

Enhancing Public Transit Access in Mississauga: Spatial Analysis

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Summary

This report, *Enhancing Public Transit Access in Mississauga: Spatial Analysis*, examines transit accessibility in the city of Mississauga. Through spatial analysis in ArcGIS Pro, the study identifies underserved area and evaluates potential reasons for limited transit accessibility. Key tools and methods include performing a buffer analysis, to locate areas within 500m of bus stops and those without nearby stops. These census data of these areas was then analyzed to determine potential underlying reasons for their lack of access. The results revealed two underserved areas. One area near North Service Road and Courtneypark Drive East, a low income area, and the Mississauga Golf and Country Club, a medium-high income area. The findings suggest that population density and socio-economic factors significantly influence transit accessibility.

Key Terms

Spatial Analysis: A method used in Geographic Information Systems (GIS) to study locations and patterns.

Transit Accessibility: The ease that people can reach and use public transit services.

Buffer: A spatial tool that creates zones around features.

Kernel Density Analysis: A Spatial method used to visualize the concentration of features in a given area.

Underserved Areas: Geographic regions lacking adequate public transit services compared to population needs.

1. Introduction

1.1 Background

Access to transportation is a necessity for everyone. From commuting to work, class, or accessing essential services, the presence of reliable and efficient transportation can be the difference between someone achieving their goals or facing challenges. This problem is outlined by Hartell (2008) as the author discusses inadequate transportation and its effect on community involvement, identifying that transportation can be a significant barrier, particularly for populations that are low-income or minorities. Similarly, Tilahun and Li (2015) discuss the last-mile problem. These are the challenges individuals face when accessing transit stations. Their research revealed that barriers such as excessive wait times, safety from crime, and sidewalk availability all contributed in influencing people's decision to walk to transit.

Furthermore, the lack of suitable transportation access, not only creates challenges, but also deprives individuals of immense benefits. As outlined by Litman (2024), increased access to public transit leads to economic, social, and environmental advantages. This is because it provides equity benefits, reduces traffic congestion, as well as reduces air and noise pollution. In terms of the economy, improved transit systems will allow for increased access to jobs, and attract businesses to underserved areas. (Litman, 2024) Additionally, people will save a great deal of money as vehicle ownership will no longer be a necessity for some. (Weisbrod & Reno, 2009)

Recognizing these benefits, the federal government of Canada has committed \$112 million, over the next decade, to improve Mississauga's transit system. The current Mayor of Mississauga, Carolyn Parrish, exclaimed that this action would ensure 'families are going to come to Mississauga,' and that investors will be convinced to invest in the city. This statement outlines the clear benefits of transit improvement. The reason for Mississauga's selection for this investment is because it is one of the fastest growing cities and it requires an optimal transit system to continue to flourish. (Cornwell, 2025)

Overall, these findings highlight the need for a refined transportation system, aligning with this study's goal of improving Mississauga's transit accessibility. Increasing access to public transit is beneficial to both the government and its people, making investments like this an exceptional decision.

1.2 Literature Review

Public transportation allows for urban mobility while influencing economic growth and environmental sustainability. Despite these benefits, the persistent issue is that many areas lack equal access to public transportation. It is because of this, that this literature review seeks to address the reason for this cause, while analyzing the methods currently used to evaluate and improve public transit accessibility. The aim is to explore the reasons for transit inequity, evaluate current methods and identify gaps in existing research to ultimately propose actionable solutions to improve transit routes and scheduling in Mississauga. Upon completion, this study will contribute to reducing commute time and increasing accessibility for underserved neighbourhoods in the city.

As previously mentioned, access to reliable and efficient public transportation is vital in terms of economic growth and environmental sustainability. A factor that is often overlooked, however, is social equity. Hartell (2008) emphasizes the detriment that inadequate transportation access can be to community participation. The study explains how this consequently impacts low-income groups as they face mobility challenges, limiting employment opportunities, access to healthcare and social gatherings. We can build on these findings by analyzing Litman's (2024)

work, for he argues that effective transit systems reduce traffic congestion, promote economic growth and decrease air and noise pollution. Economically, improved transit systems can attract business to underserved areas. Additionally, individuals will be able to save a substantial amount on transportation costs. (Weisbrod & Reno, 2009) These studies reinforce the interconnectedness of economic, environmental and social benefits of improving transit accessibility.

