Re: EX16.1

Attachment 3

Eglinton West LRT
Initial Business Case

Developing Toronto's Transit Network Plan to 2031
June 21, 2016

ENHANCED EGLINTON WEST RAPID TRANSIT

INITIAL BUSINESS CASE ANALYSIS

JUNE 2016

Cover Image: Marcus Bowman

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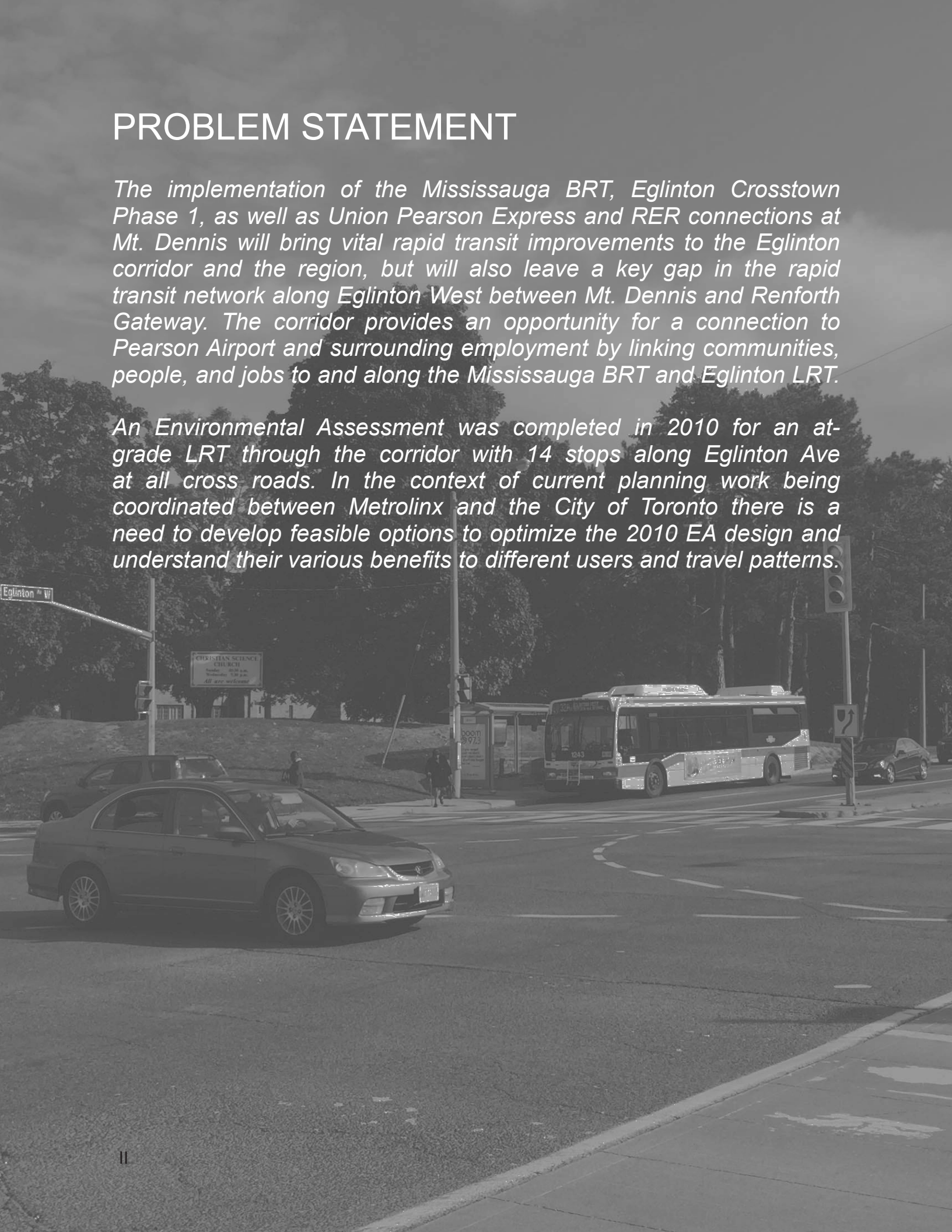
PROBLEM STATEMENT

The implementation of the Mississauga BRT, Eglinton Crosstown Phase 1, as well as Union Pearson Express and RER connections at Mt. Dennis will bring vital rapid transit improvements to the Eglinton corridor and the region, but will also leave a key gap in the rapid transit network along Eglinton West between Mt. Dennis and Renforth Gateway. The corridor provides an opportunity for a connection to Pearson Airport and surrounding employment by linking communities, people, and jobs to and along the Mississauga BRT and Eglinton LRT.

An Environmental Assessment was completed in 2010 for an at-grade LRT through the corridor with 14 stops along Eglinton Ave at all cross roads. In the context of current planning work being coordinated between Metrolinx and the City of Toronto there is a need to develop feasible options to optimize the 2010 EA design and understand their various benefits to different users and travel patterns.



1.0 INTRODUCTION

Eglinton West: A Gap in the Regional Rapid Transit Network

The Greater Toronto and Hamilton Area's Regional Transportation Plan, The Big Move, was adopted in 2008 and set out a 25-year vision for supporting growth in the region. It put forward policies and programs that advance the sustainable movement of people and goods across the region and identified needed investments in building regional rapid transit, including the transformation of the GO Transit service to Regional Express Rail (RER), and new subways, Light Rail Transit (LRT) and Bus Rapid Transit (BRT). A number of projects are already in operation or under construction, including the VIVA BRT in York Region, the Mississauga BRT, the Spadina Subway Extension, the Eglinton Crosstown LRT, the Finch West LRT, the Union Pearson Express and major expansions to GO rail and Union Station.

What is in plan for Eglinton West?

In the context of the Eglinton West corridor, The Big Move identified three important priorities:

- *The need to provide rapid transit along Eglinton Ave from Kennedy Rd to Pearson Airport*
- *The need for the Mississauga BRT*
- *The need for improved connections to the airport from all directions*

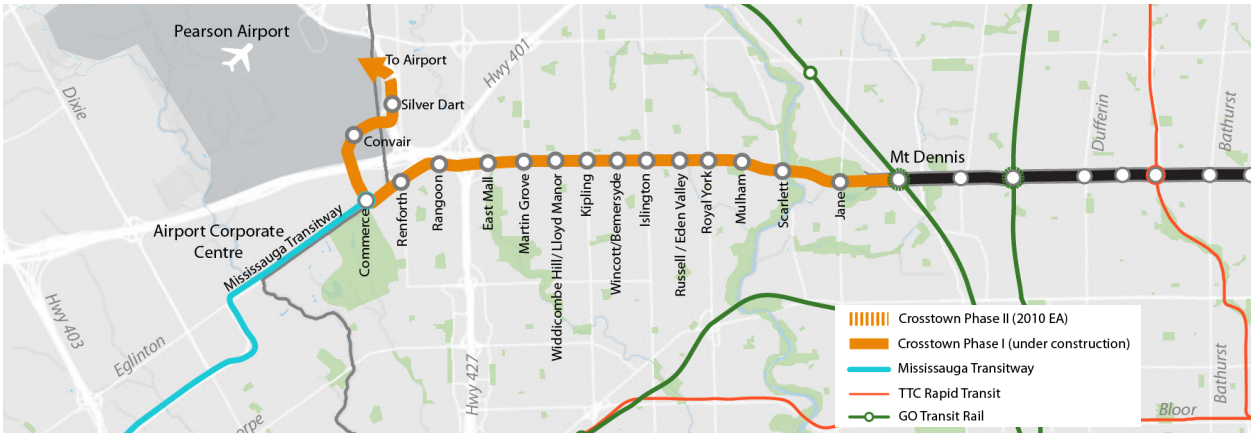
The Mississauga BRT and the Union Pearson Express are now in operation, and construction of rapid transit along Eglinton Ave is well underway as Phase 1 of the Eglinton Crosstown LRT between Kennedy Station and Mt. Dennis. These projects provide much needed transit connections to the region, particularly to the airport. However, a gap exists along Eglinton between Mt. Dennis and the Airport. An Environmental Assessment that included this segment was approved in 2010 but was not funded with the rest of the project. Extension of rapid transit through the Eglinton West Corridor will fill in this missing link.

Why Now?

Recently, renewed interest has been taken in advancing rapid transit in the Eglinton West Corridor. The City of Toronto, in coordination with Metrolinx, is advancing the SmartTrack concept, which contemplates using the GO rail corridors to provide improved access for Toronto residents to rapid transit and to connect major employment nodes. A feasibility review of the SmartTrack Western Corridor, which coincides with the Eglinton West Corridor, has concluded that heavy rail would come at a high cost, have negative community impacts, and attract comparatively lower ridership to an LRT. In March 2016, Toronto City Council endorsed removing the heavy rail option for the Western Corridor in favour of further studying of the Eglinton West LRT by reviewing the Environmental Assessment to optimize the design.

2.0 CONTEXT

In 2010, an Environmental Assessment (EA) was completed by the City of Toronto and the Toronto Transit Commission (TTC) for LRT on Eglinton Avenue from Kennedy Station in the east to Pearson Airport in the west. The project received funding from Province of Ontario and Metrolinx assumed responsibility in 2012. However, due to funding constraints, the project was subsequently split into two phases. Phase 1 stretches 19 kilometers from Kennedy Station to Weston Road in Toronto's Mt. Dennis neighbourhood, with a 10 kilometre underground section between Laird Drive and Keele Street. This part of the project, commonly referred to as the Eglinton Crosstown, is currently under construction and expected to be complete by 2021. At the western terminus of Mt. Dennis, a new GO Station is planned that will see substantially increased levels of two-way GO train service in the coming years, along with an additional stop for the Union Pearson Express (UP Express). The original 2010 EA envisioned Phase 2 of the project, the subject of the current study, as a surface LRT between Mt. Dennis Station and Pearson Airport, with 14 stops along Eglinton Avenue, and another 3 additional stops in a segment that leads into the airport. The EA did not establish an alignment on the Pearson Airport property, deferring this to future work.



