APPENDIX 8

SMARTTRACK DEMAND FORECASTING MODELLING APPROACH

1. NEW REGIONAL TRAVEL DEMAND MODEL

On December 11, 2014, City Council directed the City Manager to retain specialized services from the University of Toronto to support the planning analysis and required transit demand modelling as a component of the SmartTrack review[1].

Since January 2015, the University of Toronto has been in the process of preparing forecasts using a newly developed travel demand model known as GTAModel V4. It is a state-of-the-art regional model system that has been developed by the Travel Modelling Group within the University of Toronto Transportation Research Institute over the past two years and is based on over a decade of research work at the University of Toronto.

It is the intention of the City of Toronto City Planning Division, to adopt GTAModel V4 as its operational demand modelling system once it has been fully tested and validated. It will replace the current modelling system GTAModel V2, which was developed by the University of Toronto for the City a number of years ago. The SmartTrack initiative has provided the opportunity to accelerate the model validation process so that the GTAModel V4 is available to the City to evaluate SmartTrack alongside other transit expansion projects.

This version of the model radically departs from its predecessors by moving to an activity based design and an integrated daily model. The work is largely based upon the Travel Activity Scheduler for Household Agents (TASHA) model written by Matthew J. Roorda.

Key features of TASHA include:

- It is an agent-based microsimulation model, which simulates the scheduling of out-of home activity and travel episodes for each individual within each household within the GTHA for a typical 24-hour weekday.
- It is household-based in that each person explicitly resides within a household and interacts with other household members in terms of:
    - Sharing household resources (cars, income).
    - Sharing household-level responsibilities (child care, etc.).
    - Participating in joint activities.
    - Within-household ride-sharing.
- It has a fine temporal resolution, with activity episodes and trips being scheduled in continuous time over the course of a 24-hour weekday period with five time periods represented (AM, Mid-day, PM, Evening and Overnight).
- Trip generation differs from previous models as activities are now generated discreetly for each person living in a designated zone. This allows for

[1] Link: http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2015.EX1.12

consideration of variables such as the age of the person and their occupation / employment status. This allows for the possibility to be more sensitive to local area demographic changes as trip generation rates will change for example if residents of a stable neighborhood are forecast to grow more elderly over time or an influx of younger persons is anticipated.

- It is an activity-scheduler in which individual activity episodes are generated and scheduled over the course of a day. Trips to access each activity episode are generated as needed. Thus, tours emerge out of the activity scheduling process and can be of varying complexity and type, rather than simply selected from a pre-specified set of activity/tour patterns.
- The building blocks of the model are individual "tours" that accommodate different tour lengths, containing different numbers of activity episodes of varying complexities. Sub-tours (e.g. a work-based sub-tour such as a site visit) are accommodated within overall home-based tours. Tour-based constraints are imposed; e.g., cars that leave a tour anchor point (e.g. home) must return to the anchor point at the end of the tour. Non-auto-drive tours need not use the same mode on all trips within the tour.
- The trip distribution step in a traditional four-step transportation demand model has been replaced by a 'discrete location choice' sub-model that looks at both the previous activity's location and the next activity's location and computes a time prism. The prism allows us to exclude zones that are too far away to visit from the choice set and helps to result in a more natural location selection. For example if the person had just finished work was going home but needed to do some grocery shopping, zones between their work and home would be more attractive. Within a traditional four step model only the location of home would have mattered in the calculation.
- Mode choice evaluates each trip and then assigns it a mode that optimizes the tour as a whole. This helps with policy sensitivity to transit services. For example, if transit is improved in the AM but remains unchanged in the PM, you will likely see less mode shift (compared to a four-step model) to transit as the mode choice in the AM takes into account the utility of the return trip home.
- Within households, ridesharing is explicitly modelled.

GTAModel V4 provides numerous advances relative to GTAModel V2 that make it the best tool currently available within the Greater Toronto and Hamilton Area (GTHA) to undertake this analysis. In summary, its greater functionality includes:

1. Calibration of the model using the most recent comprehensive region-wide travel behaviour survey data available (i.e. the 2011 Transportation Tomorrow Survey);

2. Capability to simulate full day (24 hour) travel demand instead of just the busiest (AM peak) period given that peak travel mode is often influenced by trips made at other times in the day;

3. Improved representation of counter-peak commuter flows:

4. Providing greater flexibility to model alternative fare structures;

5. Introducing capacity constraints on the transit network; and
6. Automated procedures to extract key network performance measures.

