**MEMORANDUM**

To: Metro COG

From: Alta Planning + Design

Date: 2/3/22

Re: Metro COG Bicycle and Pedestrian Plan- Existing Conditions Memo

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## Introduction

Quantitative analyses of existing conditions in the Fargo-Moorhead Metro COG service area provide a baseline understanding to inform future phases of the Bicycle and Pedestrian Plan, including developing recommendations for improving active transportation options within the region. The multi-faceted spatial analyses conducted for this plan help to describe spatial dynamics of systems impacting active transportation, including community sociodemographic features and the built environment.

The existing conditions analysis began with the creation of a comprehensive street dataset using Open Street Map data, which was then enhanced with local data and desktop review of aerial and street-level imagery. This streets dataset was the basis for Pedestrian and Bicycle Level of Traffic Stress (LTS) analyses, which informed the connectivity analysis. An active trip potential analysis, equity analysis, and collision analysis shed light on the demand, demographic, and safety conditions in the Fargo-Moorhead area. The priority investment areas analysis combined all of the existing conditions analyses results to produce a composite picture of geographic areas where investment in active transportation is likely to have the greatest impact. The priority investment areas analysis will inform the development of pedestrian and bicycle network development and project prioritization.

## Creation of a Comprehensive Street Dataset

The primary data source for the street network, including both the spatial data describing where streets are located and the non-spatial data describing characteristics of those streets (e.g., number of lanes, lane widths, etc.), was Open Street Map (OSM). OSM is an open-source, public mapping project that aggregates data reported by members of the public and makes those data freely available. OSM typically offers a more comprehensive description of transportation infrastructure than do other sources of similar data. Municipal and regional datasets compiled by local governments in the Fargo-Moorhead region augmented OSM data.

Descriptive analyses of the OSM data and visual comparison of OSM features to corresponding features in satellite imagery and in datasets provided by Metro COG helped in identifying missing or incorrect values in OSM data--for example, the absence of road or sidewalk segments, or inaccurate road speed limits.

Some of the most important characteristics of a street network dataset are:

- the **spatial characteristics** of the data, including whether road, bicycle, and pedestrian infrastructure are present and interconnected; and
- the **non-spatial characteristics** of the data, including the widths, speeds, allowed uses, and directionality of transportation infrastructure.

The OSM data for the Metro COG region were very comprehensive spatially in comparison to other data sources and also offered more detailed and accurate non-spatial data for many core variables. However, Metro COG provided shared use path and bike facility data that offered additional details not captured in the OSM data. Missing shared use paths and bike facilities were added to the OSM network. Additionally, speed limits for many rural roads were inaccurate in the OSM data, which typically reported speed limits of 30 miles per hour. A review of street level imagery determined that 50 miles per hour is a more typical speed limit for rural roads in the area. Accordingly, all roads located a half-mile or more outside of a municipality or other Census-designated place were updated with a 50 mile per hour speed limit.

## Pedestrian Level of Traffic Stress (LTS) Analysis

High levels of traffic stress make walking an infeasible or uncomfortable mode of transportation. The Pedestrian Level of Traffic Stress (PLTS) analysis provides an understanding of the areas within the Metro COG region where walking may be easiest and most challenging. LTS scores range from one to four, where one represents the lowest stress and four represents the highest stress and discomfort.

### Methodology

The PLTS analysis methodology is adapted from the Oregon Department of Transportation (ODOT)'s *Analysis Procedures Manual* [1] and is intended as a companion for Bicycle Level of Traffic Stress (BLTS). For the Metro COG Bicycle and Pedestrian Plan, PLTS was determined by characteristics of a given roadway segment that affect a pedestrian's perception of safety and comfort including posted speed limit and number of travel lanes. Additional factors that would provide a more fine-grained understanding of pedestrian comfort, including sidewalk presence, width, pavement quality, and buffer from roadway, were not available in OSM data or public agency data. Assumed values for these factors are detailed below.

PLTS scores classify road segments into one of four levels of traffic stress and considers both user experience and the level of attention required:

- **PLTS 1** represents roadways where pedestrians of all ages and abilities would feel comfortable walking and require little attention to traffic.
- **PLTS 2** represents slightly less comfortable roadways that require more attention to traffic and are suitable for children over 10, teens and adults.
- **PLTS 3** represents moderately uncomfortable roadways, where most adults without mobility challenges would feel uncomfortable but safe.
- **PLTS 4** represents high traffic stress and would be used only by adults without mobility challenges who have limited route choices.

[1] Oregon Department of Transportation, Transportation Development Division Planning Section: Transportation Planning Analysis Unit. 2020. Analysis Procedures Manual Version 2. https://www.oregon.gov/odot/Planning/Pages/APM.aspx

The PLTS analysis was completed through an assessment of street segments using OSM data. Each segment of the roadway is evaluated primarily on speed, number of lanes, and sidewalk presence/completeness to produce a PLTS score.

Scores for each element of the pedestrian environment are assigned to each segment of the sidewalk centerline, and the worst (highest scoring) of the elements is used. If two sidewalks are present on a street, the worst (highest scoring) result is mapped to the centerline.

Figure 1 illustrates the overall PLTS scoring process. Notes on data inputs and assumptions are found in Table 1. Segment scores are assigned as shown in Table 2 through Table 5.