Many people living in Toronto, Etobicoke, and Mississauga travel across the region to jobs in Downtown Toronto and the Pearson Airport Area, which includes employment surrounding the airport and the Mississauga Airport Corporate Centre (MACC). Outside of Downtown Toronto, the Pearson Airport Area has the second largest number of jobs in the GTHA, making it a key regional destination.

A review of current trip patterns for this part of the region using the Transportation Tomorrow Survey provides some detail about the number of trips to these key employment areas. For trips starting in Etobicoke, about 25% stay within the area, while another 25% are headed downtown or to destinations located to the east along Eglinton Avenue, 25% are headed north and south, and about 10% are headed to the airport area. The total number of trips originating in the area, bound for employment hubs is modest compared to other areas. For example, trips from Etobicoke to downtown and the Eglinton Corridor are about 12,300 trips, while from Mississauga to the same areas is about 19,500 trips.

The Transportation Tomorrow Survey is a household survey of trip patterns conducted every 5 years since 1986 by the Data Management Group at the University of Toronto. The 2011 survey contains over 850,000 trips in South Central Ontario. The survey incorporates all modes (car, transit or other). The survey reflects morning commuting trips (AM peak period) but does not fully capture all airport passengers

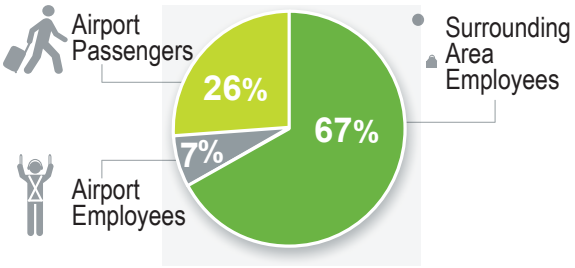
For the Pearson Airport Area and Mississauga Airport Corporate Centre (MACC), current trips predominantly come from the west, with few trips coming from Etobicoke and the Eglinton Avenue corridor; reflective of the poor transportation links from the east along the Eglinton corridor. Trips from Mississauga to Downtown Toronto and the

Eglinton West corridor north of downtown, are significant at 19,500 trips, and represent 9% of all outbound trips from this area. Trips to Etobicoke and Eglinton West are fairly low at about 2% of trips or 2,600 trips. Morning commuting trips to Mississauga are predominantly from the west, with few trips currently from Toronto.

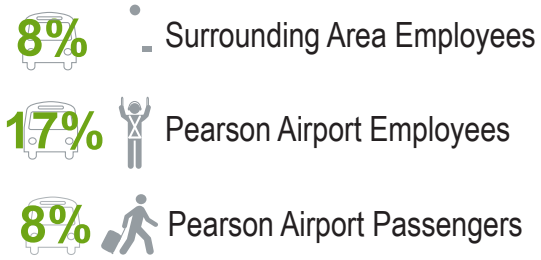
The 'Transportation Study of the Pearson Airport Area,' completed by Metrolinx in 2015, estimates that about 40,000 people are employed within the airport proper, and another 245,000 jobs are located in the surrounding Pearson Airport Area. Together, this makes up more than 280,000 jobs, which is more than the number of jobs in the central business districts of either Calgary (140,000 jobs) or Vancouver (145,000 jobs). By 2031, this number is expected to increase by 41%. More specifically, there are approximately 35,000 jobs within the Mississauga Airport Corporate Centre (MACC), and by 2041, another 10,800 jobs are expected for this sub-area. In addition to this, about 33 million passengers move through Pearson Airport annually. This number is expected to increase by 92% by 2031.

Despite being a major area of activity in the region, only a small percentage of people use transit to access the airport and the surrounding area. Even under free flow conditions, only 18% of trips can be made within 30 minutes by public transit, making the area challenging to access by transit. Despite planned and ongoing implementation of numerous transit projects in this part of the region, namely Mississauga BRT, Renforth Gateway, Eglinton Crosstown Phase 1, UP Express, and GO RER, a key gap in the rapid transit network still remains along the Eglinton Avenue West Corridor. Direct access to Pearson Airport will improve with the implementation of these higher order transit projects. However, employment in the greater Pearson Airport Area, even within the Mississauga Airport Corporate Centre (MACC), is dispersed and more difficult to serve with rapid transit alone. These areas will require the support of a strong local transit network with connections to key hubs to complement higher order services.

Who travels to the Pearson Airport Area?



What percent take transit?



The Greater Toronto Airport Authority recently released the study 'Pearson Connects: A Multi-Modal Platform for Prosperity', which similarly identified the urgent need for a new, multi-modal transit hub at the airport. The report suggests that a multi-modal transit hub, comparable in scale to Union Station, would fill a critical missing link in the regional transit system, connecting air travel and regional transit to local services to the surrounding areas.

Rapid transit in the Eglinton West corridor contributes to the objective of creating a multi-modal hub at Pearson Airport. It opens up an opportunity to provide an additional connection to the airport and surrounding employment area, and completes the link between the Eglinton Crosstown LRT in the east and the Mississauga BRT in the west. Extension of the rapid transit connection through Eglinton West would also provide additional opportunity for Etobicoke residents transferring to rapid transit from north-south feeder buses, and serve to improve the overall redundancy of the regional transportation network.

3.0 STUDY OVERVIEW

Metrolinx, The City of Toronto and the TTC have undertaken a study of rapid transit options for the Eglinton West corridor to better understand people's travel needs; to estimate how many people would use and benefit from different transit options and configurations, and the benefits and costs for implementing different transit options. This work was done in coordination with the SmartTrack Western Corridor, lead by the City of Toronto, which examined the feasibility and costs of a heavy rail option with three stops in this segment of Eglinton Avenue. The study concluded that heavy rail would be excessively expensive to construct, disruptive to the local community and attract lower ridership than the base case LRT option. In March 2016, Toronto City Council directed that the heavy rail option be removed from consideration and that options to enhance the LRT design be studied instead.

Approved EA Alignment and Stops

The base case for this study is the Eglinton Crosstown Phase 2 LRT option, approved in the 2010 EA. Phase 2 extends the Eglinton Crosstown LRT from Mt. Dennis, westward to Renforth Gateway and Pearson Airport, with 14 at-grade stations along Eglinton Avenue, and an additional 3 stations in the airport segment.

Key Considerations

In the development of options for rapid transit in the corridor, the following were key considerations:

1 **Local access vs. travel speed.** The number of stops determines the extent to which a transit line provides for local access as compared to faster travel times for people going longer distances. This study looked at options with 17, 11, and 6 stops in order to understand how many people might use the system and the travel time benefits associated with each.

2 **Extent of separation from road traffic.** The extent to which a rapid transit line is mixed with road traffic impacts the speed and reliability of the service. This study looked at four types of options to align the LRT either above, below or at the roadway: 1. the EA option, where LRT travels at-grade in the centre of the road separated from traffic, but still interacts with traffic at intersections; 2. fully separated from traffic, either elevated or in a tunnel; 3. a hybrid option where grade separation only occurs at intersections; and 4. targeted grade separations where the LRT is strategically separated from traffic to avoid congestion, use natural topography or improve transfers.

3 **Type of transit technology.** In addition to LRT, a BRT option was also explored. BRT can often provide rapid transit service levels at lower cost and with greater service flexibility. BRT is typically used in corridors where potential transit ridership is higher than a standard bus, but where the capacity of an LRT is not yet warranted.

Options Overview

A total of 6 representative options, including the approved EA option, were studied to isolate how various design features may impact the cost, function, and effectiveness of rapid transit in this corridor. With the key considerations in mind, the options were altered from the EA option to have varying numbers of stops and stop spacing, different levels of grade separation, and technology.

At-Grade LRT

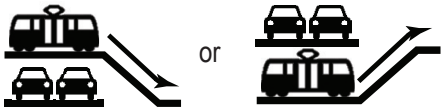
1 **17 stops** (14 on Eglinton) Approved EA option
Designed for local access

2 **11 stops** (8 on Eglinton)
Designed to balance speed and access

3 **6 stops** (3 on Eglinton)
Designed for higher speed and longer trips

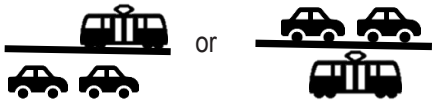
+ Potential Targeted Grade Separations

At-Grade LRT, with Grade Separations at Arterials



4 **6 stops** (3 on Eglinton)
Designed to avoid intersection delay

Fully Grade Separated LRT



5 **6 stops** (3 on Eglinton)
Designed for maximal speed and longer trips

At-Grade BRT

6 **17 stops** (14 on Eglinton)
Designed for local access

The LRT options have been designed as extensions of the Eglinton Crosstown LRT using the same fare and service pattern assumptions. A rider traveling westbound from the Eglinton Crosstown LRT would not have to transfer at Mt. Dennis in order to continue traveling through the Eglinton West Corridor. However, those wishing to continue into Mississauga via the Mississauga BRT would have to transfer onto the bus at Renforth Gateway, the eastern terminus of the transitway.

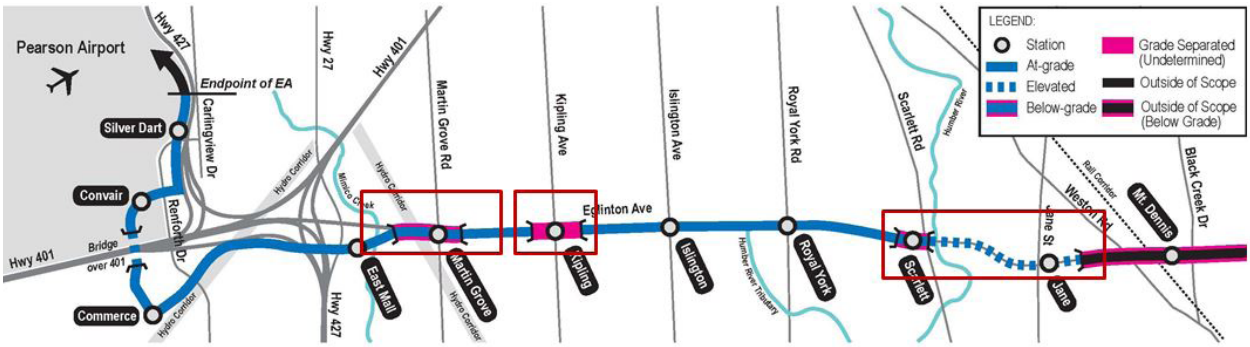
The at-grade LRT options (#1-3) also included study of targeted grade separations, places where specific infrastructure interventions could be used to address potential impacts or improve the benefits of the project. This analysis included high-level costing and feasibility assessment of three targeted grade separation

The BRT option in this study was designed to be comparable to the 17 stop at-grade option in the Approved EA. As an extension of the Mississauga BRT, it would interface with Phase 1 of the Eglinton Crosstown LRT at either Jane Station, or Mt. Dennis. A connection at Jane Station would require that the Eglinton Crosstown LRT be extended to Jane Street from its current terminus at Mt. Dennis, as it would in all the LRT options. A connection at Mt. Dennis would, likewise, require a short underground segment to avoid corridor constraints in this segment of Eglinton Avenue.