2. THIRD PARTY PEER REVIEW

The City of Toronto has retained a Peer Review Consultant (a consortium led by Parsons Corporation in collaboration with David Kriger Consultants and Cambridge Systematics). The scope of the consultant's work will include the following tasks:

1. Review of the Modelling Framework - Documentation of the model framework and its underlying assumptions will be provided in one or more technical memoranda prepared by the University of Toronto. The consultant will either recommend that adjustments be made or confirm the robustness of the modelling framework.
2. Review of the Model Calibration - Documentation of the model calibration process, including a review of all travel forecasting model parameters, will be provided in one or more technical memoranda prepared by the University of Toronto. The consultant will either identify areas where further adjustment may be warranted or confirm that the model has been calibrated within acceptable industry standards.
3. Review of the Model Validation - Documentation of the model validation process, including a review of sensitivity testing and comparison of simulated base year auto and transit volumes to ground counts will be provided in one or more technical memoranda prepared by the University of Toronto. The consultant will either identify areas where further adjustment may be warranted or confirm that the model has been validated within acceptable industry standards.
4. Review and Comment on Transit Network Ridership Forecasts and Network Performance Metrics - Ridership forecasts and associated network performance metrics will be prepared by the University of Toronto for a range of transit network configurations, and for multiple horizon years including 2011 (base year), 2021, 2031 and 2041. The consultant will review and comment on the reasonableness of the modelling results.

3. TRAVEL DEMAND FORECASTING OBJECTIVES

Key objectives of the first round of modelling work includes assessments of:

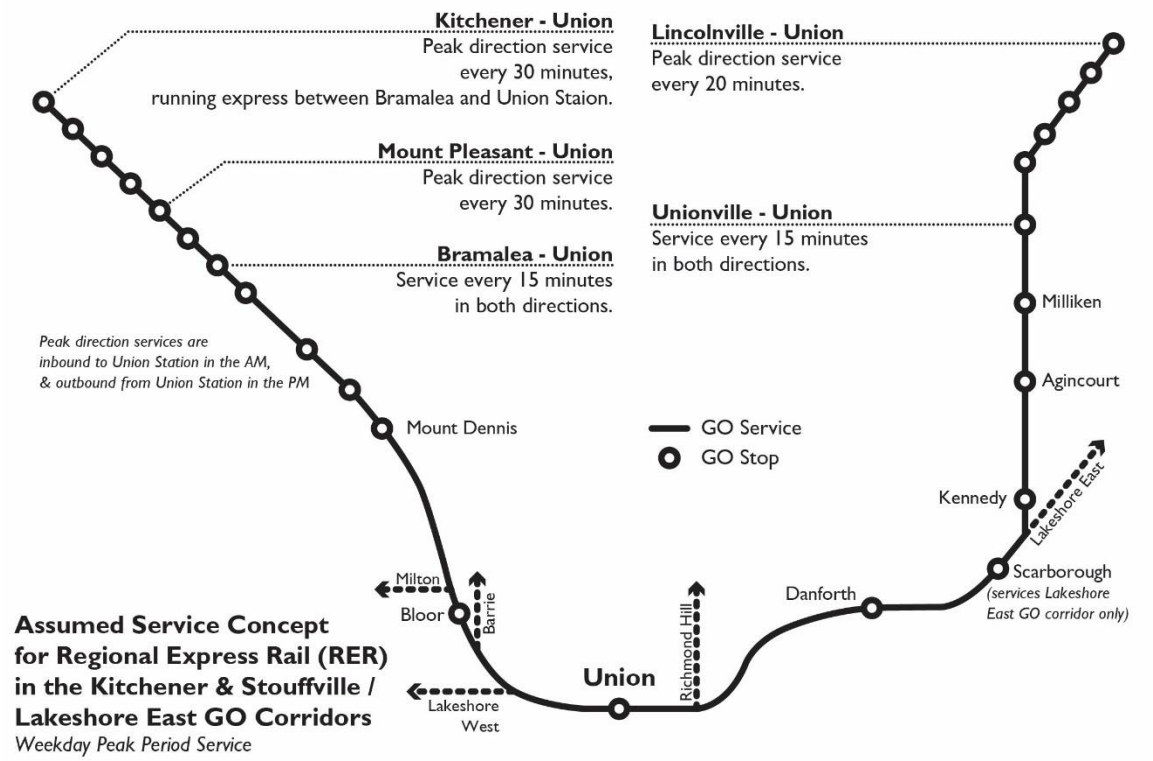
1. The ridership potential and ridership characteristics of SmartTrack;
2. The ridership potential and ridership characteristics of the GO Regional Express Rail (RER), particularly within the Stouffville and Kitchener GO Rail corridors;
3. Comparing the ridership potential and ridership characteristics between SmartTrack and GO RER;