*Figure 1. The PLTS Scoring Process*

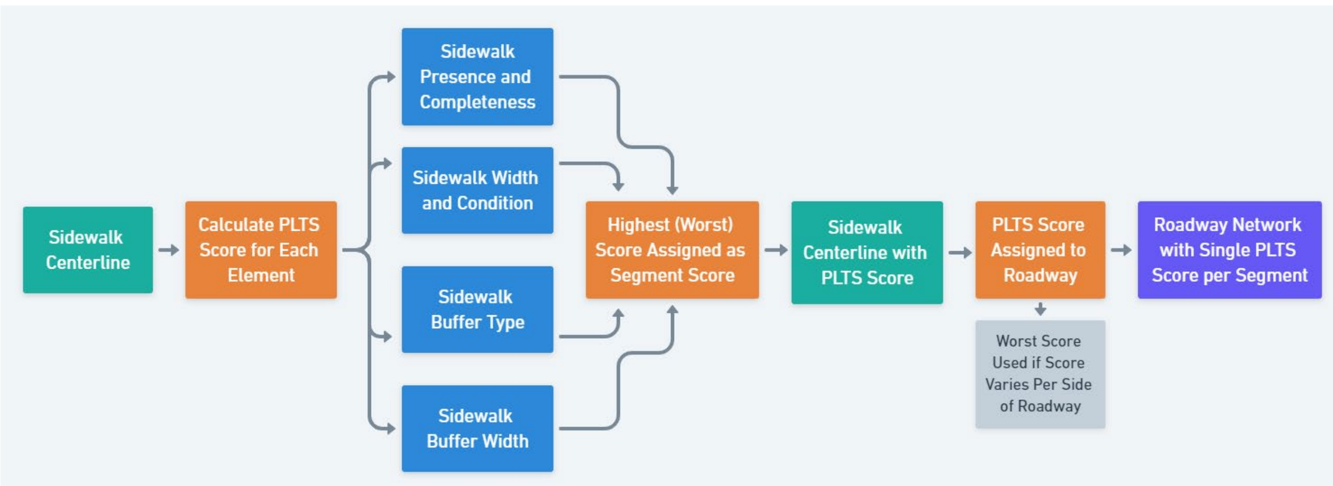

*Table 1. Data Inputs and Assumptions*

| Pedestrian Element | Rationale | Data Inputs |
|---|---|---|
| Sidewalk Presence and Completeness (Table 2) | The presence and completeness of sidewalk facilities is the baseline for measurement. At a minimum, sidewalks should be present and complete on most roadways to facilitate pedestrian travel. | Sidewalk presence and completeness were based on OSM data. |
| Sidewalk Width and Condition (Table 3) | The width of the sidewalk can have an impact on the associated comfort level. Wider sidewalks provide greater comfort, especially on higher speed roadways. The condition of the sidewalk is primarily based on concrete quality. | Local data was unavailable. Sidewalks were assumed to have a width of 6 ft and to be in good condition. |
| Sidewalk Buffer Type (Table 4) | The buffer type changes the pedestrian experience as it can offer a range of perceived and actual levels of protection. Higher speed roadways are considered to be less comfortable, and a more substantial buffer increases pedestrian comfort. | Local data was unavailable. Sidewalks were assumed to have no buffer. |
| Sidewalk Buffer Width (Table 5) | Total buffering width is the summation of the width of buffer, width of parking, width of shoulder, width of curb & gutter, and width of the bike lane on the same side of the roadway as the pedestrian facility being evaluated. | Local data was unavailable. Sidewalks were assumed to have no buffer. |

Table 2 through Table 5 specify the scoring criteria based on sidewalk presence, sidewalk width and condition, buffer type, and buffer width, in relation to the existing roadway condition (factors such as speed and number of lanes). These tables are used in combination to assign an overall PLTS score; if multiple scores are present within a segment the highest (most stressful) score is used as the overall segment score. Due to a lack of data on sidewalk width, condition, buffer type, and buffer width, some scores were not possible and are shown in dark gray in the tables. For example, in Table 3, since all sidewalks were assumed to be 6 feet wide and in good condition, LTS 1 was the only possible score. All other scoring combinations are in gray.

*Table 2. PLTS Based on Sidewalk Presence and Completeness*

| Number of Travel Lanes | Posted or prevailing speed | | | | |
|---|---|---|---|---|---|
| | <= 25 mph | | 30 – 35 mph | | >= 40 mph |
| | 2 lanes | > 2 lanes | 2 lanes | > 2 lanes | 2 lanes |
| Complete sidewalk on both sides[1] | LTS 1 | LTS 2 | LTS 2 | LTS 3 | LTS 3 |
| Complete sidewalk on one side | LTS 2 | LTS 3 | LTS 3 | LTS 4 | LTS 4 |
| No sidewalk | LTS 2[2] | LTS 4 | LTS 4 | LTS 4 | LTS 4 |

1. Partial sidewalk coverage on a block is not considered complete.
2. 25 mph residential (OSM Highway class local) roadways without sidewalk default to LTS 2; other 25 mph roadways without sidewalk default to LTS 4.

*Table 3. PLTS Based on Sidewalk Width and Condition*

| Actual / Effective Sidewalk Width (ft)[12] | | Sidewalk Condition[3] | | | |
|---|---|---|---|---|---|
| | | Good | Fair | Poor | Very Poor |
| Actual/Effective Width (ft) | <4 | LTS 4 | LTS 4 | LTS 4 | LTS 4 |
| | ≥4 to <5 | LTS 3 | LTS 3 | LTS 3 | LTS 4 |
| | ≥5 | LTS 1 | LTS 2 | LTS 3 | LTS 4 |
| | ≥6 | LTS 1 | LTS 1 | LTS 2 | LTS 3 |

1. Effective width is the available/useable area for the pedestrian clear of obstructions. Effective width does not include areas occupied by storefronts or curbside features.
2. For analysis purposes, a standard width of 6 feet was assumed for all sidewalks.
3. Sidewalk conditions is assumed to be 'Good' – more detailed information was not available for this analysis.

*Table 4. PLTS based on Physical Buffer Type*

| Buffer Type[1] | Prevailing or Posted Speed | | | |
|---|---|---|---|---|
| | ≤25 MPH | 30 MPH | 35 MPH | ≥40 MPH |
| No Buffer (curb tight) | LTS 2[2] | LTS 3 | LTS 3 | LTS 4 |
| Solid surface | LTS 2[2] | LTS 2 | LTS 2 | LTS 2 |
| Landscaped | LTS 1 | LTS 2 | LTS 2 | LTS 2 |
| Landscaped with trees | LTS 1 | LTS 1 | LTS 1 | LTS 2 |
| Vertical | LTS 1 | LTS 1 | LTS 1 | LTS 2 |

1. No data available on buffer type: all segments assumed to have no buffer.
2. If no centerline is present (residential street) or the street is traffic calmed (including sporadic vertical separation such as street furniture, street trees, lighting, planters, surface change, etc.) then the PLTS can be lowered by 1 PLTS level.

