MEMO

TO: Jeff Dea, Transportation Services, City of Toronto

FROM: Jim Gough / Mark Sadoway

SUBJECT: **Traffic Analysis Summary, REimagining Yonge Street EA**

DATE: **January 29, 2018**

This document summarizes the traffic analysis completed for the REimagining Yonge Street Environmental Assessment.

1. EXECUTIVE SUMMARY

The key tool used in the analysis is a computerized transportation simulation model, which has been created for the project and used to assess conditions for the weekday a.m. and p.m. peak periods, for 2021 and 2031 horizon years. The memo provides an overview of the model and the results for both the **Stage 1** work completed in 2016 and the **Stage 2** work currently underway in 2017/18. Stage 2 is focused on alternatives for bike lanes on Beecroft Road and/or Doris Avenue.

STAGE 1 PREFERRED ALTERNATIVE

Stage 1 of the EA study concluded with the recommendation of **Transform Yonge** as the preferred alternative. Transform Yonge includes the introduction of cycle tracks on Yonge Street and a reduction from 6 to 4 lanes between Sheppard and Hendon/Bishop Avenues. Yonge Street between Avondale Avenue and Sheppard Avenue would be reconstructed with 6 lanes. No changes would be made to Beecroft Road or Doris Avenue except for the addition of off-peak on-street parking in certain locations.

STAGE 2 PREFERRED ALTERNATIVE

The preferred alternative for Stage 2 of the EA study is **Transform Beecroft and Enhance Yonge,** which includes a reconstruction of Beecroft Road to 4 lanes (same as existing) with unidirectional northbound and southbound cycle tracks between Poyntz and Hendon Avenues. Yonge Street would be reconstructed without cycle tracks with 6 lanes from Avondale to Hendon/Bishop Avenues.

OVERALL PREFERRED ALTERNATIVE

The conclusion of the EA study involved comparing the Stage 1 and 2 preferred alternatives and weighing overall costs and benefits using the evaluation criteria. The overall preferred alternative is **Transform Yonge**.

TRAFFIC ANALYSIS SUMMARY

The principle question of the scenario modelling and results comparisons discussed below is whether or not Yonge Street can function acceptably in a 4-lane configuration from Sheppard to Finch.

The model is a "meso/microsimulation" model, which models auto traffic, buses, pedestrians and cyclists at an individual level, and includes parameters to reflect the range of behaviours in each group. Combining this with a detailed representation of the road network and traffic signal operations, it represents traffic and transportation operations to a level of accuracy that is acceptable for long range modelling analysis and planning studies. Detailed microsimulation was undertaken for the area from Beecroft Road to Doris Avenue. The slightly less detailed mesosimulation was completed for the entire study area, from Steeles Avenue to Wilson Avenue/York Mills Road, and from Bathurst Street to Bayview Avenue; this allowed for traffic to divert to other streets to balance demands and travel times across the network. All arterials and collector roads were included; local roads were included only in North York Centre. The model was calibrated to existing conditions, and then the effects of approved development across the Greater Toronto and Hamilton Area were applied to forecast future travel demands. Adjustments were made to future mode splits, to reflect the attractiveness of dedicated cycling facilities for cyclists.

Weekday morning and afternoon peak hours were modelled – the periods of highest demand on the network. The pattern of traffic volumes over the 24-hour day in this area were examined. They indicate that over the vast majority of the day, volume is substantially below capacity. This is illustrated graphically in **Exhibit 1** below.

STAGE 1 SCENARIOS

The scenarios analyzed for Stage 1 included:

- **Do Nothing**, which models the effect of the growth in traffic on the existing and currently approved road network. The approved road network includes the realignment and extension of Doris Avenue to Avondale Avenue (Doris-Tradewind Connection) by the 2031 horizon year; this was not included for 2021.
- **Alternative**, which models the effect of a reduction in lanes from 6 to 4 on Yonge Street from Sheppard Avenue to Finch Avenue. This scenario also includes 2021 and 2031 pedestrian volumes at key intersections and 2031 cyclists using the bicycle lane/track on Yonge Street.

The preferred Stage 1 alternative is **Transform Yonge** in which Yonge is reduced to 4 lanes from Sheppard to Finch and one-way cycle tracks added to the east and west boulevards. This is equivalent to the Alternative scenario in terms of traffic impacts.

STAGE 2 SCENARIOS

The scenarios analyzed for Stage 2 included:

- **Do Nothing**, which has the same characteristics as the Stage 1 Do Nothing scenario noted above.

- **Worst Case**, reflecting the removal of a traffic lane from both Beecroft Road and Doris Avenue. (This was conceptualized at the beginning of Stage 2; in the end, no lane removals were recommended).

In each of these Stage 2 scenarios, Yonge Street remains as 6 lanes.

The draft preferred Stage 2 alternative, having completed the various required analyses, is **Transform Beecroft and Enhance Yonge** in which the existing lane arrangement is retained but with the addition of one-way cycle tracks on Beecroft Road only. This is equivalent to the Do Nothing alternative scenario in terms of traffic impacts; it does not involve removing any traffic lanes.

RESULTS SUMMARY

The magnitude of the impact for Transform Yonge indicates that traffic operations will be manageable, with marginal increases in travel time and some increases in queuing. Note that the queues reported are the 95th percentile probability, and are thus expected to be of acceptable lengths for 19 observations of typical conditions out of 20 (i.e. once in 20 queues, the length may exceed this number). Queue lengths are projected to be manageable under Transform Yonge – they are not expected to reach back to the adjacent signalized intersection, beyond the level seen today.

The traffic modelling results show that **Transform Yonge** (cycle tracks on Yonge, removal of one traffic lane per direction on Yonge from Sheppard to Finch) would have generally less impact on traffic operations than the Worst Case Stage 2 alternative (3 lanes on each of Doris and Beecroft, with bike lanes on both streets). However, the preferred Stage 2 alternative, **Transform Beecroft and Enhance Yonge**, is equal to the Do Nothing analysis scenario, and has few discernible traffic impacts.

A majority of the traffic on Yonge Street originates in York Region. The current (2016) turning movement counts at the Yonge/Steeles intersection were used to determine southbound traffic volumes from York Region continuing south into North York Centre, and northbound traffic departing North York Centre for York Region. Approximately 73% of vehicles at peak times are traveling to and from York Region – therefore at the north end of North York Centre, only 27% of the traffic originates in the City of Toronto.

Longer distance regional trips can be served through parallel corridors. This data also indicates that trips of longer lengths could use parallel streets, namely Bayview Avenue and Bathurst Street. Lane utilization (vehicles per lane per hour) tends to be higher on Bayview and Bathurst compared to Yonge. This is likely due to curbside uses such as deliveries and transit buses serving stops. There are also potential efficiency gains and operational improvements which can be implemented on Yonge.

Traffic volumes are projected to increase due to planned growth across the region - by approximately 3% and 9% to 2021 and 2031 respectively during the PM peak period. This growth in demand and impact to traffic flow will occur regardless of the alternative implemented. As discussed below, much of the change in traffic operations relates to this growth, not to the introduction of a new concept for Yonge Street or the parallel streets.

MITIGATING THE IMPACTS

In both **Transform Yonge** and **Transform Beecroft and Enhance Yonge** alternatives, full signals are proposed to be added to two intersections: Yonge/Ellerslie and Yonge/Horsham. The addition of these full signals is intended to provide additional east-west crossing opportunities for pedestrians in areas where there are long gaps between signals, and to aid in emergency vehicle access by creating more gaps in the traffic stream. The proposed signal at Ellerslie would facilitate access from the emergency services facility on Canterbury Place.

In the case of either alternative, consideration can be given to design of the median on Yonge Street to allow crossover points for emergency vehicles in certain locations. This mitigation measure will be assessed further during the detailed design phase, in consultation with the Fire, Paramedic and Police Services. Traffic operations strategies to facilitate emergency services vehicle movement will also be addressed at that stage (including signal pre-emption at Yonge/Ellerslie, for example).

For the Transform Yonge alternative, it will be important to implement a traffic operations strategy that capitalizes on the service road capacities and optimizes performance of Yonge Street as well. This strategy should include the following:

- A review of obstacles to effective throughput of traffic on Beecroft Road and Doris Avenue (for example, school buses stopping on-street – the potential to move these off-street should be addressed)
- Improvements to traffic signal coordination to maximize traffic throughput on each street
- Provision of Transit Signal Priority on Sheppard and Finch Avenues, between Beecroft and Doris, to enhance reliability of TTC buses
- Upgrades to signals equipment, to support further advances in traffic progression
- Consolidation of GO bus stops on Yonge Street (these have been identified on the design plans for Yonge)
- Prohibition of northbound and southbound left turns at Sheppard Avenue/Yonge Street. These left turns can be accommodated via other links in the network, based on the modelling for the project. This prohibition is included in the design plan
- Completion of the Doris-Tradewind extension, to enhance the capacity of the Doris Avenue service road throughout North York Centre.

2. TRANSPORTATION SIMULATION MODEL

A transportation simulation model is simply a mathematical representation of the real-life decisions and behaviour of individuals moving from one place to another. Transportation modelling includes modelling at several different levels of detail:

- **Macroscopic** (macro) or strategic travel demand modelling is usually used to model traveller behaviour at a large scale and relatively low level of detail. Movement is considered in terms of "flows" with "average" characteristics rather than individual travellers or vehicles. Models at this level are intended to translate population and employment levels and spatial distribution into groups of trips represented by their average characteristics and with their associated purposes, origins and destinations, and timing. From there, flows are allocated to different modes of travel and then to specific routes.
- **Microscopic** (micro) simulation models are designed to consider the movement of individual vehicles or persons at a high level of detail and, typically, over a smaller area due to the associated data and computational demands. The level of detail is such that individual driver decisions to accelerate, decelerate, change lanes, move into a gap in traffic etc. in response to traffic regulations and controls, the infrastructure available, vehicle performance, and the behaviour of other nearby drivers are considered within the context of the driver's level of "aggressiveness" and other factors. Microscopic models, like human behaviour, are stochastic and deal with individual characteristics selected from an appropriate distribution rather than with averages. The behaviour of individuals and vehicles in the model can be finely controlled through adjustment of a large number of parameters. Microscopic models usually include route-choice decision-making as well.
- **Mesoscopic** models (meso) fall somewhere in between macro and micro models in terms of the level of detail although they cover a fairly wide spectrum in this regard – some are closer to macro models and some have more of the characteristics of micro models with a reduced level of detail
- **Hybrid** models are a relatively recent phenomenon, combining the increased resolution of microscopic modelling over the portion of the modelled area of most interest with the computational efficiency (lower run times) of mesoscopic modelling where the requirement for detail is less.

Traditional methods of transportation analysis, both analytical and empirical, have been around since the 1940s and are still used for the bulk of transportation analysis done today. The main difference between traffic simulations with traditional methods is that they are considered to be "static" models whereas micro simulation models and some meso simulation models are considered to be "dynamic".

Some examples of the dynamics that can be represented in simulation models, giving them an edge as an operational analysis tool, include:

- Traffic flows vary from minute to minute due to prior events and due to conditions upstream
- A queue accumulates at one intersection and impedes traffic at an adjacent intersection
- A left-turn queue extends beyond the left-turn lane and impedes through traffic
- Traffic is held up at a construction or incident-related lane closure, metering the traffic flow and resulting in fewer cars and faster speeds downstream
- Traffic attempting to move to the right to exit a highway has to weave through traffic entering the highway

- A queue at bottleneck accumulates over the peak hour and extends into the following hour.

The model for this project extends from Steeles Avenue to Wilson Avenue/York Mills Road, and from Bathurst Street to Bayview Avenue. In the segment between Doris Avenue and Beecroft Road (encompassing Yonge Street), microsimulation was undertaken. Mesosimulation was completed for the broader network.

3. MODEL CALIBRATION

Calibration is the process of adjusting a model's inputs and parameters to improve the representation of reality in the model. Validation is the measurement of how well this has been achieved. Calibration and validation are necessary in traffic simulation for two key reasons:

1. Inconsistencies between travel demand inputs used for simulation and real-life conditions. Travel demand inputs are often developed from the outputs of a macroscopic travel demand model (i.e. a regional travel demand model). Despite the calibration applied to macroscopic models, it is too much to expect that such inputs match well with real-life data at a detailed level (e,g., individual turning movements).
2. Transferability (or lack thereof) of driver behaviour or other parameters. Default parameters provided in the software reflect the conditions under which the supporting data was collected and may not be transferable to other situations. For example, data collected in a less-congested location or time period may not reflect the level of driver urgency/aggressiveness that is usually present in congested urban environments during peak hours.

There are several steps in the calibration process:

- Coding the model to accurately represent the road network and traffic signal operations;
- Calibrating the demand inputs, and therefore the traffic volumes produced by the model, under existing demand and network conditions to represent as closely as possible the observed volumes; and.
- Calibrating driver reaction time. This is a key parameter in Aimsun (the modelling software). Calibrating driver behaviour parameters so that traffic performance as obtained from the simulation represents, as closely as possible, observed traffic operating conditions (in terms of factors such as saturation flows at intersections, travel times, speeds, and congestion/queuing patterns). In some cases, calibration may extend to the operational characteristics of vehicles and the mix of different characteristics in the vehicle fleet.

These latter two points are not independent steps as both traffic volume and driver behaviour contribute to traffic performance. The required process involves an incremental and iterative adjustment of both demand inputs and driver behaviour parameters. That has been completed for this project.

The City of Toronto's 2011 AM and PM peak hour auto driver trip matrices from the regional travel demand forecasting model were used to establish the existing traffic patterns in the study area. For calibration purposes, the auto matrices were adjusted to the observed total vehicle control volumes and then disaggregated after calibration to create auto and truck matrices based on proportions derived from existing traffic counts. The nominal calibration year was set as 2016 since traffic volume counts used as control data ranged from 2013 to 2016, with many of the intersections being counted by WSP in May 2016.

Traffic speed and travel time data used for control purposes was obtained from the City of Toronto's 2014 Travel Time Survey, and this data was also collected in 2016 by WSP to bolster the City database.

In the Aimsun analysis software, there are two parameters that have a significant impact on the relationship between volumes and travel times/speeds/delays. These are reaction time and reaction time when stopped. The first determines the nature of the speed/flow relationship while vehicles are moving while the second influences the saturation flow from a stopped condition at intersections.

Parameters reflecting driver behaviour, such as reaction time, were calibrated iteratively, in conjunction with demand/volume adjustments, to ensure that traffic operations and the resulting travel times were representative of reality based on the control dataset.

A saturation flow survey was conducted at the Yonge/Sheppard intersection to provide initial values for reaction time when stopped.

4. TRAVEL DEMAND INPUTS

The City of Toronto provided auto driver trip matrices for the AM and PM peak hours for 2011 and for the 2031 planning horizon. These matrices were used to establish the existing vehicular travel patterns within the study area and to estimate future changes to these travel patterns.

The matrices were manually disaggregated along the Yonge Street corridor between Finch Avenue and Sheppard Avenue (within the study focus area) to create a more fine-grained zone system based on census information at the dissemination area level.

For calibration purposes, the auto driver matrices were adjusted to represent total vehicle matrices based on turning movement control volumes. (The auto driver matrices represent only a portion of the total traffic stream; some other vehicles, such as trucks and buses, needed to be added.)

Transit services were only modelled for the 2021 and 2031 horizon years. Existing pedestrian intersection-level matrices (does not include the portion of pedestrian trips between intersections) were developed based on pedestrian information summarized from turning movement counts. The pedestrian volumes were projected to 2031 based on growth factors calculated for population and employment growth within the study area.

The 2021 demands were interpolated from the 2016 and 2031 volumes.

5. SCENARIOS EVALUATED

Traffic volumes are projected to increase by approximately 3% and 9% to 2021 and 2031, respectively during the PM peak period, due to the planned growth across the region, and irrespective of any road changes in this area. The 2021 and 2031 traffic demands were used to evaluate both the Do-nothing and Alternative scenarios along Yonge Street, Beecroft Road, and Doris Avenue. If Yonge Street is reduced to four lanes, or Doris Avenue and Beecroft Road were reduced to three lanes respectively (modelled as a worst-case theoretical alternative), traffic redistributes across the road network to achieve a new equilibrium condition – i.e. volumes are redistributed so that each route has approximately equal conditions in terms of travel time and other performance measures.

The scenarios evaluated for this project were as follows:

STAGE 1

2016 (EXISTING) SCENARIO

This scenario serves as a baseline reference point, reflecting existing conditions. It includes the existing road network (with the 6-lane cross-section for Yonge Street) and the 2016 calibrated traffic demand, along with existing pedestrian demand. Transit vehicles were not modelled explicitly for this scenario but were included as part of the truck matrices. Bicycles were not modelled explicitly due to the very low volumes and the complexities inherent in shared use of the curb lane by bicycles and vehicles, particularly under new traffic regulations (1 metre separation has to be maintained by drivers, requiring vehicles to intrude on the adjacent lane in cases of standard-width or narrow lanes).

FUTURE 6-LANE YONGE STREET (DO-NOTHING) SCENARIO

This scenario also serves as a baseline reference point but allows us to evaluate the role that traffic growth plays in determining future traffic conditions versus the role played by the changes inherent in the Alternative scenario. It includes the existing road network (with the 6-lane cross-section for Yonge Street) and horizon 2031 traffic demands. It also includes 2031 pedestrian volumes at key intersections and does not explicitly model bicycles or transit vehicles, reflecting the current network operations. Minor adjustments were made to this scenario to improve the manageability of traffic operations.

4-LANE YONGE STREET (ALTERNATIVE) SCENARIO

This scenario includes the following network modifications:

- A cross-section reduction from 6 to 4 lanes on Yonge Street from Sheppard Avenue to Finch Avenue;
- The removal of both NB and SB left-turns and left-turn lanes at the intersection of Yonge Street and Sheppard Avenue;
- New traffic signals at the intersection of Northtown Way/Horsham Avenue and Yonge Street and at the intersection of Ellerslie Avenue and Yonge Street.
- Unidirectional cycle tracks added on each side of Yonge Street from Avondale Avenue to Bishop/Hendon Avenues.
- This scenario also includes 2031 pedestrian volumes at key intersections and 2031 cyclists using the bicycle lane/track on Yonge Street. GO Transit bus services on Yonge Street and TTC bus services on Sheppard and Finch Avenues between Beecroft Road and Doris Avenue are explicitly included along with the associated bus stops. This scenario includes a number of minor modifications (for example to traffic signal timings) needed to improve the manageability of traffic operations.
- This scenario is considered equivalent to the **Transform Yonge** preferred overall alternative.

STAGE 2

PREFERRED TRANSFORM SCENARIO (DO-NOTHING)

The do-nothing scenario includes maintaining the existing number of lanes on all streets. It is considered equivalent to the **Transform Beecroft and Enhance Yonge** preferred alternative

which includes the addition of one-way cycle tracks on Beecroft Road only, and maintaining 6 lanes on Yonge Street.

WORST CASE SCENARIO

The worst case Stage 2 alternative scenario includes bike lanes on Doris Avenue and Beecroft Road for the 2021 and 2031 planning horizons, and a reduction of traffic lanes – effectively to maintain 2 lanes per direction counter-clockwise on the service roads, to reflect existing demand patterns.

The following changes to the existing network configuration were assumed:

- Yonge Street remains, as per existing conditions, with a six-lane cross section, and the median is extended to include the sections from Poyntz Avenue to Sheppard Avenue and from Park Home Avenue to Finch Avenue.
- Beecroft Road is reduced from 2 lanes to 1 lane in the northbound direction.
- Doris Avenue is reduced from 2 lanes to 1 lane in the southbound direction.
- Unidirectional bike lanes are added on each side of Doris Avenue and Beecroft Road. On Beecroft Road, the bike lanes start at Poyntz Avenue (connecting to Yonge Street) and end at Hendon/Bishop Avenue. For this purpose, Poyntz Avenue westbound is reduced from 2 to 1 lane between Yonge Street and Beecroft Road. On Doris Avenue, the bike lanes start at Sheppard Avenue in 2021 and at Avondale Avenue in 2031; for both horizons the bike lanes end at Hendon/Bishop Avenue.

For all scenarios, the following improvements were included:

- Proposed traffic signals are included at the intersection of Northtown Way/Horsham Avenue and Yonge Street and at the intersection of Ellerslie Avenue and Yonge Street.
- The Doris-Tradewind Connection is included for the 2031 scenario only.
- Beecroft Road is assumed to terminate at Hendon Avenue for all horizon years and scenarios due to uncertainty regarding timelines for completion to Drewry Avenue and Steeles Avenue (as recommended by the Yonge Street North planning study)
- 2021 and 2031 pedestrian volumes at signalized intersections on Beecroft Road, Yonge Street and Doris Avenue are included while 2031 cyclist volumes are also used for 2021. GO Transit bus services on Yonge Street and TTC bus services on Sheppard and Finch Avenues between Beecroft Road and Doris Avenue are explicitly included along with the associated bus stops.

