MEETING SMALL URBAN TRANSIT NEEDS IN NORTH DAKOTA: A CASE STUDY PERSPECTIVE

Del Peterson∗
Dustin Ulmer
Jill Hough

Small Urban & Rural Transit Center
Upper Great Plains Transportation Institute
North Dakota State University

October 2004

∗ Peterson is an Associate Research Fellow, Ulmer is a Graduate Research Assistant, and Hough is the Director of the Small Urban & Rural Transit Center.

TABLE OF CONTENTS

ABSTRACT

Mobility and the connectivity it provides are important elements in our economy and society. They are essential for the economic success and social integration of the individual. Yet, these elements are sometimes minimal or absent in small urban and rural settings. Many of the Northern Plains states' (North Dakota, South Dakota, Montana, Wyoming, and parts of Iowa and Minnesota) elderly, disabled and low income residents rely on public transportation services. In some cases, these services are very limited. The lack of funds forces transit managers to make difficult choices to the point of reducing or eliminating services. Within North Dakota, many transit systems offer primarily paratransit (on demand response) services. The James River Transit system is an example of a system that is exclusively paratransit in nature.

James River Transit is a paratransit system serving the Jamestown community. It provided 50,180 one-way rides in 2000 and 45,100 one-way rides in 2001 while traveling 130,476 miles and 129,118 miles for those two calendar years, respectively. The system operates seven days per week, and its ridership may warrant some form of fixed-route system.

Fixed-route service may help Jamestown adapt to the emerging trends of the state which suggest that providing transit service in the future will become even more challenging. One trend is the increasing age of North Dakota's rural population. In 1970, roughly 10 percent of the U.S. population was older than 65. In 2020, an estimated 17 percent of the U.S. population will be older than 65. Many of these people are unwilling to leave their small urban and rural communities for more urbanized areas offering a greater range of services. Census data from 2000 reveals that Jamestown's population was 15,571 in 1990 and 15,527 in 2000, a decrease of only 44 people, while the population of residents 65 and older went from 2,633 in 1990 to 2,806 in 2000, a 6.2 percent increase.

The James River Transit survey was distributed to current transit users. The questionnaire was divided into two main parts. The first part dealt with the existing paratransit service provided by James River Transit as well as feelings towards potential fixed-route service. The second part identified demographic characteristics of James River Transit riders. Numerous computer simulations were also performed to develop the most effective fixed-route for Jamestown with many routes being considered for implementation. The cost-effectiveness of the Jamestown fixed-route system was analyzed. The evaluation included discussion on a proposed fare structure and general calculations to determine necessary subsidies for James River Transit.

A primary goal of the James River study is to provide a useful tool for other transit agencies to utilize in determining whether or not a fixed-route bus system is feasible in their communities. Comparisons between Jamestown and other communities can provide insight into what options are available to transit agencies in small towns in addition to standard paratransit services. Ultimately, the goal of this research is to provide a stepping stone to the modernization of transit agencies throughout North Dakota and the entire country.

CHAPTER 1: INTRODUCTION

Mobility and the connectivity it provides are important elements in our economy and society. They are not only critical but essential for the economic success and social integration of the individual. Yet, these elements are sometimes minimal or absent in small urban and rural settings. Many of the Northern Plains states' (North Dakota, South Dakota, Montana, Wyoming, and parts of Iowa and Minnesota) elderly, disabled and low income residents rely on available public transportation services. In some cases, these services are very limited. Lack of funds forces transit managers to make difficult choices to the point of reducing or eliminating services. Within North Dakota, many transit systems offer primarily paratransit (demand response) services. The James River Transit system is an example of a system that is exclusively paratransit.

North Dakota has 45 transit systems serving parts of all 53 counties within the state. Forty-one of these systems offer paratransit service while only four systems, located in Fargo, Minot, Grand Forks, and Bismarck offer both paratransit and fixed-route service. Some of North Dakota's larger communities (classified as small urban) such as Jamestown are candidates for fixed-route service in either its traditional form, or in a modified form based on community needs.

Cost is a primary reason a fixed-route system has potential to succeed in a community such as Jamestown. The cost of providing a paratransit ride for James River Transit is approximately $5.96 per passenger. The cost of providing fixed-route service is generally lower per passenger. For example, the cost of providing fixed-route service in Fargo is $2.72 per passenger and the cost of providing fixed-route service in Minot is $2.36 per passenger. Transit systems with a large number of miles traveled each year accompanied by increased ridership may reduce their costs by utilizing a fixed-route system. Cost savings could also be passed on to riders, reducing the cost and increasing ridership.

The Research Problem

James River Transit is a paratransit system serving the Jamestown community. It provided 50,180 one-way rides in 2000 and 45,100 one-way rides in 2001 while traveling 130,476 miles and 129,118 miles for those years, respectively. The system operates seven days per week and its ridership may warrant some form of fixed-route system.

Jamestown also has a large population of individuals with special needs. This large demographic group, along with FTA requirements, will not allow for the complete elimination of James River Transit's current paratransit system. However, implementing a fixed-route system and reducing the number of miles traveled and the number of individual trips provided by the paratransit service may allow James River Transit to reduce costs and charge lower fares for fixed-route service.

Changing North Dakota Trends

Fixed-route service may help Jamestown adapt to the emerging trends of the state which suggest that providing transit service in the future will become even more challenging. One trend is the increasing age of North Dakota's rural population. In 1970, roughly 10 percent of the United States population was older than 65. In 2020, an estimated 17 percent of the U.S. population will be more than 65 years old. Many of these people are unwilling to leave their small urban and rural communities for more urban areas offering a greater range of services. Census data from 2000 reveals that Jamestown's population was 15,571 in 1990 and 15,527 in 2000, a decrease of only 44 people, while the population of residents 65 and older went from 2,633 in 1990 to 2,806 in 2000, a 6.2 percent increase that continues to rise every year.

A second trend is the changing socioeconomic landscape of North Dakota's rural communities. Continued out-migration of young rural residents affects transit in two ways: It reduces the tax base which leads to limited funding for transit in rural areas, and it leaves fewer family members available to provide transportation to aging family members. A third trend is the federal government's involvement in small urban and rural public transit. The federal government has long been involved in public transit, and changes in administration and transportation policies have influenced transportation in the past and will continue to do so into the future. Transit systems rely heavily upon federal, state, and local funding. Systems need to be prepared to adjust when change occurs and they must look for ways to reduce costs which is paramount to the success of any system. Looking for innovative ways to better serve customers with limited funding will enable rural and small urban systems to remain viable while providing much-needed service to local residents.

Study Objective

The objective of this study is to evaluate the operational feasibility of altering the James River Transit paratransit system to include fixed-route service and measure the improvement in service to residents as well as cost savings to the transit system and riders.

Report Organization

This report is organized into four main chapters. Chapter Two discusses recent literature pertaining to fixed-route implementation and its feasibility. Chapter Three describes research methodology used in the study. Chapter Four contains survey results along with computer simulation and cost-effectiveness analysis. Chapter Five discusses conclusions and recommendations of the study and is followed by appendices containing the survey instrument and proposed fixed-route maps for Jamestown.