4. The degree to which SmartTrack and GO RER could potentially relieve passenger crowding on the Yonge subway line and at Union Station; and
5. The degree to which projected ridership on the Scarborough Subway Extension and the Relief Line may be affected by SmartTrack and GO RER.

4. SERVICE CONCEPT ASSUMPTIONS

The SmartTrack concept operates within the existing Stouffville and Kitchener GO rail corridors. Consequently both SmartTrack and the broader GO RER concept will need to coexist. The detailed GO RER service concept is still being worked on, but Metrolinx has published planning assumptions[2]. Figures 1-4 show the assumed service concepts used in the initial GTAModel V4.0 modelling work for scenarios with and without SmartTrack, in the peak and midday/evening time periods.

Figure 1. Assumed Weekday Peak Period Service Concept for GO RER



[2] http://www.metrolinx.com/en/regionalplanning/rer/rer_stouffville.aspx
http://www.metrolinx.com/en/regionalplanning/rer/rer_kitchener.aspx

Figure 2. Assumed Weekday Peak Period Service Concept for SmartTrack/RER

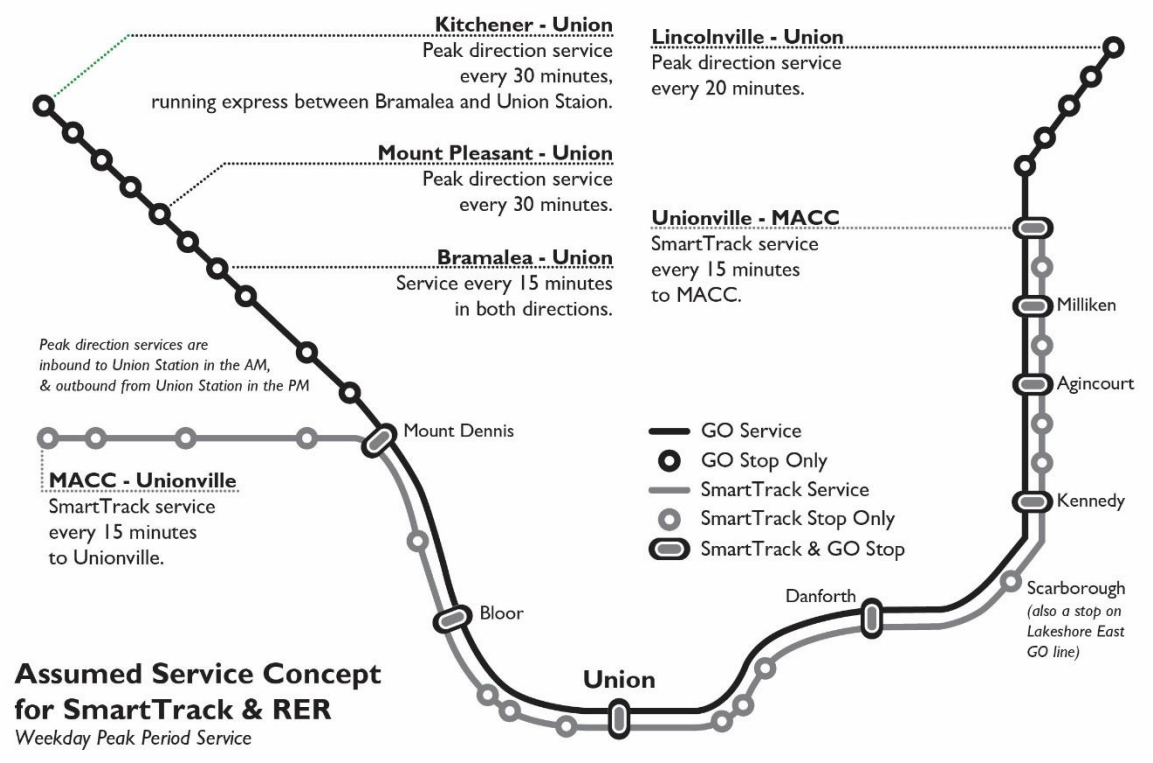


Figure 3. Assumed Off Peak Service Concept for GO RER

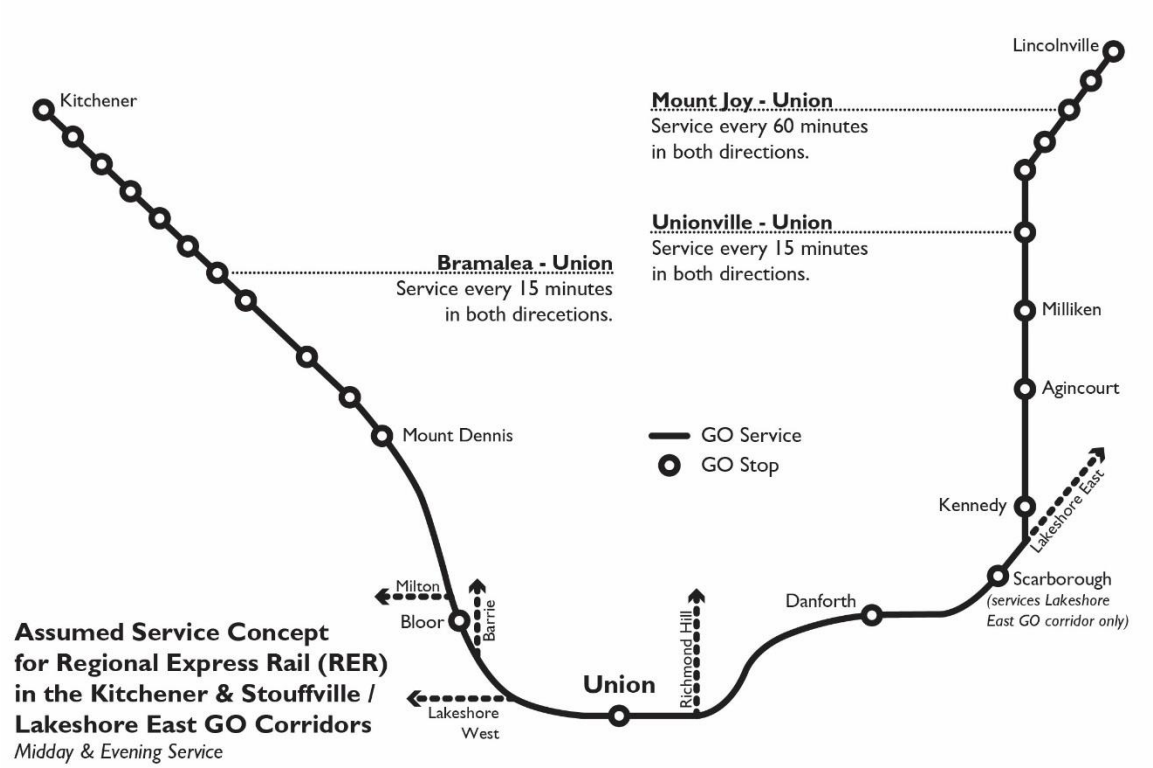
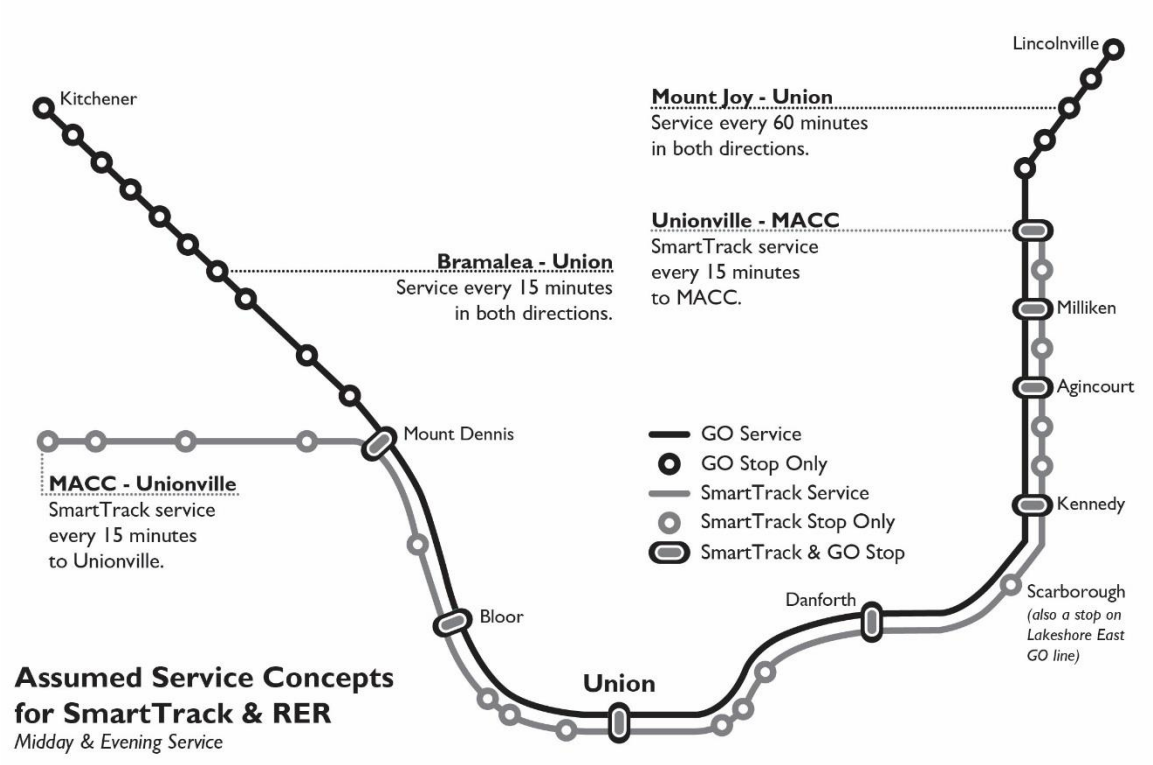


