

December 2016

Analyzing Transportation Services for Older Adults in Southeastern Wisconsin

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ANALYZING TRANSPORTATION SERVICES FOR
OLDER ADULTS IN SOUTHEASTERN WISCONSIN

by

Elizabeth Saunderson

A Thesis Submitted in
Partial Fulfillment of the
Requirements for the Degree of

Master of Science
in Engineering

at

The University of Wisconsin-Milwaukee

December 2016

ABSTRACT

ANALYZING TRANSPORTATION SERVICES FOR OLDER ADULTS IN SOUTHEASTERN WISCONSIN

by

Elizabeth Saunderson

The University of Wisconsin-Milwaukee, 2016
Under the Supervision of Professor Yue Liu

Older adults are important users to consider in the evaluation of transportation services. Many older non-drivers take fewer trips than their driving peers. It is important that transportation services meet the needs of older adults to provide greater access to this subset of the population. This thesis applies the Analytical Hierarchy Process (AHP) to evaluate the thirty-one non-private transportation services that exist in southeastern Wisconsin. The AHP structure uses multiple criteria to evaluate and rank several alternatives based on a stated goal. An optimization model using the LINGO solver introduces a fuzzy scale level to the AHP and assigns weights to each criterion. The chosen criteria cover cost, reliability, flexibility, availability, and accommodations categories, and they are used to assign scores to and rank the thirty-one transportation services.

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ACKNOWLEDGEMENTS

First and foremost, I would like to thank my advisor, Professor Yue Liu, who has taught me throughout my time as a graduate student at the University of Wisconsin-Milwaukee. His knowledge and insight has helped me grow as a student and as an engineer. I would also like to thank my committee members, Professor Xiao Qin and Professor Bob Schneider, for their excellent feedback on and support for my thesis.

I would like to thank my parents, Brian and Linda, for supporting me throughout my undergraduate and graduate studies and always believing in me.

Finally, I want to thank my husband, Ryan, for being my rock while I've been attending graduate school. While life has gotten busy at times, he's always been there for me providing encouragement and support.

1 Introduction

Southeastern Wisconsin offers a variety of transportation services throughout its seven-county region. Many services are available to the general public, and others are dedicated to serving older adults or disabled persons. The types of services available include public transit, paratransit, shared-ride taxis, flexible transit, specialized transportation, and volunteer-based transportation. Most services are provided by a local county or municipality, but many are offered by non-profit organizations. The many transportation options available vary a bit in the service they provide and their costs and limitations.

Many older adults in the region rely on some form of public transportation to get around if they cannot drive or prefer not to drive. For a transportation service to be useful to most older adults, it needs to be affordable, reliable, available when it's needed, and allow for flexibility. Additionally, some older adults who have mobility limitations or are disabled require more accommodations from a transportation service.

This thesis seeks to evaluate the existing transportation services available to older adults in the southeast region of Wisconsin in terms of how well they meet the needs of older adult users.

An Analytical Hierarchy Process (APH) multi-criteria evaluation model is used to score and rank the many services based on a set of criteria. The results provide an outlook on the state of transportation for non-driving older adults in the seven-county region.

1.1 Background

The rise of the automobile and urban development in the United States have influenced and altered travel patterns over the past several decades. Automobile travel has become a major

mode choice for many Americans. Many areas, especially those developed after widespread usage of the automobile, have become auto-dependent, often with limited options for other transportation modes. With an aging population, accessibility to multiple transportation options is especially important for the elderly who often cannot or choose not to drive. Reasonable transportation options are necessary to provide senior citizens with the ability to live independently.

The population in the United States has been growing older due to a few reasons: people are living longer than they used to, baby boomers (born between 1946 and 1964) are now between 52 and 70 years old and growing older, and people are having fewer children than in the past. According to a Transportation Research Board (TRB) report *Safe Mobility for Older Americans*, many older Americans prefer “aging in place” or continuing to live in the same locations after they retire, even in areas that are auto-oriented and have few alternative transportation options. Approximately 23% of elderly Americans are living in rural areas and 56% are living in suburban areas.¹ *Safe Mobility for Older Americans* asserts the importance of older persons retaining access to their own automobiles for as long as possible due to difficulties in accessing and affording alternative transportation.² However, this report does not provide alternatives for the many older Americans who choose not to drive, are no longer able to drive, or should not drive but do so anyway because driving is their only means of transportation.

¹ (Rosenbloom 2003)

² (Transportation Research Board 2005)

1.1.1 Factors Affecting Travel of Aging Americans

As Americans age, the number of trips they take decreases. Data from the 2009 National Household Travel Survey (NHTS) show that the number of trips that aging adults take tends to begin dropping considerably around age 70. Further analysis based on NHTS data is conducted to investigate how the elderly's travel changes associated with sex, race, income, mode of transportation, driver status, and residential locations. Understanding which factors affect the travel patterns of aging adults can assist in developing and improving transportation options that best cater to their needs.

Race, Geography, and Income

Figure 1 displays the average number of daily trips by age and race. The number of daily trips decline as age increases, but the decline accelerates after age 70. This pattern is relatively consistent across races. Although race does not appear to significantly affect the trip numbers, whites reported taking approximately 0.5 more trips in a day than Americans of other races of the same age.

The pattern of declining travel with age is consistent among those living in different parts of metropolitan areas, as shown in Figure 2. Those in suburban areas tended to take the most trips while those in urban areas took the least number of trips, but with only a slight difference of less than 0.5 trips in a day.

Income appears to make the greatest difference in the number of trips taken. Figure 3 shows that all income groups display the overall trend of travel decline with increasing age, but the average number of daily trips is clearly affected by the individual's income. As might be

expected, wealthier individuals—who can most easily afford the costs associated with travel—took the greatest number of trips in all age groups; and poorest individuals—for whom transportation costs might be deterrence—took the fewest number of trips. From ages 50 through 69, the individuals in the wealthiest income group took an average of 1.3 more trips than the poorest income group.

Again, all income groups begin to show significant decreases in travel after age 70. The one possible exception is the poorest household income group – those making under \$20,000 – which shows a steady decrease in travel after ages 50-54. While individuals in wealthier households take the greatest number of trips before age 70, their travel decreases the most as they age. In households with total incomes greater than \$80,000, individuals in the 90-94 age bracket took 2.9 fewer daily trips than those in the 50-54 age bracket. Middle income households (\$40,000 to \$80,000 household income) show a decrease of 2.3 daily trips, and low income households (less than \$40,000 household income) only show a decrease of 1.9 daily trips.

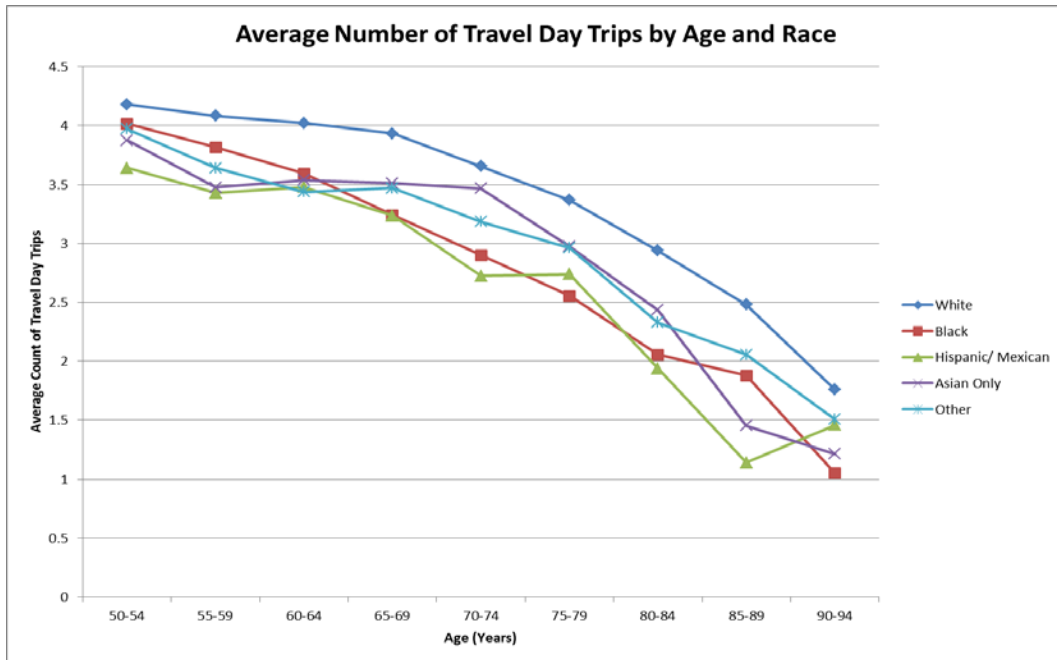


Figure 1: Average Number of Travel Day Trips by Age and Race

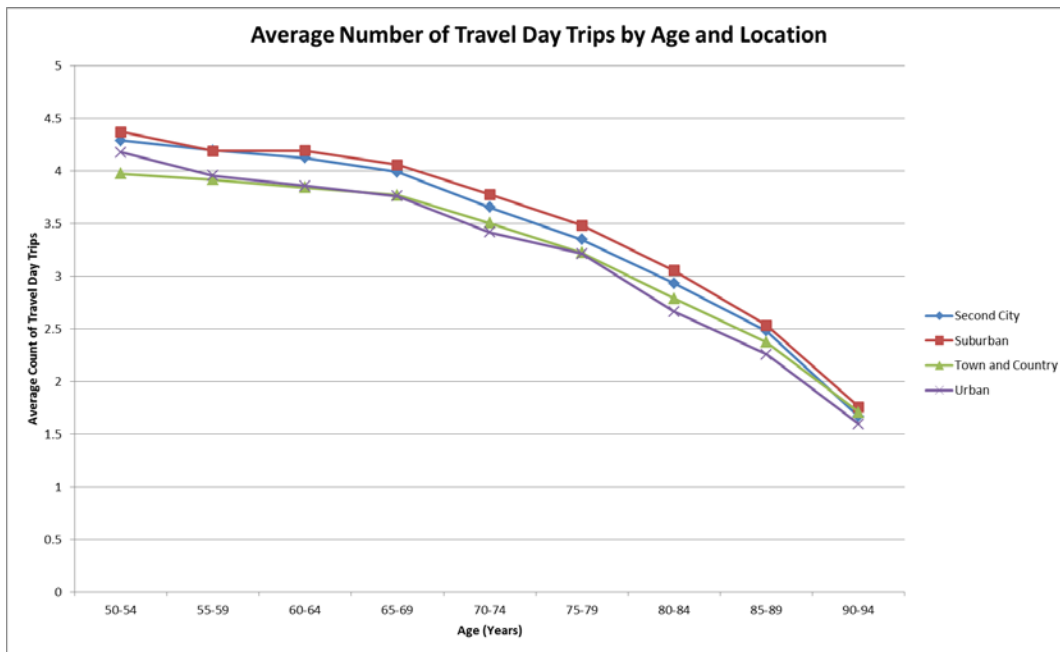


Figure 2: Average Number of Travel Day Trips by Age and Location

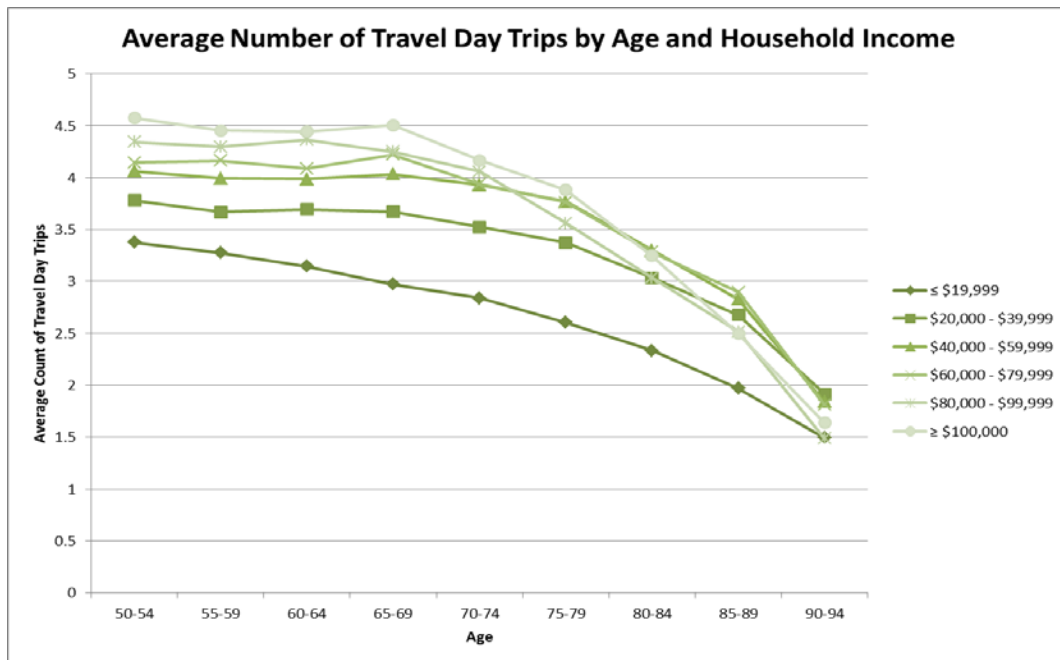


Figure 3: Average Number of Travel Day Trips by Age and Household Income

Mode of Transportation, Sex, and Driver Status

Daily trips may be made by any mode of transportation. Table 1 shows a mode split by age and by trip purpose. Only ages 70 years and older are considered here because, as previously shown, travel begins to noticeably decrease after age 70. In all modes of transportation, the number of trips taken decreased with age. The greatest number of trips taken and the greatest miles travelled were done so in the privately-operated vehicle (POV).

Table 1: Personal Trips by Mode Choice, Age, and Purpose

Personal Trips by Mode Choice, Age and Purpose							
Sum of Person Trips (in millions)	Family/ Personal						Grand Total
	Earn a Living	Business	Other	School/ Church	Social & Recreational	Unreported	
Air	0.2	0.43	6.9		4.7	0.69	12.92
Bike	1.52	80.87		2.02	75.81	0.43	160.65
70-74	0.58	43.76			33.25	0.23	77.82
75-79	0.55	33.38		1.84	33.53	0.2	69.5
80-84		2.97		0.18	6.4		9.55
85+	0.39	0.76			2.63		3.78
Other	24.48	306.06	6.89	23.42	192.22	10.07	563.14
POV	1541.94	14725.39	122.51	1613.62	7294.94	174.14	25472.54
70-74	839.47	5824.35	65.75	623.36	2896.67	54.57	10304.17
75-79	489.13	4282.46	28.36	440.78	2204.39	55.87	7500.99
80-84	162.2	3010.31	20.82	285.49	1450.45	37.52	4966.79
85+	51.14	1608.27	7.58	263.99	743.43	26.18	2700.59
Transit	43.23	174.69	3.57	8.82	90.53	16.14	336.98
70-74	29.57	58.01	0.88	3.2	36.68	1.86	130.2
75-79	11.9	58.2	0.76	2.02	21.33	8.81	103.02
80-84	1.28	38.43	1.5	2.8	20.16	5.4	69.57
85+	0.48	20.05	0.43	0.8	12.36	0.07	34.19
Unreported	4.49	19.7	0.13	0.82	4.3	8.23	37.67
Walk	52.45	915.89	11.72	73.99	1352.23	48.91	2455.19
70-74	21.83	377.35	6.27	23.25	509.87	12.9	951.47
75-79	12.84	218.94	1.74	22.52	380.31	22.42	658.77
80-84	10.12	199.1	1.29	20.68	295.53	10.31	537.03
85+	7.66	120.5	2.42	7.54	166.52	3.28	307.92
Grand Total	1668.31	16223.03	151.72	1722.69	9014.73	258.61	29039.09

Gender appears to affect travel as well. Table 2 shows that in persons over age 70, women tended to take fewer trips than men. There were also noticeably more non-driving women than men. In both genders, drivers took significantly more trips and travelled significantly more miles than did non-drivers. However, drivers showed a more significant decrease in their number of daily trips as they aged than did non-drivers, who generally showed a very slight decline. Additionally, the total number of drivers dropped significantly in the age bracket of 85 and

older, while the number of non-drivers was much more stable across age groups, indicating that many older adults cease driving as they age.

Table 2: Annual Travel Behavior by Driver Status, Sex, and Age

Annual Travel Behavior by Driver Status, Sex and Age				
	Average Person Trips	Average Vehicle Trips	Average Person Miles	Average Vehicle Miles
Driver	1258.181034	917.1226054	9385.823187	6089.459564
Female	1191.375949	771.6942485	7811.733225	3853.69405
70-74	1320.710988	844.0777312	9473.556241	4433.787261
75-79	1162.91208	784.9716738	7968.959985	4162.925096
80-84	1063.970753	664.9421267	6049.33856	2961.316633
85+	1028.305907	672.1066231	4517.711592	2566.399202
Male	1333.468504	1081.016314	11159.77874	8609.105036
70-74	1416.787108	1155.637474	12145.68278	9916.075285
75-79	1375.480712	1112.925706	12675.60228	9374.384877
80-84	1286.531072	1049.132619	10046.37954	7193.230039
85+	1016.032712	794.8329811	5608.200035	4500.724564
Non-Driver	515.6312392	0	2702.036179	0
Female	503.3324016	0	2486.909034	0
70-74	495.8390393	0	2365.561227	0
75-79	594.5446661	0	2873.373807	0
80-84	568.0406249	0	2859.57152	0
85+	399.0367565	0	2024.527244	0
Male	557.96722	0	3442.562968	0
70-74	626.2874421	0	3087.05786	0
75-79	597.2981393	0	2398.62358	0
80-84	569.4387305	0	6022.450779	0
85+	481.5817985	0	2675.533973	0
Grand Total	1072.122696	687.3221143	7711.087958	4563.64307

As Table 2 shows, travel by non-drivers changes relatively little as they age. This may be because most non-drivers' trips are essential. On the other hand, drivers may be taking a greater number of "extra" or non-essential trips during their younger years. On average, drivers over age 70 took 743 more trips per year, or 2 more trips per day, than non-drivers of the same age. This indicates that there is a potential for non-drivers to take up to an additional two trips per day if more reasonable transportation services were available to them.

1.1.2 Providing Transportation to Aging Adults

There are many possible ways to provide transportation options to older Americans, but each method has its limitations. The populations of older Americans for whom transportation accessibility is the biggest concern are those who live in areas with limited non-private automobile transportation choices. Three general approaches for increasing transportation accessibility for these aging Americans have been identified:

1. Allow older Americans to retain access to their private automobiles for as long as possible and remain living where they are.
2. Encourage senior citizens to move to places with greater access to public transportation and/or shorter distances (i.e. walking distances) to daily destinations.
3. Implement supplemental transportation programs in areas where public transportation doesn't meet the needs of older populations.