CHAPTER 2: OPERATIONAL FEASIBILITY OF DEMAND-RESPONSE AND FIXED-ROUTE IMPLEMENTATION

Decades before the 1990 passage of the Americans with Disabilities Act (ADA), Ed Roberts, along with other leaders of the independent living movement from both congressional and grass-root perspectives, stressed access to fixed-route transit for people with disabilities. Fixed-route transit is defined by APTA (2003) as service provided on a repetitive, fixed-schedule along a specific route with vehicles stopping to pick up and deliver passengers to specific locations. Special services, such as demand-response, independent living activists argued, are too limiting and go against the integrationist spirit of their cause (Bowe 1979). Demand-response transit service is defined by Kirby et al. (1974) as transportation that "provides door-to-door service on demand to a number of travelers with different origins and destinations.

To better understand the process of fixed-route implementation, several factors must be addressed. The discussion will begin with a state-of-the-practice description for integrated transit services throughout the United States, followed by a comparison between demand-response and fixed-route transportation, and concluded by discussing technology advancements that have aided fixed-route implementation for people with disabilities.

State-of-the-Practice Description for Integrated Transit Services

In the United States, many transit agencies are considering integrating their demand-response service with traditional fixed-route service. In some cases, it may be advantageous to the transit agency or to the passenger to coordinate traditional demand-response transit service with fixed-route services. Two main studies highlighting the transition and implementation of fixed-route services are discussed in the following subsections. These include studies conducted in British Columbia and Delaware. Both involved the transition of demand-response customers to fixed-routes.

British Columbia Transit

British Columbia (BC) Transit is committed to ongoing improvements in the accessibility of fixed-route transit services for mobility, health, economic, and social benefits. To maximize the benefits to the customer, the transit system, and the community at large, BC Transit must continue to assess needs while developing and promoting programs and services to support those able to use fixed-route services (Sowden and Wick 2001).

BC Transit offers a full range of transportation options, including accessible buses, door-to-door handy Daily Access Rapid Transit (DART) service, the Taxi Saver program and Community Travel Training. The Community Travel Training Program is designed to be a short-term, comprehensive, sequential, consistent, individual and community-based support effort. Over the past two years the program trained more than 150 seniors and individuals with disabilities, ranging in age from 12 to older than 80, and has established and maintained partnerships with more than 300 representative organizations, schools, hospitals, and residential and recreational

facilities. BC Transit estimated the cost per trip for demand-response services to be $12.50. The first year that training was offered, 50 clients switched from demand-response to fixed-route service, saving a potential demand-response transit cost of $195,000. Subtracting $45,000 for training costs and $50,000 for added fixed-route costs, BC Transit saved roughly $100,000 last year with similar savings and results indicated for the current year (Sowden and Wick 2001).

New Castle County, Delaware Transit

New Castle County, Delaware, was the only county in the state with an extensive fixed-route system at the time this study was conducted. The study's intent was to explore the "willingness" or receptivity of the current riders to the concept of transitioning to fixed-route services for planning purposes (Denson 1998).

The average cost of providing a paratransit trip in the study's state is $26.89 with riders paying $2 for a one-way trip, and each fixed-route trip is $2.67 with riders paying $1.15 per trip (Benson 1998). The potential savings of any significant move to fixed-route services become apparent based on the previous demand-response and fixed-route transit cost differences.

The results of this study support two key themes of the general literature on transportation for people with disabilities. First, an accessible bus fleet is just one aspect of the systematic accessibility required to make fixed-route public transit a viable option for people with disabilities. Second, even when steps are taken to improve accessibility within the entire public transportation system, a significant number of paratransit riders will be unwilling to stop using a service with which they are generally satisfied.

Demand-Response Versus Fixed-Route Transportation

Two broad trends characterize the current evolution of public transportation in the United States. First, as the population moves out of larger cities to the suburbs, small cities, and towns, fewer Americans rely on fixed-route public transportation. This results in growing reliance on the personal automobile with resulting effects on the social and physical environment. Second, as the population ages, reliance on publicly funded demand-response systems for transportation to medical and other facilities increases. The two trends work against each other with respect to fixed-route implementation.

Pros and Cons of Demand-Response and Fixed-Route

The decline in the use of fixed-route service has some undesirable consequences. Demand-response systems can be very expensive to operate, because there are few passengers in the vehicle, sometimes only one. Cost per trip for demand-response service range from $5 to $27, whereas fixed-route service costs range from $1.75 to $4 per trip, a substantial cost difference. In fact, it is often the case that government pays local taxi companies to transport eligible citizens to doctors' offices and other destinations. Also, demand-response systems, unlike fixed-routes, do not reduce use of the private automobile (O'Connell et. al. 2002).

Relationship of Demand Response and Fixed-Route Transit

Historically, fixed-route transit and demand-response developed independently. Transit operators provided fixed-route transit, and social service agencies provided demand-response, although there were notable exceptions. Demand-response became the only public transit operation in many small cities in the states that provided funding for this type of transportation. The notion that demand-response and fixed-route transit both have a role in a family of services for specific markets has been slow to spread (Lave and Mathis 2001).

Technology Advancements

The transit industry has shown significant interest in new technology such as vehicle-location systems and automated fares. However, these applications are typically agency specific. Advanced technology across two or more agencies is far less common (Giuliano et. al. 2002). The most advanced integrated transit services exist today in the United States in the form of "feeder service" and "smart shuttle" programs that utilize computer-assisted scheduling routines in the integration of transit services.

Concepts for Integrating Transit Services

Integrating demand-response service with other modes is the main goal of a flexible operation system. The objectives have always been to integrate rail, fixed-route bus and demand-response services into a homogenous public transit network. In a complex transit system, demand-response modes are effectively used to supplement fixed-route service in areas where the traffic demand is too low and scattered to provide acceptable fixed-routes or schedules (Greschner 2001).

Tools for Integrating Transit Services

For many years, people have designed concepts to integrate demand-response with fixed-route service. A recent Federal Transit Administration report describes the roles and successes of advanced technologies such as geographic information systems (GIS), Advanced Vehicle Location (AVL), and operations software at North American Transit Agencies (Hickman and Blume 2001).

GIS has the ability to integrate and maintain large-size spatial transportation databases from different data sources and can conduct and support spatial and temporal analysis (Li and Kurt 2001). Highly-sophisticated AVL techniques for demand response and fixed-route planning have provided enormous break-throughs for scheduling. The advantages are based on data and communication systems allowing for the transfer of information and messages (Greschner 2001).

Transit services and costs vary substantially throughout the United States. Whether or not fixed-route or demand-response service is better for a given area is very subjective and often based on many underlying factors. The following chapter will highlight the research methods used within the study, and how the demographics and available technologies may influence fixed-route implementation with the James River Transit Center.

CHAPTER 3: RESEARCH METHODS

This study investigated the feasibility of fixed-route implementation within small urban and rural communities. Fixed-route studies are often done within large urban areas, but there is a lack of research available pertaining to smaller communities. The following discussion highlights the research methods utilized to investigate the community of Jamestown, ND, which was used as a case study model for this research.

The research methods section is separated into four sections. First, the survey instrument used in the study and its design are discussed. This is followed by focus group meeting perceptions. Focus groups were developed to allow the research team to gain first-hand knowledge of Jamestown's current transit systems and to gain a better understanding of local riders' perceptions toward a fixed-route transit system in Jamestown. Geographic Information Systems (GIS) analysis is then examined and used to analyze different routes and their timing. Finally, methods used to evaluate the cost effectiveness of implementing a fixed-route system in Jamestown are discussed.

