Multimodal Network Connectivity Study

Mahoning and Trumbull Counties, Ohio

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16. Abstract

Eastgate will determine the state of multimodal network connectivity in the region, identify key connections needed to enhance multimodal connectivity to economic and community destinations, identify how well MTP projects address needed improvements, develop multimodal performance metrics, and author a Measuring Multimodal Network Connectivity Report.

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Serving Northeast Ohio since 1973

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- Serve as the Metropolitan Planning Organization (MPO) in Mahoning and Trumbull counties, with responsibility for the comprehensive, coordinated, and continuous planning for highways, public transit, and other transportation modes, as defined in Fixing America's Surface Transportation Act (FAST Act) legislation.
- Perform continuous water quality planning functions in cooperation with Ohio and U.S. EPA.
- Provide planning to meet air quality requirements under FAST Act and the Clean Air Act Amendments of 1990.
- Administration of the Economic Development District Program of the Economic Development Administration.
- Administration of the Local Development District of the Appalachian Regional Commission.
- Administration of the State Capital Improvement Program for the District 6 Public Works Integrating Committee.
- Administer the area clearinghouse function, which includes providing local government with the opportunity to review a wide variety of local or state applications for federal funds.
- Administration of the Clean Ohio Conservation Funds
- Administration of the regional Rideshare Program for Ashtabula, Mahoning, and Trumbull Counties.
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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

Table of Contents

List of Figures

List of Tables

Executive Summary

Eastgate's vision is to provide our local communities with a framework to establish a transportation network that is efficient, equitable, and safe for all users. This vision will set our region on a path to diversify our transportation network across all modalities and make it easier to improve intermodal links to increase our overall network connectivity. To advance this vision, a standard evaluation of the performance of the agency's programs is critical. This Multimodal Network Connectivity Study will measure the region's existing performance across a set of metrics that can be monitored and evaluated as communities make transportation investments.

This study will help clarify the agency's vision and goals for how the region's infrastructure should support multimodal transportation. Having defined a vision and goals, the agency can outline alternate improvement strategies for the local communities, help evaluate and prioritize the identified strategies, integrate the strategies into the development of transportation plans, prioritize projects that emphasize the new focus areas through the Transportation Improvement Program, and then assist local communities with project development and system operations. Throughout this series of inputs, it is critical to integrate feedback from or related to public involvement, economic development, local budgets, Title VI, air quality, and environmental sustainability.

Specifically, through this study, Eastgate plans to investigate ways in which our planning and funding programs can be improved to see continual improvement in the performance of our multimodal transportation network. Are the agency's current funding programs configured in a way that encourages improvements to multimodal transportation and is the funding for these programs proportionate to make a significant improvement? Are the agency's planning-based programs providing the right information to the local communities to assist them in making sound decisions for the improvement of their network connectivity for nonmotorized transportation in areas where those improvements contextually make sense? The outcomes of this plan will help the agency better understand these questions and establish a baseline of analysis that can be incorporated into the Metropolitan Transportation Plan as well as the agency’s other programs.

This study utilizes information on the physical characteristics of the region’s transportation infrastructure, census demographic and community data, as well as composite data created by analytical processes. Eight activity centers were identified to define the study area of the project. Sidewalk and roadway data within one, two, and five mile buffers of the activity centers were analyzed to generate Pedestrian and Bicycle Level of Service ratings for functional class roadway segments. The level of service ratings are analyzed alongside other datasets to identify roadway segments that act as barriers to pedestrian and bicycle transportation. These barriers are the basis for future planning and assistance to the local communities.

It was found that current sidewalk coverage, especially within one mile of the activity centers could be improved in most of the locations and the level of service ratings are sufficient to establish performance measures to track the improvement of this infrastructure as local communities plan and implement projects. With regards to bicycling infrastructure, the analysis led to the creation of a barriers data layer that can serve as the basis for further evaluation to identify priority roadway segments for improvement.

Multimodal Transportation Planning

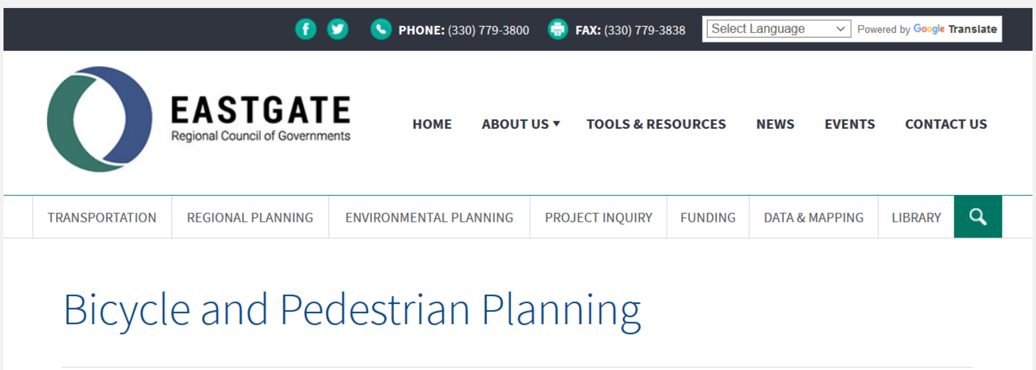
For Mahoning and Trumbull Counties, Ohio

The Eastgate Regional Council of Governments (Eastgate) is the Metropolitan Planning Organization (MPO) for the Youngstown–Warren Metropolitan area. Eastgate collects and maintains data on pedestrian and bicycle transportation use, infrastructure, and safety. Finding meaningful ways to analyze this data to support decision-making can be challenging because many key decisions about transportation investments are made by municipalities and units of governments that own and maintain the infrastructure. This plan will establish guidelines for the future collection and analysis of data as well as provide a standard basis for which that analysis can be performed.

Eastgate's vision is to provide our local communities with a framework to establish a transportation network that is efficient, equitable, and safe for all users. This vision will set our region on a path to diversify our transportation network across all modalities and make it easier to improve intermodal links to increase our overall network connectivity. To advance this vision, a standard evaluation of the performance of the agency's programs is critical. This Multimodal Network Connectivity Study will measure the region's existing performance across a set of metrics that can be monitored and evaluated as communities make transportation investments.

"Eastgate's vision is to provide our local communities with a framework to establish a transportation network that is efficient, equitable, and safe for all users."

Additionally, Eastgate's role as an MPO requires the agency to prepare a Metropolitan Transportation Plan (MTP), in accordance with 49 USC 5303(i), to accomplish the objectives outlined by the MPO, the state, and the public transportation providers with respect to the development of the metropolitan area's transportation network. This plan must identify how the metropolitan area will manage and operate a multi-modal transportation system (including transit, highway, bicycle, pedestrian, and accessible transportation) to meet the region's economic, transportation, development and sustainability goals – among others – for a 20+-year planning horizon, while remaining fiscally constrained. The bicycle and pedestrian evaluation measures identified in this study will be utilized in Eastgate's MTP as well as the agency's Transportation Improvement Programs (TIP).



Eastgate's Bicycle and Pedestrian Planning Webpage – eastgatecog.org/bikeped

This study will set a foundation for a Regional Multimodal Plan, will ensure multimodal connectivity is considered in the planning and project prioritization process, and will generate a base conditions profile and suitable assessment techniques from which ongoing evaluations can be generated.

Background of Previous Work

Eastgate's 2010 Regional Bicycle Plan[1] was created as a supporting document and incorporated into to the agency's update to the 2040 Long Range Transportation Plan. The plan outlined the short-term goals related to completing the plan, and some long-term goals for bicycle transportation in the region. It also outlined existing, planned, and conceptual bikeways in the Eastgate area, identified bicycle-vehicle crash locations, evaluated crash data, and summarized bicycle use through census data. The plan also identified funding options and outlined the project development process for communities interested in partnering with Eastgate. The goals of the plan included identifying a regional bicycle network, providing planning and funding to see the network to development, encouraging routine accommodation for bicyclists, identifying safety projects, promoting bicycling as a means of transportation, supporting educational outreach, and collecting data useful for bicycle planning.

As a result of the findings and recommendations outlined in the Regional Bicycle Plan, Eastgate evaluated the region's existing roadway network and developed a Bicycle Suitability[2] rating for each road to help identify routes appropriate for bicyclists of varying levels of skill and comfortability riding on roadways. This suitability has served as the basis for the agency's Regional Bike Maps and has been revised with new information as recently as 2018.

Eastgate has also been maintaining a sidewalk inventory[3] for the region starting in 2010 and updating the dataset as new aerial imagery is acquired or when local communities notify the agency of sidewalk projects. This dataset identifies the location of sidewalks and the presence of crosswalks and/or ADA curb ramps.

