

The 401RT: Rescuing Highway 401 and Decongesting Transportation in The Greater Toronto Area

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The absence of an east-west inter-municipal rapid transit line through the suburban middle of northern Toronto is the most significant single factor in preventing major modal shifts to public transit.

A review of MTO’s AADT on-ramp and commercial vehicle survey files (2013 adjusted to 2019) indicates that on a typical weekday there were 1.8 million vehicles on Highway 401 between Hurontario Street in Mississauga and Liverpool Road in Pickering. Of these, approximately 1.5 million were non-commercial automobiles, carrying 1.7 million persons.

Traffic volumes on Highway 401 will increase as close to four million people will live and work in Toronto by 2051. Approximately 1.7 million of them will live in the northern half of Toronto, reduced somewhat by post-pandemic work-at-home situations. Population growth in the municipalities around Toronto will add to cross-boundary traffic pressures. Highway 401 in the core of the Greater Toronto Area will not be able to accommodate travel demand growth much beyond 2030, as segments of the highway in Toronto cannot be widened further.

Traffic on the highway is highly leveraged toward congestion, and is a scenario that must be avoided. Reducing the overall number of motor vehicles (be they powered by gasoline, electricity or hydrogen) is also a necessary part of efforts to reduce the brutal effects of rapid climate change. Unfortunately, current rapid transit expansions approved by the government of Ontario will not have a significant effect on the number of trips taken by automobiles on Highway 401.

Getting across the Greater Toronto Area from Scarborough to Pearson Airport, or from Hurontario Street in Mississauga to any point in North York, or to thousands of other destinations in suburban Toronto, Mississauga and Pickering normally means driving a car. Most residents of northern Toronto who travel to and from downtown Toronto will not ride a bus from Etobicoke or Scarborough to the Yonge Street or University/Spadina/York subway – it’s simply too slow. The result is congestion on Highways 401, 427, 409, the 404/Don Valley Parkway, and on city streets.

The Greater Toronto Airports Authority (GTAA) has been concerned that more than 90% of all trips to Pearson International Airport are by automobile; this ratio holds true for its surrounding employment area. Forecasted growth in air travel will strain the GTAA’s ability to provide access

and car parking, and daily trips by more than 300,000 workers and visitors to the overall employment area contribute to clogged roads on Highway 401 and city streets. Because of the threats posed by growth-related congestion in the airport area, the GTAA is pursuing the creation of a transit hub on its property at Airport Road. Its intention is to provide linkages among various current and planned bus and rail-based transit services. Unfortunately, it will not have an adequate effect on travel modes.

Existing rapid transit services in Toronto are not practical for travelers who have some or all of their daily trips in parts of the northern half of Toronto. GO Rail provides a radial service to and from the downtown core that is used by just 1% of Toronto residents per day. The 5-kilometre Sheppard subway is too short to have an impact on road traffic congestion. The Eglinton Crosstown LRT, soon to become operational, is too far south in Toronto to produce a significant reduction in trips by automobile to and from most northern Toronto locations, including longer distance trips. End-to-end trip times on the planned on-street 11-kilometre Finch West LRT will be too long to attract a significant number of new transit riders, although most existing TTC users of the Finch bus will be better served. Improvements to transit to and from Toronto's employment areas and in its underserved communities, particularly in northwest Toronto and eastern Scarborough, are necessary.

New rapid transit services initiated by the government of Ontario will generate enough modal shifts to transit to keep 2051 trips by automobile near 2016 volumes; however, they will not keep pace with traffic growth beyond 2051, including commercial vehicle traffic growth, nor is maintaining current levels of congestion a desirable target. (The Ontario initiatives include expansions of GO Transit, the Finch West and Eglinton Crosstown LRTs, and the \$28.5 billion plan for an Ontario Line, a Danforth subway line extended further into Scarborough, an Eglinton West LRT that will eventually connect to Pearson International Airport, an extension of the Yonge subway to Highway 7, and a Hurontario LRT.)

The Ontario government's Greater Golden Horseshoe Transportation Plan, finalized in 2022, includes a number of transit expansions in Toronto beyond currently-funded initiatives, including a short easterly extension of the Sheppard Subway, an Eglinton East LRT, a extensions of the Finch West LRT, a Jane Street LRT, LRTs along the Toronto waterfront, and a few other transit lines. A new cross-boundary rapid transit line from Pickering to Mississauga through northern Toronto has not been considered; yet it is **essential** if traffic congestion throughout Toronto is to be avoided and climate change damage is to be reduced. *Nothing else will be enough.*

Highway 401RT

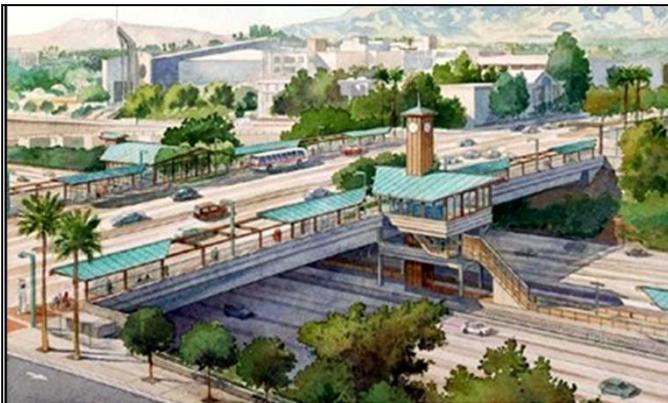
This document proposes the creation of an affordable suburb-to-suburb rapid transit line with up to 35 stations, operating from Highway 401 at Hurontario Street in Mississauga to Pickering Town Centre, aligned mostly within the Highway 401 right-of-way. The need for this "401RT" is urgent. Because of long implementation timelines, planning for its construction should begin now, and be fully completed within 15 years. This document will show that a 401RT is affordable, and highly practical for travelers.

It is estimated that the 401RT, plus the addition of many more buses for intersecting bus services, will generate approximately 174 million *new* transit trips per year by 2051, and more in subsequent

years as the region's population continues to grow. Another 12 million or more boardings per year will come from transfers from existing parallel bus routes. The 401RT would be able to link travelers to nine intersecting north-south rapid transit lines and at least 50 surface bus routes.

The 401RT can be mostly at-grade in the highway corridor or, preferably, be elevated above the highway. Diversions to major off-highway destinations would be either underground or elevated. Off-highway destinations include Pearson International Airport, the Mississauga Airport Corporate Centre (MACC), Yorkdale Shopping Centre, Scarborough City Centre and Pickering Town Centre, plus other destinations as may be decided. Off-highway diversions also include the Sheppard Subway, which would become an integral segment of the 401RT. Off-highway diversions may also include other locations in Mississauga (described below).

A Mostly-At-Grade 401RT: A mostly-at-grade 401RT would require a barrier-separated conversion to transit of the leftmost express lane in each direction on Highway 401, plus absorb shoulder lanes



Pasadena California's Gold Mile concept is illustrated. Highway 401 is wider, and 401RT stations would be fully enclosed.

for platforms at stations. The rail right-of-way would have to use of medium-capacity rail cars that do not require the transit right-of-way to be wider than the standard width of a Highway 401 lane.

Westward of the 401-Islington station, the 401RT would run below grade until it can be routed above, on or adjacent to the Kitchener GO Line tracks to the new Woodbine GO station, and may run below grade at Airport Road. In Toronto, the 401RT would serve northwest Etobicoke and eastern

Scarborough directly, connecting residents to opportunities across all of Toronto. **An illustrative map of the 401RT concept is shown on the last page of this document.**

401RT stations at grade in the highway corridor would use a single centre platform, accessed by station entrances above the highway where intersecting roads run above the highway, and below the highway where arterial roads run below the highway. Platforms would be between 20 and 25 feet wide and only one station (at Keele Street) would require movement of pillars that support overhead roadways. In a few locations, at-grade dividers between express and collector lanes may need to be re-aligned.

An Elevated 401RT: The alternative to a mostly-at-grade 401RT is one that is elevated above the highway for almost all of its length, excluding the existing five-kilometre Sheppard Subway, with which it is integrated. An elevated 401RT avoids the conversion to transit of an express highway lane in each direction. For some segments, the track structure would need to be high enough above ground to cross over intersecting arterial road bridges. Tunneling may be limited to 7 kilometres – at Yorkdale subway station, connections to and from the Yonge-Sheppard Subway station, and at Pearson International Airport. The 401RT would be 63 kilometres in length, including the Sheppard Subway and the option to extend to Mississauga's City Centre area.

The elevated option would enable full-sized rail cars to be used, enabling more travelers to be carried for more years into the future, and have wider station platforms. Stations in the highway

corridor would be elevated, with their entrances either above the intersecting arterial roadway or designed to enable entrances at the edge of the highway. An elevated 401RT would also enable multi-track maintenance yards to be built over the highway at several points, rather than tunneling to off-highway sites. Property acquisition costs would be almost entirely avoided.

Because the overall number of new and transfer trips on the 401RT would continue to increase, plus its integration with the Sheppard subway, and because longer average trip lengths mean higher occupancy rates on trains, subway rather than light rail technology is the preferred mode for the mostly-elevated 401RT option.

An alternative 401RT alignment may be to bypass the Sheppard subway entirely, and to continue the 401RT on or above the surface in the highway corridor between Avenue Road and Victoria Park Avenue, with additional stations at Yonge, Bayview, Leslie, and Don Mills. This alignment may cost \$1.1 billion more than tunneling to/from Sheppard Avenue. With this alignment, travelling on the 401RT would be somewhat faster, and be of slightly shorter distance end-to-end. In this bypass scenario, the Sheppard subway would be closed. Sheppard Avenue would be served by enhanced bus services running seamlessly from Scarborough to Etobicoke.

As an alternative to the 401RT's alignment between MACC station (Mississauga Airport Corporate Centre) and Highway 401 at Hurontario Street, the 401RT can, west of MACC station, run southwesterly towards and through Mississauga's city centre to Mavis Road. Mississauga's city centre area has become a populous area of high-density growth. This alignment may cost \$1.8 billion more to construct, mostly due to its longer length, but would likely generate significantly more new transit trips than the northwestern 401RT segment to Hurontario Street at Highway 401.