Survey Instrument Design

A five-page survey was developed by the research team and the James River Transit Center. It will be described in this section. James River Transit tried to survey as many of its current riders as possible. The survey contained 21 questions. Questions dealt with respondents' current usage of James River Transit, rider travel patterns, and how they felt about the current service. Further questions asked respondents to indicate their views towards a new fixed-route system which would compliment, not eliminate, the already existing paratransit service. Demographic information comprised questions fifteen through nineteen of the survey.

Focus Group Meetings

Focus group meetings were held March 3, 2004. Feedback from James River Transit riders obtained during the focus group meetings were given considerable attention when fixed-route scheduling and timing were developed. The goal of the focus group meetings was to gain first-hand knowledge of the day-to-day operations of James River Transit.

Geographic Information Systems (GIS) Analysis

GIS has the ability to model and refine bus routing networks and control quality-of-information flow among various models. This fits perfectly with the needs of the research team in determining optimal fixed routes for James River Transit and their timing. In order to model the bus route flow more accurately, an average route speed of 12 miles per hour was used on all applicable routes. Although all speed limits on routes fell between 25 and 40 miles per hour, using 12 miles per hour as the benchmark allowed time for stops and the loading and unloading of riders who might be traveling with the aid of a wheelchair or other travel aid.

ArcView Network Analyst was the GIS software used to analyze potential James River Transit fixed routes. Network Analyst utilizes Dijkstra's Algorithm to solve the problem of finding the shortest path from a point (the source) to a destination. Dijkstra's Algorithm is often referred to as the single-source shortest path algorithm. A simplified mathematical formulation is represented below as explained in (Taylor 2002).

Assume the James River road system is represented as **G** below. Given this, the formulation can be stated as:

G = (V,E) where

V is a set of vertices and

E is a set of edges

Dijkstra's algorithm keeps two sets of vertices:

S is the set of vertices whose shortest paths from the source have already been determined and **V – S** are the remaining vertices.

The other data structures needed are:

D which is an array of best estimates of shortest path to each vertex and

pi which is an array of predecessors for each vertex.

The basic mode of operation is:

1. Initialize **d** and **pi**,
2. Set **S** to empty,
3. While there are still vertices in **V – S**,
    a. Sort the vertices in **V – S** according to the current best estimate of their distance from the source
    b. Add **u**, the closest vertex to **V – S**, to **S**,
    c. Relax all the vertices still in the **V – S** connected to **u**

The relaxation process updates the costs of all the vertices, **v**, connected to a vertex, **u**, if one could improve the best estimate of the shortest path to **v** by including (**u, v**) in the path to **v**.

Fixed-Route Cost Effectiveness

Evaluating the implementation of the fixed-route system involved determining a suitable cost structure for the new system and also evaluating its effect on the existing paratransit system. The proposed cost structure was based largely on a comparison between James River Transit and other transit agencies. A wide variety of transit systems were used in this comparison. Fargo, ND, Minot, ND, and Hibbing, MN, are three transit agencies representing various sizes and complexities whose present fixed-route and paratransit systems were analyzed. Developing funding sources for the fixed-route system was another issue that was addressed. Local businesses and employers who would benefit from the service were thought to be the main funding sources from which to draw additional financial support.

CHAPTER 4: RESULTS AND FINDINGS

This chapter presents results of the James River Transit user survey along with computer simulation results of potential fixed-route implementations in Jamestown. The survey was divided into two main parts. The first part dealt with the existing paratransit service provided by James River Transit as well as respondents' feelings towards potential fixed-route service. The second part identified demographic characteristics of James River Transit Riders. Numerous computer simulations were also performed to develop the most effective fixed-route for Jamestown.

Survey Results

Some general demographics of respondents will be discussed first to identify how respondents compare to the general population. The total number of survey respondents (55) consisted of 15 male and 40 females. Respondents' ages ranged from 18 to 83 with almost 60 percent being 50 years old or older.

Almost all respondents specified their ridership to be either daily or 2 to 3 times per week (Figure 3.6). This shows both the need and demand for the service on a daily basis. Also, over 90 percent of respondents rated the current paratransit service as either very good or good (Figure 3.7). This is a testament to the quality of service provided by James River Transit and its drivers.

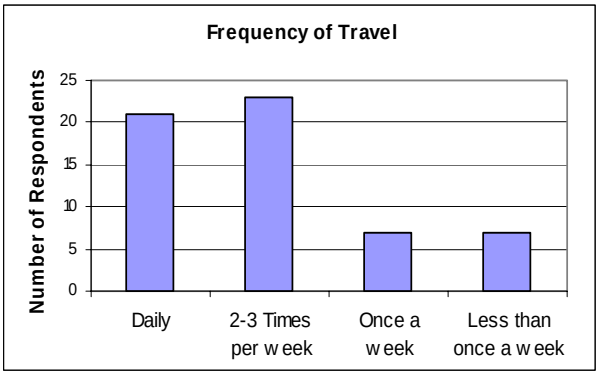


Figure 3.1 Transit travel frequency

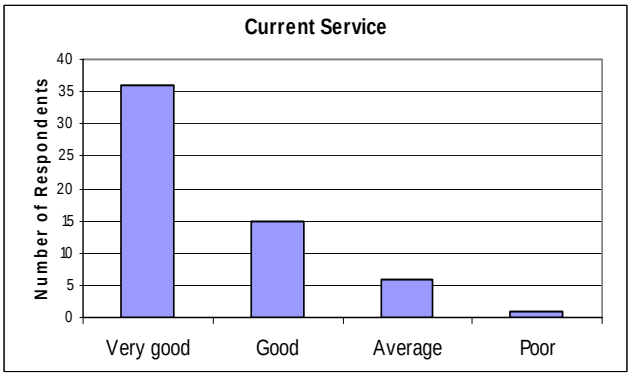


Figure 3.2 Opinions toward current service

An important step in determining the fixed-route stops was to determine travel patterns of current riders. Main travel destinations will be used as stops along the fixed-route system. The major retail stores (Walmart, Kmart) and grocery stores (Hugos, County Market) were found to be the most-traveled-to locations in the Jamestown area currently served by James River Transit (Figure 3.9).

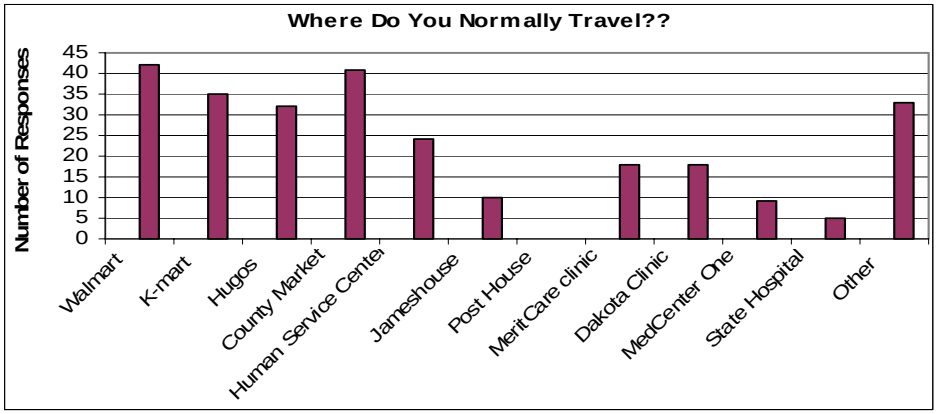


Figure 3.3 Travel destinations for James River Transit riders

Important features of the fixed-route must also be determined to maximize its daily ridership. Riders were asked what would encourage them to use the fixed-route system. Responses indicated that increased flexibility, with numerous routes and schedules, along with accessibility were important to maximize ridership in Jamestown (Figure 3.11). Also, nearly 30 percent (15) of respondents indicated they were unaware of ways to increase the ridership of a fixed-route system.