[1] https://eastgatecog.org/docs/default-source/multi-modal/regional-bicycle-plan-june-2010.pdf
[2] https://eastgate.maps.arcgis.com/apps/webappviewer/index.html?id=6d20c323fe80468e9046aad9716210e8
[3] https://eastgatecog.org/docs/default-source/maps/pedestrian.pdf

Planning Context

While Eastgate has previously collected data and to some extent identified and evaluated areas of need, more in depth analysis can help the agency provide a clearer understanding of what kind and where infrastructure investments can have the largest positive impact. By providing our local communities better information we can then assist them in developing more meaningful and equitable projects aimed at accommodating all road users and making transportation all across the region more accessible, efficient, and less burdensome for those who do not have access to a personal vehicle, whether that be for reasons relating to age, economic, physical ability, or other reasons.

> **"This study will help clarify the agency's vision and goals for how the region's infrastructure should support multimodal transportation."**

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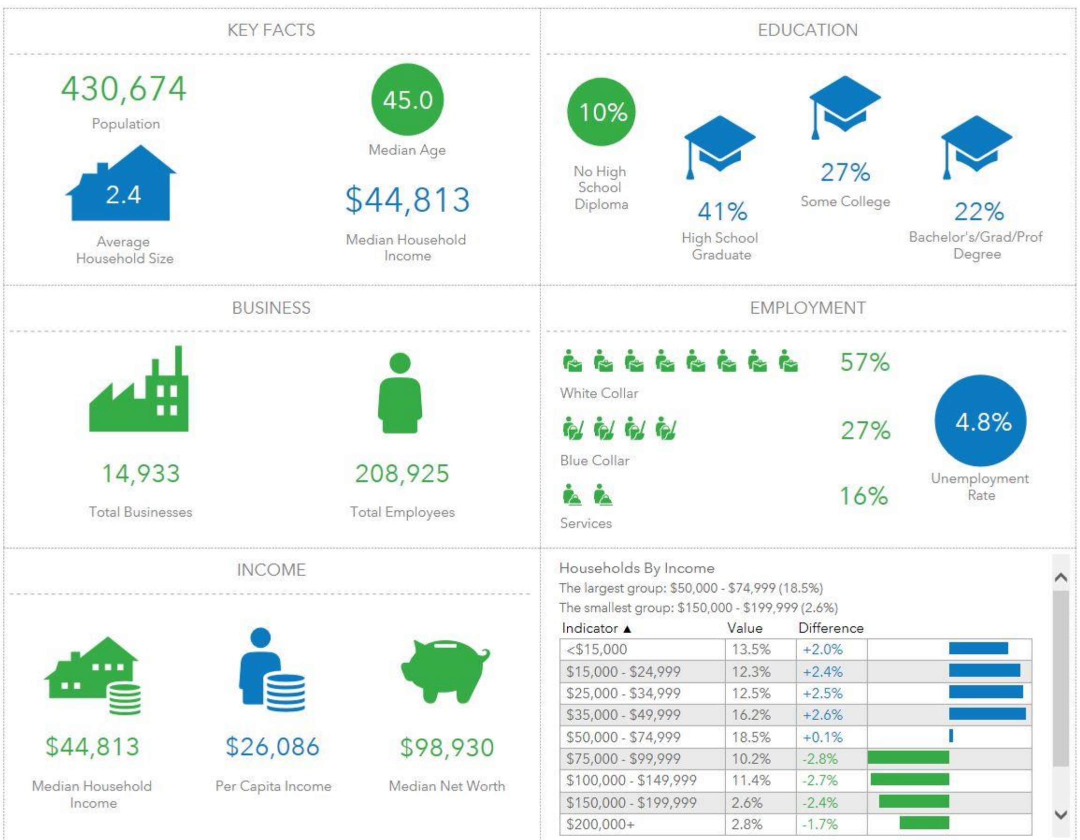
The following figures illustrate an overview of the region's population and economic status.

Figure 1: A demographic overview of Mahoning and Trumbull Counties with household income related to the statewide average



Indicator ▲	Value	Difference
<$15,000	13.5%	+2.0%
$15,000 - $24,999	12.3%	+2.4%
$25,000 - $34,999	12.5%	+2.5%
$35,000 - $49,999	16.2%	+2.6%
$50,000 - $74,999	18.5%	+0.1%
$75,000 - $99,999	10.2%	-2.8%
$100,000 - $149,999	11.4%	-2.7%
$150,000 - $199,999	2.6%	-2.4%
$200,000+	2.8%	-1.7%

Figure 2: Detail on the at risk populations of Mahoning and Trumbull Counties

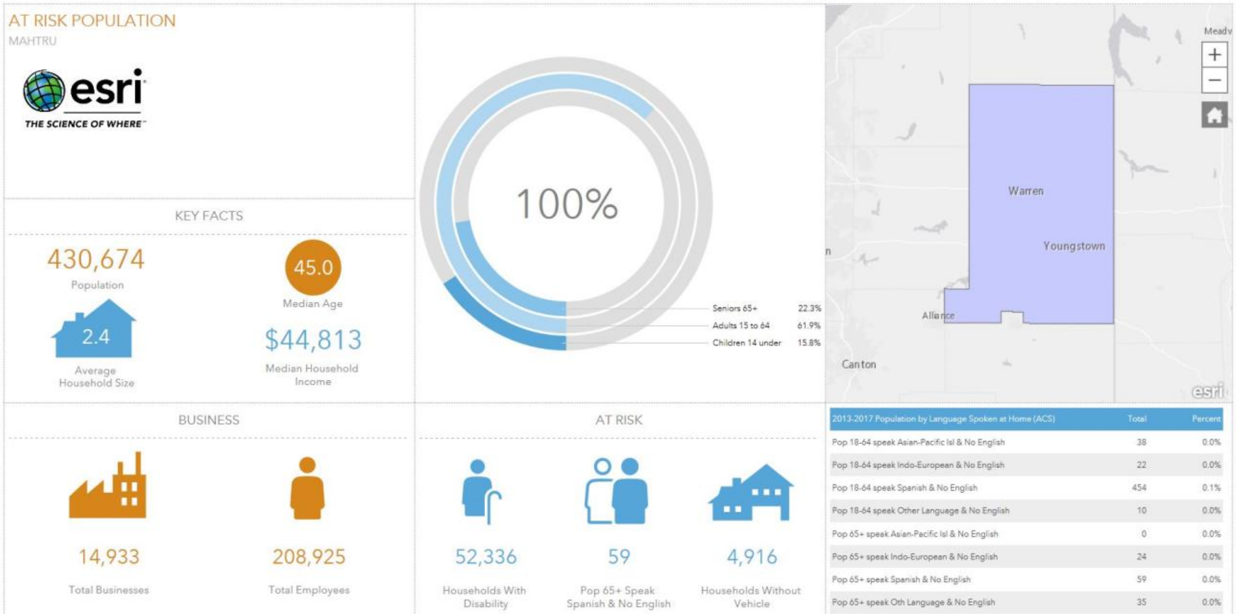
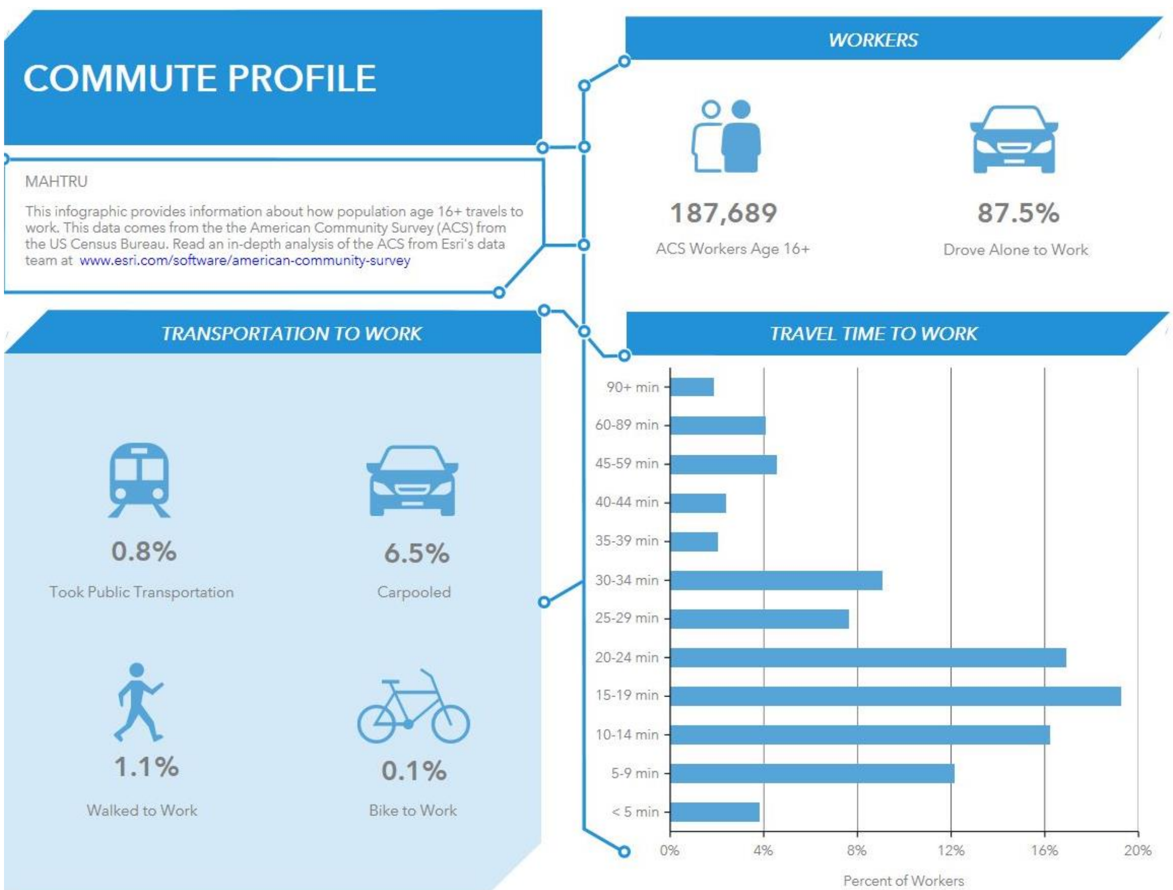