Most on-highway 401RT stations are entered from arterial roads that cross the 401 above the highway; others are entered from below, or are off-highway stations. Due to constraints of space for the mostly-at-grade 401RT, station designs are recommended to be of a simple, practical nature. For the elevated alternative, stations can be larger, and would be more complex, involving greater vertical distances for stairways, escalators, and elevators.

Passenger car drop-off and pick-up facilities can exist where space allows at Highway 401 on-ramps and off-ramps. For stations where right turn on-ramps to Highway 401 would interfere with the safe movement of buses leaving 401RT station stops, left turns onto the 401 governed by traffic signals can replace circular right-turn on-ramps to the highway; alternatively, signal lights can enable bus merges from bus bays into mixed traffic. At a few stations, multi-level pay-for-parking garages can be built with passenger drop-offs incorporated in their designs.

Importantly, the 401RT concept includes 16 additional buses for each intersecting arterial bus route to improve service frequencies, plus a transit shelter at every bus stop on these routes. Most transit trips begin with a bus ride, and ensuring maximum comfort, convenience, more express options, and shorter wait times is essential. These improvements will tend to make the first/last kilometre segments of trips acceptable to more travelers. Another new factor that will enhance the first/last mile experience is the growing use of electric scooters and e-bicycles. These enable relatively fast access to/from bus stops, especially in suburban areas, with little or no muscular effort. All bus stops and train stations should include scooter and bicycle lock-ups.

Overall, the 401RT itself will generate approximately 128 million new transit trips per year (416,000 per day) by 2051, while improved TTC bus services on north-south routes that intersect with the 401RT will attract an additional 46 million new trips per year that bypass the 401RT (see Transit Ridership Analysis section). New intersects with GO Transit will add another 16 million to GO ridership per year by 2051. Altogether, including ongoing work-from-home circumstances and other rapid transit initiatives, the number of daily trips on Toronto's roads in 2051 may be reduced by close to 19% below 2016 levels.

Altogether, the 401RT will enable the trip capacity of the highway corridor itself to be at least doubled; modal shifts to transit will reduce or end highway congestion for commercial vehicle trips (mostly trucks). The implementation of varied highway tolls for small and large vehicles, and by distance traveled, can also foster more efficiencies.

The 401RT's connections to north-south rapid transit and bus services and its ability to take travelers end-to-end from Pickering Town Centre through Toronto and into Mississauga in one hour make it a practical choice for travelers. Its visibility and speed compared to rush hour road congestion will create a general equilibrium that will see modal shifts to transit occur when the highway is congested or too frustrating to accept, and from transit to driving when the highway is seen as more desirable. Traffic will continue to flow.

Without a 401RT or similar rapid transit option, ongoing road congestion is inevitable.

The idea of widening the highway to increase its road capacity has been proposed, but property acquisition, reconstruction of intersecting bridges and adding more pavement would be extremely expensive, and is also contrary to the promotion of transit ridership and the reduction of greenhouse gas emissions. Adding highway road capacity would encourage more road traffic on city streets. Conversions of vehicles to electric power will reduce end-use GHG emissions, but GHG emissions will remain significant, from the mining and production of EVs and the fossil-fuel electric power plants that fuel EVs. While currently-approved transit system expansions and enhancements and the 401RT may seem to be ambitious, in light of the dire consequences to all life of accelerating global warming, they are far short of enough. ***The climate crisis alone is sufficient reason to create a 401RT.*** Appendix 1 highlights the dangers of worsening climate change. Appendix 3 answers a variety of questions or concerns about the 401RT.

Travel Times

The 401RT would have a substantial positive effect on travel times for transit users, when compared to existing transit services and other proposed LRT services. On average, stations on the 401RT are 1.8 kilometres apart, enabling speeds between stations to reach 80 kilometres per hour, or faster. The illustration above shows a selection of trip origins and destinations, and their trip times when using the 401RT compared to other modes.

Traveling on the 401RT:		Keele at Lawrence to Centennial College in Scarborough:		Kipling subway stn. to Bathurst at Sheppard:	
Pickering Town Centre to Yonge subway	31	Using Eglinton LRT +		Using Eglinton LRT	60
Yonge & Sheppard to Pearson Terminal	25	Markham bus	49	Using B-D & Yonge subways	58
Pearson Airport to Hurontario Street LRT	8	Using 401RT	41	Using 401RT	50
	<u>64</u>				
Average speed - 54 km per hour		York Mills subway station to U of T in Scarborough:		Yonge & Lawrence to Pearson:	
St. Andrew subway stn to Pearson Term':		Using Eglinton East LRT	59	Using Eglinton LRT	7
Using Eglinton LRT	42	York Mills bus to Morningside	46	Using 401RT	4
Using UP Express train (walk, wait, ride)	46	401RT to Morningside + shuttle	34	Eglinton/Don Mills to Pearson Term':	
Using Spadina subway & 401RT	44			Using Eglinton W LRT	37
Sewells Rd at Morningside to Sheppard W Subway stn.:		Union station to Scarborough Centre:		Using 401RT to terminal	45
Using Sheppard bus & Sheppard subway	68	Using Bloor-Danforth subway	38	Keele at Sheppard to UTSC:	
Using 401RT	44	Using 401RT	44	Using Keele bus + Eglinton LRT	84
		Eglinton LRT + McCowan bus	56	Using Keele bus + 401RT + shuttle at Morningside	46

Benefits of a 401RT

The 401RT is of transformative significance, and would affect other transit enhancement decisions in Toronto, Mississauga, and Durham Region. The scale of the 401RT reflects the magnitude of the transportation and climate change problems facing the region. The overall traffic congestion problem in Toronto cannot be resolved with constrained approaches. The following list of general benefits is lengthy and significant, and highlights the strategic importance of the 401RT in the Toronto area. Local benefits are generally not included in this list.

1. The first practical transit alternative to driving across northern Toronto is created, bringing rapid transit much closer to many thousands of today's car-driving commuters.
2. Up to eleven new rapid transit connections are created (Hurontario LRT, Mississauga Transitway, Union-to-Pearson Express, Woodbine GO, Barrie GO, Spadina/York Subway, Yonge Street Subway, Oriole GO (re-located), an extended Ontario Line at Victoria Park Ave., the Scarborough Subway extension, and a possibly-relocated Agincourt GO station or additional GO/401RT transfer station south of the Agincourt GO station).
3. More than 50 new surface bus route connections to rapid transit are created.
4. North-south bus trips to rapid transit are significantly shorter in time and distance.
5. Gridlock on Highways 401 is avoided as high volumes of transfers from the highway to rapid transit occur.
6. The trip capacity of the highway corridor is more than doubled.
7. Overcrowding of the Yonge Subway is avoided as an Ontario Line extension (OLX) to the 401RT at Victoria Park Avenue, and to Sheppard Avenue East (described in the next section) diverts travelers from the Yonge subway that is planned to be extended to Highway 7.
8. The 401RT/OLX combination reduces or ends road congestion on the Don Valley Parkway.
9. The 401RT relieves potential over-capacity pressures on the Eglinton Crosstown LRT (currently under construction).
10. Traffic congestion on city streets throughout Toronto and in parts of Mississauga and Pickering is reduced as major modal shifts to transit occur: all road trips begin and end on local streets.
11. The 401RT and its intersect with an Ontario Line extension reduce the number of automobiles on the highway and on city streets by 19%, a reduction that can enable some streets to have more and safer bicycle lanes, wider pedestrian sidewalks, and more greenscaping.

12. Truck transport is improved as gridlock on highways 401 is avoided as car drivers transfer to transit when the highly-visible 401RT is seen to be as fast, convenient or affordable as driving.
13. Travel times across the northern half of Toronto are significantly reduced when compared to current transit services. End-to-end travel time on the 401RT (Pickering Town Centre to Hurontario Street; 63 kilometres) is 64 minutes.
14. The 401RT increases transit ridership by 189 million per year by 2051, including a 46 million annual increase in local non-401RT trips on enhanced intersecting bus services and 16 million new 401RT trips resulting from new GO Rail intersects.
15. GO ridership increases by 16 million trips per year beyond current forecasts by 2051 as a result of up to four new Intersects with the 401RT (Kitchener Line at Highway 27, Barrie GO Line, a potentially relocated Agincourt GO, and Leslie-Oriole GO).
16. The addition of large multi-level garages above the Weston and Jane 401RT stations (plus access ramps) may enable the creation of a transfer point for drivers having come from Highway 400 or Highway 401. This would enable people to avoid using city streets to get to downtown Toronto or other destinations.
17. In general, access to services and to employment across Toronto and to/from Mississauga, Pickering and Brampton become much faster and easier, including especially for people who are economically or socially disadvantaged, or do not own cars or cannot drive.
18. Rapid, affordable, and direct rapid transit access to Pearson International Airport from downtown and from suburban locations across the region is created (Approximately 85% of trips to the airport do not originate from downtown Toronto).
19. The Greater Toronto Airports Authority's plans for a transit hub are transformed to be much more effective.
20. Rapid direct access to Pearson International Airport via the 401RT from locations across Toronto makes the Government of Ontario's planned \$1.6 billion western extension of the Eglinton Crosstown LRT from Renforth to Pearson International Airport unnecessary. The MACC 401RT station at Eglinton Avenue would provide the rapid transit link to/from Pearson. (The 401RT makes the viability of the entire Eglinton West LRT questionable.)
21. Access to the employment areas surrounding Pearson airport is greatly improved; these employment areas in Mississauga and Toronto revitalize as their enhanced accessibility helps them to become more attractive to business and to workers.
22. Current and forecasted road overcapacity situations in the large employment areas around Pearson International Airport are alleviated or avoided.
23. Employment opportunities and labour market conditions are enhanced. Fewer people will decline employment opportunities near the airport due to road congestion and travel times.
24. The 401RT's intersect with the Danforth subway's extension at Scarborough City Centre significantly increases ridership on that extension.
25. A 401RT makes it unnecessary to build a Sheppard Avenue East LRT or subway, which would be replaced by the nearby and faster 401RT service. Infrastructure cost savings are more than \$1 billion for an LRT and up to approximately \$4.8 billion for a subway.
26. Enhanced access from across all of Toronto to the University of Toronto Scarborough Campus, Centennial College (Scarborough), York University, and the U of T downtown campus is created. Many students will no longer need to decide on courses of study based on travel time and distances to campuses, or need to purchase a car.
27. Improved and rapid access to the University of Toronto's Scarborough campus using the 401RT will reduce ridership volumes on the proposed Eglinton Crosstown East LRT extension, rendering

it unnecessary. Savings from eliminating the LRT extension range between \$4.0 billion to \$4.4 billion. However, it can be worthwhile to extend the LRT to Kingston Road only, a cost of approximately \$1.1 billion.)