Figure 4. Assumed Off Peak Service Concept for SmartTrack/RER



The SmartTrack and RER concepts initially modelled assume:

- Stop patterns, service frequency, and service by time of day as shown on Figure 1.
- RER services on the Stouffville and Kitchener lines terminate at Union;
- SmartTrack services do not terminate at Union station;
- Electrification allows GO RER to run 15-20% faster than today;
- SmartTrack west of Mt. Dennis is a new heavy rail line to Mississauga Airport Corporate Centre (MACC) via the Eglinton Avenue corridor.
- GO RER services stop only at current GO stations (plus the new proposed Mt. Dennis GO station);
- SmartTrack services stop at all the GO RER stations *plus* 12 new stations between Unionville and Mt. Dennis *plus* 2 stations within the Eglinton corridor between Mt. Dennis and the MACC *plus* 2 stops within the MACC (at the Renforth Gateway and on Matheson Boulevard[3]); and
- RER users pay the GO fare equivalent;
- SmartTrack users pay the TTC fare and can transfer onto other TTC services.

Additional model runs will vary these base assumptions. These sensitivity tests will include:

[3] The second stop within the MACC is assumed in the initial model assumptions but has not been widely evaluated beyond this application.

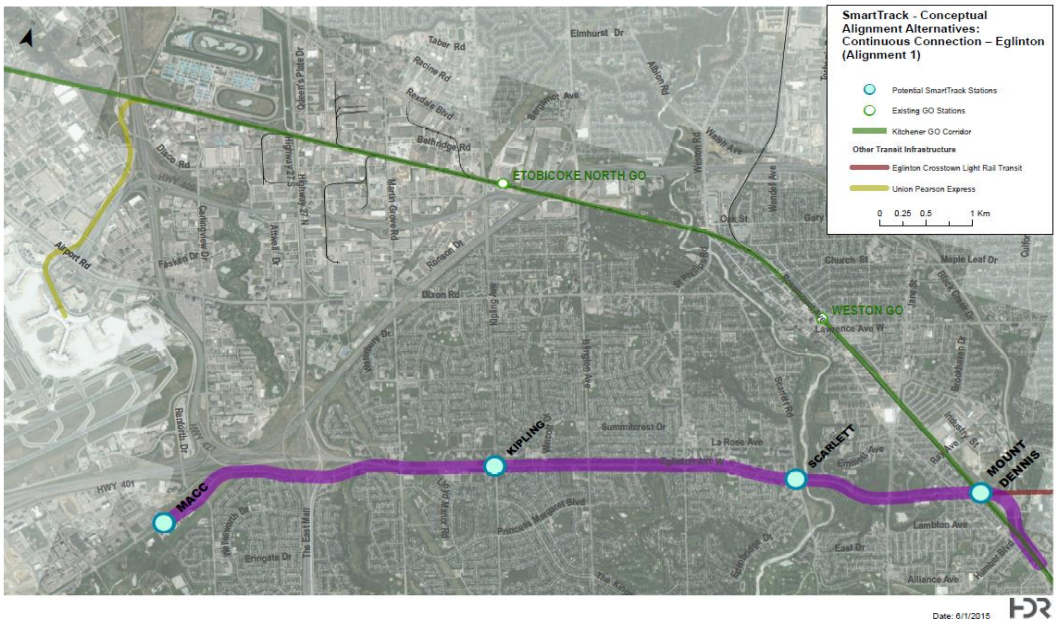
- Alternative SmartTrack routes to MACC via the Kitchener GO Rail corridor north of Mt. Dennis station via Woodbine;
