(3.2) Facilities and Infrastructure

Pedestrian Facilities. At present, the City of Lansing does not maintain a comprehensive GIS inventory of the primary implementation of pedestrian facilities—sidewalks. Creating a comprehensive, GIS based sidewalks inventory is strongly recommended by the research team as a means of tracking sidewalk conditions and facilitating the identification priorities for improvements and repairs. Unfortunately, creating such an inventory is beyond the scope of this report and would require more time than the research team will spend creating this entire report.

Bicycle Facilities. The term 'bicycle facilities' is a general term denoting improvements and provisions made by public agencies to accommodate or encourage bicycling, including parking and storage facilities, and shared roadways not specifically designated for bicycle use. (AASHTO) When planning for non-motorized transportation a thorough inventory of the existing conditions of bicycle facilities, the depth of which goes beyond the nature of this paper, should be performed. For the purpose of this paper our analysis of the existing bicycle will concentrate on the amount and quality the three most common types of bicycle facilities in Lansing; bike parking, bike lanes, and other types of bicycle paths. A growing body of research documents various phenomena influencing levels of bicycle commuting. Dill and Carr (2003) examined the relationship between bicycle facility availability and levels of bicycle ridership. This article substantiates an earlier study by Nelson and Allen which concluded that "Higher levels of bicycle infrastructure are positively and significantly correlated with higher rates of bicycle commuting."[77] In addressing the rather obvious fact that the absence of bicycle facilities reduces opportunities for people to commute using bicycles, Nelson and Allen hypothesized a positive association between bike facilities and levels of bicycle commuting.[78] Among several variables including number of college

[77] Dill and Carr, p. 7
[78] Nelson, A., and D. Allen. (1997). If you build them, commuters will use them: association between bicycle facilities and bicycle commuting. *Transportation Research Record 1578*, TRB, National Research Council, Washington, D.C., 79-83. Retrieved February 12, 2007 from http://www.enhancements.org/download/trb/1578-10.PDF. p. 80

students, terrain topography, and weather, a regression reveals that *bikeway density* (number of bicycle pathway miles per 100,000 residents) is strongly associated with higher levels of bicycle commuting. Nelson and Allen are quick to point out, however, that this relationship is one of association and not directional causation.[79] As they puts it, it remains unclear whether the presence and activities of bicyclists within a community cause the construction of more bike facilities or the construction of more bicycle facilities encourage people to use them. Dill and Carr echo this sentiment cautioning that the relationship should not be misconstrued as directional causation: it may be the case that more bicycle facilities encourage greater levels of usage, or it may be the case that cyclists are drawn to communities endowed with more bicycle facilities. Either way, creating more bicycle facilities can help communities achieve more balanced transportation systems that offer realistic alternatives to automobile exclusive transportation systems. "If you build it, they will ride" these reports seem to indicate.

Bike Parking & Storage. Lansing Codified Ordinance Sec. 6.17. (1) states: "A person shall not park a bicycle on a sidewalk where bicycle parking is prohibited…A person shall not park a bicycle on a sidewalk in a manner that would unreasonably obstruct pedestrian or other traffic." Bike parking facilities are a way to assist bicyclists in obeying the law while giving residents an incentive to use a form of non-motorized transportation. While the research team has not find any studies assessing the effect of bike parking availability on levels of bike commuting, it stands to reason that the absence of secure bike parking acts as a significant deterrent to utilitarian bike trips. Without secure parking, using a bicycle for errands or commuting to work becomes very difficult for the rider who must leave her bike unattended and unprotected for substantial periods of time. If, for example, cyclists do not have secure parking, running into a grocery store puts cyclists' personal property at risk of theft—a problem that does not affect motorists in quite the same way.

[79] Nelson, A., and D. Allen. (1997). If you build them, commuters will use them: association between bicycle facilities and bicycle commuting. *Transportation Research Record 1578*, TRB, National Research Council, Washington, D.C., 79-83. Retrieved February 12, 2007 from http://www.enhancements.org/download/trb/1578-10.PDF. p. 82

Lansing currently has over 340 locations of bicycle parking devices and eleven (11) additional proposed locations. Most of the existing locations for bike parking are located in the Downtown area (See map *Existing Conditions: Bicycle Parking*). Many different parties own and maintain these bike parking devices. Of the 340 existing locations, the Lansing Parks and Recreation department are responsible for at least 113 locations (See Figure 25).[80] This places Lansing Parks and Recreation at the top of the list in terms of who is responsible for the largest number of bike parking locations. Of nine (9) classifications of responsible parties the city of Lansing is fifth (5th).