28. The Jane Street LRT proposed by Toronto may become unnecessary as east-west connections provided by the 401RT and Eglinton Crosstown LRT at Jane reduce passenger volumes and trip-length crowding on Jane Street buses to Bloor Street. Savings may be \$2.6 billion.
29. A proposed \$2 billion Sheppard Avenue subway extension between Yonge Street and Sheppard West station would become unnecessary and should be avoided, as the 401RT would extend from the Sheppard-Yonge subway station to Yorkdale station and much farther westward, into Mississauga, making it more advantageous for travelers.
30. Access to employment opportunities and services for residents of disadvantaged communities is significantly improved (e.g., northwest Etobicoke, eastern Scarborough).
31. Direct rapid transit access to Mississauga's Airport Corporate Centre (at MACC station) from across northern Toronto and Mississauga is created.
32. Traffic congestion on Highway 401 west of Toronto is reduced, as a Kitchener GO Transit Line link to a Woodbine/Hwy 27 401RT station enables car-free access to east-west destinations in northern Toronto and links to north-south arterial transit services across the city.
33. As an economic stimulus, as approximately 170,000 job years are created as the 401RT is constructed – far more than any other public job creation project in the GTA has achieved.
34. Canada and Ontario government capital cost contributions can result in an influx of \$21 billion into the Toronto area economy.
35. Approximately 400 ongoing transit operating jobs are created.
36. Economic losses from traffic congestion are reduced; business efficiency is improved.
37. Economic losses from imports of motor vehicle fuels and automobiles are reduced – more than \$75 million per year.
38. The 401RT helps enable the transformation of Yonge Street north of Hwy 401 as the Yonge Street subway is extended to Highway 7. The 401RT will attract new transit users from north of Finch subway station, making it easier to access east-west employment.
39. Importantly, greenhouse gas emissions are reduced by close to 400,000 metric tons per year until electricity-powered vehicles become more prominent. Toxic vehicle emissions and their negative effects on health are also reduced.
40. The number of deaths and injuries from motor vehicle collisions and the traumas and costs borne by the families and friends of crash victims are reduced, as are the associated daily congestion effects of collisions.
41. The operational effectiveness of the Toronto area's pre-existing transit system is improved; for example, more people will use existing buses and new buses as service frequencies improve with the addition of more north-south buses as part of the 401RT concept.
42. Suburban sprawl is eased, as development in the central area of the GTA is attracted by the 401RT, including building construction near, at or above the highway at 401RT stations.
43. Improved transit access via the 401RT supports an increased distribution of work across Toronto outside the downtown core. Rapid access to/from the 401RT improves automobile-free connectivity for businesses and access for workers who live both downtown and in suburban areas.
44. Rapid transit access to places of work or home outside the downtown core enables the number of parking spaces downtown and across Toronto to be reduced; opportunities to transform public downtown parking spaces into open greenspaces or other public uses are increased.

45. Property tax revenues are increased from new urban development at/near 401RT stations, and from increased property values in parts of Toronto, Mississauga and Pickering, and in some '905' areas served by GO Transit.
46. Travel costs are reduced for thousands of households as fewer cars need to be owned, or are used less. Money saved can be redirected towards other household priorities. After-tax household savings vary widely, but can range to more than \$10,000 per year per vehicle, less the cost of using public transit. This is a significant household affordability opportunity.
47. Modal shifts to the 401RT from travel by automobile far exceed shifts generated by planned on-street light rail transit lines in Toronto, including the Jane Street LRT, the Sheppard East LRT (or subway), and the Eglinton East LRT extension, the majority of whose ridership would be transfers from existing TTC bus services rather than being new users.
48. The overall operating revenue-to-cost ratio for the 401RT could achieve 90% by 2051, much better than that of Toronto's overall public transit system.
49. The overall cost-effectiveness of the 401RT/OLX would be approximately 2.4 times that of Ontario's \$28.5 billion Rapid Transit Plan for Toronto, based on new transit ridership generated.
50. For Mississauga's residents, aligning the 401RT southwesterly from MACC station to and through Mississauga's city centre would enable affordable access to destinations to the airport area and to across Toronto, and generate modal shifts to public transit that would reduce growing congestion on Highway 403 to/from Toronto.
51. The operational revenue-to-cost ratio of the Hurontario light rail transit line in Mississauga is improved as its intersect with the 401RT attracts new ridership; additional high-density urban nodal development at and near Hurontario Street is supported.
52. In Durham Region and the city of Pickering, the prospects for further urban development in the Pickering Town Centre area at Liverpool Road and along Highway 2 would be enhanced. Future off-highway extensions of the 401RT above Highway 2 to Brock Road and beyond are possible. A 401RT would be an alternative to what is now a forced daily drive on congested highways to and from Toronto.
53. In York Region, the 401RT and Ontario Line extension (described in the next section) to Sheppard Avenue East would ease road congestion to and from Toronto as York Region bus services connecting into northern Toronto and to the 401RT improve.
54. In Mississauga, access to the 401RT and more frequent bus service connections reduces Highway traffic volumes to/from Toronto.

[A 'Relief Line' for the 401RT](#)

The City of Toronto and the Government of Ontario have recognized for many years the need for a "Relief Line" subway to divert transit ridership from the already-crowded Yonge subway, portions of which will be at or beyond capacity by 2031. In April of 2019, the Ontario government announced its commitment to build an "**Ontario Line**" subway from Exhibition Place to Eglinton East at Don Mills Road. The Eglinton Crosstown LRT is scheduled to become operational by the end of 2023, and will result in more transit users crowding the Yonge Street subway. Unfortunately, the Ontario Line is not scheduled to become operational until 2029 or later, long after the opening of the Eglinton LRT. This will be a significant problem for the Toronto transit system and for transit users.

It is *essential* that the Ontario Line be extended northward from its currently-approved terminus at Eglinton Avenue East, to a 401RT station. Without this connection to and from downtown Toronto, the 401RT will further worsen crowding on the Yonge Street subway. West of Yonge Street, the

Spadina/York subway line is currently operating under capacity and can accommodate transfers to and from the 401RT, via the Yorkdale subway station.

Between Eglinton and Lawrence Avenue, the Ontario Line can operate above ground. South of York Mills Road, the Ontario Line would need to descend to underground and turn eastward under York Mills Road and under the East Don River to a station at Victoria Park Avenue at Highway 401. The intersect at Victoria Park would be most effective for trips to and from Scarborough and Pickering. Stations can be at Barber Green, Lawrence East, and York Mills Road, plus a station at Sheppard Avenue East. The York Mills station, located below the Don Valley Parkway, would include a multi-level user-pay garage above or alongside the parkway intersection, to enable drivers to transfer from the 404/DVP to the Ontario Line. The Ontario government's long-term vision for the Ontario Line has been to continue to align it with Don Mills Road, to eventually pass close to Seneca College and further to Richmond Hill. However, that alignment is too close to Yonge Street to be a significant generator of new trips to/from north of Highway 401.

This 7.5-kilometre extension of the Ontario Line north of Eglinton East would cost approximately \$4.0 billion, excluding the parking garage. It is estimated to generate at least seven million new transit trips per year by 2051, including 1.8 million transferring from the 404/DVP. Net of 1/3 cost-sharing by the Government of Canada, the annual interest cost to Ontario would be approximately \$107 million per year (at 4.5%) once construction has been completed.

The Eglinton-to-Sheppard Avenue East segment of the Ontario Line would

1. Increase trips by transit between Scarborough and the downtown Toronto area, including an increase in the transit modal share of all trips;
2. Divert significant traffic volumes from the Don Valley Parkway (DVP);
3. **Together with enhancements to GO Transit, eliminate the perceived need to rebuild the Gardiner Expressway east of Jarvis Street;**
4. Create direct access to the north-south rapid transit east of Yonge Street, and 401RT stations across Toronto;
5. Enable fast transit access to/from the corporate employment area at and north of Eglinton Avenue East at Don Mills Road;
6. Increase utilization of the Eglinton Crosstown LRT by creating quick access to it from north of Eglinton Avenue East;
7. Reduce crowding on the Yonge Street subway by creating alternative access to downtown Toronto for significant numbers of new and current transit users;
8. Increase planned ridership on the Ontario Line south of Eglinton Avenue East as residents along the currently-planned route have faster access to new Ontario Line stations north of Eglinton and to many other rapid transit network connections;
9. Generate approximately 7 million new transit trips per year, plus transfers from existing bus services (primarily Don Mills Road buses);
10. Reduce crowding on the Don Mills bus service for ongoing users;
11. Promote urban infill and intensification at and near stations along its route and along intersecting roadways;
12. Reduce overall road traffic along Don Mills Road and nearby streets;
13. Increase the utilization of intersecting surface transit services (Lawrence East, York Mills/Ellesmere, Victoria Park, Sheppard East);

14. Reduce greenhouse gas emissions from modal shifts to transit, including emissions by DVP drivers who would otherwise drive long distances to destinations in Toronto; and
15. Increase attendance at the Ontario Science Centre.

Combined Effect on Road Congestion

Based on pre-pandemic modal shares of all trips (by auto driver and passenger, local transit, GO Transit, Walk/cycle/other), the total number of daily trips by motor vehicle in Toronto is estimated to increase by approximately 850,000 by 2051, or 27% over 2016 volumes; however, current approvals of major transit initiatives could reduce overall road trips in Toronto to 2.6% below 2016 volumes. While this is a significant decrease in motor vehicle trips, it is not adequate.

The 401RT and the Ontario Line extension (OLX) to Sheppard Avenue East would decrease motor vehicle trips by an additional 680,000 by 2051, producing an overall 20.7% decrease in trips compared to 2016 volumes. This magnitude of change would be transformative, enabling not only faster surface transit services and an end to most congestion, but also enables the city to improve urban spaces throughout the city, to become a city that is more pedestrian-friendly, safer, and a quieter city, and which would be able to achieve or approach net zero GHG emissions, become a more vibrant economic engine, and to become an extraordinary example of sustainable urbanity for other jurisdictions.