Allow older Americans to retain access to their automobiles

Sandra Rosenbloom (2009), in an article in the Journal of the American Society on Aging, writes that the best way to meet the transportation needs of older Americans is to keep older people driving longer. She argues that public transit and special demand services cannot meet the needs of the aging population. Rosenbloom suggests a greater policy focus on cars and pedestrian facilities to meet these needs.

This option allows older Americans who are drivers to make trips where and when they want to and allows them to continue living in places with few other transportation options. However, there are many drawbacks to this approach. This approach does not increase transportation

accessibility for older Americans who cannot or choose not to drive. For those who live in areas with few other transportation options, this could result in social isolation or a reliance on friends or family members to get to their destinations – in other words, a loss of independence. As Table 2 suggests, it is non-drivers who are the least mobile and in need of improved transportation options. A greater focus on automobiles will not provide transportation to the non-drivers who have the greatest need for better transportation. For the 79% of elderly Americans living in rural or suburban locations that likely have few destinations in close proximity, the improved pedestrian facilities that Rosenbloom suggests will do very little to improve their mobility. Additionally, crash rates and crash severity increase as people age, and fatality crash rates begin to increase at age 75. Aging Americans who rely on their automobiles for transportation may be reluctant to quit driving, even if they are no longer physically able to drive safely.

Encourage older adults to move to places with greater transportation options

In terms of providing efficient and affordable transportation options for older Americans, it may sound ideal for aging Americans to eventually move to places with more transportation options, such as public transportation, and places in proximity to daily destinations. However, based on an AARP Public Policy Institute survey of 28 people over age 75 and the TRB report, *Safe Mobility for Older Americans*, many older Americans wish to “age in place” where they are currently living. The effects of policies or programs that encourage older Americans to move to places with efficient transit services and proximity to activities, in other words, city or suburban centers, are uncertain. Moving older Americans might also separate them from the social network around their current homes.

Implement supplemental transportation programs

Implementing supplemental transportation services in areas where public transportation does not meet the needs of an aging population would allow Americans to remain living where they are and avoid relying on driving a private automobile or another person for rides. Robert Cervero (1997) states “these types of services blend the best features of mass transit (i.e., multiple occupancy) and the private automobile (i.e., flexible, on-call, pointtopoint services).” Additionally, these services might be easier for Americans with physical or mental disabilities to access and use than other forms of transportation.

The biggest drawbacks to this approach are the costs in areas with low density or low populations of the elderly requiring the service. Regardless, this appears to be the safest and most practical approach to providing aging Americans with access to transportation.

According to Cervero, there are six important benefits that supplemental transportation programs can provide: (1) increase travel choices; (2) enhance mobility; (3) improve environmental conditions; (4) impose a market discipline on public transportation; (5) make poor neighborhoods more accessible; and (6) help stimulate advanced transit technologies.³ Older Americans, in particular, may benefit from increased travel choices and greater mobility.

Many varieties of transportation services exist, and Cervero recognizes the specialized dial-a-ride service – which operates by phone request and will travel to and from anywhere within its service area – as an appropriate type for the elderly. Dial-a-ride vans allow for multiple occupancy and provide on demand services that are requested by phone. In southeastern

³ (Cervero 1997)

Wisconsin (and in the remainder of this thesis), “dial-a-ride” service is referred to as a shared-ride taxi.

1.2 Purpose

The purpose of this thesis is to investigate the current transportation services available to older adults throughout southeastern Wisconsin. There are a variety of types of transportation services currently in use in different parts of the region. This thesis aims to evaluate these many services based on their costs and benefits to older adults who may use them. From this, services that are not sufficiently meeting the needs of traveling older adults can be identified. Through a geographic analysis of the existing transportation service areas, locations with poor or non-existent transportation services can also be identified.

1.3 Objectives and Scope

The focus of this study is on the seven counties of southeastern Wisconsin.⁴ Transportation services examined are limited to any services provided by a government agency (i.e. municipality or county) or a non-profit organization. Many non-profit organizations receive some public transportation funding to support their operations. Private for-profit transportation services are not included in this study. Additionally, no express or commuter routes are considered in the evaluation of transportation services. While some older adults may use these services, this thesis concentrates on the more locally-based transportation services that provide intra-city or intra-county transportation.

⁴ See Appendix A: Seven Counties of Southeastern Wisconsin

1.3.1 Analytical Hierarchy Process (AHP)

The evaluation of the many transportation services is done using an Analytical Hierarchy Process (AHP) multi-criteria evaluation model. The model uses a mathematical approach for ranking a set of alternatives based on a set of measurable criteria. The goal of the AHP approach in this thesis is to rank the existing transportation services based on the costs and benefits to older riders. Each service is also assigned a score relative to the other services. A multi-criteria ranking model created in the program LINGO follows the AHP structure and is used to evaluate the transportation services in southeastern Wisconsin. The LINGO model was originally created by Dr. Jie Yu and Dr. Yue Liu and was used to rank highway safety improvement projects.⁵

1.3.2 Geospatial Representation of Transportation Scores

The transportation services available throughout the seven-county region vary in terms of type, costs, benefits, and service area. The service areas of each of the transportation services are first mapped by type (e.g. public transportation or shared-ride taxi) using ArcGIS, to indicate where coverage can be found. Then, using the transportation scores derived from the AHP model, scores are assigned to each service area. Locations that have multiple transportation services are assigned a cumulative score.

⁵ (Yu and Liu 2011)

2 Literature Review

2.1 Public Transportation and Older Adults

Transportation services are often evaluated by the providing entity, transportation planning agencies, or outside groups. Often the focus is on larger public transportation systems, and evaluations tend to consider cost-effectiveness and lifecycle cost analyses from the perspective of the entity providing or funding the service. Broad benefits of transportation services that are often identified include environmental, public health, economic development, and transportation system benefits.⁶ User benefits are generally considered as well, but often as part of a larger array of benefits to the overall public.

Not often do assessments of transportation services focus solely on the needs of riders and potential riders. By considering user costs and benefits from a broad perspective with a goal of minimizing costs and maximizing benefits to the overall public, certain vulnerable groups, such as non-driving older adults or those living in low-density areas, may be forgotten.

2.2 Analytical Hierarchy Process (AHP)

AHP has been applied to many different problems across numerous fields. The framework of the process makes it usable in many different applications where multiple alternatives need to be evaluated against multiple criteria. An example of where AHP has been applied in the field of transportation is in prioritizing highway safety improvement projects. Dr. Jie Yu and Dr. Yue Liu created an AHP model using LINGO to evaluate a set of candidate highway improvement projects and prioritize them using six criteria: total number of accidents reduced, number of

⁶ (Litman 2016)

fatal and injury accidents reduced, construction costs, service life, annual average daily traffic (AADT), and AADT growth factor. This AHP model could derive weights for each of the criteria based on the standard deviation of each criterion's values. The normalized criteria values and corresponding weights were then used to calculate a priority score for each of the candidate projects. These priority scores could then be used to rank the projects, which could be used to prioritize highway safety improvement projects for funding and completion. The mathematical model for the AHP evaluation created by Yu and Liu is the basis of the model used in this thesis,⁷ and more information about the model formulation can be found in Chapter 4.

⁷ (Yu and Liu 2011)

3 Data and Analysis

To evaluate the available transportation services in southeastern Wisconsin, a set of criteria were developed and data were collected about each of the services. This chapter covers each of the public transportation services considered in this thesis, the criteria used to evaluate them and the three evaluation approaches taken.

3.1 Transportation Services

A total of thirty-one transportation services throughout the seven counties of southeastern Wisconsin are considered in this thesis. These services consist of six different types of transportation services – public transit, paratransit, shared-ride taxis, flexible transit, specialized transportation, and volunteer-based transportation. A list of all thirty-one transportation services is shown in Table 3 below, also indicating the service provider, type of service, and county for each. Appendix G shows the locations of all transportation service areas throughout the region.

Table 3: Transportation Services

COUNTY	SERVICE NAME	ID	SERVICE PROVIDER	SERVICE TYPE
Kenosha	Kenosha Area Family and Aging Services	KAFASI	Non-profit Organization	Volunteer-Based Transportation
Kenosha	Kenosha Area Transit	KAT	Municipality	Public Transit
Kenosha	Care-a-van (KAT Paratransit)	KAT-PT	Municipality	Public Transit Paratransit
Kenosha	Western Kenosha County Transit System	WKCTS	County	Flexible Transit
Kenosha	Western Kenosha County Transit System Door to Door Service	WKCTS-D2D	County	Specialized Transportation
Milwaukee	Interfaith Older Adult Programs	IF-Mil	Non-profit Organization	Volunteer-Based Transportation
Milwaukee	Milwaukee County Department on Aging specialized transportation program	MCDA	County	Specialized Transportation
Milwaukee	Milwaukee County Transit System (MCTS)	MCTS	County	Public Transit
Milwaukee	MCTS Transit Plus	MCTS-PT	County	Public Transit Paratransit
Ozaukee	Cedarburg Senior Center Van Service	CSCVS	Municipality	Volunteer-Based Transportation
Ozaukee	Interfaith Caregivers of Ozaukee County	IF-Oz	Non-profit Organization	Volunteer-Based Transportation
Ozaukee	Ozaukee County Shared-Ride Taxi	OC-SRT	County	Shared-ride Taxi
Ozaukee	Ozaukee Family Services	OFS	Non-profit Organization	Volunteer-Based Transportation
Racine	Belle Urban System	BUS	Municipality	Public Transit
Racine	Dial a Ride Transportation (DART - BUS Paratransit Service)	BUS-PT	Municipality	Public Transit Paratransit
Racine	Shuttling People Around Racine County (SPARC)	SPARC	County	Flexible Transit
Racine	MyRide	MR	Non-profit Organization	Volunteer-Based Transportation
Walworth	VIP Services	VIP	Non-profit Organization	Specialized Transportation
Washington	Germantown Senior Van Service	GSVS	Municipality	Volunteer-Based Transportation
Washington	Hartford Taxi	HT	Municipality	Shared-ride Taxi
Washington	Interfaith Caregivers of Washington County	IF-Wash	Non-profit Organization	Volunteer-Based Transportation
Washington	West Bend Taxi	WBT	Municipality	Shared-ride Taxi
Washington	Washington County Shared-Ride Taxi	WC-SRT	County	Shared-ride Taxi
Waukesha	Elmbrook Senior Taxi	EST	Non-profit Organization	Volunteer-Based Transportation
Waukesha	Lake Country Cares Cab	LCCC	Non-profit Organization	Volunteer-Based Transportation
Waukesha	Muskego Senior Taxi	MST	Non-profit Organization	Volunteer-Based Transportation
Waukesha	New Berlin Senior Taxi	NBST	Non-profit Organization	Volunteer-Based Transportation
Waukesha	Oconomowoc Silver Streak	OSS	Non-profit Organization	Volunteer-Based Transportation
Waukesha	RideLine Program	RLP	County	Specialized Transportation
Waukesha	Seniors on the Go!	SOTG	Non-profit Organization	Volunteer-Based Transportation
Waukesha	Waukesha Metro	WMT	Municipality	Public Transit

3.1.1 Public Transit

Public transit is one of the most widely used methods of transportation available to the public.

There are several possible forms of public transit that exist, including buses, light rail, and subways. In southeastern Wisconsin, public transit agencies provide bus service that serve either a city-wide or county-wide area. No regional transit authorities currently exist in the region. Public transit is typically found in more densely populated, urban areas. There are four public transit agencies in southeastern Wisconsin serving its four largest cities – Milwaukee, Waukesha, Racine, and Kenosha.

1. **Milwaukee County Transit System (MCTS)** serves Milwaukee County and portions of Ozaukee, Washington, and Waukesha counties. Service is provided by Milwaukee County.⁸
2. **Waukesha Metro (WMT)** serves the City of Waukesha area in Waukesha County. Service is provided by the City of Waukesha.⁹
3. **Belle Urban System (BUS)** serves the City of Racine area in Racine County. Service is provided by the City of Racine.¹⁰
4. **Kenosha Area Transit (KAT)** serves the City of Kenosha area in Kenosha County. Service is provided by the City of Kenosha.¹¹

Service provided by these entities involves buses running along planned routes with scheduled service. Buses are wheelchair accessible and generally make stops every 1/8 to 1/2 mile. The

⁸ (Milwaukee County Transit System n.d.)

⁹ (Waukesha Metro n.d.)

¹⁰ (City of Racine n.d.)

¹¹ (City of Kenosha n.d.)

service areas of these public transit services as understood in this thesis encompass a quarter-mile distance from a bus stop or bus route. (Acceptable walking distances to transit are generally presumed to be between one quarter and one half mile.) The four public transit service areas and bus routes are displayed in Appendix B.

3.1.2 Paratransit

Paratransit is a type of transportation service for those who are eligible for federal Americans with Disabilities Act (ADA) Paratransit. Eligibility is determined by (1) an inability to navigate a transportation system independently; (2) a lack of accessible vehicles, stations or bus stops on the route they wish to use; or (3) an inability to reach a boarding point or final destination.¹² It often complements traditional public transit service and is offered by the same agency. Many of the other types of transportation services discussed in this thesis provide ADA accommodations, including curb-to-curb service, wheelchair accessibility, and personal accommodations, with their regular service instead of providing it separately. This thesis refers to paratransit services as those that are offered as a standalone program meant to complement a public transit service. Therefore, these services are available solely to those who meet the ADA Paratransit eligibility requirements. There are three such paratransit services offered in southeastern Wisconsin, and their service areas are shown in Appendix B along with the respective public transit service areas.

1. **MCTS Transit Plus (MCTS-PT)** serves all of Milwaukee County and complements the MCTS public transit system. Service is provided by Milwaukee County.¹³

¹² (Federal Transit Administration 2015)

¹³ (Milwaukee County Transit System n.d.)

2. **Dial a Ride Transportation (DART) (BUS-PT)** serves within $\frac{3}{4}$ mile of BUS routes in Racine County and complements the BUS public transit system. Service is provided by the City of Racine.¹⁴
3. **Care-A-Van (KAT-PT)** serves all of Kenosha County east of I-94 and within $\frac{3}{4}$ mile of KAT routes west of I-94, and it complements the KAT transit system. Service is provided by the City of Kenosha.¹⁵

3.1.3 Shared-Ride Taxi

Shared-ride taxi services provide demand-responsive rides, often using automobiles or shuttle buses. Rides are generally requested in advance and multiple riders may be scheduled to ride together, as the name implies. Anyone within the service area may use shared-ride taxis, regardless of age. Many shared-ride taxi services have at least one wheelchair accessible vehicle to provide rides to wheelchair users, and curb-to-curb service is provided to all. These services are provided by local or county governments, often in suburban areas without sufficient population density to support public transit systems. Private taxi services are not included as shared-ride taxis and are not considered in this thesis. Southeastern Wisconsin has two county-wide shared-ride taxi services and two municipal-based shared-ride taxi services. The service areas of these shared-ride taxi services are displayed in Appendix C.

1. **Ozaukee County Shared-Ride Taxi (OC-SRT)** serves Ozaukee County. Service is provided by Ozaukee County.¹⁶

¹⁴ (City of Racine n.d.)

¹⁵ (City of Kenosha n.d.)

¹⁶ (Ozaukee County Transit Services n.d.)

2. **Washington County Shared-Ride Taxi (WC-SRT)** serves Washington County. Service is provided by Washington County.¹⁷
3. **Hartford Taxi (HT)** serves the City of Hartford in Washington County and up to a mile outside of the City limits. Service is provided by the City of Hartford.¹⁸
4. **West Bend Taxi (WBT)** serves the City of West Bend in Washington County and up to two miles outside of the City limits. Service is provided by the City of West Bend.¹⁹

3.1.4 Flexible Transit

Flexible transit services, also called route deviation services, provides scheduled service along a designated route(s) but also accept deviation requests from riders. This type of service tends to have only one or a couple of routes in its system, and route deviations are generally limited to $\frac{3}{4}$ miles from the route. Flexible transit is often utilized in rural areas. Two flexible transit services are offered in Racine and Kenosha counties as shown in Appendix D.

1. **Shuttling People Around Racine County (SPARC)** serves a circular route in the City of Burlington in Racine County. It is designed for seniors, but anyone may use the service. Service is provided by Racine County.²⁰
2. **Western Kenosha County Transit System (WKCTS)** serves a linear route in Kenosha County. Service is provided by Kenosha County.²¹

¹⁷ (Washington County n.d.)

¹⁸ (City of Hartford n.d.)

¹⁹ (City of West Bend n.d.)

²⁰ (Racine County n.d.)

²¹ (Kenosha County n.d.)

3.1.5 Specialized Transportation

Transportation services provided by local government that do not fit the description of public transit, paratransit, shared-ride taxis, or flexible transit fall into the category of specialized transportation. Some of the services are exclusively for older adults or the disabled. There are four specialized transportation services in southeastern Wisconsin. They are all demand-responsive and provide curb-to-curb services. Specialized transportation service areas are shown in Appendix E.

1. **Western Kenosha County Transit System Door to Door Service (WKCTS-D2D)** serves Kenosha County west of I-94 as well as the cities of Burlington and Lake Geneva in Racine and Walworth counties, respectively. Anyone may use this service. The service complements the Western Kenosha County Transit System and is provided by Kenosha County.²²
2. **Milwaukee County Department on Aging specialized transportation program (MCDA)** serves Milwaukee County residents aged 60 years or older who can walk but are unable to drive, have difficulty using public transit, and are not eligible for the MCTS Transit Plus paratransit service. Services is provided by Milwaukee County.²³
3. **VIP Services (VIP)** serves persons aged 60 and older, adults with disabilities and veterans within Walworth County. Walworth County contracts with the non-profit organization VIP Services, Inc. to provide this service.²⁴

²² (Kenosha County n.d.)

²³ (Milwaukee County Department on Aging n.d.)

²⁴ (VIP Services, Inc. n.d.)

4. **RideLine Program (RLP)** serves persons within Waukesha County who are non-driving and unable to enter or exit a vehicle independently. Riders must be users of a cane, crutches, walker, wheelchair, scooter, or legally blind or must be age 65 or older. Service is provided by Waukesha County.²⁵

3.1.6 Volunteer-Based Transportation

Most volunteer-based services within southeastern Wisconsin are provided by non-profit organizations, but some are programs offered by local municipalities. As the name indicates, these services rely on volunteers to provide rides to users. Some programs require volunteers to use their own personal vehicles while others provide vehicles for volunteers to drive. There are twelve volunteer-based services provided by non-profit organizations and two provided by local municipalities in southeastern Wisconsin. Non-profit organizations generally receive some state or federal funding. Volunteer-based transportation service areas are displayed in Appendix F.