*Table 5. PLTS Based on Physical Buffer Width. Source: Based on ODOT Analysis Procedures Manual, Table 14-23.*

| Total Number of Travel Lanes (both directions)[2] | Total Buffering Width (ft)[1] | | | | |
|---|---|---|---|---|---|
| | <5 | ≥5 to <10 | ≥10 to <15 | ≥15 to <25 | ≥25 |
| <=2 | LTS 2[3] | LTS 2 | LTS 1 | LTS 1 | LTS 1 |
| 3 | LTS 3[3] | LTS 2 | LTS 2 | LTS 1 | LTS 1 |
| 4-5 | LTS 4[4] | LTS 3 | LTS 2 | LTS 1 | LTS 1 |
| 6>= | LTS 4[4] | LTS 4[4] | LTS 3 | LTS 2 | LTS 2 |

1. Total Buffering Width data was not available: All segments assumed to have no buffer. Total Buffering Width is the summation of the width of buffer, width of parking, width of shoulder, width of curb & gutter, and width of the bike lane on the side same side of the roadway as the pedestrian facility being evaluated.
2. One-way facilities are assumed to have their lanes multiplied by 2 to represent exposure to lane crossing.
3. If no centerline is present (residential street) or the street is traffic calmed (including sporadic vertical separation such as street furniture, street trees, lighting, planters, surface change, etc.) then the PLTS can be lowered by 1 PLTS level.
4. Sections with a substantial physical barrier/tall railing between the travel lanes and the walkway (like might be found on a bridge) can be lowered to PLTS 3.

## Results

The results of the PLTS analysis, shown in Map 1 in the Appendix, provide an indication of relative pedestrian comfort based on speed limits and number of travel lanes.

Outside of the municipalities in the Metro COG borders, most roads ranked as "4" for the PLTS. Given the distances between municipalities outside of the core Fargo-Moorhead urban area, pedestrian trips are likely to be rare regardless of perceptions of traffic and walkability. Improvements to reduce LTS on these more rural roads will likely bring relatively small benefits relative to the associated costs, even though these roads ranked highly in terms of level of traffic stress.

Within the core urban area, the majority of the road network ranked as PLTS 1 and 2, reflecting the abundance of residential road miles relative to collector and arterial road miles. While a relatively small subset of the urban network ranked as PLTS 3 or 4, those segments that did have high traffic stress rankings are likely also some of the most direct routes for traversing the urban area and may be unavoidable for many trips.

PLTS results should be interpreted with caution because they relate to individual segments of the road network and do not correspond to actual trips. For example, a person interested in walking from their house to the grocery store might be able to traverse a route that is 95% road segments with low levels of traffic stress, yet the remaining 5% may require walking along very high traffic stress segments, inhibiting them from walking. Additionally, the lack of detailed information on sidewalk and buffer conditions means that the PLTS results should be interpreted as an indication of relative pedestrian comfort rather than a reflection of on the ground conditions.

The connectivity analysis, described later in this memo, sheds lights on how PLTS impacts the walking network.

## Bicycle Level of Traffic Stress (LTS) Analysis

A majority of the public would like to ride bicycles more but are discouraged from doing so by perceived safety concerns, lack of facilities, or a lack of knowledge about where the appropriate facilities are located. Surveys nationally show that 50-60 percent of people say they would ride a bicycle more (or start riding) if they had access to facilities that provided more separation from traffic, lower traffic speeds, and/or lower traffic volumes.[2] Additionally, evidence has shown that increasing the number of bicyclists on the road improves safety for all transportation modes. Cities with high bicycling rates tend to have lower crash rates.[3]

Most people living in the Fargo-Moorhead area are likely to be interested in biking but are uncomfortable riding on busy streets. The Bicycle Level of Traffic Stress (BLTS) analysis estimates the level of comfort for people biking on a given roadway segment. BLTS helps to identify where gaps or deficiencies in a bike network exist and provides a measure of how likely different types of riders, based on ability and comfort level, are to use the facility.

### Methodology

BLTS is determined by characteristics of a given roadway segment that affect a bicyclist's perception of safety and comfort, including posted speed limit, number of travel lanes, and the presence and character of bicycle lanes. The combination of this criteria classifies a road segment into one of four levels of traffic stress:

- **BLTS 1** represents roadways where bicyclists of all ages and abilities would feel comfortable riding. These roadways are generally characterized by low volumes, low speeds, no more than two travel lanes,

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[2]Jennifer Dill, "Categorizing cyclists: What do we know? Insights from Portland, OR." Presentation to Velo-City Global 2012, Vancouver, BC, June 26, 2012. https://nacto.org/wp-content/uploads/2017/11/Categorizing-Cyclists-What-do-we-Know-Insights-from-Portland.pdf
Dill J, McNeil N. Revisiting the Four Types of Cyclists: Findings from a National Survey. *Transportation Research Record.* 2016;2587(1):90-99. doi:10.3141/2587-11 https://journals.sagepub.com/doi/10.3141/2587-11
[3] NACTO. Equitable bike share means building better places for people to ride. 2016. https://nacto.org/wp-content/uploads/2016/07/NACTO_Equitable_Bikeshare_Means_Bike_Lanes.pdf

and traffic control measures at intersections. These roadways may have bicycle facilities; separated shared-use paths for bicycles also fall into this category.

- **BLTS 2** represents slightly less comfortable roadways, where most adults would feel comfortable riding.
- **BLTS 3** represents moderately uncomfortable roadways, where most experienced bicyclists would tolerate riding.
- **BLTS 4** represents high-stress roadways where only strong and fearless bicyclists would tolerate riding. These roadways are generally characterized by high volumes, high speeds, several travel lanes, and complex transitions approaching and crossing intersections.

BLTS analysis is completed through an assessment of street segments using spatial data and aerial imagery. Each segment of the roadway is evaluated based on its characteristics; if multiple scores are present within a segment the highest (most stressful) score is used as the overall segment score.

Figure 2 illustrates the overall BLTS scoring process. Notes on data inputs and assumptions are found in Table 6. Segment scores are assigned as shown in Table 7 and Table 8.