Affordability

Beyond the basic numbers, there's something to be said about doing more than what is normally thought to be affordable with public funds. Until recent years, the Ontario government has declined to build more than about three kilometres of municipal rapid transit per year (Eglinton LRT, Spadina subway extension), largely attributed to a lack of fiscal resources for not undertaking more projects.

The Ontario government's \$28.5 billion Rapid Transit Plan for the GTA would add an average of 6.2 kilometres per year, if spread over a ten-year implementation. The 401RT and Ontario Line extension (OLX) north of Eglinton Avenue East would add another 4.6 kilometres per year, if spread over 15 years. While this seems to be a great deal compared to past years, it is relatively small when compared to the growing multi-billion-dollar annual cost of road congestion and the devastating impacts of climate change (Appendix 1).

The money for more and better rapid transit services exists within Ontario's \$750 billion (2019 est.) annual gross domestic product, and Canada's annual \$1.8 trillion GDP. It is fundamentally a governmental decision about the allocation balance of the GDP between supporting and enhancing public services or favouring private wants.

Before savings and offsets, the gross capital investment cost of a mostly elevated 401RT plus the Ontario Line extension to Sheppard Avenue East would be near \$26 billion. The capital cost estimate includes construction of the tunnels, rights-of-way, and tracks, rail cars, buses, adjustments to bridges and ramps, 35 new and upgraded stations, power systems, land acquisition, a maintenance yard, and equipment. The 401RT costs reflect the northwesterly alignment in Mississauga towards Hurontario Street at Highway 401; the southwesterly alternative would cost an additional \$1 billion.

For the elevated 401RT concept, the Ontario and municipal shares of building the 401RT and OLX annual debt carrying cost of the 401RT and OLX would grow to peak at approximately \$750 million per year by 2051 (at 4.5% interest). Based on Ontario paying 2/3 of the gross infrastructure costs of the 401RT/OLX, and non-residential taxpayers paying 25% of the Ontario cost, the daily cost to Toronto households of debt interest payments for the Ontario and Toronto share of the infrastructure cost will grow to approximately **20 cents per day per household by 2051**, before expenditure offsets (see below).

These costs are highly affordable when compared to the benefits of the 401RT and the negative impacts of its absence, principally widespread gridlock on roads and highways. Upper levels of government have a direct and significant economic interest in ensuring the free flow of people and goods on major highways. In the scenarios described in this document, the Ontario and Canada governments fund 100% of all rail component costs, and municipalities fund 100% of additional buses on intersecting routes.

	Infrastructure Cost - Bn\$	Gross Cost per Km. - bn\$	% Ontario Share Bn\$	Ontario Debt Carrying Cost *
401RT + Bus Component	22.0	0.35	14.2	0.64
OLX to Sheppard E.	4.0	0.57	2.7	0.12
Totals	26.0	0.37	16.9	0.76

* Annual, @ 4.5%

Consol GTA Rapid Transit SEPT 2020 (updated)

Savings and Cost Avoidances

The capital cost of the 401RT/OLX is significantly overstated because it does not include savings and cost avoidances that should be applied. As illustrated below, in a scenario where the 401RT and OLX become a planning reality, the 401RT makes several transit expansion plans contained in Ontario’s recent Greater Golden Horseshoe Transportation Plan unnecessary. The cost savings and offsets are highly significant – potentially totalling \$16.8 billion.

- The 401RT would be faster for many travelers heading to and from the University of Toronto’s Scarborough campus and the Malvern community than using the planned Eglinton East LRT extension (\$4.4 bn); ridership on the LRT would drop. However, the LRT can be extended to Kingston Road only (\$1.1 bn). Improved bus services can replace the LRT on Kingston Road and Morningside Avenue.
- The GGH transportation plan already includes a northward extension of the Ontario Line past Sheppard Avenue East. In effect, it’s already willing to pay the \$3.8 billion for the OLX, and will keep 401RT users from overloading the Yonge Street Subway.
- A short (1km) extension of the Eglinton West LRT from Renforth Drive to the 401RT’s MACC station will enable travelers on the Eglinton LRT to access Pearson International Airport via the 401RT. There is no need for the Eglinton West LRT to be extended to Pearson; a \$2 billion expenditure can be avoided.
- The Eglinton West LRT between Mt, Dennis to Renforth would also become unnecessary, with many of its potential users whose destinations are the airport area would use the Line 1 subway and 401RT to connect to the area. Ridership on the EWLRT would drop. \$4.7 billion can be saved. However, the EWLRT can/should be extended to Jane Street, where transit use is high. An extension of the Mississauga Transitway to Jane can provide high-quality seamless local-and-express bus services.
- The GGH plan also includes a \$4.8 (originally estimated at \$2.8 billion) extension of the Sheppard Subway to McCowan Road that would not be needed with a nearby 401RT in place. Many

Sheppard Subway users who have destinations west of Yonge Street would use the 401RT instead.

- A 401RT and Eglinton LRT may divert many Jane Street bus users from riding all the way to Bloor Street; a Jane LRT is probably not needed \$2.6 billion.

Not in the illustration, and not needed once the 401RT is in place are, the GGH plan's Pickering-to-Scarborough Centre portion of the proposed Durham-Scarborough Bus Rapid Transit concept, because the 401RT would replace it. Additionally, the GGH plan's extension of the Ontario Line north of Sheppard Avenue that loops to a transit hub at Highway 7 is too close to the Yonge subway to be of practical use, and would not be justifiable based on ridership.

	Kms. Of Track	Infra Cost \$m	New Trips per Year*	Cost per New Trip
401RT - Pickering T.C. to Hurontario + Buses**	58.1	21,200	173.8	\$115
401RT Effect on GO Transit		600	16.0	
Ontario Line extension to Sheppard East	7.1	3,800	7.0	\$543
Total Recommended Infrastructure	65.2	25,600	196.8	\$130
OLX already committed in GGHTP		-3,800		
	65.2	21,800	197	
Less Other Potential Expenditure Offsets:				
Eglinton West LRT - Renforth to Pearson	4.2	2,000	2.3	\$889
Eglinton W LRT - Mt. Dennis to Renforth	9.2	4,600	7.3	\$632
Eglinton W LRT - Mt. Dennis to Jane (build)	-1.0	-500	-0.8	\$632
Eglinton E LRT - Kndy to Malvern to McCowan	18.2	4,400	11.7	\$377
Eglinton E LRT - Kndy to Kingston Rd (build)	-4.5	-1,100	-7.0	-\$157
Sheppard Subway Extension to McCowan	7.0	4,800	8.6	\$560
Jane Street LRT - Steeles to Bloor	16.5	2,600	5.0	\$519
Total Offsets & Commitments	49.6	16,800	27.0	\$623
Potential Net Cost of 401RT/OLX		8,800		
Potential Net Gain in New Trips/yr.			169.8	\$52

* New Transit Trips per year in millions. New Trips are the critical indicator of road traffic decongestion.

** With Burnhamthorpe alignment in Mississauga

Importantly, the overall net additional cost of the 401RT/OLX can be as low as \$8.8 billion, while generating 197 million new transit users per year by 2051 – an average cost of \$139 per new user. The \$16.8 billion cost of the potential expenditure offsets (table above) would generate approximately 27 million new transit users by 2051 – an average cost of \$623 per new user. The 401RT/OLX is a far more cost-effective alternative to current plans, and functionally superior.

The average net cost per day per average Toronto household may be as low as 5 cents per day to build the 401RT/OLX.

N.B. Recent information regarding the cost of constructing the 67-kilometre 26-station Réseau Express Métropolitain (REM) in Montreal by CDPQInfra may indicate that the costs for building the 401RT may be significantly overstated.

However, the specific potential for savings cannot be estimated at this time, and are not included in this document. The costs of the REM are born by multiple partners (including CDPQInfra), and are not primarily subsidized by the government of Quebec.

A key point is that even if all the currently-planned unfunded initiatives are constructed, it will still be necessary to construct the 401RT/OLX. The appropriate approach would be to build the 401RT/OLX first, and then evaluate the necessity of additional transit infrastructure.

The overall capital cost of the 401RT can be further reduced if air rights over Highway 401 for private urban development are sold, and which can require the developers to build 401RT stations of basic

Annual Debt Carrying Costs (\$millions) at Completion			
	401RT/OLX	Reductions	Net
Gross capital cost	25,600	-16,800	8,800
Federal share @ 1/3	8,533.3	-5,600.0	2,933.3
	17,066.7	-11,200.0	5,866.7
Debt interest - Ontario @ 4.5%	768.0	-504.0	264.0
Household share of Ont. taxes	48.4%	48.4%	48.4%
Household share of tax cost	371.7	-243.9	127.8
Ontario population 2046	20,000,000	20,000,000	20,000,000
Avg. persons/household	2.6	2.6	2.6
Ontario households 2046	7,692,308	7,692,308	7,692,308
Annual cost per household	\$48	-\$32	\$17
Avg. cents per day	13	-9	5

design at little or no cost to government. Potentially, this may reduce the cost of building the 401RT by close to \$2 billion.

Because there is significant benefit to the federal government in terms of improved access to Pearson International Airport, contribution to federal greenhouse gas reduction targets, and increased employment, a one-third federal contribution is assumed to be attainable. Similarly, provincial funding is also appropriate because of positive impacts on provincial finances from employment, improved road traffic flow for freight transport, and reduced importation of motor fuels and automobiles.

Other affordability comparisons are also appropriate:

A high-speed rail (HSR) service between Toronto and Windsor, at a cost of approximately \$21 billion, has been proposed in the recent past. The capital cost of the 401RT and Ontario Line extension north of Eglinton Avenue East would be \$5 billion more expensive. However, while the HSR plan has been estimated to serve 10 million passengers per year, the 401RT and Ontario Line extension would carry *196 million* new transit riders per year by 2051 – almost ten times more than the proposed HSR. This advantage makes a priority implementation of the 401RT/OLX highly appropriate.