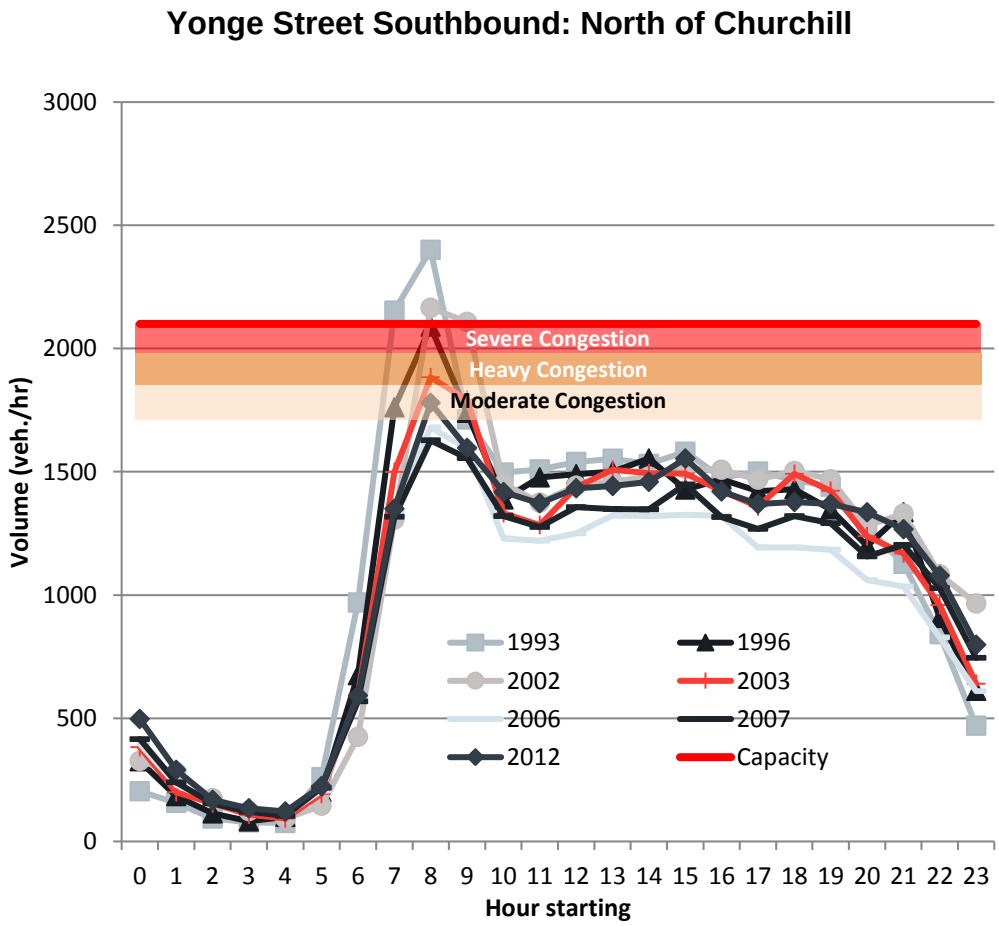
6. OBSERVATIONS

Additional observations about traffic behaviour gathered throughout the project provide more insight to the modelling results.

PEAK PERIOD DEMAND

The results reported below are for the weekday a.m. and p.m. peak periods. Outside of these times, demand levels on the North York Centre streets are considerably lower, falling below the City's guidelines for "congestion" as shown in the figure below. This graphic shows southbound volumes throughout a typical weekday at a screenline that was found to be typical of the corridor (Yonge Street just north of Churchill Avenue).

Exhibit 1



REGIONAL TRAFFIC

Traffic demand on Yonge Street during the weekday peak periods include significant volumes travelling to/from York Region. Yonge Street is used as a link to Highway 401 and the Finch TTC subway station and park and ride facility.

Using volume and turning movement counts at Steeles Avenue as an indicator of southbound traffic approaching the study area from York Region, and northbound traffic departing the study

area for York Region. Approximately 74% of traffic at this point on Yonge Street originates from York Region during the weekday morning peak period and approximately 73% of traffic is destined to York Region during the weekday afternoon peak period.

LANE UTILIZATION

A comparison of volumes on parallel streets can serve as a useful indicator of how well the available lanes are being used in the area, and what is possible in terms of throughput. Yonge Street, in the vicinity of Sheppard Avenue, carries a maximum of 1,571 southbound and 1,546 northbound vehicles, in 3 lanes per direction. This is equivalent to approximately 500 vehicles per lane. Bayview Avenue, in the vicinity of Sheppard Avenue, carries 1,439 southbound and 1,419 northbound vehicles, in 2 lanes per direction. This is equivalent to a throughput of approximately 700 vehicles per lane. Thus there is a certain amount of inefficiency in the utilization of the lanes on Yonge Street. This demonstrates that by improving operations on Yonge Street, most of the existing traffic could be accommodated in 2 lanes per direction. Given that some diversion to Beecroft Road and Doris Avenue will occur, this is a strong indication that the current (and future) traffic volumes could be accommodated with a 4-lane cross-section on Yonge Street.

Applying the projected 2031 Yonge Street traffic volumes (shown in Appendices A and B below) to this issue of utilization yields the same conclusion – Yonge Street can accommodate the projected volumes in 2 lanes per direction.

7. RESULTS

A detailed summary of the model results is appended to this memo, for both 2021 and 2031. Morning peak hour analysis for all scenarios is shown in Appendix A, and afternoon peak hour results are summarized in Appendix B. Highlights of the results for the key performance measures are as follows:

- **Travel Time changes are minimal –** generally under 1 minute for trips on Yonge (from Wilson to Steeles) or on Doris or Beecroft (from Sheppard to Finch)
- **Average speed changes** are minimal – 1 or 2 sec/km
- **Queuing –** queuing is the factor which shows the most noticeable change. Some increase is projected at Sheppard and Park Home/Empress, relative to the do nothing conditions at the two horizons.

SUMMARY OF SCREENLINE VOLUMES

A useful approach to evaluate how traffic is redistributed throughout the study area is to summarize volumes travelling across a screenline. A screenline is an imaginary line drawn on a road network, used to capture those trips crossing this line in both directions. Two screenlines were selected for review of Yonge Street, Doris Avenue, and Beecroft Road – one north of Sheppard Avenue and the second south of Finch Avenue. The section below summarizes the traffic volumes crossing these screenlines by direction under the Do-nothing and Alternative scenarios for the peak hours.

SCREENLINE NORTH OF SHEPPARD AVENUE

The Alternative scenario (associated with **Transform Yonge**) shows a reduction of traffic along Yonge Street, when compared to the 6-lane Yonge Street scenario (associated with **Transform Beecroft and Enhance Yonge**) for both the AM and PM.

This reduction in traffic along Yonge Street is typically offset by increases in traffic volumes along neighbouring Beecroft Road and Doris Avenue, but it should be noted that the model redistributes traffic on the basis of route travel time (and 5 runs are completed for each scenario, so the average result is presented). Traffic volumes along Beecroft Road and Doris Avenue increase in both southbound (SB) and northbound (NB) direction during the AM peak hour. During the PM peak hour, volumes along Beecroft decrease in the SB direction while the volume increases in the NB direction. Traffic volumes increase in the SB direction and decrease in the NB direction along Doris Avenue.

SCREENLINE SOUTH OF FINCH AVENUE

The Alternative scenario (associated with **Transform Yonge**) shows a reduction of traffic along Yonge Street SB, when compared to the 6-lane Yonge Street scenario (associated with **Transform Beecroft and Enhance Yonge**) and an increase NB during the AM. During the PM, there is a reduction both NB and SB.

Traffic volumes along Beecroft Road increase in the SB direction during the AM peak hour and in the PM peak hour. Traffic volumes decrease in the NB direction along Beecroft Road. Traffic volumes along Doris Avenue increase NB during the AM and PM peak hour. Traffic volumes decrease in the SB direction during the AM and PM peak hour.

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APPENDIX A: AM TRAFFIC ANALYSIS SUMMARY TABLE

Transform Yonge = 4 lanes on Yonge + cycle tracks + wider sidewalks; no change on Beecroft or Doris.
Transform Beecroft and Enhance Yonge = cycle tracks on Beecroft; no reduction in lanes on Yonge, Beecroft or Doris (equivalent to future "Do Nothing" scenario model in terms of traffic lanes)

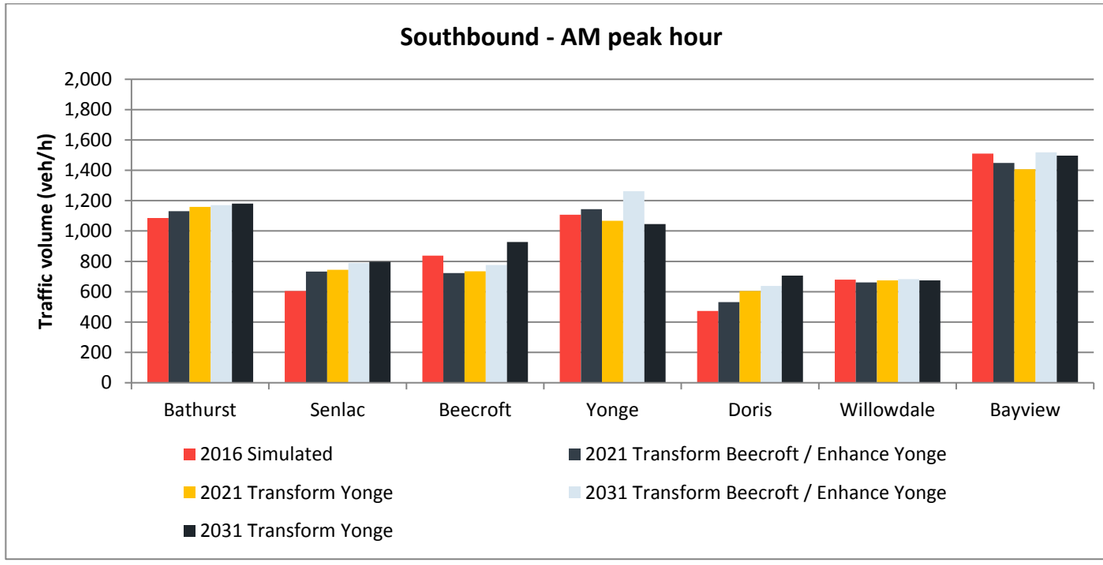
AM peak				2021		2031	
Performance Measure	**2021 Summary**	**2031 Summary**	**2016 Simulated**	**Transform Beecroft and Enhance Yonge ("Do Nothing")**	**Transform Yonge**	**Transform Beecroft and Enhance Yonge ("Do Nothing")**	**Transform Yonge**
Network performance over 3 hours							
Vehicles wanting to enter the network	3% increase over 2016 volumes	9% increase over 2016 volumes	199,132	204,756	204,558	216,268	216,949
Average speed (km/h)	1 km/h decrease relative to Do Nothing	2 km/h decrease relative to Do Nothing	37	38	37	36	34
Average delay (sec/km)	1 sec/km increase relative to Do Nothing	8 sec/km increase relative to Do Nothing	43	40	41	45	53
Travel times (min)	Change from Do Nothing:	Change from Do Nothing:					
Beecroft – Sheppard to Finch (NB/SB)	- 0.4 min increase for Transform Yonge NB	- 0.5 min increase for Transform Yonge NB+SB	3.5 / 3.3	3.4 / 3.5	3.8 / 3.5	3.6 / 3.6	4.3 / 4.1
Yonge – Wilson to Steeles (NB/SB)	- 1 min increase for Transform Yonge SB	- 2 min increase for Transform Yonge NB+SB	12.3 / 12.8	12.4 / 13.4	13.7 / 14.5	13.3 / 14.5	16.2 / 16.8
Doris – Sheppard to Finch (NB/SB)	- 0.1 min increase for Transform Yonge SB	- 1 min increase for Transform Yonge SB	3.0 / 3.3	2.9 / 3.4	3.0 / 3.5	3.0 / 3.5	3.2 / 4.8
Intersection level of service							
Beecroft/Sheppard	Little change from existing or future Do Nothing conditions		C	D	D	D	E
Yonge/Sheppard			D	D	D	D	D
Doris/Sheppard			C	C	D	D	E
Beecroft/Finch			C	C	C	C	C
Yonge/Finch			C	D	C	D	D

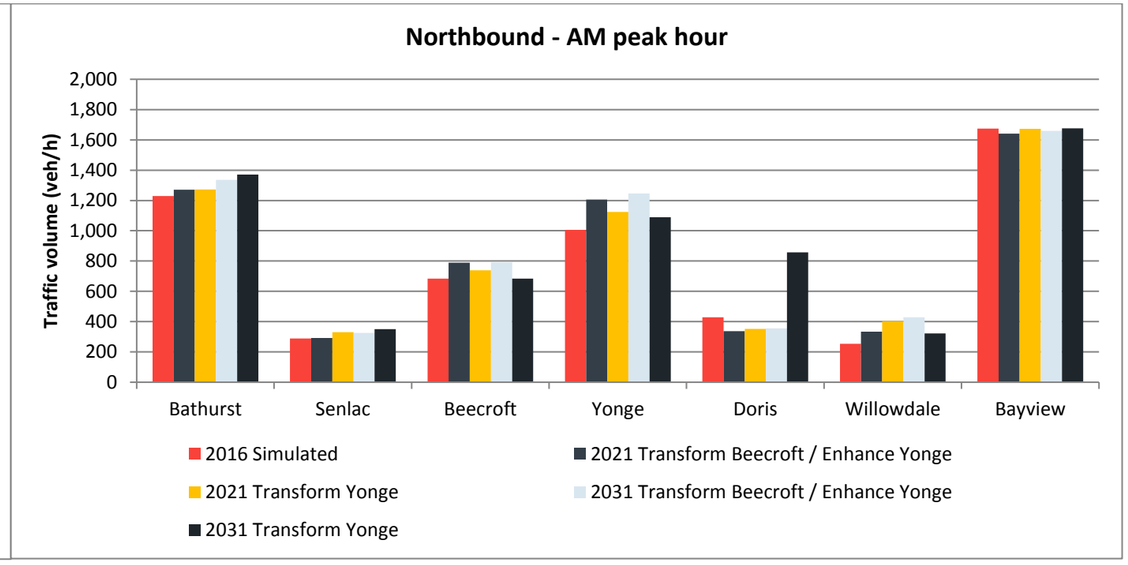
AM peak				2021		2031	
Performance Measure	**2021 Summary**	**2031 Summary**	**2016 Simulated**	**Transform Beecroft and Enhance Yonge ("Do Nothing")**	**Transform Yonge**	**Transform Beecroft and Enhance Yonge ("Do Nothing")**	**Transform Yonge**
Doris/Finch			B	B	B	B	B
Road Section Level of Service – Sheppard to Elmhurst/Greenfield (worst case section)							
Beecroft (NB/SB)	Little change from existing or future Do Nothing conditions		B / B	B / B	B / B	B / B	B / C
Yonge (NB/SB)			C / C	C / C	C / D	C / C	C / D
Doris (NB/SB)			C / C	C / C	C / C	C / C	B / D
Road Section Level of Service – Poyntz to Sheppard							
Beecroft (NB/SB)	Little change from existing or future Do Nothing conditions		D / C	D / C	B / D	D / C	D / D
Yonge (NB/SB)			C / C	C / C	D / C	C / C	C / D
Doris (NB/SB)			-	-	-	-	D / D
95th percentile queues along Yonge – Through Lanes (m)							
Finch (NB/SB)	Transform Yonge results in more than 20% increase in queue for NB and SB. Transform Beecroft and Enhance Yonge results in slight SB increase over 2016 condition	Transform Yonge results in more than 20% increase in queue for NB and SB. Transform Beecroft and Enhance Yonge results in 24 m SB increase (3 car lengths)	92 / 141	95 / 146	129 / 184	107 / 165	145 / 197
Park Home/Empress (NB/SB)	Transform Yonge results in increase of 8 car lengths SB. Transform Beecroft and Enhance Yonge yields increase of over 1 car length	Transform Yonge results in increase of 7 car lengths SB. Transform Beecroft and Enhance Yonge yields increase of 3-5 car lengths	64 / 92	72 / 103	110 / 159	99 / 118	115 / 147
Sheppard (NB/SB)	Transform Yonge results in 20m increase SB	Transform Yonge results in 50-60% increase NB	101 / 98	106 / 96	106 / 114	102 / 107	98 / 124
95th percentile queues along Yonge – Left Turn Lanes (m)							
Finch (NB/SB)	No major change from existing or future do nothing condition		50* / 50*	50* / 50*	49 / 50*	50* / 50*	43 / 50*
Park Home/Empress (NB/SB)			50* / 35*	50* / 35*	48 / 35*	50* / 35*	50* / 35*

AM peak				2021		2031	
Performance Measure	**2021 Summary**	**2031 Summary**	**2016 Simulated**	**Transform Beecroft and Enhance Yonge (“Do Nothing”)**	**Transform Yonge**	**Transform Beecroft and Enhance Yonge (“Do Nothing”)**	**Transform Yonge**
Sheppard (NB/SB)			59 / 30*	52 / 30*	-	60* / 30*	-
Notes: ** left-turn queue length exceed storage length*							

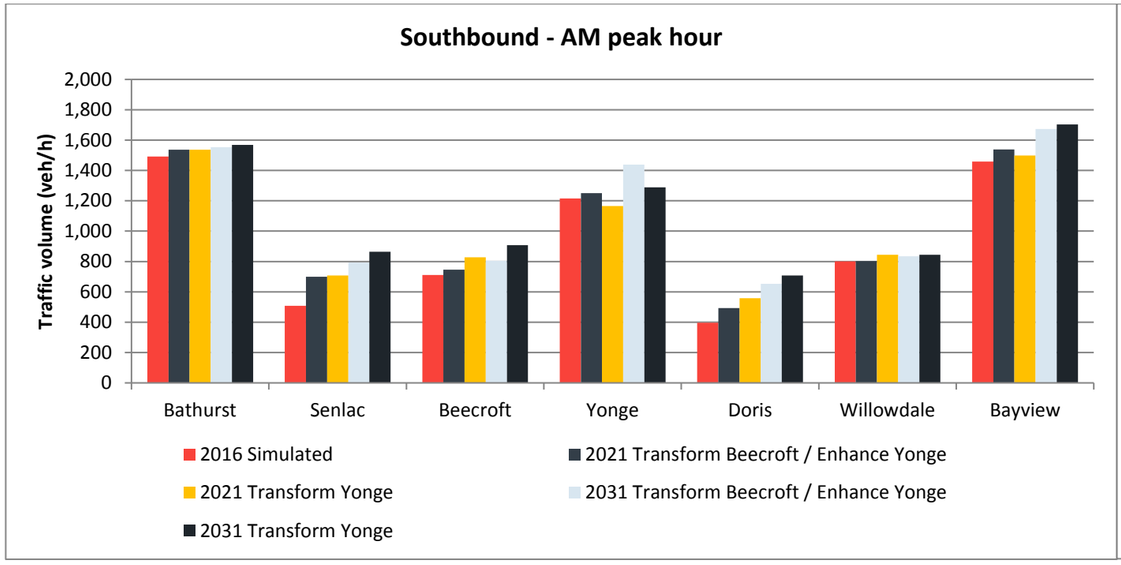
AM PEAK HOUR SCREENLINE VOLUMES

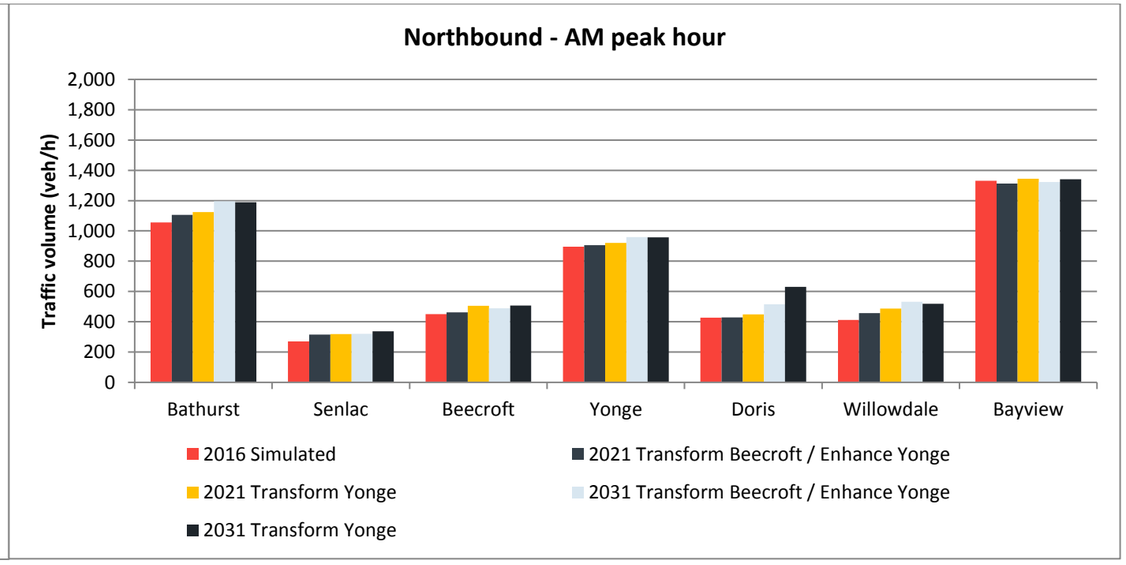
North of Sheppard





South of Finch





APPENDIX B: PM TRAFFIC ANALYSIS

SUMMARY TABLE

Transform Yonge = 4 lanes on Yonge + cycle tracks + wider sidewalks; no change on Beecroft or Doris.

