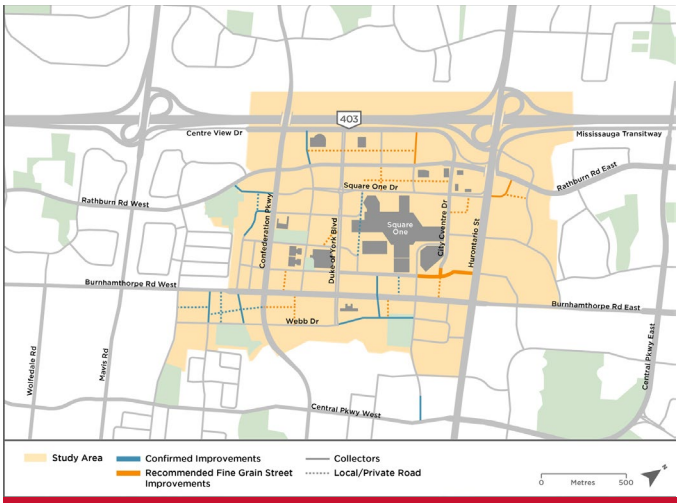
Appendix D. Alternative Evaluation Report



Alternative Evaluation Report

Downtown Movement Plan

City of Mississauga
July 18, 2022

Report Version Tracking

Version	Issue Date	Revision
Draft 1	2022-05-16	
Draft 2	2022-07-06 / 2022-07-18	Addressed city's comments

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1 Introduction

The City of Mississauga has initiated the Downtown Movement Plan (DMP) as a critical study that will update previous plans and identify the transportation infrastructure and policies required to support and guide the continued development of the Downtown Core. As part of the Phase 2 work, alternative road and transit improvements were identified and evaluated to develop a multi-modal transportation network for the 2041 horizon year. This report documents the alternative solutions, evaluation results, and the draft preferred multi-modal networks.

1.1 Background

Population and employment within the Downtown Mississauga study area are projected to grow significantly by 2041 as shown in **Figure 1-1**. Between 2016 and 2041, total population and jobs is expected to grow 102% (from 49,400 to 99,600), with population growing by 135% (from 29,200 to 68,700) and employment growing by 53% (from 20,200 to 30,900).

The combined 2041 population and employment density per hectare at the block level is shown in **Figure 1-2**. Population growth is concentrated in the southwest of the study area near Burnhamthorpe Road and Confederation Parkway where the Parkside Village and MCity developments are located. Density is expected to exceed 500 total people and jobs per hectare (ppjh). Employment growth is mostly concentrated north of Rathburn Road. The combined 2041 population and employment density for Downtown Mississauga is expected to be approximately 392 ppjh.

The current City Centre Transit Terminal located near Rathburn Road and Station Gate Road is approximately 1 km from high population and employment density areas within the study area. The overall multi-modal transportation network should consider expected high growth areas and aim to provide convenient and accessible transportation solutions throughout the entire study area.

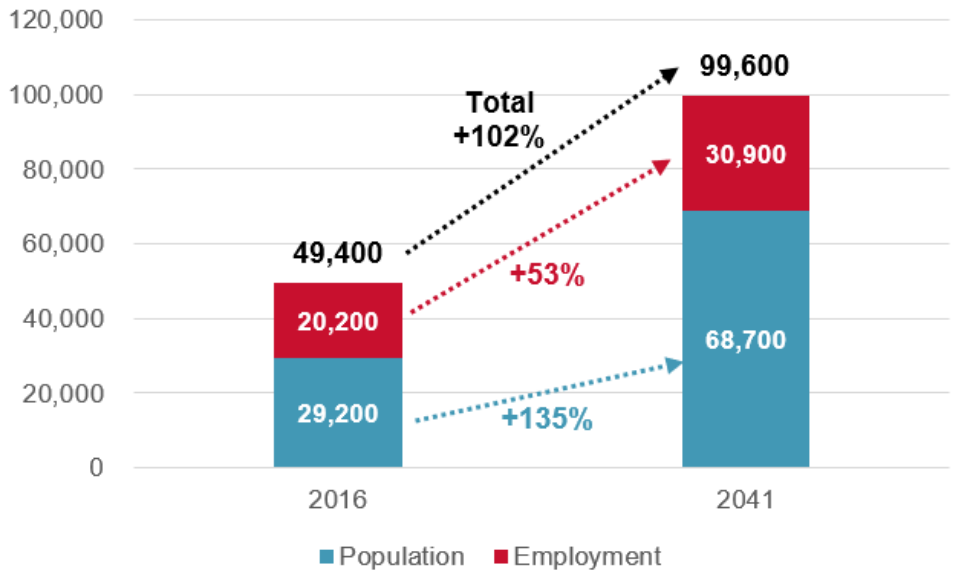


Figure 1-1. Population and employment growth in Downtown Mississauga (to 2041)

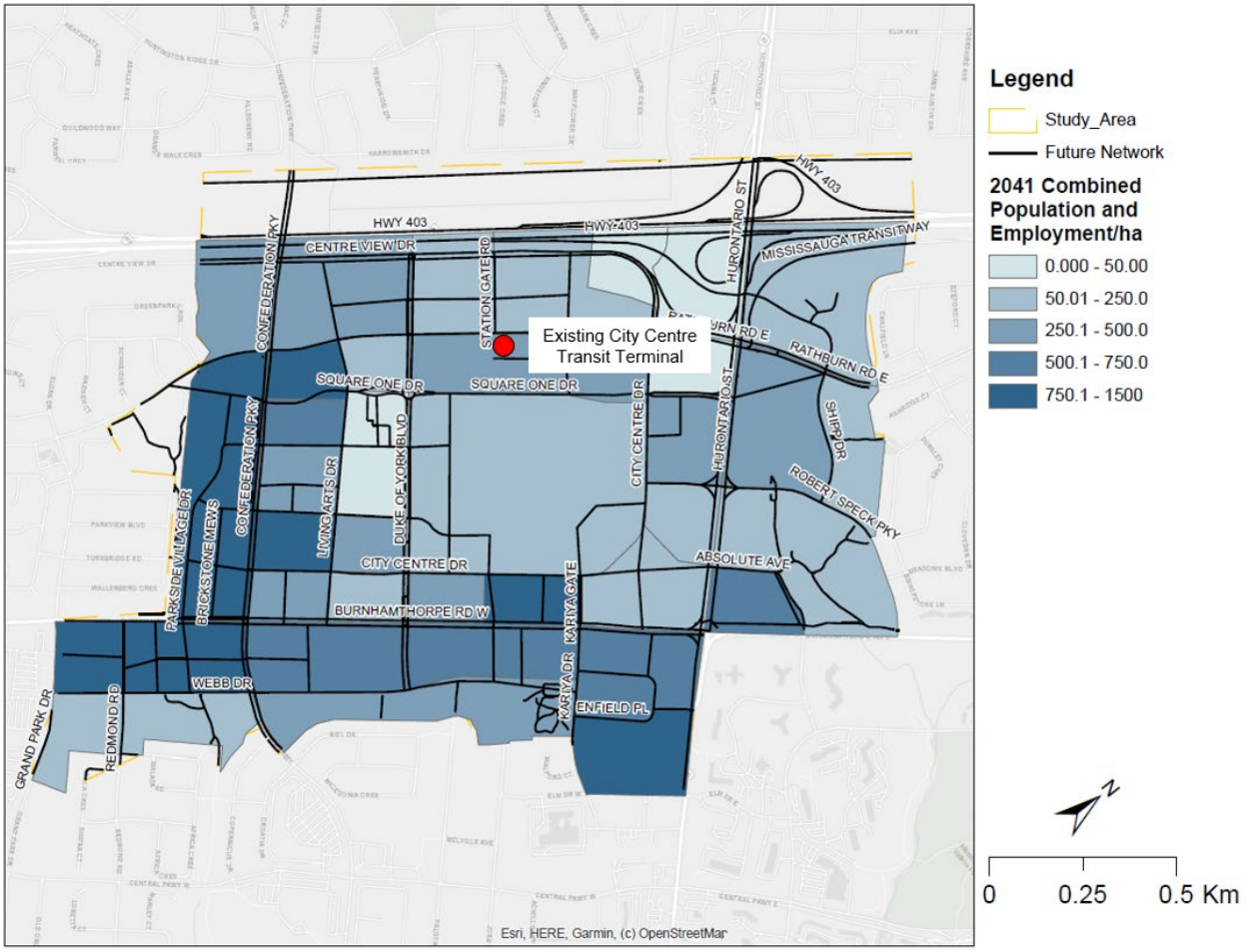


Figure 1-2. 2041 combined population and employment density in Downtown Mississauga (per hectare)

To account for major transit infrastructure improvements, densification, and overall growth in the study area, a 40% driver mode share was assumed for the study area under the preferred transportation network. Note that higher than 40% driver mode shares might be assumed for other alternative evaluation scenarios where transit improvements are not fully built. A comparison of the existing (2016) and future (2041) target mode share is shown in **Figure 1-3**. Total trips to and from the study area for the PM peak period between 2016 and 2041 are expected to increase from 60,000 and 100,000 trips based on TTS data and City's travel demand model, respectively. Further details on the methodology used to arrive at the 2041 mode split is provided in **Appendix 1**.

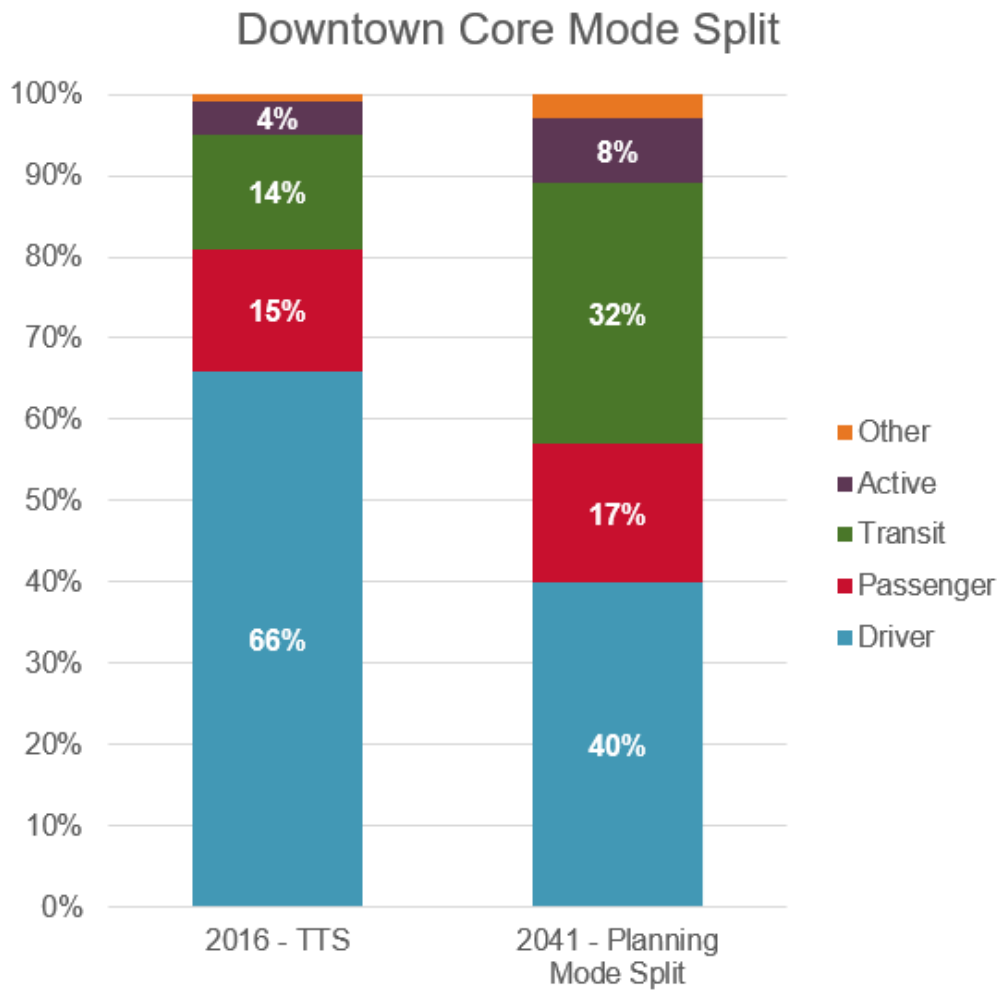


Figure 1-3: 2016 and target 2041 mode share for DMP study area (trips to, from, and within DMP study area)

1.2 Problem and Opportunity

Through the existing conditions analysis and Phase 1 public engagement, DMP has identified the problem and opportunity (P&O) statement as shown in **Figure 1-4.** The statement reflects Downtown21's vision of creating an urban place in the heart of Mississauga and guides the alternative evaluation process.