A comparison between the elevated 401RT+OLX and the Ontario Rapid Transit Plan is also useful. The 401RT+OLX achieves 2.46 times as many new transit trips than estimated for the Ontario plan, and is estimated to be 2.7 times as cost-effective.

	New Trips (Million/yr)	Gross Infra. Cost (\$Mil)	Cost per New User	New Kms. Of Track
Ontario Rapid Transit Plan	80	28,500.0	356.2	57.4
Elevated 401RT + OLX	197	26,000.0	132.1	70.1
Comparative Ratio	2.46	0.91	0.37	1.22
401RT/OLX Cost Effectiveness Advantage			2.70	

Generating New Transit Ridership

Approximately 1.3 million people call the northern Toronto area their home. It is also where there are almost 400,000 jobs and many other destinations. By 2051, the area’s population and number of jobs may increase by 30% or more. It is underserved by rapid transit, which to date has been focused mainly on bringing people to and from the downtown Toronto core. The 401RT will provide the east-west and north-south connectivity that is missing.

It is estimated that by 2051, a 401RT plus its arterial road feeder buses would carry 174 million new transit riders annually, plus 12 million or more transfers from existing local transit services. The Ontario Line extension to Sheppard Avenue East at Victoria Park Avenue would generate 7 million new transit trips per year. The 401RT would also boost GO Transit ridership by approximately 16 million trips per year.

An important viability factor is that the longer the length of an urban rapid transit line, with stations added along the way, the more intensively it is used. As length is increased and new stations are added, new ridership not only originates at each new station added; the new stations also become destinations for additional transit riders whose trip origins are at pre-existing stations and who can now easily access the new stations. The Sheppard subway’s relative shortness (5.5 km.) is the principal reason why it is not operationally viable.

Ridership on the 401RT would come from a variety of sources, including

- ◆ Modal shifts by drivers using Highway 401 between and beyond the east and west 401RT terminals at Pickering Town Centre (Liverpool Road), and Hurontario Street in Mississauga;
- ◆ Modal shifts from local roads and current and planned transit services;
- ◆ Future growth in suburban travel demand that cannot be accommodated by Highway 401 and other roads due to road traffic congestion;
- ◆ Toronto drivers whose trip origins and/or destinations are in close proximity to Hwy 401, principally on intersecting arterial roads; accessibility to transit is extended once the use of e-bikes and e-scooters becomes more widespread;
- ◆ Car drivers who use the Don Valley Parkway and Highway 427 to travel downtown but who would, via a 401RT, have quick access to the eastern and western segments of the Line 1 subway and the extended Ontario Line;
- ◆ Drivers from north of Toronto who use Highway 400 to access downtown Toronto and across northern Toronto who would be able to park-and-ride the 401RT using user-pay garages above the 401 at Weston and Jane stations
- ◆ People who currently drive to the airport and its employment area from trip origins near the existing rapid transit network;
- ◆ Travelers who wish to access destinations directly at 401RT stations (such as Pearson International Airport and Scarborough Town Centre);
- ◆ Downtown residents who would have access to suburban destinations via existing rapid transit (GO Transit and the Line 1 subway);
- ◆ Transfers from existing nearby east-west surface transit routes (such as Sheppard Avenue, Wilson Avenue, Belfield Road, and Ellesmere Road);
- ◆ Transfers from GO Transit: the Barrie GO Rail Line, the Kitchener GO Rail line, possibly at Kennedy Road/Agincourt, and a new Oriole GO Station at the Leslie subway station (to replace the current station at Highway 401);
- ◆ Travelers whose trip origins and destinations are in close proximity to the extended Ontario Line and locations in Scarborough and Pickering that are near the 401RT;
- ◆ Future residential and commercial development over, adjacent to and near to the Highway 401 corridor and at off-highway stations in Mississauga (e.g., Dixie, Kennedy-Britannia) and Pickering (Whites Rd);
- ◆ Residents of Mississauga's densely urbanizing city centre area who have been heavily dependent on travel by automobile to access Toronto and employment areas around Pearson International Airport;
- ◆ People who live or work close to north-south surface transit services that link to 401RT stations;
- ◆ Non-401RT users who are attracted by significantly-improved bus service frequency on north-south arterial routes, and by shelters at every transit stop;
- ◆ From many other locations in the GTA, people who wish to reduce their household cost of transportation;
- ◆ People who face financial hardship caused in part by motor vehicle ownership, or who wish to reallocate transportation funds towards other household priorities;
- ◆ People who do not have access to personal transportation and would benefit from the improved access that the 401RT/OLX provides;
- ◆ Drivers and automobile passengers who are 'fed up' with the stresses and delays of daily gridlock on highways and city streets.

The fact that the 401RT would not be located in a high-density urban corridor is not as important a factor as the speed and comfort of the 401RT service, its long length and linkages to other transportation services, the relatively inexpensive cost of using the service, and the frustrations of traffic congestion. As with most suburban transit nodes, boardings onto 401RT trains would be mostly via transfers from feeder bus services and adjacent commuter parking lots, where they may exist. However, significant walk-on ridership can occur at Pearson International Airport, the Mississauga Airport Corporate Centre (MACC station), Yorkdale, Yonge at Sheppard, Scarborough Centre, and Pickering Town Centre, and Mississauga’s city centre.

Destinations at or near 401RT	
1 Pearson International Airport	14 Seneca College
2 Mississauga Airport Corporate Ctr.	15 Richmond Hill GO
3 Hurontario LRT	16 North York General Hospital
4 Malton community	17 Fairview Mall
5 Employment Area	18 Stouffville GO
6 Woodbine Entertainment Centre	19 Scarborough Town Centre
7 Kitchener GO to/from Brampton	20 Centennial College
8 Downsview Park	21 Malvern Community
9 Yorkdale Mall	22 Scarborough Health Network
10 York University	23 Univy of Toronto Scarborough
11 Barrie GO	24 Toronto Zoo
12 Humber River Hospital	25 Pickering Town Centre
13 Downtown North York	26 Kennedy retail/employment area
	27 Rouge National Urban Park

Both the 401RT and GO Transit’s Lakeshore Line run through, and have stations in, mostly suburban areas. GO Transit is highly successful even though transit access to GO stations is often impractical. Ridership on the 401RT is enhanced by the fact that its length is long enough to serve both shorter-distance and longer-distance travelers. Importantly, a 401RT would have no rapid transit competition – it is significantly distant from the Eglinton Crosstown LRT, filling a critical void in the transit network, and is unique.

Quantifying new transit trips for the 401RT:

Because of the uniqueness of the 401RT, no comparable ridership forecasting methodology was found. However, it is estimated that the 401RT itself would generate 127,800,000 **new** transit trips per year after it becomes fully operational. The estimate is partly based on the Ontario Ministry of Transportation’s 2011 Transportation Tomorrow Survey’s origin-destination matrix for trips by residents by automobile for 24 hours for 44 Wards (those in effect prior to 2018) in Toronto plus 16 close-by Wards in neighbouring municipalities, and was adjusted to 2041 and 2051 for population growth. Modal shift factors to transit were assigned based on the proximities of trip origins and destinations to the Highway 401 corridor and by length of trip. Additional ridership was added for increased road traffic congestion resulting from travel demand growth beyond 2041, new high-density urban development assumed to occur at and near 401RT stations, trips to/from Toronto by residents living beyond the 60 Wards, positive impacts on GO/RER ridership, the effect of direct access to Pearson International Airport from across Toronto, and driving costs. The figures exclude additional new transit trips that would occur with the 401RT extension southwesterly from MACC station.

401RT Ridership Estimate, to 2051	
55,100,000	O-D matrix: 401RT trips 2041 by residents– modal shifts by auto driver and passenger
600,000	Non-resident trips to/from 401RT (travelers living outside the 60 Ward survey area)
23,000,000	New urban development at/near/above 401RT stations; @ higher transit usage
16,000,000	401RT ridership increase re GO RER intersects with 401RT
22,800,000	Add'l. Hwy 401 congestion shift 2041 to 2051. Hwy unable to carry 1/2 of demand growth.
4,200,000	Reduction in 90% auto share of air passenger trips to/from Pearson
6,100,000	Driving cost Increase factors (5% impact)
127,800,000	TOTAL - New TTC Riders using 401RT by 2051
46,000,000	N-S bus component: New non-401RT trips; 25% incr. in curret bus ridership
173,800,000	New transit trips per year by 2051
7,000,000	Ontario Line Extn. (OLX) -Eglinton to Sheppard
180,800,000	Estimated total 401RT/OLX users by 2051
16,000,000	GO Transit ridership incr. re 401RT intersects
196,800,000	TOTAL - New ridership effect of 401RT/OLX
+12,000,000	Transfers of existing nearby TTC users

The 401RT's bus component assumes that ridership would increase on bus routes that intersect with the 401RT in Mississauga, Toronto and Pickering, for trips not involving a transfer to or from the 401RT itself. This would be due to improvements in service frequencies, a mix of express and local services, shelters at **every** bus stop, and more comfortable buses. It is estimated that overall ridership intensity on intersecting bus services would increase by 25%, and total 46,000,000 by 2051. Bus ridership increase estimates are preliminary and should be further reviewed.

401RT Bus Component Ridership:	
2011 Daily Boardings on 36 intersecting bus routes	559,500
Travel demand growth to 2041	27%
Boardings 2041	710,565
Number of existing buses	626
401RT: Additional buses	464
Ridership spread over all buses	1,090
Boardings per bus	652
Assigned ratio fares to boardings	70%
Total fare boardings per bus 2041	456
Assumed effect of improved service frequency + comfort	25%
New fare ridership per bus	114
Total buses on intersecting routes	1,090
New ridership/day re 401RT impact	124,349
Annual equivalent @ 308 FTE days	38,299,000
Population increase 2041 to 2051	7.8%
	41,303,000
Add'l modal shifts re road congestion (e.g. on-demand vehicles) and transit	1.05
Driving cost increase scenario (tolls, carbon taxes, new technology)	1.05
	Annual 46,000,000
	Daily 149,351

The Ontario Line extension (OLX) north of Eglinton East is estimated to generate 7 million new transit user trips per year, plus transfers from existing transit routes, such as Don Mills Road and Victoria Park Avenue bus services. Ridership is adjusted for population growth to 2051, a portion of Don Mills bus ridership, plus a 25% modal shift of daily Don Valley Parkway traffic volumes between Don Mills and Highway 401, and then extrapolated to a year, based on an annual conversion factor of 308 volume-equivalent days. More detailed analyses can refine estimates. **The OLX is essential** if overcapacity problems on the Yonge Street subway segment of the Line 1 subway in Toronto are to be avoided, while still encouraging new transit ridership on the Yonge Street subway.