1. **Kenosha Area Family and Aging Services (KAFASI)** serves persons aged 60 and older or the disabled who have difficulty with public transit within Kenosha County. Service is provided by a non-profit organization.²⁶
2. **Interfaith Older Adult Programs (IF-Mil)** serves older adults in Milwaukee County. Service is provided by a non-profit organization.²⁷

²⁵ (Waukesha County n.d.)

²⁶ (Kenosha Area Family and Aging Services, Inc. n.d.)

²⁷ (Interfaith Older Adult Programs n.d.)

3. **Cedarburg Senior Center Van Service (CSCVS)** serves adults aged 55 years and older in the City of Cedarburg in Ozaukee County. Service is provided by the City of Cedarburg.²⁸
4. **Interfaith Caregivers of Ozaukee County (IF-Oz)** serves seniors and the disabled (except for wheelchair users) in Ozaukee County. Service is provided by a non-profit organization.²⁹
5. **Ozaukee Family Services (OFS)** serves senior citizens in Ozaukee County. Service is provided by a non-profit organization.³⁰
6. **MyRide (MR)** serves adults aged 55 and older who don't drive in Racine County. Service is provided by a non-profit organization.³¹
7. **Germantown Senior Van Service (GSVS)** serves adults aged 55 years and older in the City of Germantown in Washington County. Service is provided by the City of Germantown.³²
8. **Interfaith Caregivers of Washington County (IF-Wash)** serves adults aged 60 years and older in Washington County. Service is provided by a non-profit organization.³³
9. **Elmbrook Senior Taxi (EST)** serves ambulatory seniors and disabled adults in the City of Brookfield, Town of Brookfield, Village of Elm Grove, and Village of Butler located in Waukesha County. Service is provided by a non-profit organization.³⁴

²⁸ (City of Cedarburg n.d.)

²⁹ (Interfaith Caregivers of Ozaukee County n.d.)

³⁰ (Ozaukee Family Services n.d.)

³¹ (Volunteer Center of Racine County, Inc. n.d.)

³² (Village of Germantown n.d.)

³³ (Interfaith Caregivers of Washington County n.d.)

³⁴ (Elmbrook Senior Taxi n.d.)

10. **Lake Country Cares Cab (LCCC)** serves non-drivers or limited drivers aged 65 years or older in the Village of Hartland, Town of Merton, City of Delafield, and Village of Nashotah in Waukesha County. Service is provided by a non-profit organization.³⁵
11. **Muskego Senior Taxi (MST)** serves adults aged 65 and older and ambulatory or cognitively disabled adults in the City of Muskego, Village of Big Bend, and Town of Vernon in Waukesha County. Service is provided by a non-profit organization.³⁶
12. **New Berlin Senior Taxi (NBST)** serves seniors in the City of New Berlin in Waukesha County. Services is provided by a non-profit organization.³⁷
13. **Oconomowoc Silver Streak (OSS)** serves seniors aged 55 and older and adults with disabilities in the City of Oconomowoc, Town of Oconomowoc, and Town of Summit in Waukesha County. Service is provided by a non-profit organization.³⁸
14. **Seniors on the Go! (SOTG)** serves adults aged 55 and older in the Village of Mukwonago, Town of Mukwonago, Village of Big Bend, Village of Eagle, and Town of Vernon in Waukesha County. Service is provided by a non-profit organization.³⁹

3.2 Criteria

The evaluation of transportation services in southeastern Wisconsin for this thesis is focused on the needs of non-driving older adults. Therefore, it's important that the criteria used in the evaluation reflect these needs. The chosen criteria cover cost, reliability, flexibility, availability, and accommodations of the transportation services. The criteria values for each of the

³⁵ (Lake Country Cares Cab n.d.)

³⁶ (Muskego Senior Taxi Service, Inc. n.d.)

³⁷ (City of New Berlin n.d.)

³⁸ (Oconomowoc Silver Streak n.d.)

³⁹ (Seniors on the Go! n.d.)

transportation services that are used as inputs for the evaluation process are summarized in Appendix H. Information about each transportation service was gathered from each service's website. The websites for each service are listed in the references section and referenced in Section 3.1.

Table 4: Criteria

Category	Criteria	Unit of Measurement
Cost	Minimum cost per trip	dollars
	Maximum cost per trip	dollars
	Maximum cost per trip / service area	dollars / square mile
Reliability	Reliance on volunteers	(yes / no)
Flexibility	Days of advanced notice required	number of days
	Limitation on types of destinations	(yes / no)
Availability	Average weekday ⁴⁰ availability	number of hours
	Average weeknight ⁴¹ availability	number of hours
	Average weekend day ⁴² availability	number of hours
	Average weekend night ⁴³ availability	number of hours
Accommodations	Curb-to-curb service	(yes / no)
	Wheelchair accommodations	(yes / no)
	Personal accommodations	(yes / no)

3.2.1 Cost

The cost criteria relate to the cost of an older to make a trip using a transportation service.

There are three cost criteria applied in the evaluation: minimum cost per trip, maximum cost per trip, and the relative maximum cost per square mile of service area for each transportation service. For many transportation services, the minimum and maximum costs per trip are the same. Others vary in price based on length of the trip or due to discounts based on income, for example. Therefore, it's important to account for the range of prices that an older adult may have to pay to use the service. Many older adults are on a fixed income, so it's particularly

⁴⁰ Monday through Friday, 7 am to 7 pm

⁴¹ Monday through Friday, 7 pm to 7 am

⁴² Saturday and Sunday, 7 am to 7 pm

⁴³ Saturday and Sunday, 7 pm to 7 am

important to them that costs are affordable. Costs included in this analysis account for any discounts for adults over age 70. The third cost criterion accounts for the value of the service based on the size of the service area. This criterion value is measured in maximum cost per trip divided by the total square mile area of the service area.

3.2.2 Reliability

Another important factor for any transportation service is reliability. This can often be a difficult element to measure. For this thesis, reliability is measured by whether the service relies on volunteers for its operations. This assumes that volunteer-based services may not be consistent in the number of volunteers or the times periods that volunteers are available, resulting in variability in the quality of the service provided. This is a binary criterion, measured with a value of 0 for services that do not rely on volunteers and a value of 1 for those that do rely on volunteers.

3.2.3 Flexibility

In this thesis, flexibility is measured in by two criteria: the length of time required for advanced notice and whether there are any limitations on the types of destinations that may be accessed. Many of the transportation services available in southeastern Wisconsin rely on riders providing advanced notice or requests for a ride. Some services allow same-day notice, while others require up to seven days advanced notice for a ride. This criterion is measured in the number of days of advanced notice required. For services that do not require any advanced notice (e.g. public transit), the value is 0, and a value of 0.5 is used for those services that require same-day notice.

Additionally, some transportation services limit the types of destinations that may be reached. Some of these services only provide transportation to places such as medical or dental appointments, grocery stores, or senior dining facilities. This is another binary criterion that uses a value of 0 to represent no restriction on accessible destinations and 1 where there is a restriction on destinations that may be reached.

3.2.4 Availability

Criteria for hours of availability are broken down by day of the week and time of day. The four criteria that cover availability are: hours of weekday availability, hours of weeknight availability, hours of weekend day availability, and hours of weekend night availability. Weekdays and weeknights include Monday through Friday, and weekend days and weekend nights cover Saturdays and Sundays. For this thesis, daytime hours are defined as the hours between 7 am and 7 pm, and nighttime hours are from 7 pm to 7 am.

3.2.5 Accommodations

Of concern for aging adults (as well as those with disabilities) is the ability to use a transportation service independently. Some older adults use a wheelchair to get around, but not every transportation service is wheelchair accessible. For others, walking may be a challenge, and curb-to-curb transportation services can limit the amount of walking that's required. Some services offer more personal accommodations while getting into and out of a vehicle, such as door-to-door service. While not every older adult requires these services to get around, to many others they may make transportation possible or provide a great benefit.

3.3 Analysis

To evaluate the varied set of transportation services available to older adults, an AHP model is used to perform a multi-criteria evaluation. This model assigns weights to each of the criteria that are used to evaluate the services. Criteria weights are determined by the amount of variation within each criterion's set of values. The weights and the criteria values for each service are then used to calculate a score for each transportation service. Higher scores indicate services that better meet the needs of non-driving older adults than services with lower scores. Finally, the services are ranked based on their scores.

Three separate approaches are used for evaluations. First, all thirty-one transportation services are analyzed using the AHP model. Results from this analysis indicate how well each service generally meets the needs of older adults as compared to each of the other services. The next two approaches consider the abilities of older adult riders. The second approach considers only the eleven services that may be used by disabled older adults; these services provide curb-to-curb service, wheelchair accessibility, and personal accommodations. The third approach looks at non-paratransit transportation services that are available to able-bodied older adults. Evaluations of these services are performed with and without consideration of the three accommodations criteria.

4 Analytical Hierarchy Process (AHP) Model

The Analytical Hierarchy Process (AHP) has been used in many applications and fields to attack multi-criteria decision-making problems. The general AHP has three hierarchical levels: the goal, criteria, and alternatives. For this application, the goal is to determine which transportation services in southeastern Wisconsin best meet the needs of older adults. The criteria are the costs and benefits to older adults for using each of the services, as discussed earlier. Finally, the alternatives in this situation are the thirty-one transportation services available to older adults in the region.

The multi-criteria model used by Yu and Liu and used in this thesis introduces a fuzzy scale level to the AHP structure.⁴⁴ This fuzzy scale level normalizes the criteria, or indicators, to be applied to the alternatives evaluation. Normalizing the criteria accounts for the fact that each criterion may use a different unit of measurement and allows for a synthesized score to be calculated for each alternative.

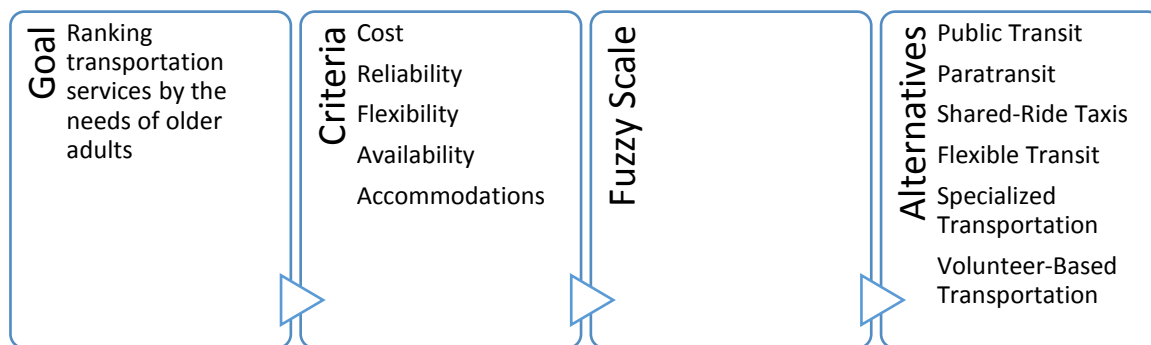


Figure 4: Hierarchical AHP Structure

⁴⁴ (Yu and Liu 2011)

The following is the model formulation as set up by Yu and Liu in *Prioritizing highway safety improvement projects: A multi-criteria model and case study with Safety Analyst*.⁴⁵ The same model is used for evaluation of transportation services in this thesis.

4.1 Fuzzy Scaling

Many of the criteria used in this multi-criteria evaluation have different units of measurement. The scales of these criteria values must be normalized by fuzzy scaling before they can be used for comparison to one another. Two equations are used perform the fuzzy scaling. The first is for “cost” criteria. For evaluation of transportation services, these include (1) the minimum cost per trip, (2) the maximum cost per trip, (3) the maximum cost per trip divided by the service area, (4) reliance on volunteers, (5) the length of time required for advanced notice, and (6) limitations on accessible destinations.

For “cost” criteria, where a lower value is desired:

$$\mu_{ik} = [x_{i(\max)} + x_{i(\min)} - x_{ik}] / [x_{i(\max)} + x_{i(\min)}]$$

The second equation is applied to “benefit” criteria. These include (1) weekday hours of availability, (2) weeknight availability, (3) weekend day availability, (4) weekend night availability, (5) availability of curb-to-curb service, (6) wheelchair accessibility, and (7) availability of personal accommodations.

For “benefit” criteria, where a higher value is desired:

$$\mu_{ik} = x_{ik} / [x_{i(\max)} + x_{i(\min)}]$$

⁴⁵ (Yu and Liu 2011)

The parameters for these equations are defined as:

u_{ik} :	Fuzzy membership value corresponding to indicator x_{ik}
x_{ik} :	Indicator representing alternative k being evaluated by criterion i
$x_{i(min)}$:	Minimal crisp value for criterion i
$x_{i(max)}$:	Maximum crisp value for criterion i

4.2 Pair-wise Comparisons

Following the fuzzy scaling of each criterion, the standard deviations of the normalized criteria indicators, s_i , are calculated using the following equation:

$$s_i = \sqrt{\sum_{k=1}^m (u_{ik} - \bar{u}_i)^2 / (m - 1)}$$

where m is the number of alternatives and \bar{u}_i is the average fuzzy membership value for criterion i .

The standard deviations of normalized criteria indicators are then applied to a pair-wise comparison matrix that reflects the relative importance of criterion i over criterion j . This matrix

$A = (a_{ij})_{n \times n}$ uses the following equation:

$$a_{ij} = \begin{cases} \frac{s_i - s_j}{s_{max} - s_{min}} (a_m - 1) + 1, & s_i \geq s_j \\ 1 / \left[\frac{s_j - s_i}{s_{max} - s_{min}} (a_m - 1) + 1 \right], & s_i < s_j \end{cases}$$

where $a_m = \min\{9, \text{int}[s_{\max}/s_{\min} + 0.5]\}$ is a comparison scale for all criteria. This was a recommendation by Jin et al.⁴⁶

Parameters for this equation are defined as:

a_{ij} : Relative importance of criterion i over criterion j

s_{\min} : $\min\{s_i | i = 1, \dots, n\}$

s_{\max} : $\max\{s_i | i = 1, \dots, n\}$

n : Number of criteria

4.3 Weights Determination

Yu and Liu proposed a non-linear optimization model to estimate the weights $\{w_i | i = 1, \dots, n\}$ of each criterion i . The program LINGO is used for this non-linear programming model as represented below:

$$\min C.I.C.(n) = \sum_{i=1}^n \sum_{j=1}^n |y_{ij} - a_{ij}|/n^2 + \sum_{k=1}^m \sum_{l=1}^m |y_{ij}w_j - w_i|/n^2$$

such that

$$y_{ii} = 1 \quad i = 1, \dots, n$$

$$1/y_{ji} = y_{ij} \in \{a_{ij} - da_{ij}, a_{ij} + da_{ij}\} \quad i = 1, \dots, n; \quad j = i + 1, \dots, n$$

$$w_i > 0 \quad i = 1, \dots, n$$

⁴⁶ (Jin, Wei and Ding 2004)

Parameters for this model are defined as:

$C.I.C.(n)$: Consistency index coefficient

$Y = (y_{ij})_{n \times n}$: Consistency judgement matrix

w_i : Weight for criterion i

$d = 0.04$: Systematic variation parameter

Solving the optimization model in LINGO results in information for the pair-wise comparison matrix $A = (a_{ij})_{n \times n}$, the consistency judgement matrix $Y = (y_{ij})_{n \times n}$, and the weights for each criterion w_i .

The weights derived for each criterion are a reflection on that criterion's variability. In other words, criteria with greater variability are assigned greater weights. This is not to say that criteria with lower weights are less important than those with greater weights. It is only to indicate the relative influence that each criterion has on the overall ranking goal. A criterion with little variability is less able to differentiate between alternatives than a criterion with greater variability. For example, when looking at the four availability criteria, the "weekday daytime" availability has the least variability. This is because all services are available during some weekday daytime hours. Weekday daytime availability is, of course, a very important element of transportation. That all thirty-one services offer weekday daytime availability in some capacity emphasizes its importance. However, the relative uniformity of this criterion amongst the transportation services also makes it less useful in distinguishing the services from one another.

4.4 Synthesis

The final step in applying the AHP model is to determine the scores of each of the alternatives or transportation services. Scores S_k for each alternative k are calculated by cumulating the weights w_i for each criterion i multiplied by the fuzzy membership values u_{ik} as shown in the equation below:

$$S_k = \sum_{i=1}^n u_{ik} \cdot w_i$$

The scores S_k reflect the overall preference for transportation services with respect to the needs of older adults. These scores can then be used to rank the transportation services.

5 Results

As discussed earlier, the AHP model is applied to the transportation services in three main approaches. First, the model is applied all transportation services available to older adults to determine scores and ranks for all services with respect to one another. Then the model is applied only to transportation services available to older adults with disabilities. Finally, the model is applied to transportation services available to able-bodied older adults.

5.1 All Transportation Services for Older Adults

In evaluating all transportation services, all thirteen criteria are used. The inputs to the model are shown in Appendix I. Outputs are documented in Appendix J. The calculated weights for each criterion, shown in the model outputs, indicate which criteria have a greater influence on the final scores for each transportation service. As the model formulations indicate, the sum of all thirteen criteria weights equals one. The resulting weights for this evaluation range from 0.025 to 0.146. Criteria with higher weights have greater influence on the resulting score and rank of each alternative. In this evaluation, criteria with the greatest assigned weights in order are: reliance on volunteers, wheelchair accommodations, personal accommodations, weekend daytime hours of availability, and limitations on destination types. The remaining criteria had less impact on the final scores.

The resulting scores and ranks for each of the thirty-one transportation services is shown in Table 5 below. The types of services that rank the best are paratransit, shared-ride taxis, and public transit. Higher ranking services tend to not rely on volunteers, provide wheelchair accommodations, and have greater weekend daytime availability.