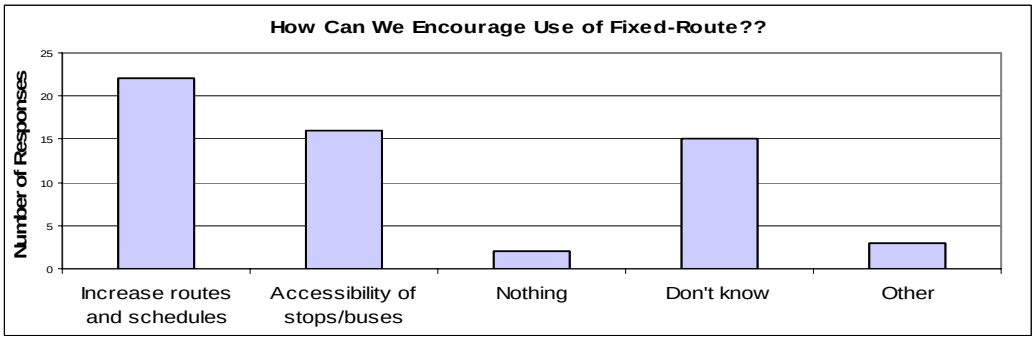


Figure 3.4 Ways to encourage fixed-route usage

Riders were then asked why they, personally, would be unable to use a fixed-route bus. Nineteen riders (nearly 40 percent) indicated they did not know why they could not ride the bus. Disabilities and the inability to walk from their residence to a fixed-route bus stop were other common replies. These results show the need for flexibility in service with a fixed-route system.

James River Transit riders were then asked whether they need assistance getting in and out of vehicles and whether or not they can board a bus independently. Thirty-nine respondents indicated they do not need help getting out of vehicles while 41 replied they could not board a bus independently. At first glance these results seem to contradict each other, however, climbing the steps of a bus is often far more difficult for the elderly and handicapped than simply getting into or out of a personal automobile. This line of reasoning may explain the responses to these

questions.
Finally, questions of improving the current service and advantages of fixed-route versus paratransit service were asked. Sixteen respondents indicated they felt nothing could be improved upon with regards to the current service (Figure 3.18) while eight responses highlighted the request for cheaper service. This will be addressed with a fixed-route bus as the per-ride fare will be less than the per ride paratransit fare. Evening bus service was another sought-after improvement by respondents with six people indicating this as a need. Running the fixed-route bus in the evening a couple of days per week is an option that was recommended by the research team and is being considered by James River Transit.

The main advantage of fixed-route service compared to paratransit is cheaper fares. More than 60 percent (34 respondents) indicated this as an advantage with 50 percent indicating that scheduled service would be an advantage (Figure 3.19). Forty percent of respondents also indicated that fixed-route service being more environmentally friendly than paratransit was a noteworthy benefit.

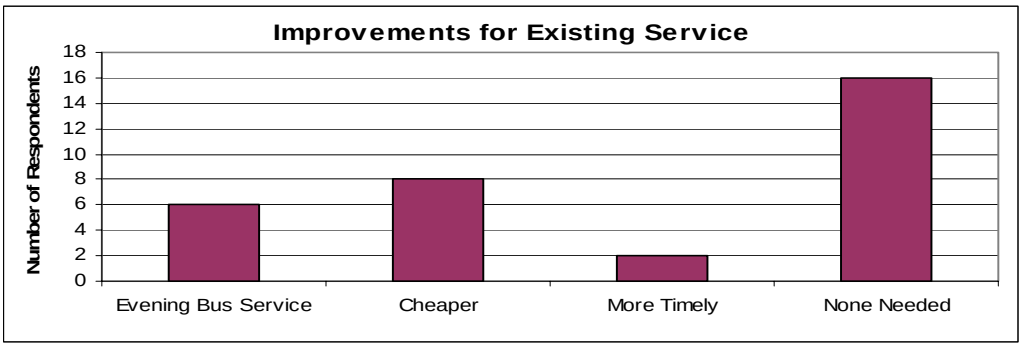


Figure 3.5 Possible improvements to existing paratransit service

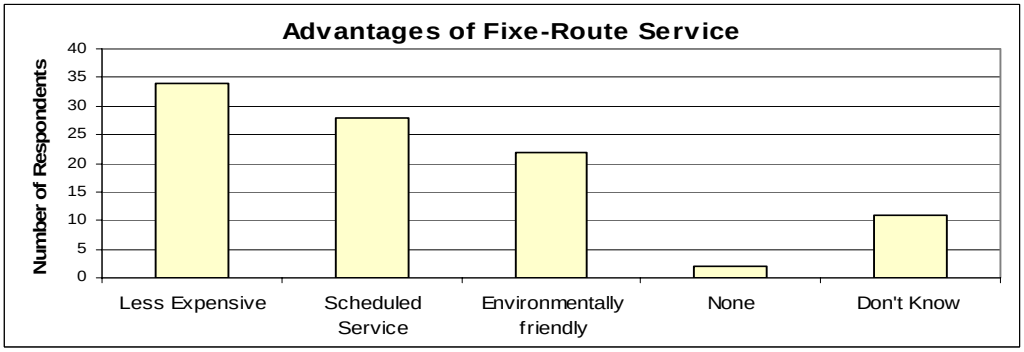


Figure 3.6 Advantages to fixed-route service versus paratransit

Overall, the survey results indicate that James River Transit is doing an excellent job providing its current paratransit service. Riders desire better and cheaper service, things which are virtually impossible to provide. A fixed-route system, or something similar, will make riding the bus in Jamestown more affordable for current riders and potential riders who currently use other means of transportation.

Fixed-Route Options

Computer simulation results of routes that were considered for implementation will be discussed in this section. Routes considered for implementation included:

1). Full Town Route
2). Full Town Two Bus Route
3). Half Town Route
4). Circulator Route
5). Specialized Route
6). Flex Route

The first route considered (Full Town Route) was a one to one and one-half hour route using a single bus which covered all of the main stops in town. The second proposed route (Full Town Two Bus Route) covered most of the same area as the first, but it would use two buses running simultaneously to fully cover the route in 30 minute cycles. The third route (Half Town Route) was a one-hour route using one or two buses, but it covered a more limited area than the first and second routes. The fourth route considered (Circulator Route) was a circulator route that would stop at the major shopping points in town using a single bus and run on a 30 minute cycle. The fifth consideration (Specialized Route) was a hybrid deviated fixed-route where certain days of the week a bus would travel to assigned destinations (i.e. Walmart) at a discount to the riders. The sixth and final route considered for implementation (Flex Route) was another hybrid route which served a fixed-route schedule but allowed for deviations off the scheduled route to accommodate rider needs. The Full Town, Half Town and Flex Routes are discussed with more detail in the following subsections.