To address the issue of inadequate transit access, it is important to understand its barriers. To accomplish this, Tilahun and Li (2015) explore the factors influencing individuals' decision to walk to transit stations. In this study, they identify excessive wait times, safety concerns and sidewalk availability to be key barriers. Moreover, Pakissi and Dentinho (2016) discuss transit access equity through the analysis of spatial and economic disparities. The primary takeaway from their study was that transit planning often favors high-income and high density areas, while low-income areas are underserved. While it is expected that high density areas receive greater access due to the increased demand, it is unjustifiable to neglect low-income areas with equal or greater need. This inequity is relevant to Mississauga's situation, where urban expansion has grown quicker than transit infrastructure has had time to develop. Furthermore, Weisbrod and Reno (2009) highlight the inconsistent transit schedules and overcrowding to be key factors in deterring riders. Thus, these findings suggest that improved service frequency along with optimized transit routes, would result in an increase in overall accessibility.

Understanding these barriers, we can evaluate how transit efficiency and equity are measured in existing research. Currently, transit performance is most commonly assessed using efficiency and equity indicators. A framework proposed by Pakissi and Dentinho, (2016) incorporates spatial data. To predict how people move around the city, they use spatial interaction models. (SIMs) In this model, they divide the city into zones and look at factors such as the number of people that live there, where their work is and how far they travel. It also takes into account how attractive these zones are, ultimately estimating how much people are willing to pay to live near public services like school or workplaces, a concept known as bid rent. Tilahun and Li (2015) on the other hand, utilize stated preference surveys to evaluate walking access to transit stations. While the study reveals perceived barriers that influence transit usage, it is reliant on self-reported data. Additionally, the study also analyzes service frequency, which can be obtained through general transit feed specification data (GTFS). However, a limitation of using data like this is that it does not account for service disruptions or seasonal variations.

While the existing literature provides valuable insights regarding transit accessibility, there are multiple gaps remaining unaddressed. As previously mentioned, solely relying on service frequency data can decrease the reliability of the study. Similarly, the framework utilized by Pakissi and Dentinho (2016), while effective in analyzing spatial equity and bid rents, fails to account for rapidly growing areas like Mississauga, where population growth has outpaced transit infrastructure. To address these limitations, this study builds on the strengths of existing

methods while making adjustments to suit the context of Mississauga, a mid-sized city that is growing rapidly. To account for the rapidly growing area, we can map current population densities to aid in finding underserved areas. Furthermore, to improve accuracy, this study will better integrate spatial data through the mapping of GTFS data, allowing for a stronger analysis of transit accessibility and service gaps.

Overall, this literature review highlights the importance of public transit accessibility, identifying key barriers that prevent equitable transit access. Existing research indicates that inadequate transit access greatly affects low-income communities, potentially contributing to further the social and economic disparity between high and low-income communities. While various methods have been used to evaluate transit performance, there are gaps concerning cities like Mississauga. This study aims to address these gaps, providing a comprehensive understanding of transit accessibility in Mississauga.

1.3 Research Question

What strategies can be implemented to enhance public transit routes and schedules in Mississauga, aiming to minimize commute times and increase accessibility for neighborhoods with limited transit services?

1.4 Objectives

Primary Objective: To determine areas that are underserved in terms of transit routes and scheduling and provide recommendations to improve transit accessibility and improve commute times.

Secondary Objective: To identify potential reasons for these areas being underserved, including economic or demographic factors.

2. Method

2.1 Study Area

The study will focus on Mississauga, Canada, a rapidly growing city within the Greater Toronto Area (GTA). Mississauga is an urban city with a solid transit system, including MiWay and GO Transit. Areas that are identified as underserved will be of focus.

2.2 Data Collection

Data was sourced primarily from the city of Mississauga's Open Data platform as well as Statistics Canada. The following data sets were used:

- Mississauga boundary shapefile
- MiWay bus stops and transit locations
- Peel Region census data