Figure 3: Detail on commuting statistics for workers in Mahoning and Trumbull Counties



Data & Analysis

Description of Data

The primary data layers utilized for most of this study's analysis are Eastgate's functional class road network files for both Mahoning and Trumbull Counties and the sidewalk inventory for the region. Our analysis of the region's roadways was limited to those on the functional class system due to availability of specified attributes such as the number of lanes, width of travel lanes, traffic volumes, speed, and buffer width. Future studies should be preempted by the collection of these attributes for roadways that are not on the functional class system so that a complete regional analysis can be performed.

Other data sources helped provide valuable background information and context to the results produced by the analysis. US Census 2017 American Community Survey (ACS) 5-year Table B08201 provided data on vehicle access by household at the Census Tract level. Additionally, 2017 ACS 5-year Table B01003 provided total population at the Census Tract level, which was then used to generate a population density for people per square mile to identify the densest Census Tracts.

Lastly, some data layers were used during the study, but ultimately weren't included as a part of any of the analysis. An overlay of the Western Reserve Transit Authority's (WRTA) fixed bus routes were initially included, but ultimately removed as it was determined to be outside the scope of this project. It is recommended to be studied in the future, as transit can positively impact connectivity for both pedestrians and cyclists and help mitigate some of the barriers that the existing infrastructure creates. Crash data from the Ohio Department of Public Safety (ODPS) was examined, but not included in any of the analysis. It was determined that crash data could be used more as the agency continues to examine and prioritize areas to be improved by verifying poor level of service designations or helping to identify problem areas that are not identified by the level of service analysis.

Activity Centers

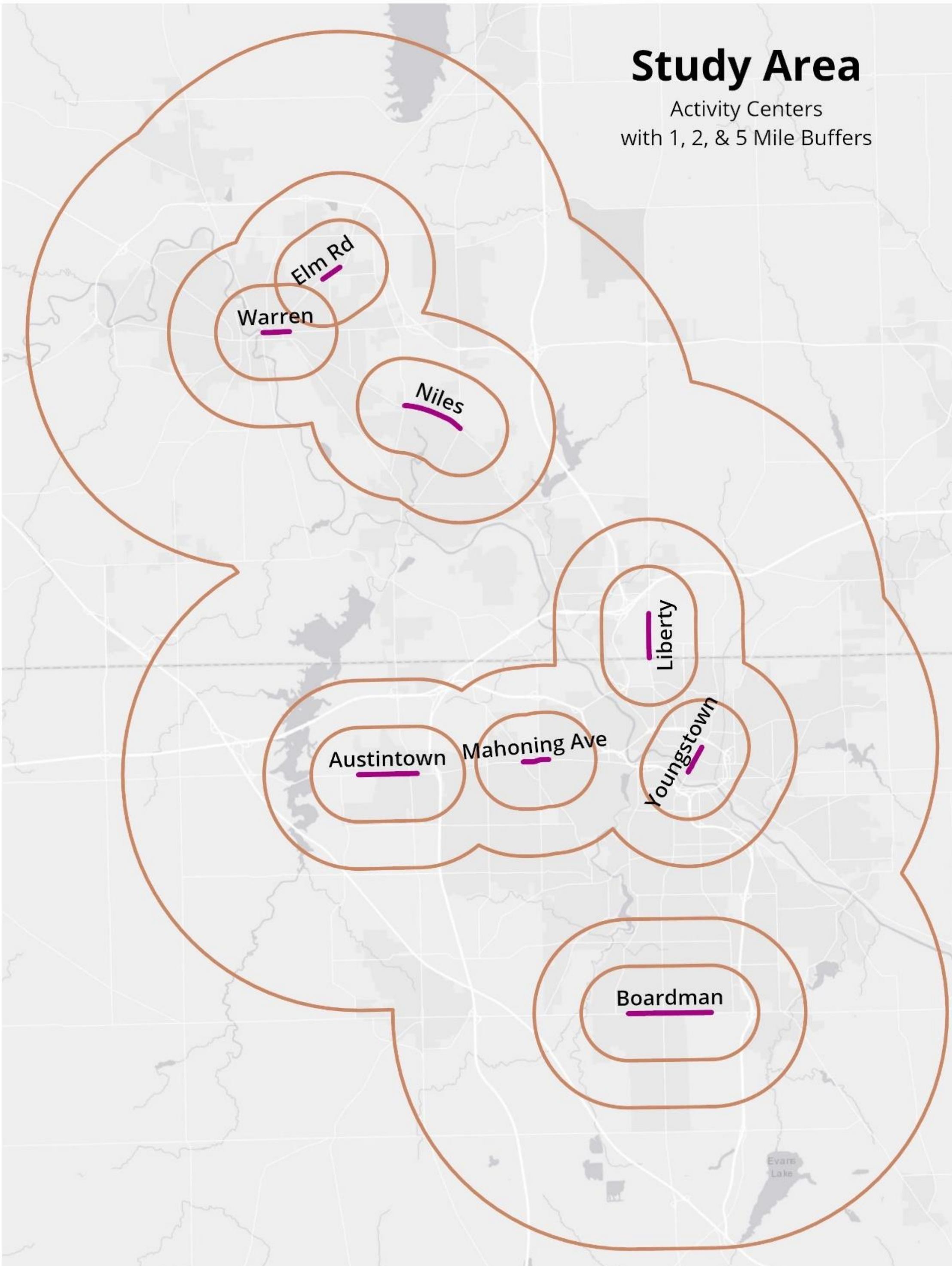
Defining the study area for this project was important to help tie the analysis to connectivity. It was determined that the best way to do this was to identify "Activity Centers" by highlighting areas where a large proportion of the region's population frequently interacts with. To develop these locations, a software named StreetLight was utilized to find roadway segments by creating a composite dataset of the following features:

- Traffic volume
- Employment data
- Travel destination
- Proximity to residential population
- Proximity to Job Hubs
    - Job Hubs were defined through previous work of the Eastgate Economic Development program in partnership with the Fund for Our Economic Future

Using the Activity Centers, buffers of one mile, two miles, and five miles were created to focus the analysis even further. The selected distances were determined to be appropriate for the distance a person would walk or bike to or from the activity center and to evaluate the connectivity at those scales.

Eight Activity Centers were selected to be examined for the study. The eight locations have very little overlap at the one mile buffer scale, form three nodes at the two mile buffer scale, and cluster within the five mile buffer that represents a majority of the region's urban area.

Figure 4: The study area consists of 8 activity centers with 1, 2, and 5 mile buffers



Bicycle Suitability of Roadways

The evaluation of existing conditions and the development of priorities is one of the first steps in moving toward complete streets. A roadway inventory report was previously developed by Eastgate in 1997 to identify and prioritize conditions along roadways and document their potential for use as bicycle routes. The inventory report was developed in cooperation with area bicyclists who recommended that specific routes be available to provide service between local residential neighborhoods and public or commercial attractions.

Eastgate analyzed and evaluated their recommendations while taking into consideration traffic volumes, posted speeds, observed speeds, width of outside lanes and the presence or absence of connectivity at activity centers. Roads were assigned a priority rating as follows:

Priority 1: Route segments that will require major rehabilitation to be conducive to bicycle travel

Priority 2: Route segments that are somewhat conducive to bicycle travel but need minor rehabilitation.

Priority 3: Route segments that are relatively better for bicycle travel but planning activities and rehabilitation may still be warranted.

The priority ratings were updated to reflect major roadway improvements which have occurred since the original inventory was documented. However, ratings will receive a full revision to accurately reflect current circumstances and needs.

The new bicycle suitability will also show how favorable conditions are for cycling on a particular roadway. Eastgate will review roadway segments, using methodology developed by other regional agencies, resulting in a detailed assessment of current roadway conditions.

The bicycle suitability data will serve several purposes:

- It will show where inadequate conditions or broken connections exist.

- It will serve as resource when developing and prioritizing a regional network plan.
- It will serve as a route planning tool for cyclists.

