An analysis and approach to improving the Grand River Transit system in Ontario's Waterloo Region

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1 Background

In April of 2024, I came across an article written in the Waterloo Region Record calling for more people over the age of 25 to take Grand River Transit (GRT) who may be willing to pay higher fares. The article outlined the current problems with the GRT: the system currently depends on bulk fares negotiated by universities and geared toward transporting students and other community members who have few alternatives to transit. This has led to mediocre services which tend to see the majority of people who graduate from student-rate fares transitioning to car ownership or active forms of transportation as an alternative to continued use of GRT. Compared to other cities in Southern Ontario, the GRT system does not serve well people who are no longer students. Throughout this article, I will further analyze this problem, investigating why the desired group of transit customers—people over the age of 25, are not taking transit, and what could be done, on top of existing GRT plans to encourage its use.

1.1 Problem Statement

The GRT system is not retaining individuals who are no longer students among its ridership base, leading to a reduced quality of services and comparatively low average fare per passenger.

1.2 Breakdown of the Problem

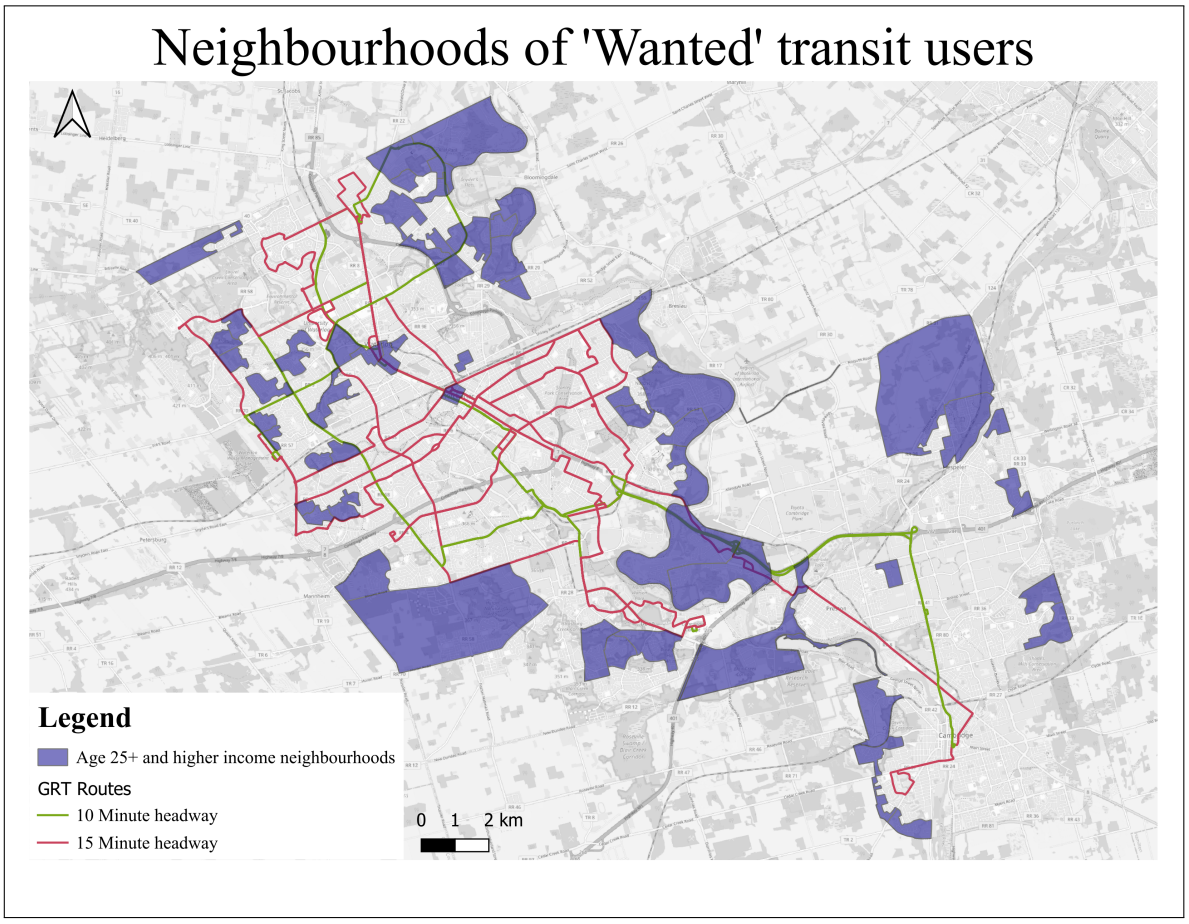
1.2.1 Location and Distribution of Desired Riders