2.3 Analytical Method

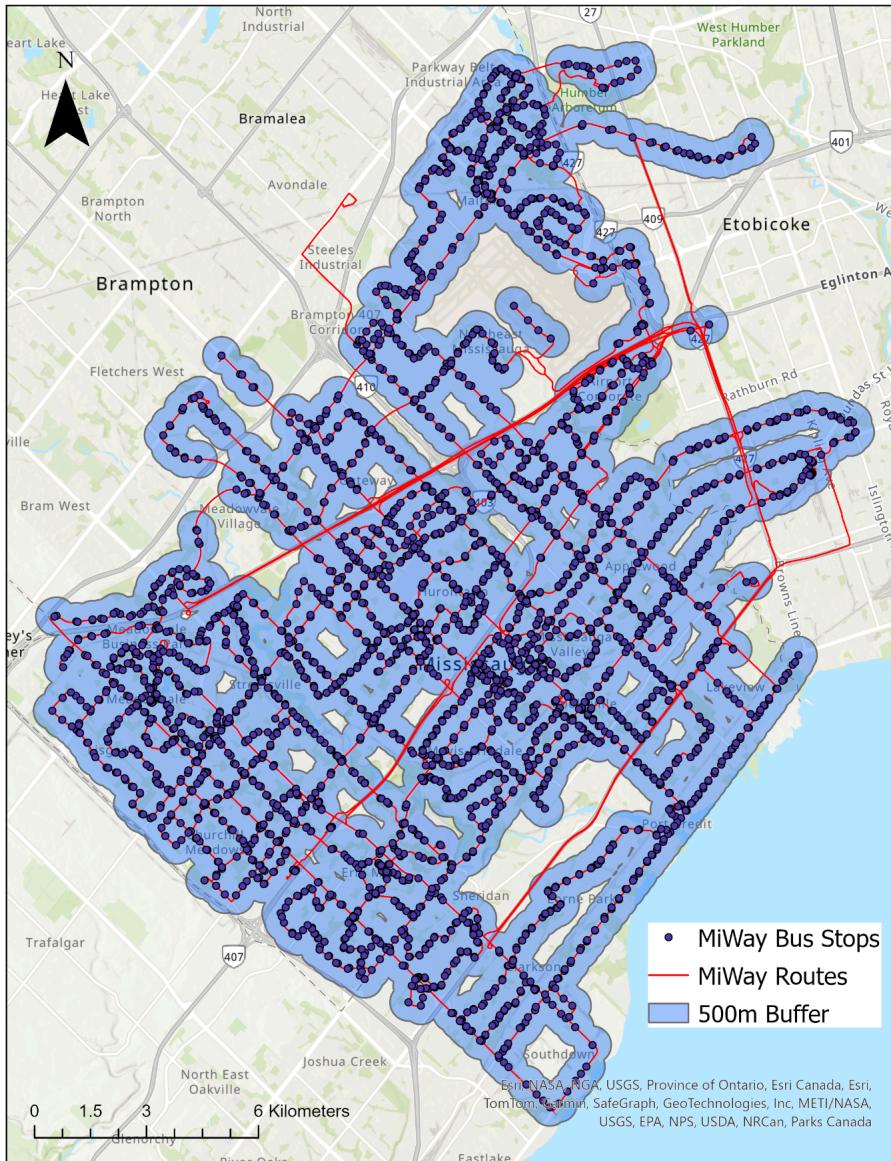
Spatial analysis was conducted using ArcGIS Pro using the following tools and methods:

- Projection: All spatial data was analyzed using the NAD83 projection as it is most accurate for the study area
- Buffer Analysis: Created 500m buffers around all bus stops to assess transit coverage/accessibility
- Kernel Density Analysis: Performed kernel density analysis to display the concentration of bus stops across Mississauga
- Created choropleth maps to visualize population density and income levels for clear interpretation

This choice of methodology is supported by Tilahun and Li's (2015) study on the last-mile problem which used spatial analysis to evaluate walking access to transit stations.. Similarly to this study, they focus on transit station accessibility with their findings highlighting the importance of walking distance. Moreover, the use of spatial analysis and accessibility metrics is also supported by Pakissi and Dentinho (2016), who discuss the importance of measuring public transit distribution through efficiency and equity indicators. By combining these approaches, this study aims to identify underserved neighbourhoods in Mississauga.

3. Results

Mississauga Transit Accessibility: 500m Walkable Areas



Map authored by: Mohamed-Amin Yousuf
Data Source: Mississauga Open Data
Projection: NAD 1983 UTM Zone 17N

Figure 1: Map displaying 500m buffers around MiWay bus stops in Mississauga

From this map we can see a general overview of Mississauga's MiWay transit system. Using a 500m buffer, the map illustrates walkable areas surrounding each bus stop. While a majority of the city is covered, there are clear gaps in the northern and southern regions. Towards the north of the map around North Service Road and Courtneypark Dr E intersection, there are no bus

stops within 500m which is problematic for residents who reside in this area and rely on public transit. Furthermore, towards the south, another area in need of greater transit access is the Mississauga Golf and Country club, with no nearby bus stops as well.