For modelling purposes it was assumed that this BRT segment acts as one leg of the BRT, with half of all buses from the Mississauga Transitway diverted to the Eglinton Corridor instead of to Kipling Subway Station, Pearson Airport, or to Malton. In the westbound direction, the same buses make the return trip, and are joined by other buses destined for Pearson Airport, giving the airport segment a higher combined frequency.

Targeted Grade Separations

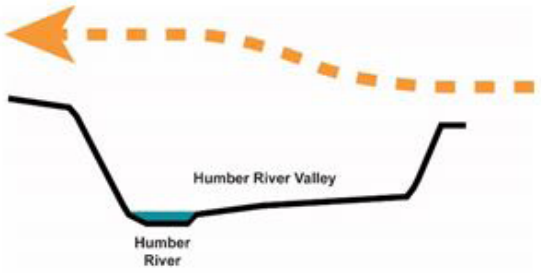
The Eglinton West Corridor was studied for locations where targeted grade separations could provide benefits. Three potential areas were identified and developed further to assess high level costs and feasibility. These included: Jane and Scarlett, Kipling and Martin Grove. These separations could be added to the at-grade options (#1-3).



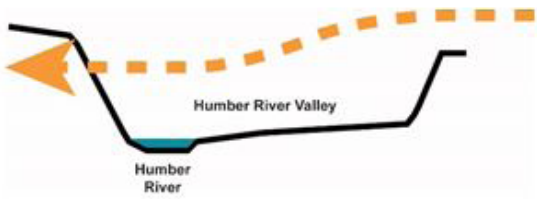
Jane and Scarlett Grade Separation

A grade separation in this area may provide benefits through mitigation of traffic impacts, improving passenger transfers with intersecting transit services, and taking advantage of the natural topography.

Grade separation of the Eglinton LRT at Jane and Scarlett would require the LRT operate to the north of Eglinton Avenue, over Jane Street, Emmet Avenue, and the Humber River Valley. At Scarlett Road, the LRT would either go over the roadway before tying back in to the centre median of Eglinton Avenue, or descend into the valley and underneath the roadway before emerging from a portal in the centre median.



LRT elevated over Scarlett Road



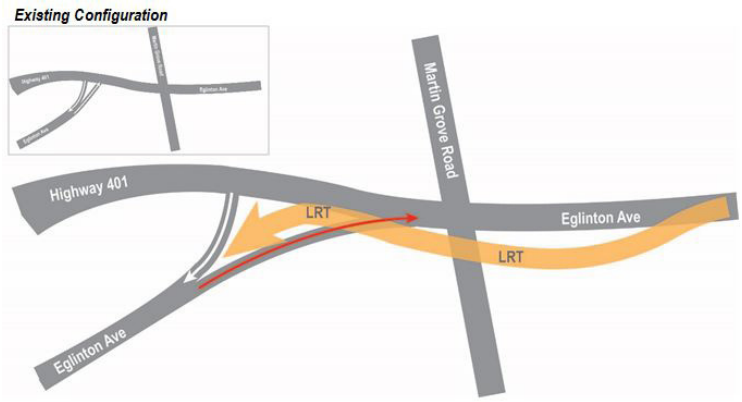
LRT under Scarlett Road, into western embankment

Kipling Grade Separation

The Kipling stop is located near the mid-portion of the study area. The primary reason for grade separation at Kipling would be to provide a more convenient bus to LRT transfer. Grade separation at Kipling would likely require lowering the LRT into a trench below the roadway to prevent negative impacts on the surrounding residential communities.

Martin Grove Grade Separation

Martin Grove is located in the western portion of the study area and is one of the busiest intersections along the project corridor, with significant eastbound left turns during both the AM and PM peaks. Eglinton Avenue connects directly into Highway 401 just west of Martin Grove, contributing to large volumes of traffic. Because of the highway, continuing west on Eglinton Avenue, requires a left turn at an angular intersection.



Proposed Reconfiguration of Eglinton Avenue

Community consultation has indicated that traffic volumes are further exacerbated by drivers seeking alternate routes during lane closures on Highway 401. Due to the height limitations imposed by the hydro corridor, grade separation in this area would likely be below-grade. The LRT would enter a tunnel east of Martin Grove Road and emerge from a portal in the middle of a reconfigured Eglinton Avenue west of the on-ramps to highway 401.

Method of Analysis

To better understand the impacts of the various options, detailed analysis of the six options was undertaken using the four chapter Metrolinx Business Case framework. The City's 'Feeling Congested' framework was applied to better understand the differences between the 17-stop and 11-stop options (Options 1&2) and was incorporated into the Strategic Case. The Strategic Case also included a corridor analysis, market analysis and ridership projections. A corridor analysis of the project area examined the types of development and destinations that exist today, and identified potential areas for new development or redevelopment along the corridor. The market analysis was used to examine current travel patterns based on information contained in survey data of households in the region (from the University of Toronto's Transportation for Tomorrow Survey). Ridership projections were produced through travel demand modeling to predict future travel patterns that will result from growth in the region, and in response to implementation of each option.

Order of Magnitude costing was developed based on the conceptual layout of each proposed option, which have been adjusted to overcome the major constraints of the corridor. The economic case involved quantification of costs and benefits for all options, which accounts for travel time savings for transit users, new fare revenue, and reductions in travel by personal vehicles. A review of right of way allowances and other constraints along the corridor informed the operations and deliverability case.

Key Findings

Eglinton West represents a gap in the regional rapid transit network, serving medium and longer distance trips:

- Extension of rapid transit would fill a gap in connectivity between ECLRT Phase 1 and the Mississauga Transitway,
- Westbound travel from Toronto to Pearson Airport, the Airport Corporate Centre, and elsewhere in Mississauga is significant,
- Based on 2031 forecasted boardings the line is mostly served by transfers from N-S buses (50%) and from the Mississauga Transitway (30%), with walk-on ridership comprising the balance (20%).

This study finds that LRT is an appropriate rapid transit solution for the Eglinton West corridor, with between 17 and 11 stops LRT and some targeted grade-separation. This effectively balances local accessibility for the community and travel speeds for people who travel longer distances within Toronto and to Mississauga.

4.0 STRATEGIC CASE

Options were assessed based on their strategic effectiveness to meet the objectives of higher order transit service in this area. An effective rapid transit connection in the Eglinton West Corridor would bridge the gap in the transportation network, effectively balance the needs of both local and regional markets and advance broader city building objectives. An optimal option also must comfortably accommodate projected travel demands through the corridor, and be able to attract a sustainable level of ridership.

The strategic case begins with a summary of key high-level findings considering the above criteria. followed by a more detailed strategic analysis of the two emerging preferred options. The detailed analysis was conducted only on Options 1 and 2 and used the City of Toronto's 'Feeling Congested' framework. This framework was developed through the recent review of the City's Official Plan transportation policies and is applied by the City across all transit projects. By applying the framework to Options 1 & 2 which are differentiated by the number of stations on Eglinton Avenue West, preliminary analysis is available to inform finalization of station locations in the next phase of this work.

Strategic Case Key Findings:

- Eglinton West represents a gap in the regional rapid transit network serving longer distance trips
- An Eglinton LRT extension improves transit for Etobicoke residents, particularly Northern Etobicoke
- The LRT option in the approved EA can be further refined, including consideration of reducing the number of stops
- LRT better serves the travel market in the corridor compared to BRT
- A hybrid option with at-grade LRT and grade separations at select targeted locations may provide benefits.

Structure of the 'Feeling Congested' Framework

Principle	Criterion
People	**Experience** *Capacity to ease crowding / congestion; reduce travel times; make travel more reliable, safe and enjoyable*
	Choice *Develop an integrated network that connects different modes to provide for more travel options*
	Social Equity *Allow everyone good access to work, school and other activities*
Places	**Shaping the City** *Develop an integrated network that connects different modes to provide for more travel options*
	Healthy Neighbourhoods *Changes in the transportation network should strengthen and enhance existing neighbourhoods; promote safe walking and cycling within and between neighbourhoods*
	Public Health & Environment *Support and enhance natural areas; encourage people to reduce how far they drive; mitigate negative impacts*
Prosperity	**Supports Growth** *Investment in public transportation should support economic development: allow workers to get to jobs more easily; allow goods to get to markets more efficiently*
	Affordability *Improvements to the transportation system should be affordable to build, maintain and operate*