Full Town Route

The Full Town Route (map located in Appendix B) was the first route considered for implementation. Initial steps included geocoding the addresses of passenger residences and paratransit stop locations. The first Full Town Route simulation was run to minimize travel time while stopping at all of the assigned stops. Stops were allocated at various high volume paratransit stops and residential locations. For example, the County Market grocery store and Dewey Apartments have high-volume ridership with the paratransit service and were included as stops on the Full Town Route.

The Full Town Route design was discussed with James River Transit management and drivers. It was found to provide good service to all major areas of town, but it was clumsy to operate with many awkward turns and stops. Also, the route took far too long to cover with an estimated route time of one and a half hours when driven by James River Transit drivers. A major point of discussion with this route and others was whether or not to provide service to the Jamestown State Hospital on the southeast corner of town. Serving the hospital was considered to be inefficient as

it took far too long to get to and from the hospital with limited ridership between it and the next scheduled stop.

Based on the above analysis, the Full Town Route was found to be an unviable option for Jamestown. The length and awkwardness of the route were the major concerns. The next step would be to break the route down further while considering other options. Utilizing two buses to serve different parts of town was thought to be a better scenario.

Half Town Route

The Half Town Route (map located in Appendix B) utilizes features of both the Full Town Route and the Two Bus Route. It has a single route to be traveled like the Full Town Route, but it does not serve the southeast part of town or the Jamestown State Hospital, similar to the Two Bus Route. Additionally, all points on this route can be met within the one-hour time frame. The route path that traveled east on 3rd Street Southwest and north on 12th Avenue Northeast in the Full Town Route was also eliminated as it created timing problems. It was also thought to be a 'dead zone' for the route with few riders and stops along those route segments.

The main concern with the Half Town Route was whether or not enough riders were going to be served to warrant the route's existence. Ultimately, this will not be known until the route is running daily, which is characteristic of any new fixed-route. Further research was done to investigate comparable communities which are currently running fixed-route bus systems. It was found that smaller, less complicated circulator routes are a feasible option for towns with similar characteristics to Jamestown. Based on these findings, a circulator route was designed by the research team and presented to James River Transit as another fixed-route option.

Flex Route

The final route proposed to James River Transit was a Flex Route. The Flex Route (map located in appendix B) would provide fixed-route service at a reduced fare to riders willing to walk to the route's path. However, the route would deviate within a few blocks on either side of its designated route to provide regular paratransit service, at the paratransit fare, to riders. James River Transit saw the Flex Route as the most acceptable proposal to meet its needs. Similar flex routes in Hibbing, MN, and Apple Valley, MN, have been very successful in providing door-to-door along with fixed-route service at the same time.

The main concerns with the Flex Route are that deviations will result in timing inconsistencies for the fixed-route and that riders will be unable to understand the route's functioning and pricing. Initially, it will take more trial and error for the Flex Route to function properly than would a normal fixed-route. Providing training services for potential riders will be even more imperative for a Flex Route compared to other routes as well. However, once the Flex Route passes its preliminary phase, the service it provides should fit the needs of James River Transit successfully.

Cost Effectiveness Evaluation

A main goal of this research was to determine the cost effectiveness of a fixed-route service in Jamestown. The current fare for the James River Transit paratransit service is $2.50 per ride. Local fixed routes in Minnesota, North Dakota, and South Dakota range from $1 to $2 per ride.

A fare of $1.50 per ride was recommended for Jamestown's fixed route based on these findings.

Analysis was performed to determine savings for James River Transit comparing its current service with one offering paratransit and fixed-route service. Another analysis looked at the cost savings to Jamestown residents. Analyses were based on the assumption that James River Transit would provide 50,000 one-way rides per year (they provided 50,180 in 2000 and 45,100 in 2001). The cost of providing paratransit service would be $6 per ride (their current cost estimate is $5.96 per ride). It was also assumed that the cost of providing a fixed-route ride would be $2.50 per ride. This was based on the cost of providing fixed-route service in Fargo and Minot which are estimated at $2.72 and $2.36 per ride. Finally, based on other local route fares, the fixed-route fare for Jamestown would be $1.50 per ride, and the paratransit fare would be the current $2.50 per ride.

The analysis showed that if just 5 percent of the current riders switched from paratransit to fixed-route, based on the above assumptions, the annual service cost for James River Transit would drop nearly $9,000 from $300,000 to $291,250 (Table 3.1). Furthermore, if 20 percent of the rides switched from paratransit to fixed-route, $35,000 in annual service costs would be saved (Figure 3.20).

Table 3.1 Cost of Providing Service

Ridership (Annual)		**Per Ride Cost of Providing Service**		
Paratransit	Fixed-Route	Paratransit	Fixed-Route	**Total Cost**
50,000	0	$6.00	$2.50	**$300,000.00**
47,500	2,500	$6.00	$2.50	**$291,250.00**
45,000	5,000	$6.00	$2.50	**$282,500.00**
42,500	7,500	$6.00	$2.50	**$273,750.00**
40,000	10,000	$6.00	$2.50	**$265,000.00**

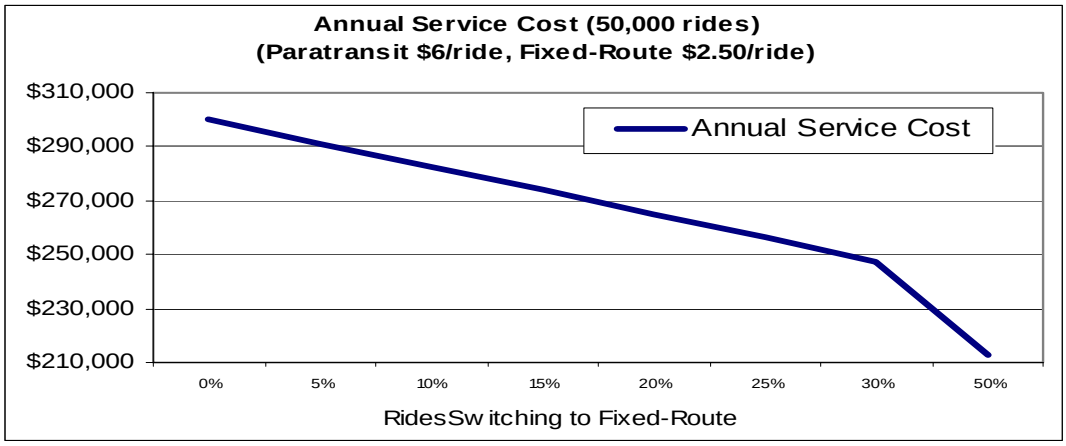


Figure 3.7 Annual service cost for James River Transit

The senior population of Jamestown (65 and older) grew from 2,633 in 1990 to 2,806 in 2000, a

6.2 percent increase. This trend is projected to continue throughout and beyond the next 5 to 10 years. An aging population leads to an increase in the demand for transportation services. Ridership has increased by roughly 12 percent during the past 5 years. Considering a conservative ridership gain of 1 percent per year, ridership would increase from the current estimate of 50,000 rides for 2004 to more than 53,000 rides by 2010 (Table 3.2). Assuming the fixed-route system would handle 20 percent of the total rides and half of the new rides each year, the annual subsidy required for James River Transit will be $158,571 in 2010 with fixed-route service as compared to $185,766 without a fixed-route system.This nearly $30,000 in savings is because the fixed-route service only would be subsidized $1per ride (revenue $1.50, cost $2.50) while the paratransit service is subsidized $3.50 per ride (revenue $2.50, cost $6.00).

