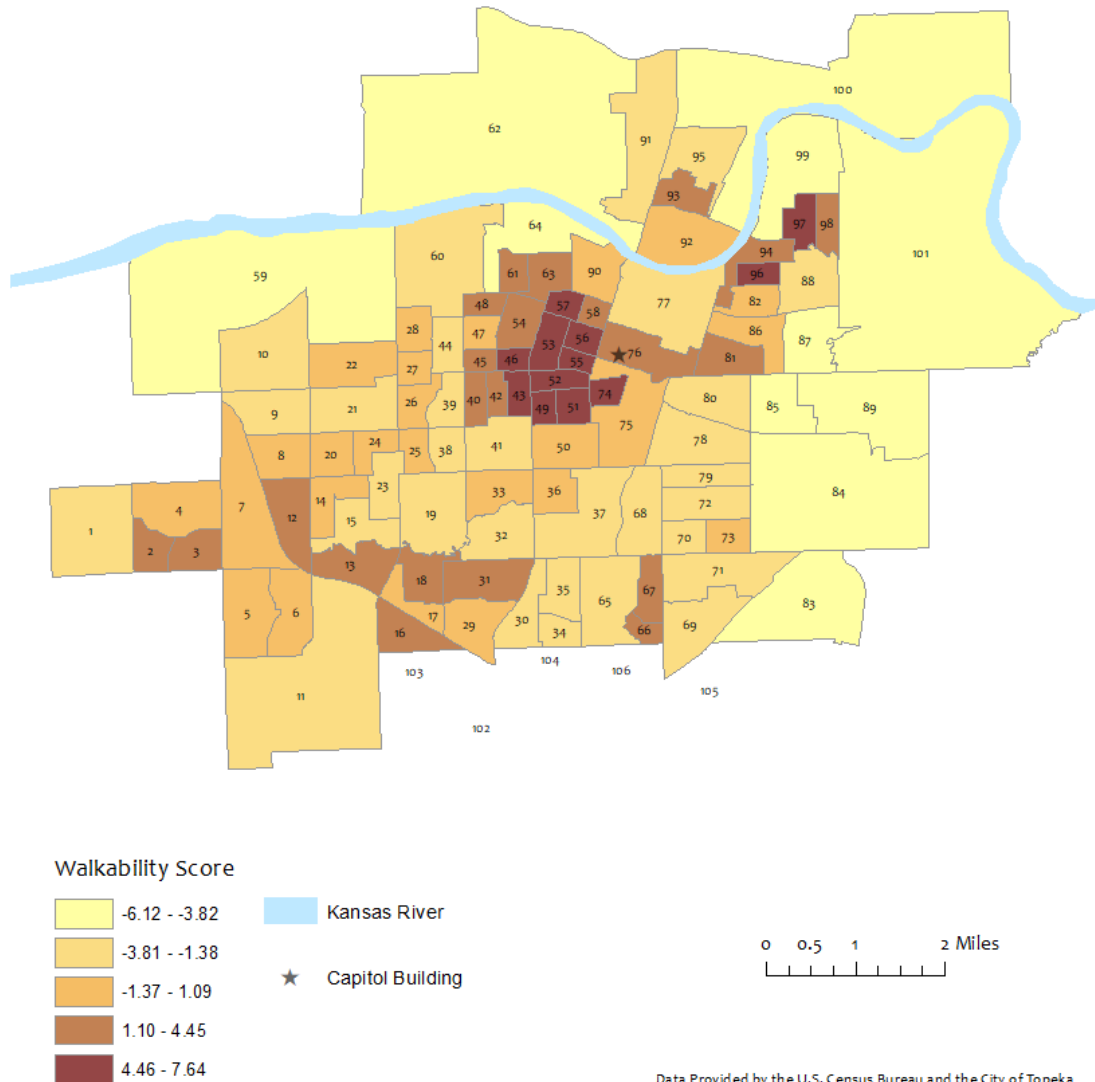
Figure 13- This map shows the walkability score of each Block Group in Topeka, Kansas with a centroid that is completed covered by the city limits. The walkability is highest in the core of the city.