*Figure 2. BLTS Generalized Segment Scoring Process*

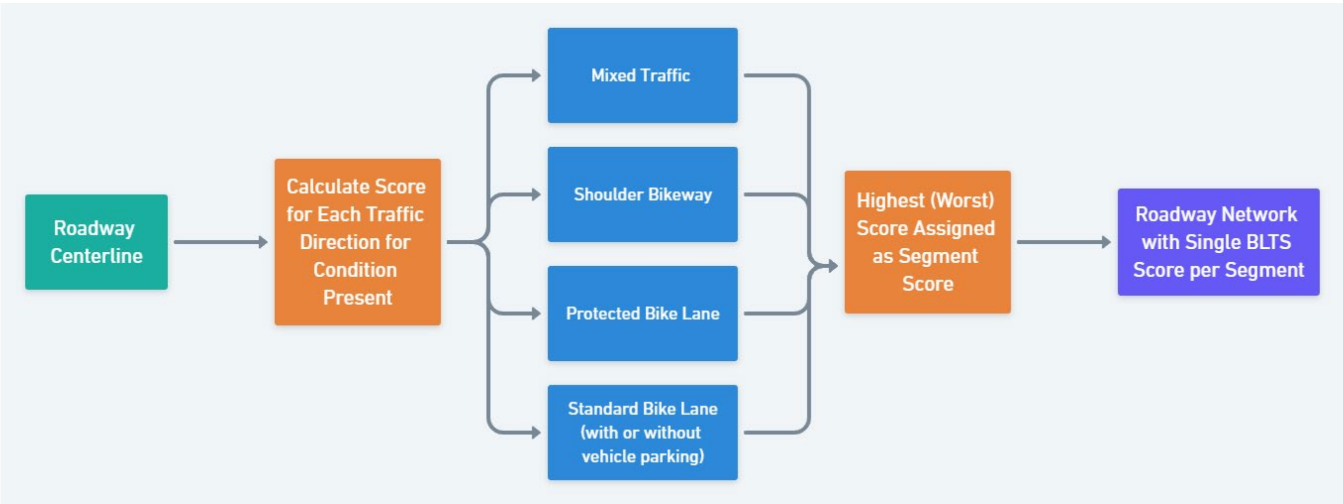


*Table 6. Data Inputs and Assumptions*

| Inputs | Notes | Assumptions |
| --- | --- | --- |
| Bicycle Facilities | Bicycle lanes have a positive impact on bicycle level of travel stress and are a primary input for developing a BLTS model. The width of facilities can have an impact on the associated comfort level. Wider facilities provide greater comfort, especially on higher speed roadways. | For analysis purposes, a standard width of 6 feet was assumed for all bike lanes. Buffered bike lanes, which provide an additional degree of separation from motor vehicles and great operating space for bicyclists, were assumed to be 8 feet wide, meeting the requirements for a BLTS 1 score. |
| Speed Limit | Higher speed roadways are considered to be less comfortable for bicyclists, particularly in mixed traffic or with minimal separation from motor vehicles. Low-speed roadways are considered more comfortable. | Speed limits were assigned based on OSM and updated as previously noted above in "Creation of Comprehensive Street Dataset." |
| Presence and width of on-street parking adjacent to bicycle lanes | On-street parking is particularly important for corridors on which bicycle lanes are present. Bicycle levels of travel stress are greater on bicycle lanes adjacent to parking than on bicycle lanes not adjacent to parking, due to the potential for 'dooring' incidences. | Data on parking lanes was not available. All bike lanes are assumed not to be adjacent to a parking lane. |
| Number of Lanes | The number of travel lanes corresponds with an increase in the roadway width, which has an effect on bicyclists' level of stress. Roadways with fewer lanes are generally less stressful for bicyclists. | Number of lanes were assigned based on OSM data. |
| Presence of Trails | Class I facilities can be a vital component of a municipality's active transportation network. Increased separation from motor vehicles can improve comfort and safety. | Class I facilities are scored as a BLTS 1. |

Table 7 and Table 8 specify the scoring criteria based on roadway configuration, speed, and bike lane/parking lane presence and width. The criteria are adapted from the original 2012 Mineta Institute report. These tables are used in combination to assign an overall LTS score; if multiple scores are present within a segment the highest (most stressful) score is used as the overall segment score These tables are used in combination to create the segment, approach, and intersection scores described above.

*Table 7. Criteria for Bicycle Level of Traffic Stress in Mixed Traffic*

| Prevailing Speed or Speed Limit (mph) | Street Width | | |
|---|---|---|---|
| | 2-3 Lanes | 4-5 Lanes | 6+ Lanes |
| ≤ 25 | BLTS 1 or 2[1] | BLTS 3 | BLTS 4 |
| 30 | BLTS 2 or 3[1] | BLTS 4 | BLTS 4 |
| ≥ 35 | BLTS 4 | BLTS 4 | BLTS 4 |

1. Lower value is assigned to streets without marked centerlines or classified as residential with fewer than 3 lanes. Residential roadways are identified based on the Open Street Map 'highway' tag.

*Table 8. Criteria for Bike Lanes Not Alongside a Parking Lane[1]*

| | BLTS 1 | BLTS 2 | BLTS 3 | BLTS 4 |
|---|---|---|---|---|
| Street Width (Through lanes per direction) | 1 | 2 | More than 2 | (no effect) |
| Bike Lane Width | 6 feet or more | 5.5 feet or less | (no effect) | (no effect) |
| Speed Limit (mph) | 30 mph or less | (no effect) | 35 mph | 40 mph or more |
| Bike lane blockage[2] | rare | (no effect) | frequent | (no effect) |

1. Parking lane data was not available. All bike lanes are assumed not to be adjacent to a parking lane.
2. Bike lane blockage is part of Alta's analysis methodology, but assumed to be rare by default.

## Results

The results of the BLTS analysis (shown in Map 2 in the Appendix) help identify existing areas that are low-stress for many bicyclists and highlight which roadways must be improved in order to provide a comfortable experience for riders of all ages and abilities.

Outside of the municipalities in the Metro COG region, most roads ranked as BLTS 4. Given the distances between municipalities outside of the core Fargo-Moorhead urban area, bicycle trips may be relatively rare regardless of perceptions of traffic and bikability. Many of those bicycling on rural roads are likely to be people who cycle long distances recreationally. General improvements to reduce LTS on these more rural roads will likely bring relatively small benefits relative to the associated costs, even though these roads ranked highly in terms of level of traffic stress. Targeted improvements to create high quality recreational routes may support bicycle tourism.

Within the core urban area, the majority of the road network ranked as BLTS 1, reflecting the abundance of residential road miles relative to collector and arterial road miles. However, significant portions of the network ranked as BLTS 2. While a relatively small subset of the network ranked as BLTS 3 or 4, those segments are likely some of the most direct routes for traversing the urban area and may be unavoidable for many trips.

Blocks of low-stress local/residential streets act as 'islands' in the roadway network; while bicycling is relatively comfortable within these islands, the network is fragmented by roadways that have higher (worse) LTS scores. The grid of LTS 1 streets is broken by streets such as 13th Avenue South and University Drive South in Fargo; 8th Street South and 1st Avenue North in Moorhead; and 7th Avenue West and Center Street in West Fargo, all of which are classified as LTS 3 and 4. These classifications mean the roadways may be used by enthusiastic and confident bicyclists, but they do not create a comfortable bicycling experience for users, and many potential riders may avoid these roadways—and trips that require traveling along these roadways—altogether.