Table 5: Ranking of All Transportation Services for Older Adults

SERVICE	COUNTY	PROVIDER	TYPE OF SERVICE	SCORE	RANK
MCTS-PT	Milwaukee	County	Public Transit Paratransit	0.90	1
WC-SRT	Washington	County	Shared-ride Taxi	0.86	2
OC-SRT	Ozaukee	County	Shared-ride Taxi	0.82	3
MCTS	Milwaukee	County	Public Transit	0.76	4
GSVS	Washington	Municipality	Volunteer-Based Transportation	0.76	5
IF-Wash	Washington	Non-profit Organization	Volunteer-Based Transportation	0.76	6
BUS-PT	Racine	Municipality	Public Transit Paratransit	0.76	7
HT	Washington	Municipality	Shared-ride Taxi	0.75	8
WKCTS-D2D	Kenosha	County	Specialized Transportation	0.75	9
KAT-PT	Kenosha	Municipality	Public Transit Paratransit	0.74	10
RLP-PT	Waukesha	County	Specialized Transportation	0.69	11
WMT	Waukesha	Municipality	Public Transit	0.69	12
BUS	Racine	Municipality	Public Transit	0.68	13
WBT	Washington	Municipality	Shared-ride Taxi	0.65	14
KAT	Kenosha	Municipality	Public Transit	0.64	15
IF-Mil	Milwaukee	Non-profit Organization	Volunteer-Based Transportation	0.61	16
IF-Oz	Ozaukee	Non-profit Organization	Volunteer-Based Transportation	0.61	16
WKCTS	Kenosha	County	Flexible Transit	0.60	18
MCDA	Milwaukee	County	Specialized Transportation	0.60	19
VIP	Walworth	County	Specialized Transportation	0.57	20
SOTG	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.52	21
CSCVS	Ozaukee	Municipality	Volunteer-Based Transportation	0.47	22
OFS	Ozaukee	Non-profit Organization	Volunteer-Based Transportation	0.47	23
MST	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.42	24
SPARC	Racine	County	Flexible Transit	0.42	25
EST	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.39	26
MR	Racine	Non-profit Organization	Volunteer-Based Transportation	0.38	27
OSS	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.37	28
KAFASI	Kenosha	Non-profit Organization	Volunteer-Based Transportation	0.37	29
NBST	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.37	30
LCCC	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.35	31

5.2 Transportation Services for Disabled Older Adults

While the previous analysis provides an overall ranking of transportation services for older adults, there are some older adults with disabilities that cannot use most these services.

Services without wheelchair accommodations, services that require walking to access the

service, or services that do not provide personal accommodations to help users from the door to the vehicle are inaccessible to many disabled adults. Therefore, the model is run a second time to evaluate only transportation services that provide all three accommodations.

Accommodations criteria are not included in this evaluation as it would not provide any differentiation between the alternatives. Like the evaluation of all transportation services, reliance on volunteers, weekend daytime availability, and limitations on destinations were assigned the highest weights. Due to the exclusion of the accommodations criteria in this evaluation, the minimum cost per trip has an increased impact on the results. Inputs and outputs to this model are documented in Appendix K and Appendix L, respectively. The scores and ranks for each accommodating transportation service are shown in Table 6 below.

Table 6: Ranking of Accessible Transportation for Older Adults with Disabilities

SERVICE	COUNTY	PROVIDER	TYPE OF SERVICE	SCORE	RANK
MCTS-PT	Milwaukee	County	Public Transit Paratransit	0.83	1
WC-SRT	Washington	County	County Shared-ride Taxi	0.77	2
OC-SRT	Ozaukee	County	County Shared-ride Taxi	0.71	3
IF-Wash	Washington	Non-profit Organization	Volunteer-Based Transportation	0.67	4
BUS-PT	Racine	Municipality	Public Transit Paratransit	0.62	5
WKCTS-D2D	Kenosha	County	Specialized Transportation	0.60	6
KAT-PT	Kenosha	Municipality	Public Transit Paratransit	0.58	7
RLP	Waukesha	County	Specialized Transportation	0.49	8
GSVS	Washington	Municipality	Volunteer-Based Transportation	0.44	9
VIP	Walworth	Non-profit Organization	Specialized Transportation	0.29	10
SOTG	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.29	11

Some locations provide multiple transportation services to disabled older adults. The map in Figure 5 shows the cumulative scores of transportation services for older adults with disabilities by location. Washington County, and particularly the City of Germantown, offer multiple services and have the highest cumulative scores. On the other hand, there is a noticeable lack of accessible transportation services for older adults with disabilities in most of Racine County.

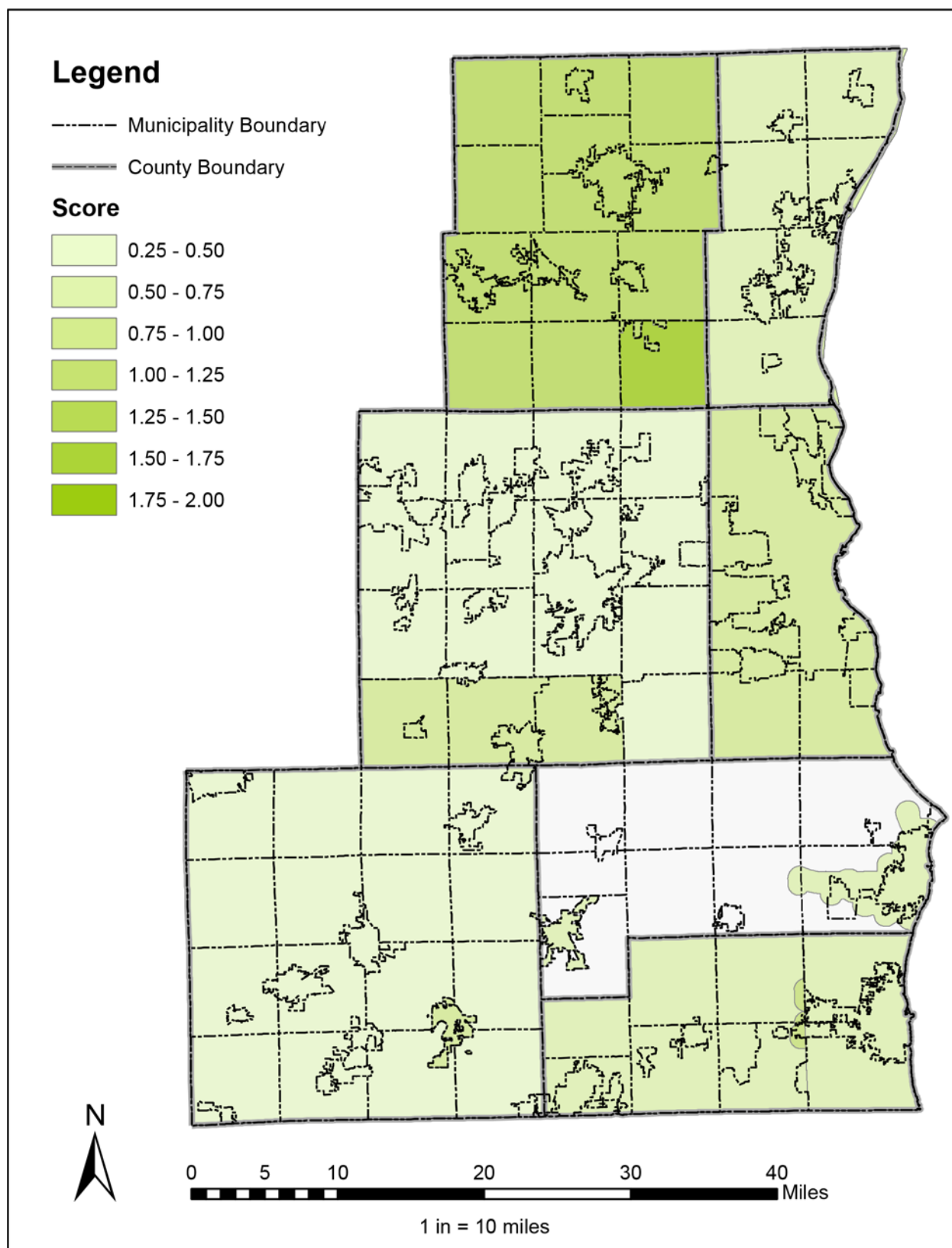


Figure 5: Cumulative Scores of Transportation Services for Older Adults with Disabilities

5.3 Transportation Services for Able-Bodied Older Adults

Older adults with disabilities cannot use certain transportation services if they do not provide the appropriate accommodations. Conversely, able-bodied older adults are ineligible for paratransit services based on the ADA Paratransit eligibility requirements. Two evaluations are performed that consider only non-paratransit transportation services available to able-bodied older adults. The first applies all thirteen criteria. The second excludes the three accommodations criteria.

5.3.1 With Accommodations Criteria

Applying the model to non-paratransit transportation services for able-bodied older adults results in similar weights applied to the thirteen criteria as in the evaluation of all services. Again, reliance on volunteers, wheelchair accommodations, personal accommodations, weekend daytime availability, and limits on available destinations were weighted most heavily. Inputs to and outputs from this model are shown in Appendix M and Appendix N, respectively. Table 7 summarizes the resulting scores and ranks of each service.

Table 7: Ranking of Transportation for Able-bodied Older Adults (with Accommodations Criteria)

SERVICE	COUNTY	PROVIDER	TYPE OF SERVICE	SCORE	RANK
WC-SRT	Washington	County	County Shared-ride Taxi	0.86	1
OC-SRT	Ozaukee	County	County Shared-ride Taxi	0.82	2
MCTS	Milwaukee	County	Public Transit	0.76	3
WKCTS-D2D	Kenosha	County	Specialized Transportation	0.75	4
IF-Wash	Washington	Non-profit Organization	Volunteer-Based Transportation	0.75	5
HT	Washington	Municipality	Municipal Shared-ride Taxi	0.75	6
RLP	Waukesha	County	Specialized Transportation	0.70	7
WMT	Waukesha	Municipality	Public Transit	0.68	8
BUS	Racine	Municipality	Public Transit	0.68	9
WBT	Washington	Municipality	Municipal Shared-ride Taxi	0.66	10
KAT	Kenosha	Municipality	Public Transit	0.63	11
GSVS	Washington	Municipality	Volunteer-Based Transportation	0.62	12
WKCTS	Kenosha	County	Flexible Transit	0.61	13
IF-Mil	Milwaukee	Non-profit Organization	Volunteer-Based Transportation	0.60	14
IF-Oz	Ozaukee	Non-profit Organization	Volunteer-Based Transportation	0.60	14
MCDA	Milwaukee	County	Specialized Transportation	0.60	16
VIP	Walworth	Non-profit Organization	Specialized Transportation	0.57	17
SOTG	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.53	18
CSCVS	Ozaukee	Municipality	Volunteer-Based Transportation	0.47	19
OFS	Ozaukee	Non-profit Organization	Volunteer-Based Transportation	0.47	20
SPARC	Racine	County	Flexible Transit	0.43	21
MST	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.43	22
EST	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.40	23
OSS	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.38	24
NBST	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.38	25
KAFASI	Kenosha	Non-profit Organization	Volunteer-Based Transportation	0.38	26
MR	Racine	Non-profit Organization	Volunteer-Based Transportation	0.37	27
LCCC	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.36	28

5.3.2 Without Accommodations Criteria

Many able-bodied older adults do not benefit from or do not require special accommodations, such as curb-to-curb service, wheelchair accessibility, or personal accommodations. By analyzing the non-paratransit services without the three accommodations criteria, the resulting scores and ranks better accounts for the needs of able-bodied older adults. After removing the

accommodations criteria and rerunning the model, all public transit, one flexible transit service, the two municipal-based shared-ride taxis, and many of the volunteer-based services moved up in rank, with two public transit services making the top of the list. These services offer fewer accommodations, but they have other benefits that may be more important to able-bodied older adults. For this evaluation, reliance on volunteers has even more weight than in any other evaluation performed, keeping volunteer-based transportation services towards the bottom of the list. Weekend daytime availability and limitations on destinations again follow as the next most influential criteria.

Figure 6 is a map showing the cumulative scores of transportation services for able-bodied older adults by location. The scores shown in this map are from the analysis of non-paratransit services without considering the three accommodations criteria. It appears that Ozaukee County and Milwaukee County provide the best coverage of transportation services for able-bodied older adults. The three southern counties – Walworth, Racine, and Kenosha – have large areas with lower cumulative scores, indicating fewer and lower-scoring services are found here.

Table 8: Ranking of Transportation for Able-bodied Older Adults (without Accommodations criteria)

SERVICE	COUNTY	PROVIDER	TYPE OF SERVICE	SCORE	RANK
MCTS	Milwaukee	County	Public Transit	0.91	1
WMT	Waukesha	Municipality	Public Transit	0.80	2
HT	Washington	Municipality	Municipal Shared-ride Taxi	0.79	3
BUS	Racine	Municipality	Public Transit	0.79	4
WC-SRT	Washington	County	County Shared-ride Taxi	0.79	5
OC-SRT	Ozaukee	County	County Shared-ride Taxi	0.73	6
KAT	Kenosha	Municipality	Public Transit	0.73	7
WBT	Washington	Municipality	Municipal Shared-ride Taxi	0.66	8
WKCTS-D2D	Kenosha	County	Specialized Transportation	0.63	9
IF-Wash	Washington	Non-profit Organization	Volunteer-Based Transportation	0.63	10
IF-Mil	Milwaukee	Non-profit Organization	Volunteer-Based Transportation	0.63	11
IF-Oz	Ozaukee	Non-profit Organization	Volunteer-Based Transportation	0.63	11
WKCTS	Kenosha	County	Flexible Transit	0.59	13
RLP	Waukesha	County	Specialized Transportation	0.54	14
SPARC	Racine	County	Flexible Transit	0.53	15
CSCVS	Ozaukee	Municipality	Volunteer-Based Transportation	0.44	16
GSVS	Washington	Municipality	Volunteer-Based Transportation	0.44	17
OFS	Ozaukee	Non-profit Organization	Volunteer-Based Transportation	0.43	18
MCDA	Milwaukee	County	Specialized Transportation	0.40	19
MST	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.37	20
VIP	Walworth	Non-profit Organization	Specialized Transportation	0.35	21
EST	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.33	22
SOTG	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.31	23
OSS	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.31	24
NBST	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.30	25
KAFASI	Kenosha	Non-profit Organization	Volunteer-Based Transportation	0.30	26
MR	Racine	Non-profit Organization	Volunteer-Based Transportation	0.29	27
LCCC	Waukesha	Non-profit Organization	Volunteer-Based Transportation	0.27	28

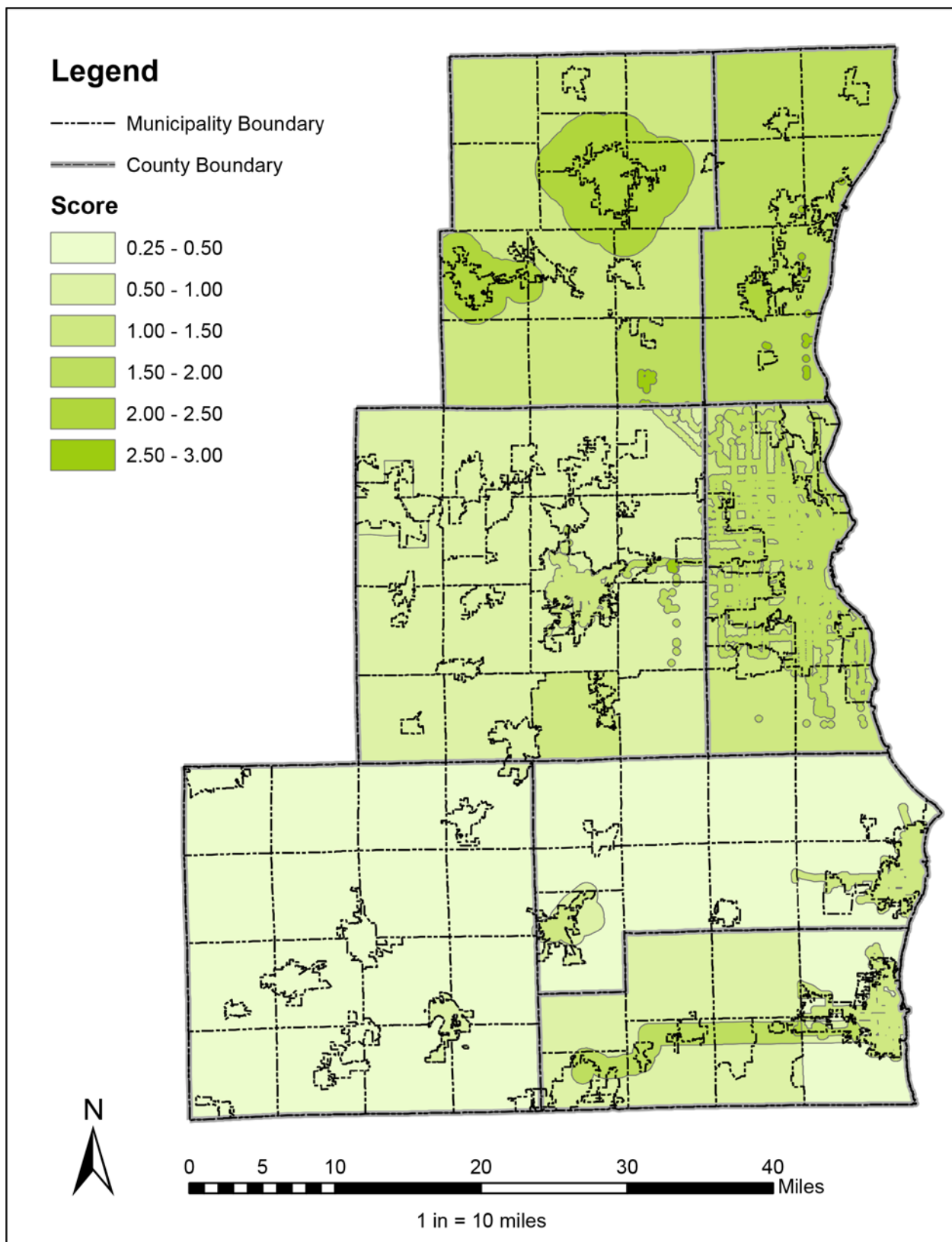


Figure 6: Cumulative Scores of Transportation Services for Able-Bodied Older Adults (without Accommodations Criteria)

6 Summary and Recommendations

There are many transportation services available to non-driving older adults in the seven counties of southeastern Wisconsin. Because non-driving older adults are a group that rely on public transportation services to get around, it's important that these services meet the needs of older adult riders.

By applying the AHP model to all thirty-one transportation services in the region, the resulting scores and ranks identify how well each service is meeting the needs of older adults with respect to one another. Using the same process to analyze only the transportation services available to disabled older adults, followed by an evaluation of transportation services available to able-bodied adults (all except paratransit,) rankings of services that are more specific to the different users are determined. By mapping the cumulative scores of these services, it becomes apparent which areas provide the most service and which areas are lacking in sufficient transportation service for older adults, both disabled and able-bodied. This information can be used to determine where to add more transportation services or make improvements to existing services.

A way to improve the model used in this thesis would be to improve upon the measurement of reliability. Using a binary criterion representing whether a transportation service relies on volunteers is a simple substitute for reliability, but it doesn't tell the whole story. Other factors for which data are more difficult to collect, such as the percent of on-time vehicles or wait times for on-demand services, would provide a more accurate representation of reliability.

To expand upon this thesis, future research should consider the relationship between the services provided throughout the region and how funding is provided for their operations. This would help determine how funds for transportation services are currently being used and how they might be used to better serve older adults. More research into the use of these services by older adults (i.e. older adult ridership) compared to the populations they serve and the number of trips older adults take in each area would also provide a better sense of their success with this target population.