4.1 Strategic Case Findings

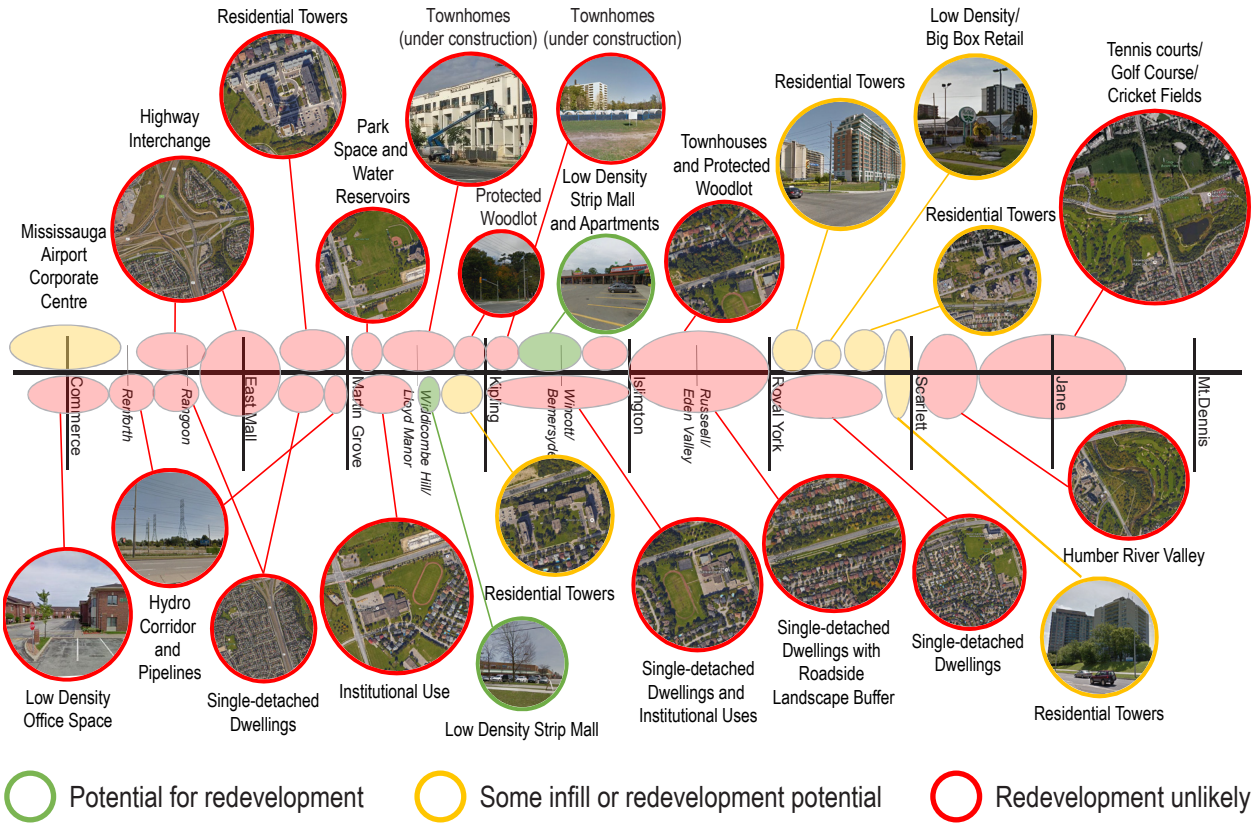
Eglinton West represents a gap in the regional rapid transit network serving longer distance trips.

Particularly trips connecting:

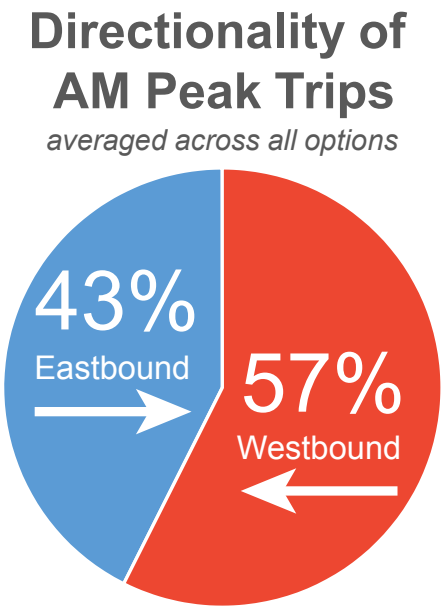
- *City of Toronto residents to Pearson Airport and the broader Airport Employment Area;*
- *Etobicoke with York University, Downtown Toronto, and the Pearson Airport Area*
- *Mississauga with Downtown Toronto and York University*

The Eglinton West corridor has few major destinations as compared to the rest of the Eglinton corridor, and the adjacent land use to the north and south is predominantly single-detached homes. While redevelopment is unlikely along many portions of the corridor, there are opportunities for intensification which may be encouraged by new rapid transit. The corridor hosts a mix of longer-distance and local travel.

Development Potential on Eglinton Ave



While travel demand is present in both directions, demand during the morning rush period was observed to be stronger in the westward direction for all options explored, connecting Toronto and Etobicoke to the Airport and Pearson Airport Area. This is unsurprising given the findings of the Transportation Study of the Pearson Airport Area, which recognizes the airport as a major regional node. Although the study showed that travel demand for employment in the surrounding airport area originates predominantly from Brampton and Mississauga in the west, a significant amount of airport employee and passenger traffic also comes from the east, from western Toronto and the rest of the GTHA.



An analysis of traveler benefits generated from travel time savings reveals that people destined for Pearson Airport are likely to receive the most significant benefits. To a somewhat lesser extent, York University, Downtown Toronto, and Etobicoke destined travelers are also likely to benefit from notable travel time savings. Extension of rapid transit through the Eglinton West corridor benefits most of the region with regards to access to the airport, with those originating from Toronto, but located just outside of the Union Station catchment area, benefiting the most.

Those travellers who begin their trips in Etobicoke and along the Eglinton Corridor also enjoy a strong travel time savings. Transit users coming from Mississauga experience some travel time savings, but because they are coming from a wider geographic area and they have a large range of viable travel options to Downtown Toronto, the relative benefit is not as strong as for travelers coming from the City of Toronto in the opposing direction.

An Eglinton LRT extension improves transit for Etobicoke residents, with a particular emphasis on benefits for the northern portion of Etobicoke.

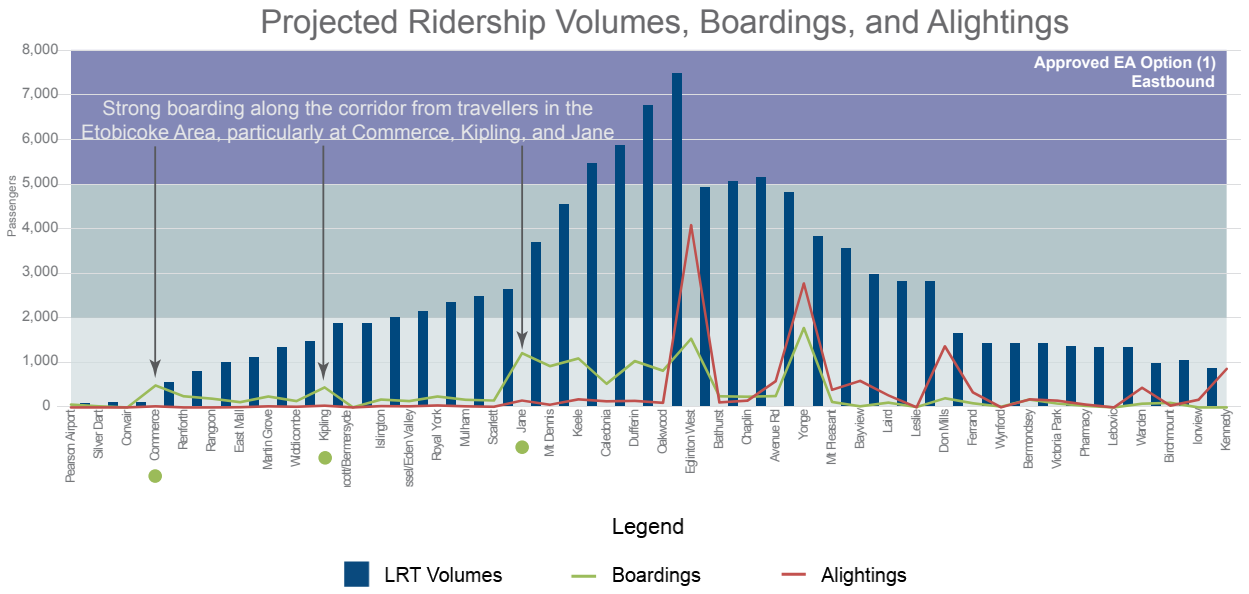
An extension of the Eglinton LRT improves transit for Etobicoke residents, serving the local community through north-south bus connections on the major roads. The travel benefits are strongest north of Eglinton, where fewer high-order transit options exist as compared to those living south of Eglinton who can more easily access the Bloor-Danforth Subway (TTC Line 2).

The LRT option in the approved EA can be further refined, including consideration of a reduced stop option that may better target the travel market and provide improved travel time savings.

The LRT option in the approved EA was developed as part of the wider Eglinton Crosstown LRT project. Not surprisingly, the option has merit as part of the overall network, but may benefit from further refinement to improve the business case.

A key adjustment that may bolster the benefits of the LRT is a refinement in the number of stops along the corridor. The number of stops along a corridor, and the resulting distances between them, presents a trade-off between the ease of local access and faster journey times. Decisions about the number of stops will have to consider the numbers of riders that will be attracted to the service by the benefits of local access versus higher travel speed, striking a balance between these two opposing objectives.

Given the value of longer distance trips for travelers across the region, an option with fewer stops appears to be more favourable in improving the economic case. Detailed analysis was undertaken for both 17-stop and 6-stop options, and suggested that some intermediate number of stops may be optimal as there is some ridership gain with moderate increase in stop spacing, and decrease in number of stops. While the 6 stop option creates larger stop spacings, and as a result, faster journey times, it provides limited local access along the corridor, which makes the services less



attractive for some users. From the analysis, this effect was most evident in the eastbound direction of travel, where the benefit of faster journey times from the 6 stop option is superseded by the access benefits of having more stops. Ridership and benefits approximated for an intermediary 11 stop option resulted in a more favourable business case than both the 17 and 6 stop options, but more comprehensive analysis is still needed to identify an optimal number of stops due to the complexities of travel demand modelling on a local scale.

Further analysis is recommended in two key areas; undertaking transportation modeling and benefits case analysis to fine tune the number of stops and to undertake detailed traffic analysis and simulation of the refined options to fully understand the impacts and benefits at a fine-grain level.

A hybrid option with at-grade LRT and grade separations at select targeted locations may provide benefits.