BLTS results should be interpreted with caution because they relate to individual segments of the road network and do not correspond to actual trips. For example, a person interested in biking from school to the mall might be able to traverse a path that is 95% road segments with low levels of traffic stress, yet the remaining 5% may require biking along very high traffic stress segments, inhibiting them from biking at all.

The connectivity analysis sheds lights on how BLTS impacts the biking network.

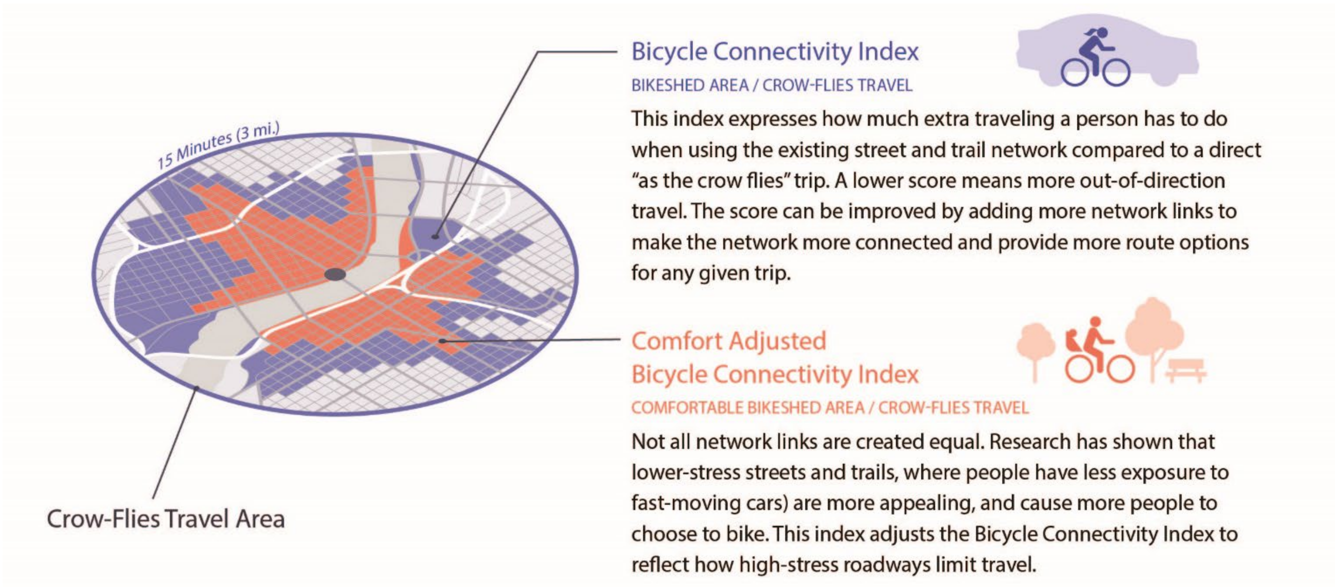
## Connectivity Analysis

Building on the LTS analyses described above, which look at individual segments of roadway in isolation, the connectivity analysis aims to understand how pedestrians and bicyclists travel along roadway segments to complete trips. Connectivity describes how well the network facilitates fast and efficient trips. By incorporating LTS scores from the preceding analyses, the connectivity analysis takes into account user comfort along different network paths.

### Methodology

Alta's connectivity metric determines what percentage of the network a user can actually travel to within a 10-minute walk (assuming an average walking speed of 3 mph) or 15-minute bicycle ride (assuming an average biking speed of 10 mph) as compared to the perfect case scenario represented by an "as the crow flies" buffer around the same starting point. Better connected portions of the road network come closer to approaching "crow-flies" connectivity, and thus have a connectivity index closer to one.

*Figure 3. Connectivity Index Infographic*




This connectivity index is measured and reported for four use cases: pedestrians, bicyclists, pedestrians reacting to traffic stress conditions, and bicyclists reacting to traffic stress conditions. Routing is limited to network segments that allow pedestrian and bicyclists to traverse them. For example, this means the connectivity analysis accounts for how freeways often fragment network connections; as modeled, bicyclists and pedestrians cannot navigate freeway segments. The traffic stress-adjusted analysis assumes bicyclists have to get off and walk their bikes on BLTS 3 and BLTS 4 roadways, and assumes people walking avoid PLTS 3 and 4 roadways. The connectivity index is illustrated in Figure 3.

## Results

### Pedestrian and Bicycle Connectivity

All connectivity analysis maps can be found in the Appendix. Map 3 shows pedestrian connectivity, and Map 4 shows bicycle connectivity. Road segments with the highest connectivity ratios (0.5 or above) were exclusively found within municipal borders in the Metro COG region. The core downtown areas of Fargo and Moorhead ranked very highly, as did other areas in western and southwestern Fargo and in eastern West Fargo.

While some smaller municipalities outside of the urban core had high-ranking road segments in the center of town for pedestrian connectivity, bike connectivity ratios in these areas were relatively low, suggesting that policy changes (e.g., reduced speed limits) and infrastructure improvements (e.g., bike lanes, lane reductions) could help improve bikeability.

The connectivity analysis reveals the impact of major barriers on active transportation. Pedestrian and bicycle connectivity generally decreases on facilities parallel to or approaching interstate highways in the region. Connectivity also declines noticeably along the Red River, around the Sheyenne River in West Fargo, and around the railroad tracks in the northern parts of Fargo and West Fargo. Higher-quality and more frequent links across these impasses could help pedestrians and bicyclists move between different neighborhoods in Fargo, Moorhead, and West Fargo, in particular.

#### Pedestrian and Bicycle Connectivity Adjusted for Level of Traffic Stress

Maps 5 and 6 show connectivity adjusted for level of traffic stress for pedestrians and bicyclists, respectively. While pedestrian connectivity decreases slightly when taking into account LTS, bicycle connectivity decreases noticeably. When LTS is taken into account, the average bicycle connectivity index drops 31% from 0.4 to 0.275, while the average pedestrian connectivity index drops 8% from 0.39 to 0.36.

Map 7 examines low LTS-adjusted bicycle connectivity segments (defined as below the average index of 0.275) and shows the degree to which LTS impacts bicycle connectivity. Areas with low connectivity and high LTS impact on connectivity (shown in darker colors) are places where multi-lane, higher speed streets restrict bicycle movement. Reducing traffic stress in these areas will lead to improvements to connectivity. Areas with low connectivity and low LTS impact on connectivity (shown in lighted colors) are places where the street grid is interrupted by rivers. Building new bridges across rivers will lead to improvements to connectivity.