- A non-SmartTrack route to MACC assuming GO RER plus the (planned but unfunded) Phase 2 of Eglinton LRT between Mt. Dennis and the Pearson International Airport passenger terminals via Renforth Gateway;
- SmartTrack users pay a GO fare equivalent such that a TTC fare would be incurred to transfer to TTC services and similarly, a local transit fare would be incurred to transfer to local transit services in Mississauga and Markham;
- Alternative patterns of stops, with various combinations of stations in/out; and
- Alternative service frequencies (headways of 5, 10 and 15 minutes).
- Population and Employment: low, medium and high population and employment projections will be tested over three horizon years (2021, 2031, and 2041)

5. INITIAL ROUTE OPTIONS

Two variations of the SmartTrack concept are being modelled, reflecting alternative options for providing a continuous connection between the MACC and the Kitchener GO Rail corridor. These options will be compared to a base scenario which assumes GO RER plus a connection to the MACC provided through transfer to a (planned but unfunded) westerly extension of the Eglinton Crosstown LRT.

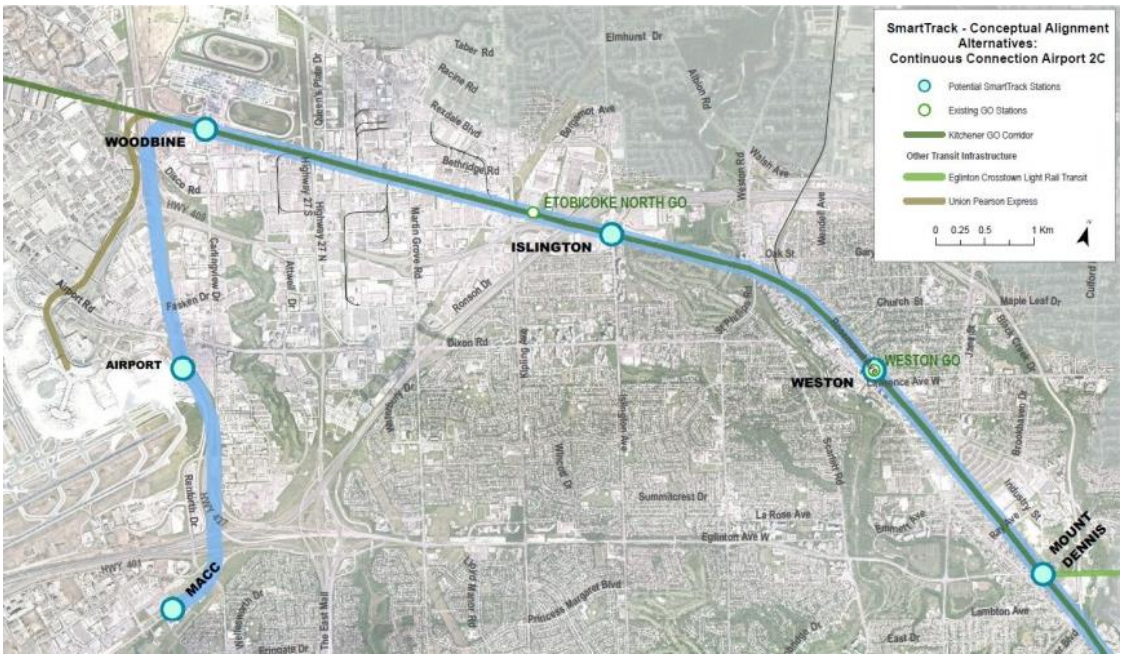
A continuous heavy rail service from the Kitchener Corridor directly to the Airport Corporate Centre within the Eglinton corridor (note that this figure shows one station in MACC but the initial modelling work will assume two stations for the purposes of reflecting better walk-in access to SmartTrack for employees of the MACC).