A major issue in enticing additional ridership, especially for a group of potential consumers who are employed, is that obtaining transit alternatives is more feasible. Hence, these consumers will deeply internalize the time saving of transit use, particularly in the case where they already own a personal automobile. Additionally, time for a working professional is much more valuable than to a student who has little alternatives. Hence, if transit requires a long wait, or is slow in comparison to driving directly to a destination, riders will seldom choose the inconvenient transit option. Figure 1 illustrate the geographic distribution of people in the Waterloo Region, working over the age of 25 and the frequent transit routes operated by GRT at 10 and 15 minute headways.

These neighbourhoods tend to be on the perimeter of the urban boundary and designed with a winding road layout, which increases the time to walk to transit stops, often located along main arterial

roads. When adding the walk time to wait times at bus or LRT stops, an assumed value I will use as half of the headway time, these individuals spend as much as 20 minutes walking and waiting for the bus. Comparatively, using a car to get from your origin to destination of interest can be covered by 20 minutes in most cases within the region. Clearly, transit in its current form is at a severe disadvantage.

Figure 1: Distribution of desired users and frequent routes



Notes: This figure plots the neighbourhoods across the Waterloo Region home to the highest deciles of income earners and quantity of people over age 25. The green routes outline GRT routes operating at 10 minute headways. The red routes outline GRT routes operating at 15 minute headways. Data was obtained by the Canadian Census.

1.2.2 Routing and Time

Arguably the biggest decision criteria for individuals with multiple mobility options is convenience. With a choice of all transportation methods to get from an origin to a destination, a commuter will pick that which has the lowest opportunity cost. In the current form of GRT transit, there are few destinations that can be reached by higher income neighbourhoods with a large share of 25y/o+ residents faster by transit than by car.

To illustrate this comparison, I have selected a group of neighbourhoods throughout the Region that simultaneously house the highest decile of income earners and the highest decile of population over the age of 25. I have then measured the time it would take to commute from the centre of each neighbourhood, representing the distance for the average resident in that group, to a series of employment and amenity centres of interest throughout Kitchener, Waterloo and Cambridge.

In generating this table I have made the following assumptions: (1) an individual will wait at the transit stop for at least half the headway of the route. For example, on a route with 10 minute frequency, the rider will wait for at least 5 minutes. (2) an individual will not walk more than 10 minutes to reach a transit stop, or walk more than 10 minutes from a stop to a destination. This aligns with the academic research on transit accessibility, which suggests that 800m distances or about 10 minute walks are the maximum tolerable distance to reach a bus service. (3) bus transit travels on average at 22kmh and LRT at 30kmh when considering stopping and dwell time. Car traffic will travel at the posted speed limit. (4) the destination areas are determined by the centroid of an area with high levels of employment or amenity concentration.