The information in the inventory report will be transferred into a usable two-county bicycle map which will categorize roadways as appropriate for either the experienced, average or novice bicyclist. Eastgate's former method of categorizing cyclists and roadways will be reviewed and modified in the process. Bicyclists and roadways were formerly categorized as experienced, intermediate and novice using the following criteria:

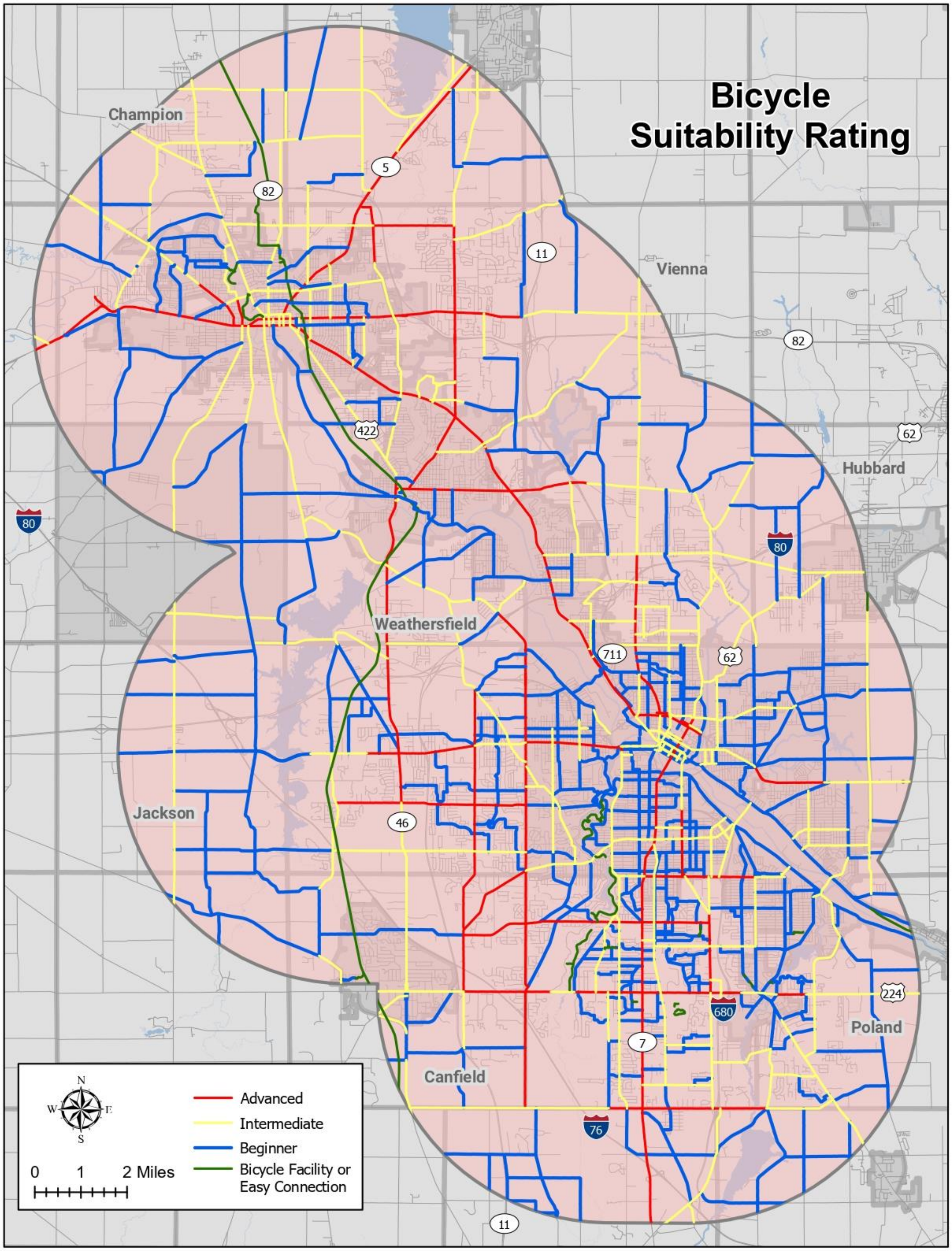
- Advanced
    - Bicyclist is knowledgeable in bicycling and comfortable riding in traffic. A roadway rated as suitable for the experienced rider has one of the following conditions:
        - Fair or good pavement surface, an outer lane with of at least 12 feet and speeds not in excess of 45 mph; or
        - A paved clean shoulder at least 3-foot wide.
- Intermediate
    - Bicyclist rides in traffic but prefers to ride on the shoulder away from traffic. For a route to be considered compatible with these riders the roadway requires one of the following conditions:
        - A good pavement surface, an outer lane width of at least 14 feet (or 12 feet when more than one lane exists) and speeds not in excess of 35 mph; or
        - A 3-foot shoulder and speeds of 45 mph or less.

- Beginner
    - Bicyclist is uncomfortable riding in traffic and requires a right-of-way outside the flow of traffic. A roadway rated as suitable for the experienced rider has the following conditions:

- A continuous paved shoulder in good condition that is at least 3-foot wide and traffic speeds less than 40 mph.

The suitability designations resulting from Eastgate's analysis will be modified by a group of experienced cyclists. Their recommendations will be used to adjust the suitability designations derived from statistical means as a way of ground truthing the data. Local cyclists have been informed of this project and are eager to participate.

Figure 5: Bicycle suitability ratings for roads within 5 miles of activity centers



Level of Service

Bicycle Level of Service (BLOS)[4] and Pedestrian Level of Service (PLOS)[5] are nationally used measures of comfort level as a function of a roadway's geometry and traffic conditions. BLOS measures on-road bicycling conditions for mid-block cross-sections. PLOS measures pedestrian perception of comfort and safety for mid-block cross-sections, including any sidewalks and buffers. Roadways with a better (lower) score are more attractive (and usually safer) for adult cyclists and pedestrians. The output of the model is a numerical value that corresponds to a grade range from "A" (best) to "F" (worst).

Several different models and methodologies have been developed to synthesize this data. For this study, it was important to select a model that has been used by other agencies similar to Eastgate and has received some level of consensus in providing reliable data. The model selected for use was developed by Sprinkle Consulting and has been incorporated into the Highway Capacity Manual.

Bicycle Level of Service (BLOS)

BLOS evaluation may be useful in several ways:

- A bicycle map can be produced for the public to assist them in route selection.
- The most appropriate routes for inclusion in the community bicycle network can be identified.
- "Weak links" in the bike and pedestrian network can be determined, and sites needing improvement can be prioritized.
- Evaluate alternate treatments during design of bike or pedestrian specific infrastructure - providing flexibility to engineers
- Road project selection formulas can include a BLOS term to encourage implementation of bike planning goals.

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[4] Landis et al., TRB 1578
[5] Landis et al, TRB 1773

Data regarding the motorized roadway traffic and the physical roadway infrastructure are the required inputs for the BLOS model. The variables are described as follows:

- Motorized Roadway Traffic
    - Traffic volume
    - Speed
    - Percentage of truck traffic
    - Percentage of occupied parking
- Physical Roadway Infrastructure
    - Number of travel lanes
    - Pavement condition
    - Width of outside lane and extra pavement (shoulder/parking/bike lanes)

The following equation shows the process by which the BLOS model applies the input variables to assign a value for the roadway segments being analyzed:

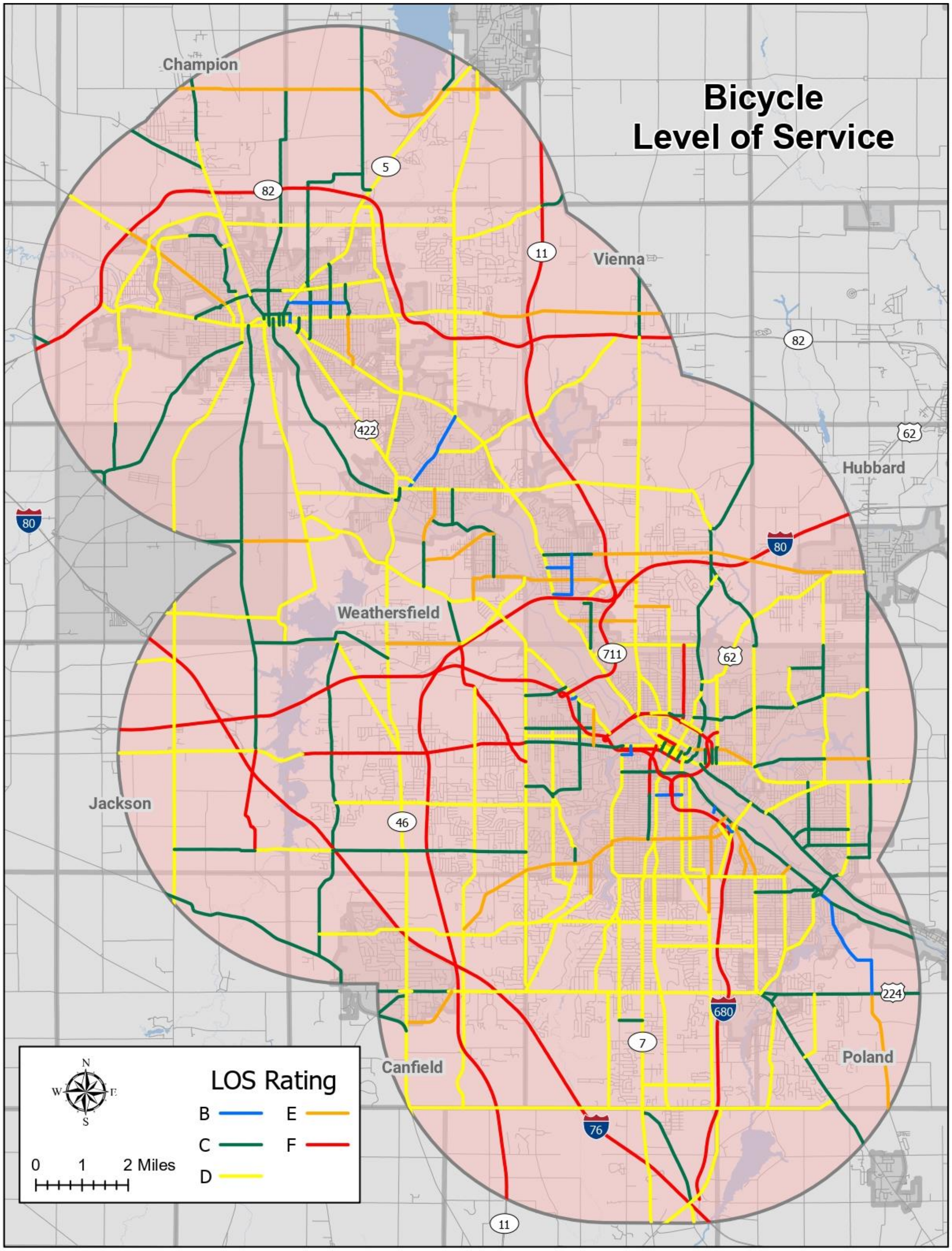
$$BLOS = 0.507 \ln(Vol_{15}/L) + 0.199\, SP_t\, (1+10.38HV)^2 + 7.066(1/PR_5)^2 - 0.005\, W_e^2 + 0.760$$

Vol_{15} = volume of directional traffic in 15 minute time period
L = total number of through lanes
SP_t = effective speed limit = $1.1199 \ln(SP_p-20) + 0.8103$, SP_p is posted speed
HV = percentage of heavy vehicles
PR_5 = FHWA's 5-point surface condition rating (5=best)
W_e = average effective width of outside through lane = $W_t + W_l - \Sigma W_r$
W_t = total width of outside lane and shoulder/parking pavement
W_l = width of paving from outside lane stripe to pavement edge
ΣW_r = width reduction due to encroachments in outside lane

The model ultimately produces a numerical BLOS Score that can be correlated to a LOS letter grade by arranging the scores as a set of ranges. The LOS ratings and grades can be seen below:

- LOS A = BLOS ≤ 1.5
- LOS B = BLOS > 1.5 and ≤ 2.5
- LOS C = BLOS > 2.5 and ≤ 3.5
- LOS D = BLOS > 3.5 and ≤ 4.5
- LOS E = BLOS > 4.5 and ≤ 5.5
- LOS F = BLOS > 5.5

Figure 6: Bicycle Level of Service ratings for functional class roads within five miles of activity centers



Pedestrian Level of Service (PLOS)

Data regarding the motorized roadway traffic, physical roadway infrastructure, and the physical sidewalk infrastructure are the required inputs for the PLOS model. The variables are described as follows:

- Motorized Roadway Traffic
  - Traffic volume
  - Speed
  - Percentage of occupied parking
- Physical Roadway Infrastructure
  - Number of travel lanes
  - Width of outside lane
  - Width of extra pavement (shoulder/parking/bike lanes)
- Physical Sidewalk Infrastructure
  - Sidewalk width
  - Buffer width and type (e.g. tree spacing)

The following equation shows the process by which the PLOS model applies the input variables to assign a value for the roadway segments being analyzed:

$$PLOS = -1.227 \ln(W_{ol} + W_l + f_P \times \%OSP + f_b \times W_b + f_{SW} \times W_S) + 0.009\,(Vol_{15}/L) + 0.0004\,SPD^2 + 6.046$$

W_{ol} = width of outside lane
W_l = width from outside lane stripe to pavement edge (shoulder, parking, bike lanes)
f_P = on-street parking effect coefficient
%OSP = percent of segment with on-street parking
f_b = buffer area barrier coefficient
W_b = buffer width (between edge of pavement and sidewalk)
f_{SW} = sidewalk presence coefficient
W_S = width of sidewalk

Vol_{15} = volume of directional traffic in 15 minute time period
L = total number of through lanes
SPD = average running speed of traffic

The model ultimately produces a numerical PLOS Score that can be correlated to a LOS letter grade by arranging the scores as a set of ranges. The LOS ratings and grades can be seen below:

- LOS A = PLOS ≤ 1.5
- LOS B = PLOS > 1.5 and ≤ 2.5
- LOS C = PLOS > 2.5 and ≤ 3.5
- LOS D = PLOS > 3.5 and ≤ 4.5
- LOS E = PLOS > 4.5 and ≤ 5.5
- LOS F = PLOS > 5.5

Figure 7: Pedestrian Level of Service ratings for functional class roads within one mile of an activity center in the Youngstown area

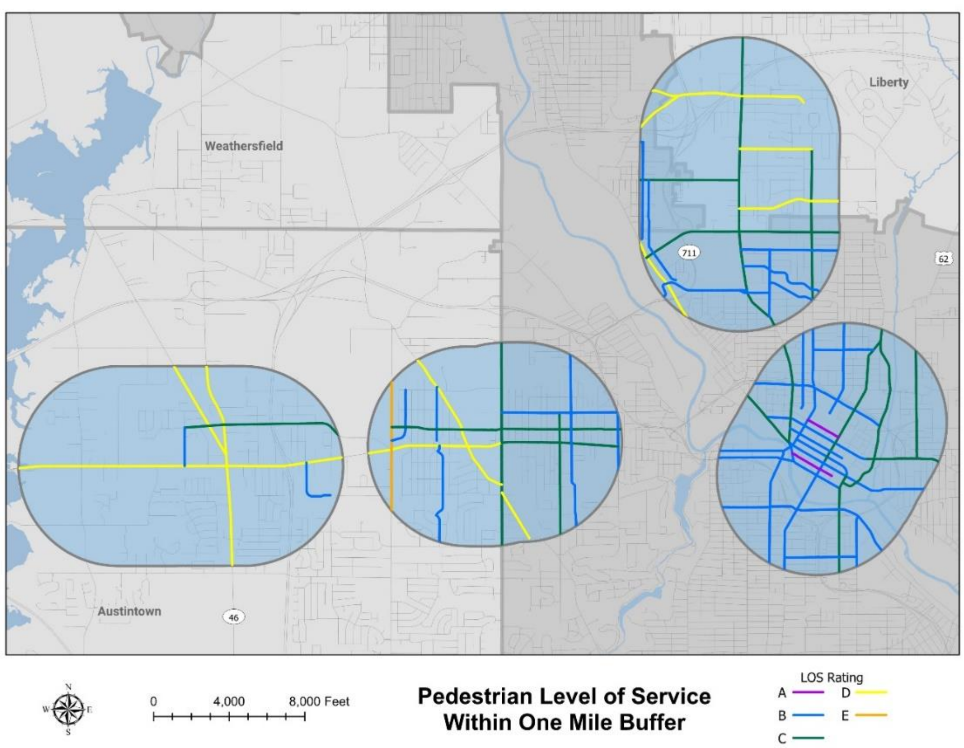


Figure 8: Pedestrian Level of Service ratings for functional class roads within one mile of an activity center in the Warren area