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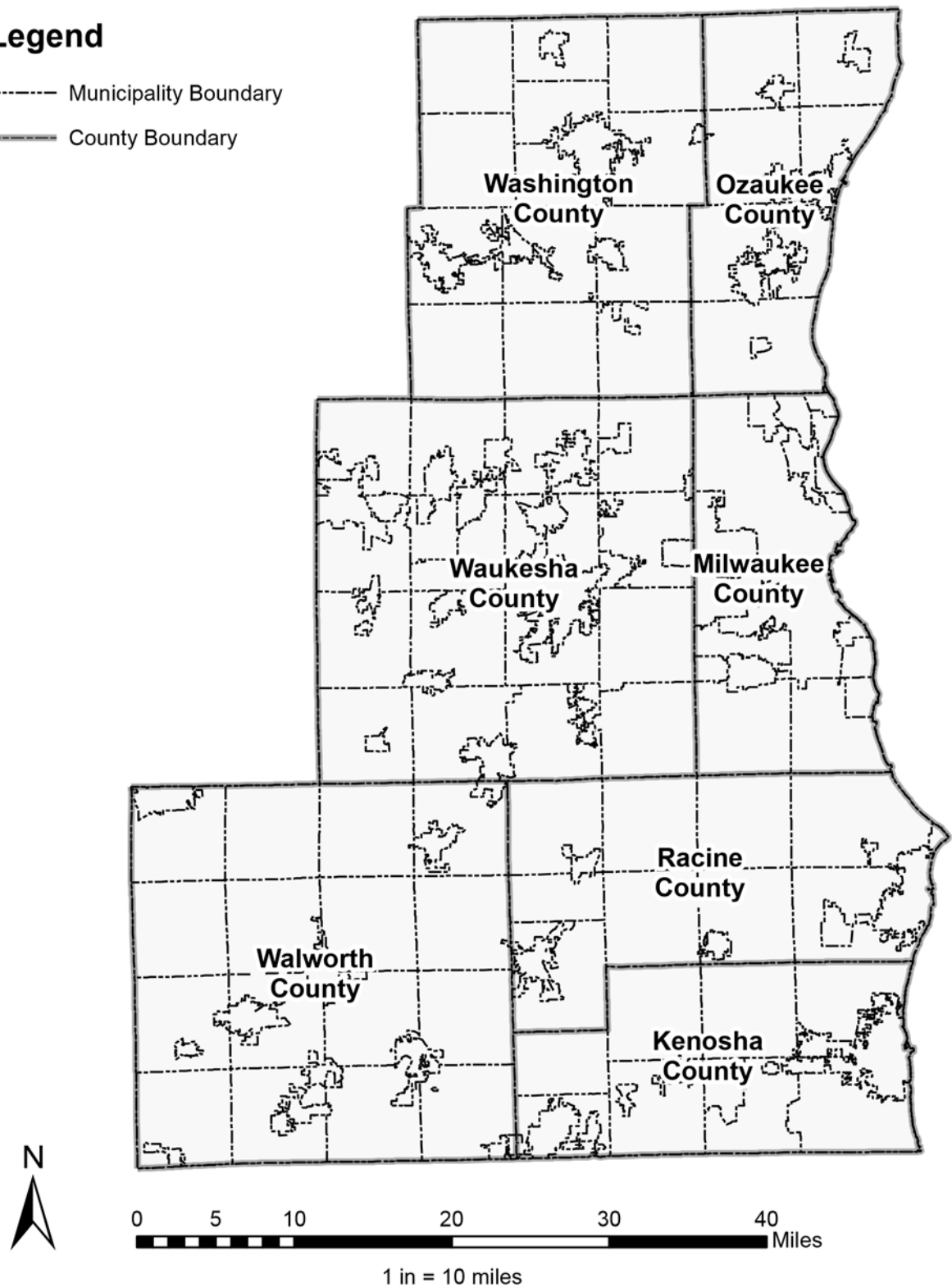
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Appendix A: Seven Counties of Southeastern Wisconsin

Legend

----- Municipality Boundary

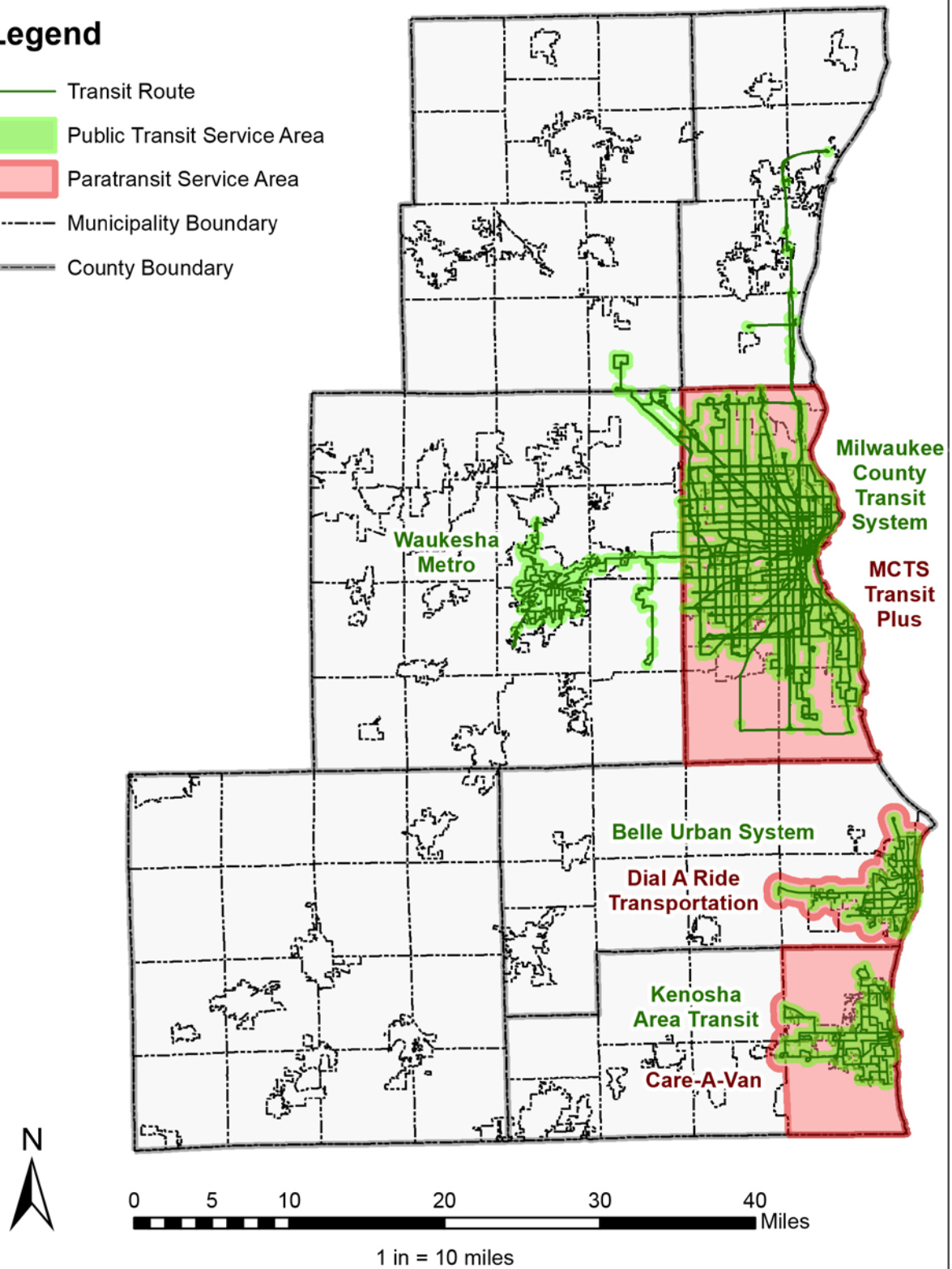
==== County Boundary



Appendix B: Public Transit and Paratransit Services




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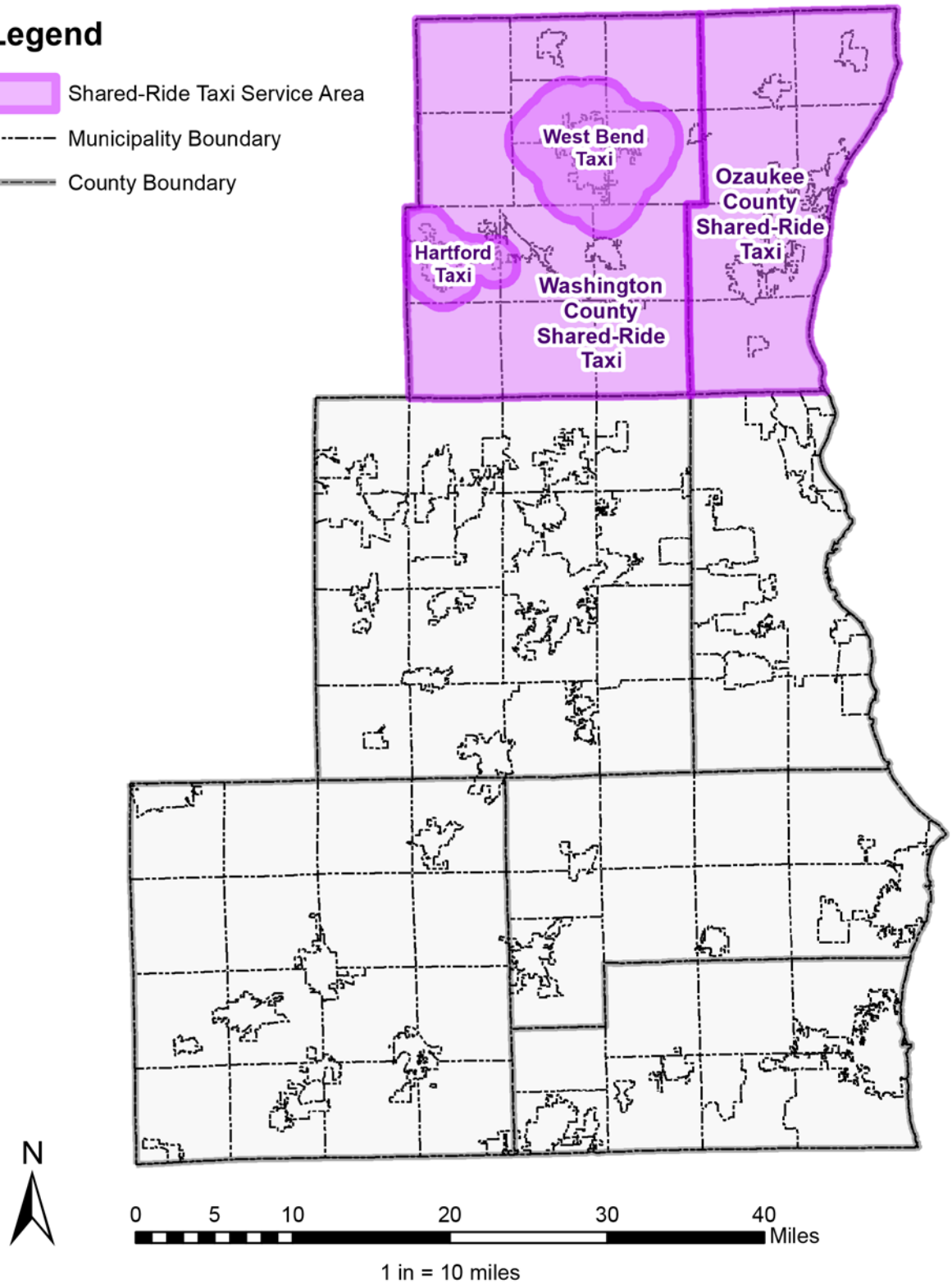
- Transit Route
- Public Transit Service Area
- Paratransit Service Area
- - - Municipality Boundary
- County Boundary



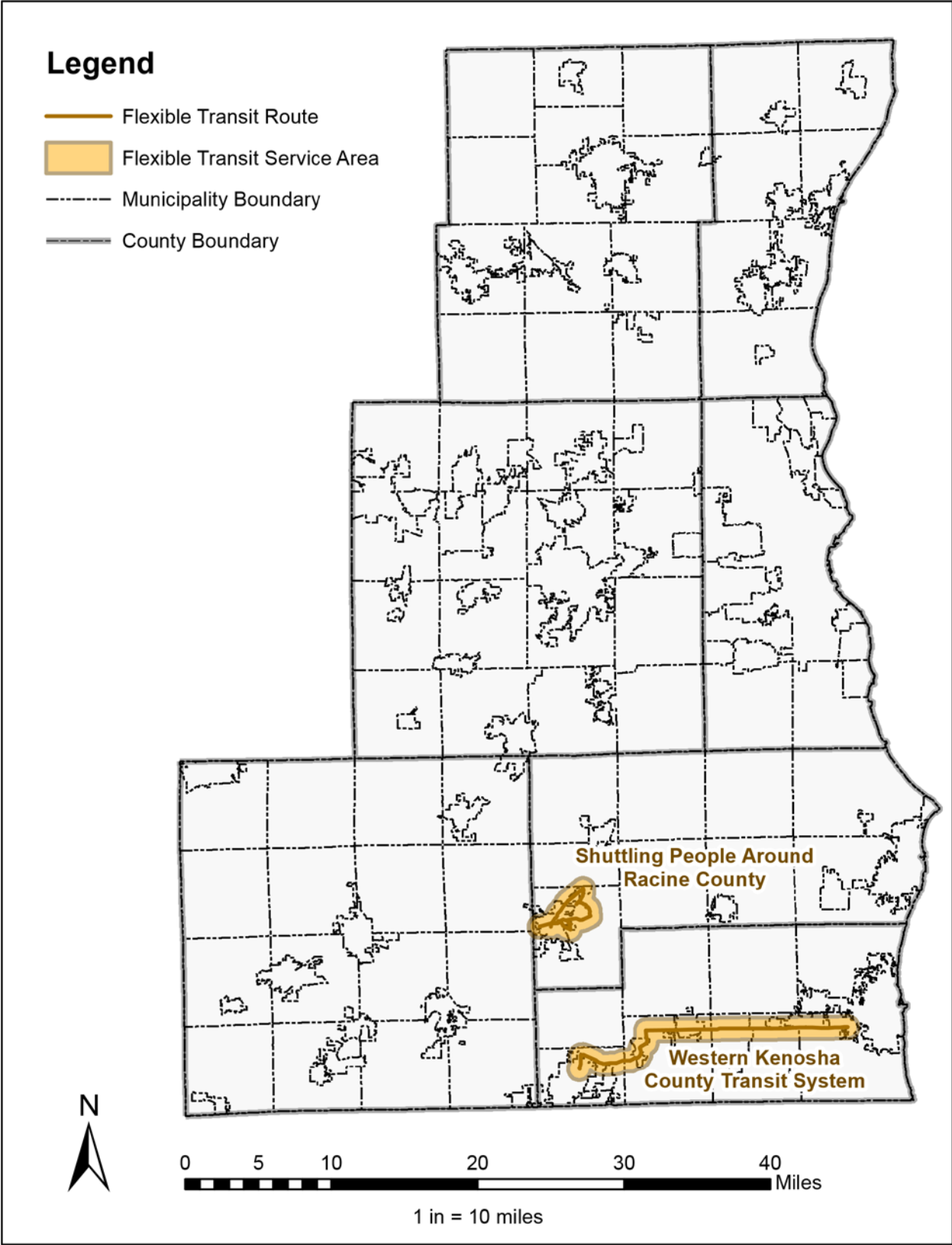
Appendix C: Shared-Ride Taxi Services

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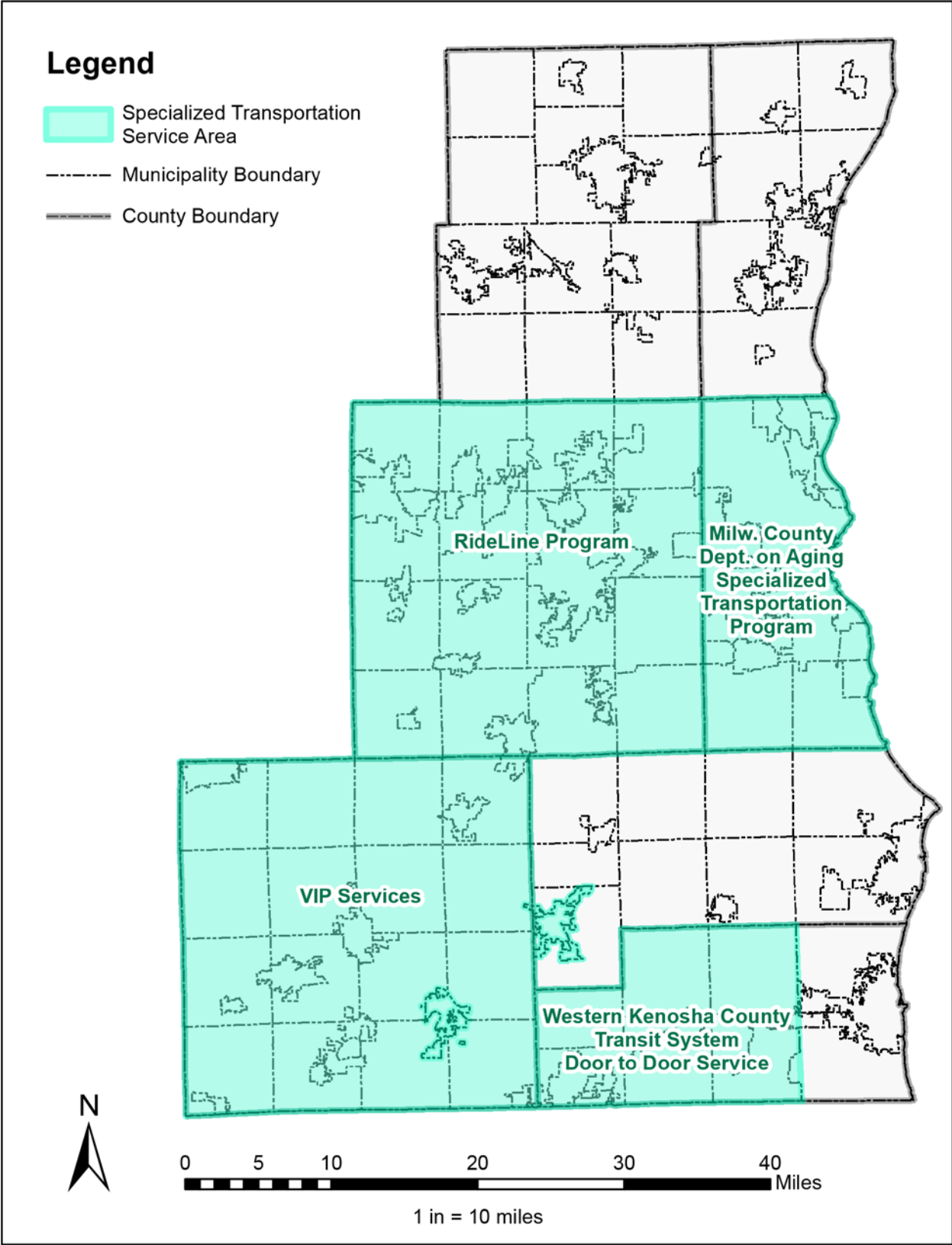
-  Shared-Ride Taxi Service Area
-  Municipality Boundary
-  County Boundary