## Active Trip Potential Analysis

Understanding where short trips are concentrated in the Metro COG region will help to identify where facilities could be needed to support walking and bicycling. The Active Trip Potential analysis estimates the total number of trips per zone that could be pedestrian and bicycle trips (i.e., are three miles or less) by leveraging trip origin-destination (OD) data from Replica, a private data vendor.

### Methodology

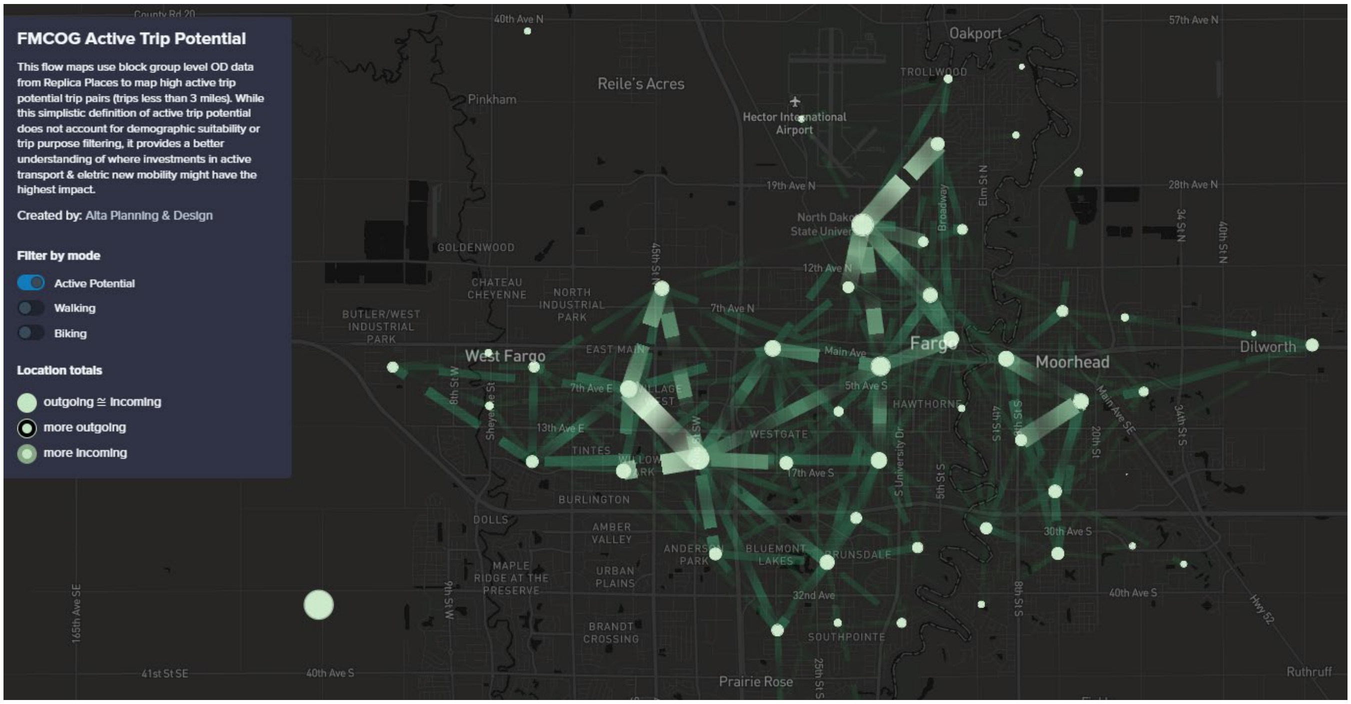
This analysis leverages data from Replica Places, an activity-based model developed using a combination of mobile, land use, census, and transaction data to generate Census block group-level trip origin and destination estimates. These estimates describe trip distances and common origins and destinations, as well as mode split and trip purpose.

### Results

The interactive map shows the origins and destinations of bicycling and walking trips as well as trips less than three miles long that could conceivably be served by walking, bicycling or other micromobility options. Trip origins and destinations are summarized at the census block group level. A screen shot of active trip potential (trips under three miles) is shown in Figure 4 below.

High volumes of trips under three miles flow between the block groups containing downtown Fargo, downtown Moorhead, North Dakota State University, Concordia College, Minnesota State University Moorhead, and the West Acres shopping area.

*Figure 4. Image of Interactive Active Trip Potential Map*




The Replica model estimates that there are 300,000 trips of one mile or less in the region on a typical Fall weekday. Thirty-eight percent of those trips are currently made by walking and 2% by biking, while 50-60% of trips one mile or less are currently made by driving.

Map 8 in the Appendix displays trips less than one mile beginning in each block group, normalized by the area of the block group. Block groups with the highest number of trips under one mile per square mile are shown in darker blue. Many trips of under a mile could be converted from driving to walking or bicycling if low-stress, comfortable facilities are provided. In Fargo, the block groups with high one-mile active trip potential are located around the West Acres, Brunsdale, Lewis & Clark, South High, Jefferson/Carl Ben, Roosevelt/NDSU, and Downtown neighborhoods. In Moorhead, the areas around downtown, Concordia College and Minnesota State University Moorhead have high one-mile active trip potential. The far east side of West Fargo and part of Dilworth also have high one-mile active trip potential.

Approximately half of the 940,000 daily trips that begin in the Metro COG region are three miles or less. Map 9 displays trips less than three miles beginning in each block group, normalized by the area of the block group. Census block groups with the highest number of trips under 3 mile per square mile are shown in darker blue. Many trips of under three miles could be converted from driving to bicycling if low-stress, comfortable facilities are provided.

The geographic distribution of three-mile active trip potential is similar to that of one-mile active trip potential. Areas that rank noticeably higher for three-mile active trip potential than one-mile active trip potential include the Westgate, Madison/Unicorn Park, Clara Barton, and Jefferson/Carl Ben neighborhoods in Fargo; around the West Fargo High School; and around Moorhead High School, Horizon Middle School and Robert Asp Elementary School in Moorhead. One area in Dilworth ranks more highly for one-mile active trip potential than three-mile active trip potential.