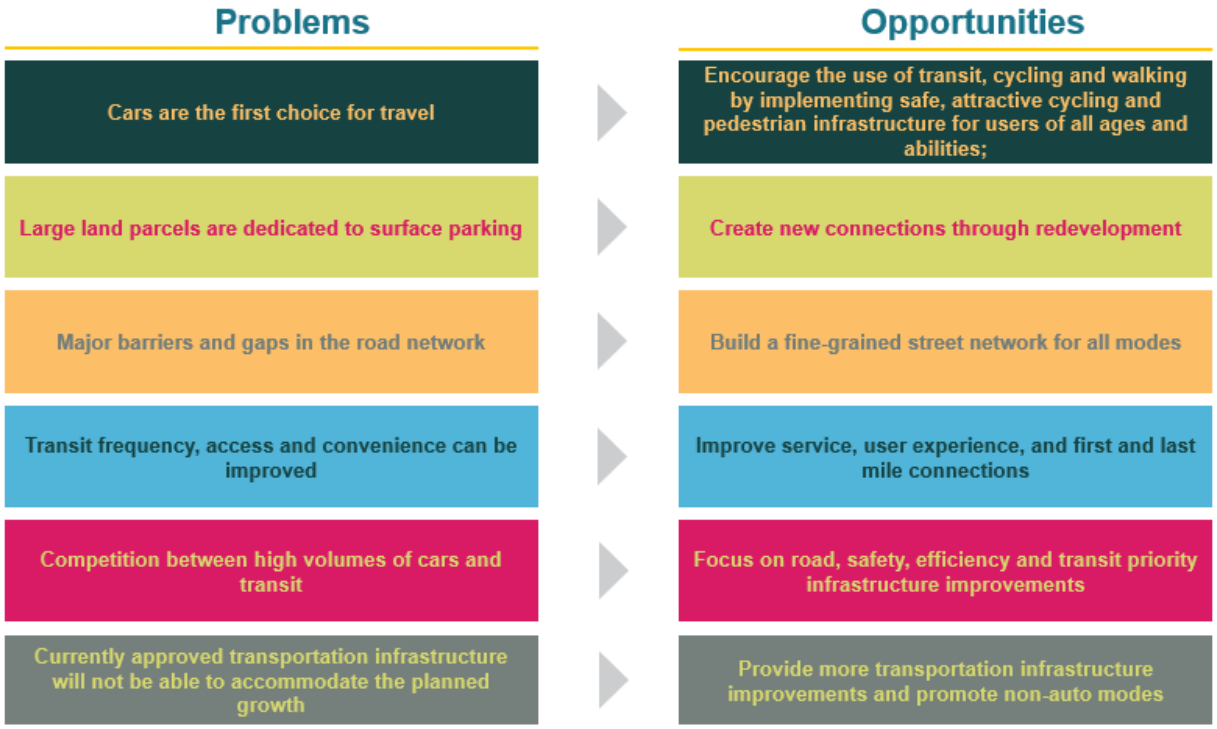


Figure 1-4: Problem and Opportunity Statement

1.3 Evaluation Criteria

The alternative evaluation criteria are grouped by five categories:

- **Strategic/City Building**: to assess whether the alternative is aligned with the vision and P&O statement;
- **Economic:** to assess the alternative's costs and benefits (saving time, supporting growth, etc.) at a high level;
- **Operations:** to assess alternative's impacts on traffic operations and local accesses;
- **Constructability:** to assess the ease of delivering the alternatives and potential conflicts with existing or under construction infrastructure; and
- **Safety/Vision Zero:** to assess whether the alternatives support Mississauga's Vision Zero plan and improve the safety for all modes.

The five main criteria are further detailed and tailored to either roadway improvements or transit improvements in each category, as shown in **Figure 1-5.**

	Roadway Improvements	Transit Infrastructure Improvements
Strategic/City Building	Build a Fine-Grained Street Network for All Modes	Transit Network Connectivity
	Create New Connections	Attract People to Downtown
	Encourage the Use of Transit, Cycling and Walking	Encourage the Use of Transit, Cycling and Walking
	Improve Service, User Experience, and First and Last Mile Connections	Potential to Upgrade to LRT
Economic	Capital Cost	Capital Cost
	Travel Times and Delays	Transit Travel Times
	Support Future Growth	Transit Reliability
		Ridership
	Goods Movement	Goods Movement
Operations	Traffic Operations	Impacts to Traffic Operations
	Local Access (Driveways)	Local Access (Driveways)
Constructability	Property and Right-of-way Constraints	Property and Right-of-way Constraints
	Ease of Implementation	Ease of Implementation
	Tree Conservation	Tree Conservation
Safety/ Vision Zero	Local Pedestrian/Cyclists Convenience and Safety	Local Pedestrian/Cyclists Convenience and Safety
	Traffic Safety and Conflicts	Traffic Safety and Conflicts

Figure 1-5: Evaluation Criteria

1.4 Evaluation Process

The infrastructure alternatives are grouped into three packages: Fine-grained Street Improvements, Transit Improvements, and Road Capacity Improvements. The fine-grained street improvements comprise new local or collector roads that provide additional connectivity within the downtown area. Transit improvements are mainly higher-order transit improvements such as light rail transit (LRT) or dedicated bus lanes. Road capacity improvements include road widening or other major roads improvements that have significant impact on the overall network capacity.

A layered approached is applied to assess the three packages, starting with fine-grained street network, then transit improvements on top of the recommended fine-grained street network, and, lastly, road capacity improvements on top of the recommendations from the previous two packages. This layered approach helps to define the impacts of each package more clearly and better attribute the benefits to specific projects. It also supports the City's strategic priorities and is fiscally responsible.

Within each package, alternatives are firstly assessed against the evaluation criteria qualitatively (pre-screening). If no clear preferred alternative is identified, further modelling assessment is conducted to assess the alternatives quantitatively.

This evaluation process is illustrated in **Figure 1-6**.

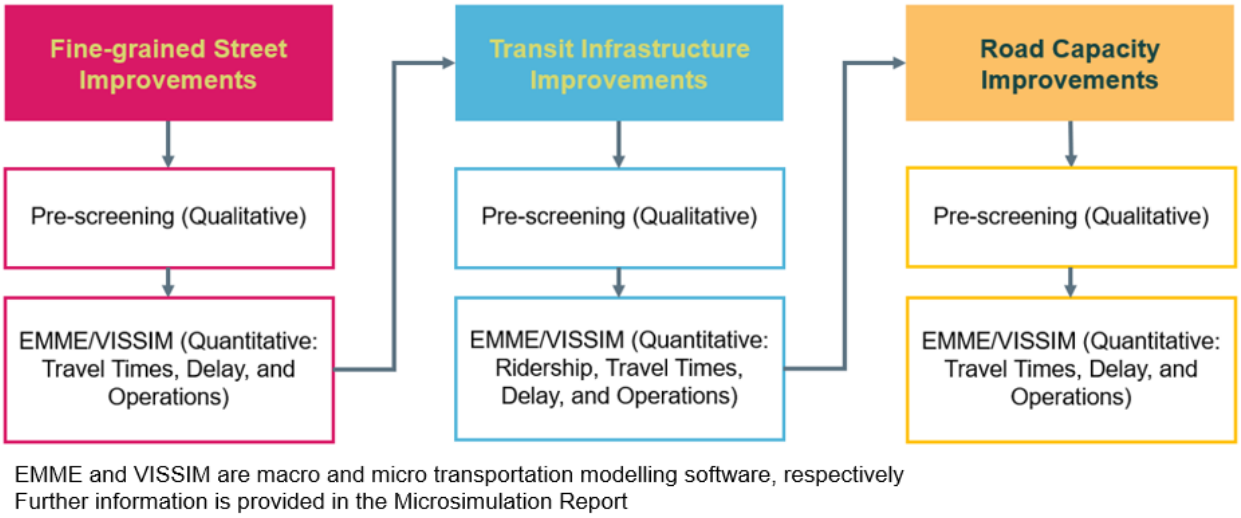


Figure 1-6: Evaluation Process

2 Fine-grained Street Alternatives and Evaluation

2.1 Fine-grained Street Alternatives

Fine-grained street network alternatives were developed based on planned and proposed future road network improvements from City of Mississauga's Downtown Core Local Area Plan and other background studies as documented in the *DMP Task B: Multi-modal Networks Report*. The alternatives also considered future base transit network assumptions as documented in **Appendix 2**, which includes improvements such as bus bays on Burnhamthorpe Road between The Exchange and Kariya Drive.

There are fine-grained streets already approved by environmental assessments (EA) or part of ongoing developments such as MCity or Parkside Village. These approved improvements – blue lines in **Figure 2-1** – were treated as part of the base network. Other alternatives were considered and evaluated in the fine-grained street alternatives package shown as orange lines in **Figure 2-1,** with road names and detailed descriptions shown in **Table 2-1.**

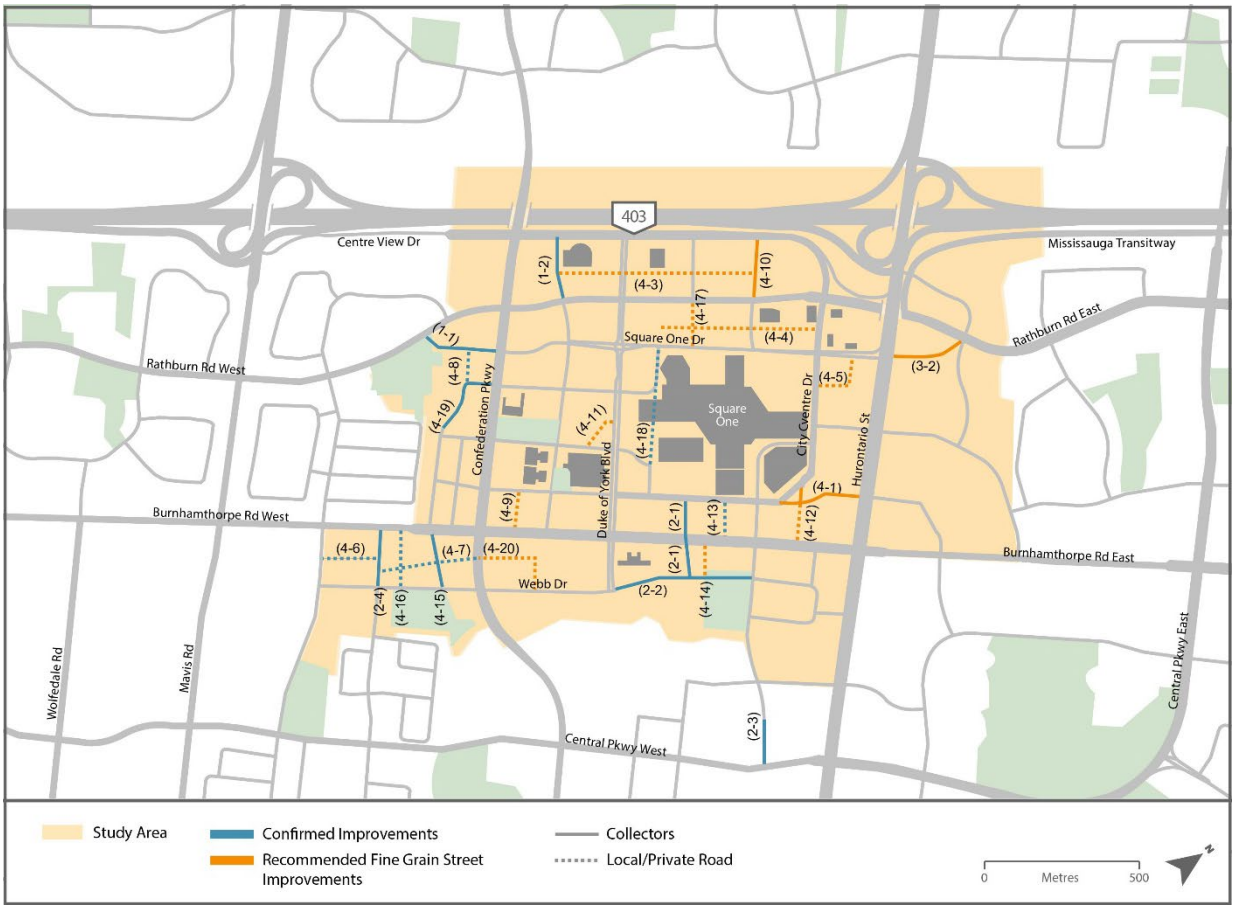


Figure 2-1: Fine-grained Street Road Improvements

Table 2-1: Road Improvements in Fine-grained Street Alternatives

Index #	Road Name	To	From	Improvement Type
3-2	Square One Drive E	Hurontario St	Rathburn Rd E	Road extension (2 lanes)
4-1	City Centre Dr (Street C)	Kariya Dr / City Centre Dr	Hurontario St	Road extension (Minor collector - 2 lanes)
4-3	Street E	Living Arts Dr	East of Station Gate	New road (private road with public easement)
4-4	Street F	West of Station Gate	City Centre Dr	New road (private road with public easement)
4-5	Street I	City Centre Dr	Square One Dr	New road (Local road - 2 lanes)
4-9	Street H	City Centre Dr	Burnhamthorpe Rd. W	New road (Local road - 2 lanes)
4-10	Hammerson Dr (Street A)	City View Dr	Rathburn Rd W	Road extension (Minor collector - 2 lanes)
4-11	Street B	Princess Royal Dr	Duke of York Blvd	New road (Local road - 2 lanes)
4-12	City Centre Dr (Street D)	City Centre Dr	Burnhamthorpe Rd W	New road (Minor collector - 2 lanes)
4-14	Street L	Burnhamthorpe Rd W	Webb Dr Extension	New road (Local road - 2 lanes)
4-17	Station Gate Road	Rathburn Rd	Square One Dr	Road extension (2 lanes)
4-20	Street P	Confederation Pkwy	Webb Dr / Burnhamthorpe Rd	New road (Local road - 2 lanes)

2.2 Fine-grained Street Network Evaluation

Table 2-2 summarizes the evaluation for the fine-grained street alternatives package. Detailed evaluation for each alternative is provided in **Appendix 3**. While there are location specific constraints that may impact constructability, all the fine-grained alternatives were carried forward due to the positive impacts based on strategic, economic, operations, and safety criteria.

Table 2-2: Fine-grained Street Alternative Evaluation Summary

Criteria	General Evaluation	Notes
Strategic / City Building	Highly positive	Additional connections in a fine-grained network encourages use of sustainable modes.
Economic	Positive	Supports future growth, improves travel times, and supports goods movement (loading/unloading opportunities and more routing options)
Operations	Positive	More routing and turning options. Need further investigation on the control type and operations for closed spaced intersections.
Constructability	Mixed	Location specific: results dependent on property, right-of-way constraints, environmental crossings, grade differences, and tree conservation.
Safety / Vision Zero	Highly Positive	Local connections provide safer public realm for sustainable modes, function as traffic calming, and has potential to reduce safety conflicts.

