SRPRS.18.085
Appendix 2

Town of Richmond Hill

HIGH TECH ROAD

Active Transportation and Access Modification Study

18081/200 February 2018

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1 INTRODUCTION

Following the completion of the Red Maple Road and High Tech Road Operations Review (RMHT Operations Review) dated May 2015, a number of conclusions and recommendations were provided to the Town of Richmond Hill with respect to improving safety and operations of the High Tech Road and Red Maple Road area. These conclusions and recommendations also extended to improving active transportation connectivity and safety, primarily at unsignalized intersections lacking controlled or uncontrolled pedestrian crossings.

The purpose of this study is to update the findings and recommendations of the RMHT Operations Review regarding High Tech Road, or in particular the High Tech Road & 30 High Tech Road/Cinema Driveway, as well as to provide a series of access modification options and an accompanying evaluation matrix. These options and the evaluation matrix are to inform the Town of the various pro and cons of each potential option.

In developing the series of options, a number of transportation analyses and assessments from the RMHT Operations Review will be updated, or new analyses and assessments will be added. These will include:

- Walking/Cycling Audit with Connectivity Options;
- Pedestrian/Cycling Surveys with Assessment of Pedestrian/Cycling Travel Behaviours; and,
- Updated Synchro Analysis of High Tech Road & High Tech Road Driveways.

2 BACKGROUND & CONTEXT

This study will investigate High Tech Road between Yonge Street and Red Maple Road. As revealed in the RMHT Operations Review, a number of transportation concerns are present along this road segment, as well as at the abutting properties on both the north and south sides of High Tech Road. **Figure 2-1** below illustrates the study area of focus and key points of interest.