Figure 25

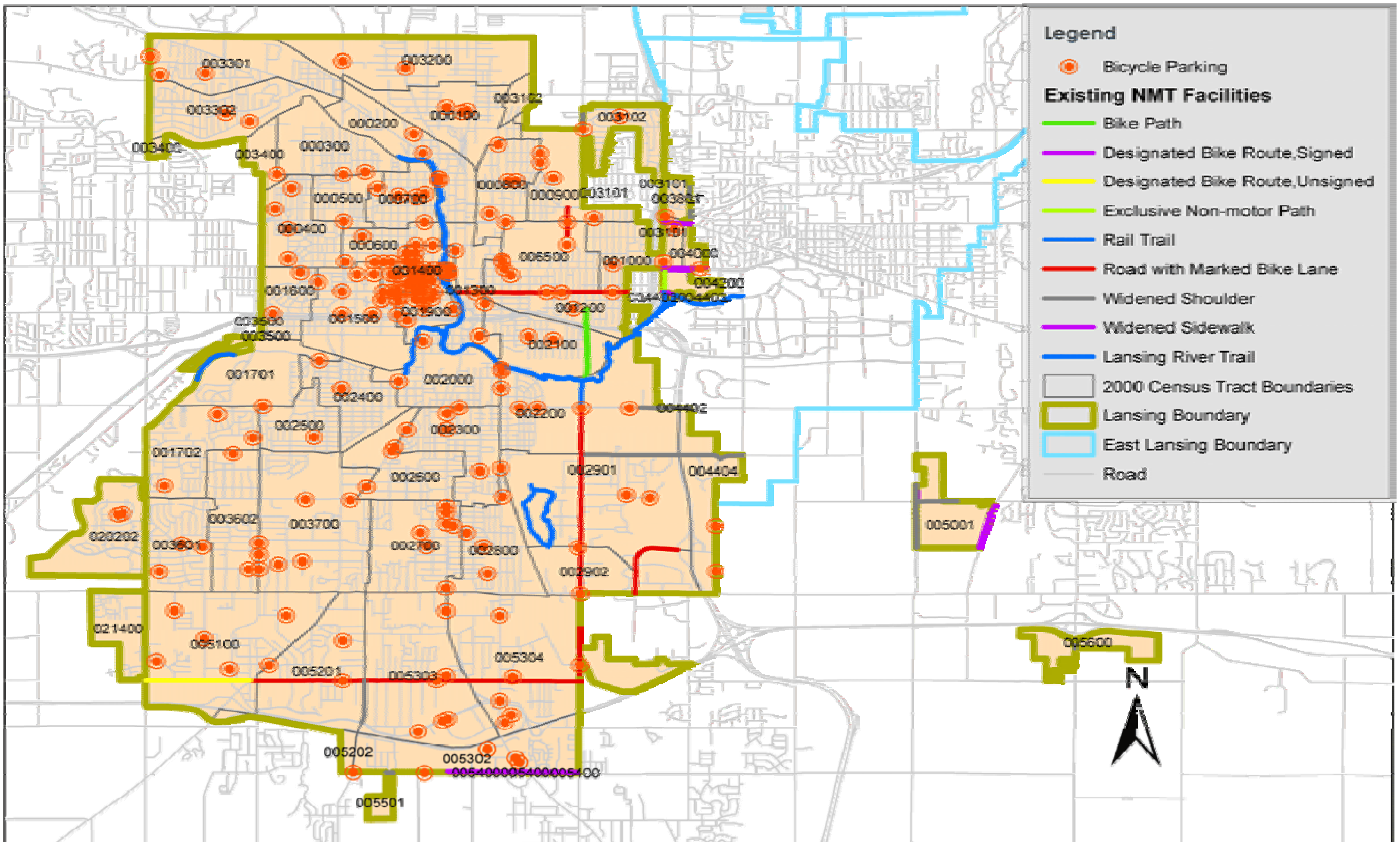
Responsibility of:	Rank By #	Total
CATA	9	1
City	6	18
County Parks	8	2
Federal	7	3
Lansing P & R	1	113
Private	3	62
School, non-pub.	5	20
School, public	4	46
State	2	67
Grand Total		**332**

It is reasonable to conclude from the apparent distribution of bicycle parking represented in the map that beyond this cluster of downtown bike parking locations, additional bike parking options seem to become sparser. Bike parking, furthermore, does not appear to consistently accompany with attractors of bicycle and other utilitarian NMT trips. The close up map (See map *Existing Conditions: Bicycle Parking, Michigan Avenue*) depicts both (1) the lower concentration of bike parking and (2) the lack of parking on

80 Note: The team was unable to determine the responsibility of 8 locations

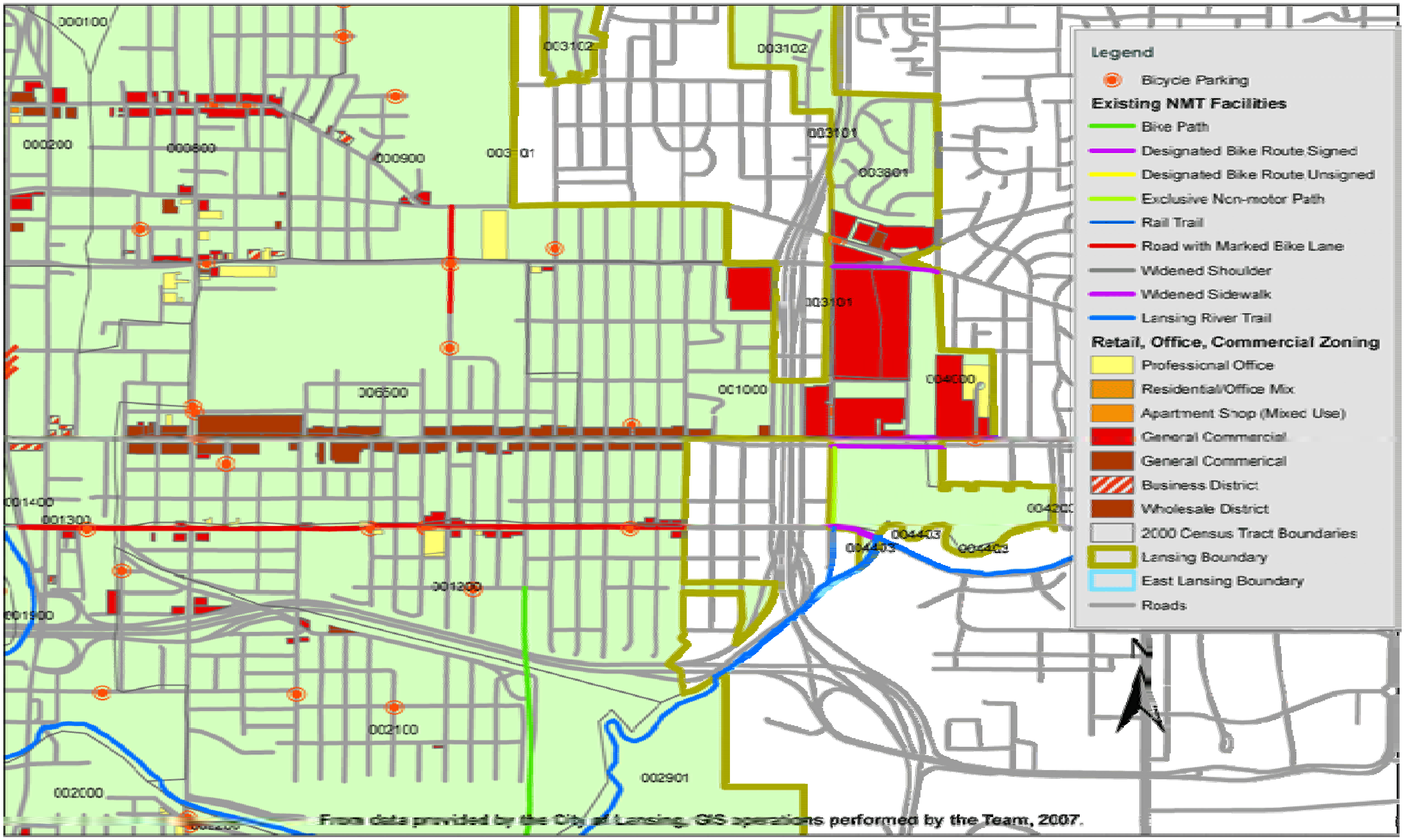
a major commercial thoroughfare in Lansing. Michigan Avenue has a mix of land uses, and a mix that can generate bicycle trips (See Land Use Section, below). Unfortunately, there are few parking options for riders using this section of Michigan Avenue, and none in immediate proximity to the commercial establishments on both sides of the road. This holds true for the Frandor shopping center where the Team found only 4 bicycle racks serving a shopping center with more than 50 retail stores and restaurants.