2.3 Fine-grained Street Network Refinements

Additional refinements were made to specific projects as indicated in the following subsections.

2.3.1 Alternative 3-2: Square One Drive Extension Evaluation

Alternative 3-2: Square One Drive Extension is a 2-lane road extension from Hurontario Street to Rathburn Road East. Two alignments – Option 1: Roundabout and Option 2: Signalized Intersections – were further evaluated for this key improvement. The Roundabout configuration would extend the Square One Drive extension to the intersection of Rathburn Road at Shipp Drive, forming a five-legged roundabout. The Signalized Intersections configuration includes a two-way connection to Rathburn Road at the existing access to 4310 Sherwoodtowne Boulevard plus a direct connection between Square One Drive Extension and Shipp Drive about 70 metres south of Rathbun Road. The two alignments are presented in . A summary of the evaluation for the two options are provided below in .

Option 1 – Roundabout evaluates well under the strategic and city building, economic, and operations evaluation criteria as it will provide additional network granularity that will help serve pedestrians, cyclists, transit, and automobiles, and improve goods movement in the area. The

extension of Square One Drive and the intersecting roundabout will be costly to implement due to land acquisition and construction costs and may reduce safety at the intersection of Rathburn Road with Shipp Drive due to the addition of a fifth intersecting leg and less clear right-of-way for pedestrians travelling across the traffic lanes.

Option 2 – Signalized Intersections scores well under the city building criteria, as the configuration will provide additional connections for a fine-grained network that encourages use of sustainable modes, and the grid-like network near the intersection of Rathburn Road with Shipp Drive will improve development opportunity on the adjacent lands. Construction of the Square One Drive extension will improve goods movement in the area. The signalized configuration would have lower property acquisition costs relative to a roundabout due to the smaller footprint of a signalized intersection but would require installation of signal equipment and regular maintenance. There will be an improved level of comfort and accessibility for pedestrians due to the clear right-of-way provided by pedestrian signals, the new pedestrian connections introduced across Rathburn Road, and the minimized crossing distance for pedestrians at Shipp Drive. The configuration introduces a new signal approximately 100 metres from the Rathburn / Shipp signal and may require signal coordination to optimize traffic flow on Rathburn Road. This option will also feature a new 2 lane east-west connection between the elbow of the Square One Drive extension and Shipp Drive. The signalized scenario is expected to be safer as it would maintain the current four-legged intersection at Rathburn / Shipp and provide clear right-of-way for vehicles and pedestrians.

As a result of improved strategic/city building and safety conditions, it is recommended that **Option 2 – Signalized Intersections** be carried forward for the comparison of higher-order transit alternatives.

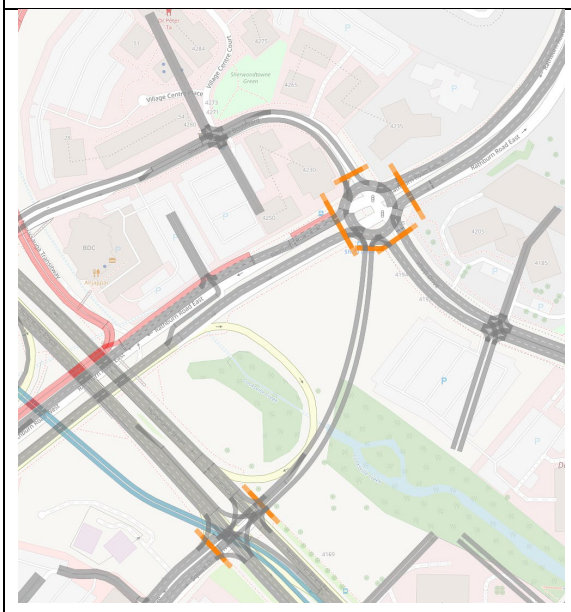
Option 1: Roundabout	Option 2: Signalized Intersections
	

Figure 2-2: Two Alignments of Square One Drive Extension

Table 2-3: Square One Drive Extension Signalization Alternative Evaluation

Project	Option 1 - Roundabout	Option 2 - Signalized
Criteria		
Strategic / City Building	Positive	Highly Positive
Economic	Positive	Positive
Operations	Positive	Positive
Constructability	Negative	Negative
Safety / Vision Zero	Negative	Positive
Action	**Not Preferred**	**Preferred**

2.3.2 Alternative 4-20: Street P

Alternative 4-20: Street P is a connection between Confederation Parkway and Webb Drive. There is an opportunity to further refine the “L” shaped connection to a “T” shaped connection with an extension to Burnhamthorpe Road. This extension would utilize the existing access to Burnhamthorpe Road at the same location and provide additional connection between Webb Drive and Burnhamthorpe Road to support all modes. The “T” shaped connection has been carried forward for recommendation.

2.3.3 Alternative 4-1 and 4-12: City Centre Drive extension

Alternatives 4-1 and 4-12: City Centre Drive extensions are realigned to form a signalized intersection. The existing curve of City Centre Drive at this location would be removed associated with the extensions and redevelopment at this parcel. City Centre Drive extensions to Burnhamthorpe Road and Hurontario Street would help alleviate the congestion at Hurontario Street and Burnhamthorpe Road.

2.4 Fine-grained Street Network Recommendations

The recommended fine-grained street network including refinements is presented in **Figure 2-3**.

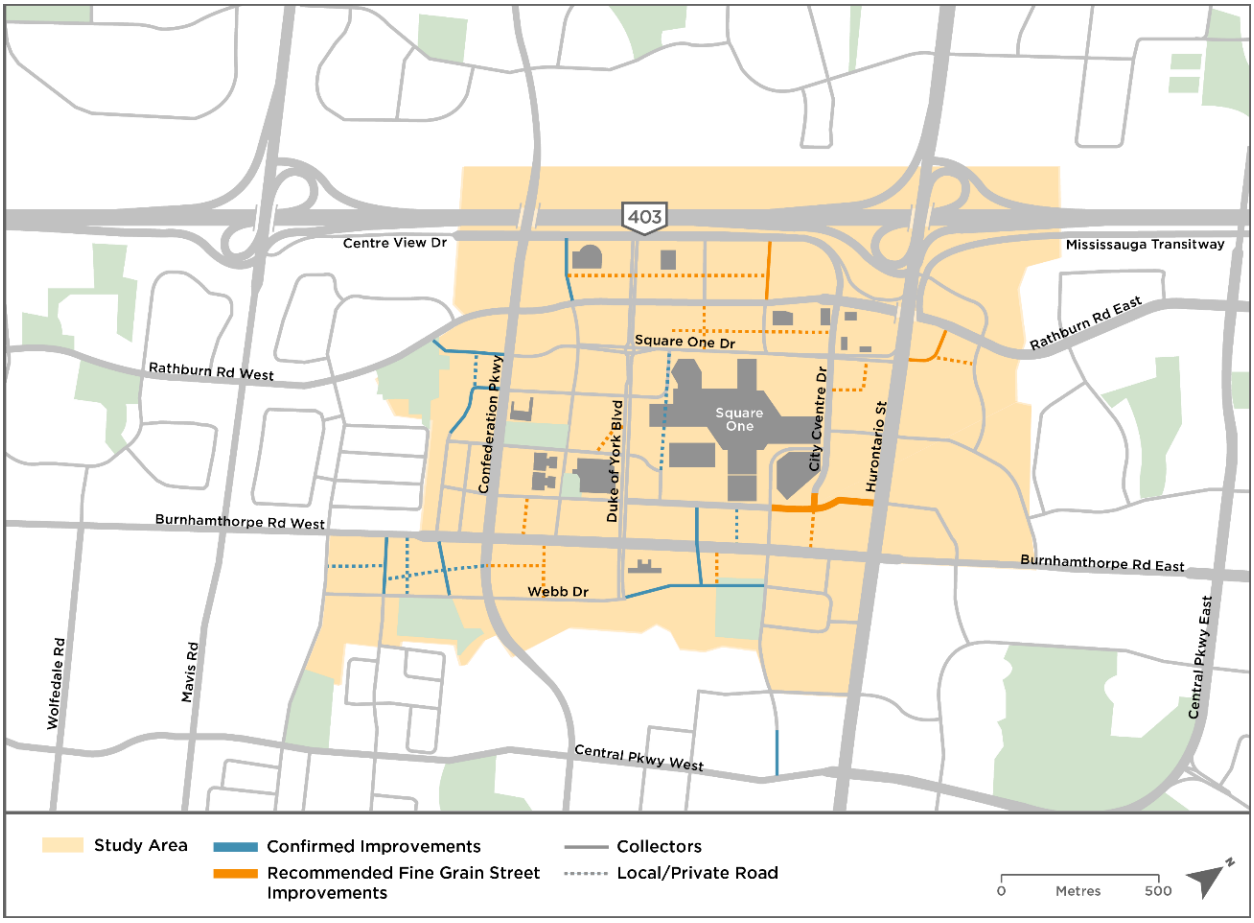


Figure 2-3: Recommended Fine-grained Street Network

3 Higher-order Transit Alternatives and Evaluation

The existing road network operates close to capacity at major intersections within Downtown Mississauga. The street network, with limited opportunities for expansion, will not have the capacity to support this level of growth with population and employment increasing from approximately 50,000 in 2016 to approximately 100,000 in 2041. Higher-order transit infrastructure will be needed and will play a significant role in increasing the capacity for moving people within and to/from Downtown Mississauga.

The Hurontario Light Rail Transit (HuLRT) as shown in **Figure 3-1** is under construction with an anticipated completion date of Fall 2024. The HuLRT will have three stops in Downtown Mississauga. From north to south, they are City Centre Terminal, Robert Speck stop, and Burnhamthorpe stop.

The HuLRT will significantly increase the capacity of moving people north-south through the Downtown; however, two key travel needs will remain unaddressed without additional improvements:

- Higher-order transit is not provided to support circulation within Downtown, especially towards the densest growth area in the southwest part near Confederation Parkway and Burnhamthorpe Road. Currently, this area is more than 1 km away from the closest HuLRT stop.
- There is no higher-order transit that can move people east-west to and from Downtown. The north-south HuLRT plus an east-west higher order transit can create a transit hub within Downtown Mississauga to support the growth.

The higher-order transit alternatives in this study were aimed to address these two needs.

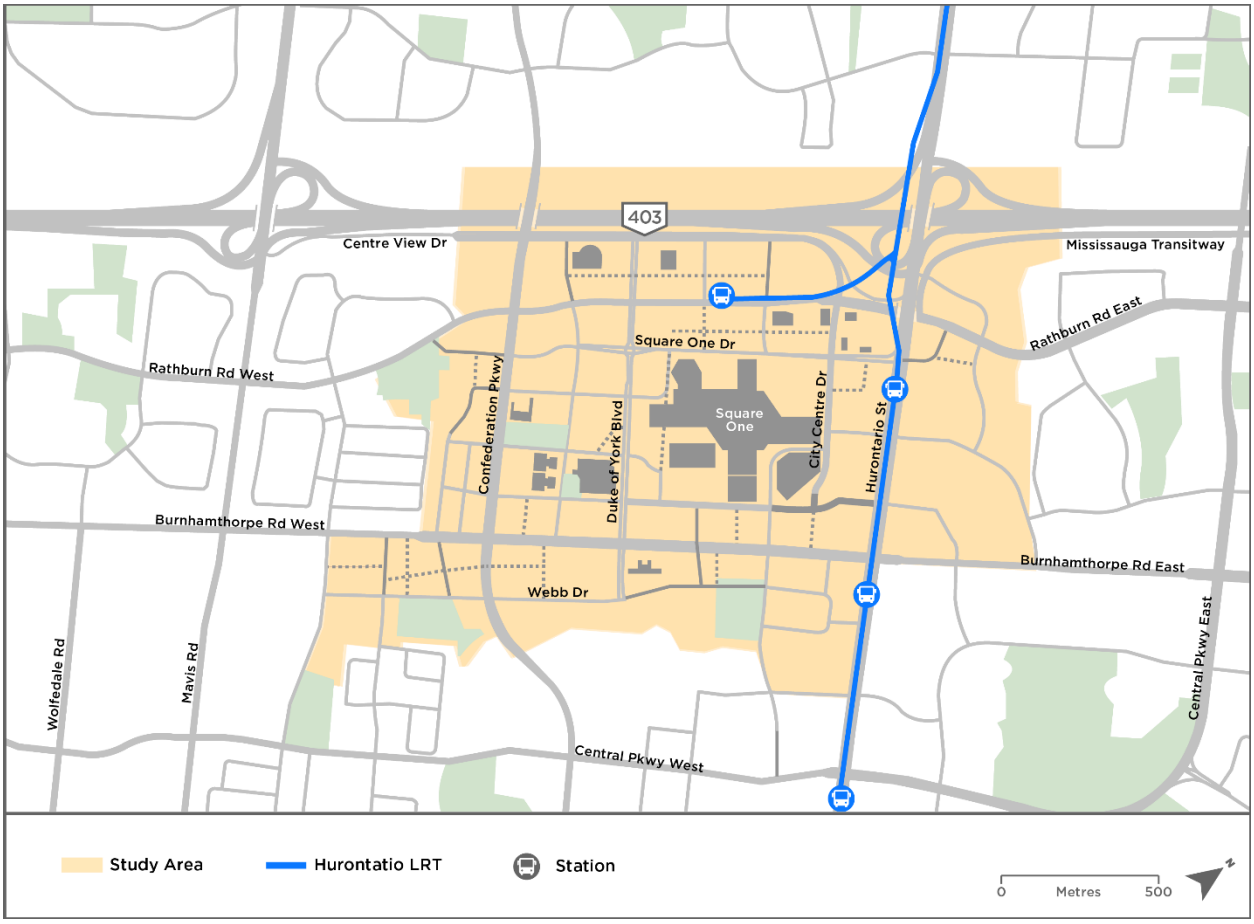


Figure 3-1: Hurontario LRT

3.1 Downtown Loop Alternatives and Evaluation

In the 2014 environmental assessment for Hurontario-Main Street LRT (HMLRT), the preferred track alignment for Mississauga Downtown Core included a LRT loop along Rathburn Road West, Duke of York Boulevard, and Burnhamthorpe Road West as shown in **Figure 3-2.** This LRT loop alternative can improve circulation within Downtown and bring the higher-order transit service closer to the dense development areas along Burnhamthorpe Road and Confederation Parkway corridors.