Transform Beecroft and Enhance Yonge = cycle tracks on Beecroft; no reduction in lanes on Yonge, Beecroft or Doris (equivalent to future "Do Nothing" in terms of traffic lanes)

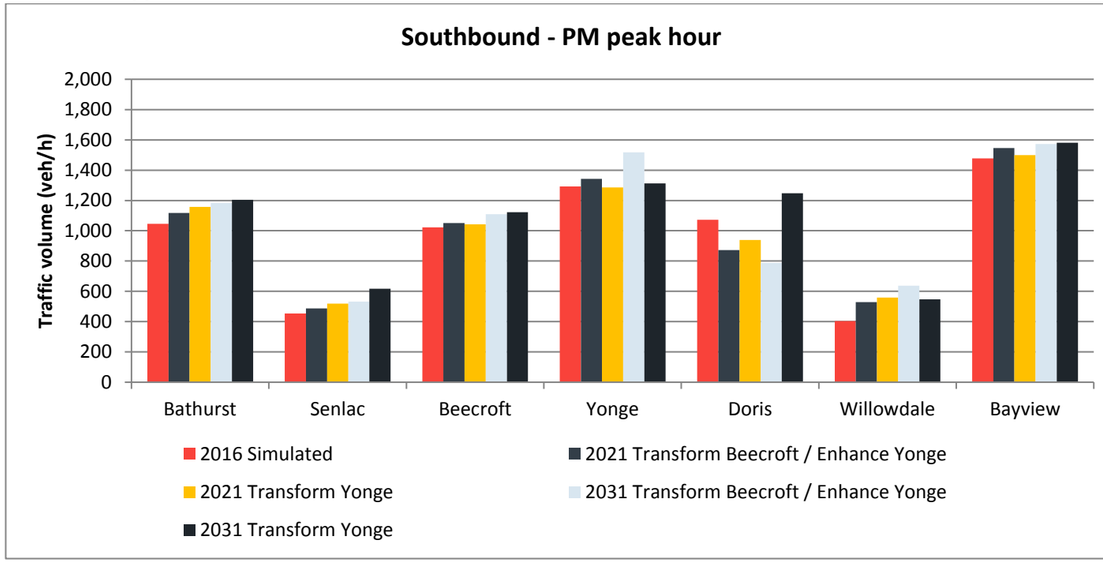
PM peak				2021		2031	
Performance Measure	**2021 Summary**	**2031 Summary**	**2016 Simulated**	**Transform Beecroft and Enhance Yonge ("Do Nothing")**	**Transform Yonge**	**Transform Beecroft and Enhance Yonge ("Do Nothing")**	**Transform Yonge**
Network performance over 3 hours							
Vehicles wanting to enter the network	3% increase over 2016 volumes	9% increase over 2016 volumes	212,731	220,325	220,092	236,010	236,220
Average speed (km/h)	1 km/h decrease relative to do nothing	minimal change	36	36	35	30	30
Average delay (sec/km)	2 sec/km increase relative to do nothing	1 sec/km increase relative to do nothing	45	45	47	65	66
Travel times (min)	Change from do nothing:	Change from do nothing:					
Beecroft – Sheppard to Finch (NB/SB)	– Transform Yonge: minimal change	– Minimal change for Transform Yonge NB+SB	3.3 / 3.2	3.4 / 3.4	3.5 / 3.7	3.6 / 4.6	3.7 / 4.2
Yonge – Wilson to Steeles (NB/SB)	– Transform Yonge: minimal change	– Transform Yonge: minimal change	12.9 / 12.7	13.4 / 12.9	13.8 / 14.0	14.4 / 14.8	15.4 / 15.2
Doris – Sheppard to Finch (NB/SB)	– Transform Yonge: minimal change	– Transform Yonge: minimal change – (SB Do Nothing is questionable)	3.0 / 4.3	3.0 / 6.7	3.1 / 7.4	3.2 / 13.7	3.6 / 5.8
Intersection level of service							
Beecroft/Sheppard	Little change from existing / do nothing		D	E	E	F	E
Yonge/Sheppard			D	D	D	E	D
Doris/Sheppard			D	E	E	F	F
Beecroft/Finch			C	C	C	C	C
Yonge/Finch			C	C	C	D	D
Doris/Finch			B	B	B	C	C
Road Section Level of Service – Sheppard to Elmhurst/Greenfield (worst case section)							
Beecroft (NB/SB)	Little change from existing / do nothing		B / C	B / C	B / C	B / D	B / D

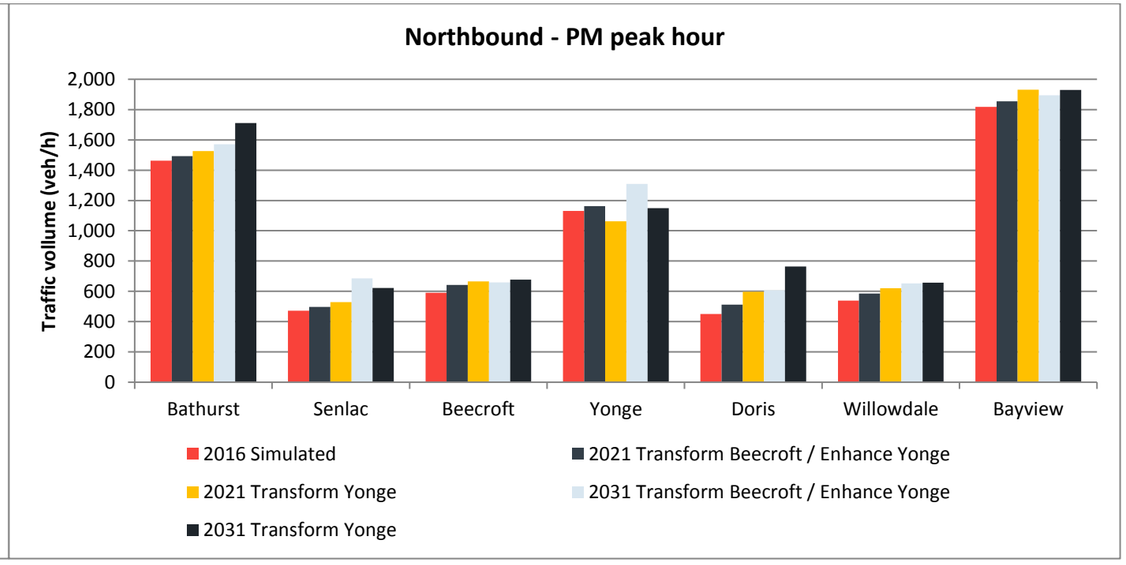
PM peak				2021		2031	
Performance Measure	**2021 Summary**	**2031 Summary**	**2016 Simulated**	**Transform Beecroft and Enhance Yonge ("Do Nothing")**	**Transform Yonge**	**Transform Beecroft and Enhance Yonge ("Do Nothing")**	**Transform Yonge**
Yonge (NB/SB)			C / C	C / C	C / D	C / D	C / D
Doris (NB/SB)			C / D	C / F	C / F	C / F	A / E
Road Section Level of Service – Poyntz to Sheppard							
Beecroft (NB/SB)	Little change from existing / do nothing		D / D	D / C	D / D	D / D	D / D
Yonge (NB/SB)			C / C	C / C	C / C	D / C	C / C
Doris (NB/SB)			-	-	-	-	E / D
95th percentile queues along Yonge – Through Lanes (m)							
Finch (NB/SB)	Transform Yonge alternative results in 10-20% increase in queue for NB and SB.	Transform Yonge alternative results in more than 20% / 40% increase in queue for NB / SB.	109 / 111	118 / 122	130 / 153	126 / 128	148 / 172
Park Home/Empress (NB/SB)	Transform Yonge results in more than 20% increase SB.	Transform Yonge results in more than 40% increase NB + SB.	95 / 79	88 / 70	113 / 117	101 / 90	145 / 133
Sheppard (NB/SB)	Transform Yonge results in 20% increase SB.	No change from do-nothing	99 / 109	106 / 107	105 / 121	106 / 120	106 / 120
95th percentile queues along Yonge – Left Turn Lanes (m)							
Finch (NB/SB)	No major differences. Shows that left turns are not expected to impede through movements generally		50* / 50*	50* / 50*	38 / 50*	50* / 50*	45 / 50*
Park Home/Empress (NB/SB)			42 / 35*	48 / 35*	50* / 35*	50* / 35*	50* / 35*
Sheppard (NB/SB)			60* / 30*	60* / 30*	-	60* / 30*	-

Notes:
** left-turn queue length exceed storage length*

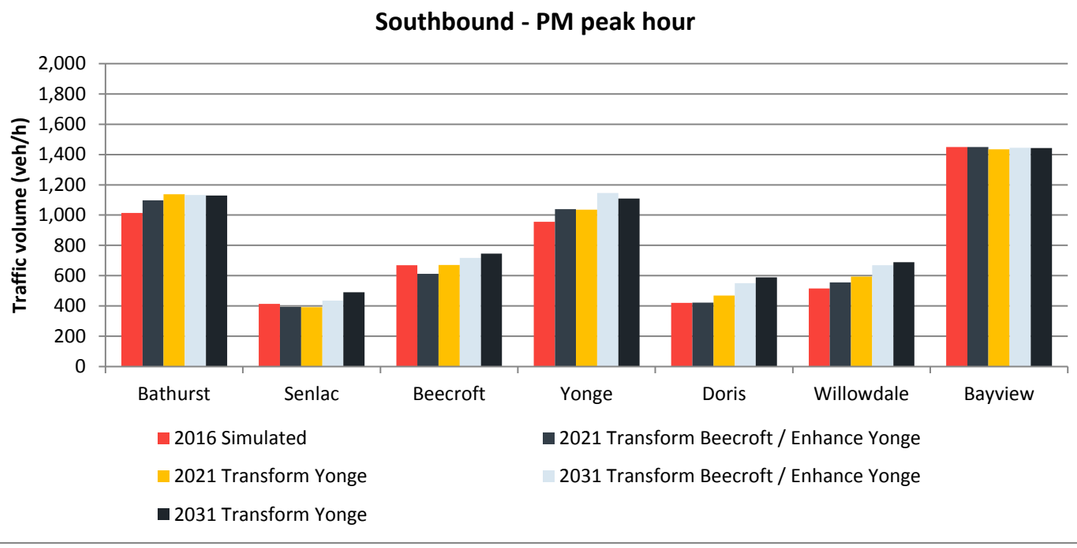
PM PEAK HOUR SCREENLINE VOLUMES

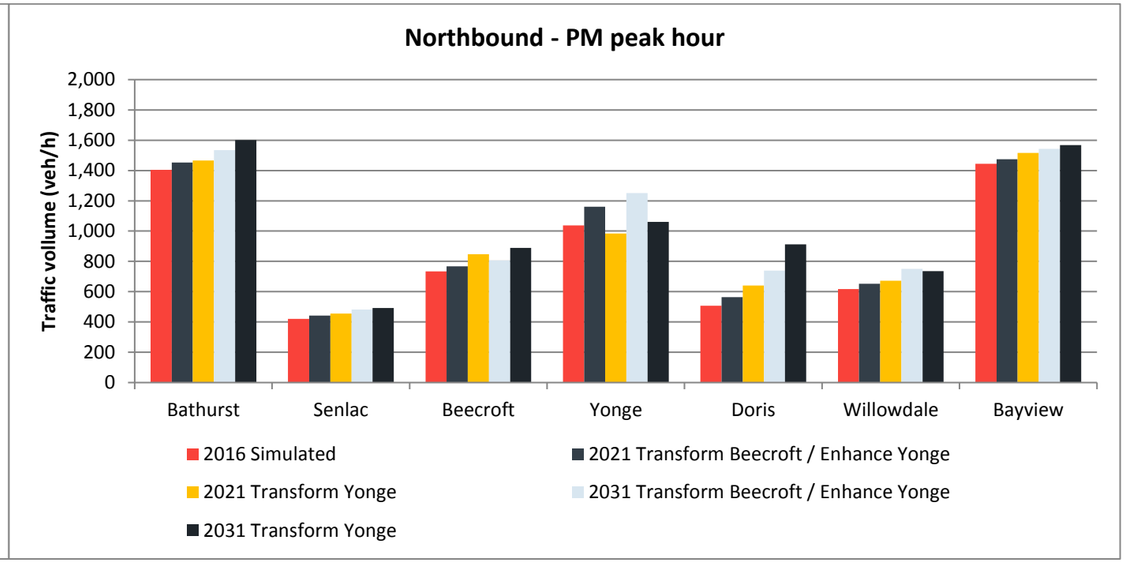
North of Sheppard





South of Finch





Re-Imagining Yonge Street

Sheppard Avenue to Finch Avenue

Class Environmental Assessment

AIMSUN Model:

2031 AM evaluation results summary

Transit mitigation assessment summary

October 2, 2019

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1. Executive Summary

This report documents the update of the Aimsun analysis to address concerns expressed by the TTC with respect to their operations in the vicinity of the Finch Subway Station bus terminal and more broadly across the project Study Area, from Bathurst Street to Bayview Avenue. This report addresses weekday AM peak hour conditions, using 2016 as a baseline but then projecting conditions in 2031. For 2031, four scenarios are tested: do-nothing (i.e. Yonge Street 6 lanes); Transform Yonge 1, reducing Yonge to 4 lanes from Sheppard Avenue to Finch Avenue; Transform Yonge 2, adding the extension of Beecroft Road to Drewry Avenue; and Transform Yonge 3, which included a cul-de-sac on Hendon Avenue west of Beecroft Road.

The report includes notes outlining approaches to key issues of interest to the TTC.

Key findings from the analysis are as follows:

- The growth between 2016 and 2031 in the total number of trips using the network during the peak period is approximately 7% for the Do-Nothing scenario and 9% for the Transform Yonge scenarios.
- Generally speaking, the traffic impact, across the study area network, of implementing the Transform Yonge scenarios in 2031 is noticeably less than the impact associated with traffic growth between 2016 and 2031.
- At the network level, there are no significant differences between three 2031 Transform Yonge scenarios.
- An increase in traffic volume is observed on most north-south corridors between 2016 and 2031 Do-nothing due to growth at the screenlines north of Sheppard Avenue and south of Finch Avenue. In the Transform Yonge scenarios, the simulated traffic volume on Yonge Street increases relative to the Do-nothing, and those on Doris Avenue and Beecroft Road increase. The change on other parallel street (for example Bathurst Street and Bayview Avenue) are negligible, indicating that the configuration of Transform Yonge has very little impact outside the focus area.

The following findings from the Transform Yonge scenarios are relative to the 2031 do-nothing scenario:

- Travel time changes on Yonge Street resulting from Transform Yonge are minimal - ranging from zero to 0.8 minutes.
- Travel time changes on other roads are also small. The largest increase is southbound on Doris Avenue, showing a range of increases from 1.2 to 1.9 minutes.
- Impacts on TTC bus services have been assessed:
    - Factors such as average speed and delay do not change relative to the do-nothing scenario;
    - At TTC terminal access points, bus level of service remains the same, generally. The westbound right turn exit from Pemberton shows an increase in delay, which is largely mitigated if Beecroft Road is extended; and
    - Travel time and delay on Yonge Street do not increase notably relative to the do-nothing case; some relative improvement is forecast for Scenarios 2 and 3.

- Projections of road section level of service show that little change is expected on Yonge (and the change is primarily outside the Transform Yonge area, suggesting the change is due primarily to growth). Little change is also projected on Beecroft Road. Some segments of Doris Avenue are projected to be at capacity southbound, on an intermittent basis.
- Intersection levels of services are not projected to worsen overall. Only the intersection of Yonge Street/Elmhurst Avenue/Greenfield Avenue is expected to reach LOS 'E' due to the removal of northbound left-turn movement at Yonge Street/Sheppard Avenue.
- Regarding queue lengths, the only locations where large increases are projected are at the intersections of Yonge at Drewry Avenue, Elmhurst Ave/Greenfield Ave, and Florence Ave/Avondale Ave. Potential mitigating measures are identified in this report.
- Traffic infiltration to adjacent neighbourhoods is projected to be minor; in some cases, the volumes decrease in the Transform Yonge scenarios.
- Impacts have been assessed for the Highway 401 ramps, mainline and ramp terminals. Volume changes on the Yonge ramps are not projected to increase beyond the levels seen under do-nothing.

2. Scenarios evaluated

The scenarios evaluated are summarized below:

2016 (existing) scenario

This scenario serves as a baseline reference point for existing conditions. This scenario includes the existing road network (with the 6-lane cross-section for Yonge Street) and the 2016 calibrated traffic demand, along with existing pedestrian demand. Transit vehicles were modelled explicitly within the focus area. Transit services outside the focus area were included as part of the truck matrices. Bicycles were not modelled explicitly due to the very low volumes and the complexities inherent in shared use of the curb lane by bicycles and vehicles, particularly under new traffic regulations (1 metre separation has to be maintained by drivers, requiring vehicles to intrude on the adjacent lane in cases of standard-width or narrow lanes).

2031 Do-Nothing scenario + Doris/Tradewind connection

This scenario includes the existing road network (with the 6-lane cross-section for Yonge Street) and 2031 traffic demand. This scenario includes 2031 pedestrian volumes and transit services at an increased frequency (2% growth per year for TTC and YRT) at all signalized intersections and do not explicitly model bicycles. This scenario also includes the Doris/Tradewind connection at Sheppard Avenue as shown in Figure 2-1.

Figure 2-1: *A schematic illustrating the Tradewind connection*

2031 Transform Yonge Scenario 1

This scenario includes the following network modifications:

- A cross-section reduction from 6 to 4 lanes on Yonge Street from Sheppard Avenue to Finch Avenue;
- The addition of bike lanes on Yonge Street from Florence Avenue/Avondale Avenue to Hendon Avenue/Bishop Avenue;
- The removal of both northbound and southbound left-turns and left-turn lanes at the intersection of Yonge Street and Sheppard Avenue;
- New traffic signals at the intersection of Northtown Way/Horsham Avenue and Yonge Street and at the intersection of Ellerslie Avenue and Yonge Street;
- The conversion to right-in-right-out (RIRO) on Yonge Street at the intersections of Tolman Street/Olive Avenue, Norton Avenue, Parkview Avenue, Upper Madison Avenue, Harlandale Avenue, Bogert Avenue, Johnston Avenue/Glendora Avenue, as per the Transform Yonge design;
- Revised GO and TTC bus stops as per the Transform Yonge design; and
- The addition of the Doris/Tradewind connection at Sheppard Avenue.

This scenario also includes 2031 pedestrian volumes at signalized intersections and cyclist volumes using the bicycle lane/track on Yonge Street. Transit services within the focus area are explicitly included along with the associated bus stops.

2031 Transform Yonge Scenario 2

This scenario includes all network modifications from Scenario 1. In addition, the following changes were applied:

- Beecroft Road extension from current terminus to Drewry Avenue with 4-lane cross section;
- Mid-block connection on the Beecroft Road extension at Turnberry Court with 4-lane cross section;
- New signalized intersection at Beecroft Road and Drewry Avenue; and
- New two-way stop-controlled intersections at Beecroft Road and Hendon Avenue, and Beecroft Road and Turnberry Court.

2031 Transform Yonge Scenario 3

This scenario features the same network as in Scenario 2 with the exception of the termination of Hendon Avenue as a cul-de-sac west of the Beecroft Road extension. The intersection of Beecroft Road and Hendon Avenue operates as a T-intersection with the east approach being stop-controlled.

Minor adjustments were made to the 2031 scenarios as necessary (for example changes to signal timing) to improve the manageability of traffic operations.

Notes on the Model

There have been a number of requests for clarification or further information. These requests and the responses are provided below:

- Mean and Max queuing on Bayview and Bathurst was requested. *Response: queuing on Bayview and Bathurst would come from the Synchro analysis.*

- The method that is used to estimate PPUDO trips for AM and PM was requested. *Response: PPUDO trips are mostly pass-by trips. We have attempted to estimate PPUDO trips entering Finch Station based on two approaches:*

    1. *Based on the difference between southbound counts at the intersections of Yonge/Finch GO Terminal and Yonge/Bishop/Hendon (however, these counts were not conducted on the same day): AM peak hour: 405 vehicles, PM peak hour: 250 vehicles,*
    2. *Based on the 2016 TTS data at Finch Station. AM peak hour: 649 vehicles, PM peak hour: 342 vehicles, we note that the TTS data suggests higher number of trips, which is expected as on-street drop-off or pick-up or could have used the alternate facilities without being separately identified.*

    In the existing AM conditions report, we noted that the demand adjustment procedure generally accounted for the trips entering the PPUDO due to difference in counts at adjacent intersections. Instead of exiting at the PPUDO, these trips (approximately 320 vehicles) exit at a centroid connector further upstream (north of the GO Terminal

intersection). For the future scenario evaluations, these trips were assigned to a new centroid at the PPUDO entrance, which involves the re-routing of trips that are already on the network. This change would have minimal impact on the traffic operation on Yonge Street and overall.