Existing Conditions: Bicycle Parking



From data provided by the City of Lansing, GIS operations performed by the Team, 2007.

Existing Conditions: Bicycle Parking, Michigan Avenue

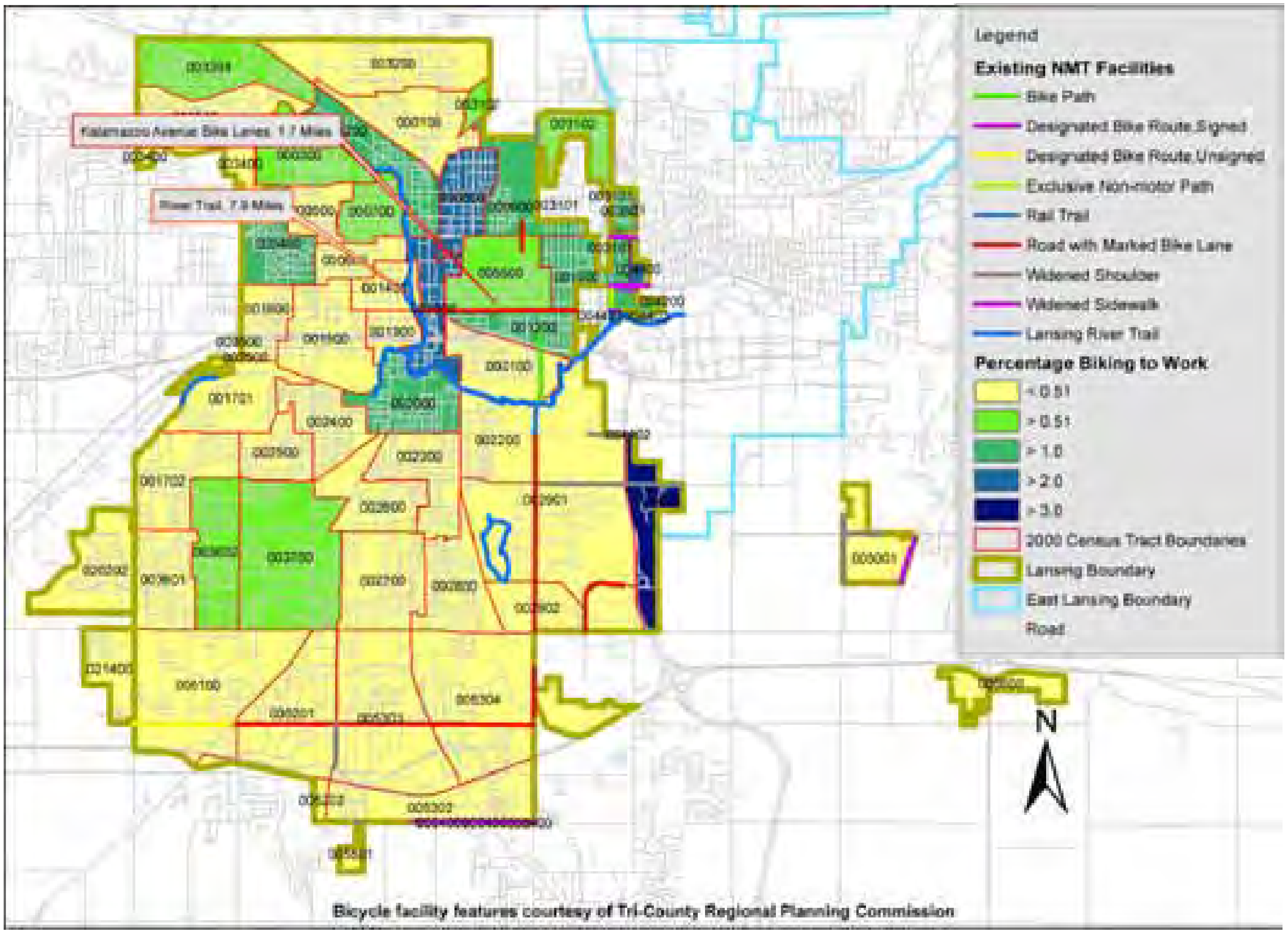


Bike lanes, paths, thoroughfares. The *Existing Conditions: Existing NMT Facilities* map depicts the extent of all existing signed, on-road bike lanes in the city of Lansing. Altogether they amount to 7.25 miles (calculations by author). What is more important than the linear extent of these lanes is that the majority of them lie on the periphery of the City, outside the higher density urban core. Much of the development in these areas is lower density with street patterns that more closely approximate the winding streets of suburban subdivisions than the tight grid iron pattern of urban Lansing neighborhoods (See *Land Use*, below). These newer neighborhoods and districts are, in other words, less conducive to utilitarian bicycle travel, and lower rates of bicycle commuting are to be expected. And looking at *Existing Conditions: Existing Facilities & Commuting by Bicycle* it becomes apparent that this is true.

The relationship between the location of lower percentage bike commuter census tracts and these bike facilities that lie on the periphery of Lansing's urban core lend some support to this idea: the southern most of these lanes, and the longest extent, runs through census tracts 51, 22.01, 53.03, and 53.04 (See *Existing Conditions: Existing Facilities & Bicycle Commuting*) all of which recorded lower than average (less than 0.5%) levels of bicycle commuting according to 2000 Census data. The extent of marked bike lanes running north from this extent along Aurelius Road also passes through census tracts with very low levels of bicycle commuting.

The only significant extent of marked on-road bike facilities passing through the denser neighborhoods of the urban core runs along Kalamazoo Avenue between U.S. 127 and Cedar (See *Existing Conditions: Existing Facilities & Bicycle Commuting*. In fact, these bike lanes represent a very important east/west thoroughfare for bicycle commuters by providing them with the only marked bike lanes that (1) connect the city of Lansing with the city of East Lansing other easterly communities and (2) that facilitate east/west movement through the urban core of Lansing. While other routes most certainly exist, the absence of marked lanes discourages bicycle commuting by reducing the amount of space afforded to cyclists when vehicular traffic is present. It should also be noted that census tracts with higher levels of bicycle commuting lie along or in very close proximity to these bike lanes. Unfortunately, the bike lanes along Kalamazoo Avenue stretch for only 1.7 miles (calculations by author).