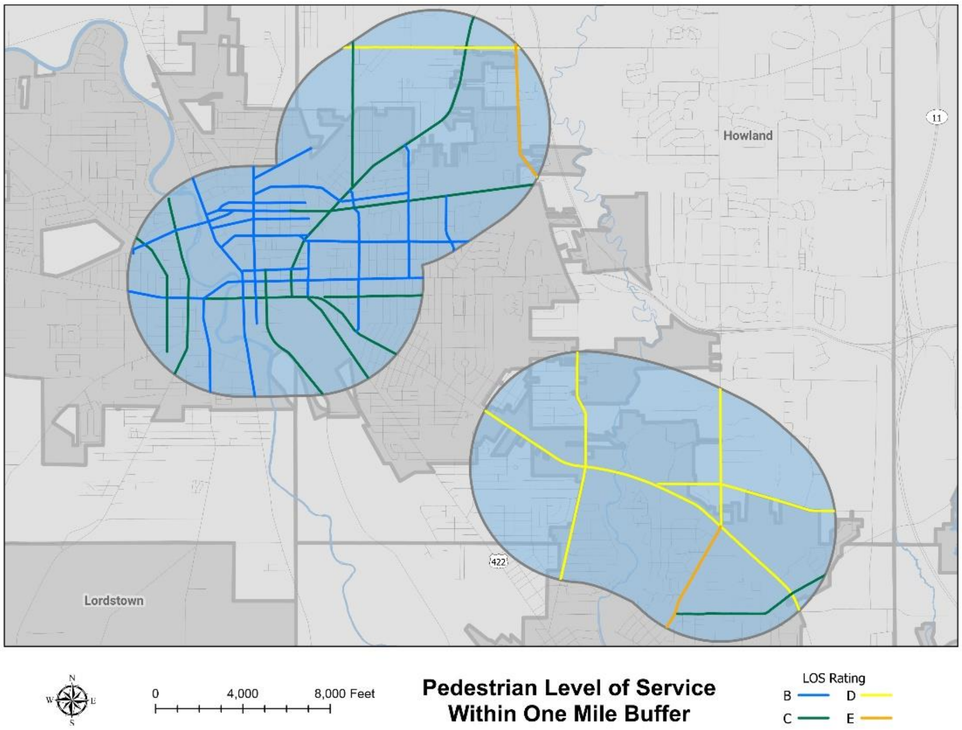
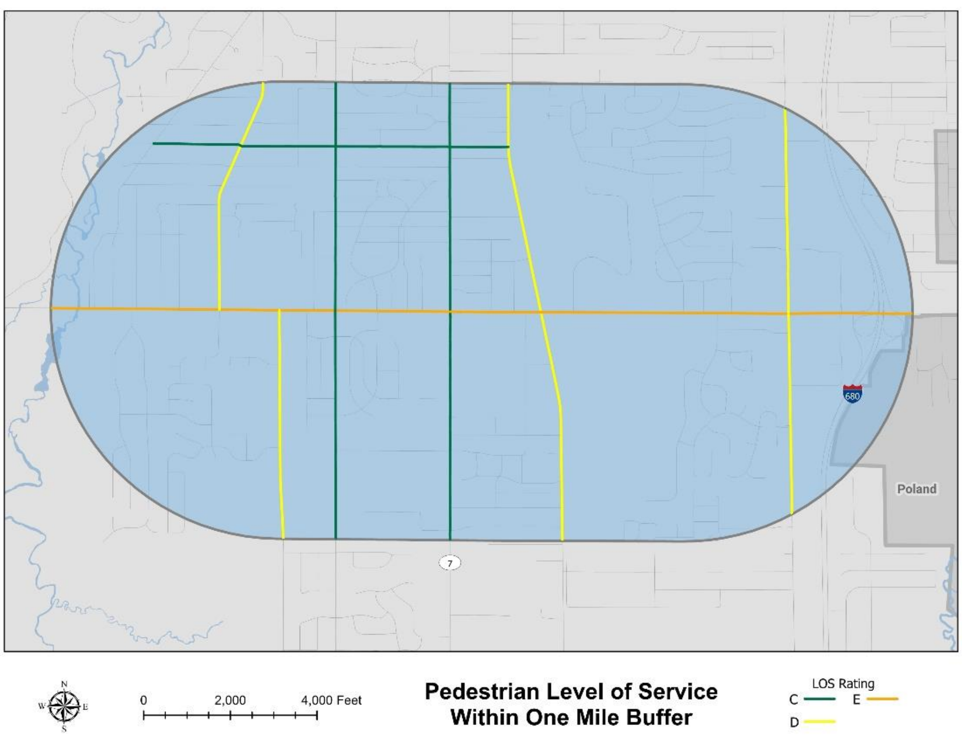


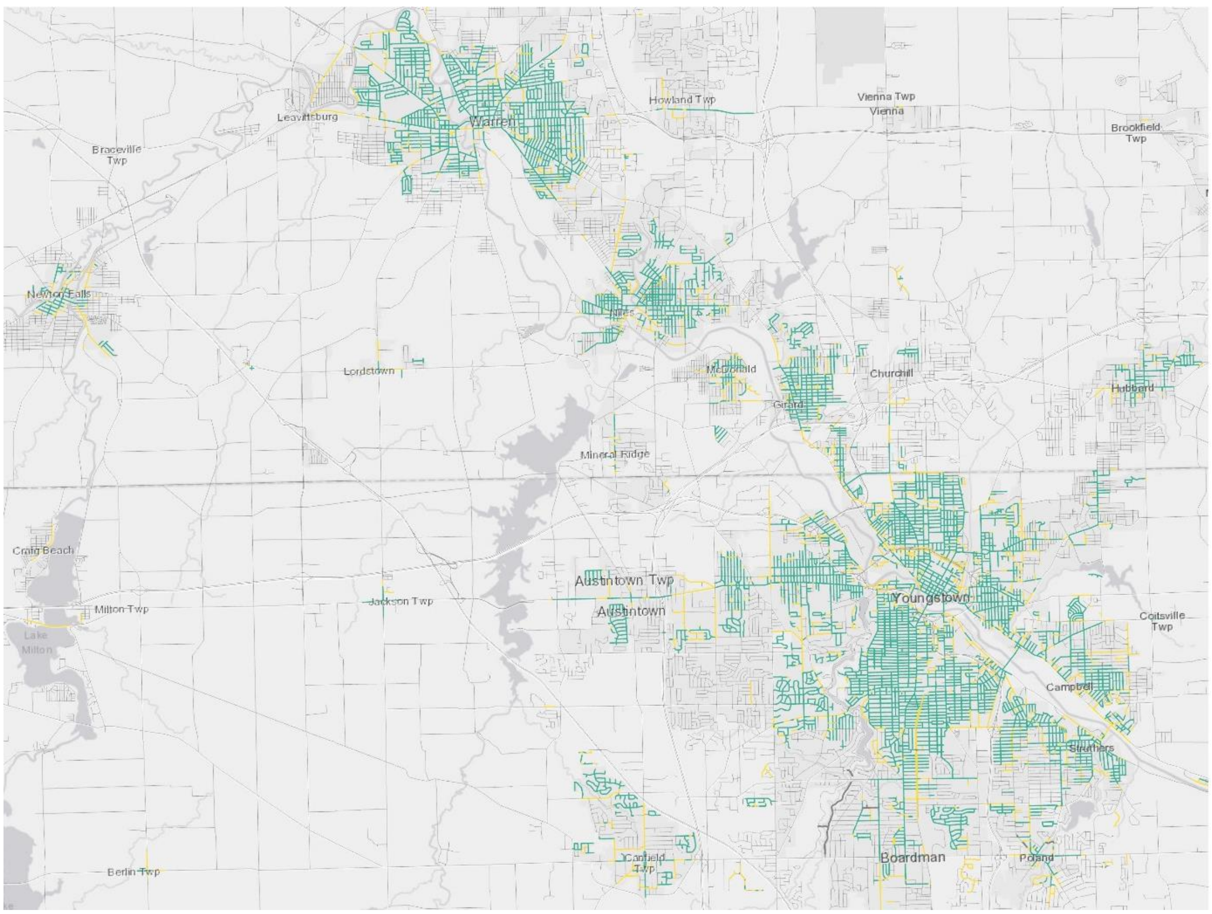
Figure 9: Pedestrian Level of Service ratings for functional class roads within one mile of an activity center in the Boardman area