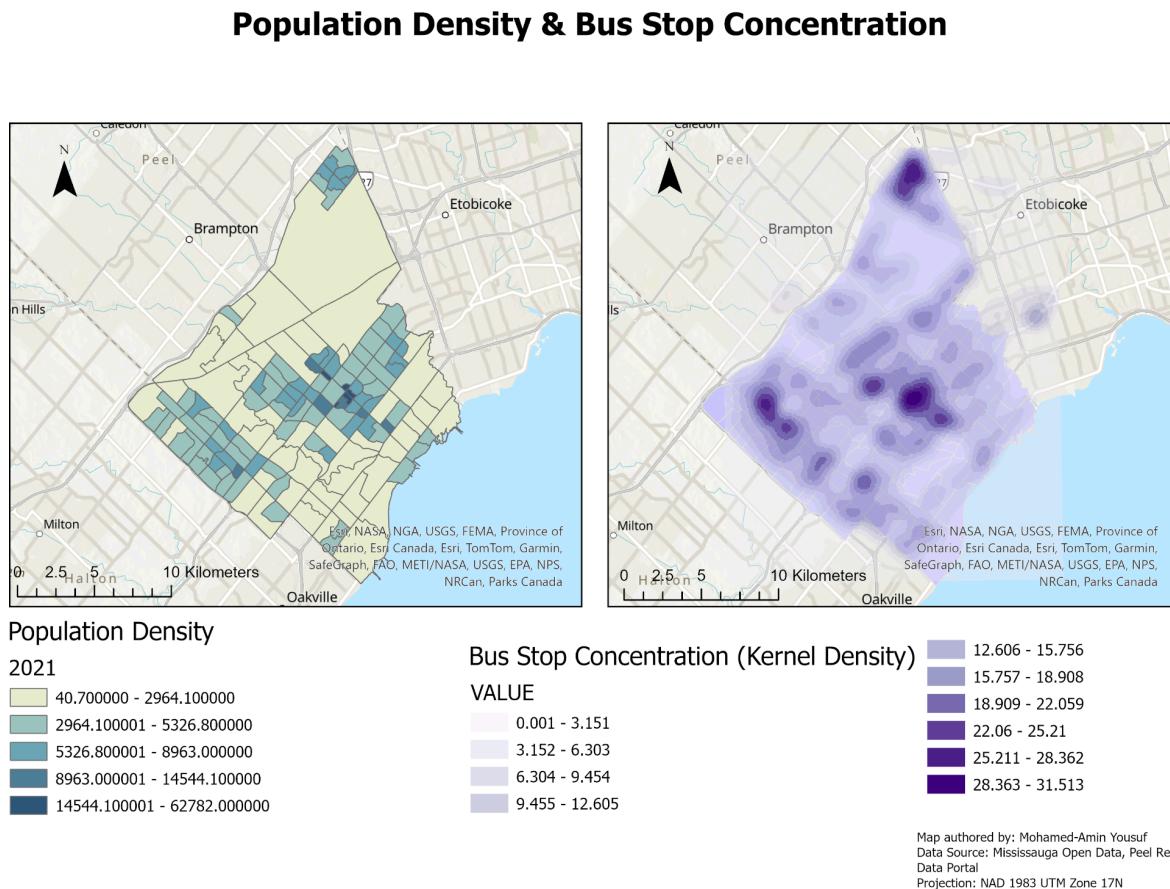


Figure 2: Map displaying population density (left) and bus stop concentration (right) side by side

From Figure 2, we can see a clear correlation between population density and bus stop concentration. Despite their general similarities, there are areas where these variables contradict each other. In the north east and smaller areas in the south west, we can find areas with relatively higher population density but lower bus stop concentration. To dig deeper into potential reasons for this discrepancy, we can analyze Figure 3.