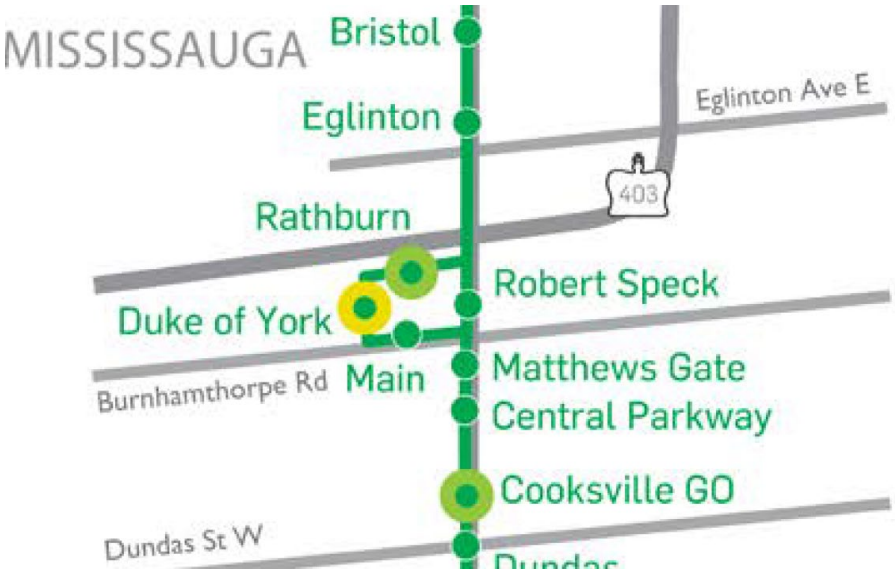


Figure 3-2: Hurontario-Main L.R.T. Preferred Track Alignment

Through the pre-screening process of this study, other transit solutions were also explored along both Burnhamthorpe Road (between Grand Park Drive and Robert Speck Parkway) and Duke of York Boulevard (between Burnhamthorpe Road and Rathburn Road) to serve the same needs and support the growth within Downtown.

The preferred transit alternatives resulting from the pre-screening were further compared and evaluated against the LRT loop.

3.1.1 Downtown Loop Alternatives Pre-screening

BURNHAMTHORPE ROAD

Burnhamthorpe Road between Grand Park Drive and Robert Speck Parkway considered three options as described below and shown in **Figure 3-3**. All options would result in a loss of a general purpose lane per direction. It should be noted that the cross sections are intended to illustrate travel lanes. Other elements along Burnhamthorpe Road (including on-street parking at various locations and proposed bus bays between The Exchange and Kariya Drive) are not part of the figures.

- **Option 1 – Centre median BRT**: Dedicated transit lanes in the median of the road. Passengers board and alight from transit amenities located within the centre of the road. This option requires protected left turns at intersections and restricts midblock driveways to only right-in-right-out (RIRO) access.
- **Option 2 – Curbside bus lanes**: Dedicated transit lanes along the curbside lanes of the road. Passengers board and alight from transit amenities within the boulevard, similar to conventional bus services. This option requires signage and/or pavement markings at intersections to indicate shared space where vehicles may access the curbside lanes to complete right turns only.

- **Option 3 – Curbside HOV lanes**: Curbside lanes shared by transit and high-occupancy vehicles (HOVs). Passengers board and alight from transit amenities within the boulevard. This option requires signage and/or pavement markings to indicate shared space to allow single-occupancy vehicles (SOVs) access to the curbside lanes to complete right turns only.

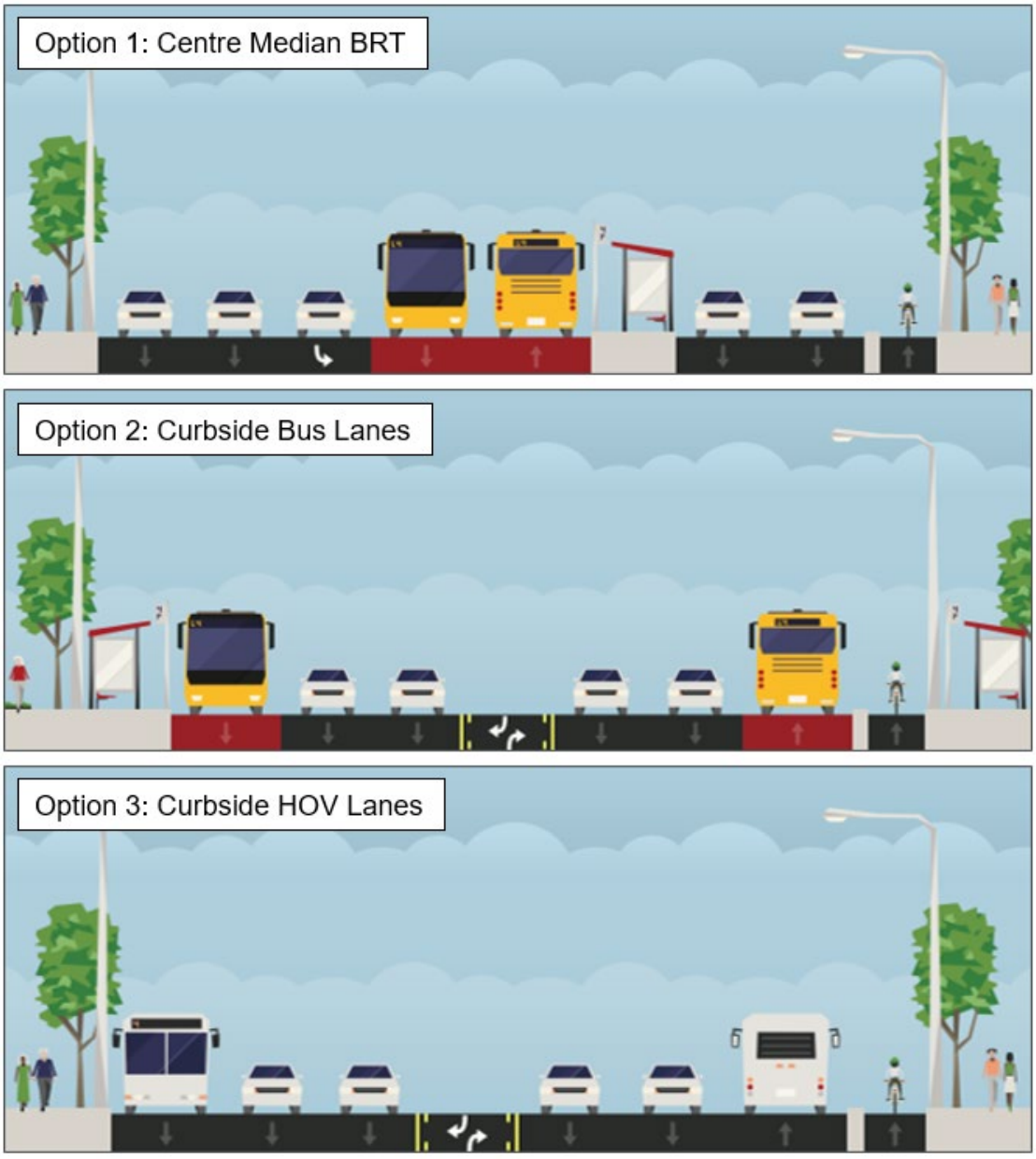


Figure 3-3. Burnhamthorpe Road Transit Options

A summary of the evaluation of transit alternatives on Burnhamthorpe Road between Grand Park Drive and Robert Speck Parkway is shown in **Table 3-1**, with the full evaluation provided in **Appendix 4**.

Option 1 – Centre median BRT provides the most positive benefits to strategic/city building due to the best transit reliability and travel times, opportunities to improve connectivity with the HuLRT and upgrade to future LRT along Burnhamthorpe, and iconic BRT station design for easy wayfinding. While there is a high construction cost ($64 M) and goods movement is impacted by the reduction in general-purpose lanes and increased traffic delays at intersections (such as protected left turns) to accommodate all modes and movements, this option will provide the best ridership, travel times, and reliability. A centre-median BRT will also restrict some driveway accesses to right-in-right-out (RIRO). A long construction duration is anticipated to reconstruct the lanes. The inclusion of median transit lanes provides opportunities to improve the pedestrian and cycling realm; however, longer wait times to cross the streets may be experienced.

Option 2 – Curbside bus lanes provides strong benefits to strategic/city building through improved transit travel times and connectivity to the HuLRT. Transit vehicles can travel in dedicated lanes without impedance or queues from auto vehicles. Travel times and reliability are improved and at a significantly lower cost ($2.3 M) than Option 1. Curbside bus lanes will have impact on goods movement and require some reconstruction of Burnhamthorpe Road to add new stations and/or curbs at intersections to accommodate the bus movement. While protected left turns are not required at all intersections, there is potential conflict with right-turning vehicles in the curb lanes. The provision of curbside transit lanes may also provide opportunities to improve the pedestrian and cycling realm.

Option 3 – Curbside HOV lanes generally provides limited additional benefits compared to business-as-usual. Compared to curbside bus lanes, HOVs will be allowed to use this lane and may have conflicts with transit vehicles at bus stops or intersections. The cost is expected to be relatively low (<$2.3 M); however, transit travel times are expected to only improve slightly due to mixed traffic operations with HOVs and limited opportunities to apply transit signal priority. Potential conflicts for right-turning vehicles with HOV and transit vehicles are expected in the curbside HOV lane.

I**t is recommended Option 1 – Centre median BRT be carried forward** for comparison with LRT Loop operation due to the highest benefit to strategic/city building and economic criteria within Downtown Mississauga.

Table 3-1. Burnhamthorpe Road Transit Alternatives Evaluation

Project	Option 1 Centre Median BRT	Option 2 Curbside Bus Lanes	Option 3 Curbside HOV Lanes
Criteria			
Strategic / City Building	Highly positive	Positive	Neutral
Economic	Positive	Positive	Neutral
Operations	Negative	Negative	Neutral
Constructability	Negative	Negative	Negative
Safety / Vision Zero	Neutral	Neutral	Neutral
Action	**Preferred**	**Not Preferred**	**Not Preferred**

DUKE OF YORK BOULEVARD

For Duke of York Boulevard between Rathburn Road and Burnhamthorpe Road, five options were considered as described below. All options would at minimum include a loss of a general purpose lane per direction.

- **Option 1: Centre median BRT** features dedicated transit lanes within the centre of the roadway. A conceptual rendering of this service is shown in **Figure 3-4**.
- **Option 2: Eastside BRT** features dedicated lanes on the east side of the right-of-way, where general-purpose lanes are located on the west side.
- **Option 3: Curbside bus lanes** features dedicated transit lanes along the curbside lanes of the road. Aside from signal delays at intersections, transit vehicles can travel in dedicated lanes without impedance from auto vehicles. This option may require signage and/or pavement markings to indicate shared space where other vehicles may access the curbside lanes to complete right turns.
- **Option 4: Curbside HOV lanes** features curbside lanes shared by transit and HOVs. Transit travel times are expected to be better than mixed traffic, but still has impedance from HOV vehicles. Passengers will board and alight from transit amenities within the boulevard, similar to conventional bus services. This option may also require some signage and/or pavement markings to indicate shared space where other vehicles may access the curbside lanes to complete right turns.

- **Option 5: Transit mall** features dedicated transit lanes on one side of the road right-of-way (similar to Option 3 Eastside BRT). The remainder of the road right-of-way will be made into a pedestrian mall, where auto vehicles are not permitted.

Figure 3-4: Conceptual rendering of centre median BRT along Duke of York Boulevard

A summary of the evaluation of transit alternatives on Duke of York Boulevard between Rathburn Road and Burnhamthorpe Road is shown in **Table 3-2**, with the full evaluation provided in **Appendix 3**.

Option 1 – Centre median BRT provides strong strategic/city building and economic benefits due to the best transit ridership, travel times, and reliability and improved connectivity with the HuLRT that encourages sustainable mode choices and attracts travellers to Downtown Mississauga. However, there are higher costs ($15 M), impacts to goods movement and auto travel, and lower constructability due to the reconstruction of Duke of York Boulevard to convert an existing general-purpose lane to a dedicated transit lane. Protected left turns for auto will also be required at all intersections.

Option 2 – Eastside BRT evaluates very similarly to Option 1 Centre Median BRT (including capital cost) for all criteria. However, because fewer eastside BRTs have been built within the Greater Toronto Area than median BRTs, road users may be less familiar with the conflicts between northbound right turning vehicles and the BRT which increases the risk of collisions.

Option 3 – Curbside Bus Lanes provides similar strategic/city building benefits as Option 1 Centre Median BRT and Option 2 Eastside BRT. Transit ridership, travel times, and reliability are better than business-as-usual, but less than the prior two options; however, the cost is significantly less ($0.8 M). The reduction in lanes at the curbside will continue to impact goods movement, auto travel, and constructability due to the reconstruction of Duke of York Boulevard. There is now potential conflict with right turn vehicles instead of left turning vehicles.