A fully grade-separated LRT would cost almost twice as much as an alignment at grade and could have significant impacts on the community. However, there are recognizable benefits to grade separation, including reducing traffic impacts, avoiding geographical constraints and improved transit connections. Some of these benefits can be achieved through targeted grade separations at specific points of opportunity or constraint. Incorporating select grade separated treatments into an at-grade LRT may improve the operational efficiency and provide travel time savings as compared to a full grade separated option while managing costs and community impacts.

LRT better serves the travel market in the corridor compared to BRT.

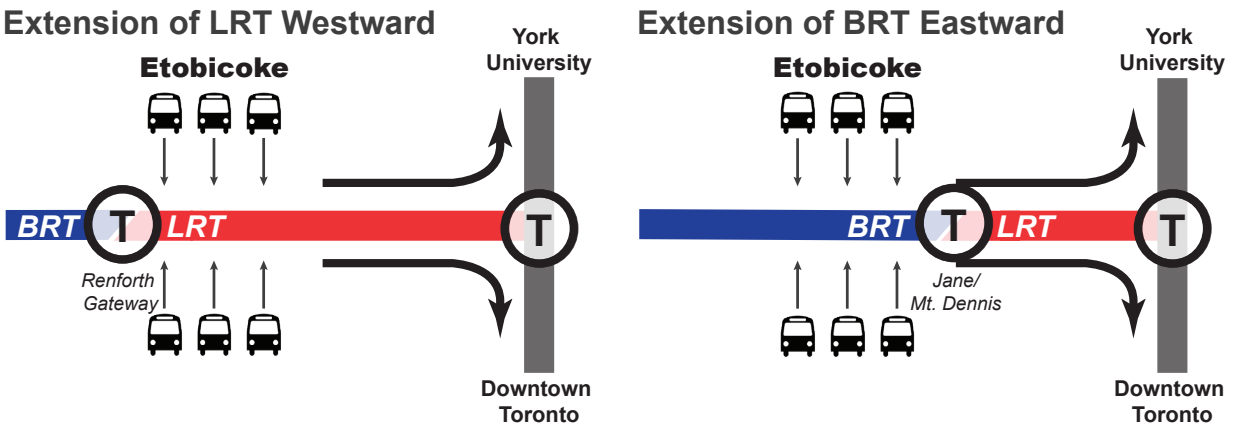
BRT was considered as a potentially lower cost alternative to LRT, with many of the same benefits in terms of quality of service and journey times. The BRT option assessed in this study was envisioned to be similar to the VIVA Rapidway project in York Region, operating in the centre median, separated from traffic except where it crosses intersections.

A key consideration in the evaluation is how Eglinton connects to the Mississauga BRT and whether the transfer between LRT and BRT should occur at Renforth Gateway in the west, or at Jane/Mt. Dennis in the east.

Those traveling eastbound from Mississauga to destinations beyond Etobicoke, which represents the majority of eastbound travelers originating from Mississauga, have to transfer at some point from BRT to LRT regardless of where the transfer is located, so the location has little to no impact. In the opposite direction, the impact of the transfer location is dependent on each traveler's intended destination. Similar to the eastbound direction, westbound travelers who wish to continue beyond the length of the project corridor into Mississauga would be unaffected by the transfer location since they will have to switch from LRT to BRT regardless, but those looking to end their trip at or before Pearson Airport, and the Pearson Airport Area, would experience added inconvenience if the transfer was located in the east at Jane/ Mt. Dennis. In this case, the predominance of westward travel from Toronto and Etobicoke to the airport and airport employment areas suggests that extending the LRT and having a transfer free trip better serves the broader market. In addition, the Greater Toronto Airports Authority (GTAA) is advancing significant plans for improving transit accessibility to the Pearson Airport Area.

In addition, LRT is more favourable for the Etobicoke market as it serves as a core service for local buses to feed into, giving improved access to Downtown Toronto and York University. With BRT, Etobicoke residents on local buses would be required to transfer to BRT, then again to LRT before they can enter the larger rail network, adding an additional transfer to their journey. The diagrams below show the impact of the BRT to LRT transfer location on Etobicoke riders, with the BRT extension adding an extra transfer point for eastbound Etobicoke travelers.

LRT provides reliable, quiet, energy efficient, accessible and higher-level public transit that meets the demand projections for the corridor and helps to advance Provincial and Municipal land-use goals. Taking all factors into consideration, light rail would meet the future projected travel needs on Eglinton Avenue, as well as provide capacity for future growth, in the most cost-effective way possible.



4.2 Detailed Analysis of Option 1 & Option 2

Serving People

Experience

Evaluating how a transit project improves a traveller's experience is directly related to how many people choose to take transit, given that they will choose to take transit if it offers a better experience than a different mode of travel. Experience can further be understood in terms of change in travel time between origins and destinations, how many destinations a rider can access using the transit network and the ability to mitigate crowding on transit.

It is estimated that Option 2 would incent marginally more riders than Option 1 to use transit daily. However, Option 2 increases the average generalized transit travel times slightly. More investigation will be conducted to determine the degree to which this represents travel time savings for trips or a shift towards shorter trips being taken by transit.

SmartTrack also provides much needed relief to congested Bloor-Yonge Station and on Line 1 (Yonge-University Subway) south of Bloor.

Option 1 and Option 2 perform similarly from an Experience perspective.

Choice

The project's impact on choice can be understood both in terms of how many opportunities there are to transfer to other rapid transit lines that serve destinations that people want to travel to (more opportunity is positive), and how many transfers riders need to make to reach their destinations (fewer transfers is positive).

The Eglinton West LRT makes the key transit connection between the Renforth Gateway at the Mississauga Airport Corporate Centre and the rest of SmartTrack at Mount Dennis.

Each of these points is identified as a Mobility Hub, and should be planned as important connection points in the future. These hubs act as intermediary points on many transit trips to downtown Toronto and elsewhere in the city, in addition to being important destinations in their own rights.

The Eglinton West LRT would be constructed as an extension to the Eglinton Crosstown LRT and also connect with the Mississauga Transitway. The connection with the rest of SmartTrack and GO Rail at Mount Dennis is significant.

Option 1 and Option 2 do not differ significantly from one another in terms of the average number of transfers required.

The number of connections to major walking and cycling infrastructure is also related to transportation choice. Examples of this type of infrastructure include downtown's PATH system for pedestrians, the Waterfront Trail system or the West Toronto Rail Path. The options do not differ significantly in their impacts or ability to connect to any such pedestrian or cycling facilities.

On balance, all options perform equally well with respect to Choice.

Social Equity

The impact of a transit investment can be expressed in terms of a change in access to jobs for residents of Neighbourhood Improvement Areas (NIA) and number of NIA residents served by rapid transit.

The Eglinton West LRT would serve a moderate number of social equity seeking individuals. Option 1 would serve nearly 20% more than Option 2, by virtue of its additional stations. There may be an opportunity to strategically include specific stops from Option 1 in the final list of stop locations in order to improve access to NIA residents. The additional stations in Option 1 would also result in increasing coverage by over 28%.

Option 1 performs better than Option 2 with respect to Social Equity.

Summary of Social Equity Metrics

	Option 1 (17 stops)	Option 2 (11 stops)
Change in Coverage	8.2 km^2	6.4 km^2
Change in Social Equity Seeking Individuals Served	12,700	10,700

Strengthening Places

Shaping the City

Transit investments can play a very significant role in the residential development of the city. Rapid transit may be constructed to serve areas of high population density in order to relieve congestion and increase capacity of local transit services, or rapid transit can be built in areas planned for higher population density in order to increase transportation accessibility and thus incent residential development in appropriate areas.

Existing population represents an established market which makes benefits associated with serving it more certain than those associated with serving growth. Option 1 serves over 20% more existing residents than Option 2. Population growth expected for the area is similar between the two options with Option 1 being slightly higher. Although the line serves areas outside the City of Toronto's borders, all of the population served is within Toronto.

By virtue of its additional stations, Option 1 provides some additional benefit over Option 2 with regards to Shaping the City.

Summary of Shaping the City Metrics

	Metric	Option 1 (17 stops)	Option 2 (11 stops)
Existing Population	Existing GTHA population	28,700	23,400
	Existing GTHA population density	2,800 people/km^2	2,800 people/km^2
Service to residential growth areas	Area of land designated for population growth	0.1 km^2	0.1 km^2
	Proportion of land designated for population growth	0.8%	0.9%
Population Growth	Projected population growth	2,800	2,500
	Projected increase in population density	300 people/km^2	300 people/km^2

Healthy Neighbourhoods

Just as transit investments can be a powerful force in shaping the city, they can also have long-term detrimental impacts on existing, stable neighbourhoods. A significant proportion of the Eglinton West LRT study area is recognized as stable neighbourhoods, to which adding a station could bring unwanted development pressure and change. Option 1 is in close proximity to 3.3 km^2 of stable neighbourhoods and Option 2 is 2.4 km^2 (40% and 38% respectively). This means that approximately half of the additional coverage provided by stations only in Option 1 is recognized as stable neighbourhoods.

Option 1 is associated with a greater likelihood of unwanted development pressure and change in the area. Therefore, Option 2 performs better with respect to Healthy Neighbourhoods.

Public Health & Environment

Transit has a very positive impact on public health and the environment due largely to enabling travel by modes other than private automobiles, which contribute significantly to air quality issues and encourage sedentary lifestyles. However, large infrastructure projects like rapid transit may also have detrimental impacts to natural features, which must be avoided or mitigated.

Option 2 is associated with a very slight reduction in daily vehicle kilometres travelled relative to Option 1.

The Eglinton West LRT has some environmental challenges associated with it, in the crossing of the Humber Valley and Mimico Creek. However, these challenges affect Option 1 and Option 2 equally. All options perform equally well with respect to public health and the environment.

Summary of Public Health & Environment Metrics

	Option 1 (17 stops)	Option 2 (11 stops)
Auto Mode Share	55%	55%
Significant Environmental Challenges	None	None

Supporting Prosperity

Supports Growth

As with residential growth areas, transit investments can play a very significant role in the employment development in the city. Rapid transit may be constructed to serve areas of high employment density, or rapid transit can be built in areas planned for higher population density in order to increase transportation accessibility and thus incent businesses to locate high density employment like offices in appropriate areas.