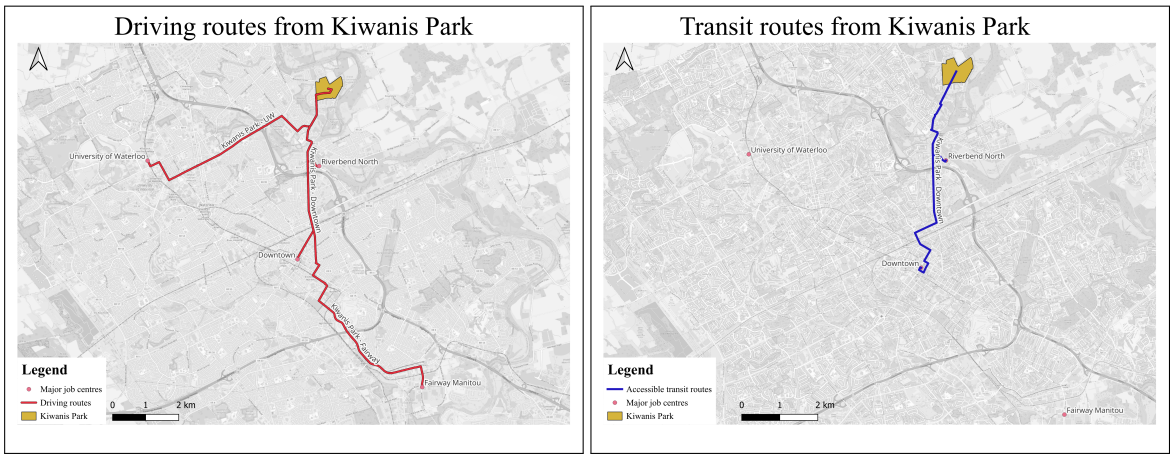
Table 1 indicates that there are no destinations in the selected sample throughout the region that can be reached by transit faster than can be reached by driving, indicating that for the average household, transit is much less convenient than driving. As a caveat, those rows that include an "NA" for Transit Time are routes that cannot be completed by transit because they violate the walking distance assumption (2). Where both the Transit Time and Driving Time are "NA", this represents that the Origin and Destination are the same place. Of course, this table is not all-encompassing, but represents a sample of several origin-destination combinations.

Figure 2 and Figure 3 both show feasible routes from the neighbourhoods of Beechwood Forest and Kiwanis Park to major destinations of UW, Riverbend office park, Fairway Manitou and Downtown Kitchener. Clearly, these destinations are easily accessible by car from both neighbourhoods. However, lack of frequency, long walking distances, high weight times and multiple connections has resulted in long commute times by transit, and for many cases, the violation of the assumptions above chalks them up to being infeasible for the average commuter.