Table 3.2 Annual subsidy required with and without fixed-route service

	Ridership (Annual)					**Total Subsidy Required**	
Year	Total Rides	Paratransit	Fixed-Route	**Annual Cost**	**Annual Rev.**	**With Fixed-Route**	**Without Fixed-Route**
2004	50,000	50,000	0	$300,000	$125,000	**$175,000**	**$175,000**
2005	50,500	40,150	10,350	$266,775	$115,900	**$150,875**	**$176,750**
2006	51,005	40,552	10,454	$269,443	$117,059	**$152,384**	**$178,518**
2007	51,515	40,957	10,558	$272,137	$118,230	**$153,908**	**$180,303**
2008	52,030	41,367	10,664	$274,859	$119,412	**$155,447**	**$182,106**
2009	52,551	41,780	10,770	$277,607	$120,606	**$157,001**	**$183,927**
2010	53,076	42,198	10,878	$280,383	$121,812	**$158,571**	**$185,766**

The current annual subsidy required for the James River Transit service was also analyzed (Figure 3.21). Analysis, based once again on the previous assumptions, indicated that if just 5 percent of rides switched from paratransit to fixed-route, the annual subsidy required would be reduced by more than $6,000. Also, if 20 percent of rides switched from paratransit to fixed route, the annual subsidy required for the James River operation would decrease by $25,000.

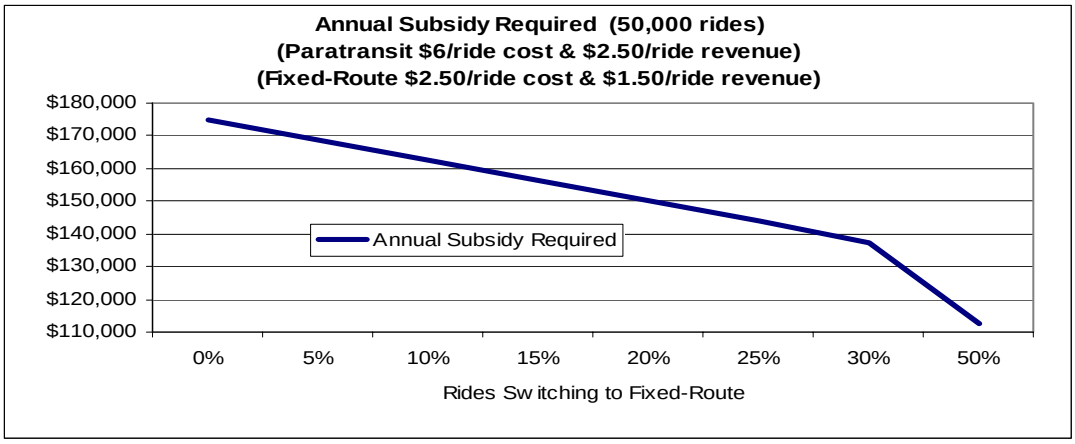


Figure 3.8 Annual subsidy required for James River Transit

The savings riders will experience using the fixed-route system is also worth noting. In a survey of James River transit riders, more than 60 percent of respondents indicated their income was less than $10,000 per year and 82 percent indicated there income was less than $15,000 per year. Low-income riders, such as these, could save a large percentage of their income by utilizing a fixed-route system for their transportation needs.

James River may decide to offer fixed-route service at a cost of $1 per ride to its customers. This would offer an even greater cost savings to riders. A rider paying for 300 annual trips who switches 25 percent of those trips to the fixed-route system from paratransit would save between $113 and $150 per year (Table 3.4).

Table 3.3 Cost Savings for Switching to Fixed Route (Fixed-Route Fare $1)

					Total Savings	
					$2.50	$3.00
Annual Trips	%Fixed-Route	Paratransit Fares		Fixed-Route	Paratransit Fare	Paratransit Fare
300	5%	$2.50	$3.00	$1.00	**$23**	**$30**
300	15%	$2.50	$3.00	$1.00	**$68**	**$90**
300	25%	$2.50	$3.00	$1.00	**$113**	**$150**
300	35%	$2.50	$3.00	$1.00	**$158**	**$210**
300	45%	$2.50	$3.00	$1.00	**$203**	**$270**
300	55%	$2.50	$3.00	$1.00	**$248**	**$330**
300	65%	$2.50	$3.00	$1.00	**$293**	**$390**
300	75%	$2.50	$3.00	$1.00	**$338**	**$450**
300	85%	$2.50	$3.00	$1.00	**$383**	**$510**
300	95%	$2.50	$3.00	$1.00	**$428**	**$570**

Numerous fixed-route options along with cost evaluations were presented to James River Transit. The cost savings will aid James River Transit in moving towards a more efficient public transit system. The fare reduction with the addition of a fixed-route system will also save the riders' income to spend on other necessities. Start-up costs do apply with training, signage, etc., but will not require an additional bus purchase as paratransit vehicles already in James River's fleet will be used to run the fixed route initially. Ridership may take some time to meet projections for the fixed route. The campus circulator at North Dakota State University, for example, took two years before its ridership reached expectations. The following discussion will present conclusions and recommendations based on the research and findings of the study.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

The demographic profile of Jamestown is dominated by an aging, diminishing population. Almost all current riders of James River's paratransit service are either elderly, physically or mentally handicapped, or both. Because of this, fixed-route requirements have to be specialized to allow a percentage of current riders to utilize the service. Currently, new ridership will not provide a sufficient amount of riders to make a fixed-route feasible.

The research team believes that the two best options for Jamestown to consider are the Half Town Fixed-Route and the Flex Route. The Half Town Route would cover a large portion of town giving it the ability to attract both current and potential riders. Also, with its current route it would have the ability to stop hourly at Jamestown College to offer service to both students and faculty. Marketing the service on campus will be critical to promote ridership, especially for students who do not have an automobile available for their own personal transportation. Offering introductory free service would allow students to become familiar with the service and its positive attributes.

The Flex Route is likely the most feasible route based on James River's current ridership. It allows riders to use a combination of the paratransit and fixed-route services at a lower cost than using the paratransit service solely. The Flex Route will also encourage riders to plan ahead and walk to designated stops to save money by paying the reduced fare. It will also lessen the pressure on James River's current paratransit service area allowing it to focus on an area outside of the Flex Route's service area. The Flex Route will not serve as large a potion of town as the Half Town Route, however, thereby limiting its attraction to potential riders who want service to and from their place of residence.

The cost evaluation shows that switching a large portion of current rides from paratransit to fixed-route is not necessary to save money when comparing the two services. However, it is quite obvious that the more rides taken on a fixed-route, the more affordable the service becomes for both the riders and the transit association. Unfortunately, many of James River Transit's current riders have physical or mental disabilities which may inhibit their ability to utilize a fixed-route service. This fact has been taken into consideration throughout the research process. The attraction of new riders to a fixed-route, whether they be college students, local residents, or some other source, is important to the longevity of a fixed-route's success in Jamestown.

A main goal of the James River Transit study is to provide a useful tool for other transit agencies to utilize in determining whether or not a fixed-route bus system is a feasible alternative in their community. Comparisons between Jamestown and other communities can provide insights into what options are available to local transit agencies. Ultimately, the goal of this research is to promote the responsiveness and efficiency of transit agencies throughout North Dakota and the entire country.