As for population, existing employment represents an established market. The benefits associated with serving existing employment are more certain than those associated with serving growth.

The key growth areas served by the Eglinton West LRT is the Mississauga Airport Corporate Centre and Toronto Pearson which are served equally well by Option 1 and Option 2.

Option 1 and Option 2 perform similarly from the perspective of Supporting Growth.

Summary of Supporting Growth Metrics

	Metric	Option 1 (17 stops)	Option 2 (11 stops)
Existing Employment	Existing Toronto employment	4,500	4,100
	Existing non-Toronto employment	21,500	21,500
	Existing employment density	2,600 jobs/km^2	3,100 jobs/km^2
Service to Employment Growth Areas	Area of land designated for employment growth	0.5 km^2	0.5 km^2
	Proportion of land designated for employment growth	7%	8%
Projected employment growth	Projected employment growth	14,300	14,100
	Projected increase in employment density	1,400 jobs/km^2	1,700 jobs/km^2

Affordability

Affordability considerations are covered in the Financial Case, but it also plays an important role in understanding the strategic case for a project. Capital costs are the most important consideration, however life-cycle costs and cost recovery are also key parameters. Removing stops means that Option 1 has lower capital costs however the difference is within the range of total costs. Option 2 may require parallel TTC bus service because of the distance between stops, which would increase its life-cycle costs. Parallel bus service for the 11-stop option is not included in the Initial Business Case analysis.

5.0 FINANCIAL CASE

Costs were developed to support a comparative study of the options. The dollar amounts generated are not intended to define the precise capital costs to construct each option, but rather to give a sense of how different design features, such as the number of stops, or the level of grade separation, influences the overall cost.

The estimates were calculated using standard estimating procedures from the Toronto LRT Program for order-of-magnitude costs. Calculations and unit values were based on information from the 2010 EA report, parametric estimates from Metrolinx, a review of the corridor and options, calculation of major quantities and validation of major cost drivers with external cost data. Capital costs do not include escalation, financing costs, lifecycle and operating and maintenance.

Each cost includes an 'Airport Allowance' to account for the segment of the line that connects into Pearson Airport. As the alignment on the Pearson Airport property has not yet been established, costs were not broken out into greater detail. Key decisions about the alignment of the route leading into the airport property will have to be determined before a more accurate estimate can be developed. For the purpose of this study, an 'Airport Allowance' of $0.28B was included in the capital cost estimates for all LRT options, while $0.14B was included for the BRT option. This estimate covers the segment of the project from the stop at Silver Dart Drive, where the EA approved alignment ends, to a terminus Toronto Pearson International Airport. Further work is required, in coordination with the Greater Toronto Airports Authority (GTAA), to determine the best way to provide access to the airport property. Metrolinx, the City of Toronto and major stakeholders are coordinating with the GTAA on the 'Pearson Connects' study which proposes significantly improving the accessibility of transit to Pearson Airport and its surrounding area.

Operating and maintenance costs for the options with only three stops on Eglinton Ave include provision for a parallel TTC local bus service. Although not currently costed, the 11-stop option may require a parallel local bus. This will be confirmed in a future phase of this work.

More detail about financial case assumptions is available in the appendix.

Comparing the options to the approved EA option, BRT introduces significant capital cost savings. Decreasing the number of stops also has the effect of decreasing capital cost, though to a lesser extent. Grade separation, even with the number of stops decreased to 6, is significantly more expensive.

Summary of Costs

	Order of Magnitude Costs (2014 $billions)					
	At-Grade LRT			At-Grade LRT, with Grade Separations at All Arterials	Fully Grade Separated LRT	At-Grade BRT
Option	**1**	**2**	**3**	**4**	**5**	**6**
Stops	17	11	6	6	6	17
Airport Allowance	$0.28	$0.28	$0.28	$0.28	$0.28	$0.14
Capital Cost*	$1.4 - $1.8	$1.4 - $1.7 With Targeted Grade Separations: $1.5 - $2.1	$1.3 - $1.7	$1.7 - $2.1	$2.0 - $3.0	$1.0 - $1.3
Operating and Maintenance Cost	$0.9	$0.8	$1.0	$0.9	$0.8	$0.2

*Capital costs do not include escalation, financing costs, lifecycle and operating and maintenance

Total Project Cost Estimates with Targeted Grade Separations (2014 $billions)

Grade Separations	Jane and Scarlett	Jane and Scarlett	Jane and Scarlett	Jane and Scarlett
	Kipling	Kipling	Kipling	Kipling
	Martin Grove	Martin Grove	Martin Grove	Martin Grove
Total Project Capital Cost	$1.5 - $1.8	$1.5 - $1.9	$1.6 - $2.0	$1.7 - $2.1

6.0 ECONOMIC CASE

A benefit-cost analysis (BCA) was conducted to assess the relative economic merits of each option. All options were compared to a "Do Minimum" base case, defined as maintaining the existing local (all-stop) bus service operating along Eglinton Avenue (TTC Route 32) west of the Mt. Dennis station. The following benefits were monetized and incorporated into the analysis:

- Travel time savings (existing and new users);
- Reliability/quality benefits, converted to a time-savings equivalent (existing users);
- Unperceived vehicle operating cost savings (auto switch users);
- Fare revenue from local transit agencies and GO transit (transit agencies); and
- Reduction of emissions, accidents, and congestion due to reduced VKTs (external benefits)

The following are the outcomes of the benefit-cost analysis:

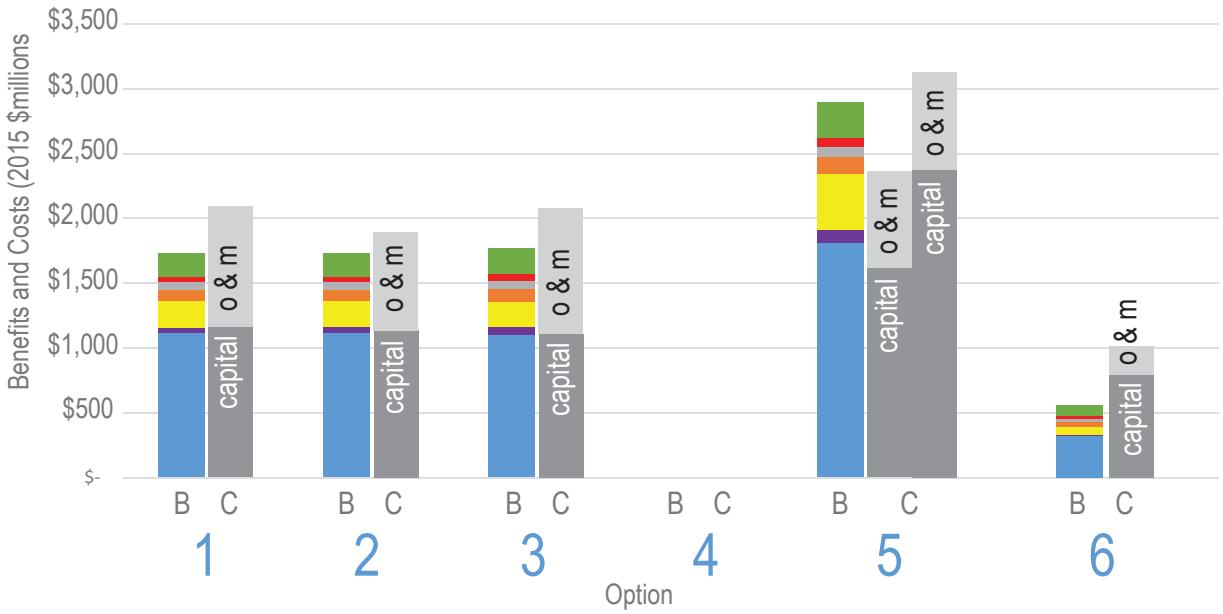
	Benefit-Cost Ratios					
Option	**1** At Grade 17-stops	**2** At Grade 11-stops	**3** At Grade 6-stops	**4** Partially Grade Separated 6-stops	**5** Grade Separated 6-stops	**6** BRT
Benefits	1.9	1.9	1.8		2.8	0.6
Costs (Lifecyle, NPV)	2.1	1.9	2		2.4-3.1	1
Benefit Cost Ratio (BCR)	0.9	1	0.9		0.9-1.2	0.6

Through development of the conceptual layout of option 4, it became apparent that the vertical profile of having an LRT that ascends and descends in repetition would not only be challenging to design and construct, but also be operationally challenging and be of major disbenefit to passenger comfort. Though these factors are not quantified within the current benefit-cost calculation framework, they were deemed sufficient in justifying the elimination of option 4 from the list of potential options. As such, a benefit-cost ratio was not calculated for option 4.

For the grade separated option, option 5, a range of benefit-cost ratios have been calculated to capture the large variability in costs - a difference of $1 billion between the highest and lowest costs. With a benefit-cost ratio of 1.2 at the lower end of the cost range and 0.9 at the higher end, it can be seen that the variability in cost can impact the performance of the service.

Out of all the options, option 6, the BRT option, resulted in the most unfavourable benefit-cost ratio at 0.6. Although the cost of constructing BRT is significantly lower than LRT, this study has revealed that BRT would be much less suitable for meeting the needs of travellers in this corridor. As discussed in the strategic case section, a key factor influencing the suitability of either mode is the location of the transfer point. As the BRT option would be an extension of the Mississauga BRT, the transfer point between LRT and BRT would be located at either Jane or Mt. Dennis. However, because a greater portion of travellers travel westbound beyond this point, a transfer at either Jane or Mt. Dennis results in a disbenefit to a larger portion of travellers. As a result, the BRT option would only be able to attract a nominal amount of ridership compared to the LRT options.