Table 1: Comparison of Transit and Driving Times by Origin–Destination Pair

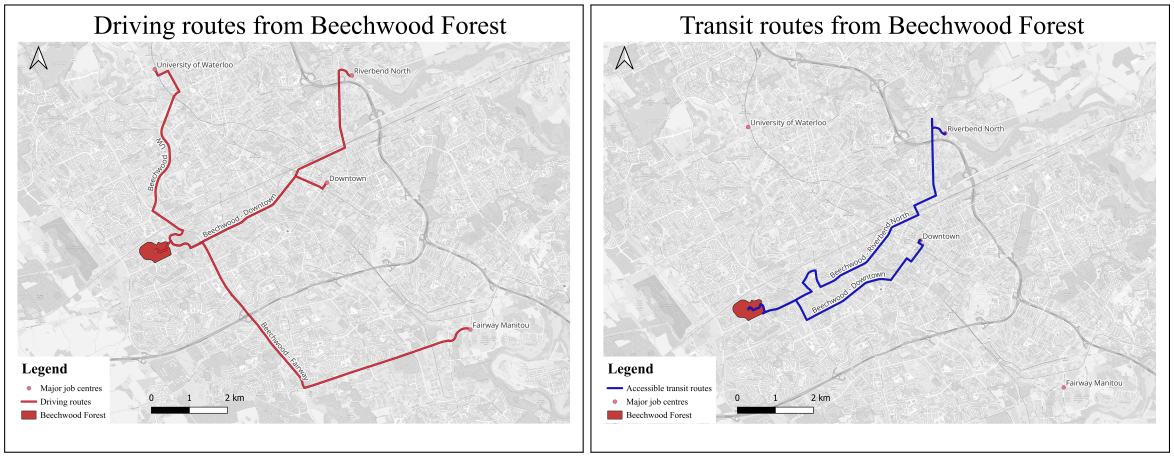
Origin	Destination	Transit Time	Driving Time	Time Saving
Uptown Waterloo	Conestoga	NA	9.16	9.16
Uptown Waterloo	University of Waterloo	NA	6.75	6.75
Uptown Waterloo	Riverbend North	37.21	6.49	30.72
Uptown Waterloo	Downtown Kitchener	25.62	4.71	20.91
Uptown Waterloo	Fairway Manitou	NA	11.94	11.94
Uptown Waterloo	Pinebush	NA	25.19	25.19
Uptown Waterloo	Uptown Waterloo	NA	NA	NA
Beechwood Forest	Conestoga	NA	13.79	13.79
Beechwood Forest	University of Waterloo	NA	9.79	9.79
Beechwood Forest	Riverbend North	57.22	11.30	45.92
Beechwood Forest	Downtown Kitchener	40.91	7.45	33.46
Beechwood Forest	Fairway Manitou	NA	12.60	12.60
Beechwood Forest	Pinebush	NA	27.16	27.16
Beechwood Forest	Uptown Waterloo	41.82	6.84	34.98
Downtown Kitchener	Conestoga	NA	11.04	11.04
Downtown Kitchener	University of Waterloo	NA	8.96	8.96
Downtown Kitchener	Riverbend North	34.89	5.47	29.42
Downtown Kitchener	Downtown Kitchener	NA	NA	NA
Downtown Kitchener	Fairway Manitou	NA	8.68	8.68
Downtown Kitchener	Pinebush	NA	21.93	21.93
Downtown Kitchener	Uptown Waterloo	25.04	4.06	20.98
Devil's Creek	Conestoga	NA	30.28	30.28
Devil's Creek	University of Waterloo	NA	28.11	28.11
Devil's Creek	Riverbend North	87.79	24.02	63.77
Devil's Creek	Downtown Kitchener	69.81	19.47	50.33
Devil's Creek	Fairway Manitou	NA	13.01	13.01
Devil's Creek	Pinebush	NA	10.28	10.28
Devil's Creek	Uptown Waterloo	77.51	23.23	54.28
Laurelwood	Conestoga	NA	11.65	11.65
Laurelwood	University of Waterloo	NA	6.79	6.79
Laurelwood	Riverbend North	59.63	12.29	47.34
Laurelwood	Downtown Kitchener	51.96	11.79	40.17
Laurelwood	Fairway Manitou	NA	17.62	17.62
Laurelwood	Pinebush	NA	32.18	32.18
Laurelwood	Uptown Waterloo	46.10	7.51	38.59
Doon	Conestoga	NA	24.80	24.80
Doon	University of Waterloo	NA	21.92	21.92
Doon	Riverbend North	69.05	17.82	51.23
Doon	Downtown Kitchener	51.07	13.28	37.80
Doon	Fairway Manitou	NA	6.81	6.81
Doon	Pinebush	NA	16.43	16.43
Doon	Uptown Waterloo	58.77	17.03	41.75
Kiwanis Park	Conestoga	NA	12.23	12.23
Kiwanis Park	University of Waterloo	NA	12.18	12.18
Kiwanis Park	Riverbend North	34.67	5.96	28.71
Kiwanis Park	Downtown Kitchener	38.80	9.21	29.59
Kiwanis Park	Fairway Manitou	NA	16.61	16.61
Kiwanis Park	Pinebush	NA	26.40	26.40
Kiwanis Park	Uptown Waterloo	38.75	9.05	29.70

Figure 2: Driving and Transit Routes from Kiwanis Park



Notes: This figure notes the transit and driving routes from a neighbourhood near Kiwanis Park to the destinations of Downtown Kitchener, Univeristy of Waterloo, Riverbend and Fairway Manitou. All routes are accessible by car, but the walking distance to reach an appropriate bus to access Fairway Manitou and UW by transit is beyond reasonable for the average person. Thus, these transit routes are not shown as feasible in blue.