The overall effect of implementing the 401RT/OLX rapid transit lines, combined with the implementation of current rapid transit commitments by the Ontario government, would be a reduction of approximately 680,000 daily automobile trips in Toronto by 2051, compared to 2016, and an increase in trips by transit of more than 1,600,000 (GO + municipal transit). Appendix 2 provides more information.

Operating Revenue-to-Cost Ratios

Annual operating costs for the completed 401RT and expanded feeder bus services would be approximately \$470 million annually, based on \$8 million for each of 31 new stations (compared to an estimated \$4.2 million for each of the new Spadina subway extension stations), and \$450,000 for each new bus on intersecting transit route. Overall, it is estimated that fare revenues would offset 84% of operating costs. No segmentation of 401RT operating outcomes has been estimated for Mississauga, Toronto and Durham transit systems; these will vary the figures to a minor extent.

Operating Revenue-to-Cost Ratios

	401RT Rail Component	401RT Bus Component	OLX Eglinton to Sheppard	Total 401RT/OLX
New stations	31		6	
No. of buses		496		
Unit operating cost	\$8,000,000	\$450,000	\$8,000,000	
Total Cost	\$248,000,000	\$223,200,000	\$48,000,000	\$519,200,000
New Fares 2051*	127,800,000	46,000,000	7,000,000	\$180,800,000
Average fare	\$2.46	\$2.21	\$2.46	
	\$315,000,000	\$101,900,000	\$17,300,000	\$434,200,000
Surplus or Deficit	\$67,000,000	-\$121,300,000	-\$30,700,000	-\$85,000,000
				84%

*Excludes 16m new transit users on GO Transit (4 intersects with 401RT)

Urban Development Impacts

The alignment of the 401RT provides opportunities for development and redevelopment at most stations, for either the mostly-at-grade concept or the mostly-elevated concept. Off-highway stations, such as the Scarborough Town Centre area, at/around Pickering Town Centre, the planned Woodbine/Hwy 27 GO station and the Mississauga Airport Corporate Centre are near lands that may be underutilized and can generate both residential and non-residential opportunities.

Development potential exists adjacent to many stations that are in the highway 401 corridor, within a five- to ten-minute walk from station entrances. In addition, development rights over the highway and over highway stations can be sold or leased. The government of Ontario can or may offer opportunities for private development at new subway stations, if building developers fund the capital costs of the stations themselves. This is already the policy for new GO Rail stations.

Unaffordable Not To Do

The costs of traffic congestion in the Greater Toronto and Hamilton Area are oft-quoted, totalling billions of dollars a year (with ranges from \$1.5 billion to \$11 billion per year), based on pre-COVID-19 traffic volumes. Even with increased work-from-home factors, traffic volumes will return and increase as the GTA's population continues to increase. Unless significant new investments in rapid transit are made, the problem will continue as travel demand continues to grow. Implementation of current rapid transit plans by Metrolinx and others will stabilize road traffic demand to 2051, but beyond 2051 the alignments/locations of its transit plans will not enable it to keep pace.

As mentioned, major modal shifts to public transit are necessary as part of efforts to stabilize the effects of rapid climate change. Although electricity-powered vehicles are touted as the solution to transportation-source GHG emissions, it assumes that mining for minerals needed for vehicle production, fabrication of auto parts and assembly of vehicles will all be environmentally benign; it is also unlikely that the sources of electricity will be generated without GHG emissions. The body of scientific evidence pointing to rapid deterioration of the Earth's natural life support systems is conclusive. The United Nations Intergovernmental Panel on Climate Change warns that global greenhouse gas emissions need to be cut in half by 2030 if devastating and unstoppable consequences for humankind and the biosphere are to be avoided. For North Americans, who are among the world's worst emitters of greenhouse gases, much more than half of GHG emissions should be eliminated by 2030. **This is critical information. Refer to Appendix 1 for more information.** There is general agreement that, for urban areas, the solution for both environmental stability and avoiding road congestion lies with massive transfers of daily trips to mass transit, reductions in the number of motor vehicles, and major progress in building pedestrian-oriented urban environments. A 401RT, an extended Ontario Line, and other new transit initiatives are **essential** if GHG emissions are to be reduced.

Based on a broader definition of affordability – beyond the narrow public budgetary definition – not building the 401RT and an extension of the Ontario Line to Sheppard Avenue East *is unaffordable*. Detailed feasibility and impact studies should begin now.

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Appendix 1 - Rapid Climate Change

The Devastating Blows to Survival from Rapid Climate Change

Climate change is happening now, hundreds of times faster than natural changes in the past. It has consequences that will dramatically damage us in our lifetimes, and become far, *far* worse for our children and grandchildren.

An indication of a frightening global change is in the past: 250 million years ago, the Permian-Triassic extinction that left only a few species of life on earth alive was caused by rising carbon dioxide in earth's atmosphere, and also by huge releases of methane, resulting in a 5° Celsius warming of the planet. We are adding carbon dioxide into the atmosphere at a rate that is, by and large, ten times faster, and humanity is also now causing methane to be released from permafrost. There is right now a third more carbon in the atmosphere than at any time in the last 800,000 years*.

The rapid destabilization and heating of the earth requires actions much greater in scale than are currently planned, and they must be undertaken **now**. The UN's Intergovernmental Panel on Climate Change (IPCC), reflecting the conclusions of thousands of scientists around the world, said bluntly in October of 2018 that unless global GHG emissions are cut by 40% to 45% by 2030 (now just 10 years away), we will not be able to limit global heating to 1.5° Celsius above pre-industrial norms, and will face devastating consequences.

Instead of decreasing, global GHG emissions are still rising. The 1.5°C target will be exceeded by between 2030 and 2052*. **According to the IPCC, current nationally stated commitments to cut GHGs, if achieved, will result in a 3.2° increase in global temperatures by 2100, and higher beyond that.** If we do not meet those reduction targets, the 2100 average temperature increase will be more than 4°, very close to the levels of 250 million years ago. Temperatures in northern latitudes will be higher – possibly 7 or 8 degrees. **This will be devastating for Canada and other countries.** Because North Americans produce a very disproportionate share of global GHG emissions, GHG emissions in North America need to decrease to almost zero.

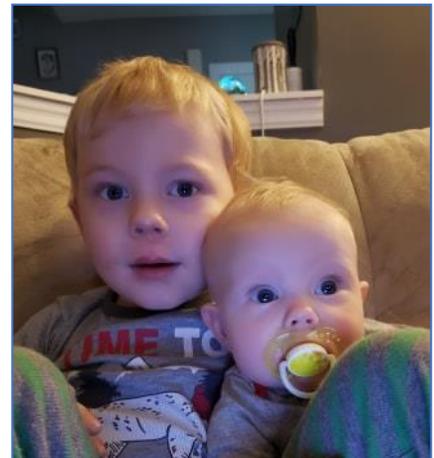
Rapid global warming of 3.2° will have the following devastating and inter-connected impacts.

Each of us will be affected as temperatures move rapidly higher to that level by 2100.

1. Every natural ecosystem will be at risk of collapse, and many will have collapsed.
2. There will be a much higher frequency of droughts and precipitation deficits, and lasting for longer periods. This will affect food production; food prices will be much higher than today, where food is available.
3. Extreme heat events will become normal, and will last longer. Costs to cool buildings will more than double. The mid-latitudes (including southern Canada, much of the USA, the Mediterranean, central Europe) will experience an average rise of 4° Celsius (7.2° Fahrenheit).
4. Heat-related morbidity and deaths will multiply, and be especially deadly in low latitude countries. Conflicts and economic dislocations will become widespread.
5. The loss of livestock and declines in livestock health will affect prices and human diets everywhere.
6. The number of wildfires will multiply and be more widespread. Controlling them will become more difficult, and drain public finances. The devastating fires in Australia, at the beginning of its 2019 summer season, is a current example.
7. Rising temperatures and dryness in parts of the USA will make much of its southern regions unlivable by 2100. Canada will experience a massive flow of climate refugees that will strain our ability and desire to accommodate them.
8. Heating and habitat loss will decimate plant, insect and other animal populations. Rates of extinction will accelerate beyond already extreme rates.

9. Arctic and Antarctic ice will continue to melt, at a more rapid rate than is happening now, and will not stop. Sea levels will rise by metres (6 metres once all of Greenland becomes ice-free), to the point that coastal cities will become at least partially flooded, and today's coastal marshes will be lost.
10. By 2100, almost all ocean beaches will have disappeared.
11. Less arctic ice means more heat from the sun will be absorbed into the oceans, creating a feedback loop that will melt more ice.
12. Permafrost is thawing *now*, emitting billions of tons of methane, a greenhouse gas 20 to 25 times more powerful as a GHG than carbon dioxide. The permafrost will thaw faster, and may never freeze again. A feedback loop is already occurring that will accelerate global heating.
13. Boreal forests will be degraded, and some will be lost.
14. Vector-borne diseases will migrate with climate changes.
15. The ocean is becoming and will become more acidic, and will experience oxygen loss. Coral reefs will face total die-off. Populations of fish dependent on them will, in turn, decline. Food production from fishing and aquaculture will drop. Land animals will become a greater source of food in many regions; extinction rates of land animals will increase.
16. Armed conflicts will increase as famine and human-caused disasters spread. North America will likely not be without some strife. Military costs and emergency aid to other countries will increase.
17. National, regional and local economies will be strained as more financial resources are allocated towards adaptation and mitigation of climate events and trends. Employment dislocation and poverty rates will increase (with artificial intelligence systems as an additional factor), constraining the ability of governments to keep up with its social costs. Enforcement of laws to limit crimes of desperation will be more difficult. Politically-driven tax cuts to offset increased household costs of climate change will cripple the ability of governments to keep up with change. Delays in moving to net-zero carbon energy production will make necessary actions more difficult to undertake.
18. Political and monetary pressure from fossil fuel industries will make a rapid transition to energy based on non-fossil fuels very difficult, and perhaps dangerous (How far will fossil fuel energy producers go to protect their industries?).
19. A multitude of small regional and local effects will require solutions.