Median Total Income & Bus Stop Concentration

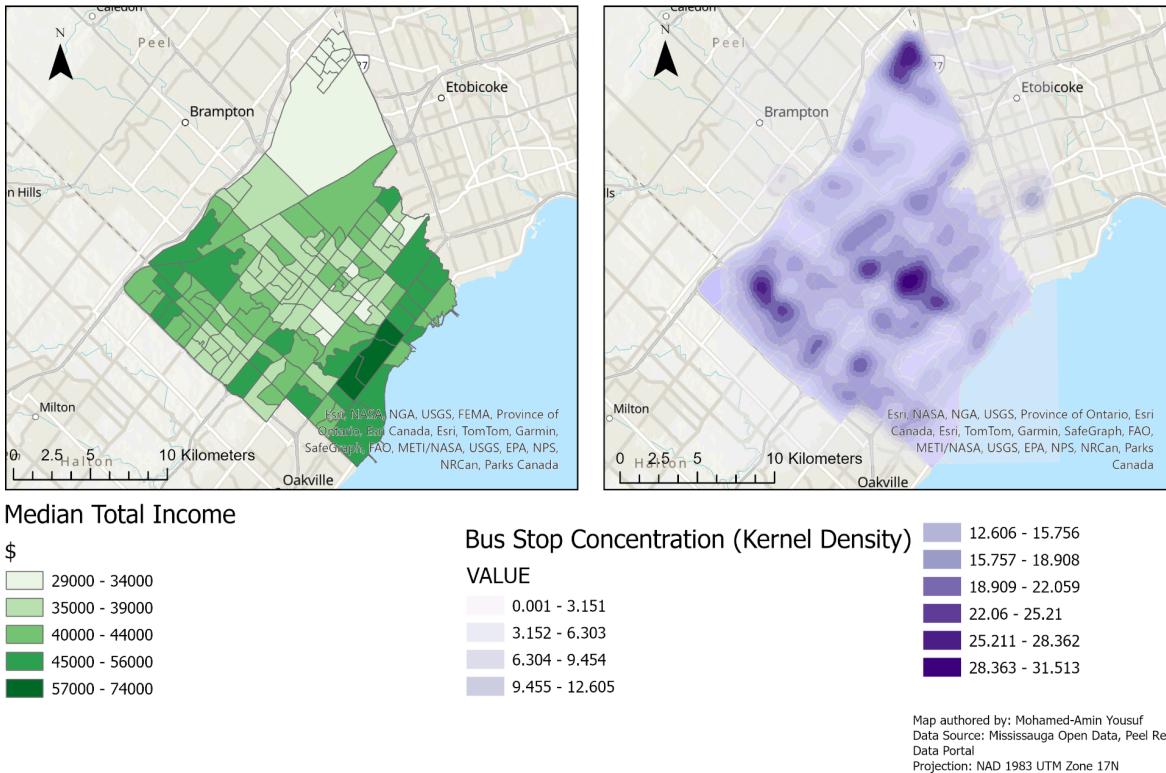


Figure 3: Map displaying median total income (left) and bus stop concentration (right)

This map does not display the same correlation seen previously in Figure 2. However, there are areas with low income that have extremely low bus stop concentration. This can be seen in ward 5 (largest region in the north) as the bus stops are heavily concentrated north of this ward, leaving the people of this area with limited access. This is reinforced by Figure 1's analysis which identified large areas with no bus stops nearby, one of which was in ward 5. (North Service Road and Courtneypark Dr E) We can see that this area is also a low-income area. Additionally, the other area identified as having limited access to transit in Figure 1 was the Mississauga Golf and Country Club. This area is of much higher income in comparison. (medium-high)

4. Discussion

Overall, This analysis identified clear areas that require greater transportation access, while pointing to potential reasons for them being underserved. The two areas identified include, North Service Road and Courtneypark Dr E, and Mississauga Golf and Country Club. In Figure

3, we identified North Service Road and Courtney Park Dr E, to be a low income area, potentially being a reason for it being underserved, despite their dependence on public transit. This indicates a severe need for transit improvement in this area. Additionally, the Mississauga Golf and Country Club was identified as a medium-high income area. A potential reason for the lack of transit stops may be that transit reliance in this area is low, due to the increased income of the residents. Nevertheless, it is currently difficult for individuals to commute here by transit.

5. Conclusion

Overall this study was successful in accomplishing its tasks. Despite this, there were limitations. In the next steps of this project, to provide further analysis and for deeper insights, utilizing GTFS data is key. Moreover, analyzing specific walkability data would allow for greater insights in determining the true accessibility of transit. Additionally, the demographic data collected from the census is from 2021, as it is collected every five years, meaning the results may not completely reflect recent population shifts or economic changes.

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