### Limitations of Active Trip Potential

While short trips are indicators of trips that can be met using active modes, it is unrealistic to expect all short trips to convert to active transportation. Even if supportive infrastructure and policy are implemented, there are a number of reasons why a trip might still be made by non-active modes, including:

- **Heavy Loads** - While cargo bikes can support many types of grocery or shopping trips, some heavy loads are often bulky or heavy enough to warrant using another transportation mode.
- **Travel Tour Type** - Some trips are chained in a way that make it difficult to envision using active transportation for the entire trip sequence. If one leg of a trip trips is too long to consider using an active mode, then the entire tour might be better made using another transportation mode.
- **Personal Preference -** Some members of the community may elect to never bike or walk even if an all ages and ability network is provided in a community.
- **Disability** - Some people may have a disability or impairment that prevents them from comfortably using active transportation.
- **Seasonal Weather** - Active trips become more difficult to accomplish in extreme weather conditions, especially when adequate facilities, policies, maintenance, and personal equipment or supplies are not available. While trips are still viable in many instances by walking and biking, there will be some times where it is inadvisable, such as a heat wave, unhealthy air conditions, or heavy snow-fall. Active transportation mode share may decrease accordingly during such weather events.

Conversely, many people routinely complete trips of more than three miles by walking or biking. Longer trips have been omitted from these analyses because shorter trips are more likely to be converted active transportation. However, given supportive infrastructure and policies, many longer trips may be converted to active transportation as well.

## Equity Analysis

Understanding equity is important for the development of multi-modal transportation plans. The historical, social, and political dynamics in the United States have produced transportation infrastructure that is unevenly distributed across communities, and transportation policy inequitably distributes the benefits and costs of transportation systems between different groups of people. These dynamics have also caused segregation of housing by race and income. Housing that is affordable to people with lower incomes is often located close to high traffic roadways that increase levels of noise and pollution and restrict options for active transportation.

People with lower incomes are frequently cost-burdened by car ownership and would benefit from access to transit and safer walking and biking facilities. People with higher incomes, privileges, and easier access to power, such as the ability to speak English fluently and Whiteness, often have more transportation options, less exposure to high traffic roadways, and more access to green spaces.

The equity analysis incorporates multiple datasets describing sociodemographic and built and natural environment characteristics for the Metro COG region in order to identify areas where active transportation investments and supporting policy changes are particularly needed.

## Methodology

The equity analysis leveraged data from the Centers for Disease Control and Prevention (CDC) and Environmental Protection Agency (EPA) to create an equity measure for each census block group in the Metro COG region. Scores for seven indicators encompassing income, race, vehicle access, traffic proximity, disability, and pollution were weighted and summed to identify block groups in the Metro COG region that should be prioritized for pedestrian and bike improvements.

Census block groups were compared to each other in the equity analysis to produce percentile rankings (e.g., in the top 10%, 20%, etc.). Percentile rankings were calculated for six measures from the Social Vulnerability Index (SVI; CDC) and EJSCREEN (an environmental justice dataset; EPA) at the block group level: income, vehicle access, race, disability, traffic proximity, and air pollution exposure. Constituent variables were weighted when computing the composite index to take into account that some measures of inequity (e.g., income) may be more important to consider than others (e.g., PM 2.5 exposure). Weighting of variables was as follows:

- Percent of population with low income: 3
- Percent of population with no vehicle access: 2
- Percent of population identifying as people of color: 2
- Percent of population identifying as having a disability: 1
- Traffic proximity[4]: 1
- Pollution (PM 2.5): 1

The weighted scores for each variable were added together to produce a composite score, with 10 being the highest possible composite score. The composite score for block groups with the highest levels of concentrated Whiteness (in the top 20 percent of block groups for percent of population identifying as White) was reduced by one point.

Values were calculated for every block group in the Metro COG region to estimate how social conditions may expose certain groups to disproportionate burdens relating to transportation while also depriving those groups of equal access to transportation resources, and how those effects differ spatially. Composite scores were ranked by quintile, with those block groups ranking in the top 20 percent considered to be the highest priority for pedestrian and bike improvements.

## Results

Map 10 in the Appendix shows the results of the equity analysis. The highest priority block groups are exclusively located in the core urban area, with all but one of these highest priority areas located in Fargo and Moorhead (the remaining block group was located in West Fargo).

[4] Traffic proximity was missing for some block groups. In these cases, the median value was assumed.

The downtowns of both Fargo and Moorhead had multiple contiguous blocks groups ranking in the top 20 percent, suggesting that coordinated, inter-municipal bike and pedestrian policies and facilities could address equity considerations while also building better connections between the two cities and their major population centers.

Investing in active transportation in the metropolitan core is likely to both benefit high-priority equity populations and the greatest number of users, dollar-for-dollar, as compared to comparable investments in more suburban and rural areas within the region.

## Collision Analysis and High Injury Network Development

The collision analysis describes the spatial and temporal distribution of different types of collisions in relation to characteristics of the built environment. A high injury network builds on a collision analysis by identifying the highest-risk corridors throughout the region (to the extent collision data facilitates). Jointly, these two processes help to characterize the places where active transportation users are most exposed to injuries and fatalities, which in turn can help to inform future investment decisions.

### Methodology

The collision analysis included crashes from 2016 through 2020. Crashes were categorized by both type (vehicle only, pedestrian-involved, or bicyclist-involved) and severity (property damage only, possible injury, minor injury, serious injury, fatality) to produce a weighted score for each crash, as shown in Table 9.

*Table 9. Crash Weights by Type and Severity*

| Crash Severity | Crash Type: Vehicle-Only | Crash Type: Pedestrian- or Bicyclist- Involved |
|---|---|---|
| Property Damage Only | 1 | 3 |
| Possible Injury | 2 | 6 |
| Minor Injury | 3 | 9 |
| Serious Injury | 4 | 12 |
| Fatality | 5 | 15 |

All crashes within 10 feet were joined to the OSM network to produce a total collision score for each segment. For example, if a fatal bicycle crash and a property damage only vehicle crash occurred on the same roadway segment, the total collision score would be 16. The roadways with the highest collision scores are considered to be the high injury network.

## Results

There were 9,735 reported crashes from 2016 through 2020 on roads where walking and bicycling are permitted within the Metro COG boundaries (Table 10). Seventy-five crashes involved a person walking, and 93 crashes involved a person bicycling. While crashes involving people walking and biking make up less than 2% of all crashes, they account for 10% of all minor injury crashes, 13% of all serious injury crashes, and 14% of all fatality crashes. As shown in Table 11, the vast majority of vehicle-only crashes (77%) result in property damage only, while only 3% of pedestrian-involved crashes and 9% of bicyclist-involved crashes were property damage only.