Existing Conditions: Existing Facilities & Bicycle Commuting



MICHIGAN STATE UNIVERSITY

Competing with automobiles (those that are moving as well as those that are parked) for space on roads does *not* encourage utilitarian or recreational cycling. This is particularly true for utilitarian/commuter bicyclists. Citing the *2002 Omnibus Study* conducted by the BTS, Dill and Carr observed that bicycle commuters tend to use bike lanes more often than recreational cyclists.[81] To this extent, the findings mentioned at the beginning of this section are especially important for communities seeking to increase levels of bicycle commuting. Through their own analysis of Census 2000 Supplemental Survey (C2SS) the Team found that the number of miles of Type 2 bike lanes (bike lanes are on-street bicycle lanes) was strongly and statistically significantly associated with higher levels of bicycle commuting.[82] In fact, analysis of variables for vehicle ownership, number of days of rain, and state spending on pedestrian and bicycle facilities revealed that the number of miles of Type 2 bicycle lanes was the strongest predictor of levels of bicycle commuting: *For more typical U.S. cities over 250,000 population, each additional mile of Type 2 bike lanes per square mile is associated with a roughly one percent increase in the share of workers commuting by bicycle.*[83] Although Lansing is roughly half the size of cities studied by Dill and Carr, these findings should be considered seriously: Lansing currently has only 0.23 linear miles of type 2 bicycle lanes per square mile.

It should be emphasized, however, that creating bike lanes alone is not a viable strategy for increasing overall levels of bicycle commuting. Dill and Carr report that land use patterns can also have profound impacts on levels of bicycle commuting as is the case for cities like San Diego, San Jose, and Riverside, California. In each of these cases, lower density land use patterns could explain higher than average automobile ownership and lower than average levels of bicycle commuting. They continue, "…*bicycle paths alone are not likely to increase bicycle commuting. Bike lanes and paths need to connect popular origins and destinations, greater efforts should be taken to educate commuters about bicycling as an option, and commuters need adequate and safe parking at*

[81] Dill and Carr, p. 2
[82] Dill and Carr, p. 4
[83] Dill and Carr, p. 2

work."[84] Other variables, like those discussed above, should be analyzed at the disaggregate level in order to determine relationships between socioeconomic factors and levels of bicycle commuting within specific communities.

---

[84] Dill and Carr, p. 7

(3.3) Land Use Patterns

This section examines the characteristics of the physical environment through and in which NMT facilities are located. In preparing a non-motorized plan, it is important to examine socioeconomic factors influencing transportation choices. That said, the influence of the physical environment cannot be overlooked. As discussed before, the presence or absence and overall quality of pedestrian and bicycle facilities can encourage or discourage use of NMT. But the availability of NMT facilities alone does not represent the only way in which the built environment and landscape interact with non-motorists. Researchers have found that land use patterns, for example, can also have profound impacts on levels of bicycle commuting as was the case in a study that documented low levels of bicycling in cities with extensive NMT infrastructure like San Diego, San Jose, and Riverside, California.[85] Given their magnitude and pervasiveness, it is hardly surprising that land use patterns and the built components of urban landscapes strongly affect the choice and ability to use NMT. More specifically, the connectivity, density, and land use diversity of our neighborhoods and cities are essential determinants of NMT success or failure in Lansing and elsewhere. The following is intended to provide a brief assessment of land use patterns and the quality of Lansing's built environment.

85 Dill, J. and T. Carr. (2003). *Bicycle commuting and facilities in major U.S. cities: if you build them, commuters will use them – another look*. TRB 2003 Annual Meeting CD-ROM 1-9. p. 7; Targa, F. and K. J. Clifton. (2005). Built environment and non-motorized travel: Evidence from Baltimore City using the NHTS. *Journal of Transportation and Statistics*, 8.3, 55-70. Retrieved February 12, 2007, from http://www.wam.umd.edu/~ftarga/downloads/Papers/Targa-Clifton-2005.pdf

3.3.A. Street Networks & Connectivity

The features of the built landscape most obviously related to any kind of transportation are, of course, the networks of streets that crisscross urban and (increasingly) rural areas. As Lawrence Frank, Chair in Sustainable Urban Transportation Systems at University of British Columbia, puts it "[t]heir importance for travel by all modes cannot be overstated, for they connect nearly every destination to one another within cities […] because streets are so ubiquitous, they are an important dimension of the urban fabric in their own right."[86] Judging from the NMT plans reviewed for this report, street networks throughout the United States integrate NMT facilities to varying degrees and with varying degrees of success. As we have already discussed above, Lansing has relatively few existing NMT facilities for cyclists. In the case of pedestrian facilities, the built factors encouraging and discouraging walking differ in character and consequence. Although it is certainly likely that many of the city's neighborhoods do provide sidewalks (the primary pedestrian travel facility), the mere presence of sidewalks alone does not create the conditions necessary for an efficient pedestrian network that attracts and encourages increasing numbers of users. The characteristics of street networks into which NMT might be integrated are themselves of great importance.

One reason for this is really quite simple: travelers using NMT for utilitarian purposes expect to complete their trips with a reasonable degree of efficiency, and NMT facilities that do not connect destinations efficiently and make NMT travel more difficult for non-motorists discourage greater use of NMT. This may not be a problem for recreational walking and cycling, where walkers and cyclists are not concerned with reaching destinations efficiently, if at all. In those cases, non-motorists may even prefer wide, meandering suburban streets with minimal intersections.[87]

