Mistry, Natasha (MTO)

From:	Kutisker-Jacobson, Laura (MTO)
Sent:	October-21-16 9:54 AM
To:	Amirali, Abid (MTO)
Subject:	RE: HSR 250kph note
Attachments:	250 kph Preliminary Benefits and Costs v1.docx

Attached

From: Amirali, Abid (MTO)
Sent: October 21, 2016 9:12 AM
To: Kutisker-Jacobson, Laura (MTO)
Subject: FW: HSR 250kph note

steer davies gleave

Technical Note

To	Ministry of Transportation - Ontario
Cc	Krista Adams, Abid Amirali, Jacqueline Lively
From	Patrick Miller and Leslie Buckman
Date	19 October 2016
Project	Preliminary Business Case for High Speed Rail on the Toronto to Windsor Corridor
Project No.	22897601

Update on Costs and Benefits of 250 km/h Operation Toronto to Kitchener-Waterloo

Introduction

1. In early 2016, Steer Davies Gleave developed a Preliminary Business Case for High Speed Rail (HSR) in the Toronto-Windsor corridor. At that time, two scenarios were developed, providing a range of the costs and benefits of a HSR system:

   - Scenario A, providing 300kph operational capabilities, with direct access to Pearson Airport;
   - Scenario B, which aimed to use existing rights of way where feasible and operate at a lower speed of 200kph; access to Pearson was assumed via a station on the Kitchener corridor with some form of dedicated transit access

2. Following that study, the HSR proposal has been developed further, with consideration given to the appropriate specification for HSR. The result is a preference for a 250kph capable system.

3. This note therefore provides an update on the business case for HSR with a 250kph system. The focus of the analysis reported here is on the Toronto-Kitchener section of the corridor.

Comment [KL(1]: Understood for the context of this memo. However, for the final report, presentation should respond to the whole corridor.

Updates on runtimes, ridership and revenue

4. Changing to a 250 km/h compliant vehicle improves the overall journey time for passengers along the Toronto to Kitchener segment of the HSR corridor. A comparison of runtimes between the assumed RER network, Scenario B used in the preliminary business case and the new HSR 250 km/h scenario is shown in Table 1. Note that these times are the minimum achievable; in practice, the addition of slack time and the constraints of timetabling will extend these times marginally.

Comment [KL(2]: Previous advice from planners have indicated an empirical 15-30% factor can be added to runtimes for these types of constraints. Is there any more concrete guideline that could be used to assess the actual impact?

Table 1: Comparison of Runtimes for HSR and RER from Toronto to Kitchener-Waterloo

	HSR – Scenario B	HSR – 250km/h	RER
Runtime (hh:mm)	00:51	00:44	00:58
Top Speed	190 km/h	250 km/h	160 km/h
Average Speed	114 km/h	130KM/H	100 km/h

5. With corridor optimization, HSR at 250 km/h is able to provide an improved runtime, with identified ways to improve the corridor's speed allowances, thus achieving longer cruise times at higher speeds.

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6. Scenario B did not include RER service expansion above those provided in Scenario 5 of the RER business case (2 peak direction trains/hr, providing 6 trains in total inbound in the weekday morning and 6 outbound in the weekday evening). Current proposals are for 2 trains/hr two way all day (TWAD), providing service akin to the Lakeshore Line now.

7. The 250 km/h HSR analysis assumed two RER options:

- **Option 1 -** Two trains per hour for RER and HSR
- **Option 2 – (a)** one RER train per hour and **(b)** four RER trains per hour – both with two HSR trains per hour

8. Table 2 shows the resulting HSR and RER ridership for each option, and the peak ridership and peak capacity.

Table 2: Comparison of Ridership for HSR and RER Scenarios

	Scenario B	Option 1 RER (2tph)	Option 1 HSR (2tph)	Option 2a RER (1 tph)	Option 2a HSR (2tph)	Option 2b RER (4tph)	Option 2b HSR (2tph)
Annual Demand (2041)	8,184,000	2,603,000	6,122,000	2,017,000	5,007,000	2,658,000	6,067,000
Daily Demand (2041)	32,500	10,400	24,500	8,100	20,000	10,600	24,300
Peak Point Demand (passengers)	1,890	620	1,800	480	2,000	620	1,700
Peak Capacity	2,400	2,600	1,200	1,300	1,200	5,200	1,200
Volume/Capacity peak	75%	24%	150%	37%	167%	12%	142%
Shoulder peak demand	1580	510	1500	400	1670	520	1420
Peak Shoulder Capacity	2,400	2,600	1,200	1,300	1,200	5,200	1,200
Volume/Capacity shoulder peak	66%	20%	125%	31%	139%	10%	118%
Total pass daily demand suppressed			12%		15%		10%

Comment [KL(3]: Further discussion with SDG required. We don't fully understand why demand changes with service patterns. Suspect it may have to do with service frequency but a little more explanation might be useful. Please also see comments on page 5 – point 17.

