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**APPENDIX I**

**TRANSIT TRAVEL TIME SAVINGS**

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**TO:** Rob Hunton  
**FROM:** Ian Borsuk  
**DATE:** July 21, 2010  
**OUR FILE:** 7499 West Transitway (Bayshore to Moodie)  
**SUBJECT:** Transit Travel Time Benefits – 2021 and 2031 Planning Horizon

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**APPENDIX A – TRAVEL TIME CALCULATIONS**

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## **1.0 Introduction**

The purpose of this memo is to document the forecast transit travel times for alternative configurations of the proposed West Transitway extension from Bayshore Station to Moodie Drive. The analysis considers the alternative geometry, average transit operational speed, as well as signal and congestion delays at the at-grade intersections.

The analysis is based on traffic and transit volumes that have been forecasted for the 2031 and 2021 planning horizon as documented in the MEMO titled “Traffic Analysis – 2031 planning horizon & 2021 Interim Year.”

Existing traffic and transit conditions have been documented previously in a MEMO titled “West Transitway Existing Transit and Transportation Review” dated February 18, 2010.

## **2.0 Alternative Transitway Configurations**

It is proposed for the West Transitway extension project, that the Transitway be located on the north side of Highway 417. This analysis considers the alternative intersection configurations of the Transitway with Holly Acres Road and with Moodie Drive. The “do-nothing” alternative is also considered with 2031 traffic and transit volumes in order to compare the forecast travel times.

Two alternatives are considered where the Transitway intersects Holly Acres Road; at-grade or grade separated. At Moodie Drive there are three alternatives considered; an at grade intersection, a grade separation, or a partial grade separation where eastbound buses are at-grade while westbound buses are grade separated. The following table summarizes the combination of alternatives being considered:

**Table 1: Alternative Transitway Configurations**

<b>Alternative Configuration</b>	<b>Intersection</b>	
	<b>Holly Acres</b>	<b>Moodie Drive</b>
1	Do Nothing	Do Nothing
2	At Grade	At Grade
3	At Grade	Partially Separated
4	At Grade	Grade Separated
5	Grade Separated	At Grade
6	Grade Separated	Partially Separated
7	Grade Separated	Grade Separated

## **3.0 Travel Time Savings**

Changes in travel time are due to two primary factors; changes in the physical design of the facility (such as length), and changes in signal and congestion delay. Both of these elements are discussed in the sections below. The analysis assumes that station dwell

times are constant in all alternatives and are therefore not included in the overall travel time comparison.

**3.1. Travel Time Savings Due to Physical Design**

Relocating the eastbound Transitway to the north side of the highway between Moodie Drive and Holly Acres Road, results in a shorter route length than the “Do nothing” alternative. Various Transitway configurations may also allow buses to travel at higher average operational speeds. Without considering signal and congestion delay, an at-grade intersection results in lower average operational speeds than the grade separated alternatives. The following two tables present the travel time based on the physical design of the facility only.

**Table 2: Eastbound from Eagleson Road to Bayshore Station**

Alternative	Intersection		Length	Travel Time
	Holly Acres	Moodie	Meters	min:sec
1	Do Nothing	Do Nothing	7365	6:51
2	At Grade	At Grade	7178	6:51
3	At Grade	Partially Separated	7161	7:05
4	At Grade	Grade Separated	6901	6:16
5	Grade Separated	At Grade	7178	6:50
6	Grade Separated	Partially Separated	7161	6:37
7	Grade Separated	Grade Separated	6901	6:02

**Table 3: Westbound from Bayshore Station to Eagleson Road**

Alternative	Intersection		Length	Travel Time
	Holly Acres	Moodie	Meters	min:sec
1	Do Nothing	Do Nothing	6625	6:05
2	At Grade	At Grade	6625	6:05
3	At Grade	Partially Separated	6625	6:05
4	At Grade	Grade Separated	6625	6:05
5	Grade Separated	At Grade	6625	5:50
6	Grade Separated	Partially Separated	6625	5:50
7	Grade Separated	Grade Separated	6625	5:50

**Notes:**

1. Acceleration and deceleration rates assumed to be constant (  $a = 1 \text{ m/s}^2$ ,  $d=1.2 \text{ m/s}^2$ )
2. Effects due to profile grades not factored in the calculations
3. Does not consider station dwell times, signal delay, or congestion delay

Providing grade separations at both Holly Acres and Moodie Drive with the Transitway results in an eastbound travel time savings of approximately 50 seconds compared with the “do-nothing” scenario without considering the effects of highway congestion or signal delay at intersections.