Vehicles leaving the PPUDO are also accounted for as the simulated volumes around the PPUDO exit reasonably match available counts.

- Assumptions or adjustments used for commuter parking trips. *Response: In EMME, there is a zone representing the Finch Station commuter parking lots. We proportionally split the commuter parking trips from EMME into the west and east parking lots based on number of parking spaces. The available intersection counts were then used in the demand adjustment process.*

- Assumptions or adjustments used to model pedestrians and vehicles conflicts in the Meso area. *Response: Pedestrians were not modelled in the meso portion of Aimsun. It is not clear whether vehicle/pedestrian interaction could be properly represented in meso given the pedestrian crossing is a microscopic element. We are currently inquiring with Aimsun regarding this issue. More detailed analysis would come from Synchro. However, given that the majority of the volume increase in the meso area is due to growth, not Transform Yonge, it is not expected that the findings will be significant.*

- The method that is used to calculate 95th percentile queue length for movements that is affected by Transit Stations. *Response: The maximum queue outputs are used to estimate the 95th percentile queue lengths. Maximum queues are generated every five minutes during the peak hour and for each of the five replications for a total of 60 measurements at each location. The 95th percentile queues are estimated as the 4th highest queue lengths out of the 60 measurements. Aimsun outputs queue lengths in number of vehicles, therefore a conversion to distance is made by multiplying the queue for each vehicle type by an assumed length in queue and adding the queues observed for all vehicle types.*

3. Traffic performance of the scenarios

3.1 Overall network performance

The statistics and discussion presented in this section are performance measures collected over the entire modelled study area (Wilson Ave./York Mills Rd. to Steeles Ave., Bathurst St. to Bayview Avenue). Table 3-1 summarizes the network performance for all vehicle types combined during the morning peak period. The current version of Aimsun is unable to separate out the statistics for the focus area only, and thus both the meso and micro areas are included.

Growth in traffic demand

These numbers indicate how many vehicles attempted to enter the network during the 3-hour peak period – the actual demand. These include all vehicle types: autos (SOV and HOV), trucks, and buses, but do not include bicycles. The City supplied different 2031 EMME travel demand models with a 6-lane configuration and a 4-lane configuration on Yonge Street. The EMME models were used to establish the future traffic demand matrices for the Do-nothing

and Transform Yonge scenarios, respectively. The growth between 2016 and 2031 in the total number of trips using the network during the peak period is approximately 7% in the Do-Nothing scenario and 9% for the Transform Yonge scenarios (Scenario 1-3). The minor difference in demand between the Transform Yonge scenarios is due to the stochastic nature of the model.

Proportion of traffic demand accommodated

These numbers summarize the proportion of those trips attempting to enter the network that were actually able to complete their trip during the peak periods. These numbers are high, with the remainder either still circulating in the network (see the "in the network" row in the table) or waiting to enter the network at the end of the peak period (the virtual queue). The percentage of demand accommodated remains the same at 97% in the 2031 scenarios, although the both the number of vehicles inside and waiting to enter the network are also higher. Scenario 2 has the lowest number of vehicles waiting to enter the network at the end of the simulation.

Mean vehicles in queue

This statistic represents the average number of vehicles sitting in a queue anywhere in the network based on observations at periodic intervals. If we compare that to the total number of vehicles in the network at a given time (in this case using the number in the network at the end of the peak period as a proxy), it averages out to approximately 38% of all vehicles sitting in a queue for existing conditions, 47% for the 2031 Do-nothing scenario, and 45% for all three of the 2031 Transform Yonge scenarios. There is an increase of 7% to 9% between the 2016 and 2031 scenarios due to traffic growth, however, the differences between the Do-nothing and Transform Yonge scenarios are not significant, with approximately 2% fewer vehicles in queue in the Transform Yonge scenarios.

Vehicle hours of travel

This represents the total hours spent travelling by all vehicles combined over the peak period but does not include the time spent in virtual queues (waiting to enter the network). There is an increase of 21% between the 2016 and 2031 Do-nothing scenarios. There is a 3% to 4% increase between the 2031 Do-nothing and 2031 Transform Yonge scenarios due to higher total demands in scenarios 1-3.

Average speed, delay, and density

Average speed is not an indicator of speed at any given location or point in time but rather an average speed over the network (including time stopped/spent in queues) based on the total travel time and the total distance travelled by all vehicles. As a result, the average speeds are much lower than what you might see on the speedometer while driving. During the morning peak period, the speed reduction across the model network is 11% between 2016 and the 2031 Do-nothing scenario (from 36 km/hr to 32 km/hr). The average speed drops by an additional 3% (1 km/hr) in the 2031 Transform Yonge scenarios.

A similar pattern is observed for the average delay and average density measurements at the network level.

Network performance summary

Generally speaking, the traffic (congestion) impact, across the study area network, of implementing the Transform Yonge scenarios in 2031 is noticeably less than the impact associated with traffic growth between 2016 and 2031. At the network level, there are no

significant differences between three 2031 Transform Yonge scenarios. However, the traffic impacts are not uniformly felt at all locations and on all facilities. The following sections provide additional detail on impacts at the local level.

Table 3-1: *Network performance/statistics during the AM peak period*

Numbers in parentheses represent % change from 2016 (existing conditions)	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
At end of 3 hours					
Wanted to enter the network (total demand)	197,007	211,498 (+7%)	214,919 (+9%)	214,947 (+9%)	214,951 (+9%)
In the network	4,567	5,529	5,995	5,967	6,036
Waiting to enter the network	569	1,156	1,202	997	1,029
Exited the network	191,870	204,814	207,722	207,982	207,886
% of demand exiting	97%	97%	97%	97%	97%
Over the 3 hours					
Average number of vehicles sitting in a queue	1,758	2,571	2,674	2,691	2,712
Total veh-hrs travelled*	15,916	19,337 (+21%)	19,719 (+24%)	19,819 (+25%)	19,870 (+25%)
Average speed (km/h)	36	32 (-11%)	31 (-14%)	31 (-14%)	31 (-14%)
Average delay (sec/km)	46	61 (+33%)	62 (+35%)	63 (+37%)	63 (+37%)
Average density (veh/lane-km)	7.0	8.5 (+21%)	8.7 (+24%)	8.7 (+24%)	8.8 (+26%)
Average virtual queue (veh)	301	664	640	590	591

** Total veh-hrs travelled does not include time spent in the virtual queue*
Network statistics are based on all vehicle types combined

There is a large increase in the average virtual queue between the 2016 and 2031 do-nothing scenarios. This is primarily observed at gateways north of Steeles (Yonge and Dudley/Willowdale) due to intersection operation at Yonge/Steeles. There is also some virtual queue on Hwy 401 WB east of Bayview during the peak hour. And please note it is in the do-nothing case, so not a function of Transform Yonge; nor is it happening in the area that will be affected by Transform Yonge.

3.2 Traffic volumes

The redistribution of traffic throughout the study area as a result of network configuration changes between the 2031 scenarios can be evaluated by considering the volumes travelling through a screenline. A screenline is an imaginary line drawn on a road network and used to capture those trips crossing this line in both directions. Two screenlines were selected for review based on the logical re-distribution of traffic resulting from the lane reduction on Yonge Street north of Sheppard Avenue and south of Finch Avenue. Table 3-2 and Table 3-3 summarize the traffic volumes crossing these screenlines under the Do-nothing and Transform Yonge Scenarios 1-3 for the AM peak hour by direction. Figure 3-1 and Figure 3-2 provide a graphical comparison of the simulated volumes.

Screenline North of Sheppard Avenue

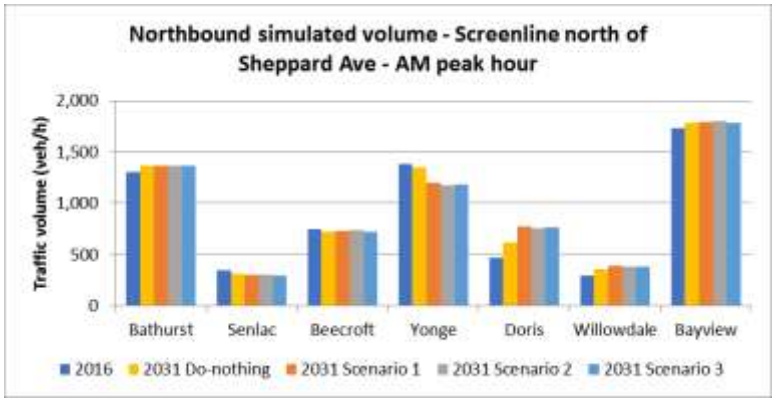
Comparing the 2016 northbound volumes to the 2031 do-nothing values, only Doris Avenue shows a growth of more than 100. In the southbound direction, Bathurst Street, Yonge street, Beecroft Road, and Bayview Avenue exhibit increases of more than 100 vehicles, due to general growth in demand. With the introduction of the Transform Yonge scenarios, volumes

on Bathurst Street and Bayview Avenue remain largely the same as the Do-nothing scenario. This shows that Transform Yonge has very little impact on these two parallel streets.

The Transform Yonge scenarios show a reduction of traffic along Yonge Street, when compared to the 2031 Do-nothing scenario, of 154 to 177 vehicles northbound and 157 to 231 vehicles southbound during the AM peak hour. The reductions on Yonge Street are higher in Scenarios 2 and 3 than Scenario 1. These reductions in traffic along Yonge Street are typically offset by increases in traffic along neighbouring Beecroft Road and Doris Avenue. The simulated traffic volumes along Doris Avenue increase by 140 to 156 vehicles northbound and by 46 to 69 vehicles southbound during the AM peak hour, compared to the 2031 Do-nothing scenario. Traffic volumes on Beecroft Road increase by 6 to 21 vehicles northbound and 44 to 59 vehicles southbound.

Table 3-2: 2031 peak-hour volumes for screenline north of Sheppard Avenue

	Simulated AM peak hour volumes (veh/h) – screenline north of Sheppard Ave									
	2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
Bathurst St	1,306	1,180	1,365	1,311	1,362	1,311	1,363	1,298	1,369	1,307
Senlac Rd	351	599	314	584	300	619	307	616	296	605
Beecroft Rd	746	837	720	1,047	730	1,091	741	1,101	726	1,106
Yonge St	1,386	1,288	1,352	1,464	1,198	1,307	1,175	1,242	1,185	1,232
Doris Ave	467	602	616	656	772	702	756	725	765	711
Willowdale Ave	299	563	354	656	387	675	384	672	382	679
Bayview Ave	1,727	1,357	1,786	1,628	1,790	1,641	1,799	1,652	1,784	1,639



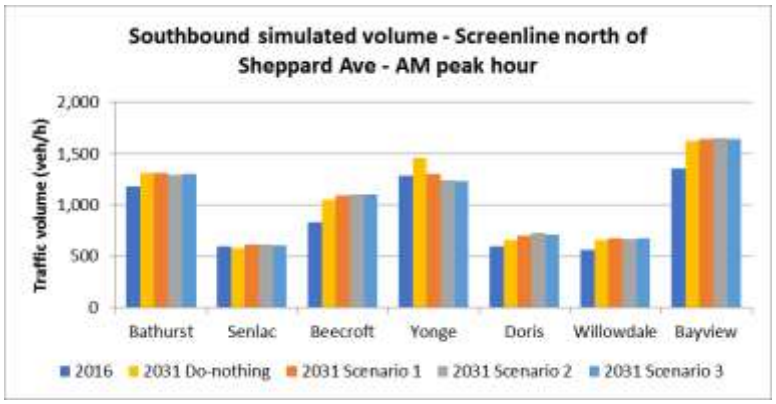


Figure 3-1: *2031 peak-hour volumes for screenline north of Sheppard Avenue*

Screenline South of Finch Avenue

Comparing the 2031 Do-nothing volumes to the 2016 volumes, very little growth is projected northbound, while in the southbound direction, growth is projected on Beecroft Road, Yonge Street, Doris Avenue, and Bayview Avenue. These increase in simulated volumes are due to the growth in traffic, not the implementation of Transform Yonge.

Compared to the 2031 Do-nothing scenario, the Transform Yonge scenarios show a reduction in traffic volumes along Yonge Street of 223 to 302 vehicles northbound and 270 to 330 vehicles southbound during the AM peak hour. The traffic volumes on Beecroft Road increase by 81 to 121 vehicles northbound and 97 to 105 vehicles southbound. The traffic increase is negligible on other parallel corridors, which suggests that the impact of Transform Yonge scenario on parallel routes is negligible. Overall at the screenline level, all three Transform Yonge scenarios have lower simulated volumes south of Finch Avenue, which could be due to a combination of increased level of congestion and due to differences in the demand matrices used.

Table 3-3: 2031 peak-hour volumes for screenline south of Finch Avenue

	Simulated AM peak hour volumes (veh/h) – screenline south of Finch Ave									
	2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
Bathurst St	1,141	1,414	1,197	1,486	1,171	1,444	1,171	1,440	1,184	1,455
Senlac Rd	293	563	289	609	298	639	306	627	327	625
Beecroft Rd	445	807	403	877	483	973	524	982	499	980
Yonge St	1,013	1,255	1,045	1,347	822	1,017	743	1,049	746	1,077
Doris Ave	469	595	495	755	530	756	490	761	496	762
Willowdale Ave	252	532	314	579	353	615	350	627	346	618
Bayview Ave	1,161	1,284	1,253	1,523	1,249	1,531	1,268	1,543	1,248	1,539

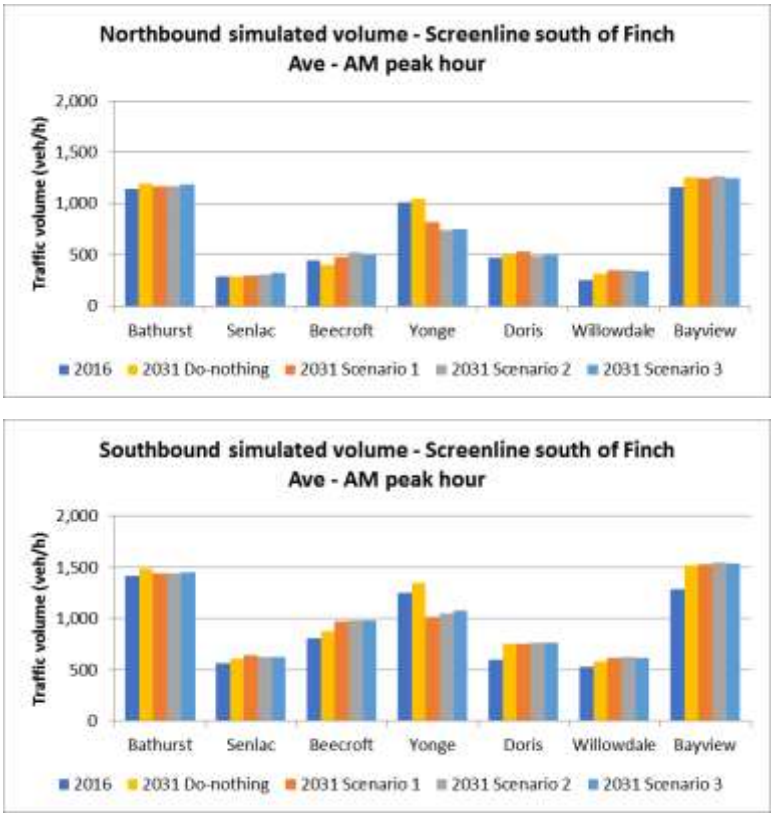


Figure 3-2: *2031 peak-hour volumes for screenline south of Finch Avenue*

3.3 Travel times and speeds

Table 3-4 summarizes the AM peak hour travel times along Yonge Street for the 2031 Do-nothing scenario and Transform Yonge scenarios 1-3. Between the simulated 2016 and 2031 scenarios, the overall travel times along Yonge Street between Wilson Avenue and Sheppard Avenue increase by 1.1 minutes to 1.4 minutes (or 14% to 16%) in the northbound direction and by 1.1 minutes to 1.9 minutes (or 7% to 12%) in the southbound direction. The highest increase in travel time is observed in Scenario 3 in the northbound direction and in Scenario 1 in the southbound direction. The average speeds decrease accordingly along Yonge Street.

In the 2031 Do-nothing scenario, the northbound section between Highway 401 and Sheppard Avenue experiences an increase in travel time of 0.7 minutes due to higher traffic demand and over-capacity left-turn movements. This increase is not observed in Scenarios 1-3 due to the removal of northbound left turn movements at Sheppard Avenue, Bogert Avenue, and Johnston Avenue/Glendora Avenue. There is however, an increase in travel times between Sheppard Avenue and Finch Avenue for the Transform Yonge scenarios due to the reduction in cross-section from 6 to 4 lanes on Yonge Street. Other sections generally show slightly longer travel times in 2031 due to increased traffic demand.

Table 3-4: *AM peak-hour travel times (min) along Yonge Street*

	2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Section	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
Wilson Ave to Hwy 401	2.0	2.6	2.3	2.9	2.1	2.8	2.0	2.8	2.1	2.7
Hwy 401 to Sheppard Ave	3.8	2.1	4.5	2.5	3.7	2.4	3.7	2.5	3.8	2.5
Sheppard Ave to Empress Ave	2.0	2.4	2.3	2.4	3.0	2.4	2.9	2.5	2.9	2.4
Empress Ave to Finch Ave	2.2	2.2	2.4	2.5	2.9	3.1	3.0	3.1	3.1	3.2
Finch Ave to Drewry Ave	2.1	2.4	2.4	2.8	2.4	2.8	2.3	2.8	2.3	2.8
Drewry Ave to Steeles Ave	3.1	4.5	3.6	4.2	3.4	4.6	3.4	3.9	3.4	3.8
Total Travel Time (mins)	**15.2**	**16.2**	**17.5**	**17.3**	**17.5**	**18.1**	**17.3**	**17.6**	**17.6**	**17.4**
Difference (relative to 2016)			2.3 (+15%)	1.1 (+7%)	2.3 (+15%)	1.9 (+12%)	2.1 (+14%)	1.4 (+9%)	2.4 (+16%)	1.2 (+7%)
Difference (relative to 2031 do-nothing)					0.0 (0%)	0.8 (4.6%)	-0.2 (-1.1%)	0.3 (1.7%)	0.1 (0.6%)	0.1 (0.6%)
Average Speed (km/hr)	**24.1**	**22.6**	**20.9**	**21.2**	**20.9**	**20.2**	**21.2**	**20.8**	**20.8**	**21.0**

Table 3-4 highlights the differences in travel time on Yonge between the 2031 do-nothing and the Transform Yonge scenarios. These are minimal.

Table 3-5 shows the travel times on the study area roads. The southbound travel time on Doris Avenue increases in the 2031 scenarios, especially for Scenarios 1 to 3. This is expected due to traffic growth and a diversion away from Yonge Street as a result of the lane reduction in the Transform Yonge scenarios. The travel time increases from 6.3 minutes in the 2031 Do-nothing scenario to 8.2 minutes in Scenario 1. In Scenario 2 and 3, the travel time is slightly lower than Scenario 1 at 7.5 and 7.8 minutes, respectively. The westbound travel time on Finch Avenue also increases in 2031. Compared to a travel time of 10.8 minutes in Scenario 1, the travel time is reduced by 1.0 to 1.2 minutes in Scenarios 2 and 3 with the Beecroft Road extension. The travel times on Sheppard Avenue also increase in 2031 in both directions during the AM peak hour, with the increase being observed consistently across all the Transform Yonge scenarios.

Travel times along other roadways in the study area show a mixture of minor increases and decreases that are generally comparable between the 2031 Do-nothing and 2031 Transform Yonge scenarios.