Figure 3: Driving and Transit Routes from Beechwood Forest



Notes: This figure notes the transit and driving routes from Beechwood Forest to the destinations of Downtown Kitchener, Univeristy of Waterloo, Riverbend and Fairway Manitou. All routes are accessible by car, but the walking distance to reach an appropriate bus to access Fairway Manitou and UW by transit is beyond reasonable for the average person. Thus, these transit routes are not shown as feasible in blue.

1.2.3 The Transit vs Driving Experience

On a qualitative basis, it is important to consider the holistic environment that transit and automobile commuters are exposed to when making their journeys. For commuters with a greater choice of transportation mode, these are factors that strongly influence the choice of one mode over

another.

For the driver of the automobile, these factors include accessing their vehicle, the comfort of the driving experience, the perceived safety of the commute, the ease of finding parking, the walking environment to and from their vehicle and their destination, the stress of the driving experience, etc. If these experiences are comparatively more positive than those associated with taking transit, commuters will be much more likely to continue driving. Important as well is the time and monetary cost of the driving process. This would include variable costs such as refuelling, regular maintenance, paying for parking and the time it takes to commute. Individuals who have also spent a significant of money on purchasing a vehicle, or who service regular car payments may experience a bias toward using their vehicle and getting perceived use of their money. If the combined cost of operating a car with the opportunity cost of time spent driving is lower than that of transit, this will be a strong deterrant away from switching to the transit mode. At the same time, if the sunk cost of purchasing a vehicle acts as a strong motivator to continue using the car, even in cases where it is not fully the most convenient option, transit use is less likely.

For the transit user, the qualitative features are similar, but vary in their details. They include: the ease of accessing a bus or LRT stop at their origin, and their destination from the stop at their terminus, the perceived safety and comfort of the transit vehicle while on board, at the waiting points, and during the walk to and from transit, the stress or ease of figuring out the network and route required to reach their destination. Given that transit users tend to reach their origin by active transportation such as walking or cycling, the comfort, stimulation and safety on that leg is very important too. Many of these factors are difficult to control, and if they are much more negative than the driving experience, users will be drawn away from transit. Once again, the monetary and opportunity cost of time is an important consideration too. The monetary cost is primarily the fare of using transit, which is relatively low compared with automobiles. Time is a large consideration. If transit takes significantly longer to connect a user with a destination than by alternative modes, it is assumed that individuals determine the cost of what they can do with their lost time, and thus make decisions with this information as well.

I assume that commuters take into consideration all of this information when they make a decision to use one commute mode over another. Thus, the holistic transit environment is an important consideration in the analysis of why existing commuters are not using public transportation. We cannot expect individuals to be willing to use a service, let along pay more for it, if it is not meeting their needs, completing the trips they require, or competing effectively with other modes of transportation.

1.2.4 Paying fares

Currently, the fare payment system is technologically behind systems in other major cities. Users are not able to tap their credit and debit cards on a fare box to access the transit vehicle. For individuals who may wish or decide to spontaneously use transit, and do not have an EasyGo card, they must make the deliberate choice to carry exact change for the fare. This can act as a strong barrier to entry to using the bus or LRT system. Forcing riders to load or reload a fare card, buy tickets in advance, or carry change to use the system does not invite new users to try the system, or use it at their convenience.

1.3 Possible Remedies

This next section will outline possible choices that can be made to position the GRT system toward providing a better service to the non-student demographic over the age of 25 years. The proposed options are outlined in their perceived ease of implementation.

1.3.1 Updating fare boxes to accept card payments

The lowest hanging fruit and option that the GRT can take to make taking transit more convenient in the region is to update the fare box system to accept credit and debit cards. This would allow users to avoid having to plan the exact amount of cash to carry in order to complete their journey, and would improve the level of spontantaneity possible in using transit for the average working person.