9. This preliminary demand analysis suggests that all HSR options will have suppressed demand in the peak and shoulder peaks (peak period). This limits both the revenue and the benefits that can be realized by the HSR service. However, RER has excess capacity and so these riders may choose RER; conversely, they may chose to remain with their existing mode choice (bus, air, auto).

Comment [KL(4]: Is this "However" or "In addition, ". It seems that this sentence would exacerbate the limitations on HSR revenue and benefits.

Update on infrastructure requirements and costs

Table 3 outlines the incremental costs to deliver HSR above the investment required to deliver RER along the corridor. These costs reflect the significant changes required to provide both RER and a 250 km/h HSR, which are noted in

Comment [KL(5]: Typo? Should be a continuous sentence.

10. Table 4. The same costs and requirements are used for option 1 and option 2a; however, 2b has not been calculated and is expected to exceed both 1 and 2a.

Table 3: Infrastructure requirements for 250 km/h HSR

	Incremental HSR cost above RER development (million 2015$)
Track Costs Excluding Electrification	$459
Civil Costs	$1,420
Rail Systems Cost Excluding Electrification	$523
Utility and Clearing/Grubbing Cost	$415
Station Cost	$880
Electrification Cost	$177
Total	$3,874

Table 4: HSR 240 km/h Infrastructure Requirements Incremental to RER

Change	Description
Rail-to-rail grade-separation at Wice	UPX tracks go over the main line tracks from the north side of the corridor at Hwy 27 to the south side by Hwy 427.
Fly-under at Halwest	Eastbound slow track passes beneath the fast tracks to get from the south side at Bramalea station to the north side at Halwest near Torbram Rd.
Staged pocket arrangement between Winston Churchill Blvd (west of Mt Pleasant) and the Credit River bridge	This arrangement provides a pocket track between the eastbound slow and the eastbound fast tracks near Winston Churchill Blvd, another pocket track between the two fast tracks in the middle, and a third pocket track between the westbound fast and westbound slow tracks near the Credit River.
Bridge Widening	Bridges have been recalculated to accommodate four tracks in areas where previously fewer than four had been accommodated east of Acton, with the exception of Brampton where some bridges remain two tracks wide. Freight by-pass has a cost assigned for widening it from two to four tracks.
Service Tracks	Service tracks between Kipling Ave in Toronto and Rutherford Rd in Brampton have been added to the HSR estimate as it is forcing challenges beyond what RER envisions for accommodating mixed traffic.
Station Modifications	Bramalea and Georgetown stations have been given an allowance for modifications to tracks and platforms for straightening the alignment, and in the case of Georgetown, an additional allowance has been provided to move the historic station building which is obstructing a straightening of the alignment in its existing location.
Silver Junction	Silver junction has been costed for reconfiguration to allow a straight-run through on the Guelph subdivision from the Halton subdivision. This was not a part of RER, even though it would have been logical to be part of RER. There is no merit to maintaining the existing arrangement if through-freights have been moved off the line.
Malton Station	Malton station expansion and upgrade to HSR specification has been added, replacing the standalone Pearson HSR station cost used previously. This matches what has been done for Guelph station.

Comment [KL(6]: Not necessarily as part of this memo, we would appreciate a breakdown of these cots. For example, utilities and clearing and grubbing may largely be covered by RERE (apart from pocket tracks) and out initial feel is that this number may be high. Utility costs should be minimal IF relocations are coordinated with RER works. Please show capital and uplifted costs in this section

Comment [KL(7]: 250?

Comment [KL(8]: 1. In a subsequent submission, schematics of these upgrades would be useful
2.For phasing report due next week, we suggest that these interventions are analysed for which should be planned *with* RER (i.e. prior to RER completion but without jeopardising RER timelines) and which could be implemented *after* RER. The latter situation would result in slower initial HSR service (with possible short term impacts to demand) but ensure that RER commitments are not jeopardised by HSR delivery. If there is insufficient detail on RER development plans available, the final report should include working around planning integration and construction optimisation.
3.For station modifications, have amendments to platform heights (and potentially lengths) have been considered for level boarding.
4.Could further motivation for the need for grade separations.