Table 3-5: *AM peak-hour travel times (min) on study area roads*

	2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Section	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
Yonge – Wilson to Steeles	15.2	16.2	17.5	17.3	17.5	18.1	17.3	17.6	17.6	17.4
Beecroft – Finch to Sheppard	4.6	4.8	4.6	5.0	4.7	5.2	4.7	5.3	4.7	5.4
Doris – Finch to Sheppard	4.4	5.6	4.5	6.3	4.6	8.2	4.6	7.5	4.7	7.8
Senlac – Finch to Sheppard	3.0	2.9	3.0	2.7	3.0	2.7	3.1	2.7	3.1	2.7
Willowdale – Finch to Sheppard	3.0	3.2	3.0	3.3	3.0	3.3	3.0	3.3	3.0	3.3
Bathurst – Finch to Sheppard	2.7	2.7	2.7	2.8	2.7	2.8	2.7	2.8	2.7	2.8
Bayview – Finch to Sheppard	3.1	2.9	3.1	3.4	3.1	3.2	3.1	3.3	3.1	3.3
Section	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**
Finch – Bathurst to Bayview	6.7	7.0	7.1	10.5	7.2	10.8	7.0	9.8	7.2	9.6
Churchill/Church – Senlac to Willowdale	3.9	3.7	4.0	3.9	4.1	4.0	4.2	4.0	4.2	4.0
Park Home/Empress – Senlac to Bayview	6.7	7.2	7.3	7.2	7.8	7.4	7.4	8.4	7.3	8.0
Sheppard – Bathurst to Bayview	8.8	8.0	9.3	9.0	9.5	9.9	9.6	9.6	9.6	9.8

3.4 Roadway level-of-service

This section discusses road section level of service calculated according to the methodology outlined in the Highway Capacity Manual, 6th Edition (2015), Volume 3 - Chapters 16 and 17. Level-of-service in this sense is based on section speeds and is quite different from the level-of-service calculated for intersections, based on intersection-related delay. This methodology relies on the calculation of a base free flow speed (in the absence of traffic controls) and level of service is based on the percentage of this speed achieved – in this case as measured by the simulation model. The level of service for each section reflects the travel time associated with travel between intersections as well as the travel time (delay) associated with the intersections themselves. The level-of-service criteria are summarized in Table 3-6.

Note that the version of Aimsun (8.0.10) used for the evaluation does not directly produce HCM results. The speed and delay outputs from Aimsun, which are used as input in the calculations, may not be compatible with the HCM methodology. Therefore, level of service results documented in this section and Section 3.5 are for scenario comparison purposes only.

Table 3-6: *Road section level-of-service criteria*

Actual average speed as % of base free flow speed	Level of service
> 85%	A
67 – 85%	B
50 – 67%	C
40 – 50%	D
30 – 40%	E
<30%	F

The HCM methodology includes a secondary criterion that suggests a volume/capacity ratio greater than 1.0 at a critical downstream intersection approach automatically leads to level-of-service F for the approaching road section. Aimsun does not generate volume/capacity ratio information – in fact capacity is a somewhat nebulous concept as it is driven by signal timings which can be variable if actuated or SCOOT-controlled. Instead we have flagged situations (asterisk and note) where the downstream intersection approach has a level-of-service F.

Table 3-7 to Table 3-9 summarize the level of service for Yonge Street, Beecroft Road, and Doris Avenue, by section during the AM peak hour.

The levels-of-service on Yonge Street, Beecroft Road, and Doris Avenue tend to be slightly worse for the Transform Yonge scenarios, although there is variability among these results. This is indicative of changing congestion (bottleneck) patterns. When a network is operating at or close to capacity, localized changes in traffic demand activate or de-activate bottlenecks. An active bottleneck meters downstream traffic, temporarily mitigating downstream bottlenecks. A bottleneck that is temporarily mitigated allows more traffic through, increasing the probability of bottlenecks downstream. The result is a changing pattern of bottlenecks, causing further variability in local traffic demand and in the measured level-of-service. This phenomenon is somewhat analogous to constantly shifting shock-wave patterns on a highway and the attendant stop-and-go operation.

For Yonge Street, the only section within the Transform Yonge change area which is projected to be above capacity is from Greenfield Avenue to Sheppard Avenue. Outside of this short section, there is no distinct pattern of change visible.

Table 3-7: *Road section level-of-service – Yonge Street – AM peak hour*

Yonge Street	Arterial LOS									
	Northbound					Southbound				
Crossing Road	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Steeles Ave										
Athabaska Ave	E	E	E	E	E	D	D	D	D	D
Moore Park Ave / Madawaska Ave	C	C	C	C	C	E	E	E	E	E
Patricia Ave	C	C	C	C	C	C	C	C	C	C
Drewry Ave / Cummer Ave	C	C	C	C	C	F	F	F*	E	E
Turnberry Ct	D	E	D	D	D	D	E	E	E	F
Finch GO Terminal	C	C	C	D	C	B	B	B	B	B
Hendon Ave / Bishop Ave	B	B	B	B	B	D	E	D	D	D
Finch Ave	D	D	E	D	D	E	E	E	E	D
Kempford Blvd	C	C	D	C	D	C	C	C	C	C
Churchill Ave	B	C	C	D	C	C	C	D	E	E
Ellerslie Ave	C	D	D	D	D	B	B	C	C	C
Park Home Ave / Empress Ave	B	B	C	C	C	C	C	C	C	C
North York Blvd / Elmwood Ave	C	C	C	C	C	C	D	D	D	D
Elmhurst Ave / Greenfield Ave	C	D	D	D	D	C	C	C	C	C
Sheppard Ave	D	D	F*	F*	F*	E	E	E	E	E
Poyntz Ave / Anndale Dr	F	F	F	F	F	D	D	D	D	D
Florence Ave / Avondale Ave	E	E	E	E	E	D	E	E	E	E
Franklin Ave	E	F	E	E	E	B	B	B	B	B
Highway 401 SRT / Lord Seaton Rd	B	**D**	B	B	C	D	D	D	D	D

**Note: LOS F at downstream intersection approach*

For Beecroft Road, the only section projected to be above capacity is also from Elmhurst to Sheppard, under two of the Transform Yonge scenarios. Otherwise, only marginal change is projected, within capacity.

For Doris Avenue, more sections are projected to worsen marginally, from LOS 'E' to 'F' southbound.

Table 3-8: *Road section level-of-service – Beecroft Road – AM peak hour*

Beecroft Road	Arterial LOS									
	Northbound					Southbound				
Crossing Road	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Drewry Ave										
Turnberry Ct				E	D				B	B
Hendon Ave				B	B				B	B
Finch Ave	C	C	C	B	B	E	E	E	E	E
Kempford Blvd	D	D	D	D	E	C	C	C	C	C
Churchill Ave	C	C	C	C	C	C	D	C	C	D
Ellerslie Ave	C	C	D	C	C	C	C	C	D	C
Park Home Ave / Empress Ave	C	C	C	C	C	C	C	D	D	D
North York Blvd / Elmwood Ave	C	C	C	C	C	C	C	C	C	C
Elmhurst Ave / Greenfield Ave	C	C	C	C	C	C	C	C	C	C
Sheppard Ave	C	C	C	C	C	E	E	E	F	F
Poyntz Ave / Anndale Dr	E	E	E	E	E	D	D	D	D	D

Table 3-9: *Road section level-of-service – Doris Avenue – AM peak hour*

Doris Avenue	Arterial LOS									
	Northbound					Southbound				
Crossing Road	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Hendon Ave / Bishop Ave										
Finch Ave	E	E	E	E	E	E	E	E	E	E
Kempford Blvd	C	C	C	C	C	C	C	C	C	C
Churchill Ave	D	D	D	D	D	C	C	D	D	C
Ellerslie Ave	D	D	D	D	D	B	B	B	B	B
Park Home Ave / Empress Ave	B	B	B	B	B	D	E	F	F	F
North York Blvd / Elmwood Ave	D	D	D	D	D	B	B	B	B	B
Elmhurst Ave / Greenfield Ave	B	B	B	B	B	E	F	F	F	F
Sheppard Ave	D	D	D	D	D	F	E	E	F	F
Poyntz Ave / Anndale Dr		E	E	E	E		D	D	D	D
Florence Ave / Avondale Ave		D	D	D	D		D	D	D	D

3.5 Intersection level-of-service

The intersection level of service was obtained using the average delay outputs from Aimsun in conjunction with the delay-based level-of-service criteria used in the Highway Capacity Manual, 6th Edition (2015), SYNCHRO, etc. for signalized and unsignalized intersections, as summarized in Table 3-10.

Table 3-10: *Intersection level-of-service criteria*

Level of service	Control delay per vehicle (s)	
	Signalized Intersections	Stop-Controlled Intersections
A	≤ 10	≤ 10
B	> 10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 15 and ≤ 25
D	> 35 and ≤ 55	> 25 and ≤ 35
E	> 55 and ≤ 80	> 35 and ≤ 50
F	> 80 or v/c > 1.0	> 50 or v/c > 1.0

Levels of service (LOS) for the intersections along Yonge Street, Beecroft Road and Doris Avenue for the 2016 existing scenario and 2031 Do-nothing and Transform Yonge scenarios are summarized in Table 3-11 to Table 3-13 for the AM peak hour. These tables show overall (average) intersection LOS although this measure is typically biased due to the inclusion of non-critical approaches, protected movements that are often timed to operate at capacity, and green times constrained by pedestrian crossing requirements. Except for a few locations,

the levels-of-service are generally similar across the future 2031 scenarios with less variability than the road-section level-of-service results.

Level-of-service values within the range of "A" to "D" indicate that the intersection is operating at an acceptable level in the context of a large, generally congested, urban area. Level of service "E" suggests that the intersection is operating at a marginally acceptable level and periodic but unsustained queueing may be experienced. Level of service "F" indicates that the intersection is operating at an unacceptable level subject to sustained queuing.

Comparing the 2031 Transform Yonge scenarios to the 2031 Do-nothing scenario, there is a slight increase in the intersection level-of-service from "A" to "B" on Yonge Street at Horsham Avenue/Northtown Way and Ellerslie Avenue due to signalization at these locations. The removal of northbound and southbound left-turn movements at Sheppard Avenue, which resulted in more left-turn demand at the adjacent intersection of Elmhurst Avenue/Greenfield Avenue, results in a reduced intersection level-of-service from "C" to "E". The removal of the northbound left-turn movement improved the intersection operation at Bogert Avenue from "C" to "A".

Table 3-11: *Level of service for intersections along Yonge Street – AM peak hour*

	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Steeles Ave	F	F	F	F	F
Nipigon Ave	A	B	B	B	B
Abitibi Ave	A	A	A	A	A
Athabaska Ave	B	B	B	B	B
Otonabee Ave	A	A	A	A	A
Moore Park Ave /Madawaska Ave	B	B	B	B	B
Pleasant Ave / Newton Dr	A	A	A	A	A
Goulding Ave	A	A	A	A	A
Centre Ave	A	A	A	A	A
Homewood Ave	A	A	A	A	A
Patricia Ave	B	B	B	B	B
Connaught Ave	A	A	A	A	A
Wedgewood Dr	A	A	A	A	A
Drewry Ave / Cummer Ave	E	E	F	E	E
Turnberry Ct	C	D	D	D	D
Finch GO Terminal	A	A	A	A	A
Hendon Ave / Bishop Ave	D	D	D	D	D
Finch Ave	D	D	D	D	D
Tolman St / Olive Ave	A	A	A	A	A
Holmes Ave	A	A	A	A	A
Kempford Blvd	A	B	B	B	B
Byng Ave	B	B	B	C	B
Horsham Ave / Northtown Way	A	A	B	B	B
Churchill Ave / Church Ave	C	C	C	C	C
McKee Ave	A	A	A	A	A
Norton Ave	A	A	A	A	A
Ellerslie Ave	A	A	B	B	B
Parkview Ave	A	A	A	A	A
Kingsdale Ave	A	A	A	A	A
Park Home Ave / Empress Ave	C	C	C	C	C
Hillcrest Ave	A	A	A	A	A
North York Blvd / Elmwood Ave	C	D	D	D	D
Hollywood Ave	A	A	A	A	A
Upper Madison Ave (N Jct)	A	A	A	A	A
Spring Garden Ave	A	A	A	A	A
Upper Madison Ave (S Jct)	A	A	A	A	A

	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Elmhurst Ave / Greenfield Ave	C	C	E	E	E
Harlandale Ave	A	A	B	B	A
Sheppard Ave	D	D	D	D	D
Bogert Ave	C	C	A	A	A
Poyntz Ave / Anndale Dr	C	D	D	D	D
Johnston Ave / Glendora Ave	B	B	B	B	B
Florence Ave / Avondale Ave	D	D	D	D	D
Cameron Ave	A	A	A	A	A
Franklin Ave	C	A	A	A	A
Highway 401 NRT	B	C	C	C	C
Highway 401 SRT / Lord Seaton Rd	D	E	D	D	D

Along Beecroft Road, the overall intersection level of service are similar across the 2031 scenarios and they are also comparable to the 2016 conditions. With the Beecroft extension, the overall level-of-service at Drewry Avenue is “F” in Scenario 2 and slightly better at “E” in Scenario 3. This is mostly due to the eastbound congestion downstream at Yonge Street and Drewry Avenue/Cummer Avenue intersection. In addition, the westbound through traffic is often impeded by left-turn vehicles which share the same lane. In Scenario 3, where Hendon Avenue is cul-de-sac west of Beecroft Road, the intersection level-of-service improves from “C” to “A”.

Table 3-12: *Level of service for intersections along Beecroft Road – AM peak hour*

	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Drewry Ave				F	E
Turnberry Ct				A	A
Hendon Ave	C	C	C	C	A
Finch Ave	C	C	C	C	C
Lorraine Dr	A	A	A	A	A
Kempford Blvd	B	B	B	B	B
Horsham Ave (N Jct)	A	A	A	A	A
Horsham Ave (S Jct)	A	A	A	A	A
Churchill Ave	B	B	B	B	B
Ellerslie Ave	B	B	B	B	B
Basil Hall Ct	A	A	A	A	A
Park Home Ave	C	D	D	D	D
North York Blvd	B	B	B	B	B
Elmhurst Ave	B	B	B	B	B
Harlandale Ave	A	A	A	A	A
Sheppard Ave	E	E	E	E	E
Bogert Ave	A	A	A	A	A
Poyntz Ave	B	B	B	B	B

Along Doris Avenue, the level of service at Finch Avenue is “D” to “E” in 2031, as a result of westbound congestion at the Yonge Street and Finch Avenue intersection. The level of service worsens from “D” to “E” in the 2031 Transform Yonge Scenarios due to high westbound and southbound delay from increased demand. The level of service at Sheppard Avenue also drops from “D” to “E”.

Table 3-13: *Level of service for intersections along Doris Avenue – AM peak hour*

	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Bishop Ave	A	D	A	A	A
Finch Ave	C	E	E	D	D
Olive Ave	A	A	A	A	A
Holmes Ave	A	A	A	A	A
Byng Ave	B	B	B	B	B
Sommerset Way	A	A	A	A	A
Northtown Way	A	A	A	A	A
Grandview Way	A	A	A	A	A
Church Ave	B	C	C	C	C
McKee Ave	A	A	A	A	A
Norton Ave	A	A	A	A	A
Parkview Ave	A	A	A	A	A
Kingsdale Ave	A	A	B	C	C
Empress Ave	D	D	E	E	E
Hillcrest Ave	A	A	A	A	A
Elmwood Ave	A	A	A	A	A
Hollywood Ave	A	A	A	A	A
Spring Garden Ave	A	C	F	D	E
Greenfield Ave	D	D	D	D	D
Sheppard Ave	D	D	E	E	E
Anndale Dr		A	A	A	A
Glendora Ave		A	A	A	A
Avondale Ave		A	A	A	A

3.6 Queue lengths

Table 3-14 to Table 3-16 summarize the 95th percentile peak-hour queue lengths for intersections along Yonge Street, Beecroft Road, and Doris Avenue during the morning and afternoon peak hours. Instances where the 95th percentile queue lengths exceed the available storage length, based on either existing or proposed designs, are identified.

The only locations where large increases are projected are Drewry Avenue, Elmhurst/Greenfield and Florence/Avondale. Potential mitigating measures are identified in this report.

Table 3-14: *95th percentile queue lengths for intersections along Yonge Street – AM peak hour*

95th percentile queue (m)		AM peak hour									
		2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Crossing road	Approach	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane
STEELES AVE	East	155*	219**	155*	219**	155*	219**	155*	219**	155*	219**
	West	110*	370**	110*	370**	110*	370**	110*	370**	110*	370**
	North	50*	317**	50*	317**	50*	317**	50*	317**	50*	317**
	South	50*	229**	50*	229**	50*	229**	50*	229**	50*	229**
ATHABASKA AVE	East	0	8	0	15	0	8	0	8	0	8
	West	23	0	23	0	30	0	23	0	23	0
	North	0	213**	0	213**	0	213**	0	213**	0	213**
	South	8	145**	8	145**	8	145**	8	145**	8	145**
MOORE PARK AVE	East	38	8	38	15	30	15	38	15	30	15
	West	53	15	53	30	45	23	45	23	45	23
	North	0	142**	0	142**	0	142**	0	142**	0	142**
	South	30*	204	30*	212**	30*	212**	30*	212**	30*	212**
PATRICIA AVE	East		0		0		0		0		0
	West	-	0	-	0	-	23	-	15	-	23
	North	-	217**	-	217**	-	217**	-	217**	-	217**
	South	8	189	15*	233	8	225	15*	233	15*	225
DREWRY AVE	East	45	255	85*	478	85*	466	75	523	60	338
	West	40*	462**	40*	462**	40*	462**	40*	150**	40*	150**
	North	53	296**	55*	296**	55*	296**	55*	296**	55*	296**
	South	50*	218	50*	275**	50*	248	38	225	30	218
TURNBERRY CT	East	25*	23	25*	38	25*	45	25*	72**	25*	72**
	West	8	8	0	0	0	0	60	38	68	45
	North	0	276**	0	276**	0	276**	0	274**	0	274**
	South	0	166	0	182**	0	182**	30*	173	30*	165
FINCH GO TERMINAL	East	-	38	-	38	-	38	-	38	-	38
	West	-	38	-	15	-	23	-	15	-	15
	North	25*	75	25*	158	25*	90	25*	68	25*	75
	South	-	68	-	73**	-	68	-	73**	-	73**
BISHOP AVE	East	-	185**	-	185**	-	187**	-	187**	-	187**
	West	35*	117**	0	43**	35*	121**	35*	122**	35*	122**
	North	60*	77**	60*	77**	60*	76**	60*	76**	60*	76**
	South	31	169**	35*	169**	35*	169**	30	169**	35*	169**
FINCH AVE	East	35*	86**	35*	86**	35*	89**	35*	89**	35*	89**
	West	45*	130**	45*	130**	45*	128**	45*	128**	45*	128**
	North	45	165**	50*	151	50*	158	50*	167**	50*	167**
	South	50*	98**	50*	98**	50*	98**	50*	98**	50*	98**
TOLMAN ST	East	-	60	-	45	-	38	-	23	-	30
	West	-	53	-	45	-	60	-	53	-	38
	North	0	15	0	15	-	15	-	23	-	15
	South	15	0	0	8	-	15	-	8	-	23

95th percentile queue (m)		AM peak hour									
		2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Crossing road	Approach	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane
HOLMES AVE	East	-	45	-	45	-	53	-	68	-	60
	West										
	North	15	31	23	45	38	60	38	61	30	60
	South	-	8	-	0	-	0	-	8	-	8
KEMPFORD BLVD	East										
	West	23	38	30*	75	30*	30	30*	30	30*	30
	North	-	69**	-	69**	-	68**	-	68**	-	68**
	South	15*	22**	15*	22**	15*	21**	15*	21**	15*	21**
BYNG AVE	East	-	38	-	53	-	53	-	53	-	60
	West										
	North										
	South	-	113	-	120	-	121	-	150	-	121
HORSHAM AVE/ NORTHTOWN WAY	East	-	38	-	45	-	53	-	53	-	60
	West	-	45	-	45	-	60	-	53	-	45
	North	8	31	15	68	15	143	23	150	23	158
	South	8	8	8	30	8	113	8	120	15	133**
CHURCHILL AVE/ CHURCH AVE	East	60	95**	75*	95**	75*	98**	75*	98**	75*	98**
	West	30	72**	38	72**	15	76**	23	76**	23	76**
	North	30*	132**	30*	132**	30*	132**	30*	132**	30*	132**
	South	15	73**	30	73**	15	73**	23	73**	30	73**
MCKEE AVE	East	-	53	-	83	-	75	-	68	-	68
	West										
	North	25*	23	25*	15	25*	45	25*	30	25*	23
	South	-	15	-	15	-	0	-	23	-	15
NORTON AVE	East	-	38	-	30	-	8	-	15	-	15
	West										
	North	25*	53	25*	30						
	South	-	15**	-	21**	-	21**	-	21**	-	21**
ELLERSLIE AVE	East										
	West	-	45	-	63**	-	66**	-	66**	-	66**
	North	-	0	-	21**	-	92**	-	92**	-	92**
	South	15	15	23	38	30*	93**	30*	93**	30*	93**
PARKVIEW AVE	East	-	75	-	83	-	38	-	30	-	38
	West										
	North	15	0	15	8						
	South	-	0	-	0	-	23	-	15	-	8
KINGSDALE AVE	East	-	30	-	23	-	23	-	23	-	23
	West										
	North										
	South	-	0	-	8	-	15	-	15	-	23
PARK HOME AVE/ EMPRESS AVE	East	38	113	50*	135	45	152**	30	152**	38	152**
	West	30	53	30	53	38	75	38	68	38	83
	North	35*	135	35*	158	35*	150	35*	135	35*	143
	South	45	113	50*	135	50*	143	50*	135	50*	128
HILLCREST AVE	East	-	30	-	23	-	23	-	23	-	23
	West										
	North										
	South	-	15	-	15	-	60	-	45	-	38
NORTH YORK BLVD/ ELMWOOD AVE	East	128	60	170*	68	170*	68	170*	60	170*	60
	West	30*	38	30*	38	30*	53	30*	45	23	75
	North	23	188	23	196	15	188	23	233	23	188
	South	55*	74**	55*	74**	55*	85**	55*	85**	55*	85**
HOLLYWOOD AVE	East	-	38	-	15	-	15	-	23	-	23
	West										
	North										