Walksheds

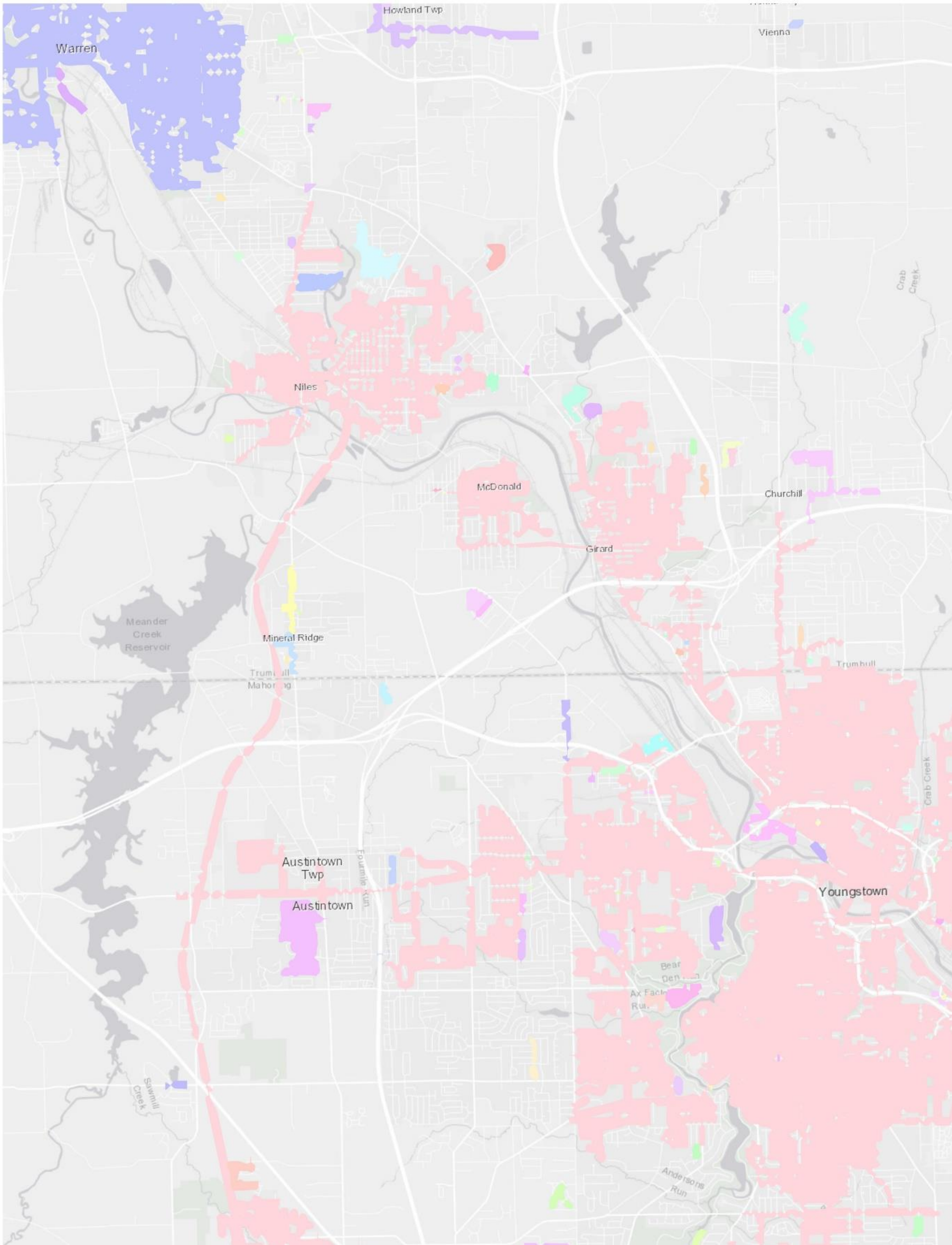
In evaluating the region's existing sidewalk infrastructure, it was important to understand the connectivity of walkable roads. This investigation began with Eastgate's sidewalk inventory data layer, which included segments of existing sidewalks along roadways and identified if they were present on one-side, both-sides, or absent from the roadway. Multi-use paths, of which a few exist in the region, were included in this dataset as well.

Figure 10: Existing sidewalks in the Eastgate Region



The sidewalk inventory dataset was corrected to create a continuous network on which the service area tool could be run. The parameters for the analysis were set so that each roadway segment with sidewalks on at least one side of the street were considered walkable and roadway segments that lacked an available sidewalk were removed to act as barriers for connectivity. This tool generated a walkshed data layer that showed isolated zones of connected, walkable streets.

Figure 11: Walksheds generated to show connected sidewalks in the Eastgate region



Results

Pedestrian Analysis

To have a full understanding of the current conditions of pedestrian infrastructure, Table 1 contains information on the percentage of roads with a presence of sidewalks on one or both sides, as well as no sidewalk presence.

Table 1: Sidewalk availability in the Eastgate region

Roads with Sidewalks	MAH & TRU Counties	Urban Area	Proximity to Activity Centers		
			within 1 mi	within 2 mi	within 5 mi
One Side	4%	7%	8%	8%	6%
Both Sides	16%	29%	41%	36%	26%
None	80%	64%	51%	56%	68%

This establishes a baseline for availability of sidewalks that future goals and performance measures can be based off. With relation to the activity centers, the absence of sidewalks out measures the availability. This is an identifier of accessibility issues and lack of connectivity to the destinations of the activity centers, especially for the roadways within one mile. This data is also available in miles, so that come time for project development, local communities can make estimations regarding the cost of adding new sidewalk infrastructure.

While understanding the availability of infrastructure and establishing a baseline for which to track performance is helpful, we can take the data a step further by evaluating its connectivity and visualizing how connected those existing sidewalks are. Figure 11 above shows some of the connected sidewalk networks for the region. The largest walksheds are centered around the cities of Youngstown and Warren, with smaller walkshed being disconnected in the suburban communities. Utilizing the connected sidewalk data, comparisons between the activity centers were drawn to have a better understanding of how the existing infrastructure was facilitating connectivity and accessibility for pedestrians within one mile of each activity center. Table 2 below demonstrates that the cities of Warren and Youngstown have relatively good connectivity of sidewalk infrastructure, while Niles, Austintown, and Boardman show a low percentage of roads with connected sidewalks.

Table 2: Comparison of pedestrian data for infrastructure within one mile of each activity center

	Population Estimate	Residential Land Use	Commercial Land Use	Roads with Sidewalks	Connected Sidewalks	Roads with Connected Sidewalks
Austintown	5255	47.9%	8.8%	24.40%	46.30%	11.30%
Boardman	12430	42.3%	15.6%	30.60%	55.30%	16.90%
Elm Rd	7523	36.8%	11.5%	49.20%	89.90%	44.20%
Liberty	7238	35.5%	8.0%	36.90%	97.10%	35.80%
Mahoning Ave	11286	35.5%	7.9%	63.40%	91.40%	57.90%
Niles	10190	38.6%	7.4%	19.00%	1.30%	0.20%
Warren	9110	31.0%	19.0%	88.30%	98.90%	87.30%
Youngstown	7190	28.7%	12.2%	73.30%	97.70%	71.70%

With an understanding of the coverage of the pedestrian network, marrying that information to network quality enabled further refinement of the data. PLOS modeling was run on the functional class roads within one mile of the activity centers. Table 3 shows the breakdown of LOS ratings for each one mile activity center. Note that an “F” LOS rating is shown on Table 3. This rating correlates to restricted access divided highways and those road segments were not included in any further analysis.

Table 3: PLOS ratings for functional class roads within one mile of activity centers

Warren

PLOS Rating	Length (mi)	Percentage
A	0	0%
B	15	63%
C	9	37%
D	0	0%
E	0	0%
F	0	0%
Total	**24mi**	**100%**

Elm Road

PLOS Rating	Length (mi)	Percentage
A	0	0%
B	5	33%
C	6	40%
D	2	13%
E	1	7%
F	1	7%
Total	**15mi**	**100%**

Niles

PLOS Rating	Length (mi)	Percentage
A	0	0%
B	0	0%
C	1	10%
D	8	80%
E	1	10%
F	0	0%
Total	**10mi**	**100%**

Liberty

PLOS Rating	Length (mi)	Percentage
A	0	0%
B	1	5%
C	8	40%
D	6	30%
E	0	0%
F	5	25%
Total	**20mi**	**100%**

Youngstown

PLOS Rating	Length (mi)	Percentage
A	1	3%
B	19	54%
C	8	23%
D	0	0%
E	0	0%
F	7	20%
Total	**35mi**	**100%**

Mahoning Ave

PLOS Rating	Length (mi)	Percentage
A	0	0%
B	2	16%
C	6	50%
D	3	25%
E	1	9%
F	0	0%
Total	**12mi**	**100%**

Austintown

PLOS Rating	Length (mi)	Percentage
A	0	0%
B	0	0%
C	0	0%
D	8	80%
E	0	0%
F	2	20%
Total	**10mi**	**100%**

Boardman

PLOS Rating	Length (mi)	Percentage
A	0	0%
B	0	0%
C	4	25%
D	6	37%
E	4	25%
F	2	13%
Total	**16mi**	**100%**

Figures 7, 8, and 9 display a geographic visualization of the PLOS ratings and when combined with the walksheds data layer, provide a basis for helping prioritize future pedestrian improvements with the local communities.

Combining network coverage with network quality enabled the identification of roadway segments that act as barriers. Segments with a LOS rating of C, D, or E were identified as a barrier and should be analyzed further to build out a priority list of planned improvements. Improving these segments would connect isolated walksheds and increase the number of people that can access destinations within the activity centers. Figures 12 and 13 provide a visualization of these barriers for Mahoning and Trumbull Counties, focused on the more urban areas.