Adequacy of action is and will be constrained by denials of the existence and/or severity of the scientific evidence and, unfortunately for some, climate change has become politicized, **at the expense of our children's future well-being.**

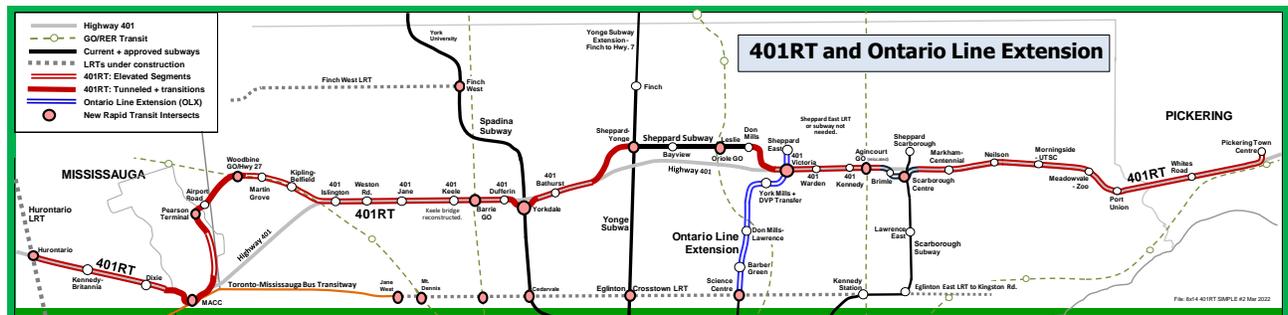


* Per sources identified in the book "The Uninhabitable Earth: Life After Warming", by David Wallace-Wells.

Appendix 2 – A Scenario of Effects of Transit Initiatives

Estimate of daily trips in Toronto	Automobile + Trucks	Municipal Transit	GO Transit	Other	Total	
Toronto population 2051, adj. from Min. of Finance Summer 2020 Forecast, ages 11+ only					3,342,376	
Trips per day per person, adjusted downward for aging demographics					1.85	
Total daily trips					6,183,000	
Modal split, per 2016 TTS, for Toronto	Millions	57%	27%	1%	15%	100%
	per Year	Daily	Daily	Daily	Daily	Daily
Daily trips by mode, Toronto residents, 2051 estimate*	3,631,000	1,720,000	64,000	955,500	6,370,000	
Cross-boundary trips into & out of Toronto by 2051	341,000	76,000	400,000	90,000	907,000	
Reduction in travel re work-from-home	-170,000	-170,000	-340,000	0	-680,000	
Commercial vehicle trips (mainly trucks) by 2051	806,000				806,000	
Total trips in Toronto - 2051	4,608,000	1,626,000	124,000	1,045,500	8,083,000	
TTS 2016 trips in Toronto, adjusted, excl. commercial vehicles	3,151,000	1,437,000	296,000	829,000	5,713,000	
Add: 2016 daily trips by commercial vehicles (mainly trucks)	603,000				603,000	
TTS 2016 trips in Toronto, adjusted	3,754,000	1,437,000	296,000	829,000	6,316,000	
Increase in total trips by 2051, before major transit initiatives (including estimations for Work-From-Home)	854,000	189,000	-172,000	216,500	1,767,000	
		27%				
Add major announced rapid transit enhancements:						
GO Transit Enhancements (net; to 200m)	161.7	(525,000)		525,000	0	
Spadina Subway extn. into Vaughan	18.5	(60,000)	60,000			
Eglinton Crosstown LRT	16.0	(52,000)	52,000		0	
Finch West LRT Humber Coll to Spadina/York subway	5.9	(19,000)	19,000		0	
Est. increase in transit trips arising from the 2019 Ontario rapid transit plan:					0	
Ontario Line University Ave. to Pape Stn.	25.9	(84,000)	84,000		0	
Ontario Line Pape Stn. To Eglinton East	49.6	12.9	(42,000)	42,000	0	
Ontario Line University Ave. to CNE	10.8	(35,000)	35,000		0	
Eglinton West tunneled LRT to Renforth	73.9	6.5	(21,000)	21,000	0	
3-Stop Scarborough Subway to Sheppard East	8.9	8.9	(29,000)	29,000	0	
Yonge subway extn. to Richmond Hill	8.9	8.9	(29,000)	29,000	0	
Hurontario LRT (assumed as 100% in Peel; 7.7m new/yea	-	-	0		0	
Increases in active transportation	- 10.8	(35,000)	35,000		70,000	
Effect of listed transit enhancements	265.2	(931,000)	336,000	525,000	70,000	
Other transit plans to 2051 (GGH Transportation Plan:						
Finch West LRT extension to Yonge	6.6	(21,000)	21,000			
Eglinton West LRT Renforth to Pearson	7.3	(24,000)	24,000			
Eglinton East LRT Kennedy to Malvern to Sheppard	- 7.0	23,000	(23,000)			
Sheppard Subway extension to McCowan	5.0	(16,000)	16,000			
Jane Street LRT	27.0	(88,000)	88,000			
Net change in daily trips in Toronto, by 2051	304.0	(1,057,000)	462,000	525,000	70,000	
SUMMARY:						
Daily trips in 2051 before current approved transit initiatives	304.0	4,608,000	1,626,000	124,000	1,045,500	8,083,000
Effect of current approved transit initiatives + work-from-hc		(1,057,000)	462,000	525,000	70,000	0
No. of daily trips in 2051 after current approved transit initiatives		3,551,000	2,088,000	649,000	1,115,500	8,083,000
TTS 2016 trips in Toronto, adjusted (per above)		3,754,000	1,437,000	296,000	829,000	6,316,000
Change from 2016 - Number of daily trips in Toronto		(203,000)	651,000	353,000	286,500	1,767,000
		-5.4%	45.3%	119.3%	34.6%	28.0%
Recommended additional transit infrastructure:						
401RT - Pickering Town Ctr. To Hurontario Street (rail)	111.8	(363,000)	363,000			
401RT - Additional buses intersecting with 401RT	46.0	(149,000)	149,000			
401RT - Additional ridership from GO Rail intersects	16.0	(52,000)	52,000			
Total for 401RT	173.8	(564,000)	564,000			
Additional effect of 401RT-GO links on GO ridership	16.0	(52,000)		52,000	0	
Ontario Line N extn: Eglinton to 401RT & to Sheppard E	7.1	(23,000)	23,000			
Increases in active transportation	(12.3)	(40,000)	(40,000)		80,000	
Effect of recommended transit infrastru	184.5	(679,000)	547,000	52,000	80,000	
Less GGHTP rapid transit not needed (duplicative):						
Eglinton West LRT Renforth to Pearson	(7.3)	24,000	(24,000)	0	0	
Eglinton East LRT Kennedy to Malvern to Sheppard	7.0	(23,000)	23,000	0	0	
Sheppard Subway extension to McCowan	(5.0)	16,000	(16,000)	0	0	
Jane Street LRT	(27.0)	88,000	(88,000)	0	0	
Sum of Unneeded/Duplicative initiatives	(32.3)	105,000	(105,000)	0	0	
SUMMARY:						
Total trips in Toronto by 2051 before transit initiatives	304.0	4,608,000	1,626,000	124,000	1,045,500	7,403,000
Effect of current transit enhancements		(1,057,000)	462,000	525,000	70,000	-
Effect of recommended additional transit infrastructure	184.5	(679,000)	547,000	52,000	80,000	-
Effect of unneeded/duplicative transit infrastructure	(32.3)	105,000	(105,000)	0	0	0
No. of daily trips in Toronto in 2051 after all initiatives	456.2	2,977,000	2,530,000	701,000	1,195,500	7,403,000
No. of daily trips in Toronto in 2016		3,754,000	1,437,000	296,000	829,000	6,316,000
Change in daily trips, 2016 to 2051		(777,000)	1,093,000	405,000	366,500	0%
		-20.7%	76%	137%	44%	0%
	Automobile + Trucks	Municipal Transit	GO Transit	Other	Total	
* For Municipal transit, it is assumed that the TTC will undertake a variety of day-to-day enhancements over years to existing TTC services, such as adding buses & more trains to existing routes, to keep pace with population growth. Excludes new subway and LRT routes or extensions.						
N.B. Toronto plans for LRTs on Jane, Sheppard East, Eglinton Avenue East and the waterfront are not included.						

Appendix 3 – Answers to Questions and Concerns



Why A 401RT? – Answering Concerns, and Rescuing Highway 401

August 2021

An east-west rapid transit line across the northern half of Toronto is essential to the Toronto area's economic and social prosperity and environmental sustainability. Its absence is a costly handicap to progress. It has been presented as a "401RT" extending from Pickering Town Centre to Hurontario Street in Mississauga, with up to 34 stations over a 64-kilometre length (including its Sheppard subway segment). Although a great deal of work is now underway on other rapid transit initiatives, it is important that *work to study the feasibility and impacts of a 401RT begins now*.

Although the Eglinton Crosstown LRT and expansions to GO Transit are underway, and plans for new subway and LRT lines have been approved, the scale of what is needed to cut road traffic congestion and its costs is being missed, and measures being taken to date are a collection of piecemeal actions.

Concerns of those who are skeptical of the 401RT idea as workable and important for Toronto are addressed here:

1. For the mostly at-grade 401RT option: Removing a highway lane on Highway 401 when traffic is already congested is a non-starter.

- A survey of Highway 401 users is very likely to show that a significant portion of them would take an east-west rapid transit line across the city to their destinations or to north-south transit. If the modal shift is 20% or more, the lane loss is offset.
- Failure to construct a rapid transit line that can compete with Highway 401 means inevitable worsening congestion and gridlock as Toronto's population and employment continues to grow. Eventually, nothing will move for long periods of the day.
- The 401RT will rescue the 401 by more than doubling the corridor's trip capacity.
- Locating segments of the 401RT at grade in the 401 corridor is the least expensive construction option. However, a mostly-elevated 401RT can be built that avoids closure of a highway lane, but would cost an additional \$2.2 billion to construct.
- Major modal shifts away from using automobiles is a vital part of reducing rapid climate change impacts.