95th percentile queue (m)		AM peak hour									
		2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Crossing road	Approach	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane
	South	-	0	-	8	-	45	-	53	-	38
UPPER MADISON AVE (N JCT)	East										
	West										
	North	-	23	-	23	-	46	-	38	-	38
	South	20*	15	20*	15						
SPRING GARDEN AVE	East	-	45	-	45	-	45	-	45	-	45
	West										
	North										
	South	-	38	-	23	-	45	-	23	-	42
UPPER MADISON AVE (S JCT)	East										
	West	-	29**	-	29**	-	29**	-	29**	-	29**
	North	-	15	-	23	-	30	-	61**	-	45
	South										
ELMHURST AVE/ GREENFIELD AVE	East	50*	98	50*	188	50*	212**	50*	212**	50*	212**
	West	30	50**	23	50**	38	68	23	68	30	53
	North	35*	52**	35*	52**	35*	52**	35*	52**	35*	52**
	South	60*	75**	60*	75**	60*	172**	60*	172**	60*	172**
HARLANDALE AVE	East										
	West	-	75	-	128	-	90	-	150	-	75
	North	-	60	-	79**	-	79**	-	79**	-	79**
	South	25*	60	25*	23						
SHEPPARD AVE	East	110*	136	90	166	110*	143	110*	150	110*	150
	West	45	122**	30	122**	30	122**	30	122**	30	122**
	North	30*	64**	30*	64**	-	65**	-	65**	-	65**
	South	60*	55**	60*	55**	-	145**	-	145**	-	145**
BOGERT AVE	East										
	West	-	83	-	102**	-	75	-	90	-	83
	North	-	58**	-	58**	-	58**	-	58**	-	58**
	South	20*	61**	20*	61**						
POYNTZ AVE/ ANNDALE DR	East	45	98	50*	113	50*	113	50*	143	50*	150
	West	15	110**	38	107**	15	109**	8	109**	8	109**
	North	23	62**	15	62**	15	61**	15	61**	23	61**
	South	35*	74**	35*	71**	35*	70**	35*	70**	35*	70**
JOHNSTON AVE	East	-	15	-	15	-	8	-	8	-	8
	West	-	53	-	61	-	53	-	38	-	32
	North	8	66**	8	66**	-	66**	-	66**	-	66**
	South	25*	68**	25*	68**	-	70**	-	70**	-	70**
FLORENCE AVE/ AVONDALE AVE	East	35*	72**	35*	72**	35*	74**	35*	74**	35*	74**
	West	40*	143	40*	271	40*	210	40*	272	40*	249
	North	45*	74**	45*	74**	38	74**	38	74**	38	74**
	South	105*	316**	105*	316**	105*	316**	105*	316**	105*	316**
CAMERON AVE	East										
	West	-	143**	-	136	-	105	-	135	-	75
	North	-	15	-	53	-	60	-	46	-	68
	South										
FRANKLIN AVE	East										
	West	-	135**	-	105	-	83	-	75	-	99
	North	-	15	-	60	-	39	-	15	-	61
	South										

Notes:

The 95th percentile queue is approximated, based on the maximum queues across 5 replications, as this statistic is not an output of Aimsun.
- left-turn movement is not permitted or there is no exclusive left-turn lane
** left-turn queue length exceeds storage length*

Table 3-15: *95th percentile queue lengths for intersections along Beecroft Road – AM peak hour*

95th percentile queue (m)		AM peak hour									
		2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Crossing road	Approach	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane
DREWRY AVE	East							-	144**	-	144**
	West							-	287**	-	287**
	North										
	South							90	120	98	105
TURNBERRY CT	East							68	38	68	38
	West										
	North							8	0	8	0
	South							-	0	-	0
HENDON AVE	East	-	53	-	61	-	69**	-	69**	-	60
	West	-	72**	-	72**	-	72**	-	70**		
	North	-	0	-	0	-	0	8	0	30	8
	South	-	45	-	38	-	45	-	15	-	0
FINCH AVE W	East	30*	69**	30*	69**	30*	69**	30*	69**	30*	69**
	West	23	68**	15	68**	8	68**	25*	65**	25*	65**
	North	15	83	15	105	23	128	30*	98	30*	98
	South	83	68	85*	90	85*	90	85*	135	85*	114
LORRAINE DR	East	-	30	-	30	-	38	-	38	-	38
	West										
	North	-	23	-	23	-	30	-	23	-	23
	South	-	15	-	15	-	15	-	15	-	15
KEMPFORD BLVD	East	25*	60	25*	53	25*	68	25*	68	25*	60
	West										
	North	38	83	50*	83	30	98	30	120	38	113
	South	-	53	-	75	-	90	-	98	-	90
HORSHAM AVE (N JCT)	East	-	38	-	30	-	30	-	30	-	38
	West										
	North	-	30	-	45	-	60	-	61	-	60
	South	-	0	-	0	-	0	-	0	-	0
HORSHAM AVE (S JCT)	East	-	23	-	23	-	15	-	23	-	23
	West										
	North	-	23	-	53	-	53	-	53	-	53
	South	-	0	-	0	-	8	-	15	-	15
CHURCHILL AVE	East	23	58**	25*	58**	23	58**	25*	58**	25*	58**
	West	15	83	15	98	15	136	15	120	15	136
	North	38	82**	60*	82**	38	82**	53	82**	45	82**
	South	23	53	15	75	15	83	23	75	25*	75
ELLERSLIE AVE	East	40*	15	40*	15	40*	15	40*	15	40*	15
	West										
	North	15	90	15	105	8	128	23	135	15	135
	South	-	45	-	49**	-	49**	-	49**	-	49**
BASIL HALL CT	East	-	30	-	38	-	45	-	45	-	45
	West										
	North	8	0	15	0	8	0	20*	0	20*	0
	South	-	15	-	8	-	15	-	15	-	15
PARK HOME AVE	East	25*	68	23	75	25*	83	25*	83	25*	83
	West	35*	180**	35*	180**	35*	180**	35*	180**	35*	180**
	North	45	113	53	121	53	143	53	150	53	165
	South	45*	68	45*	75	45*	68	30	75	30	68
NORTH YORK BLVD	East	23	30	23	30	30	30	30	38	23	45
	West	20*	30	15	45	20*	38	15	38	15	38
	North	45*	120	45*	128	45*	135	45*	135	45*	158
	South	-	53	-	68	-	68	-	60	-	68
ELMHURST AVE	East	90	30	98	23	98	38	83	30	90	38

95th percentile queue (m)		AM peak hour									
		2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Crossing road	Approach	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane
	West										
	North	25*	90	25*	106	25*	136	25*	114	25*	158
	South	-	72**	-	72**	-	72**	-	72**	-	72**
HARLANDALE AVE	East	-	68	-	53	-	30	-	45	-	23
	West										
	North	23	23	15	65**	30	65**	23	65**	23	65**
	South	-	23	-	15	-	23	-	15	-	15
SHEPPARD AVE	East	35*	127**	35*	127**	30	127**	30	127**	23	127**
	West	115*	243**	115*	243**	115*	243**	115*	243**	115*	243**
	North	40*	73**	40*	73**	40*	73**	40*	73**	40*	73**
	South	35*	60	35*	64**	35*	64**	35*	64**	35*	64**
BOGERT AVE	East	-	75	-	91	-	68	-	83	-	90
	West										
	North	-	53	-	67**	-	67**	-	67**	-	67**
	South	-	0	-	0	-	0	-	0	-	0
POYNTZ AVE	East	-	23	-	38	-	45	-	38	-	45
	West	-	30	-	83	-	75	-	90	-	83
	North	-	65**	-	65**	-	65**	-	65**	-	65**
	South										

Notes:

The 95th percentile queue is approximated, based on the maximum queues across 5 replications, as this statistic is not an output of Aimsun.
- left-turn movement is not permitted or there is no exclusive left-turn lane
** left-turn queue length exceeds storage length*

Table 3-16: *95th percentile queue lengths for intersections along Doris Avenue – AM peak hour*

95th percentile queue (m)		AM peak hour 2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Crossing road	Approach	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane
BISHOP AVE	East	-	128	-	196**	-	108	-	102	-	53
	West	-	0	-	0	-	0	-	0	-	0
	North										
	South	23	23	8	45	23	45	23	45	23	45
PEMBERTON AVE	East										
	West	-	75	-	96**	-	96**	-	96**	-	96**
	North	-	45	-	53	-	45	-	53	-	53
	South	25*	45	25*	68	25*	68	25*	75	25*	68
FINCH AVE	East	55*	105	55*	201**	55*	201**	55*	201**	55*	201**
	West	60*	117**	60*	117**	60*	117**	60*	117**	60*	117**
	North	30	87**	38	87**	45*	87**	38	87**	38	87**
	South	23	83	15	90	15	98	15	105	15	98
OLIVE AVE	East										
	West	-	30	-	23	-	15	-	15	-	8
	North	-	8	-	15	-	15	-	8	-	8
	South	8	0	8	0	15	0	8	0	8	0
HOLMES AVE	East	-	30	-	38	-	30	-	30	-	30
	West	-	38	-	45	-	60	-	53	-	53
	North	0	0	8	0	0	0	8	0	8	0
	South	8	0	15	0	8	0	8	0	8	0
BYNG AVE	East	-	30	-	30	-	15	-	23	-	15
	West	-	23	-	23	-	23	-	23	-	23
	North	8	68	8	90	8	96**	8	96**	8	96**
	South	23	53	30*	68	30*	68	30*	60	30*	68
SOMMERSET WAY	East	-	30	-	38	-	38	-	38	-	38
	West										
	North	-	15	-	23	-	23	-	38	-	30
	South	-	0	-	0	-	0	-	0	-	0
NORTHTOWN WAY	East										
	West	-	30	-	32**	-	32**	-	32**	-	32**
	North	-	0	-	0	-	0	-	0	-	0
	South	-	15	-	15	-	23	-	23	-	15
GRANDVIEW WAY	East	-	23**	-	38	-	38	-	45	-	45
	West										
	North	0	0	8	23	0	30	0	38	0	23
	South	-	0	-	1	-	15	-	0	-	15
CHURCH AVE	East	30*	83	30*	113	30*	106	30*	113	30*	98
	West	30	53	45	68	45	75	38	83	38	76
	North	23	61**	15	61**	15	61**	15	61**	23	61**
	South	30	45	15	53	38	68	38	53	38	68
MCKEE AVE	East										
	West	-	30	-	45	-	45	-	45	-	45
	North	-	8	-	15	-	15	-	15	-	15
	South	-	0	-	0	-	23	-	23	-	23
NORTON AVE	East										
	West	-	38	-	53	-	23	-	23	-	23
	North	-	0	-	0	-	0	-	0	-	0
	South	-	16	-	8	-	15	-	30	-	30
PARKVIEW AVE	East										
	West	-	45	-	38	-	30	-	38	-	38
	North	-	0	-	0	-	0	-	0	-	0
	South	-	8	-	8	-	15	-	8	-	15
KINGSDALE AVE	East										

95th percentile queue (m)		AM peak hour									
		2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Crossing road	Approach	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane	LT lane	TH/RT lane
	West	-	38	-	38	-	124**	-	124**	-	124**
	North	-	8	-	30	-	73**	-	73**	-	73**
	South	-	38	-	23	-	15	-	15	-	15
EMPRESS AVE	East	-	176**	-	176**	-	176**	-	176**	-	176**
	West	-	68	-	90	-	90	-	105	-	90
	North	45*	75**	45*	75**	45*	75**	45*	75**	45*	75**
	South	23	68	8	68	23	83	8	83	23	83
HILLCREST AVE	East										
	West	-	38	-	38	-	53	-	53	-	53
	North	-	15	-	8	-	15	-	15	-	15
	South	-	23	-	23	-	30	-	23	-	30
ELMWOOD AVE	East										
	West	-	60	-	45	-	90	-	83	-	75
	North	-	0	-	0	-	45	-	8	-	16
	South	-	30	-	30	-	38	-	45	-	38
HOLLYWOOD AVE	East										
	West	25*	23	25*	23	25*	15	25*	15	25*	15
	North	-	0	-	1	-	77**	-	15	-	70
	South	-	15	-	23	-	23	-	30	-	23
SPRING GARDEN AVE	East										
	West	-	53	-	90	-	217**	-	210	-	217**
	North	-	113	-	121	-	131**	-	131**	-	131**
	South	-	53	-	60	-	53	-	60	-	60
GREENFIELD AVE	East	-	38	-	60	-	60	-	68	-	60
	West	-	15	-	8	-	68	-	8	-	54
	North	-	94**	-	94**	-	94**	-	94**	-	94**
	South	-	75	-	98	-	128	-	166	-	136
SHEPPARD AVE	East	-	62**	90*	196**	83	196**	90*	196**	90*	196**
	West	0	46	68	174	110*	165	110*	173	110*	150
	North	113	121	113	143	114	180**	113	180**	120	180**
	South			23	113	23	120	30	120	30	120

Notes:

The 95th percentile queue is approximated, based on the maximum queues across 5 replications, as this statistic is not an output of Aimsun.

- left-turn movement is not permitted or there is no exclusive left-turn lane

** left-turn queue length exceeds storage length*

3.7 Traffic infiltration

Roads are typically classified as arterial, collector, local, etc. based on the nature and volume of the traffic that is intended to use each class of road. Generally speaking, traffic infiltration might be defined as the use of roads by traffic that is inconsistent with their classification, in terms of volume, through vs. local traffic, etc. However, in real life, regardless of classification, residents living adjacent to roads are sensitive to any traffic not perceived as having a local origin or destination.

In a generally congested, urbanized area with a grid-based road system, it is inevitable that some or all of the roads, regardless of classification, will be used as alternative routes to avoid congestion and bottlenecks. To counter this tendency, traffic calming measures can be implemented to reduce the attractiveness of these alternative routes and/or to ensure that traffic using these roads is doing so at a speed consistent with a high level of safety.

In the case of the study area, the planning of changes to the road system over the past 35 years was done in such a way so as to minimize the use of local roads adjacent to the North York Centre by traffic oriented to the Centre. In particular, local roads were largely isolated from the road system providing circulation within the Centre.

For this assignment, local roads were not included in the traffic simulation model. This has the important benefit that the performance of the road network **is not dependent on** the use of local roads for traffic circulation consistent with the level of performance reported here for the network. On the other hand, it is inevitable, in real life that some traffic will use these roads and the traffic simulation model will not capture such usage.

The traffic simulation model generally includes roads designated in the North York Centre Secondary Plan as collector roads, such as:

- Avondale Avenue
- Bishop Avenue
- Church Avenue
- Churchill Avenue
- Empress Avenue
- Florence Avenue
- Hilda Avenue
- Kenneth Avenue
- Park Home Avenue
- Talbot Road
- Tamworth Road

Generally speaking, it is these roads, along with the relevant arterial and minor arterial roads, that have been maintained as connections between the Centre and the surrounding road network. The Secondary Plan does not preclude additional traffic roads on the listed roads but does provide that appropriate traffic control measures be implemented before these roads reach “planning capacity” levels.

The “service” roads, generally Doris Avenue and Beecroft Road, are also intended to function as collector roads, while Cummer Avenue and Drewry Avenue are intended to function as minor arterial roads. The concept of infiltration is not relevant to these roads.

To get some sense of the potential for infiltration, we have summarized in Table 3-17 anticipated increases in the estimated AM peak hour volumes respectively for those roads in the simulation model connecting the Centre (focus area) to the adjacent road system. Projected changes are minimal; in some cases, volumes decrease.

Table 3-17: *Change in traffic volume on east-west collector roads serving the focus area – AM peak hour*

Simulated AM peak hour traffic volumes (veh/h)								
	2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Section	EB	WB	EB	WB	EB	WB	EB	WB
Church Ave east of Doris Ave	174	438	199	397	195	400	190	393
			(+25)	(-41)	(+21)	(-38)	(+16)	(-45)
Churchill Ave west of Beecroft Rd	283	241	305	218	307	243	331	273
			(+22)	(-23)	(+24)	(+2)	(+48)	(+32)
Empress Ave east of Doris Ave	249	459	270	455	270	437	265	445
			(+21)	(-4)	(+21)	(-22)	(+16)	(-14)
Park Home Ave west of Beecroft Rd	568	257	545	280	553	281	556	279
			(-23)	(+23)	(-15)	(+24)	(-12)	(+22)

3.8 Implications for Highway 401

Changes in traffic volumes at the Highway 401 interchanges in the study area

Table 3-18 summarizes the change in volume at the Yonge, Bayview, and Avenue Road interchanges due to growth between 2016 and 2031 and due to the implementation of the Transform Yonge scenarios (4-lane Yonge) compared to the Do-nothing scenario (6-lane Yonge).

Table 3-18: *Changes in traffic volumes at Highway 401 interchanges due to growth and implementation of the Alternative scenario – AM peak hour*

Simulated AM peak hour ramp volumes (veh/hr)					
Ramp	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Yonge St IC					
E-N/S off ramp	1,321	1,259	1,479	1,484	1,461
W-N/S off ramp	1,184	1,286	1,259	1,269	1,269
N/S-E on-ramp	1,554	1,476	1,427	1,416	1,411
N-W on-ramp	1,388	1,606	1,577	1,564	1,586
S-W on-ramp	464	448	451	437	449
Total	5,911	6,075 (+3%)	6,193 (+5%)	6,170 (+4%)	6,176 (+4%)
Bayview Ave IC					
E-N/S off ramp	1,725	1,729	1,748	1,737	1,735
W-N/S off ramp	788	879	821	831	828
N-W on-ramp	551	616	704	706	712
S-W on-ramp	242	182	192	190	191
N-E on-ramp	764	715	706	720	713
S-E on-ramp	565	784	777	776	777
Total	4,635	4,905 (+6%)	4,948 (+7%)	4,960 (+7%)	4,956 (+7%)

Ramp	Simulated AM peak hour ramp volumes (veh/hr)				
	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Avenue Rd IC					
E-N/S off ramp	966	1,060	1,086	1,070	1,100
W-N/S off ramp	695	719	681	673	674
N-W on-ramp	96	100	99	99	99
S-W on-ramp	464	637	651	647	652
N-E on-ramp	244	393	367	349	367
S-E on-ramp	737	683	698	698	697
Total	3,392	3,592 (+6%)	3,582 (+6%)	3,536 (+4%)	3,589 (+6%)

Changes in traffic volumes on the Highway 401 mainline in the study area

Table 3-19 summarizes the changes in mainline Highway 401 volumes resulting from the implementation of the Transform Yonge scenarios relative to the Do-nothing scenario for 2031 based on the changes in interchange volumes from Table 3-18. These changes are mostly minor increases relative to the total mainline volumes and relative to day-to-day variations in traffic volume. The highest change is observed westbound between Yonge Street and Bayview Avenue in Scenario 2, with an increase of 335 vehicles relative to the Do-nothing scenario during the AM peak hour.

Table 3-19: *Changes in traffic volumes on the Highway 401 mainline (express and collector lanes combined) due to implementation of the 2031 Transform Yonge scenario*

NC = No change or reduction	Simulated AM peak hour mainline traffic volumes (veh/h)							
	2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Section	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**
West of Avenue Rd	11,291	13,281	11,322 (+31)	13,340 (+59)	11,334 (+43)	13,378 (+97)	11,321 (+30)	13,332 (+51)
Between Avenue Rd and Yonge St	11,590	13,638	11,661 (+71)	13,729 (+91)	11,674 (+84)	13,754 (+116)	11,666 (+76)	13,735 (+97)
Between Yonge St and Bayview Ave	11,667	13,061	11,695 (+28)	13,347 (+286)	11,705 (+38)	13,396 (+335)	11,681 (+14)	13,347 (+286)
East of Bayview Ave	11,996	14,419	12,050 (+54)	14,504 (+85)	12,069 (+73)	14,483 (+64)	12,042 (+46)	14,439 (+20)

Off-ramp queues at the Highway 401 interchanges in the study area

As noted previously, one of the potential concerns of the Ministry involves the possibility of queues on off-ramps backing up to the mainline, resulting in reductions in operational and safety performance of the highway. Table 3-20 summarizes the 95th percentile queue lengths associated with existing conditions as well as those expected for the 2031 Do-nothing and Transform Yonge scenarios. For comparison, the distance from the ramp terminals to the mainline bullnose is also provided.

The 95th percentile queue length today (2016) for the E-N/S off-ramp at Yonge Street is approximately 251 meters. Under 2031 conditions, the Do-nothing scenario would result in a 238 m increase in queue length and the Transform Yonge scenarios would result in increases of between 91 m and 135 m. The lengthening of the queue between 2016 and 2031 is primarily due to increased travel demand. The reduced cross-section for Yonge Street will

actually make the use of this particular off-ramp less attractive, thus reducing the queue lengths. Scenario 2 has the shortest 95th percentile queue at the Yonge Street westbound off-ramp, followed by Scenario 1 and Scenario 3. It is noted that the estimated queue lengths are similar between Scenarios 1, 2, and 3 and are all within the distance to bullnose.