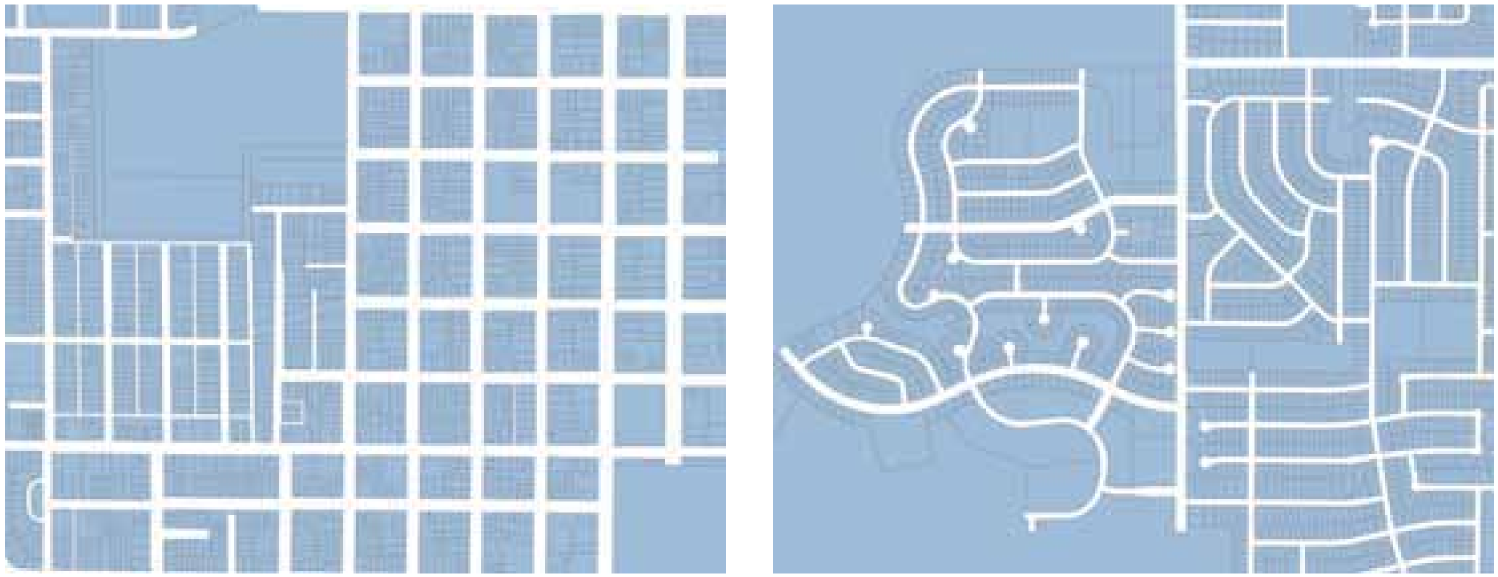
---

[86] Frank, D., P. Engelke, and T. Schmid. (2003). *Health and Community Design*. Washington D.C.: Island Press.
[87] Shriver, K. (1997). Influence of environmental design on pedestrian travel behavior in four Austin neighborhoods. Transportation Research Record 961076, TRB, National Research Council, Washington, D.C., 1997, 64-75.

Street networks are often placed by researchers into one of three categories. Organic streets are typically found in older cities and reflect the earliest periods of urbanization when cities began to emerge as unplanned centers of human settlement. The gridiron is also quite ancient in its origins, but has endured to become (until recently) the preferred network pattern for urban places—city and (first ring) suburb alike. One needs to look no further than Lansing's own core neighborhoods to find many examples of this type of street network. The gridiron is characterized by shorter blocks, relatively straight avenues, and many intersections (See Figure 26, next page). Hierarchical networks emerged partly as a reaction to the rigid geometry of the grid, and partly because of the increasing reliance on the private automobile by the middle of the twentieth century. Every American motorist is familiar with its basic tenets: "streets are deliberately ordered into a hierarchy […] At the top of the hierarchy are major arterial roads, which are designed primarily for high-volume automobile traffic and often feature no amenities for bicyclists or pedestrians. At the bottom of the hierarchy are local residential streets […]."[88] Such networks have longer blocks, fewer intersections and external access points, and more internal loops (See Figure 27, next page).

[88] Frank, D., P. Engelke, and T. Schmid. (2003). *Health and Community Design*. Washington D.C.: Island Press. p. 123

Figure 26 & Figure 27
Lansing Neighborhood Connectivity Diagrams



Source: Author, 2007

For all types of transportation, non-motorized and motorized alike, gridirons provide efficient connections between destinations that are comprehensible due to their cardinal orientation and predictable intervals. And, more importantly, gridirons provide travelers with much more direct routes than the curvilinear alternatives offered by hierarchical networks of arterials, connectors, and disconnected neighborhood meanders. Recent research conducted by Katherine Shriver assessed the influence of typical gridiron and hierarchical networks on pedestrian travel behavior. She selected four Austin, Texas neighborhoods to represent these two distinct street network patterns that characterize *modern* and *traditional* neighborhoods. The traditional neighborhoods were built on grids with shorter blocks, more intersections, and straighter streets that do not terminate in cul-de-sacs.[89] The modern neighborhoods used in this study actually had "thirty-two (32%) percent fewer four-way intersections and half the street connections to arterials at neighborhood borders."[90]

Shriver found that traditional neighborhoods are characterized by design features like shorter building setbacks and porches with outdoor seating, whereas modern neighborhoods are characterized by larger set backs and greater off-street parking. Modern neighborhoods tend to provide less outdoor public space and more off-street parking for commercial land uses than do traditional neighborhoods. The effect of these characteristics is that they make some neighborhoods more conducive to utilitarian and recreational walking versus recreational walking alone.

Shorter distances and greater internal connectivity facilitate greater utilitarian pedestrian travel in traditional neighborhoods. For example, Shriver found that sixty-five (65%) percent of pedestrians in traditional neighborhoods exhibiting these attributes walk to complete errands.[91] In fact, eighty-seven (87%) percent of pedestrians in traditional neighborhoods engage in four or more activities during a single walk.[92] Targa and Clifton found that greater street connectivity was also associated with more walking trips. For every one mile less of census block perimeter, the number of expected walking trips increased by 0.258%. However, as unsubstantial as this may seem, it represents a nine (8.9%) percent increase for trips made on foot relative to other transportation modes.[93]

---

89 Shriver, K. (1997). Influence of environmental design on pedestrian travel behavior in four Austin neighborhoods. Transportation Research Record 961076, TRB, National Research Council, Washington, D.C., 1997, p. 67.
90 Ibid. p. 68
91 Shriver, K. (1997). Influence of environmental design on pedestrian travel behavior in four Austin neighborhoods. Transportation Research Record 961076, TRB, National Research Council, Washington, D.C., 1997, p. 71.
92 Ibid. p. 72
93 Targa, F. and K. J. Clifton. (2005). Built environment and Non-motorized travel: Evidence from Baltimore City using the NHTS. *Journal of Transportation and Statistics*, 8.3, 55-70. Retrieved February 12, 2007, from http://www.wam.umd.edu/~ftarga/downloads/Papers/Targa-Clifton-2005.pdf, p. 67.