BIBLIOGRAPHY

Bowe, F. Transportation: A Key to Independent Living. *Archives of Physical and Medical Rehabilitation*, Vol. 60, 1979, pp. 483-486.

Denson, Carol R. *Transitioning to Fixed-Route Services.* Transportation Research Record, No. 1623, 1998, pp. 37-44.

Kirby, R. F., K. U. Bhatt, M. A. Kemp, R. G. McGillivray, and M. Wohl. *Para-Transit: Neglected Options for Urban Mobility*. Urban Institute, Washington, D. C., 1974.

Hickman, Mark and Kelly Blume, *A Investigation of Integrated Transit Service.* Southwest Region University Transportation Center, No. 472840-00023-1, 2001, pp. 1-48.

Sowden, Susan and Laurie Wick, *Moving Paratransit Customers to Fixed-Route: The British Columbia Transit Community Travel Training Program.* Bus & Paratransit Conference, Calgary, Alberta. 2001.

O'Connell, L., Siria, B., and Grossardt, T. *Bringing Fixed-Route Transit Service to Small Cities and Towns.* Transportation Research Record, No. 1791, 2002, pp. 72-77.

Porter, D. R. *Transit Focused Development.* TCRP Synthesis 20. National Academy Press, Washington D.C., 1997.

Lave, Roy and Rosemary Mathis. *State of the Art Paratransit.* Transporation Research Board, No. A1E10, 2001, pp. 1-7.

Giuliano, G., J.E. Moore II, T. O'Brien and J. Golob. *San Gabriel Valley Smart Shuttle Technology (SGVSST) Field Operational Test Evaluation: Final Report.* Institute of Transportation Studies, University of California, Berkeley, ISSN 1055-1425, 2002, pp. 1-118.

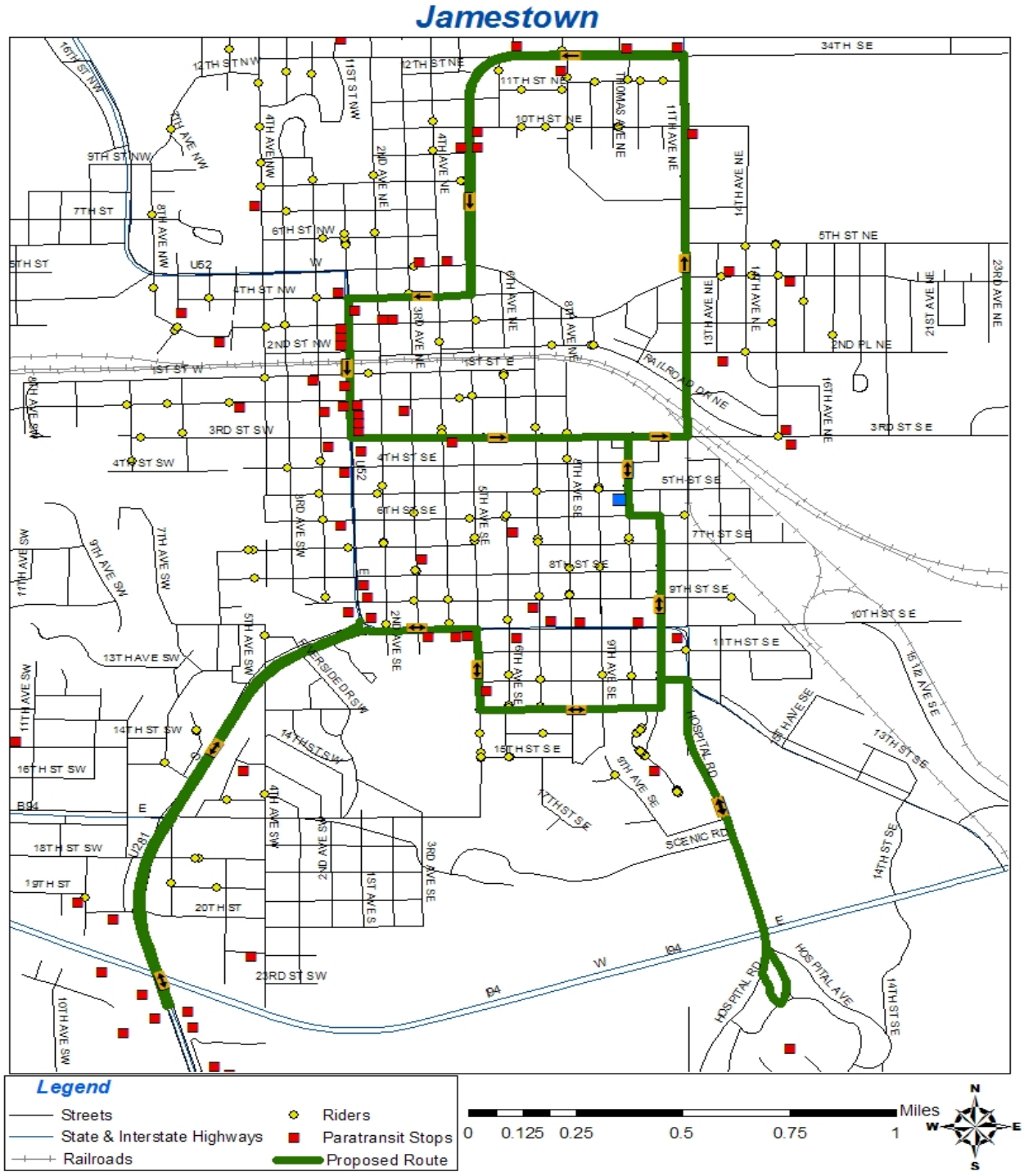
Greschner, Jurgen. *Technology Integration of Fixed-Route and Paratransit Service.* INIT Innovations in Transportation, Inc. American Public Transportation Association, 2001, pp. 1-5.

Li, Qiang and Carl Kurt. *GIS-Based Itinerary Planning System for Multimodal and Fixed-Route Transit Network.* Mid-Continent Transportation Symposium Proceedings, 2001, pp. 47-50.