Breakdown of Benefits (B) and Costs (C) by Option



Legend - Benefit Categories

- Travel Time Savings - Existing Transit Users
- Travel Time Savings - New Transit Users
- Reliability/Quality Savings - Existing Transit Users
- Vehicle Operation Savings - Auto Switch
- Emissions Savings - Auto Switch
- Collision Reduction - Auto Switch
- Congestion Reduction - Auto Switch
- New Fare Revenue

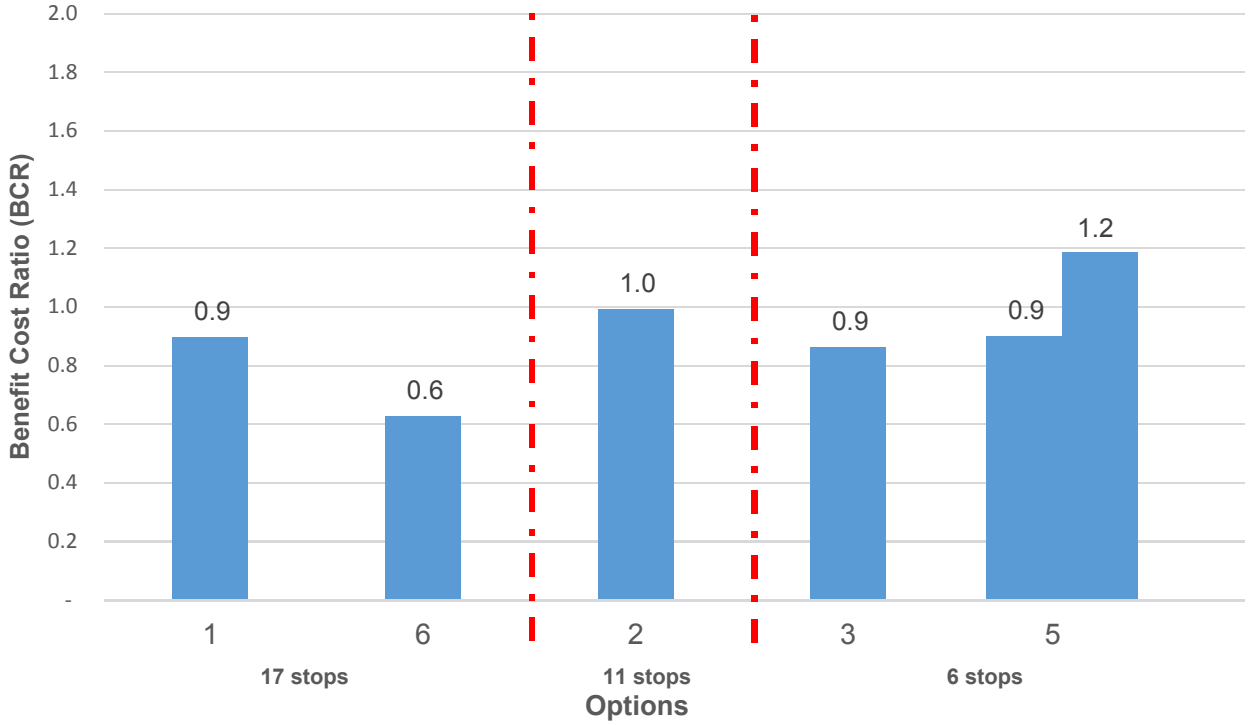
The LRT option in the approved EA can be further refined to strengthen the business case, including consideration of a reduced stop option that may better target the travel market and provide improved travel time benefits.

The LRT option in the approved EA was developed as part of the wider Eglinton Crosstown LRT project. Not surprisingly, the option has merit as part of the overall network, but may benefit from further refinement to improve the business case.

Based on the current method of analysis, the business case for the LRT option, as developed in the EA, approaches a positive benefit. A key adjustment that may bolster the benefits of the LRT is a refinement in the number of stops along the corridor. The number of stops and the resulting distances between them, presents a trade-off between the ease of local access and faster journey times. Decisions about the number of stops will have to consider the numbers of riders that will be attracted to the service by the benefits of local access versus higher travel speed, striking a balance between these two opposing objectives.

Given the value of longer distance trips for travelers across the region, an option with fewer stops appears to be more favourable in improving the economic case. While detailed analysis was undertaken for a 17-stop and 6-stop option, it appears that some intermediate number of stops may be optimal as there is some ridership gain with moderate increase in stop spacing, and decrease in number of stops. While the 6-stop option creates larger stop spacings, and as a result, faster journey times, it provides limited local access along the corridor, which may make the service less attractive to some.

Benefit-Cost Ratio by Number of Stops



A fully grade-separated option presents a positive benefits case but is costly and may be difficult to implement.

Because of the need for longer distance travel through the corridor, speed and reliability have particularly strong impacts on the benefits that each option brings to travellers. As a result, the lower range of the cost for option 5, the grade-separated option, produced a positive business case even with significantly higher costs. However, this assessment does not account for the visual impact that the elevated structure would have on the surrounding community, and the traffic implications of having the support structures in the median of the road, particularly where there are stations. While a below-grade option could provide similar benefits without these community impacts, it generates a fairly unfavourable benefit-cost ratio due to significantly higher costs.

The fully grade separated options range from three to two times as costly as a surface LRT option, with an estimated capital cost on the order of approximately $2B to just over $3B (not including escalation, financing costs, lifecycle and operating and maintenance). In the context of other regional transit priorities, it may be difficult to dedicate such substantial capital investment to this corridor even when considering the long-term operating and travel time benefits.

More information about assumptions used in the economic case is available in the appendix.

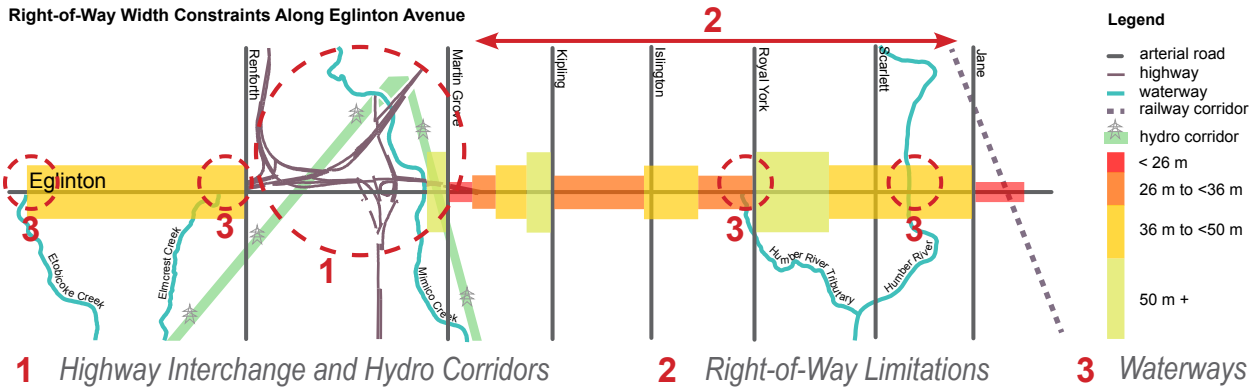
7.0 DELIVERABILITY AND OPERATIONS CASE

In addition to the quantifiable costs and benefits captured in the economic case, additional factors that influence the deliverability and operations of the project must be considered. Despite receiving a high benefit-cost ratio, some options may face barriers to implementation or result in undesirable impacts that are difficult to quantify accurately. This section captures some of the externalities that need to be considered in choosing the appropriate rapid transit option for the Eglinton West Corridor.

There are several constraints along the corridor which impact deliverability, right of way is largely available for the approved EA design.

A number of constraining features exist along the Eglinton West Corridor, limiting the options that can be implemented. The following diagram identifies some of the challenging structural and geographical features that need to be overcome at each part of the project corridor.

Existing Road Right-of-Way Along Eglinton Avenue



1 Highway Interchange and Hydro Corridors

The highway interchange between Highway 401, Highway 427, and Highway 27 poses one of the biggest challenges along this corridor. Located between Martin Grove Road and Renforth Drive, the highway interchange takes up a large portion of land, and provides virtually no opportunity for new development. To get through this area, Eglinton Avenue passes under 8 bridges, which may need to be widened if rapid transit is to operate at-grade without any loss of road space for motorists.

The hydro corridors, located in this same area, present additional challenges. Particularly to the west of Martin Grove Rd, the vertical elevation of the alignment is limited by the height of overhead hydro lines. Underground grade separation is possible, but comes at a higher cost, and potentially greater risks, particularly for flooding.

2 Right-of-Way Limitations

Long protected for the construction of the Richview Expressway some land has been incrementally sold off by Build Toronto for development purposes while protecting for the EA design. Right-of-way width along the Eglinton West Corridor has become varied, potentially making it difficult to accommodate rapid transit within the existing road allotment that differs from the EA option. One key pinch point with private property is in the section between Jane

and Mt. Dennis. For all options, it has been assumed that the connection through this area would be accomplished through an extension of the grade separated alignment from Eglinton Crosstown Phase I. Other segments along the corridor with insufficient right-of-way would require additional property acquisition much of which is already in public ownership. Several woodlots along the corridor are protected, and will require additional consideration as the design of the alignment is further refined.

The Eglinton West Corridor intersects several waterways, including Humber River and Mimico Creek. Eglinton Ave currently crosses over the Humber River using a bridge, while the other waterways are either channelized or buried beneath the roadway. Implementation of at-grade options would require the bridge over the Humber River to be widened to accommodate rapid transit in the centre median, while the design of grade separated options, particularly those underground, would have to be mindful of the constraints imposed by these waterways.

Full grade separation is costly, and can have major short and long term community impacts.

Though all options analyzed will likely require reconstruction of the roadway, grade separation comes with the highest cost, and greatest short and long term impacts on the community. Construction of grade separated infrastructure tends to be more complex, and require more time, meaning that the community surrounding the corridor would be faced with a longer period of disruption. Impacts on local businesses and the inconvenience brought to residents during construction is difficult to capture quantitatively, but is a widely recognized implication of all infrastructure projects.

While grade separation may be used to overcome some of the corridor constraints along Eglinton Avenue, full grade separation, particularly fully elevated options, can have long term impacts on the community. Much of the alignment would liley be visually obstructive with impacts on the character of the surrounding neighbourhood. Transit stops elevated above the centre median at intersections would also introduce traffic complications, as the centre median would have to be widened to fit elevators and stairs for accessing the platform, making left turns more difficult. A fully underground option would not have these same issues, but would be significantly more costly, without introducing any additional travel time savings benefits.