Option 4 – Curbside HOV Lanes evaluates very similarly to business-as-usual due to the limited improvements across all metrics; however, transit travel times and reliability is anticipated to be marginally better. The cost of improvements is expected to be the least out of all options (<$0.8 M). Some vehicle conflicts are expected from right turning vehicles and HOV vehicles on the curbside lane.

Option 5 – Transit Mall performs strongly under strategic/city building criteria and is expected to best encourage use of sustainable modes with the elimination of conflicts with auto vehicles. The option will have similar economic benefits as Option 1 Centre Median BRT and Option 2 Eastside BRT; however, additional impacts to goods movement are expected due to restricted access. The Transit Mall option is also expected to have the highest operational impacts from the removal of auto lanes and traffic will need to divert onto parallel roads. Construction is expected to be similar to Options 1 and 2. The Transit Mall option will strongly favour safety and Vision Zero initiatives with the removal of auto vehicle travel along Duke of York Boulevard.

Based on the evaluation, **it is recommended Option 1 – Centre median BRT be carried forward** for comparison with LRT Loop operation due to the highest benefit to strategic/city building and economic criteria while balancing operational challenges within Downtown Mississauga.

Table 3-2. Duke of York Boulevard Transit Alternatives Evaluation

Project	Option 1 Centre Median BRT	Option 2 Eastside BRT	Option 3 Curbside Bus Lanes	Option 4 Curbside HOV Lanes	Option 5 Transit Mall
Criteria					
Strategic / City Building	Highly positive	Highly positive	Positive	Neutral	Positive
Economic	Positive	Positive	Positive	Positive	Neutral
Operations	Neutral	Neutral	Neutral	Neutral	Highly negative
Constructability	Negative	Negative	Neutral	Neutral	Negative
Safety / Vision Zero	Neutral	Negative	Neutral	Neutral	Highly positive
Action	**Preferred**	**Not Preferred**	**Not Preferred**	**Not Preferred**	**Not Preferred**

3.1.2 Downtown BRT vs LRT Loop

Based on the findings from the Downtown Loop pre-screening, further evaluation and modelling were conducted to compare the BRT (Alternative 1) and the LRT Loop (Alternative 2). The two alternatives are illustrated in **Figure 3-5** and **Figure 3-6.** Note that the recommended fine-grained street network without the two higher order transit alternatives were used as a base to show their benefits.

- **Alternative 1 Enhanced Transit (ET) / BRT:** Dedicated median bus lanes along Burnhamthorpe Road between Elora Drive and Hurontario Street and on Duke of York

Boulevard between Burnhamthorpe Road and Rathburn Road. The connection between Duke of York Boulevard and City Centre Transit Terminal will operate in mixed traffic. HuLRT will operate with a 7.5-minute headway during the peak hour and follow its original alignment along Hurontario Street with stops serving Downtown Mississauga at City Centre Transit Terminal, Hurontario Street at Robert Speck Parkway, and Hurontario Street at Burnhamthorpe Road. Other major transit stops served by dedicated bus lanes include The Exchange at Burnhamthorpe Road and Duke of York Boulevard at Prince of Wales Drive.

- **Alternative 2 LRT-L / LRT Loop**: Dedicated LRT lanes along Burnhamthorpe Road between Hurontario Street and Duke of York Boulevard, on Duke of York Boulevard between Burnhamthorpe Road and Rathburn Road, and on Rathburn Road between Duke of York Boulevard to City Centre Transit Terminal. HuLRT can operate with a 5-minute headway during the peak hour and stop at City Centre Transit Terminal, Hurontario Street at Robert Speck Parkway, Hurontario Street at Burnhamthorpe Road, The Exchange at Burnhamthorpe Road, and Duke of York Boulevard at Prince of Wales Drive as shown in **Figure 3-6**. The LRT service coming from south of Burnhamthorpe Road will operate counterclockwise in Downtown Mississauga whereas LRT service coming from north of Rathburn Road will operate clockwise (see **Figure 3-6**).

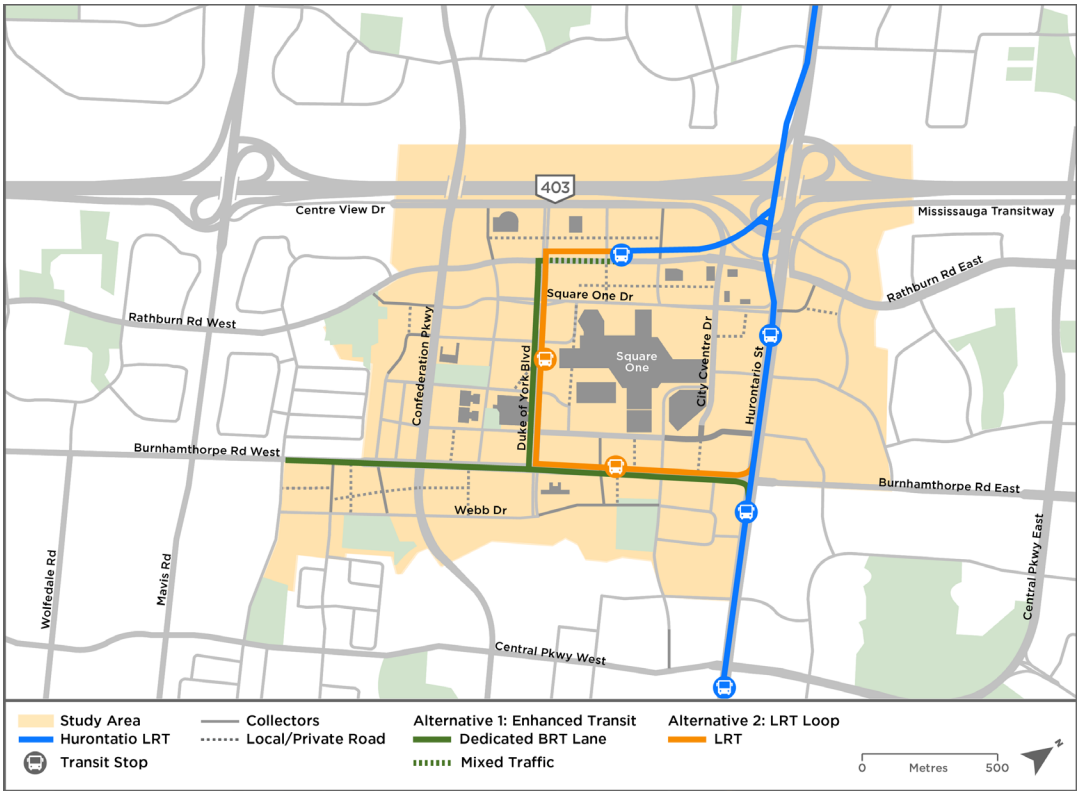


Figure 3-5: Downtown Loop Alternatives

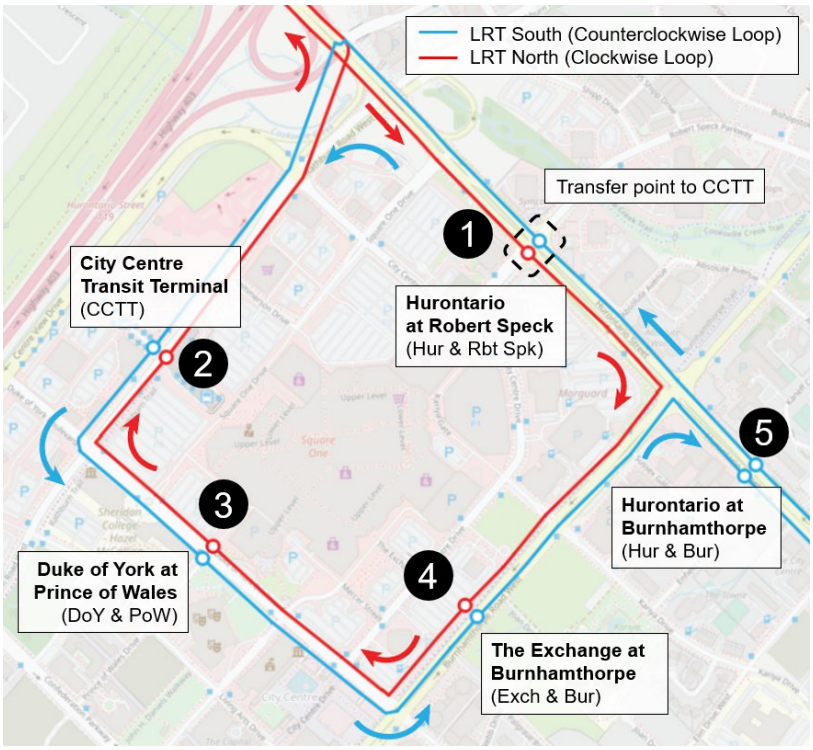


Figure 3-6: Alternative 2 LRT-L Operation

Further detailed modelling and evaluation of the two alternatives suggested that Alternative 2: LRT Loop is preferred mainly for the following reasons.

- **LRT Loop will generate more transit trips:**

  Transit ridership was derived from the City's EMME model. Alternative 1: BRT increases transit ridership by about 1,000 compared to the Base during the afternoon peak period. Alternative 2: LRT-Loop can further increases transit ridership by about 4,000 compared to BRT as shown in **Figure 3-7**. The LRT-Loop can attract more people to use transit due to its increased frequency and capacity.

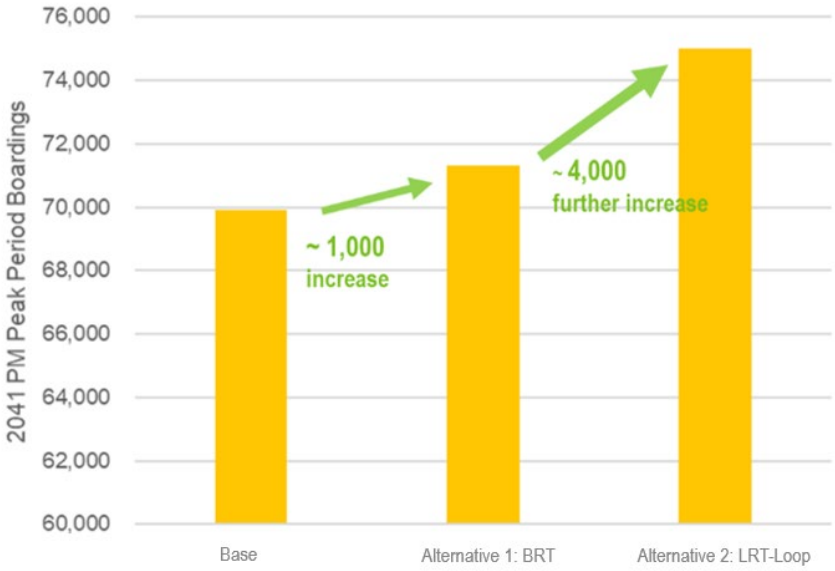


Figure 3-7: Total Boardings of Transit Lines Serving Downtown Mississauga

- **LRT Loop can improve DT transit ridership distribution:**

  LRT Loop not only can increase the ridership but also better distribute the boardings and alightings among the Downtown stations as shown in **Figure 3-8**. City-Centre Terminal is the busiest stop, with about 8,000 boardings and alightings in the Base and Alt 1 scenarios. With the LRT loop, passenger volumes at City-Centre Terminal are reduced by 2,500 riders and re-distributed to Duke of York Boulevard at Princess Royal Drive and The Exchange at Burnhamthorpe Road. It provides some capacity relief at City Centre Transit Terminal while attracting more activities at other stops and contribute to a vibrant Downtown overall.

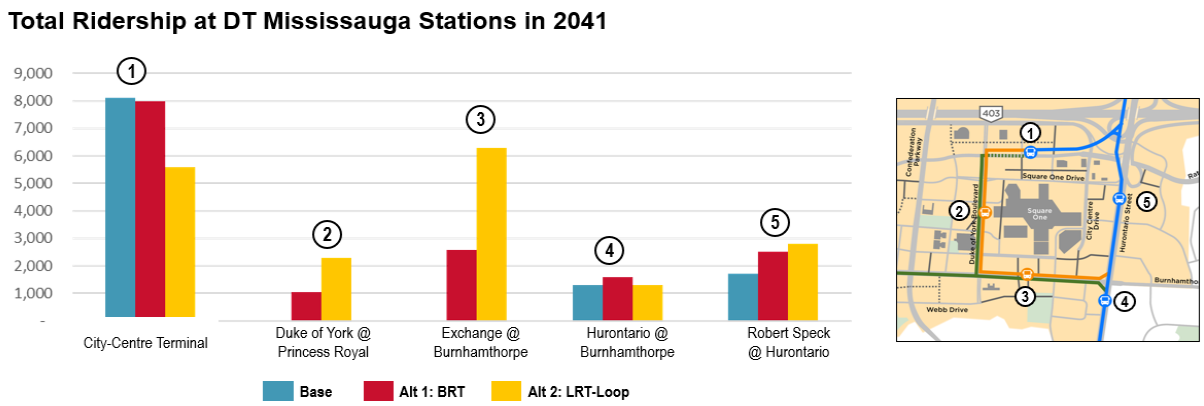


Figure 3-8: Boardings and Alightings at Higher Order Transit Stops

- **LRT Loop allows HuLRT to increase service frequency to 5 minutes, protecting for service flexibility**

  The LRT Loop allows for the north and south segments of HuLRT to operate with separate service patterns as shown in **Figure 3-6**, which can reduce the minimum headways from 7.5 minutes to 5 minutes. With the headway reduction, the capacity of HuLRT can be increased from 2,560 to 3,840 passengers per hour per direction[1]. The additional capacity can accommodate more growth within the Downtown and along the Hurontario corridor or lead to better service and flexible operations. The HuLRT system will be more resilient and flexible when handling operations issues with independent north and south services.

[1] The capacity is assumed based on 160 people per vehicle and 2 vehicles per set.