2. The suburbs are not the place for subways; ridership will not be enough.

Several factors will make a 401RT operationally viable:

- Over many decades, jobs and people have gravitated towards locations near Highway 401 or are along major arterial roads that intersect with the highway.
- Transit connections contribute to making it work. A 401RT will create potentially up to ten north-south rapid transit connections, and two dozen stops at major arterial roads.
- The 401RT would deliver many people close to final daily destinations (for example, Pearson International Airport and Scarborough Town Centre).
- Comparatively, GO Transit operates almost all of its rail stations in the suburbs and is an operational success; about 96% of its riders go to a single high-density stop (Union Station), whereas the 401RT will deliver travelers to many significant destinations.
- Many people today are forced to drive a car because of the absence of east-west rapid transit in northern Toronto, and would welcome an alternative.
- Estimated ridership for the 401RT and GO Transit impacts is 189 million new transit trips per year; the Ontario Line extension north of Eglinton East will add another 14 million new transit trips per year. An extension of the Ontario Line north of Eglinton Avenue East is necessary to avoid adding to congestion on the Yonge subway.

3. The Ontario government is already doing what it can to reduce road traffic congestion in the GTA.

- No, it is not. Politically-determined budget decisions constrain what is done and what can be done.
- Current transit initiatives funded by Ontario – the Eglinton LRT, GO Transit expansion, and Ontario’s new subway/LRT plan are necessary, but will not be enough to stop long term growth in road traffic congestion in Toronto. While altogether they may generate perhaps 120 million new transit trips per year, the total number of trips by automobile in Toronto will remain approximately the same (see Appendix 2). A 401RT across the northern half of Toronto and an Ontario Line extension to Sheppard East will reduce the use of automobiles in Toronto by more than 200 million, compared to 2016 levels.
- The key to real cuts to road traffic congestion is to maximize modal shifts, but most users of the Eglinton LRT and new subways and LRTs will be transfers of existing transit riders from current transit services. Ontario’s should focus on more modal shifts.

4. We can’t afford it. There’s a deficit and taxes are already too high.

- Failure to adequately address road congestion is much less affordable. Estimates of the cost of congestion in the Toronto area are in the billions of dollars per year, borne by households and businesses. 1.8 million people in cars and trucks on Highway 401 between Hurontario Street and Liverpool Road suffer from congestion and car costs *now*, and that is unaffordable.
- The gross infrastructure cost of the 401RT is \$19.8 billion for a mostly-at-grade 401RT and \$22.5 billion for a mostly-elevated 401RT, plus the \$3.8 billion Ontario Line extension from north of Eglinton Avenue East to Sheppard Avenue East. These costs can be partially offset

by the federal share of one-third of gross costs, and not building the Eglinton West LRT north of Renforth Drive, the Eglinton East LRT beyond Eglinton Avenue, the Sheppard subway extensions, and possibly the Jane Street LRT.

- A 401RT mostly at grade in the Highway 401 corridor is the least expensive way to move people onto a viable rapid transit line across the northern half of Toronto.
- If the 2019 Ontario Plan for Rapid Transit for Toronto is considered worthwhile, a 401RT is much more so – the 401RT is three times as cost-effective, based on cost per new transit user.
- Whether taxes are too high is a subjective opinion, based on the degree to which people have prioritized their after-tax incomes.
- ***It makes sense to undertake the 401RT analyses now***, so that construction can begin when the time is right, such as when job-creation measures are especially needed, as during an economic recession, or when current project work begins to wind down.
- Up-front analyses cost relatively little.

5. The northern parts of Toronto will be well-served by the Eglinton Crosstown LRT, especially when it is extended.

- The Eglinton Crosstown LRT is geographically within the southern half of Toronto. The northern half of Toronto and several adjacent Wards in the '905' area is home to 1.3 million people and several hundred thousand jobs – including the airport employment megazone around Pearson International Airport, and the airport itself. Under current plans, northern Toronto will remain very poorly served by east-west rapid transit.
- It should be noted that the essential 401RT would render the eastern extension and much of the western extension of the Eglinton Crosstown LRT unnecessary, while with those extensions a 401RT is still necessary – in other words, building those LRT extensions will be a duplicative mistake. (An Eglinton Crosstown LRT extension to Kingston Road, and no further, would be useful.)

6. There would be too much disruption during construction.

For a mostly-at-grade 401RT,

- Work on building a 401RT should begin before highway volumes increase further; delays will make construction more difficult and congestion temporarily worse.
- Without a 401RT, locking Toronto into permanent disruption via growing congestion and gridlock will be much worse. That must ***not*** be allowed to happen. It may also be true that few years of construction for a 401RT is not much different than delays that occur now.
- Construction can begin with off-highway segments, including to/from: Pickering Town Centre, Scarborough Centre, the Sheppard Subway, Yorkdale station, the off-highway diversion to/from Pearson, and the Mississauga Airport Corporate Centre.
- Once tunneled segments rise onto the surface of the 401, multiple construction companies can, within even a single year, construct and complete the on-highway stations and at-grade tracks between stations. However, some construction by private developers of

multi-level buildings above the highway that envelop stations may require more than a year to build.

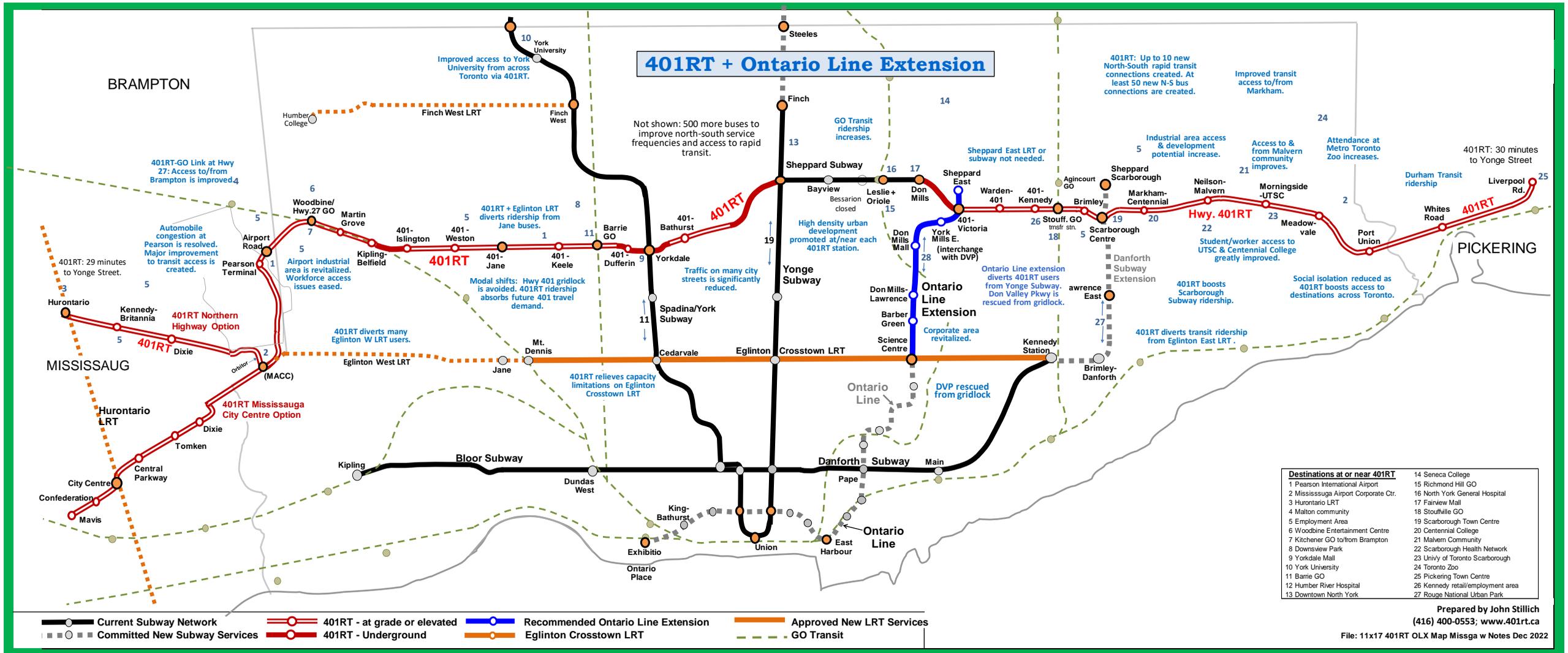
- During construction, the TTC can provide special east-west express bus services to/from key destinations.

For a Mostly-Elevated 401RT (preferred):

- For an additional ≈\$2 billion dollars, the 401RT can be built as a mostly-elevated rapid transit line above the surface of Highway 401. Ground-level disruptions can be limited to the construction of the pillars that support the transit line, safety measures that will need to be in place as stations are constructed above the highway, and scheduling to avoid peak hour highway volumes. Stations will remain above the highway until they turn to off-highway locations.

A full-length east-west rapid transit line from Pickering Town Centre and Hurontario Street across the northern half of Toronto and an extension of the Ontario Line north of Eglinton East to Sheppard Avenue East at Victoria Park Avenue will rescue the Highway 401 transportation corridor from becoming non-functional for extended periods of time each day, will rescue the Don Valley Parkway, and will transform transportation across the region. It is inevitable and needs a full detailed analysis by transportation agencies on an urgent basis.

Quite simply, if a 401RT or rapid transit line of similar length and location is not built soon, with its many north-south linkages, there is no hope of containing a worsening of road congestion and environmental damage in the core of the GTA.



Why a 401RT + Ontario Line Extension?

- 1 Current transit initiatives will not generate enough modal shifts to transit to stop road congestion or GHG emissions.
- 2 The functionality of Hwy 401 in Toronto is at risk as travel demand increases.
- 3 Trips to, from and across northern Toronto are currently poorly served by rapid transit.
- 4 66% of daily trips in 2016 by northern Toronto residents were by automobile, including trips to downtown Toronto.
- 5 Rapid climate destabilization and warming require this level of investment, on an urgent basis.
- 6 Operational viability: The 401RT's length and connectivity produce an approximate 90% cost recovery.
- 7 It is affordable. Debt carrying costs per Toronto household as low as 20 cents per day by 2051, for Ontario and Toronto shares of costs.