Figure 12: Mahoning County's barrier road segments for pedestrians and bicyclists

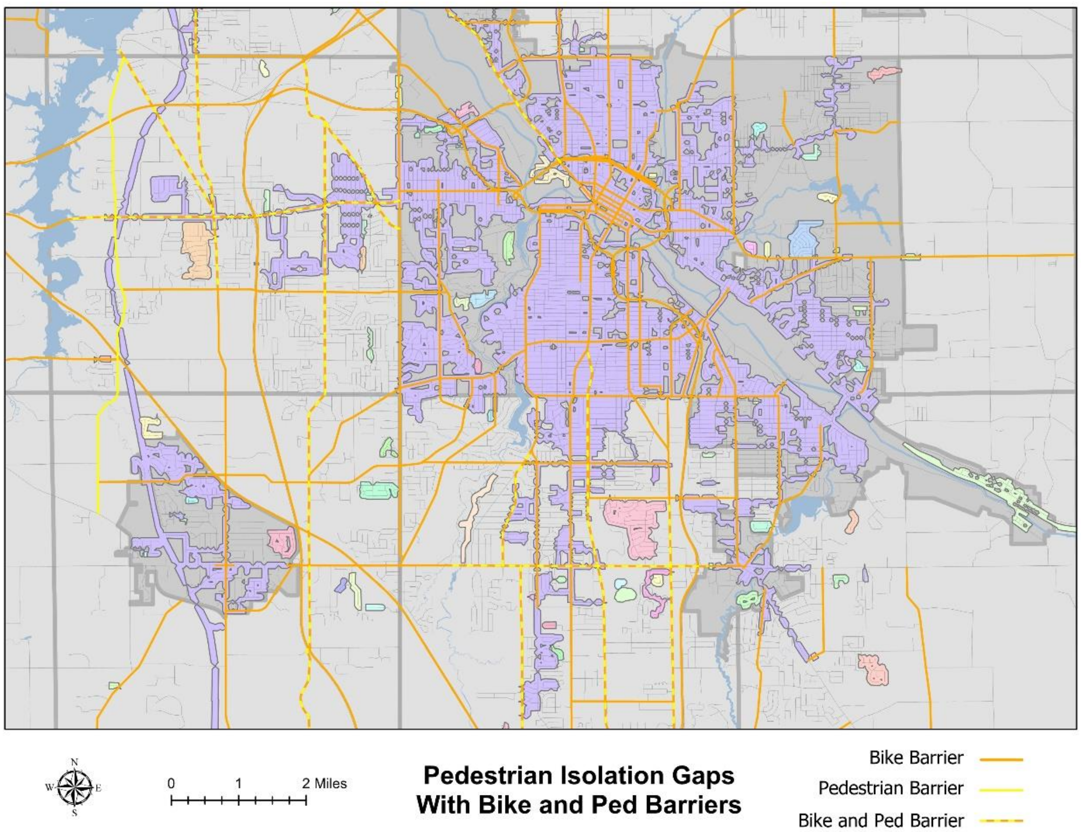
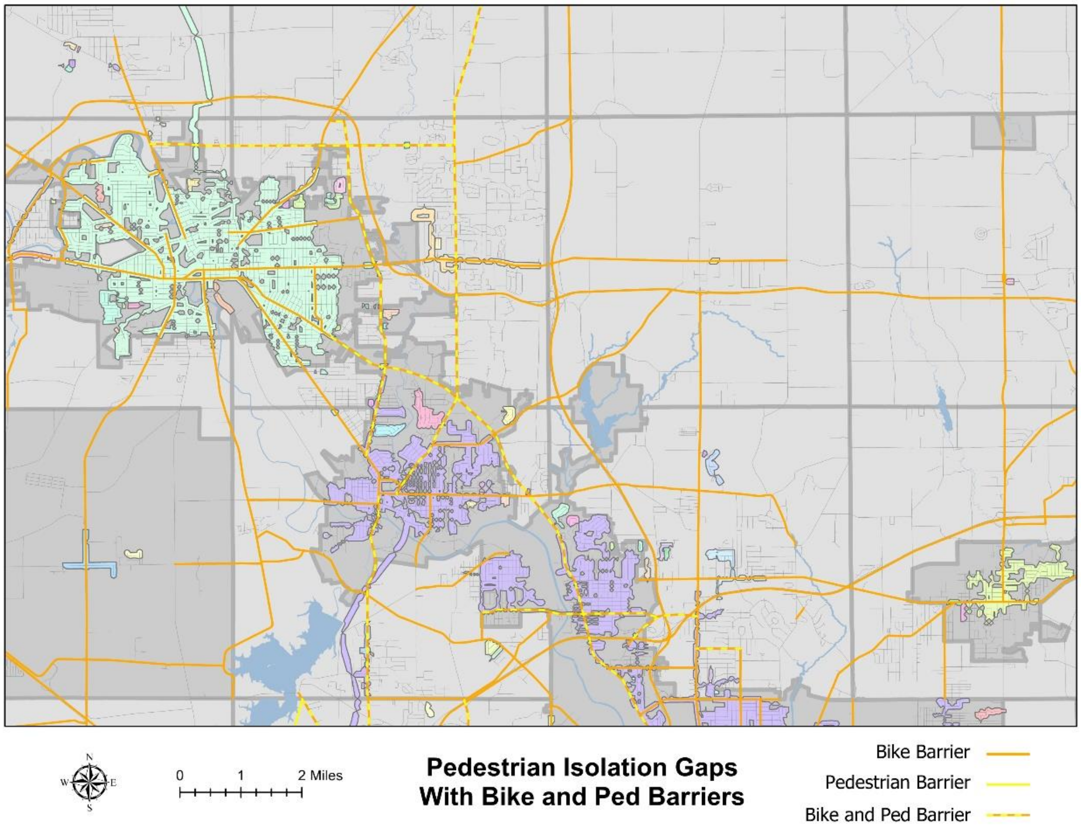


Figure 13: Trumbull County's barrier road segments for pedestrians and bicyclists



Bicyclist Analysis

Analysis of the roadway network in the Eastgate region for accessibility and connectivity by bicycle began with the creation of the bike suitability ratings. These ratings provided a baseline from which the existing roadway segments could be analyzed for quality of infrastructure. It should be noted that at the time of study, very little separated or protected bicycle infrastructure is available on the existing road network and some of the beginner rated roads would not be comfortable for a novice bicyclist that is risk averse. Figure 5 displays a visualization of the suitability ratings for the road segments within 5 miles of the activity centers and Table 4 provides data on the percentage of roadways within each suitability rating.

Table 4: Bicycle Suitability breakdown of road segments within 5 miles of activity centers

Difficulty Level	Length (mi)	Percentage
Beginner	408.6	48%
Intermediate	284.9	33%
Advanced	124.1	15%
Bicycle Facility or Easy Connection	36.1	4%

The bike suitability ratings serve as a measure of comfort and that can be used alongside the BLOS modeling to further refine the data. BLOS modeling was run on all of the functional class roads within Mahoning and Trumbull Counties. Table 5 shows the breakdown of the LOS ratings for each roadway segment.

Table 5: BLOS Ratings for all of the functional class roadways in Mahoning and Trumbull Counties

BLOS Rating	Length (mi)	Percentage
A	0	0%
B	13	1%
C	392	34%
D	458	40%
E	95	8%
F	200	17%

Due to the lack of existing separated or protected bicycle facilities, it was determined to be premature to develop a network-coverage data layer like the analysis done for the region's sidewalks. It is recommended to add that analysis to future studies as specialized infrastructure is built in the local communities.

Analysis Notes

Availability of data controls the outcomes of these studies and our lack of detailed roadway infrastructure data limited the extent to which we could analyze all of the roads in the region and had to settle on only examining the functional class roads. Also, the sidewalk analysis assumes that sidewalks are connected at each intersection. Without data on the presence of crosswalks, ADA curb ramps, or other accessibility features, this assumption could overstate the actual connectedness of the infrastructure. It is recommended that more detailed data be collected prior to re-evaluation of these datasets so that the accuracy and confidence in the results can be enhanced.

Recommendations & Next Steps

The methodology of this study established a baseline for which this analysis could continue as a component of Eastgate's planning activities. Recommendations for future work products and study areas are outlined below, as well as policy recommendations to assist with making improvements to the identified status of the current infrastructure in the region.

The analysis conducted in this study should continue to be refined by incorporating the details outlined in the results section. Most notably, more and better quality data should be sought out so that future studies can be performed with more confidence in the output.

The outcomes of the study should be incorporated into the agency's upcoming MTP and TIP. Along with incorporation, performance measures and regional goals should be established based on the baseline data collected during this study.

Use the outcomes of this analysis to further develop priority areas for targeted infrastructure improvements. Starting with the BLOS, PLOS, and Bike and Pedestrian Barriers data, Eastgate could assist local communities in the project development process to identify locations for improvements and match those projects to funding sources within and outside the agency.

The agency should consider developing and implementing a Complete Streets Policy at the MPO level. Currently, four of Ohio's other MPOs have enacted policies to guide their transportation investments – MORPC, MVRPC, NOACA, and TMACOG. Eastgate's complete streets policy should be developed with the input of the local communities and make an effort to restructure procedures to accommodate all users on every
project; develop new design policies and guides; offer workshops and other training opportunities to planners and engineers; and institute better ways to measure performance and collect data on how well the streets are serving all users.

The agency could expand its technical assistance to help local communities looking to create a Complete Streets Policy of their own. This could come in the form of a guidebook, template, or hands-on assistance.

Adjust the scoring methodology of the agency’s funding programs to prioritize the improvement of the bicycle and pedestrian infrastructure of the region.

Explore the possibility of increasing the share of funding allocated to bicycle and pedestrian infrastructure funding programs. Increasing this funding allocation could help achieve more ambitious goals for improving the regions bicycle and pedestrian levels of service.

Currently, the agency offers two programs related to multimodal transportation planning – a $30,000 biennial community led planning grant and an agency led corridor planning study. The agency could allocate more funding and/or change the grant cycle for the planning grant to yearly to see improvement in the planning and project development for multimodal transportation projects. This could help local communities set priorities and identify funding programs available to make improvements and help the agency reach its performance measure goals and targets.