Priority Block Groups based on
Pedestrian Demand and Walkability Score

Walkability Score

▢	-6.12 - -3.82
▢	-3.81 - -1.38
▢	-1.37 - 1.09
▢	1.10 - 4.45
▢	4.46 - 7.64

▬ Kansas River

★ Capitol Building

▢ Block Group Priority Areas

Pedestrian Demand

High : 6.24333
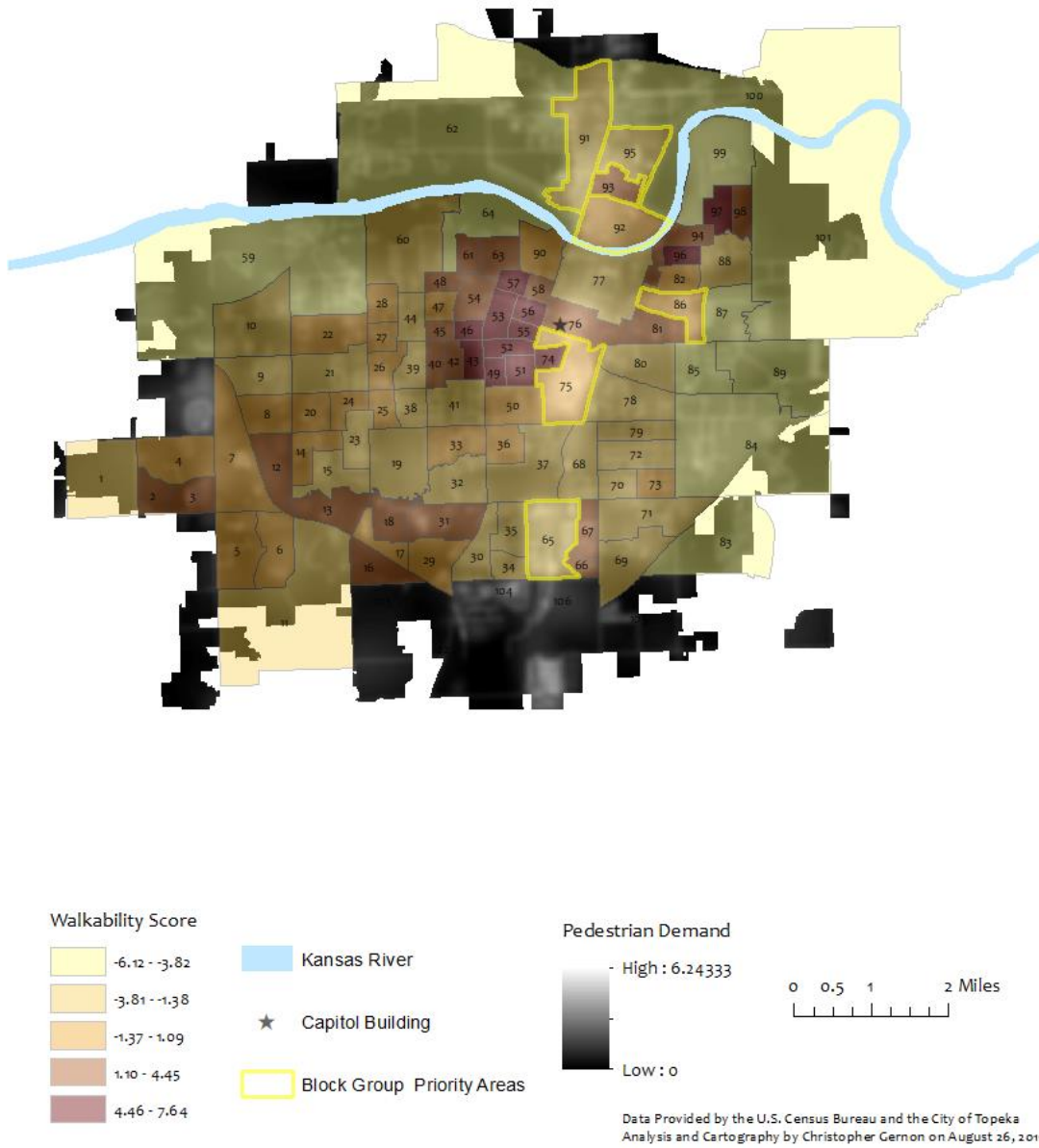
Low : 0

0 0.5 1   2 Miles

Figure 14- This map shows the intersection of pedestrian demand and how well pedestrian demand is met by pedestrian infrastructure throughout the city. The Block Group Priority Areas are areas which have a high pedestrian demand but a low walkability score.

4. Conclusions:

- The highest density of sidewalks is in the core of the city

- Immediately outside the core of the city there is a decrease in sidewalk density, especially to the Southwest

- There is a slight increase in sidewalk density 1.5-2 miles outside the core of the city

- The population is most dense near the core of the city

- There is a strip of block groups that goes through the center of the city starting with 68 and end with 96 that have low population density

- The proximity score, an indication of destinations people want to walk to, is highest near the core of the city and it gets lower as you get farther from the center of the city

- Block group 77 received a low walkability score because it is mainly comprised of the Topeka train yard

- Southeast and Northwest Topeka had the lowest Walkability Scores.

- Southwest Topeka received the highest scores away from the core of the city

5. Recommendations

- Increase Sidewalks in block groups 76 and 74 because they are next to Highland Park High School and Churches

- Block Group 65 has the largest disparity between high pedestrian demand and a low walkability score

  - Connect Landon Nature Trail to Highland Crest via Betty Phillips Park

  - Connects neighborhood directly to all stores and services off Kansas Blvd and Kansas Ave which is an area of high pedestrian demand.

- Block group 42 is where Randolph middle school is

  - 41, 46, 40 have low sidewalk density even—kids need path to get to school

- Connect Highland Crest Park with the Landon Nature Trail—Area has high pedestrian demand and a low walkability score. It moves towards the goal of the pedestrian master plan for connecting more neighborhoods