1.3.2 Improving the waiting at and commuting environment to GRT stops

At present, the waiting environment is quite unpleasant for the average commuter or transit user. To make the network simple and accessible to a larger group of people, most lines run along major arterial roads with large amounts of vehicle traffic. While this makes sense from an access point of view, it results in transit commuters waiting along the side of roads with very fast and loud vehicle traffic. At the same time, many of these roads feature driveways into businesses and homes, a lack of greenery, shade from trees and protection from the elements, especially the hot sun in the summer and cold in the winter. When compared to the climate controlled environment of a personal automobile, it is clear why many commuters choose to drive rather than take transit.

That being said, there is action that the consituent cities and the region can take to improve

this environment. Deliberate effort and investment can be made into the station and stop areas to improve the comfort and safety of riders. Imagine constructing architecturally interesting bus shelters that represent the pride, innovation and care for public services that we should be demonstrating in our city. These shelters could include greenery, trees, flowers or gardens around them to foster a pleasant environment, fans or cooling technology in the summertime and heaters in the winter time to improve climate comfort. Special attention should taken to the signage, including the system that has been included in iXpress stations to provide information on the next bus, to reduce uncertainty about waiting time.

1.3.3 Increase the speed of existing transit

To better align the commute time by driving and the commute time by taking transit, the region could take action to reduce the time that transit vehicles are stuck in traffic. Given that each bus has the potential to transport tenfold as many people per vehicle compared to a car, the argument can be made that it is fair to give certain priorities to transit vehicles to increase their speed.

There are two roadway features that could be improved to make this possible. First, certain lanes on busy roadways can be designated as transit-only lanes during the busiest times of the day. Simultaneously, including transit signal priority, where all cars in the intersection must wait for the buses to pass through before proceeding, allows for the buses to get a head start and avoid having to wait for vehicles carrying only a few passengers from slowing them down. These measures would not need to operate all day, but only when road and transit demand warrants it. Second, special lanes and dwell areas can be built into existing roads to improve the waiting environment, give buses a designated area, and take them off of through areas. For example, right turn only lanes can be used as a queue jump lane for buses, allowing them to drive ahead of the line of thru-travelling cars. This will prevent cars from having to wait behind buses while they are pulled over to allow passengers to alight and also gives buses a travelling head-start. This can simultaneously improve flow and travel for both automobile drivers and for bus passengers.

1.3.4 Re-routing trips to improve connections and service

As seen in 3 and 2 transit routes throughout the region are not directly connecting residents to their desired destinations. This is expected, given budgets are limited and neighbourhoods in the region tend not to be dense enough to support a series of direct trips at high frequency. However, the maps show that many destinations cannot be effectively completed with existing transfers between lines

either. When these transfers are possible, they often result in very long wait times and commute times. Thus, it is suggested that some routes be re-routed in order to improve the connection experience, with increased focus on connecting through the centre of town with a focus on more of a hub and spoke network, rather than through circuitous connections on the outside of the city. Without going into specifics, this could include lining up several bus routes for short spans close to Downtown Kitchener or Uptown Waterloo on the same street, ideally one with high density of businesses, amenities and residents. This would provide two key benefits. First, it would create an easier environment of commuters to switch effectively between lines, reducing the need to walk long distances to get to a transfer point. It would also improve the waiting environment, by dropping off connecting passengers in an area with an activated street landscape close to amenities and points of interest. Secondly, for residents along these spans of overlapping service, it would give them quick access to a larger selection of transit routes, while also improving frequency of bus connections along a busy and high-demand corridor, without investing a larger quantity of resources in raising the number of vehicles servicing particular routes.

1.3.5 Increasing frequency of transit trips

By raising the number of vehicles servicing the routes across the region, the GRT can reduce the waiting time for transit vehicles. This is a powerful yet expensive tool in making transit appealing for more commuters, as it allows trips to be spontaneous, and taken without giving too much attention to the schedule. If a commuter can show up at the bus stop, knowing that the next bus will arrive within a window of less than 10 minutes, there is much less stress about missing a bus and having to figure out an alternative. If frequency was improved across the board, and additional routes added to increase transit coverage across the city, arguably this would result in the most powerful draw for non-students to take transit.