The queues at other interchange off-ramp locations are comparable between the 2031 Scenarios. The westbound off-ramp at Bayview Avenue continue to see long queues, which would appear to be problematic, although this is almost totally a result of future growth and has very little to do with the implementation of the Transform Yonge scenarios. In this regard, we note that MTO is considering improvements to these ramps which would likely reduce the queue lengths.

Table 3-20: *Expected peak-hour 95th percentile queue lengths on the off-ramps at interchanges in the study area* – AM peak hour

95th percentile queue (m) *						
Ramps	**Distance to bullnose (m)**	**2016 Simulated**	**2031 Do-nothing**	**2031 Scenario 1**	**2031 Scenario 2**	**2031 Scenario 3**
Yonge St IC**						
E-N/S off-ramp	**437**	251	489	374	342	386
Bayview Ave IC						
E-N/S off-ramp	**417**	571	623	630	639	638
W-N/S off-ramp	**400**	270	256	248	248	256
Avenue Rd IC						
E-N/S off-ramp	**345**	143	150	158	158	150
W-N/S off-ramp	**294**	45	45	38	38	38
Notes:						
** The 95th percentile queue is approximated as this statistic is not an output of Aimsun*						
*** The W-N/S ramp at the Yonge interchange is uncontrolled*						

Level-of-service at the ramp terminals

Table 3-21 summarizes the level-of-service of the ramp terminal intersections at the interchanges in the study area for existing (2016) conditions and for 2031 conditions under various scenarios. Table 3-22 provides more detailed information for just the off-ramp approaches.

Table 3-21: *Change in level-of-service at the Highway 401 ramp terminals – AM peak hour*

		2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Yonge St IC						
Yonge St NRT	Delay (sec)	16	28	24	22	24
	Level-of-service (LOS)	**B**	**C**	**C**	**C**	**C**
Yonge St SRT / Lord Seaton Road *	Delay (sec)	53	62	50	49	51
	Level-of-service (LOS)	**D**	**E**	**D**	**D**	**D**
Bayview Ave IC						
Bayview Ave NRT	Delay (sec)	47	70	61	60	62
	Level-of-service (LOS)	**D**	**E**	**E**	**E**	**E**
Bayview Ave SRT	Delay (sec)	20	27	25	24	25
	Level-of-service (LOS)	**B**	**C**	**C**	**C**	**C**
Avenue Rd IC						
Avenue Rd NRT	Delay (sec)	11	12	11	11	12
	Level-of-service (LOS)	**B**	**B**	**B**	**B**	**B**
Avenue Rd SRT	Delay (sec)	3	2	2	2	2
	Level-of-service (LOS)	**A**	**A**	**A**	**A**	**A**

** The south "ramp terminal" serves the N/S-E on-ramp but the W-N/S ramp does not pass through the ramp terminal and is uncontrolled*

Table 3-22: *Change in level-of-service for the off-ramp approaches – AM peak hour*

		2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Yonge St IC						
E-N/S off-ramp	Delay (sec)	38	91	70	61	65
	Level-of-service (LOS)	**D**	**F**	**E**	**E**	**E**
Bayview Ave IC						
E-N/S off-ramp	Delay (sec)	81	137	129	128	135
	Level-of-service (LOS)	**F**	**F**	**F**	**F**	**F**
W-N/S off-ramp	Delay (sec)	38	42	40	39	39
	Level-of-service (LOS)	**D**	**D**	**D**	**D**	**D**
Avenue Rd IC						
E-N/S off-ramp	Delay (sec)	13	14	15	14	15
	Level-of-service (LOS)	**B**	**B**	**B**	**B**	**B**
W-N/S off-ramp	Delay (sec)	2	1	1	1	1
	Level-of-service (LOS)	**A**	**A**	**A**	**A**	**A**

** The south "ramp terminal" serves the N/S-E on-ramp but the W-N/S ramp does not pass through the ramp terminal and is uncontrolled*

3.9 TTC surface-transit operations

The TTC is interested in the impact of alternative future scenarios for Yonge Street on its surface operations, particularly in connection with the Finch terminal. The performance outputs presented below include overall network statistics, delay and level-of-service at intersections and access locations, and delay and travel times along Yonge Street.

Table 3-23 summarizes the network statistics for TTC vehicles during the AM peak period. Over the existing 2016 three-hour morning peak period, a total of 895 buses operated within the focus area, and 6 additional buses are waiting to enter at the end of the peak period (more likely due to schedule than to any significant delay). The average speed is 18 km/h, which includes/accounts for the dwell time at stops. The total number of TTC buses in 2031 increases to 1,179-1,180 vehicles over the three-hour period, which is consistent with the assumption of an annual growth rate of 2% per year. The 2% growth per year is applied to all existing TTC routes, implemented in the models as a reduction in headway (and thus an increase in service frequency). No new routes are added. The average speed drops to 13 km/h for the 2031 Do-nothing and Scenario 1 and to 14 km/h in Scenarios 2 and 3.

Table 3-23: *Network performance/statistics for TTC buses – AM peak period*

	2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
At end of 3 hours					
Wanted to enter the network (total demand)	901	1,179	1,179	1,180	1,179
In the network	22	30	30	29	31
Waiting to enter the network	6	0	0	0	0
Exited the network	873	1,149	1,149	1,151	1,149
% of demand exiting	97%	97%	97%	98%	97%
Over the 3 hours					
Average number of vehicles sitting in a queue	11	24	24	24	23
Total veh-hrs travelled*	66	118	118	118	116
Average speed (km/h)	18	13	13	14	14
Average delay (sec/km)	109	175	174	166	162
Average density (veh/lane-km)	0	0	0	0	0
Average virtual queue (veh)	0	1	1	1	0
** Total veh-hrs travelled does not include time spent in the virtual queue*					

Table 3-24 summarizes the simulated AM peak hour delay and the corresponding level-of-service of TTC buses around the Finch terminal and the Sheppard-Yonge station.

Table 3-24: *TTC bus level-of-service for relevant approaches at TTC access points*

		2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
Yonge St at Bishop Ave/Hendon Ave (signalized)						
SBL	Delay (sec)	36	47	56	49	49
	Level-of-service (LOS)	**D**	**D**	**E**	**D**	**D**
WBR	Delay (sec)	22	37	31	28	46
	Level-of-service (LOS)	**C**	**D**	**D**	**C**	**D**
TTC access south side of Bishop Ave (unsignalized)						
NBL	Delay (sec)	142	137	59	49	56
	Level-of-service (LOS)	**F**	**F**	**F**	**E**	**F**
EBR	Delay (sec)	6	7	6	6	6
	Level-of-service (LOS)	**A**	**A**	**A**	**A**	**A**
TTC access on Pemberton Avenue (unsignalized)						
WBR	Delay (sec)	25	25	39	29	28
	Level-of-service (LOS)	**C**	**C**	**D**	**C**	**C**
TTC access north side of Finch Avenue (signalized)						
EBL (Unsignalized)	Delay (sec)	28	56	54	50	46
	Level-of-service (LOS)	**D**	**F**	**F**	**E**	**E**
WBR	Delay (sec)	13	35	42	36	33
	Level-of-service (LOS)	**B**	**C**	**D**	**D**	**C**
SBL	Delay (sec)	47	42	44	44	43
	Level-of-service (LOS)	**D**	**D**	**D**	**D**	**D**
SBR	Delay (sec)	26	82	64	63	61
	Level-of-service (LOS)	**C**	**F**	**E**	**E**	**E**
TTC access north side of Sheppard Avenue (unsignalized)						
EBL	Delay (sec)	9	13	10	9	10
	Level-of-service (LOS)	**A**	**B**	**A**	**A**	**A**
WBR	Delay (sec)	9	9	12	13	12
	Level-of-service (LOS)	**A**	**A**	**B**	**B**	**B**
SBL	Delay (sec)	20	34	22	25	25
	Level-of-service (LOS)	**C**	**D**	**C**	**D**	**D**

		2016 Simulated	2031 Do-nothing	2031 Scenario 1	2031 Scenario 2	2031 Scenario 3
SBR	Delay (sec)	16	21	19	18	21
	Level-of-service (LOS)	**C**	**C**	**C**	**C**	**C**

The simulated travel times and delays are summarized for TTC buses serving Yonge Street in Table 3-25. The delay time includes control delay and queue delay. The travel time includes the delay time, running time, and any dwell time at stops. Delay times are broken out in Table 3-26.

Data is only summarized north of Bishop Avenue/Hendon Avenue as only one bus route runs south of Finch Avenue with a frequency of two buses per hour. There is an overall increase in travel time and delay across all 2031 scenarios when compared to existing 2016 conditions. The increases are expected given the growth in transit services along the Yonge corridor and an increase in GO Transit dwell time at stops. Scenario 3 has the shortest transit travel time and transit delay in the southbound direction and has similar performance in the northbound direction as Scenario 2. Transit performance in Scenario 1 is similar to the Do-nothing scenario.

Table 3-25: *Travel time for TTC buses on Yonge Street between Bishop Avenue/Hendon Avenue and Steeles Avenue – AM peak hour*

Simulated travel times (min) for TTC buses										
	2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Section	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
Bishop Ave/Hendon Ave to Finch GO Terminal	0.3	0.8	0.4	0.8	0.4	0.9	0.4	0.8	0.4	0.8
Finch GO Terminal to Turnberry Ct	0.6	0.3	0.5	0.4	0.5	0.4	0.6	0.4	0.5	0.4
Turnberry Ct to Drewry Ave/Cummer Ave	1.2	0.8	1.5	1.0	1.4	1.0	1.3	1.1	1.3	1.1
Drewry Ave/Cummer Ave to Patricia Ave	0.8	1.8	0.9	2.7	0.9	2.9	0.8	2.9	0.9	2.4
Patricia Ave to Moore Park Ave/Madawaska Ave	0.9	0.8	1.0	0.9	1.0	0.9	1.0	0.9	1.0	0.9
Moore Park Ave/Madawaska Ave to Athabaska Ave	0.6	0.8	0.7	0.9	0.6	0.9	0.6	0.9	0.6	0.9
Athabaska Ave to Steeles Ave	2.4	1.3	3.5	1.4	3.5	1.4	3.0	1.4	3.2	1.4
Total travel time (min)	**6.8**	**6.6**	**8.5**	**8.1**	**8.3**	**8.4**	**7.8**	**8.1**	**7.9**	**7.7**
Difference			1.7 (+25%)	1.5 (+23%)	1.5 (+22%)	1.8 (+27%)	1.0 (+15%)	1.5 (+23%)	1.1 (+16%)	1.1 (+17%)
Average speed (km/hr)	16.2	16.7	12.9	13.6	13.3	13.1	14.1	13.6	13.9	14.3

Table 3-26: *Delay time for TTC buses on Yonge Street between Bishop Avenue/Hendon Avenue and Steeles Avenue – AM peak hour*

Simulated delay times (min) for TTC buses										
	2016 Simulated		2031 Do-nothing		2031 Scenario 1		2031 Scenario 2		2031 Scenario 3	
Section	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
Bishop Ave/Hendon Ave to Finch GO Terminal	0.1	0.7	0.1	0.7	0.1	0.8	0.1	0.7	0.1	0.7
Finch GO Terminal to Turnberry Ct	0.3	0.0	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.1
Turnberry Ct to Drewry Ave/Cummer Ave	0.4	0.4	0.6	0.6	0.5	0.7	0.5	0.7	0.5	0.8
Drewry Ave/Cummer Ave to Patricia Ave	0.2	0.7	0.3	1.6	0.2	1.8	0.2	1.8	0.2	1.3
Patricia Ave to Moore Park Ave/Madawaska Ave	0.2	0.3	0.3	0.4	0.3	0.3	0.3	0.4	0.3	0.4
Moore Park Ave/Madawaska Ave to Athabaska Ave	0.3	0.3	0.3	0.4	0.2	0.4	0.2	0.4	0.3	0.4
Athabaska Ave to Steeles Ave	1.6	0.4	2.6	0.4	2.6	0.4	2.1	0.4	2.3	0.4
Total delay time (min)	**3.1**	**2.4**	**4.5**	**3.9**	**4.3**	**4.1**	**3.8**	**4.0**	**4.0**	**3.5**
Difference			1.4 (+45%)	1.5 (+63%)	1.2 (+39%)	1.7 (+71%)	0.7 (+23%)	1.6 (+67%)	0.9 (+29%)	1.1 (+46%)

4. Opportunities for network fine-tuning

Table 4-1 summarizes locations in the study area that may benefit from local or network improvements to address operational issues that were observed during the traffic simulation evaluation. This table identifies such issues, and summarizes potential contributing factors. The table also identifies some potential solutions and related considerations.

Table 4-1: Intersection performance issues and potential improvements – based on Transform Yonge scenarios – AM evaluation

Issue	Related issues	Potential contributing factors	Potential solutions	Practical considerations
Yonge St at Sheppard Ave **- LOS F for NBR**	- through movement partially impeded as right-turn vehicles unable to access right-turn lane - queue spill back beyond upstream intersection (Poyntz Ave)	- GO buses serving near-side stop on the curb/right-turn lane, these buses also have to wait for a gap to merge back to the through lanes	- provide bus bay at the south approach that is long enough to accommodate at least two buses - consider far side stop	- buses will need to cross the bike lane and right-turn lane to continue northbound, which may not be feasible
Yonge St at Elmhurst Ave/Greenfield Ave **- LOS F for WBL, NBL**	- queue spill back onto through lane - northbound through movement impeded at Yonge/Sheppard intersection	- removal of northbound left turn at Sheppard shifted vehicles to use left turn at the next downstream intersection - westbound delay likely associated with missed turns for the northbound left-turn movement due to insufficient capacity	- provide advanced northbound left-turn phase (currently operating with permissive control only) - extend left-turn storage lane length	- the southbound through/right-turn movements are currently operating at LOS B/C which could accommodate the signal timing adjustments proposed
Yonge St at Finch Ave **- LOS E for WB approach**	- queue extends beyond the Finch/Doris intersection - right-turn movement for buses impeded at the TTC access on the north side of Finch Ave	- insufficient E-W green time under 2031 demand - high pedestrian traffic and no right-turn lane	- provide additional green time for the E-W movement - provide westbound right-turn lane	- the N-S through and right-turn movements currently operate at LOS C, however, the NBL and SBL movements operate at LOS F and any improvement to E-W operation could introduce additional delay
Yonge St at Hendon Ave/Bishop Ave **- LOS E/F for EB and WB approaches**	- egress for TTC and GO buses to Bishop Avenue impeded due to queuing	- insufficient E-W capacity at the intersection	- provide advanced eastbound and westbound left-turn phases - provide left-turn lane for the westbound approach and right-turn lane for the eastbound approach - potential widening of Drewry Ave and Hendon Ave to four-lane cross-section	
Yonge St at Drewry Ave/Cummer Ave **- LOS E/F for EB, WB, and SB approaches**	- eastbound queue backs up to the Beecroft Road intersection in Scenarios 2 and 3 - southbound through movement partially impeded by right-turn vehicles	- high southbound right-turn delay due to buses serving near-side stop - insufficient E-W capacity	- provide advanced green phase for eastbound left-turn - provide eastbound and westbound right-turn lanes - extend eastbound and westbound left-turn storage lengths - potential widening of Drewry Ave to four-lane cross-section	- available green time for the N-S phases is restricted by E-W pedestrian movement, currently the split is 70 s for N-S and 50 s for E-W for a 120 s cycle length
Doris Ave at Sheppard Ave **- LOS F for EBL, WBR**		- high turning demands - impedance by pedestrians	- convert westbound shared through/right-turn lane to a right-turn only lane - provide additional green time to the eastbound advanced left-turn phase	- there is little room to reduce the N-S split as the northbound and southbound movements are operating at LOS D overall and LOS E for the left turns

Issue	Related issues	Potential contributing factors	Potential solutions	Practical considerations
Doris Ave at Greenfield Ave **- LOS E for SB approach**	- blocks EB traffic from Spring Garden Ave	- through movement impeded by left-turn and right-turn vehicles in shared lanes	- add left-turn lanes for both northbound and southbound approach with advanced green phase - provide southbound right-turn lane	- protected southbound left-turn not feasible without left-turn lanes in both northbound and southbound directions as currently the northbound approach has an advanced green phase with shared through and turning lanes. Northbound movements should not be impeded with improvements to the southbound direction because the south approach is reduced to one lane with on-street parking after 9AM
Doris Ave at Empress Ave **- LOS F for WB approach** **- LOS F for SBL, SBR**		- insufficient westbound capacity (a single lane serving all movements) - short N-S split (31 s)	- add westbound left-turn lane - increase cycle time and allocate more green time to both E-W and N-S directions - provide advanced left-turn phase in the southbound direction	
(Scenario 2 only) **Beecroft Rd at Hendon Ave** **- LOS F for EB approach, LOS E for WB approach**		- two-way stop-control on Hendon Ave	- add traffic signal at this intersection	- the N-S movements operate at LOS A due to free flow conditions - the volume between the crossing roads are not significantly different (Beecroft Ave ~ 400-500 vehicles during AM peak hour, Hendon Ave ~ 250-350 vehicles) - improving this E-W movement for this intersection will likely negatively impact the intersection at Yonge/Bishop/Hendon, which is already expected to operate with high delays
Yonge St at Steeles Ave **- LOS F for overall intersection**	- under the signal timing tested, left turns at all approaches are expected to operate with high delays - the channelized eastbound right-turn movement is also constrained due to high pedestrian activities - through movements are partially impeded			- operational issues at this intersection have previously been identified in the Yonge Transitway EA
Note: Issues in the vicinity of the Bayview interchange (Bayview Ave, Bayview/Sheppard intersection) have been noted both here and in other studies. Some potential improvements have been identified at the interchange itself and are being considered by MTO but improvement in traffic level-of-service on Bayview is constrained by the Sheppard/Bayview intersection where pedestrian volumes/crossing times and single left-turn lanes are key constraints.				

5. Assessment of transit mitigation measures

Following the calibration of the model and projection of future a.m. peak hour conditions, the primary study area has been assessed from a transit operations perspective, to establish potential transit mitigation measures. As per prior agreements with the City, transit impacts associated with parallel corridors of Bayview Avenue and Bathurst Street have been evaluated under separate cover using Synchro. It should be noted this assessment is focused on TTC buses within the primary study area. It should also be noted that the weekday AM peak hour has been modelled for the purpose of this evaluation memo because the AM peak was identified to be the busier than the weekday PM peak. This approach was agreed upon with the City of Toronto staff.

5.1 Opportunities for transit improvements

Comparing the AM peak hour transit operations between the 2016, the 2031 Do-nothing, and the 2031 Preferred Scenario (Transform Yonge Scenario 2 – through street on Hendon Ave) models, the following locations are expected to experience higher transit delay, due to growth and/or implementation of Transform Yonge. The incremental increase in delays are documented in Table 5-1.

- SBL movement at Yonge St/Bishop Ave (increased delay of 10 to 16 sec/TTC bus);
- EBL, WBR and SBR movements at the signalized TTC access on the north side of Finch Ave (increased delay ranging from 13 to 40 sec/TTC bus); and
- Travel time increase for TTC buses along Yonge Street (increased delay of up to 76 sec/TTC bus northbound and 92 sec/TTC bus southbound between Steeles Ave and Bishop Ave).

The following transit mitigation measures have been tested in Aimsun under the preferred 2031 scenario. The mitigation measures are strategically grouped and tested in different simulation runs, to distinguish the impact/effectiveness of different mitigation measures.

- ***Transit Mitigation Run 1***
    - Signal optimization along Yonge Street to improve operation. This include minor adjustments to signal timings at Cummer Ave/Drewry Ave, Turnberry Ct, Northtown Ave/Horsham Ave, Ellerslie Ave, and Greenfield Ave while respecting minimum pedestrian timings for the east-west phases;
    - Optimization along Yonge Street was applied primarily north of Finch Avenue, where there is more flexibility to work with. Most of the sidestreet approaches at intersections south of Finch are already receiving ped minimums.
    - Signal optimization at the intersection of Yonge St/Finch Ave to allocate more green time to the east-west movements on Finch Ave. This is expected to alleviate westbound congestion on Finch Ave, which will improve transit operations at the signalized TTC access on the north side Finch Ave.
- ***Transit Mitigation Run 2***
    - Convert the existing southbound (SB) HOV lane at Yonge St/Bishop Ave to a dedicated transit lane, which facilitates a transit-only SB left turn phase onto Bishop Avenue.

Figure 5-1 illustrates this concept implemented at Don Mills Subway Station. TTC has cited difficulty in accessing the existing southbound left-turn lane having to change lanes from the curb HOV lane; this proposal would address this concern. Figure 5-2 illustrates this concept at the Yonge St/Bishop Ave intersection; and

- Introduce a northbound far-side bus bay at Yonge St/Sheppard Ave to improve intersection operations and northbound travel times on Yonge St. The far-side bus bay would be long enough for 2 buses and shared with the GO bays, which is reasonable given the frequency of the TTC buses in this section of Yonge St.