3.2 Downtown Mississauga Terminal and Transitway Connection

After the HuLRT and LRT Loop, the second need to address is an east-west higher-order transit in the Downtown. The proposed Downtown Mississauga Terminal and Transitway Connection (DMTTC) serves that need. It relocates the City Centre Transit Terminal to the north side of Rathburn Road between Station Gate Road and Hammerson Drive and extends the existing transitway further west along the north side of Rathburn Road through an underground connection to the relocated transit terminal and along the north side of Centre View Drive. The configuration illustrated in **Figure 3-9** is similar to the concept plan proposed in the *Downtown Mississauga Terminal and Transitway Connection Initial Business Case*, January 2020.

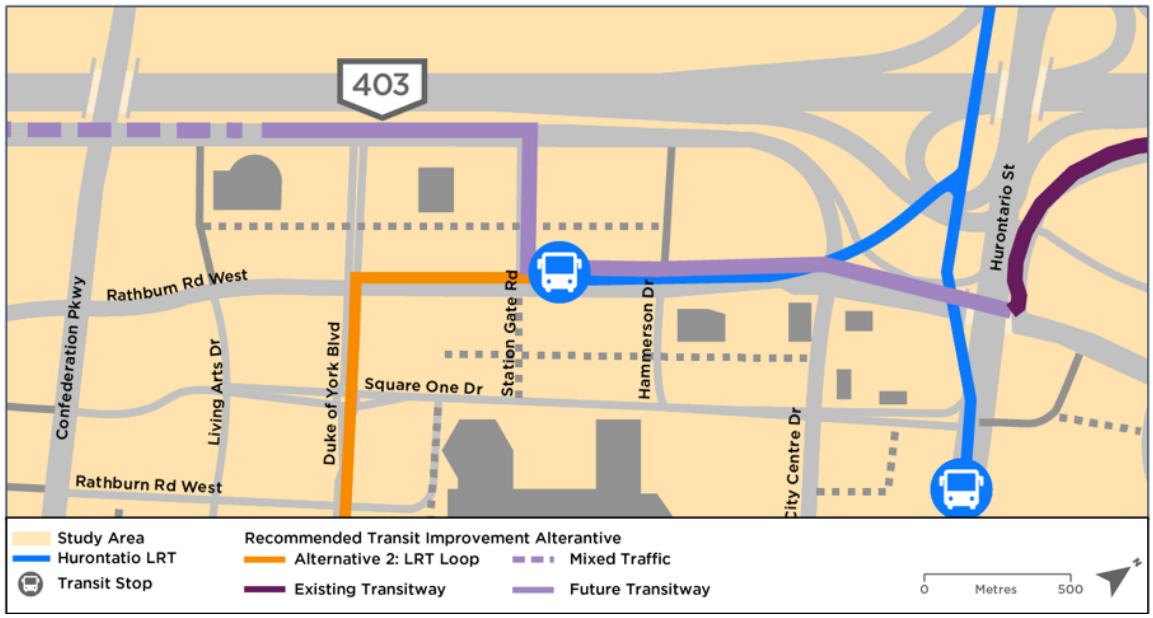


Figure 3-9: Downtown Mississauga Terminal and Transitway Extension

Figure 3-10 shows the transitway bus routes with and without DMTTC. Segment travel times from the Vissim models were compared to identify potential impacts or savings with DMTTC. As shown in **Table 3-3**, the new transitway connection is estimated to reduce travel times by more than 50% on the downtown segments. The eastbound direction experienced a reduction in total travel time from 4.9 minutes to 2.5 minutes, and the westbound direction experienced a reduction in total travel time from 6.2 minutes to 1.6 minutes. The bus operations within the terminal are slightly improved, however, it is noted that a mean dwell time of 2 minutes was assumed for the terminal transit stops which makes up a significant portion of the travel time within the terminal. With DMTTC, the following positive impacts were identified:

- On average, a reduction of 0.7 mins of delay per trip for auto.
- A 50% travel time reduction for buses using the transitway compared to mixed traffic in previous scenarios.
- A 4% increase in overall network transit ridership.
- Improved transfers between buses and the HuLRT, eliminating the need for passengers to cross Rathburn Road.

- Increased capacity for buses at the new terminal.

Based on the above benefits, DMTTC is recommended.

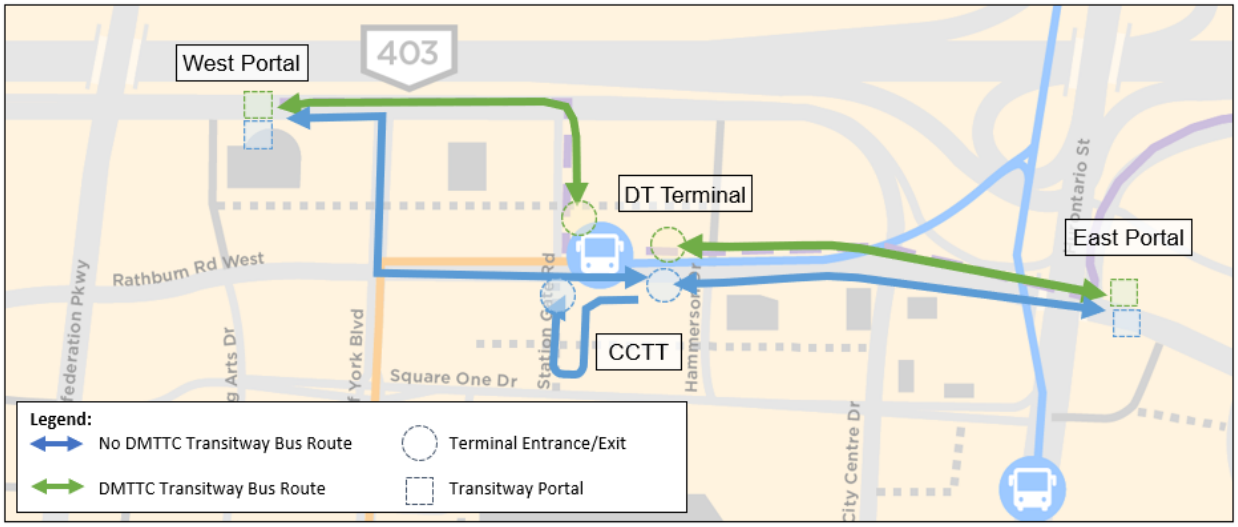


Figure 3-10: Transitway Bus Routes – no DMTTC vs DMTTC

Table 3-3: No DMTTC vs. DMTTC Travel Time Savings

Segment	Bus Travel Times (minutes)		
	No DMTTC	DMTTC	Change
EB: West Portal to Terminal	3.0	1.7	-1.3
EB: Terminal to East Portal	1.9	0.9	-1.0
Total EB	4.9	2.5	-2.3
WB: East Portal to Terminal	2.3	0.8	-1.5
WB: Terminal to West Portal	3.9	0.8	-3.2
Total WB	6.2	1.6	-4.6
Terminal Operation Time (Dwell + Running Time)	3.1	2.9	-0.1

3.3 Higher-order Transit Recommendations

The LRT Loop and DMTTC are recommended to provide convenient transit service within Downtown, bring higher-order transit closer to the dense southwest area, and fill the gap in the Mississauga transitway system. Together with the HuLRT in delivery, the two recommended higher-order transit services will help increase the transit usage and accommodate future growth within and beyond Downtown and help establish a regional transit hub at the Rathburn District.

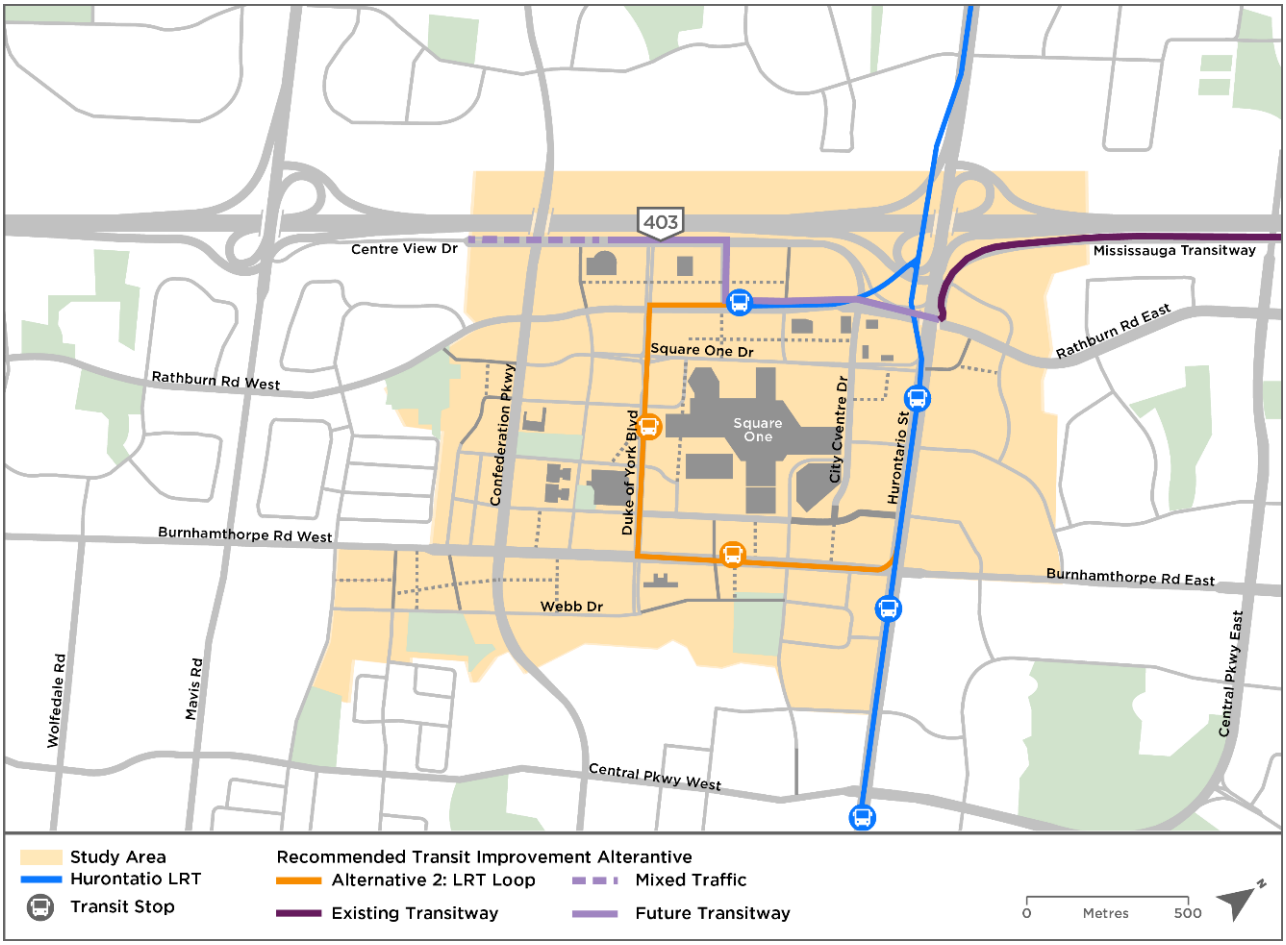


Figure 3-11: Recommended Higher Order Transit Network

4 Road Capacity Alternatives and Evaluation

4.1 Road Capacity Alternatives and Pre-screening

Three road projects that would potentially provide more capacity to the road network were evaluated in this package. They are shown in **Figure 4-1** and include the following:

1. Northern Distribution Road (NDR) and associated flyover/ramps;
2. widening of Burnhamthorpe Road (4-6 lanes); and
3. widening of Centre View Drive (4-5 lanes).