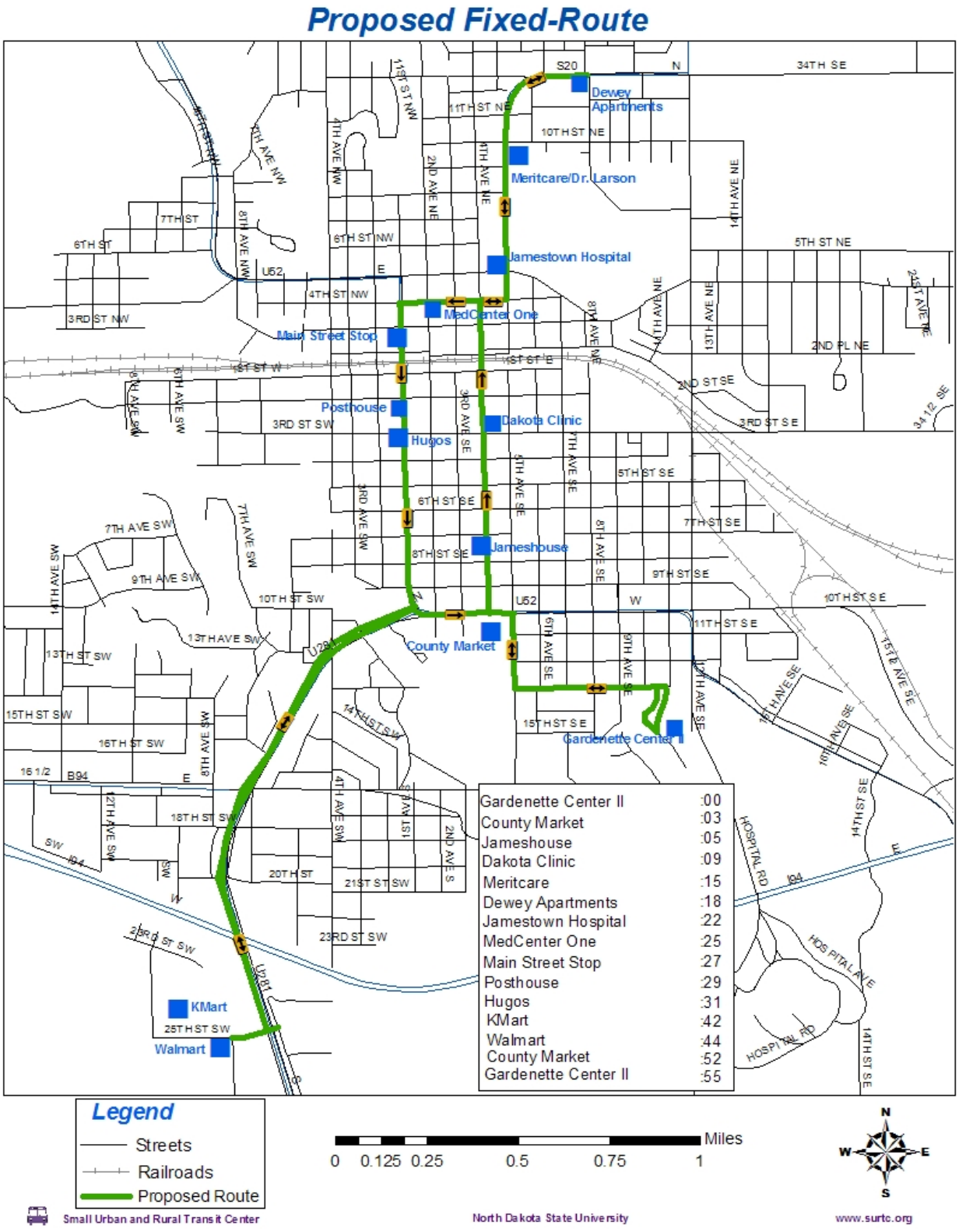
APTA General Definitions. http://www.apta.com/research/stats/overview/gendef.cfm., 2003.

APPENDIX: PROPOSED ROUTES

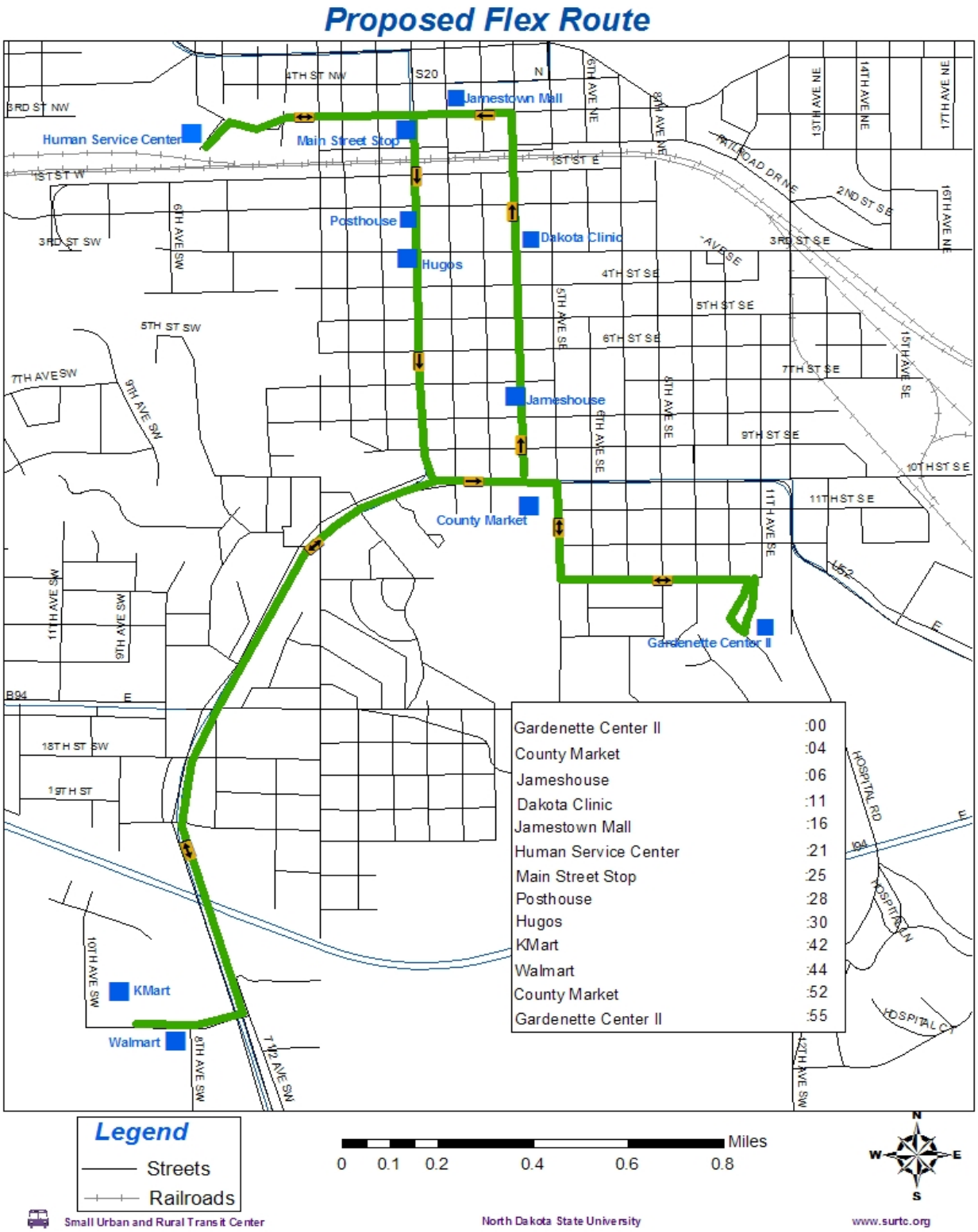
Full Town Route



Half Town Route



Flex Route


Proposed Flex Route
Jamestown Mall
Human Service Center
Main Street Stop
Posthouse
Dakota Clinic
Hugos
Jameshouse
County Market
Gardenette Center II
KMart
Walmart
Gardenette Center II :00
County Market :04
Jameshouse :06
Dakota Clinic :11
Jamestown Mall :16
Human Service Center :21
Main Street Stop :25
Posthouse :28
Hugos :30
KMart :42
Walmart :44
County Market :52
Gardenette Center II :55
Legend
Streets
Railroads
Miles
0 0.1 0.2 0.4 0.6 0.8
N
W E
S
Small Urban and Rural Transit Center
North Dakota State University
www.surtc.org