Figure 5-1: Example of bus-only left turn lane at Don Mills Subway Station

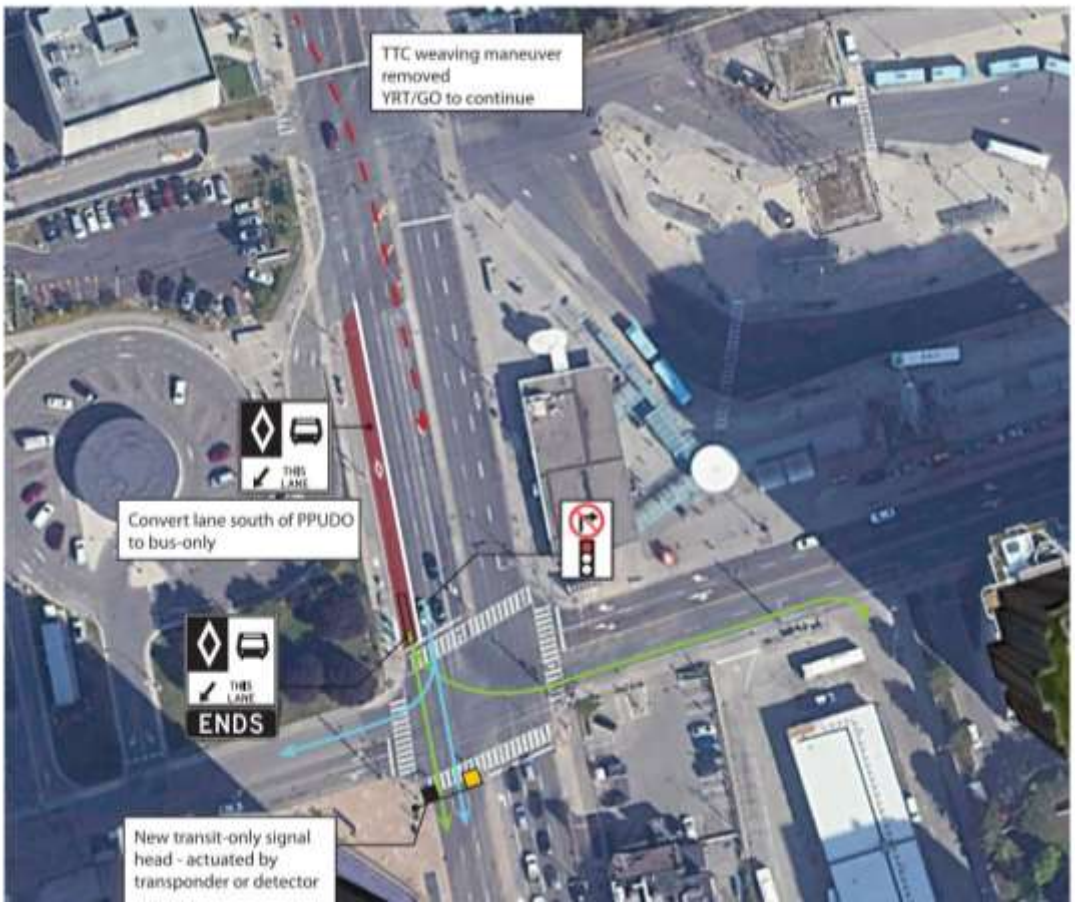


Figure 5-2: Potential exclusive southbound bus lane on Yonge Street at Bishop

- ***Transit Mitigation Run 3***
    - Extend transit-priority signal for SBL at Yonge/Bishop from the existing 22s to 30s, in an attempt to reduce SBL delay.
- ***Transit Mitigation Run 4***
    - In the northbound direction, introduce a new transit-only lane north of the Pemberton TTC access. Buses need to use the middle lane to turn right out of the access. This is the arrangement featured in the latest roll plan.
    - The proposed configuration at the Pemberton TTC access allows the southbound left-turn movement, which helps in terms of alleviating the demand of the southbound left-turn at Yonge/Bishop. In earlier versions of the transform Yonge concept, a continuous median was contemplated instead. For the purpose of this assessment, approximately 20% of the buses that would have made a southbound left-turn at Yonge/Bishop were reassigned to turn at the Pemberton access. This is based on the proportion of bus of bays at the terminal that would be logically accessed via the Pemberton access without having to loop around the terminal. Figure 5-3 shows the configuration in this run.

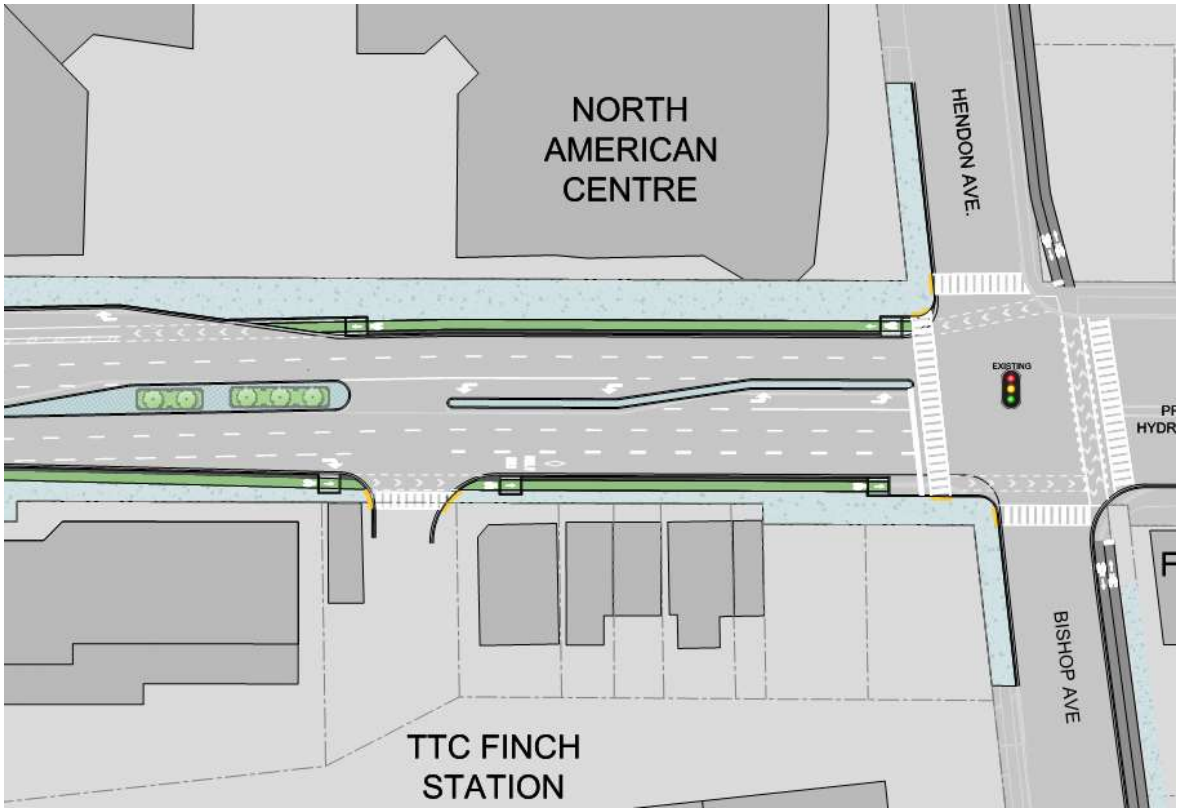


Figure 5-3: Transit-only northbound lane north of Pemberton Ave TTC access

It should be noted that the concept of maintaining a third southbound through lane between Hendon Avenue and Finch Avenue was considered, but rejected. This was because a review of the available right-of-way indicated that this would be incompatible with the provision of a southbound cycle track in this block, which was one of the prime objectives for the Transform Yonge alternatives.

Recognizing the timing of delivering this memo, a single replication was simulated and the same random seed is used. The results for the single replication are summarized in the tables below and compared. The results for the 2016, 2031 Do-nothing, and 2031 Scenario 2 (base) may be different from those presented in previous documents, as previously the average of five replications was reported. It should be noted that some differences between test runs are due to the inherent stochasticity in a simulation model.

5.2 Results

Table 5-1 summarizes the simulated delay and LOS for transit-related movements at the TTC access points. Note that many of the transit-related movements have improved operations in the base Scenario 2, relative to the Do-nothing.

In **Transit Mitigation Run 1**, the signal optimization at Yonge St/Finch Ave, which allows more green time to the east-west movements, reduces the WBR delay at the signalized TTC access on the north side

of Finch Ave by 9 seconds and the SBR delay by 6 seconds. There is however, an increase in delay for the EBL buses going into the station by 5 seconds.

In **Transit Mitigation Run 2**, the exclusive southbound transit lane at Yonge Street/Bishop Avenue introduces higher delay to the buses (and to the intersection overall). Under the existing transit signal priority scheme, SBL buses are in mixed traffic and have up to 22 seconds of protected green phase. They may also proceed on the permissive phase when there are gaps in the opposing flow. Under the exclusive transit phase arrangement, buses are only allowed to proceed on the protected phase and may have to wait an entire cycle if they arrive at the intersection on a red. In addition, the NBL at the TTC access on the south side of Bishop Avenue is also adversely impacted by the introduction of the transit lane/phase at Yonge St/Bishop St as a result of deteriorated operations along Bishop St. Therefore, this option is not preferred in terms of traffic operations. There are also other challenges associated with the implementation of this option. For example, in the Don Mills Station example, there are physical separations between the transit lane and the adjacent general traffic lane. Given the context of Yonge Street, it would be difficult to implement a physical separation, and completely mitigate general traffic using the transit lane for southbound right turns at the intersection. Moving the GO and TTC stops to the north side of the Yonge/Sheppard intersection would improve traffic operations.

The transit signal priority phase extension in **Transit Mitigation Run 3** does not result in a reduction to the SBL delay relative to the base preferred scenario; this is somewhat expected as the TSP phase will only reach maximum green in a few cycles. Buses arriving during other phases of the cycle will still incur the same delay as in the base scenario.

In **Transit Mitigation Run 4**, the new configuration at the Pemberton TTC access reduces the WBR delay by 5 seconds relative the base. The SBL is expected to operate with an average delay of 13 seconds per vehicle, which is an acceptable LOS B. The SBL delay at Yonge St/Bishop Ave also reduces by 7 seconds relative to the base. However, the WBR at Yonge St/Bishop Ave and the NBL at the TTC access on the south side of Bishop Ave are expected to experience increased delays of 11 seconds and 18 seconds, respectively, due to the addition of a northbound lane at Yonge St/Bishop Ave, which results in longer pedestrian crossing time and increase in the westbound delay.

We have also tested a signal at the TTC access on the south side of Bishop Ave, with a similar controller logic as the existing signalized access on the north side of Finch Ave. However, there is only a short distance between the intersection of Yonge St/Bishop Ave and the access (less than 30m), which makes it difficult to coordinate between the signals. In comparison, the signalized TTC access onto Finch has more intersection spacing of approximately 50m. Due to the short storage available between Yonge and the Bishop TTC driveway, there is a high potential for queue backup that would impact operations at Yonge St/Bishop Ave. Therefore, we did not move forward with the analysis for this option.

Table 5-1: TTC bus level-of-service for relevant approaches at TTC access points

		2016 Simulated	2031 Do-nothing	2031 Transform Yonge Scenario 2				
				Base	Transit mitigation 1	Transit mitigation 2	Transit mitigation 3	Transit mitigation 4
Yonge St at Bishop Ave/Hendon Ave (signalized)								
SBL	Delay (sec)	31	41	57	54	64	54	50
	Level-of-service (LOS)	**C**	**D**	**E**	**D**	**E**	**D**	**D**
WBR	Delay (sec)	51	46	31	23	63	26	42
	Level-of-service (LOS)	**D**	**D**	**C**	**C**	**E**	**C**	**D**
TTC access south side of Bishop Ave (unsignalized)								
NBL	Delay (sec)	117	79	38	43	72	38	56
	Level-of-service (LOS)	**F**	**F**	**E**	**E**	**F**	**E**	**F**
EBR	Delay (sec)	6	6	6	6	7	6	6
	Level-of-service (LOS)	**A**	**A**	**A**	**A**	**A**	**A**	**A**
TTC access on Pemberton Avenue (unsignalized)								
WBR	Delay (sec)	26	29	25	29	27	26	20
	Level-of-service (LOS)	**C**	**C**	**C**	**C**	**C**	**C**	**B**
SBL	Delay (sec)	No transit line access the Finch Station via SBL onto Pemberton						13
	Level-of-service (LOS)							**B**
TTC access north side of Finch Avenue (signalized)								
EBL (Unsignalized)	Delay (sec)	34	70	47	52	52	45	56
	Level-of-service (LOS)	**C**	**F**	**E**	**F**	**F**	**E**	**F**
WBR	Delay (sec)	13	36	31	22	25	35	34
	Level-of-service (LOS)	**B**	**D**	**C**	**C**	**C**	**C**	**C**
SBL	Delay (sec)	49	43	43	46	46	45	42
	Level-of-service (LOS)	**D**	**D**	**D**	**D**	**D**	**D**	**D**
SBR	Delay (sec)	25	65	55	49	58	56	55
	Level-of-service (LOS)	**C**	**E**	**E**	**D**	**E**	**E**	**E**
TTC access north side of Sheppard Avenue (unsignalized)								
EBL	Delay (sec)	11	8	12	10	8	9	12
	Level-of-service (LOS)	**B**	**A**	**B**	**B**	**A**	**A**	**B**
WBR	Delay (sec)	9	8	13	8	9	9	14
	Level-of-service (LOS)	**A**	**A**	**B**	**A**	**A**	**A**	**B**
SBL	Delay (sec)	20	34	18	22	29	30	24
	Level-of-service (LOS)	**C**	**D**	**C**	**C**	**D**	**D**	**C**
SBR	Delay (sec)	17	22	15	19	27	24	24
	Level-of-service (LOS)	**C**	**C**	**C**	**C**	**C**	**C**	**C**

Table 5-2 summarizes the simulated delay experienced by TTC buses as they travel along Yonge St. Comparing the results between the **Transit Mitigation Run 1** scenario and the base Transform Yonge scenario, southbound buses between Steeles Ave and Bishop Ave/Hendon Ave benefit from the signal optimization. Insignificant change is observed in the northbound direction, which may be because the peak flow along Yonge St is southbound during the AM peak.

Along Yonge St between Finch Ave and Sheppard Ave, the signal optimization results in an increase in delay time. ***However, due to the lower frequency of TTC buses travelling through this section of Yonge St. and the fact that only one replication was tested, we expect a higher variability in the results*** depending on whether a bus happen to be caught behind a GO bus, or whether it arrives at any particular intersection during the green or red phase. ***Five replications will be run and the average results will be summarized for the scenario with the recommended package of transit mitigation measures.*** Additionally, alleviating bottleneck at one intersection could adversely impact the traffic operation of downstream intersections. Therefore, the travel time benefits are not always obvious. Most of the east-west movements at intersections within the focus area are already serving the minimum pedestrian phases, which means only minor adjustments could be made.

For the far side stop in **Transit Mitigation Run 2**, there is an evident improvement in transit operation with a reduction in delay of 74 seconds northbound between Hwy 401 and Sheppard Ave. Other sections in the northbound direction experience slightly higher delays, potentially due to the shifting of traffic and bottleneck discussed above.

Transit Mitigation Runs 3 and 4 only have local improvements that are not expected to impact the overall travel time along Yonge Street. There are differences in delay relative to the base scenario, but they would mostly be due to stochasticity. The comparison is therefore not meaningful. To avoid confusion, they are excluded from the table below.

Table 5-2: Simulated TTC bus volume and delay along Yonge Street

	Simulated number of buses		Simulated delay along Yonge Street (s/veh) – TTC buses				
	2016	2031	2016 Simulated	2031 Do-nothing	2031 Transform Yonge Scenario 2		
					Base	Transit mitigation 1	Transit mitigation 2
Yonge St Northbound							
Hwy 401 NRT to Sheppard	2	3	95	361	231	254	157
Sheppard to Park Home/Empress	2	3	89	99	96	123	170
Park Home/Empress to Finch	2	3	43	48	83	95	140
Pemberton Access to Bishop/Hendon	53	69	21	35	28	33	41
Bishop/Hendon to Drewry/Cummer	64	84	66	78	57	58	64
Drewry/Cummer to Steeles	46	56	157	221	164	166	175
Yonge St Southbound							
Steeles to Drewry/Cummer	44	62	108	165	157	140	135
Drewry/Cummer to Bishop/Hendon	53	70	63	82	106	85	105
Bishop/Hendon to Finch	2	2	118	34	8	6	4

	Simulated number of buses		Simulated delay along Yonge Street (s/veh) – TTC buses				
	2016	2031	2016 Simulated	2031 Do-nothing	2031 Transform Yonge Scenario 2		
					Base	Transit mitigation 1	Transit mitigation 2
Finch to Park Home/Empress	2	2	63	71	62	105	128
Park Home/Empress to Sheppard	2	2	57	157	96	121	96
Sheppard to Hwy 401 NRT	2	2	59	78	145	134	96

Table 5-3 summarizes the network statistics for the TTC buses. All of the transit mitigation runs are performing similar to the base Transform Yonge Scenario.

Table 5-3: Network statistics for TTC buses

	2016 Simulated	2031 Do-nothing	2031 Transform Yonge Scenario 2				
			Base	Transit mitigation 1	Transit mitigation 2	Transit mitigation 3	Transit mitigation 4
At end of 3 hours							
Wanted to enter the network (total demand)	902	1182	1181	1179	1177	1182	1181
In the network	22	28	31	28	31	34	33
Waiting to enter the network	6	0	0	0	0	0	0
Exited the network	874	1154	1150	1151	1146	1148	1148
% of demand exiting	97%	98%	97%	98%	97%	97%	97%
Over the 3 hours							
Average number of vehicles sitting in a queue	11	24	23	22	24	23	23
Total veh-hrs travelled*	67	120	115	113	117	114	115
Average speed (km/h)	17	13	14	15	14	14	14
Average delay (sec/km)	111	180	161	148	158	157	163
Average virtual queue (veh)	16	15	18	13	11	11	18
** Total veh-hrs travelled does not include time spent in the virtual queue*							

5.3 Recommended transit mitigation measures

Based on the initial test runs, the following transit mitigation measures have the potential to improve TTC operations and we recommend implementing in the transit mitigation scenario for the preferred scenario (Transform Yonge Scenario 2):

1. Signal optimization on Yonge Street between Steeles Avenue and Finch Avenue; and
2. Northbound far-side bus bay at Yonge Street and Sheppard Avenue for TTC and GO Transit.

Improved configuration at the Pemberton TTC access to allow left-in is understood to be not feasible, based on TTC input.

A southbound third lane from Hendon to Finch was also rejected based on incompatibility with the goal of providing a southbound cycle track.

In addition, as part of the transit mitigation scenario, the signal timing/TSP scheme at the intersection of Yonge Street and Bishop Avenue will be revised to better reflect actual operation:

- A 4-second “stretch time” will be provided for buses after they pass the cancel loop.
- Mixed traffic will be able to call and extend the SBLA phase up to the maximum of 22 seconds, as long as there is demand on the setback loop.

APPENDIX

The following are mitigation measures that were considered:

		Potential transit mitigation measure	Feasibility
1	Pemberton TTC Access (Unsignalized)	WBR buses to use curb lane only when exiting.	Based on the auto-turn results, it is possible for exiting buses to occupying a single lane only. This will be implemented in the model moving forward.
		Half signal which is connected to the Yonge/Finch intersection.	
2	Yonge/Bishop and TTC access on south side of Bishop Avenue (unsignalized)	Double southbound left-turn lanes at Yonge/Bishop.	The SBL movement during the peak hour is about 230 vehicles, which is not enough to warrant double left-turn or protected left-turn phase. This would impact the through lane alignment southbound.
		Exclusive SB transit lane and signal	Investigated
		Traffic signal at the TTC access on south side of Bishop	Investigated A short spacing between signals might be challenging.
3	Yonge St at Finch Ave & signalized TTC entrance on the north side of Finch Ave	Signal optimization to allocate more green time to E-W movement, improve coordination between the 2 intersections.	Investigated
		Extend transit-only lane west to the Yonge/Finch intersection and designate as shared queue jump lane for buses and right-turn lane.	Property impact of widening the approach. Given the high number of right-turn vehicles (122 simulated vehicles during the AM peak hour), buses may not benefit from using this lane.
4	Yonge St at Sheppard Ave	Convert NB near-side bus stop to far-side bus bay	Investigated - There is enough space to accommodate the bus bay. The bus bay will reduce northbound congestion, especially for the NBR movement at Yonge and Sheppard.
		Re-route GO bus stop to side street	Traffic infiltration on local street undesirable. Introduce delay for GO buses due to detouring.