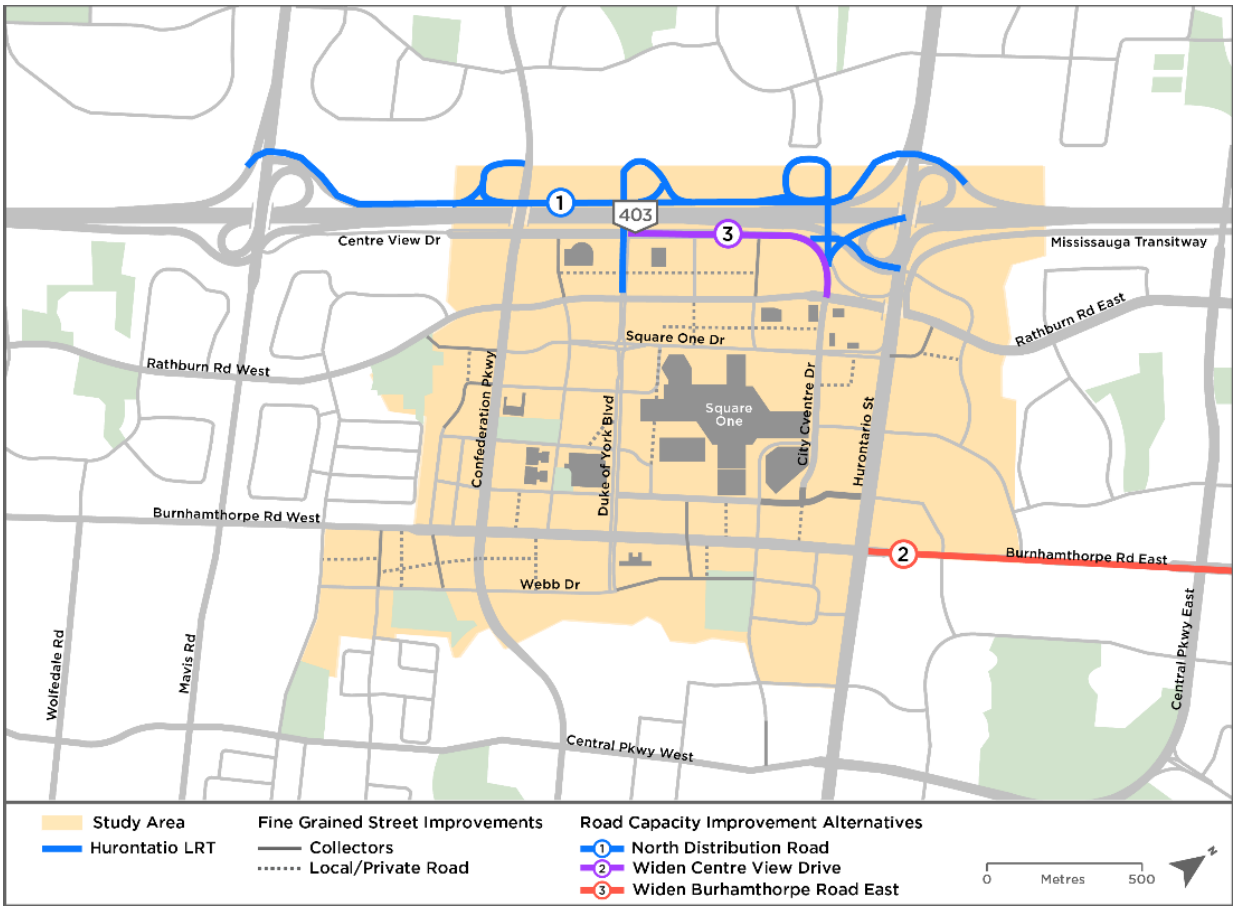


Figure 4-1. Road Capacity Improvement Options

4.1.1 Northern Distribution Road (NDR)

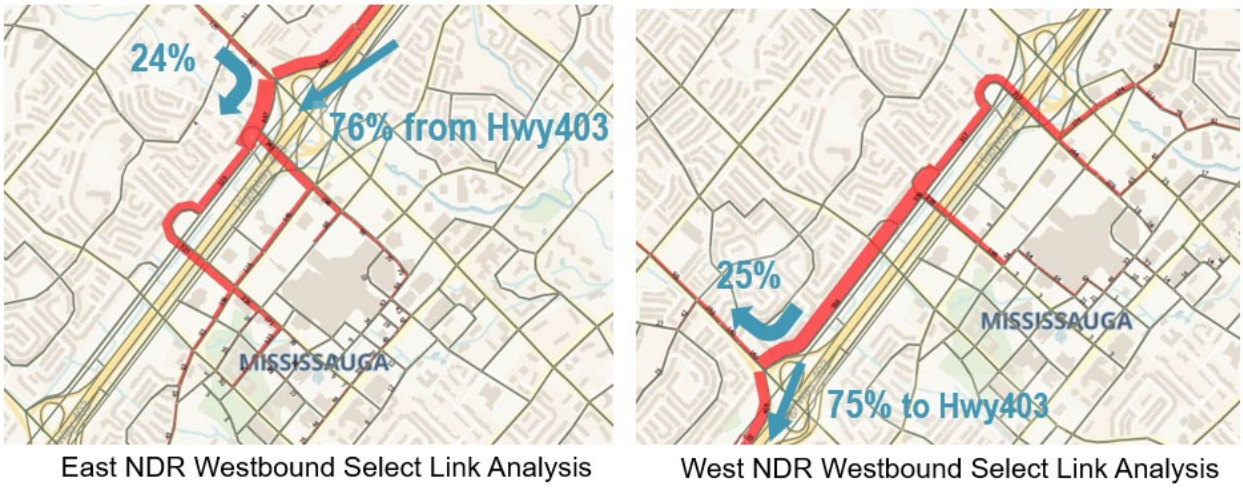
The Northern Distribution Road consists of a two-lane east-west road on the north side of Highway 403 that spans between Hurontario Street to Mavis Road, with a connection at Confederation Parkway. The new link would connect to the existing Downtown Mississauga network through two flyovers over Highway 403 that intersect with Rathburn Road – one at Duke of York Boulevard and one at Centre View Drive . Additional network changes as part of the proposed NDR include dedicated transit lanes from the DMTTC to Mavis Road and removal

of the Highway 403 eastbound off-ramp at Hurontario Street to allow Centre View Drive to connect to Hurontario Street instead.

A select link analysis (SLA) on the NDR was conducted to identify the demand on the road links and the origins and destinations of that demand. The SLA showed relatively low volumes (<700 vehicles per hour) and limited impacts to the DMP study area as shown in **Figure 4-1**. Most of the users (75%) are directly to/from Highway 403 instead of the local road network.

The space required to support the NDR would conflict with several other competing interests, including bus access to DMTTC due to the Duke of York Boulevard flyover, HuLRT elevated guideway due to the Centre View Drive flyover, MTO interchange reconfiguration at the Hurontario Street and Highway 403 eastbound off-ramp, and potential widening of Highway 403 or the East-West Cross-Regional Connection. Conflicts are summarized in **Figure 4-2**.

While the NDR would create new connections and extend the fine-grained street network, it would primarily support and encourage auto travel with minimal improvements to active transportation. The NDR could support future growth and improve travel times; however, the fine-grained street network without NDR is expected to operate with acceptable levels of service. High construction costs, implementation challenges, and conflicts with roads, properties and HuLRT outweigh the limited benefits that NDR may bring**.** More importantly, the NDR is an auto-focused infrastructure that is not aligned with the vision for Downtown Mississauga. Once built, the Duke of York and Centre View Drive flyovers may also become barriers for people crossing the streets. Therefore, NDR is **NOT** recommended**.**



East NDR Westbound Select Link Analysis

West NDR Westbound Select Link Analysis

Figure 4-2. Select link analysis for NDR

Figure 4-3. NDR Conflicts and Challenges

4.1.2 Burnhamthorpe Road Widening

The proposed Burnhamthorpe Road widening is a four to six lane widening between Hurontario Street and Etobicoke Creek.

The widening will provide additional capacity but occurs in a primarily established area. The widening does not further build a fine-grained street network nor provide new connections. Widening would also require new bridge structures at Etobicoke Creek and Cooksville Creek due to the limited widths of the existing structures. The widening may also encourage higher vehicular speeds along Burnhamthorpe Road.

Since only a limited extent of the proposed widening is within the study area, it is recommended that the widening of Burnhamthorpe Road be determined through other studies that examine travel needs beyond the downtown. There may be opportunities to explore widening of Burnhamthorpe Road to support higher-order transit.

4.1.3 Centre View Drive Widening

The proposed Centre View Drive widening is a four to five lane widening between Duke of York Boulevard and Rathburn Road. The additional lane is an eastbound lane.

Similar to the Burnhamthorpe Road improvement, the Centre View Drive widening does not help build a fine-grained street network nor provide new connections. Centre View Drive will be operating at acceptable levels of service without the widening. While there are no major implementation issues, the cost of construction does not justify the limited benefits it will bring to Downtown Mississauga.

As a result, the Centre View Drive widening is **NOT** recommended.

4.2 Summary of Road Capacity Improvements Evaluation

A summary of the road capacity improvements evaluation is provided in **Table 4-1**, with full details of each project evaluation in **Appendix 5**.

Table 4-1. Road Capacity Improvements Evaluation

Project	3-9	3-6	3-3
Road Name	Northern Distribution Road	Burnhamthorpe Road	Centre View Drive
Road Improvement	New road (2 lanes) + ramps/flyovers	Road widening (4 - 6 lanes)	Road widening (4 -5 lanes)
Criteria			
Strategic / City Building	Neutral	Negative	Negative
Economic	Negative	Neutral	Positive
Operations	Positive	Highly positive	Positive
Constructability	Highly negative	Negative	Neutral
Safety / Vision Zero	Negative	Negative	Negative
Action	**Not recommended**	**TBD by other studies***	**Not recommended**

*Note: City's Transit and Road Infrastructure Plan (TRIP) will investigate the alternatives further. If the recommendation is road widening only, it would need a subsequent EA study to follow up. If the recommendation is high-order transit improvement, it may require a business case study or a Transit Project Assessment Process (TPAP) to follow up and confirm.

5 Draft Preferred Networks and Land Use Sensitivities

5.1 Draft Preferred Networks

The draft preferred street network, cycling network, and higher order transit network are shown through **Figure 5-1** to **Figure 5-3.** The draft street network is consistent with the recommended fine-grained street network; additional road capacity improvements such as NDR were screened out.

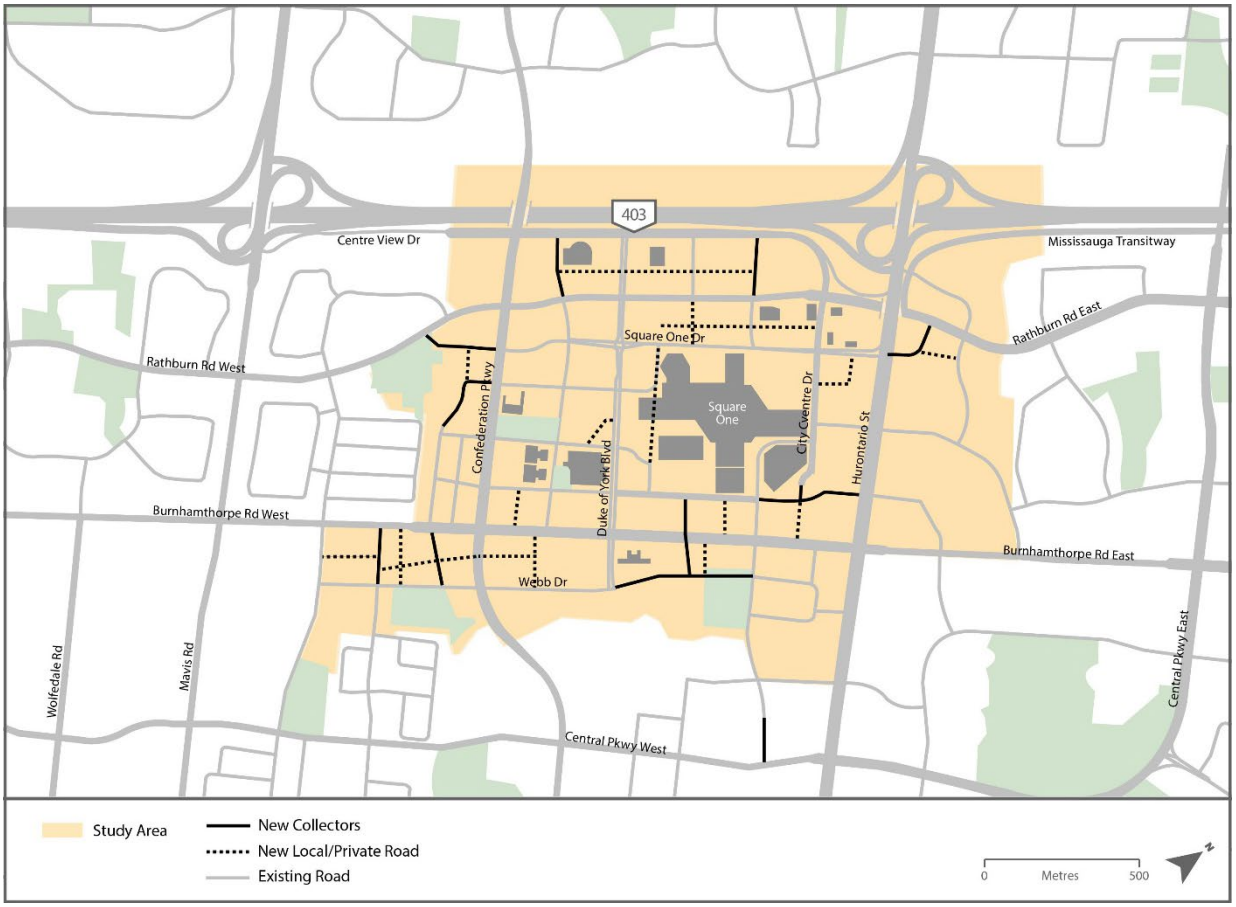


Figure 5-1: Draft Preferred Street Network

The preferred cycling network of dedicated cycling facilities is built upon the City's 2018 Cycling Master Plan and DMP's draft street network with new and refined road connections Note that the dedicated cycling facilities along Hurontario Street and along Rathburn Road between Hurontario Street and Station Gate Road are to be delivered as part of the on-going HuLRT project. Cyclists will be able to travel north-south on Hurontario Street and Confederation Parkway and travel east-west on Rathburn Road and Burnhamthorpe Road. Within the Downtown Core area, dedicated cycling routes along Square One Drive, Living Arts Drive, and City Centre Drive provide connections to all major destinations and places of interests. Note that

bike lanes on Living Arts Drive between Burnhamthorpe Road and Rathburn Road have been advanced and implemented as part of the city's Active Transportation COVID-19 Recovery Framework.

There will be cycling routes just outside of Downtown Mississauga along Central Parkway, Mavis Road, and the proposed multi-use path to the north of the Hydro Corridor. Cyclists can use these to pass through Downtown if they prefer a less busy route. Trails along Mary Fix Creek (west of Confederation Parkway) and Cooksville Creek (east of Hurontario Street) provide opportunities for recreational trips and alternatives to parallel busy streets.