Update on Benefits

11. HSR leads to two types of primary economic benefits:

- **User Benefits –** travel time savings and changes in auto operating costs
- **External Benefits –** benefits delivered by reducing automobile travel along the corridor, which leads to reduced peak congestion, automobile accidents, and air/climate change emissions

12. User benefits are driven by travellers switching to HSR. These benefits represent the difference in 'generalized time' of the transport mode chosen in the status quo compared to the HSR alternative. This difference is used to calculate a travel time saving. For users that switch from automobile, an additional benefit is calculated based on the reduction in auto travel, which reduces their operating costs over time. Fares and revenue are not included as benefits for customers (a disbenefit) and producers (revenue) because they are a transfer payment.

13. External benefits are driven by customers who are currently travelling by auto and switch to HSR. Mode shift is based upon the comparative 'generalized time' of travel along the corridor – as HSR becomes more competitive compared to automobile, there will be a larger shift and larger benefits. HSR's ability to realize benefits is also reliant on the reliability of service (not included in this stage of analysis) and the available capacity of the HSR network. If the HSR network cannot serve passenger demand, the overall benefits will be constrained to the benefits of the demand that HSR can serve.

14. A comparison of benefits between the HSR options is shown in Table 1Table 5 along with Net Present Values (NPV) and Benefit Cost Ratios (BCR) for each option.

Table 5: HSR Option Benefits from Toronto to Kitchener

Cost or Benefit	Scenario B	HSR Option 1	HSR Option 2a
Capital Costs (Million 2021$)	$7,900	$4,800	$4,800
60 year operating costs (Million 2021$)	$2,090	$2,320	$2,320
60 year life cycle costs (Million 2021$)	$730	$730	$730
Present Value of Cost (Million 2021$)	**$10,720**	**$7,850**	**$7,850**
60 Year Passenger Travel Time Benefits (Million 2021$)	$4,210	$2,690	$2,660
60 Year Auto Operating Cost Savings (Million 2021$)	$4,640	$3,170	$4,350
60 Year Decongestion Benefits (Million 2021$)	$1,390	$950	$1,310
60 Year HSR GHG Benefits (Million 2021$)	$80	$50	$70
60 Year Safety Benefits (Million 2021$)	$590	$400	$550
Present Value of Benefits (Million 2021$)	**$10,910**	**$7,260**	**$8,940**
NPV of Project (Million 2021$)	$190	-$590	$1,090
BCR	1.02	0.92	1.14

Comment [KL(9]: This comparator is entirely equivalent as the costs and benefits are still included in Scenario B. In the final report, Scenario B without these RER costs and benefits should be determined as a more accurate comparator.

Comment [KL(10]: As this figure is not the same provided in Table 3 (1Bn more), it would perhaps be clearer if the costs 'reassigned' to RER from Scenario B were indicated in the report.

Capital costs for Scenario 2b have not been calculated – they are expected to exceed costs for option and 2a.

Comment [KL(11]: Inferring from Table 2, Demand for Option 1 and 2b are the same. So if costs are much higher for Option 2b, it is not worth calculating the BCR (because demand and by extension benefits) are the same. Is this the correct inference?

Emergent Findings

15. The key variations between Scenario B and the new runs are:

- Reduced costs in option 1 and 2a – because these options use incremental costs beyond RER, their costs are lower than Scenario B, which assumed full costs
- Reduced benefits in option 1 and 2a – these options have lower benefits because of competition with RER, which reduces overall ridership and the level of demand and benefits that can be realized

16. Overall, option 2a offers a general increase in benefits driven largely by lower costs. Because this option loses less demand to RER, it has an overall higher benefits profile compared to option 1. Option 1 loses 44% of benefits and Option 2a loses 19% of benefits compared to Scenario B due to competition with RER and the inability to meet demand.
17. If option 1 were to increase its peak and peak shoulder capacity to meet all demand, its BCR would be 1.05 and its NPV would be $410million. This is an overall increase compared to the base scenario, despite the losses to RER due to lower capital costs.
18. Future work could further optimize the HSR benefits by testing further HSR service plans for both options 1 and 2a.

Comment [KL(12]: The conclusions focus around the omission of RER costs and benefits and not really on whether the faster 50km/hr results in a higher BCR. Is there a point in considering Scenario B without RER costs and benefits at this stage as a comparator so that we can determine the relative value of the 50km/hr speed increase?

Comment [KL(13]: While realising the instruction was to consider three modeling options (Option 1, Option 2a and Option 2b in this memo), does this statement imply that Option 3 should consider 1 RER and 3 HSR trains per hour?