Unfortunately, this is a very expensive decision which creates a chicken-and-egg scenario. By halving the headway on a bus line, it requires a doubling of resources allocated to the route. This means twice as many buses, twice as many drivers and additional maintenance and administration. If ridership depends on having higher frequencies, but higher frequencies require more funds collected from local taxes, the farebox or government subsidies, it is a risk to raise frequency without knowing if the ridership will materialize. It could be a large and inefficient use of resources if a route is expanded and ridership does not improve or change.

1.3.6 Modifying zoning and neighbourhood density to increase ridership

Many of the neighbourhoods that transit currently tries to serve in the Waterloo Region are low-dense, sprawling suburban areas. These types of neighbourhoods, as we've seen throughout this paper, are difficult to serve because buildings tend to be far apart, the roads are winding, and they are monotonous and not particularly friendly or interesting for active transport. They are also well suited for individuals who choose to drive. This creates long walks to transit which are accessed at busy roads, and requires constant conflict between the pedestrian and the driving environment. The low density also means that transit is drawing from a small ridership pool, spread out over a larger area, which leads to longer trips and farther journeys. By increasing the density of these neighbourhoods, more people are placed into the catchment area of the transit system, which can drive larger ridership and increases the tax base to fund the system.

Increased density can occur at an incremental and gentle pace which does not significantly alter the design and feel of a neighbourhood, which are considerations that can be accutely important to residents. This could include converting some spaces in existing homes into flats, additional apartments, granny suites or backyard cottages. For example, city zoning laws could allow for existing residents to, at their discretion, convert a garage or basement into an apartment for lease. On large enough lots, residents could be permitted to build a backyard cottage, or convert their home to a duplex or triplex. These decisions could drive additional income for residents, allow older families to stay in their home, build wealth for homeowners, all while increasing the supply of housing, and increasing the density of neighbourhoods to improve transit ridership. At the same time, these decisions do not result in major construction projects that disrupt a neighbourhood dynamic.

These actions require some alterations of municipal zoning codes and by-laws to implement. They also will not be an effective solution to the short-run issues affecting local transit. However, they are decisions that could pave the way for addressing many of the concerns of our cities.

1.4 Conclusion

In order to address the complex and highly dynamic concerns facing the public transit system in the Waterloo Region, a holistic approach must be adopted to align the provided service with the desires and requirements of the preferred clientele. In order to attract non-students, who work professional jobs and have a higher standard for their transportation services, we must design a system that aligns with those preferences. This requires taking a suite of action that focuses on the details that these

commuters care about.

In the short term, I recommend that the GRT immediately updates their fare collection technology to accept tap credit and debit card payment. Simultaneously, an effort to update the waiting area by improving the shelter and walking environment would welcome professionals in comfort to use transit. Over the next year, the routing, speed and frequency of transit should be increased. This would include updating roads and traffic signals as they come up for renewal, to support transit priority and pace to prevent lost time to traffic. Furthermore, alignments should be designed to overlap in key areas, improving connections, and frequency in amenity and employment-rich regions. On the most important routes with the highest potential for ridership growth, frequency should be increased to allow commuters flexibility and spontaneity in their transportation mode choice. Over the long run, it is recommended that transit planners work closely with land-use planning to design by-laws that create incentives to position neighbourhoods to have the choice to take high-quality public transit. All in all, this requires a holistic approach over varied time frames to improve the GRT system, an endeavour that will improve the mobility experience in the Waterloo Region for all.

For a region of cities that are quickly growing, and serve as one of the most innovative and exciting places in all of Canada, our transit and mobility system should reflect these aspirations and values. By implementing the above recommendations, the GRT will surely be aligned with these goals and characteristics.