Figure 5: Continuous Heavy Rail Corridor from Mount Dennis to MACC



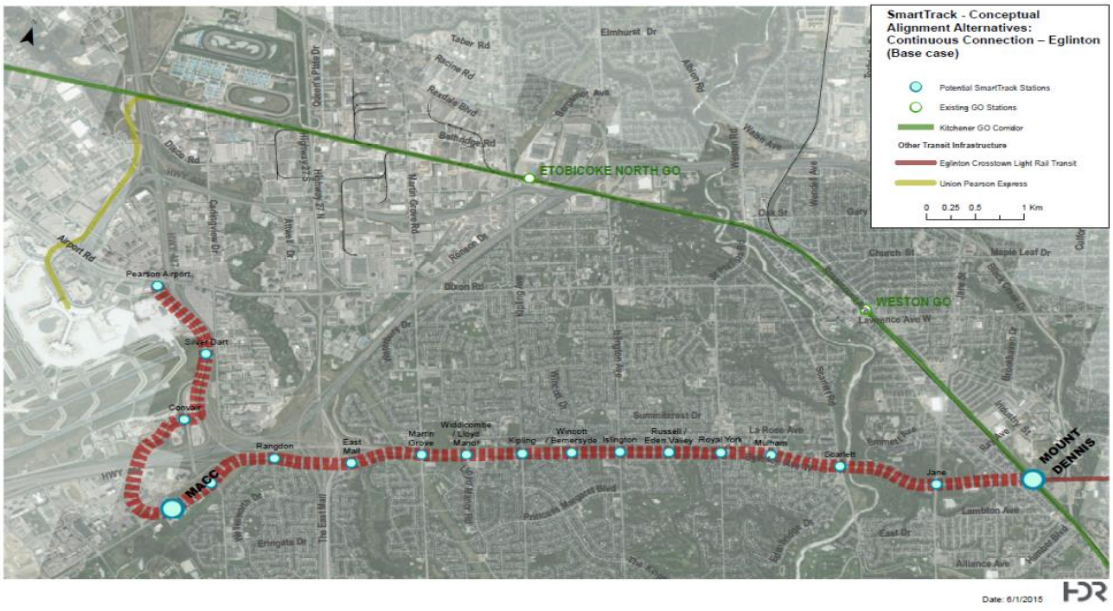
1. Extension of the SmartTrack service in the Kitchener GO Rail corridor north of Mount Dennis station to Woodbine and then diverting the service into a new dedicated SmartTrack corridor to the MACC either through Pearson International Airport or parallel to Highway 427

Figure 6: Extension on Kitchener Corridor North of Mount Dennis to MACC



These options will be compared to a base scenario which assumes SmartTrack with a connection to the MACC provided through a transfer to a westerly extension of the Eglinton Crosstown LRT.

Figure 7: Base Case Eglinton Crosstown LRT



6. FURTHER WORK

The results of the model runs will be reported in Q1 2016. These are described in Section 4 above and will include combinations of stations, fares, frequencies and service patterns.

This modelling effort is also being used to inform the development of the Relief Line and Scarborough Subway Extension and the network opportunities presented by the combined transit expansion.