With the relocation of the Downtown Transit Terminal to the parcel between Station Gate Road and Hammerson Drive extension north of Rathburn Road and the proposed East-west Cross-Regional Connection (conceptually shown along the Hydro Corridor in the GGH Transportation Master Plan), there is an opportunity to connect the two transit corridors with an active transportation bridge over Highway 403. This potential connection is identified as a purple arrow on the Draft Cycling Network shown in **Figure 5-2**

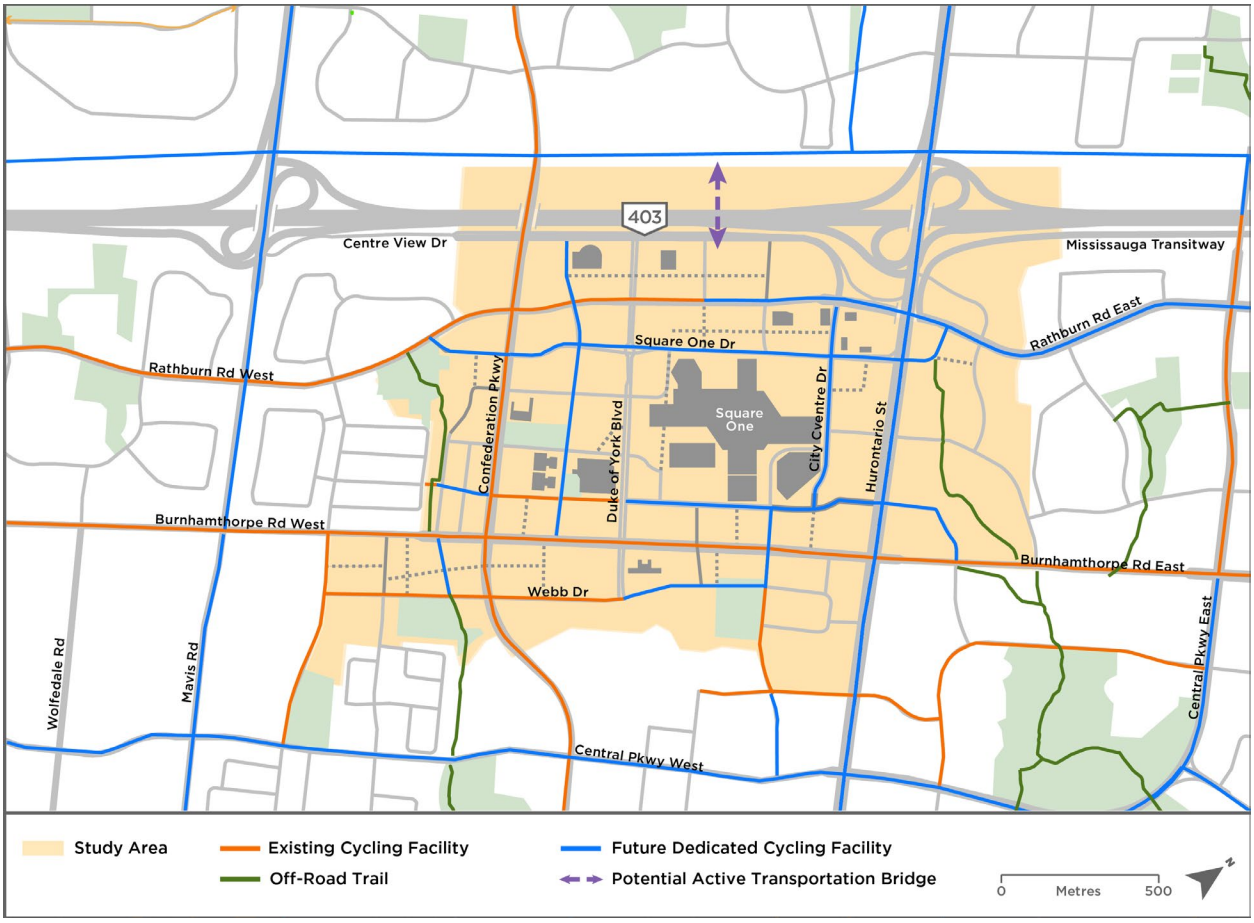


Figure 5-2: Draft Cycling Network - Dedicated Cycling Facility

Together with HuLRT, the LRT Loop and DMTTC are recommended to form a complete higher-order transit network for the Downtown Mississauga and help establish the transit hub at the

Rathburn District. The LRT Loop alignment and DMTTC alignment can be further investigated and confirmed in follow-up studies.

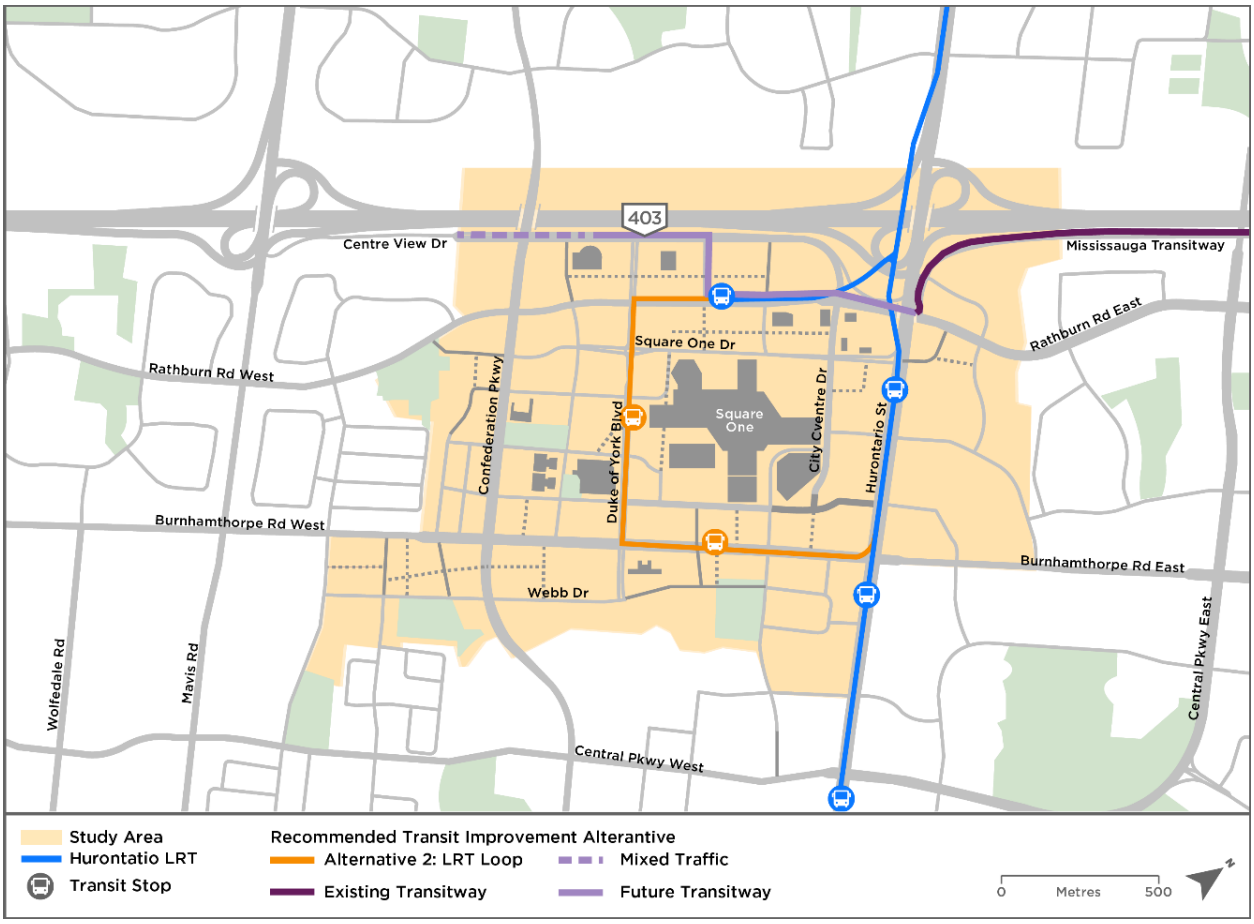


Figure 5-3: Draft Higher Order Transit Network

5.2 Land Use Sensitivity Analysis

5.2.1 Land Use Assumptions

Additional land use scenarios for Downtown Mississauga were investigated to identify impacts of higher projections for population and employment for the 2041 horizon on the draft preferred networks. Two higher population and employment forecast scenarios are shown in **Figure 5-4**:

- Scenario A: 2041 base land use forecast for alternative evaluation analysis documented in the previous sections;
- Scenario B: High residential growth, similar employment as Scenario A; and
- Scenario C: Full build out of Downtown Mississauga.

The percentage increase of the two new scenarios (Scenarios B and C) compared to the base (Scenario A) is provided in **Table 5-1**. Most of the differences between scenarios is from population, at 32% and 116% more residents compared to Scenario A for Scenarios B and C, respectively. Employment has smaller increases at 5% for Scenario B and 49% for Scenario C. Combined, population and employment increases by 23% and 95% in Scenarios B and C, respectively.

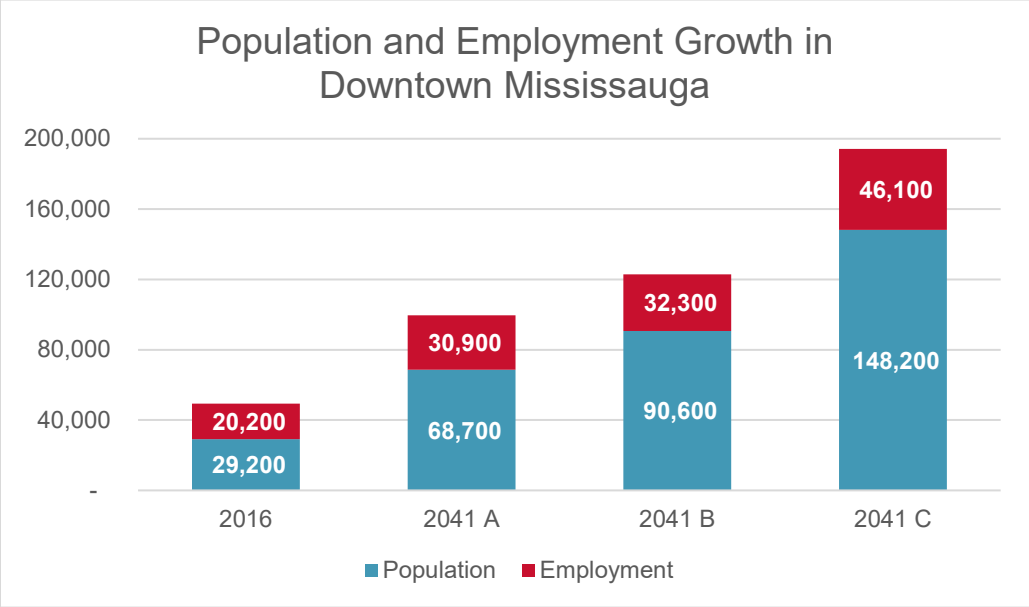


Figure 5-4: Land Use Sensitivity Scenarios - Population and Employment Forecasts in Downtown Mississauga

Table 5-1: Percentage Growth in Population and Employment (compared to Scenario A - Base)

Land use	2041 B	2041 C
Population	+32%	+116%
Employment	+5%	+49%
Total	**+23%**	**+95%**

5.2.2 Transit Capacity Analysis

A transit capacity analysis was conducted to test if the proposed transit network and services can accommodate higher growth projections per the two land use sensitivity scenarios and to identify the busiest transit routes serving Downtown Mississauga.

The transit volume-to-capacity (v/c) ratio for the afternoon peak hour was calculated based on the highest ridership and total capacity (combined seated and standing) per route. The highest ridership segment for each route within the study area was identified from the City's 2041 EMME model. Note that afternoon peak period transit volumes from the EMME model were converted to the afternoon peak hour volumes with a 0.307 conversion factor observed for auto volumes. Capacities were determined based on the anticipated vehicle size and assumed headways from the City's 2041 model. A corridor v/c ratio that combines all the services along a corridor was also calculated where both local and express routes are provided.

No over-capacity issues are anticipated for Scenario B, with the highest v/c (0.84) observed on the westbound Route 9 – Rathburn. In Scenario C, several routes are approaching capacity, including westbound Route 100 – Airport Express (0.95), westbound Route 9 – Rathburn (0.90), and westbound Route 26 – Burnhamthorpe Local (0.87); however, the overall corridor v/c for these routes remain acceptable at below 0.85. Full results of the transit capacity analysis are provided in **Appendix 6**.

Based on the transit capacity analysis. The proposed transit system has the potential to accommodate the increasing demand, should Scenario B and Scenario C occur.

5.2.3 Road Capacity Analysis

Land use Scenario B was further used to test the road network capacity and identify the critical points in the network if higher residential growth were to occur. Note that due to the significant increase in population and employment in Scenario C, the Vissim model would not be able to process the auto demand to generate valuable results; therefore, Scenario C did not proceed with the Vissim sensitivity analysis.

The analysis identified that the network conditions would not be significantly exacerbated as a result of the increased travel demand and will continue to accommodate 99% of the vehicular demand in the network. Conditions will worsen at a network-wide level with the average delay per trip increasing from 3.1 minutes to 3.4 minutes, or about a 10% increase. Specifically, intersections near Burnhamthorpe Road and Kariya Drive are expected to worsen as a result of increased demand entering and exiting the downtown core. Queueing conditions are also expected to worsen by the increase in travel demand to and from the downtown core, notably on the eastbound Highway 403 off-ramp, which will operate at capacity with significant queues.

Details of the modelled scenario and operational conditions can be found in the DMP Microsimulation Report in **Appendix 2**. A summary of the network-wide conditions for Scenario A and Scenario B is provided in **Table 5-2**.

Table 5-2: Scenario A and Scenario B Network Conditions

Scenario	Average Delay (min)	Average Speed (km/h)	Total Travel Time (h)	Total Delay (h)
Scenario A with the draft preferred road network	3.1	35.5	6,022	3,157
Scenario B with the draft preferred road network	3.4	33.5	6,465	3,560

Based on the Vissim modelling test, the draft preferred road network can accommodate higher residential growth should Scenario B occur, but more delays and worsened levels of service are expected at some key intersections.

This sensitivity analysis can help the city understand the critical points in the road network and prepare to address the potential issues early, should any indications of a higher than the planned growth occur.