Safety was also an important subjective factor influencing willingness to walk in traditional neighborhoods. Inclement weather was not a significant constraint on walking. For modern neighborhoods, where pedestrians tend to walk for recreation, respondents indicated that "walkway continuity and trees, shade, and interesting things to look at are the most important environmental attributes".[94]

[94] Targa, F. and K. J. Clifton. (2005). Built environment and Non-motorized travel: Evidence from Baltimore City using the NHTS. *Journal of Transportation and Statistics*, 8.3, 55-70. Retrieved February 12, 2007, from http://www.wam.umd.edu/~ftarga/downloads/Papers/Targa-Clifton-2005.pdf, p. 72

3.3.B. Density

The number of persons living within a given area can provide both an indicator of the density of urban land uses and is also thought to be a predictor of non-motorized travel. Frank, Engelke, and Schmid suggest that the relationship between density and walkability is often assumed to be true.[95] Indeed the connection between density and walking and bicycling (especially for utilitarian trips) seems to be quite clear: higher densities suggest that a wider variety of land uses, including residential and commercial, are located within closer proximity to one another than would otherwise be true for lower density urban environments. As mentioned above, non-motorists tend to desire reasonable proximity between destinations. And, Vojnovic (2006) adds, "Distances between activities will be shorter on average in a higher density city since the urban footprint will contain more commercial activities and residents within a smaller area—encouraging non-motorized travel."[96] Targa and Clifton, in the same study mentioned above, found that subjects living in "denser urban settings," are more likely to walk than subjects living in lower density settings. Although it may seem modest, for every one (1%) percent increase in the density in households per square mile the researchers found a 0.033% increase in the expected number of walking trips.[97]

But just exactly what is "high" density versus "low" density? Looking at the number of persons per acre (as this report does), it becomes apparent that these categories are not static and vary from place to place. Because density is tied to local culture and defined by development patterns that are (to some extent) unique to each community, density should be evaluated within an appropriate context. Different countries and different cities within different countries "have different cultural standards

95 Frank, D., P. Engelke, and T. Schmid. (2003). Health and Community Design. Washington D.C.: Island Press. p. 139.
96 Vojnovic, Igor. (2006). Building communities to promote physical activity: a multi-scale geographical analysis. *Geografiska Annaler*., 88B, p. 77.
97 Targa and Clifton, Ibid. p. 66.

regarding what are considered high and low densities."[98] For example, comparing the densities of a city like Chicago with those of a city like Lansing may not reveal very much other than the fact that Lansing is not Chicago.

Even in the proper context, the diagnostic value of this simple formulation is confounded, however, by the fact that higher densities do not necessarily create more compact and integrated urban living environments where different land uses cleave neatly together. One could easily imagine a very dense residential environment immediately adjacent to a commercial center but separated by a road with heavy traffic traveling at high speeds. For many, and especially for the youngest, oldest, and most vulnerable non-motorists, such an arrangement would conceivably discourage non-motorized travel between these destinations. When assessing the impact of density on NMT, it will be important to look at the nature of land use integration as well. Density alone should not be used as metric to judge the appropriateness of an NMT strategy.

[98] Frank, D., P. Engelke, and T. Schmid. (2003). "Health and Community Design". Washington D.C.: Island Press. pg. 141.

3.3.C. Land Use Diversity

Aside from connectivity and density, land use diversity is often examined by researchers seeking to understand the influence of land use and the built environment on non-motorized travel behavior. The "fineness" of different land uses within a finite geography can be assessed at many different scales. Land uses may vary within a single building or across a neighborhood, city, or region. For the purposes of this report, the Team was most interested in the mix of land uses within neighborhoods, block by block. When preparing corridor or neighborhood level NMT plans or strategies, those responsible are strongly encouraged to examine the level of integration of land uses as closely as possible in order to gain the best possible understanding of the land uses functioning as trip attractors within those locales.

Like density and connectivity, it is hypothesized that "mixed" use neighborhoods encourage non-motorized trips by concentrating trip generating destinations. Older neighborhoods, like those described by Shriver in the preceding discussion of connectivity, predate the urban planning practices (primarily zoning) that separate different land uses from one another and tend to increase the distance between destinations. These different land uses, and different sub-categories of each land use, are commonly found in traditional neighborhoods. Single use neighborhoods or districts are just that: places where one land use is formally permitted to the exclusion of all others. As zoning became the preferred instrument of land use control in many planning departments throughout the United States, land use patterns in emerging neighborhoods and districts drifted away from integrated, mixed use environments.[100]

[100] Frank, D., P. Engelke, and T. Schmid. (2003). Health and Community Design. Washington D.C.: Island Press.

The relationship between finer land use diversity (urban environments where more land uses share less space) and higher levels of NMT travel seems quite logical. Indeed, Shriver found that in neighborhoods that are more accessible and mixed-use, pedestrians who walk for utilitarian purposes indicated that "the two most important attributes are walkable distances to shops, work, and entertainment and access to transit.[101] Land use in her study was measured by the "number, variety, type, and location of destinations that may be comfortably reached on foot." Much like Targa and Clifton, this measure approximates "mixed-use" development patterns where a variety of land uses are concentrated within individual neighborhoods rather than distributed widely across many of them. Because land uses are segregated to a much higher degree in modern neighborhoods than in traditional neighborhoods, many destinations are less accessible to pedestrians in modern neighborhood environments. Distances between destinations are greater, and utilitarian pedestrian travel is therefore discouraged.

[101] Shriver, K. (1997). Influence of environmental design on pedestrian travel behavior in four Austin neighborhoods. Transportation Research Record 961076, TRB, National Research Council, Washington, D.C., 1997, p. 72.

3.3.D. Land Use Patterns in Lansing

Neighborhoods throughout Lansing and the whole city generally, are characterized by a range of land use patterns comprised of different types of street networks, different levels of population density, and varying degrees of land use integration or separation. To begin, Lansing's street networks are similar to street networks in older cities throughout the Midwestern United States where tighter gridiron patterns have slowly given way to more modern, hierarchical street networks. The diagrams presented above in Figures 1 and 2 (which were used to illustrate the spatial differences between gridiron and modern hierarchical street networks) are actually taken from neighborhoods in Lansing. The gridiron example is typical of older, traditional neighborhoods that lie at or near the heart of the city, while the modern hierarchical network better represents newer neighborhoods built further out (See *Connectivity* and *Connectivity Close-up Maps*)

Although this pattern is apparent from little more than glance at a Lansing street map, the Team actually identified and then categorized different areas by their level of connectedness. These categories were determined based on the characteristics of the distribution of the data and as well as practices established in the literature. Just as other studies have done, connectedness was determined by measuring the length of census block perimeters. The results of this procedure are as follows:

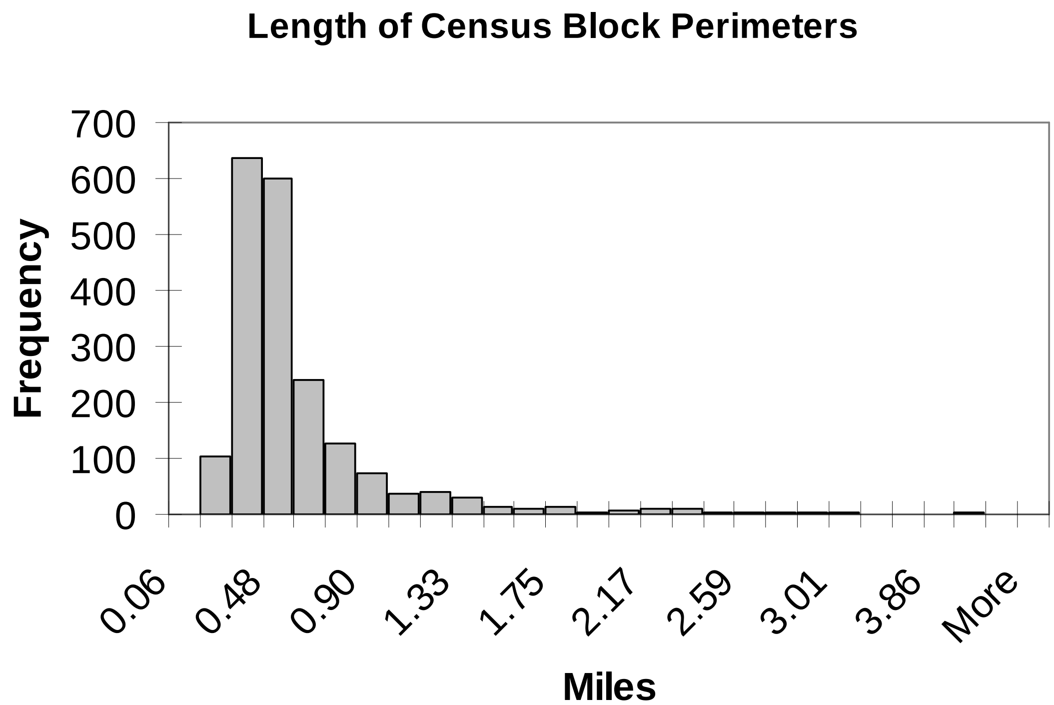
1. The average block length was 0.52 miles with a mode of 0.33 miles. In other words, the average perimeter is quite short. A block with a perimeter of 0.52 miles yields an area of approximately 10 acres and a block with 0.33 mile perimeter yields a mere 4.5 acres.[102] In comparison with the study area used by Targa and Clifton (Baltimore, Maryland), Lansing has a fairly high level of connectedness. The Existing Conditions: Connectivity Close-up Map shows a highly connected section north of downtown Lansing.

2. Not only is the average size of a census block in Lansing relatively small, as Figure 28 demonstrates, the vast majority of census blocks are concentrated around this average.

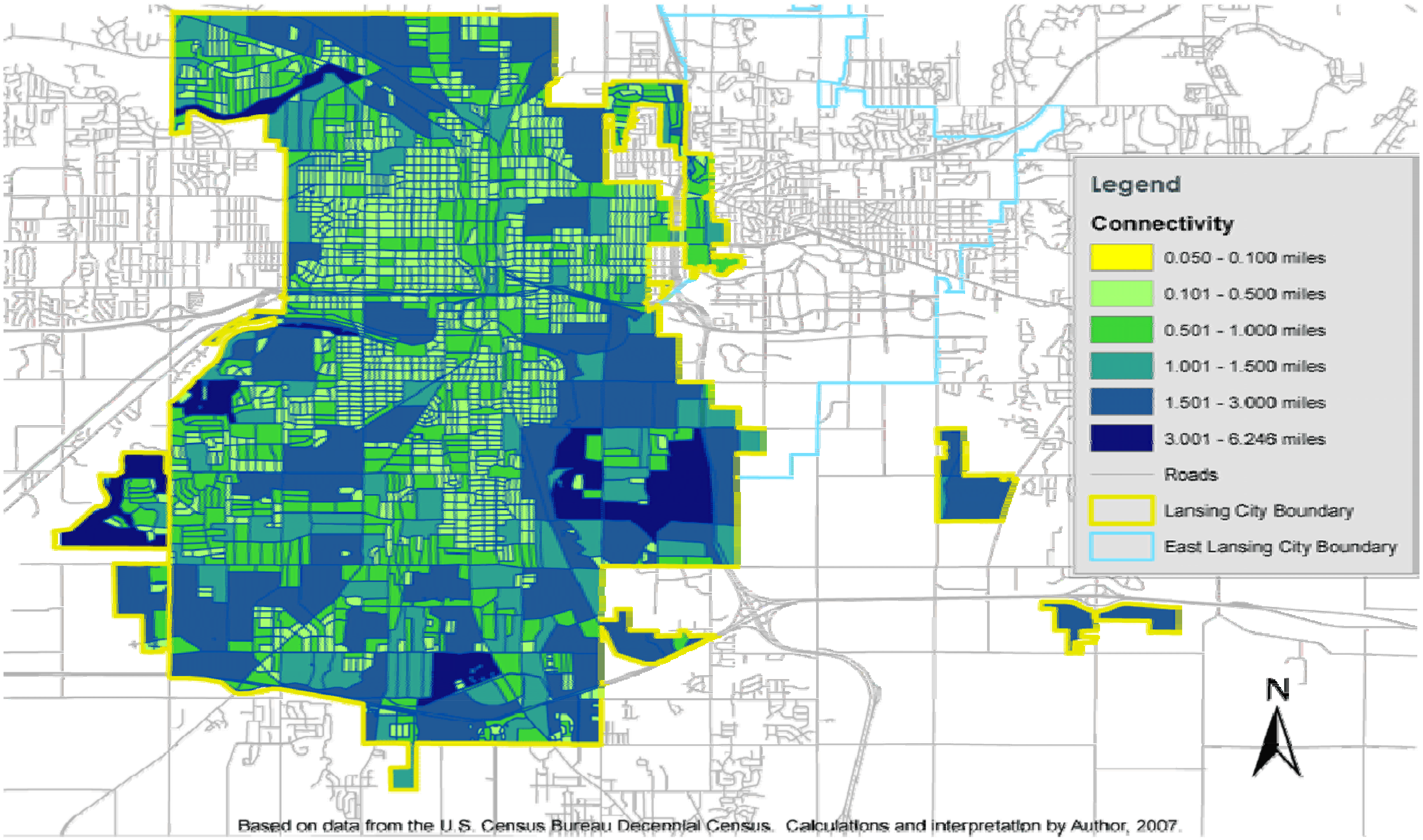
[102] Calculations by author: (0.52/4) = 0.13 miles; 0.13^2 = .0169 square miles; 0.0169 square miles * 640 = 10.816 acres; (0.33/4) = 0.0825 miles; 0.0825^2 = 0.00680 square miles; 0.00680 square miles * 640 = 4.356 acres.