There is no significant change to the length of the route for westbound buses therefore the savings would be only 15 seconds due to the design elements of the facility.

**3.2. Travel Time Savings Due to Congestion and Signal Delay**

The MEMO titled “Traffic Analysis – 2031 planning horizon & 2021 Interim Year” documented the intersection Level of Service (LOS) for the various configurations at Holly Acres Road and Moodie Drive for the 2031 planning horizon. The analysis considers the forecasted traffic and transit volumes, as well as the intersection geometry to determine appropriate signal timings. The existing traffic and transit volumes identified as part of the “West Transitway Existing Transit and Transportation Review” were used with optimized signal timings to help understand the benefits of each alternative. Optimized signal times were determined using Synchro to balances delays in all directions in order to compare with optimized 2021 and 2031 results (Appendix B). The delay identified for the Transitway approaches were identified and are used in this analysis. The following tables present the eastbound and westbound signal and congestion delays for each alternative.

**Table 4: Eastbound Transitway Average Signal and Congestion Delay (seconds)**

Intersection	Alternative	Existing		2021		2031	
		AM	PM	AM	PM	AM	PM
Holly Acres	Do Nothing	31	33	61	40	65	45
Holly Acres	At-grade	21	18	30	25	40	29
Holly Acres	Grade Separated	No Signal & Congestion Delay					
Moodie	Do Nothing	28	27	25	35	19	34
Moodie	At-grade	85	77	98	72	65.8	18.9
Moodie	Partially Separated	24	61	26	61	3.5	1.4
Moodie	Grade Separated	No Signal & Congestion Delay					

Note: Delay identified at Moodie Drive includes both ramp intersections North and South of Highway 417

**Table 5: Westbound Transitway Average Signal and Congestion Delay (seconds)**

Intersection	Alternative	Existing		2021		2031	
		AM	PM	AM	PM	AM	PM
Holly Acres	Do Nothing	34	28	47	36	81	47
Holly Acres	At-grade	12	10	18	13	23	17
Holly Acres	Grade Separated	No Signal & Congestion Delay					
Moodie	Do Nothing	26	25	38	28	34	31
Moodie	At-grade	73	142	119	124	168	214
Moodie	Partially Separated	No Signal & Congestion Delay					
Moodie	Grade Separated	No Signal & Congestion Delay					

Note: Delay identified at Moodie Drive includes both ramp intersections North and South of Highway 417

**3.3. Total Travel Time Savings**

Considering both the savings due to the revised physical design as well as the signal and congestion delay, the total average transit travel time savings between alternatives were determined. The following tables present the total travel times between Eagleson Road and Bayshore Station for eastbound and westbound buses considering the existing, 2021 and 2031 transit and traffic volumes. Station dwell times remain the same between alternatives and are therefore not included in the analysis.

**Table 6: Total Eastbound Transitway Average Travel Time (min:sec)**

Holly Acres	Moodie	Existing		2021		2031	
		AM	PM	AM	PM	AM	PM
Existing	Existing	7:50	7:50	8:16	8:06	8:15	8:10
At Grade	At Grade	8:51	8:40	9:12	8:41	8:50	7:53
At Grade	Partial	7:36	8:09	7:46	8:17	7:34	7:21
At Grade	Separated	6:37	6:33	6:45	6:40	6:16	6:16
Separated	At Grade	8:36	8:25	8:57	8:26	8:35	7:38
Separated	Partial	7:22	7:55	7:32	8:03	7:20	7:07
Separated	Separated	6:02	6:02	6:02	6:02	6:02	6:02

Note: Does not include dwell time at stations

**Table 7: Total Westbound Transitway Average Travel Time (min:sec)**

Holly Acres	Moodie	Existing		2021		2031	
		AM	PM	AM	PM	AM	PM
Existing	Existing	7:04	6:57	7:29	7:08	8:00	7:23
At Grade	At Grade	7:29	8:37	8:21	8:22	9:15	9:56
At Grade	Partial	6:16	6:14	6:22	6:18	6:27	6:22
At Grade	Separated	6:16	6:14	6:22	6:18	6:05	6:05
Separated	At Grade	7:14	8:22	8:06	8:07	9:00	9:41
Separated	Partial	6:01	5:59	6:07	6:03	6:12	6:07
Separated	Separated	5:50	5:50	5:50	5:50	5:50	5:50

Note: Does not include dwell time at stations

The above tables indicate that the existing transit services will experience increasing delays as traffic volumes increase at the signalized intersections. It is important to note that the identified travel times do not include the additional congestion delays on Highway 417 which would impact the transit service due to the existing operations in mixed traffic lanes. As highway congestion increases, the transit service would also experience more delays and overall service reliability would be impacted. An objective of the west Transitway extension between Bayshore and Moodie Drive is to provide an exclusive facility so that buses would not be impacted by highway traffic and thereby increasing overall bus service reliability.