9.0 NEXT STEPS

Following this work, a number of outstanding decisions remain for this project, including:

- Project funding
- Project proponency
- Procurement method
- Interface with the City of Toronto transit network planning process

Subsequent work, will further refine the project and help to inform these key decisions. This work includes:

1. Formalizing workplan and project coordination between Metrolinx, City of Toronto and the TTC

2. Further develop and study the options for targeted grade separation including consultation, refined analysis of costs and benefits and micro-simulation of operations

3. Detailed traffic analysis study following up on the 2009-10 EA to more fully understand the impacts and mitigation of different options on traffic operations

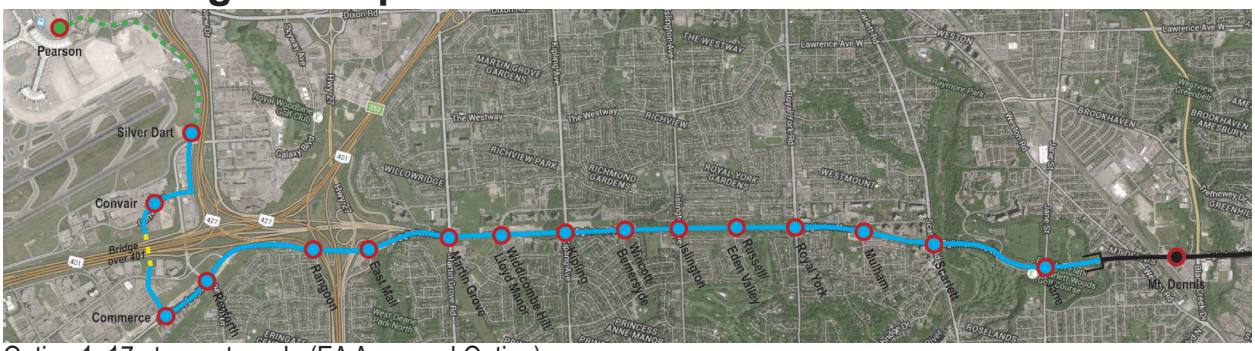
4. Planning and design work on the Pearson Airport segment with the GTAA and City of Mississauga

5. Continued consultation with the local community to understand benefits and impacts and share findings

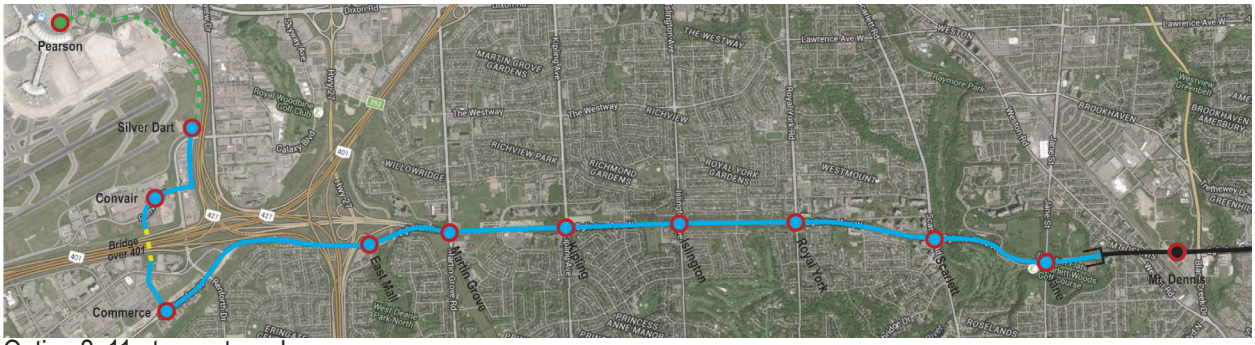
6. EA amendment, if necessary

APPENDIX

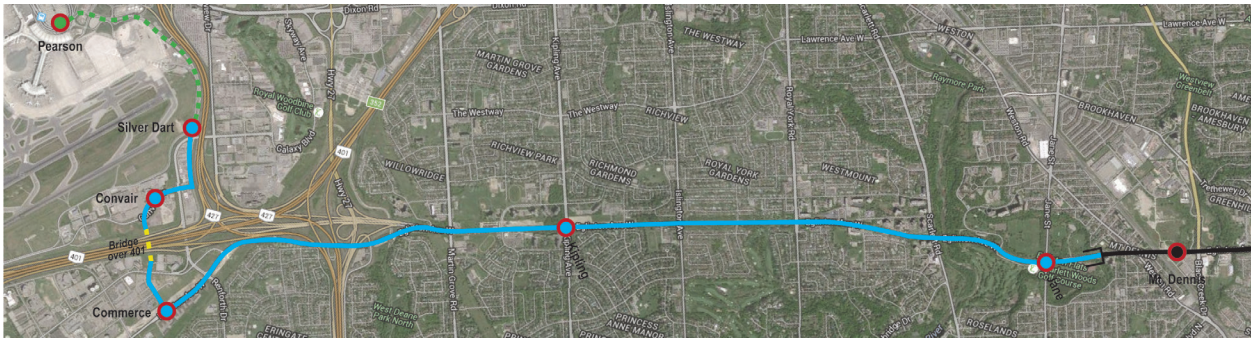
Aerial Images of Options



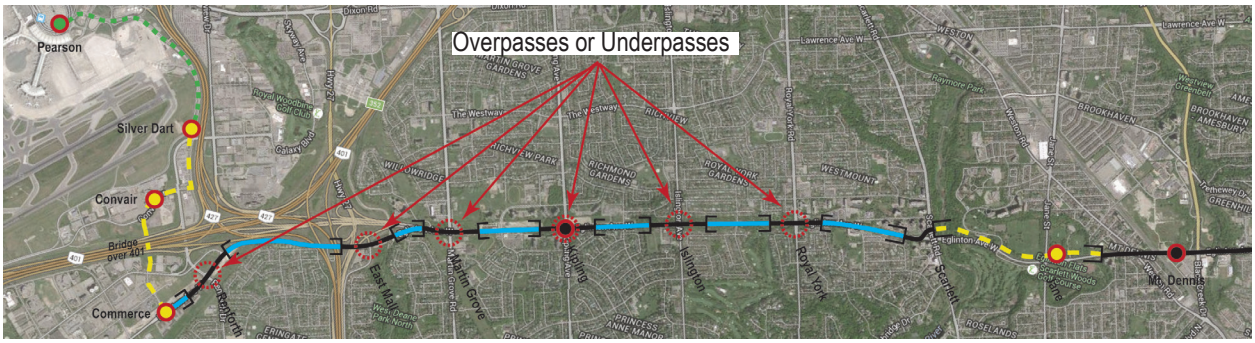
Option 1: 17-stops, at-grade (EA Approved Option)



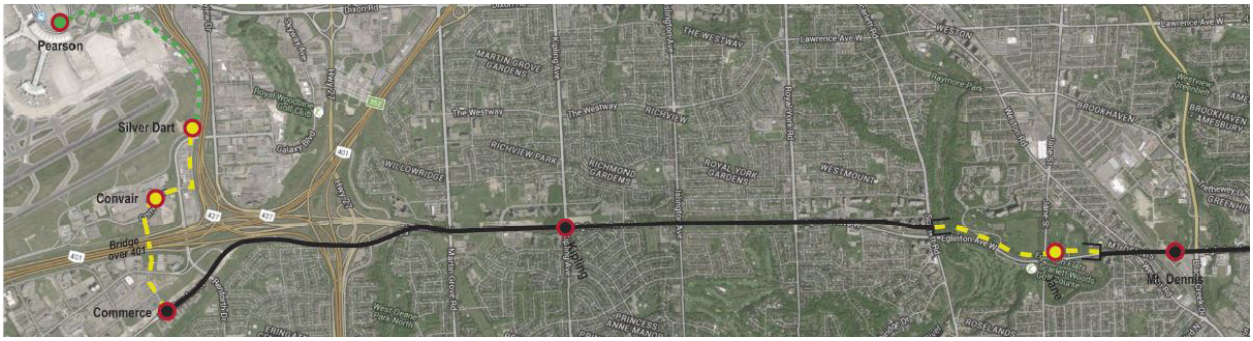
Option 2: 11-stops, at grade



Option 3: 6-stops, at grade



Option 4: 6-stops, grade separated at intersections



Option 5: 6-stops, fully grade separated

Option 6: 17-stops, Bus Rapid Transit

Summary of Assumptions

Capital costs do not include escalation, financing costs, lifecycle and operating and maintenance.

Operating and Maintenance Costs:

Options 1-2 are not assumed to require parallel local bus service, Options 3-6 do assume continued operation of a local bus service. The costs for this local bus service are based on the existing costs of the TTC bus on the route, scaled down to reflect that the service would likely only operate to Mt. Dennis. Detailed analysis of local accessibility in future work may indicate that a parallel bus service is also required in Option 2.

For the LRT option O/M costs are based on standard Metrolinx assumptions for the Toronto LRT projects.

For the BRT option O/M costs are based on the US National Transit base, converted to Canadian Dollars and adjusted to reflect typical TTC costs.

Life-cycle:

60 Years

Escalation Factors:

Value of Time escalation factors: 0.91% (2020-2024), 0.83% (2025-2043), and 0% (2044 and beyond)
PHT, VKT, Fare Revenue growth rates: 0.8% and 0% (2044 and beyond)

In-Service Date:

Construction start: 2020
Operational start: 2024

Benefits Formulas:

$$\text{Transit time change (existing)} = n_{T0} \times (t_{T1} - t_{T0})$$

$$\text{Transit time change (new)} = (n_{T1} - n_{T0}) \times \frac{t_{T1} - t_{T0}}{2}$$

$$\text{Auto km change} = (n_{A1} - n_{A0}) \times d_{A0} + n_{A0} \times (d_{A1} - d_{A0})$$

t_T	transit travel time (min.), weighted
t_A	auto travel time (min.)
n_T	transit demand (# of trips)
n_A	auto demand (# of trips)
d_A	auto distance (km)
subscript 0	base case / business as usual
subscript 1	build scenario 1