*Table 10. Number of Crashes by Type and Severity*

| Crash Severity | Crash Type: Vehicle-Only | Crash Type: Pedestrian Involved | Crash Type: Bicyclist-Involved |
|---|---|---|---|
| Property Damage Only | 7,351 | 2 | 8 |
| Possible Injury | 1,199 | 17 | 24 |
| Minor Injury | 910 | 47 | 54 |
| Serious Injury | 94 | 9 | 5 |
| Fatality | 12 | 0 | 2 |
| Total | 9,566 | 75 | 93 |

*Table 11. Percentage of Crashes by Type and Severity*

| Crash Severity | Crash Type: Vehicle-Only | Crash Type: Pedestrian Involved | Crash Type: Bicyclist-Involved |
|---|---|---|---|
| Property Damage Only | 77% | 3% | 9% |
| Possible Injury | 13% | 23% | 26% |
| Minor Injury | 10% | 63% | 58% |
| Serious Injury | 1% | 12% | 5% |
| Fatality | 0% | 0% | 2% |
| Total | 100% | 100% | 100% |

All segments with high weighted crash scores (>=10) are located within the boundaries of municipalities. In these urban areas, arterial and collector roadways are disproportionately represented among roadways with crashes, especially those with high and very high weighted crash scores. While arterial and collector roadways make up 16% of all OSM network miles, they account for 45% of miles with one or more crashes, 71% of miles with high weighted crash scores, and 79% of miles with very high weighted crash scores (Table 12).

*Table 12. Crashes on Roadways in Urbanized Areas by Functional Class[5]*

| Functional Class | Total Miles | Miles with One or More Crashes | Miles with High Weighted Crash Scores (>=10) | Miles with Very High Weighted Crash Scores (>=16) |
|---|---|---|---|---|
| Arterial/Collector[6] | 348.7 (16%) | 122.9 (45%) | 8.9 (71%) | 2.8 (79%) |
| Residential | 843.7 (38%) | 136.0 (50%) | 3.6 (29%) | 0.7 (20%) |
| Service[7] | 694.6 (32%) | 8.7 (3%) | 0.0 (0%) | 0.0 (0%) |
| Other | 316.0 (14%) | 5.4 (2%) | 0.0 (0%) | 0.0 (1%) |
| Total | 2,203 (100%) | 273 (100%) | 12.5 (100%) | 3.5 (100%) |

### High Injury Network

Map 11 highlights segments with high and very high weighted crash scores. The streets with five or more segments with high weighted crash scores (>=10) are all in Fargo, with the exception of one street in West Fargo (9th Street East). They include:

- North University Drive (19 segments)
- South University Drive (15 segments)
- 25th Street South (9 segments)
- 10th Street North (8 segments)
- 9th Street East (7 segments)
- 12th Avenue North (6 segments)
- 13th Avenue South (6 segments)
- Broadway (6 segments)

[5] Functional class derived from Open Street Map data.
[6] Arterial/collector roads are assumed to be those coded as trunk, primary, secondary, or tertiary in OSM highway field.
[7] Service miles include lanes in parking lots as well as driveways.

- Main Avenue (6 segments)
- 36th Street South (5 segments)

The streets with five or more segments with very high weighted crash scores (>=16) are all in Fargo. They include:

- North University Drive (11 segments)
- 25th Street South (5 segments)
- South University Drive (5 segments)

The segment with the highest weighted crash score (73) is on 25th Street South at the intersection with 32nd Avenue South in Fargo. All segments with extremely high weighted crash scores (>=50) are at the intersection of multi-lane roadways.

## Priority Investment Areas Analysis

Each of the preceding analyses provides a different lens for understanding the current status of, and opportunities to improve upon, the existing street network. The priority investment areas analysis synthesizes the results from each analysis, aggregating results from the LTS analyses, connectivity analysis, active trip potential analysis, equity analysis, and collision and high injury network analyses to create a composite score and maps that can inform infrastructure improvements across the region.

### Methodology

To normalize the results of each analysis, the equity, active trip potential, connectivity, LTS, and crash scores for each network link were converted to a 0-1 scale, with 1 indicating the highest score.

The priority investment areas analysis weights the results of the analyses according to the ranking of the Guiding Principles for the plan. While all Guiding Principles are important, aligning the relative importance of the Guiding Principles with prioritization will help to support a shared vision of the Plan's implementation. Collisions and level of traffic stress impact on connectivity are given a weighting of two since safety is the highest ranked Guiding Principle. Connectivity and equity are the next-ranked Guiding Principles, and are weighted at 1.5, while active trip potential is weighted at one because Sustainability/Environment is the lowest ranked Guiding Principle. This weighting approach was reviewed and approved by the plan's Study Review Committee.

For each link in the network, these weighted scores are added together to produce a composite score. The links that fall within the top 10%, top 20%, and top 50% based on their composite score are shown in the maps.

The bicycle priority investment areas analysis and pedestrian priority investment areas analysis use the same weighting, as well as the same scores for equity and collisions. For active trip potential, the bicycle analysis considers trips of three miles or less and the pedestrian analysis considers trips of one mile or less. For connectivity, the bicycle analysis is based on bicycle network connectivity and the pedestrian analysis is based on pedestrian network connectivity. For level of traffic stress impact on connectivity, the bicycle analysis uses Bicycle Level of Traffic Stress and the pedestrian analysis uses the Pedestrian Level of Traffic Stress.

## Results

### Bicycle Priority Investment Areas

Map 12 shows the results of the bicycle priority investment areas analysis. The largest clusters of highly ranked network links are located in the northern part of Fargo, the northeastern part of West Fargo, Downtown Fargo, Downtown Moorhead, and the southern part of Dilworth. Outside of these clusters, links along collectors and arterials and crossing highways and the Red River are highly ranked. Highly ranked network links can also be found in Hawley, Horace, Mapleton, and Casselton.

### Pedestrian Priority Investment Areas

Map 13 shows the results of the pedestrian priority investment areas analysis. Highly ranked network links in the pedestrian priority investment areas analysis are more tightly clustered than in the bicycle analysis. Clusters of highly ranked links are located around Downtown Moorhead and Downtown Fargo, the West Acres mall and Brundale neighborhood in Fargo, and North Dakota State University. As in the bicycle analysis, links along collectors and arterials and crossing highways and the Red River are highly ranked.