Appendix D: Flexible Transit Services



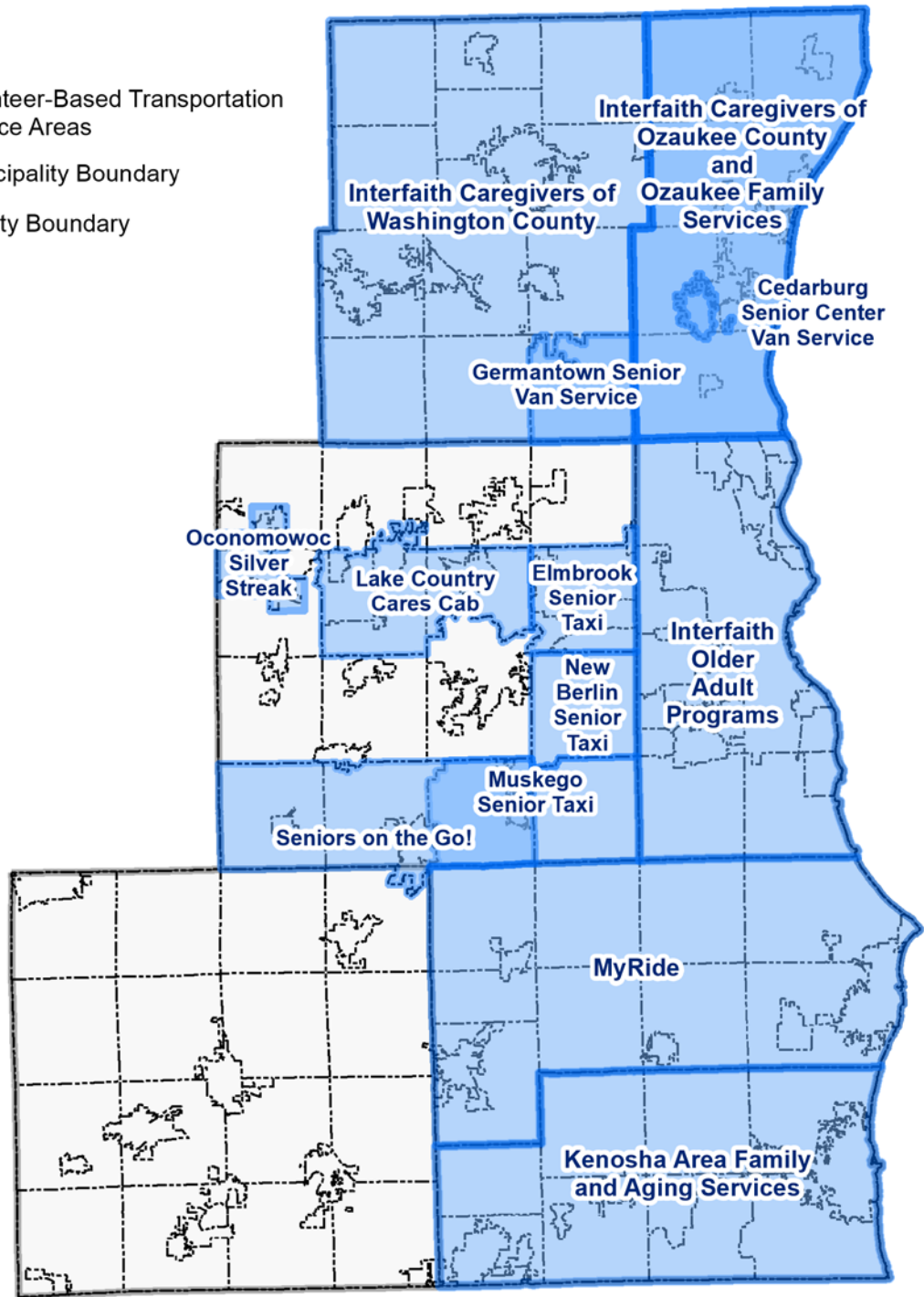
Appendix E: Specialized Transportation Services



Appendix F: Volunteer-Based Transportation Services

Legend

- Volunteer-Based Transportation Service Areas
- Municipality Boundary
- County Boundary











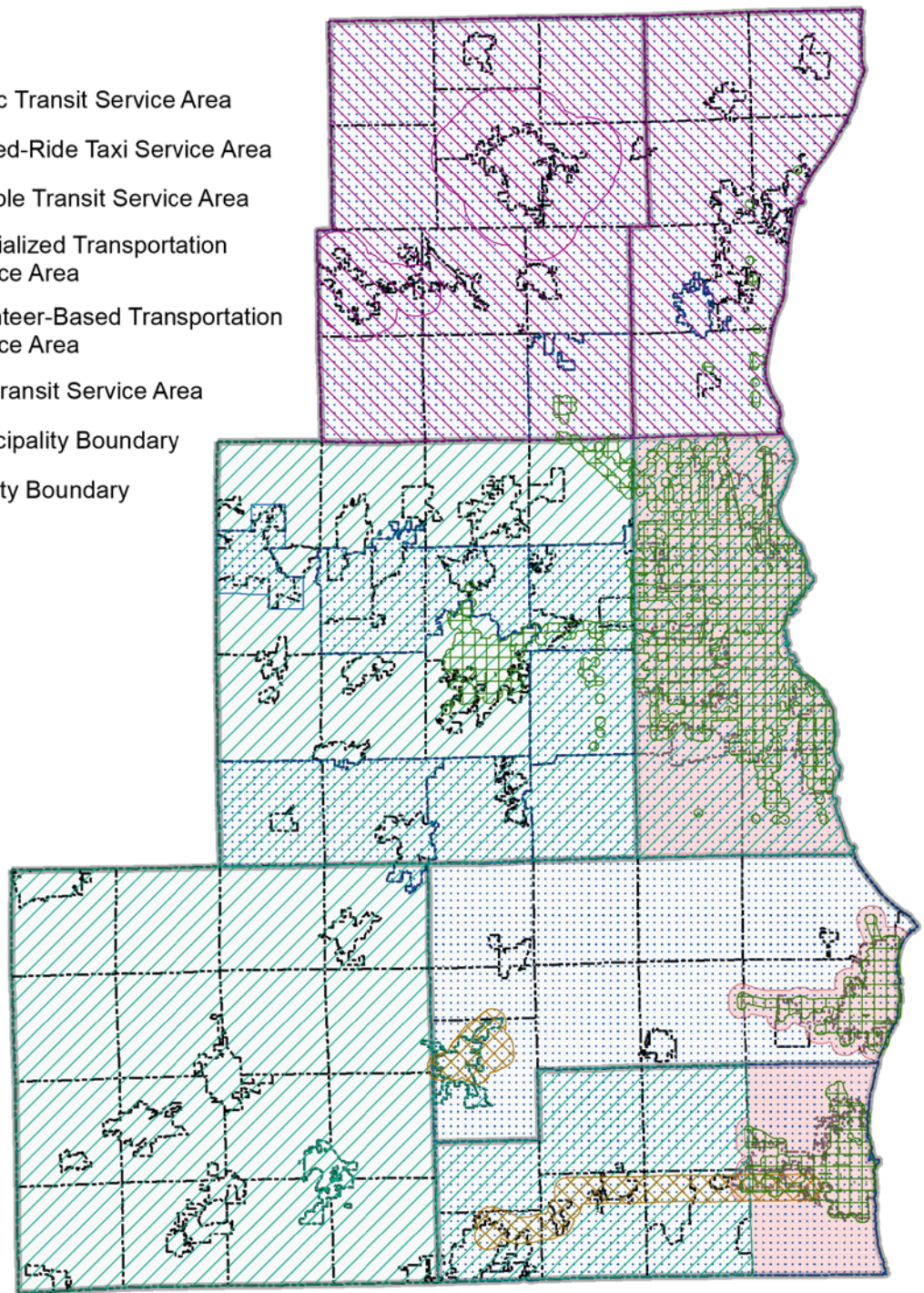
0 5 10 20 30 40 Miles

1 in = 10 miles

Appendix G: All Transportation Services

Legend

-  Public Transit Service Area
-  Shared-Ride Taxi Service Area
-  Flexible Transit Service Area
-  Specialized Transportation Service Area
-  Volunteer-Based Transportation Service Area
-  Paratransit Service Area
-  Municipality Boundary
-  County Boundary



0 5 10 20 30 40 Miles

1 in = 10 miles

Appendix H: Transportation Services Criteria Values

Service Information			Cost			Reliability	Flexibility		Weekday Availability			Weekend Availability			Accommodations		
County	Short Name	Provider	Type of Transportation	Service	Minimum Cost per Trip	Maximum Cost per Trip	Maximum Cost to Ride / Service Area	Service Relies on Volunteers	Days of Advanced Notice Required	Limit on Destination Types	Average Weekday Daytime Hours (7am-7pm)	Average Weekday Nighttime Hours (7pm-7am)	Average Weekend Daytime Hours (7am-7pm)	Average Weekend Nighttime Hours (7pm-7am)	Curb-to-Curb Accommodations	Wheelchair Accessible	Personal Accommodations
Kenosha	KAFASI	Non-Profit	Volunteer-Based	Service	\$0.50	\$12.00	\$0.04	Yes	3	No	8.5	0.0	0.0	0.0	Yes	No	Yes
	KAT	Municipality	Public Transit		\$0.85	\$0.85	\$0.07	No	0	No	12.0	1.5	7.0	0.0	No	Yes	No
	KAT-PT	Municipality	Paratransit		\$3.50	\$3.50	\$0.27	No	1	No	12.0	1.5	7.0	0.0	Yes	Yes	Yes
	WKCTS	County	Flexible Transit		\$1.00	\$3.00	\$0.27	No	0	No	11.5	1.0	0.0	0.0	Yes	Yes	No
	WKCTS-D2D	County	Specialized		\$1.00	\$3.00	\$0.02	No	1	No	11.5	1.0	0.0	0.0	Yes	Yes	Yes
Milwaukee	IF-Mil	Non-Profit	Volunteer-Based		\$0.00	\$0.00	\$0.00	Yes	1	Yes	12.0	12.0	12.0	12.0	Yes	No	Yes
	MCD	County	Specialized		\$3.00	\$3.00	\$0.01	No	2	Yes	9.0	0.0	0.0	0.0	Yes	Yes	Yes
	MCTS	County	Public Transit		\$1.80	\$1.80	\$0.01	No	0	No	12.0	10.0	12.0	8.5	No	Yes	No
	MCTS-PT	County	Paratransit		\$3.50	\$3.50	\$0.01	No	0.5	No	12.0	8.5	12.0	8.5	Yes	Yes	Yes
Ozaukee	CSCVS	Municipality	Volunteer-Based		\$0.00	\$0.00	\$0.00	Yes	1	No	8.0	0.0	0.0	0.0	Yes	No	Yes
	IF-Oz	Non-Profit	Volunteer-Based		\$0.00	\$0.00	\$0.00	Yes	1	Yes	12.0	12.0	12.0	12.0	Yes	No	Yes
	OC-SRT	County	Shared-Ride Taxi		\$2.50	\$5.50	\$0.02	No	0.5	No	12.0	3.0	9.8	0.0	Yes	Yes	Yes
	OFS	Non-Profit	Volunteer-Based		\$0.00	\$0.00	\$0.00	Yes	1	No	6.0	0.0	0.0	0.0	Yes	No	Yes
Racine	BUS	Municipality	Public Transit		\$1.00	\$1.00	\$0.10	No	0	No	12.0	5.0	10.3	0.8	No	Yes	No
	BUS-PT	Municipality	Paratransit		\$4.00	\$4.00	\$0.40	No	0.5	No	12.0	5.0	9.8	0.8	Yes	Yes	Yes
	SPARC	County	Flexible Transit		\$2.00	\$2.00	\$0.40	No	0	No	8.0	0.0	0.0	0.0	Yes	No	No
	MR	Non-Profit	Volunteer-Based		\$0.00	\$0.00	\$0.00	Yes	2	Yes	8.0	0.0	0.0	0.0	Yes	No	Yes
Walworth	VIP	Non-Profit	Specialized		\$4.00	\$25.00	\$0.05	No	2	Yes	9.5	0.0	0.0	0.0	Yes	Yes	Yes
	GSVS	Municipality	Volunteer-Based		\$0.00	\$0.00	\$0.00	Yes	0.5	No	6.0	0.0	0.0	0.0	Yes	Yes	Yes
Washington	HT	Municipality	Shared-Ride Taxi		\$0.00	\$0.00	\$0.00	No	0.5	No	12.0	3.0	9.0	0.5	Yes	No	No
	IF-Wash	Non-Profit	Volunteer-Based		\$0.00	\$0.00	\$0.00	Yes	0.5	Yes	12.0	12.0	12.0	12.0	Yes	Yes	Yes
	WBT	Municipality	Shared-Ride Taxi		\$3.00	\$4.00	\$0.27	No	0.5	No	12.0	4.0	6.0	2.0	Yes	Yes	No
	WC-SRT	County	Shared-Ride Taxi		\$2.50	\$5.00	\$0.01	No	0.5	No	12.0	5.6	10.0	4.0	Yes	Yes	Yes
Waukesha	EST	Non-Profit	Volunteer-Based		\$5.00	\$11.50	\$0.31	Yes	1	No	8.6	0.3	6.5	0.0	Yes	No	Yes
	LCCC	Non-Profit	Volunteer-Based		\$4.50	\$13.00	\$0.20	Yes	2	No	7.5	0.0	0.0	0.0	Yes	No	Yes
	MST	Non-Profit	Volunteer-Based		\$1.00	\$9.00	\$0.13	Yes	1	No	8.0	0.0	0.0	0.0	Yes	No	Yes
	NBST	Non-Profit	Volunteer-Based		\$3.50	\$9.00	\$0.24	Yes	1	No	8.0	0.0	0.0	0.0	Yes	No	Yes
Waukesha	OSS	Non-Profit	Volunteer-Based		\$3.50	\$5.00	\$0.26	Yes	1	No	8.5	0.0	0.0	0.0	Yes	No	Yes
	RLP	County	Specialized		\$3.60	\$17.65	\$0.03	No	0.5	No	11.0	1.0	0.0	0.0	Yes	Yes	Yes
	SOTG	Non-Profit	Volunteer-Based		\$4.50	\$10.00	\$0.09	Yes	1	No	9.0	0.0	0.0	0.0	Yes	Yes	Yes
	WMT	Municipality	Public Transit		\$1.00	\$1.00	\$0.04	No	0	No	12.0	3.0	10.5	1.8	No	Yes	No

Appendix I: Model Inputs – All Transportation Services

	Cost / Value			Reliability	Flexibility		Availability				Accommodations		
	Minimum Cost per Trip	Maximum Cost per Trip	Relative Trip Cost per Square Mile of Service Area	Service Relies on Volunteers	Days of Advanced Notice Required	Limitation on Types of Destinations	Average M-F Daytime Hours (7am-7pm)	Average M-F Nighttime Hours (7pm-7am)	Average Sa-Su Daytime Hours (7am-7pm)	Average Sa-Su Nighttime Hours (7pm-7am)	Door to Door Service	Wheelchair Accom.	Personal Accom.
	x_{ik}												
KAFASI	4.50	12.00	0.04	1.00	3.00	0	8.50	0.00	0.00	0.00	1	0	1
KAT	0.85	0.85	0.07	0.00	0.00	0	12.00	1.50	7.00	0.00	0	1	0
KAT-PT	3.50	3.50	0.27	0.00	1.00	0	12.00	1.50	7.00	0.00	1	1	1
WKCTS	1.00	3.00	0.27	0.00	0.00	0	11.50	1.00	0.00	0.00	1	1	0
WKCTS-D2D	1.00	3.00	0.02	0.00	1.00	0	11.50	1.00	0.00	0.00	1	1	1
IF-Mil	0.00	0.00	0.00	1.00	1.00	1	12.00	12.00	12.00	12.00	1	0	1
MCDA	3.00	3.00	0.01	0.00	7.00	1	9.00	0.00	0.00	0.00	1	1	1
MCTS	1.60	1.60	0.01	0.00	0.00	0	12.00	10.00	12.00	8.50	0	1	0
MCTS-PT	3.50	3.50	0.01	0.00	0.50	0	12.00	8.50	12.00	8.50	1	1	1
CSCVS	0.00	0.00	0.00	1.00	1.00	0	8.00	0.00	0.00	0.00	1	0	1
IF-Oz	0.00	0.00	0.00	1.00	1.00	1	12.00	12.00	12.00	12.00	1	0	1
OC-SRT	2.50	5.50	0.02	0.00	0.50	0	12.00	3.00	9.75	0.00	1	1	1
OFS	0.00	0.00	0.00	1.00	1.00	0	6.00	0.00	0.00	0.00	1	0	1
BUS	1.00	1.00	0.10	0.00	0.00	0	12.00	5.00	10.25	0.75	0	1	0
BUS-PT	4.00	4.00	0.40	0.00	0.50	0	12.00	5.00	9.75	0.75	1	1	1
SPARC	2.00	2.00	0.40	0.00	0.00	0	8.00	0.00	0.00	0.00	1	0	0
MR	0.00	0.00	0.00	1.00	2.00	1	8.00	0.00	0.00	0.00	1	0	1
VIP	4.00	25.00	0.05	0.00	2.00	1	9.50	0.00	0.00	0.00	1	1	1
GSVS	0.00	0.00	0.00	0.00	0.50	0	6.00	0.00	0.00	0.00	1	1	1
HT	0.00	0.00	0.00	0.00	0.50	0	12.00	3.00	9.00	0.50	1	1	0
IF-Wash	0.00	0.00	0.00	1.00	0.50	1	12.00	12.00	12.00	12.00	1	1	1
WBT	3.00	4.00	0.27	0.00	0.50	0	12.00	4.00	6.00	2.00	1	1	0
WC-SRT	2.50	5.00	0.01	0.00	0.50	0	12.00	5.60	10.00	4.00	1	1	1
EST	5.00	11.50	0.31	1.00	1.00	0	8.60	0.30	6.50	0.00	1	0	1
LCCC	4.50	13.00	0.20	1.00	2.00	0	7.50	0.00	0.00	0.00	1	0	1
MST	1.00	9.00	0.13	1.00	1.00	0	8.00	0.00	0.00	0.00	1	0	1
NBST	3.50	9.00	0.24	1.00	1.00	0	8.00	0.00	0.00	0.00	1	0	1
OSS	3.50	5.00	0.26	1.00	1.00	0	8.50	0.00	0.00	0.00	1	0	1
RLP-PT	3.60	17.65	0.03	0.00	0.50	0	11.00	1.00	0.00	0.00	1	1	1
SOTG	4.50	10.00	0.09	1.00	1.00	0	9.00	0.00	0.00	0.00	1	1	1
WMT	1.00	1.00	0.04	0.00	0.00	0	12.00	3.00	10.50	1.75	0	1	0