A Transitway alignment that is fully grade-separated from vehicular traffic at both Holly Acres Road and Moodie Drive has the potential of reducing the eastbound transit travel times by approximately 2 minutes in the AM peak period compared to the existing

intersection configuration in 2031. In the PM, the westbound travel time savings would be approximately 1.5 minutes.

#### **4.0 Conclusion**

The at-grade intersection of the Transitway at Holly Acres Road operates with acceptable reliability and minimal delays to transit. The geometry and signal timings results in decreased delay compared to the existing configuration. A grade separated alternative allows for higher average operating speeds and eliminates the signal delay at the intersection.

While the traffic analysis indicates that the at-grade crossing of the Transitway at Holly Acres could accommodate the forecast volumes, issues such as construction staging and vibration have been identified which has led to the recommendation of grade separation at this intersection.

The at-grade intersection of the Transitway at Moodie Drive will not accommodate the forecast 2031 traffic and transit volumes at acceptable Levels of Service. An at-grade configuration would reach capacity during the PM for the existing volumes due to the need to introduce a separate Transitway signal phase and associated greentime. With appropriate monitoring and adjustment to signal timings, the at-grade intersection would offer adequate Levels of Service for the 2021 planning horizon at which point the additional delays and queues become unmanageable.

The partial and fully grade separated alternatives of the Transitway at Moodie Drive minimize the westbound transit service delays. A partial grade separated solution will therefore need to be in place to adequately serve the forecast transit and traffic volumes for the 2021 planning horizon.

The changes in travel times are summarized as follows:

- Opening Day: At-grade at Moodie Drive
  - AM Eastbound buses: 0:46 longer than existing
  - PM Westbound buses: 1:25 longer than existing
- Interim 2021: Partially separated at Moodie Drive
  - AM Eastbound buses: 0:44 shorter than “Do Nothing”
  - PM Westbound buses: 1:05 shorter than “Do Nothing”
- Ultimate 2031: Fully grade-separated at Moodie Drive
  - AM Eastbound buses: 2:13 shorter than “Do Nothing”
  - PM Westbound buses: 1:33 shorter than “Do Nothing”

The fully grade separated alternative can only be operated once the Transitway is extended further west from Moodie Drive to Eagleson Road. The analysis shows that the interim “Partially Separated” configuration can operate adequately until the end of the 2031 planning horizon.

Memo To: R. Hunton  
Date: July 21, 2010

## **Appendix A – Travel Time Calculations**

- 2021 Signal Delay
- 2031 Signal Delay
- Travel Time Savings Due to Physical Design
  - Existing Configuration “Do Nothing”
  - Holly Acres at-grade, Moodie at-grade
  - Holly Acres grade-separated, Moodie at-grade
  - Holly Acres at-grade, Moodie partially-separated
  - Holly Acres grade-separated, Moodie partially-separated
  - Holly Acres at-grade, Moodie grade-separated
  - Holly Acres grade-separated, Moodie grade-separated

Memo To: R. Hunton  
Date: July 21, 2010

**Appendix B – Synchro™ Level of Service Calculation Sheets (Existing 2009 Volumes, Optimized Timings)**

- 2009 Holly Acres
  - Existing configuration – optimized signal timings (AM/PM)
  - At-grade (AM/PM)
- 2009 Moodie Drive
  - Existing configuration – optimized signal timings (AM/PM)
  - At-grade (AM/PM)
  - Partially-separated (AM/PM)

Note:

The Synchro LOS calculations for the existing volumes with existing signal timings are included as part of the “West Transitway Existing Transit and Transportation Review” dated February 2010.

Synchro calculations for the 2021 and 2031 planning horizons are included as part of the “Traffic Analysis – 2031 Planning Horizon & 2021 Interim Year” dated July 2010.