3. As alluded to before, higher connectivity areas and lower connectivity areas are distributed throughout the city with higher connectivity blocks and neighborhoods concentrated around the city center. As the first *Existing Conditions: Connectivity* map shows, the smallest blocks (those with the perimeters between 0.10 and 0.50 miles) are most prevalent closer to the center of the city, becoming less so further out.

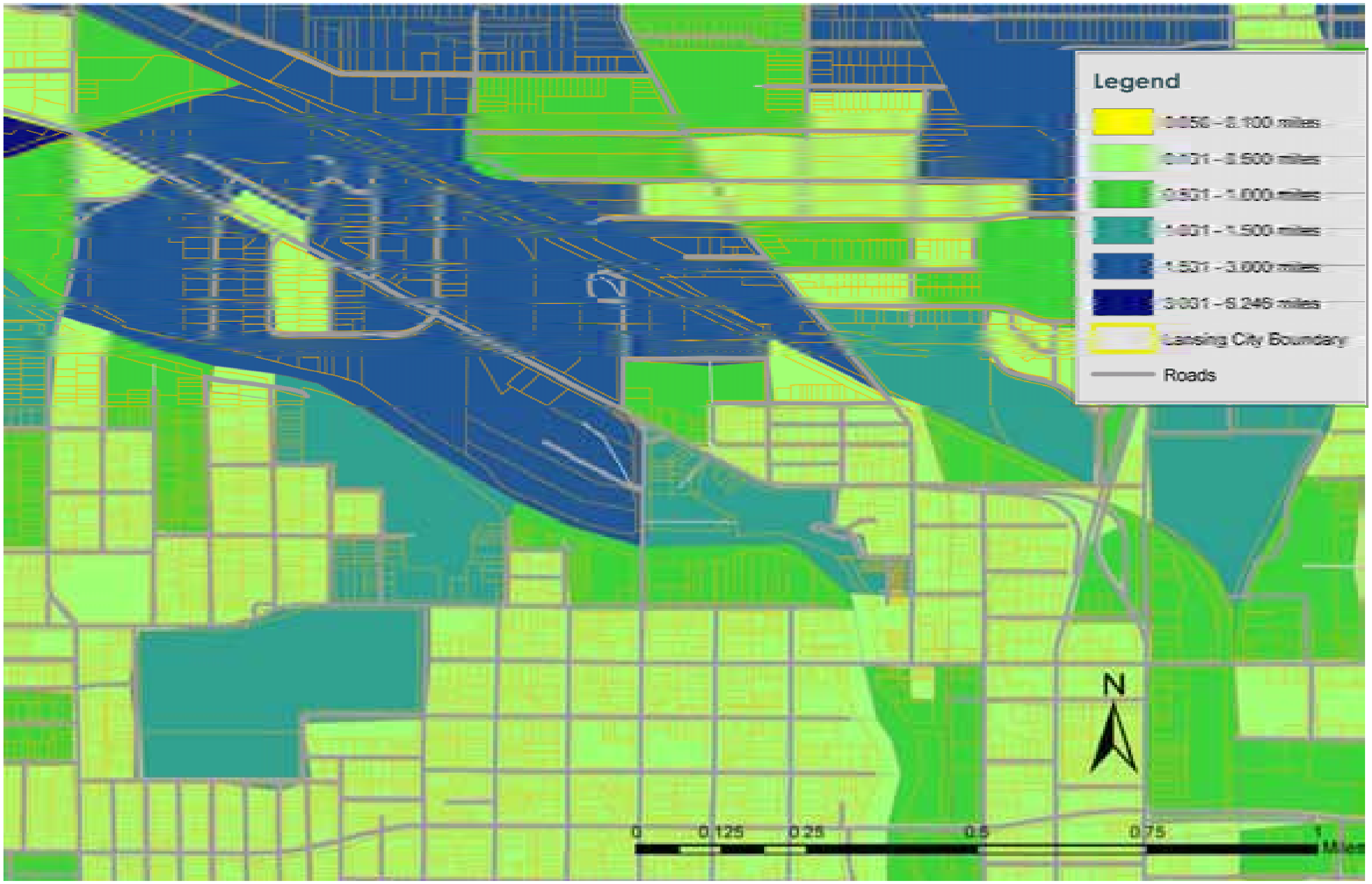
Figure 28



Existing Conditions: Connectivity



Existing Conditions: Connectivity (Closeup)



Population densities in Lansing follow a similar pattern with higher density blocks concentrated (more or less) around the center of the city. For the purposes of this report, the Team grouped the data into intervals divisible by the approximate size of a household (2.5 persons). These intervals were also constructed to reflect the distribution of the data.

Looking strictly at arithmetic averages, Lansing is not a terribly dense city. Given a population of 119,122 according to data gathered at the block level in the 2000 Decennial Census, and total land surface area of 22,672 acres within the city boundaries, the Team calculated a density of 5.25 persons per acre. This figure is, however, misleading: inspection of aerial photographs of Lansing or the current zoning map reveals that huge tracts of land within the city are devoted to industrial use, thus increasing the true population density of the city. In this sense, the spatial organization of residential and non-residential land uses across the city becomes an important aspect of population density. Until the day comes when these large industrial tracts are reused for other land uses (including residential), simple calculations of population density will not reveal very much about the distribution of Lansing's population (See *Population Density* and *Population Density Close-up* map).

Fortunately, the Team chose to examine population density at the census block level: all data pertains to blocks and is aggregated and normalized at that level. Using GIS, two population density maps help to depict the distribution of population throughout Lansing. The close-up map focuses on the same neighborhood described in the previous discussion of connectivity. At this scale, there appears to be some relationship between higher density blocks (those with 10 – 15 persons/acre and more) and the shorter perimeter, higher connectivity census blocks. This relationship is further examined below. As for the distribution of higher density census blocks (those in the 10 – 15, 15 – 35, and Over 35 intervals), more are found closer to downtown. Lower density blocks (5 – 10 persons/acre) and very low density census blocks (fewer than 5 persons/acre), symbolized by light blue and yellow, surround these higher density areas.