	u_{ik}												
KAFASI	0.100	0.520	0.890	0.000	0.571	1.000	0.472	0.000	0.000	0.000	1.000	0.000	1.000
KAT	0.830	0.966	0.837	1.000	1.000	1.000	0.667	0.125	0.583	0.000	0.000	1.000	0.000
KAT-PT	0.300	0.860	0.327	1.000	0.857	1.000	0.667	0.125	0.583	0.000	1.000	1.000	1.000
WKCTS	0.800	0.880	0.318	1.000	1.000	1.000	0.639	0.083	0.000	0.000	1.000	1.000	0.000
WKCTS-D2D	0.800	0.880	0.959	1.000	0.857	1.000	0.639	0.083	0.000	0.000	1.000	1.000	1.000
IF-Mil	1.000	1.000	1.000	0.000	0.857	0.000	0.667	1.000	1.000	1.000	1.000	0.000	1.000
MCDA	0.400	0.880	0.969	1.000	0.000	0.000	0.500	0.000	0.000	0.000	1.000	1.000	1.000
MCTS	0.680	0.936	0.973	1.000	1.000	1.000	0.667	0.833	1.000	0.708	0.000	1.000	0.000
MCTS-PT	0.300	0.860	0.964	1.000	0.929	1.000	0.667	0.708	1.000	0.708	1.000	1.000	1.000
CSCVS	1.000	1.000	1.000	0.000	0.857	1.000	0.444	0.000	0.000	0.000	1.000	0.000	1.000
IF-Oz	1.000	1.000	1.000	0.000	0.857	0.000	0.667	1.000	1.000	1.000	1.000	0.000	1.000
OC-SRT	0.500	0.780	0.941	1.000	0.929	1.000	0.667	0.250	0.813	0.000	1.000	1.000	1.000
OFS	1.000	1.000	1.000	0.000	0.857	1.000	0.333	0.000	0.000	0.000	1.000	0.000	1.000
BUS	0.800	0.960	0.750	1.000	1.000	1.000	0.667	0.417	0.854	0.063	0.000	1.000	0.000
BUS-PT	0.200	0.840	0.000	1.000	0.929	1.000	0.667	0.417	0.813	0.063	1.000	1.000	1.000
SPARC	0.600	0.920	0.000	1.000	1.000	1.000	0.444	0.000	0.000	0.000	1.000	0.000	0.000
MR	1.000	1.000	1.000	0.000	0.714	0.000	0.444	0.000	0.000	0.000	1.000	0.000	1.000
VIP	0.200	0.000	0.887	1.000	0.714	0.000	0.528	0.000	0.000	0.000	1.000	1.000	1.000
GSVS	1.000	1.000	1.000	1.000	0.929	1.000	0.333	0.000	0.000	0.000	1.000	1.000	1.000
HT	1.000	1.000	1.000	1.000	0.929	1.000	0.667	0.250	0.750	0.042	1.000	1.000	0.000
IF-Wash	1.000	1.000	1.000	0.000	0.929	0.000	0.667	1.000	1.000	1.000	1.000	1.000	1.000
WBT	0.400	0.840	0.333	1.000	0.929	1.000	0.667	0.333	0.500	0.167	1.000	1.000	0.000
WC-SRT	0.500	0.800	0.971	1.000	0.929	1.000	0.667	0.467	0.833	0.333	1.000	1.000	1.000
EST	0.000	0.540	0.223	0.000	0.857	1.000	0.478	0.025	0.542	0.000	1.000	0.000	1.000
LCCC	0.100	0.480	0.492	0.000	0.714	1.000	0.417	0.000	0.000	0.000	1.000	0.000	1.000
MST	0.800	0.640	0.679	0.000	0.857	1.000	0.444	0.000	0.000	0.000	1.000	0.000	1.000
NBST	0.300	0.640	0.392	0.000	0.857	1.000	0.444	0.000	0.000	0.000	1.000	0.000	1.000
OSS	0.300	0.800	0.342	0.000	0.857	1.000	0.472	0.000	0.000	0.000	1.000	0.000	1.000
RLP-PT	0.280	0.294	0.924	1.000	0.929	1.000	0.611	0.083	0.000	0.000	1.000	1.000	1.000
SOTG	0.100	0.600	0.773	0.000	0.857	1.000	0.500	0.000	0.000	0.000	1.000	1.000	1.000
WMT	0.800	0.960	0.900	1.000	1.000	1.000	0.667	0.250	0.875	0.146	0.000	1.000	0.000

s_i	0.34	0.24	0.33	0.50	0.19	0.40	0.11	0.33	0.43	0.33	0.34	0.50	0.44
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Appendix J: Model Outputs – All Transportation Services

Cost / Value			Reliability	Flexibility		Availability				Accommodations		
Minimum Cost per Trip	Maximum Cost per Trip	Relative Trip Cost per Square Mile of Service Area	Service Relies on Volunteers	Days of Advanced Notice Required	Limitation on Types of Destinations	Average M-F Daytime Hours (7am-7pm)	Average M-F Nighttime Hours (7pm-7am)	Average Sa-Su Daytime Hours (7am-7pm)	Average Sa-Su Nighttime Hours (7pm-7am)	Door to Door Service	Wheelchair Accom.	Personal Accom.

a_{ij}

Criteria,
i vs. j

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.000	1.813	1.135	0.448	2.209	0.686	2.768	1.077	0.597	1.089	1.015	0.458	0.558
2	0.552	1.000	0.596	0.328	1.396	0.441	1.955	0.576	0.402	0.580	0.556	0.334	0.384
3	0.881	1.678	1.000	0.422	2.074	0.628	2.633	0.945	0.553	0.956	0.893	0.432	0.519
4	2.232	3.045	2.367	1.000	3.441	1.775	4.000	2.309	1.558	2.321	2.247	1.050	1.440
5	0.453	0.716	0.482	0.291	1.000	0.375	1.559	0.469	0.347	0.472	0.456	0.295	0.333
6	1.457	2.270	1.592	0.563	2.666	1.000	3.225	1.534	0.821	1.546	1.472	0.580	0.749
7	0.361	0.511	0.380	0.250	0.642	0.310	1.000	0.372	0.291	0.373	0.363	0.253	0.281
8	0.929	1.736	1.058	0.433	2.132	0.652	2.691	1.000	0.571	1.012	0.942	0.443	0.535
9	1.674	2.487	1.809	0.642	2.883	1.217	3.442	1.751	1.000	1.763	1.689	0.663	0.895
10	0.918	1.724	1.046	0.431	2.120	0.647	2.679	0.988	0.567	1.000	0.931	0.440	0.532
11	0.985	1.798	1.120	0.445	2.195	0.680	2.753	1.062	0.592	1.074	1.000	0.455	0.554
12	2.182	2.995	2.317	0.952	3.391	1.725	3.950	2.259	1.508	2.271	2.197	1.000	1.390
13	1.792	2.605	1.927	0.694	3.001	1.335	3.560	1.869	1.118	1.881	1.806	0.719	1.000

y_{ij}

Criteria,
i vs. j

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.000	1.740	1.180	0.466	2.209	0.714	2.768	1.120	0.621	1.133	1.056	0.477	0.580
2	0.574	1.000	0.620	0.315	1.341	0.458	1.877	0.599	0.402	0.603	0.578	0.321	0.384
3	0.916	1.611	1.000	0.439	1.991	0.653	2.633	0.983	0.575	0.994	0.928	0.432	0.540
4	2.143	2.923	2.272	1.000	3.441	1.704	4.000	2.309	1.496	2.321	2.247	1.050	1.383
5	0.471	0.745	0.501	0.302	1.000	0.375	1.496	0.488	0.347	0.490	0.474	0.283	0.333
6	1.398	2.179	1.528	0.586	2.559	1.000	3.225	1.472	0.854	1.484	1.413	0.603	0.779
7	0.376	0.532	0.395	0.260	0.667	0.323	1.000	0.386	0.291	0.388	0.378	0.253	0.281
8	0.966	1.667	1.100	0.450	2.047	0.678	2.583	1.000	0.594	1.053	0.942	0.443	0.557
9	1.607	2.387	1.737	0.668	2.768	1.235	3.304	1.681	1.000	1.693	1.621	0.690	0.931
10	0.955	1.655	1.088	0.448	2.036	0.673	2.572	1.028	0.590	1.000	0.931	0.440	0.553
11	1.025	1.726	1.165	0.463	2.107	0.707	2.643	1.105	0.616	1.117	1.000	0.455	0.576
12	2.095	2.875	2.224	0.990	3.256	1.656	3.792	2.168	1.447	2.180	2.109	1.000	1.335
13	1.720	2.500	1.850	0.722	2.881	1.281	3.417	1.794	1.162	1.805	1.734	0.748	1.000

w_i

0.069	0.040	0.060	0.146	0.033	0.087	0.025	0.061	0.102	0.061	0.065	0.143	0.109
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Appendix K: Model Inputs – Transportation Services for Older Adults with Disabilities

Cost / Value			Reliability	Flexibility		Availability			
Minimum Cost per Trip	Maximum Cost per Trip	Relative Trip Cost per Square Mile of Service Area	Service Relies on Volunteers	Days of Advanced Notice Required	Limitation on Types of Destinations	Average M-F Daytime Hours (7am-7pm)	Average M-F Nighttime Hours (7pm-7am)	Average Sa-Su Daytime Hours (7am-7pm)	Average Sa-Su Nighttime Hours (7pm-7am)

x_{ik}

KAT-PT	3.50	3.50	0.27	0.00	1.00	0	12.00	1.50	7.00	0.00
WKCTS-D2D	1.00	3.00	0.02	0.00	1.00	0	11.50	1.00	0.00	0.00
MCTS-PT	3.50	3.50	0.01	0.00	0.50	0	12.00	8.50	12.00	8.50
OC-SRT	2.50	5.50	0.02	0.00	0.50	0	12.00	3.00	9.75	0.00
BUS-PT	4.00	4.00	0.40	0.00	0.50	0	12.00	5.00	9.75	0.75
VIP	4.00	25.00	0.05	0.00	2.00	1	9.50	0.00	0.00	0.00
GSVS	0.00	0.00	0.00	1.00	0.50	0	6.00	0.00	0.00	0.00
IF-Wash	0.00	0.00	0.00	1.00	0.50	1	12.00	12.00	12.00	12.00
WC-SRT	2.50	5.00	0.01	0.00	0.50	0	12.00	5.60	10.00	4.00
RLP	3.60	17.65	0.03	0.00	0.50	0	11.00	1.00	0.00	0.00
SOTG	4.50	10.00	0.09	1.00	1.00	0	9.00	0.00	0.00	0.00

u_{ik}

KAT-PT	0.222	0.860	0.327	1.000	0.600	1.000	0.667	0.125	0.583	0.000
WKCTS-D2D	0.778	0.880	0.959	1.000	0.600	1.000	0.639	0.083	0.000	0.000
MCTS-PT	0.222	0.860	0.964	1.000	0.800	1.000	0.667	0.708	1.000	0.708
OC-SRT	0.444	0.780	0.941	1.000	0.800	1.000	0.667	0.250	0.813	0.000
BUS-PT	0.111	0.840	0.000	1.000	0.800	1.000	0.667	0.417	0.813	0.063
VIP	0.111	0.000	0.887	1.000	0.200	0.000	0.528	0.000	0.000	0.000
GSVS	1.000	1.000	1.000	0.000	0.800	1.000	0.333	0.000	0.000	0.000
IF-Wash	1.000	1.000	1.000	0.000	0.800	0.000	0.667	1.000	1.000	1.000
WC-SRT	0.444	0.800	0.971	1.000	0.800	1.000	0.667	0.467	0.833	0.333
RLP	0.200	0.294	0.924	1.000	0.800	1.000	0.611	0.083	0.000	0.000
SOTG	0.000	0.600	0.773	0.000	0.600	1.000	0.500	0.000	0.000	0.000

s_i

0.36	0.31	0.33	0.47	0.19	0.40	0.11	0.33	0.45	0.35
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Appendix L: Model Outputs – Transportation Services for Older Adults with Disabilities

Cost / Value			Reliability	Flexibility		Availability			
Minimum Cost per Trip	Maximum Cost per Trip	Relative Trip Cost per Square Mile of Service Area	Service Relies on Volunteers	Days of Advanced Notice Required	Limitation on Types of Destinations	Average M-F Daytime Hours (7am-7pm)	Average M-F Nighttime Hours (7pm-7am)	Average Sa-Su Daytime Hours (7am-7pm)	Average Sa-Su Nighttime Hours (7pm-7am)

a_{ij}

Criteria,
i vs. j

	1	2	3	4	5	6	7	8	9	10
1	1.000	1.417	1.275	0.528	2.442	0.729	3.107	1.244	0.565	1.095
2	0.706	1.000	0.876	0.433	2.025	0.559	2.690	0.853	0.458	0.757
3	0.784	1.141	1.000	0.461	2.167	0.607	2.831	0.970	0.489	0.847
4	1.893	2.310	2.169	1.000	3.335	1.521	4.000	2.138	1.125	1.989
5	0.410	0.494	0.462	0.300	1.000	0.355	1.665	0.455	0.311	0.426
6	1.372	1.789	1.647	0.657	2.814	1.000	3.479	1.616	0.716	1.467
7	0.322	0.372	0.353	0.250	0.601	0.287	1.000	0.349	0.258	0.332
8	0.804	1.172	1.031	0.468	2.197	0.619	2.862	1.000	0.497	0.870
9	1.769	2.185	2.044	0.889	3.211	1.397	3.875	2.013	1.000	1.864
10	0.913	1.321	1.180	0.503	2.347	0.682	3.011	1.149	0.537	1.000

y_{ij}

Criteria,
i vs. j

	1	2	3	4	5	6	7	8	9	10
1	1.000	1.360	1.275	0.549	2.442	0.758	3.107	1.244	0.588	1.139
2	0.734	1.000	0.911	0.433	1.944	0.581	2.690	0.887	0.476	0.787
3	0.816	1.187	1.000	0.480	2.167	0.631	2.831	1.009	0.509	0.881
4	1.818	2.218	2.082	1.000	3.335	1.461	4.000	2.138	1.170	1.909
5	0.426	0.514	0.480	0.312	1.000	0.370	1.598	0.473	0.324	0.443
6	1.317	1.717	1.581	0.684	2.701	1.000	3.479	1.552	0.745	1.408
7	0.335	0.387	0.367	0.260	0.625	0.299	1.000	0.363	0.268	0.345
8	0.836	1.219	1.072	0.486	2.110	0.643	2.748	1.000	0.517	0.905
9	1.698	2.098	1.962	0.925	3.082	1.341	3.720	1.933	1.000	1.789
10	0.950	1.269	1.227	0.523	2.253	0.709	2.891	1.195	0.558	1.000

w_i

0.105	0.077	0.085	0.179	0.043	0.131	0.034	0.085	0.167	0.093
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Appendix M: Model Inputs – Transportation Services for Able-Bodied
Older Adults (with Accommodations Criteria)

Cost / Value			Reliability	Flexibility		Availability				Accommodations		
Minimum Cost per Trip	Maximum Cost per Trip	Relative Trip Cost per Square Mile of Service Area	Service Relies on Volunteers	Days of Advanced Notice Required	Limitation on Types of Destinations	Average M-F Daytime Hours (7am-7pm)	Average M-F Nighttime Hours (7pm-7am)	Average Sa-Su Daytime Hours (7am-7pm)	Average Sa-Su Nighttime Hours (7pm-7am)	Curb-to-curb Service	Wheelchair Accom.	Personal Accom.

	x _{ik}												
KAFASI	4.50	12.00	0.04	1.00	3.00	0	8.50	0.00	0.00	0.00	1	0	1
KAT	0.85	0.85	0.07	0.00	0.00	0	12.00	1.50	7.00	0.00	0	1	0
WKCTS	1.00	3.00	0.27	0.00	0.00	0	11.50	1.00	0.00	0.00	1	1	0
WKCTS-D2D	1.00	3.00	0.02	0.00	1.00	0	11.50	1.00	0.00	0.00	1	1	1
IF-Mil	0.00	0.00	0.00	1.00	1.00	1	12.00	12.00	12.00	12.00	1	0	1
MCDA	3.00	3.00	0.01	0.00	7.00	1	9.00	0.00	0.00	0.00	1	1	1
MCTS	1.60	1.60	0.01	0.00	0.00	0	12.00	10.00	12.00	8.50	0	1	0
CSCVS	0.00	0.00	0.00	1.00	1.00	0	8.00	0.00	0.00	0.00	1	0	1
IF-Oz	0.00	0.00	0.00	1.00	1.00	1	12.00	12.00	12.00	12.00	1	0	1
OC-SRT	2.50	5.50	0.02	0.00	0.50	0	12.00	3.00	9.75	0.00	1	1	1
OFS	0.00	0.00	0.00	1.00	1.00	0	6.00	0.00	0.00	0.00	1	0	1
BUS	1.00	1.00	0.10	0.00	0.00	0	12.00	5.00	10.25	0.75	0	1	0
SPARC	2.00	2.00	0.40	0.00	0.00	0	8.00	0.00	0.00	0.00	1	0	0
MR	0.00	0.00	0.00	1.00	2.00	1	8.00	0.00	0.00	0.00	1	0	1
VIP	4.00	25.00	0.05	0.00	2.00	1	9.50	0.00	0.00	0.00	1	1	1
GSVS	0.00	0.00	0.00	1.00	0.50	0	6.00	0.00	0.00	0.00	1	1	1
HT	0.00	0.00	0.00	0.00	0.50	0	12.00	3.00	9.00	0.50	1	1	0
IF-Wash	0.00	0.00	0.00	1.00	0.50	1	12.00	12.00	12.00	12.00	1	1	1
WBT	3.00	4.00	0.27	0.00	0.50	0	12.00	4.00	6.00	2.00	1	1	0
WC-SRT	2.50	5.00	0.01	0.00	0.50	0	12.00	5.60	10.00	4.00	1	1	1
EST	5.00	11.50	0.31	1.00	1.00	0	8.60	0.30	6.50	0.00	1	0	1
LCCC	4.50	13.00	0.20	1.00	2.00	0	7.50	0.00	0.00	0.00	1	0	1
MST	1.00	9.00	0.13	1.00	1.00	0	8.00	0.00	0.00	0.00	1	0	1
NBST	3.50	9.00	0.24	1.00	1.00	0	8.00	0.00	0.00	0.00	1	0	1
OSS	3.50	5.00	0.26	1.00	1.00	0	8.50	0.00	0.00	0.00	1	0	1
RLP	3.60	17.65	0.03	0.00	0.50	0	11.00	1.00	0.00	0.00	1	1	1
SOTG	4.50	10.00	0.09	1.00	1.00	0	9.00	0.00	0.00	0.00	1	1	1
WMT	1.00	1.00	0.04	0.00	0.00	0	12.00	3.00	10.50	1.75	0	1	0

	U _{ik}												
KAFASI	0.100	0.520	0.890	0.000	0.571	1.000	0.472	0.000	0.000	0.000	1.000	0.000	1.000
KAT	0.830	0.966	0.837	1.000	1.000	1.000	0.667	0.125	0.583	0.000	0.000	1.000	0.000
WKCTS	0.800	0.880	0.318	1.000	1.000	1.000	0.639	0.083	0.000	0.000	1.000	1.000	0.000
WKCTS-D2D	0.800	0.880	0.959	1.000	0.857	1.000	0.639	0.083	0.000	0.000	1.000	1.000	1.000
IF-Mil	1.000	1.000	1.000	0.000	0.857	0.000	0.667	1.000	1.000	1.000	1.000	0.000	1.000
MCDA	0.400	0.880	0.969	1.000	0.000	0.000	0.500	0.000	0.000	0.000	1.000	1.000	1.000
MCTS	0.680	0.936	0.973	1.000	1.000	1.000	0.667	0.833	1.000	0.708	0.000	1.000	0.000
CSCVS	1.000	1.000	1.000	0.000	0.857	1.000	0.444	0.000	0.000	0.000	1.000	0.000	1.000
IF-Oz	1.000	1.000	1.000	0.000	0.857	0.000	0.667	1.000	1.000	1.000	1.000	0.000	1.000
OC-SRT	0.500	0.780	0.941	1.000	0.929	1.000	0.667	0.250	0.813	0.000	1.000	1.000	1.000
OFS	1.000	1.000	1.000	0.000	0.857	1.000	0.333	0.000	0.000	0.000	1.000	0.000	1.000
BUS	0.800	0.960	0.750	1.000	1.000	1.000	0.667	0.417	0.854	0.063	0.000	1.000	0.000
SPARC	0.600	0.920	0.000	1.000	1.000	1.000	0.444	0.000	0.000	0.000	1.000	0.000	0.000
MR	1.000	1.000	1.000	0.000	0.714	0.000	0.444	0.000	0.000	0.000	1.000	0.000	1.000
VIP	0.200	0.000	0.887	1.000	0.714	0.000	0.528	0.000	0.000	0.000	1.000	1.000	1.000
GSVS	1.000	1.000	1.000	0.000	0.929	1.000	0.333	0.000	0.000	0.000	1.000	1.000	1.000
HT	1.000	1.000	1.000	1.000	0.929	1.000	0.667	0.250	0.750	0.042	1.000	1.000	0.000
IF-Wash	1.000	1.000	1.000	0.000	0.929	0.000	0.667	1.000	1.000	1.000	1.000	1.000	1.000
WBT	0.400	0.840	0.333	1.000	0.929	1.000	0.667	0.333	0.500	0.167	1.000	1.000	0.000
WC-SRT	0.500	0.800	0.971	1.000	0.929	1.000	0.667	0.467	0.833	0.333	1.000	1.000	1.000
EST	0.000	0.540	0.223	0.000	0.857	1.000	0.478	0.025	0.542	0.000	1.000	0.000	1.000
LCCC	0.100	0.480	0.492	0.000	0.714	1.000	0.417	0.000	0.000	0.000	1.000	0.000	1.000
MST	0.800	0.640	0.679	0.000	0.857	1.000	0.444	0.000	0.000	0.000	1.000	0.000	1.000
NBST	0.300	0.640	0.392	0.000	0.857	1.000	0.444	0.000	0.000	0.000	1.000	0.000	1.000
OSS	0.300	0.800	0.342	0.000	0.857	1.000	0.472	0.000	0.000	0.000	1.000	0.000	1.000
RLP	0.280	0.294	0.924	1.000	0.929	1.000	0.611	0.083	0.000	0.000	1.000	1.000	1.000
SOTG	0.100	0.600	0.773	0.000	0.857	1.000	0.500	0.000	0.000	0.000	1.000	1.000	1.000
WMT	0.800	0.960	0.900	1.000	1.000	1.000	0.667	0.250	0.875	0.146	0.000	1.000	0.000

S_i	0.34	0.25	0.30	0.51	0.20	0.42	0.12	0.34	0.43	0.33	0.36	0.50	0.46
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Appendix N: Model Outputs – Transportation Services for Able-Bodied
Older Adults (with Accommodations Criteria)

Cost / Value			Reliability	Flexibility		Availability				Accommodations		
Minimum Cost per Trip	Maximum Cost per Trip	Relative Trip Cost per Square Mile of Service Area	Service Relies on Volunteers	Days of Advanced Notice Required	Limitation on Types of Destinations	Average M-F Daytime Hours (7am-7pm)	Average M-F Nighttime Hours (7pm-7am)	Average Sa-Su Daytime Hours (7am-7pm)	Average Sa-Su Nighttime Hours (7pm-7am)	Curb-to-curb Service	Wheelchair Accom.	Personal Accom.

a_{ij}

Criteria,
i vs. j

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.000	1.711	1.353	0.442	2.125	0.638	2.737	1.056	0.614	1.094	0.910	0.450	0.529
2	0.585	1.000	0.737	0.336	1.414	0.439	2.026	0.604	0.427	0.619	0.553	0.341	0.385
3	0.739	1.358	1.000	0.382	1.772	0.521	2.384	0.771	0.504	0.794	0.689	0.388	0.446
4	2.263	2.974	2.616	1.000	3.388	1.696	4.000	2.319	1.633	2.357	2.164	1.040	1.374
5	0.471	0.707	0.564	0.295	1.000	0.371	1.612	0.483	0.363	0.493	0.450	0.299	0.332
6	1.567	2.278	1.921	0.590	2.692	1.000	3.304	1.623	0.941	1.662	1.469	0.604	0.757
7	0.365	0.494	0.420	0.250	0.620	0.303	1.000	0.373	0.297	0.378	0.353	0.253	0.276
8	0.947	1.655	1.297	0.431	2.069	0.616	2.681	1.000	0.593	1.038	0.866	0.439	0.514
9	1.630	2.341	1.983	0.612	2.755	1.062	3.367	1.688	1.000	1.724	1.531	0.628	0.794
10	0.914	1.616	1.259	0.424	2.030	0.602	2.643	0.963	0.580	1.000	0.838	0.431	0.504
11	1.099	1.810	1.452	0.462	2.224	0.681	2.836	1.155	0.653	1.193	1.000	0.471	0.559
12	2.223	2.934	2.577	0.962	3.348	1.656	3.960	2.279	1.593	2.318	2.124	1.000	1.334
13	1.889	2.600	2.242	0.728	3.014	1.321	3.626	1.945	1.259	1.983	1.790	0.749	1.000

y_{ij}

Criteria,
i vs. j

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.000	1.642	1.299	0.442	2.125	0.663	2.737	1.056	0.638	1.138	0.946	0.450	0.551
2	0.608	1.000	0.766	0.336	1.357	0.439	1.945	0.628	0.427	0.643	0.575	0.341	0.385
3	0.769	1.303	1.000	0.382	1.701	0.541	2.384	0.802	0.524	0.826	0.716	0.388	0.446
4	2.173	2.855	2.512	1.000	3.388	1.628	4.000	2.319	1.633	2.357	2.164	1.040	1.319
5	0.489	0.735	0.587	0.307	1.000	0.371	1.548	0.503	0.363	0.512	0.468	0.299	0.332
6	1.505	2.187	1.844	0.613	2.585	1.000	3.304	1.558	0.941	1.595	1.410	0.628	0.787
7	0.380	0.513	0.436	0.260	0.645	0.315	1.000	0.388	0.297	0.394	0.367	0.242	0.276
8	0.985	1.589	1.245	0.448	1.986	0.641	2.574	1.000	0.617	1.080	0.901	0.439	0.535
9	1.565	2.247	1.904	0.637	2.644	1.105	3.232	1.618	1.000	1.655	1.470	0.628	0.826
10	0.950	1.552	1.235	0.441	1.949	0.626	2.537	1.001	0.603	1.000	0.838	0.431	0.504
11	1.143	1.737	1.394	0.481	2.135	0.708	2.722	1.201	0.679	1.235	1.000	0.471	0.581
12	2.134	2.817	2.473	1.000	3.214	1.590	3.802	2.188	1.530	2.225	2.039	1.000	1.281
13	1.813	2.496	2.152	0.757	2.893	1.269	3.481	1.867	1.235	1.904	1.718	0.779	1.000

w_i

0.066	0.040	0.051	0.148	0.034	0.091	0.025	0.063	0.097	0.058	0.068	0.145	0.115
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Appendix O: Model Inputs – Transportation Services for Able-Bodied
Older Adults (without Accommodations Criteria)

Cost / Value			Reliability	Flexibility		Availability			
Minimum Cost per Trip	Maximum Cost per Trip	Relative Trip Cost per Square Mile of Service Area	Service Relies on Volunteers	Days of Advanced Notice Required	Limitation on Types of Destinations	Average M-F Daytime Hours (7am-7pm)	Average M-F Nighttime Hours (7pm-7am)	Average Sa-Su Daytime Hours (7am-7pm)	Average Sa-Su Nighttime Hours (7pm-7am)

	x_{ik}									
KAFASI	4.50	12.00	0.04	1.00	3.00	0	8.50	0.00	0.00	0.00
KAT	0.85	0.85	0.07	0.00	0.00	0	12.00	1.50	7.00	0.00
WKCTS	1.00	3.00	0.27	0.00	0.00	0	11.50	1.00	0.00	0.00
WKCTS-D2D	1.00	3.00	0.02	0.00	1.00	0	11.50	1.00	0.00	0.00
IF-Mil	0.00	0.00	0.00	1.00	1.00	1	12.00	12.00	12.00	12.00
MCDA	3.00	3.00	0.01	0.00	7.00	1	9.00	0.00	0.00	0.00
MCTS	1.60	1.60	0.01	0.00	0.00	0	12.00	10.00	12.00	8.50
CSCVS	0.00	0.00	0.00	1.00	1.00	0	8.00	0.00	0.00	0.00
IF-Oz	0.00	0.00	0.00	1.00	1.00	1	12.00	12.00	12.00	12.00
OC-SRT	2.50	5.50	0.02	0.00	0.50	0	12.00	3.00	9.75	0.00
OFS	0.00	0.00	0.00	1.00	1.00	0	6.00	0.00	0.00	0.00
BUS	1.00	1.00	0.10	0.00	0.00	0	12.00	5.00	10.25	0.75
SPARC	2.00	2.00	0.40	0.00	0.00	0	8.00	0.00	0.00	0.00
MR	0.00	0.00	0.00	1.00	2.00	1	8.00	0.00	0.00	0.00
VIP	4.00	25.00	0.05	0.00	2.00	1	9.50	0.00	0.00	0.00
GSVS	0.00	0.00	0.00	1.00	0.50	0	6.00	0.00	0.00	0.00
HT	0.00	0.00	0.00	0.00	0.50	0	12.00	3.00	9.00	0.50
IF-Wash	0.00	0.00	0.00	1.00	0.50	1	12.00	12.00	12.00	12.00
WBT	3.00	4.00	0.27	0.00	0.50	0	12.00	4.00	6.00	2.00
WC-SRT	2.50	5.00	0.01	0.00	0.50	0	12.00	5.60	10.00	4.00
EST	5.00	11.50	0.31	1.00	1.00	0	8.60	0.30	6.50	0.00
LCCC	4.50	13.00	0.20	1.00	2.00	0	7.50	0.00	0.00	0.00
MST	1.00	9.00	0.13	1.00	1.00	0	8.00	0.00	0.00	0.00
NBST	3.50	9.00	0.24	1.00	1.00	0	8.00	0.00	0.00	0.00
OSS	3.50	5.00	0.26	1.00	1.00	0	8.50	0.00	0.00	0.00
RLP	3.60	17.65	0.03	0.00	0.50	0	11.00	1.00	0.00	0.00
SOTG	4.50	10.00	0.09	1.00	1.00	0	9.00	0.00	0.00	0.00
WMT	1.00	1.00	0.04	0.00	0.00	0	12.00	3.00	10.50	1.75

	u_{ik}									
KAFASI	0.100	0.520	0.890	0.000	0.571	1.000	0.472	0.000	0.000	0.000
KAT	0.830	0.966	0.837	1.000	1.000	1.000	0.667	0.125	0.583	0.000
WKCTS	0.800	0.880	0.318	1.000	1.000	1.000	0.639	0.083	0.000	0.000
WKCTS-D2D	0.800	0.880	0.959	1.000	0.857	1.000	0.639	0.083	0.000	0.000
IF-Mil	1.000	1.000	1.000	0.000	0.857	0.000	0.667	1.000	1.000	1.000
MCDA	0.400	0.880	0.969	1.000	0.000	0.000	0.500	0.000	0.000	0.000
MCTS	0.680	0.936	0.973	1.000	1.000	1.000	0.667	0.833	1.000	0.708
CSCVS	1.000	1.000	1.000	0.000	0.857	1.000	0.444	0.000	0.000	0.000
IF-Oz	1.000	1.000	1.000	0.000	0.857	0.000	0.667	1.000	1.000	1.000
OC-SRT	0.500	0.780	0.941	1.000	0.929	1.000	0.667	0.250	0.813	0.000
OFS	1.000	1.000	1.000	0.000	0.857	1.000	0.333	0.000	0.000	0.000
BUS	0.800	0.960	0.750	1.000	1.000	1.000	0.667	0.417	0.854	0.063
SPARC	0.600	0.920	0.000	1.000	1.000	1.000	0.444	0.000	0.000	0.000
MR	1.000	1.000	1.000	0.000	0.714	0.000	0.444	0.000	0.000	0.000
VIP	0.200	0.000	0.887	1.000	0.714	0.000	0.528	0.000	0.000	0.000
GSVS	1.000	1.000	1.000	0.000	0.929	1.000	0.333	0.000	0.000	0.000
HT	1.000	1.000	1.000	1.000	0.929	1.000	0.667	0.250	0.750	0.042
IF-Wash	1.000	1.000	1.000	0.000	0.929	0.000	0.667	1.000	1.000	1.000
WBT	0.400	0.840	0.333	1.000	0.929	1.000	0.667	0.333	0.500	0.167
WC-SRT	0.500	0.800	0.971	1.000	0.929	1.000	0.667	0.467	0.833	0.333
EST	0.000	0.540	0.223	0.000	0.857	1.000	0.478	0.025	0.542	0.000
LCCC	0.100	0.480	0.492	0.000	0.714	1.000	0.417	0.000	0.000	0.000
MST	0.800	0.640	0.679	0.000	0.857	1.000	0.444	0.000	0.000	0.000
NBST	0.300	0.640	0.392	0.000	0.857	1.000	0.444	0.000	0.000	0.000
OSS	0.300	0.800	0.342	0.000	0.857	1.000	0.472	0.000	0.000	0.000
RLP	0.280	0.294	0.924	1.000	0.929	1.000	0.611	0.083	0.000	0.000
SOTG	0.100	0.600	0.773	0.000	0.857	1.000	0.500	0.000	0.000	0.000
WMT	0.800	0.960	0.900	1.000	1.000	1.000	0.667	0.250	0.875	0.146

s_i	0.34	0.25	0.30	0.51	0.20	0.42	0.12	0.34	0.43	0.33
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Appendix P: Model Outputs – Transportation Services for Able-Bodied
Older Adults (without Accommodations Criteria)

Cost / Value			Reliability	Flexibility		Availability			
Minimum Cost per Trip	Maximum Cost per Trip	Relative Trip Cost per Square Mile of Service Area	Service Relies on Volunteers	Days of Advanced Notice Required	Limitation on Types of Destinations	Average M-F Daytime Hours (7am-7pm)	Average M-F Nighttime Hours (7pm-7am)	Average Sa-Su Daytime Hours (7am-7pm)	Average Sa-Su Nighttime Hours (7pm-7am)

a_{ij}

Criteria,
i vs. j

	1	2	3	4	5	6	7	8	9	10
1	1.000	1.711	1.353	0.442	2.125	0.638	2.737	1.056	0.614	1.094
2	0.585	1.000	0.737	0.336	1.414	0.439	2.026	0.604	0.427	0.619
3	0.739	1.358	1.000	0.382	1.772	0.521	2.384	0.771	0.504	0.794
4	2.263	2.974	2.616	1.000	3.388	1.696	4.000	2.319	1.633	2.357
5	0.471	0.707	0.564	0.295	1.000	0.371	1.612	0.483	0.363	0.493
6	1.567	2.278	1.921	0.590	2.692	1.000	3.304	1.623	0.941	1.662
7	0.365	0.494	0.420	0.250	0.620	0.303	1.000	0.373	0.297	0.378
8	0.947	1.655	1.297	0.431	2.069	0.616	2.681	1.000	0.593	1.038
9	1.630	2.341	1.983	0.612	2.755	1.062	3.367	1.686	1.000	1.724
10	0.914	1.616	1.259	0.424	2.030	0.602	2.643	0.963	0.580	1.000

y_{ij}

Criteria,
i vs. j

	1	2	3	4	5	6	7	8	9	10
1	1.000	1.642	1.299	0.460	2.125	0.663	2.737	1.098	0.638	1.138
2	0.608	1.000	0.766	0.323	1.357	0.456	1.945	0.628	0.427	0.643
3	0.769	1.303	1.000	0.382	1.701	0.541	2.384	0.802	0.524	0.826
4	2.173	2.855	2.512	1.000	3.388	1.628	4.000	2.319	1.568	2.357
5	0.489	0.735	0.587	0.307	1.000	0.386	1.548	0.503	0.378	0.512
6	1.505	2.187	1.844	0.613	2.585	1.000	3.304	1.558	0.979	1.595
7	0.380	0.513	0.436	0.260	0.645	0.315	1.000	0.388	0.309	0.394
8	0.985	1.589	1.245	0.448	1.986	0.641	2.574	1.000	0.617	1.080
9	1.565	2.247	1.904	0.637	2.644	1.105	3.232	1.618	1.000	1.655
10	0.950	1.552	1.235	0.441	1.949	0.626	2.537	1.001	0.603	1.000

w_i

0.100	0.062	0.077	0.211	0.047	0.142	0.037	0.091	0.145	0.089
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