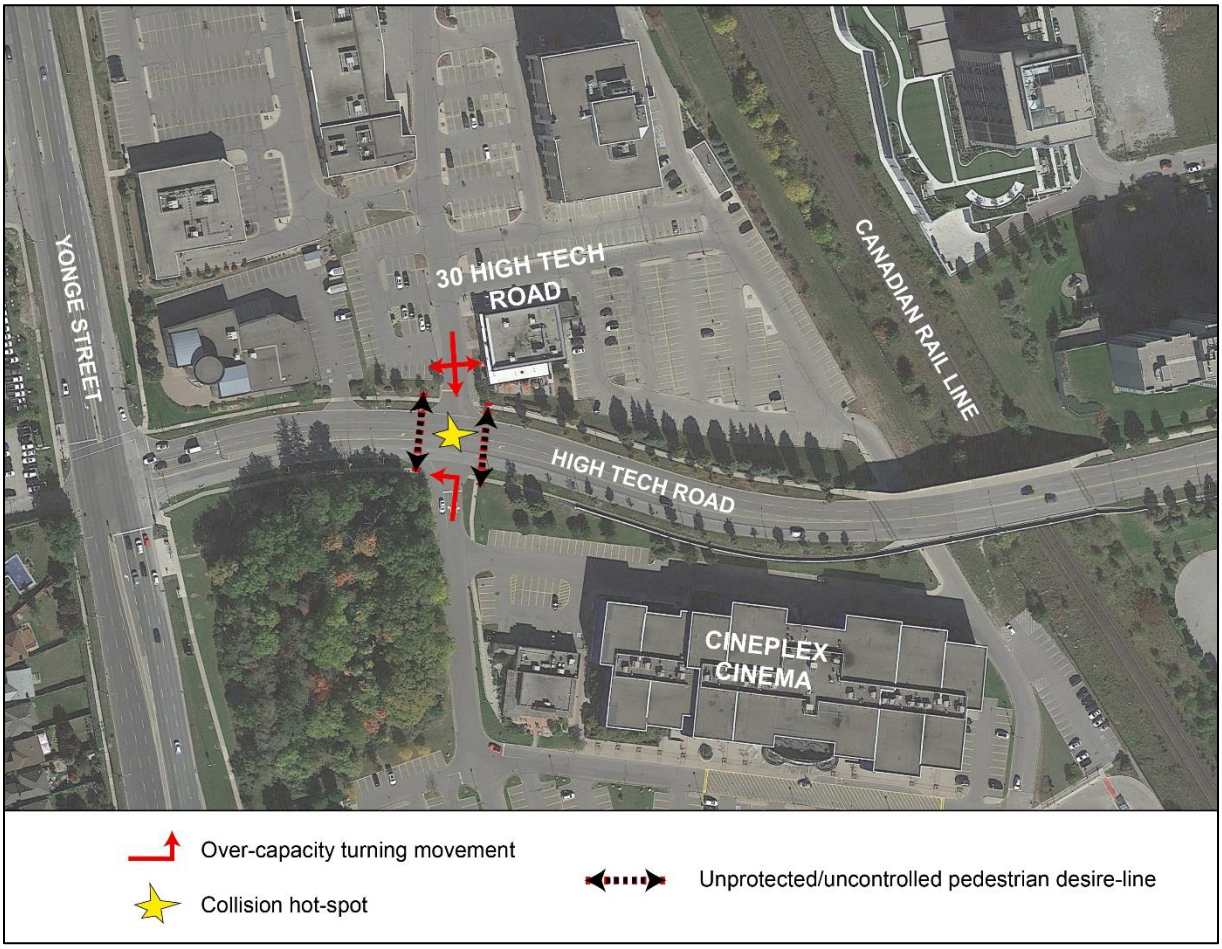


Figure 2-1: Study Area Context and Points of Interest

As discovered in the RMHT Operations Review, there are a number of key points of interest, which include:

- Constrained and over-capacity turning movements at the unsignalized intersection of High Tech Road & 30 High Tech Road/Cinema driveway;
- Significant incidence of collisions at the High Tech Road & 30 High Tech Road/Cinema driveway intersection;
- Pedestrians crossing High Tech Road between 30 High Tech Road and the cinema in the absence of either a controlled or uncontrolled dedicated crossing point; and,
- Barriers to pedestrian connectivity to the 30 High Tech Road plaza or the cinema property including the Canadian Rail Line overpass.

To address these issues, the RMHT Operations Review recommended, primarily, two (2) potential modifications to the intersection of High Tech Road & 30 High Tech Road/Cinema driveway. These two (2) potential options included:

1. **Signalization**: Signalizing the High Tech Road & 30 High Tech Road/Cinema driveway would reduce capacity constraints, and improve vehicle safety with the provision of an advanced signal warning system. Signalization would also provide a protected and controlled crossing opportunity to pedestrians and cyclists; and,

2. **Right-In, Right-Out**: An option was devised where movements at the High Tech Road & 30 High Tech Road/Cinema driveway intersection would be limited to right-in, right-out. Due to the presence of the underpass to the east of this intersection connecting the two (2) properties on the north and south side of High Tech Road, a detour would be available allowing drivers to/enter and exit either property in the desired direction. This option would greatly decrease likeliness of vehicle collision, but would not enhance pedestrian/cyclist connectivity.

Both recommended options were concluded to significantly improve vehicular operations and increase vehicular safety, with the signalized option providing the added benefit of improving pedestrian/cyclist connectivity. This study will function as an update to the High Tech Road investigation conducted in the RMHT Operations Review, building upon these previously recommended options and evaluating modifications to these options or the introduction of new options.

2.1 DATA COLLECTION PROGRAMME

As part of this study, which is to update and reassess the recommendations and findings of the RMHT Operations Review, active transportation and traffic data have been collected. **Table 2-1** below summarizes the types and locations of the collected data.

Active Transportation	Traffic
Pedestrian Crossing Volumes: • High Tech Road & 30 High Tech Road/Cinema	Turning Movement Count (TMC): • High Tech Road & 30 High Tech Road/Cinema
Cyclist Crossing Volumes: • High Tech Road & 30 High Tech Road/Cinema	Traffic Volumes: • High Tech Road Underpass
Pedestrian Volumes: • High Tech Road Underpass • High Tech Road Overpass	
Cyclist Volumes: • High Tech Road Underpass • High Tech Road Overpass	

Table 2-1: Data Collection Typologies and Location

As for the time periods of data collection, these were selected based on typical traffic and active transportation peaks, as well as peak times occurring in the study area outside of typical peak times. As a significant portion of the active transportation and traffic is influenced by the cinema, surveys were held in addition to typical peak times centred around peak movie and dinner times, primarily during Friday evening and Saturday evening. **Table 2-2** below summarizes the time periods of data collection. Surveys were conducted on Friday October 20, Saturday October 21, Wednesday October 25, and Tuesday November 7, 2017.

	Weekday Midday (11:00AM – 3:00PM)	Weekday PM (4:00PM – 8:00PM)	Friday PM (4:00PM – 11:00PM)	Saturday PM (4:00PM – 11:00PM)
Pedestrian Volumes	✓	✓	✓	✓
Cycling Volumes	✓	✓	✓	✓
TMC	✓	✓	✓	✓
Traffic Volumes	✓	✓	✓	✓

Table 2-2: Survey Time Periods

3 EXISTING CONDITIONS REVIEW

This section of the study will assess the existing conditions of High Tech Road. While this study will not repeat the existing conditions as reviewed in the RMHT Operations Review, the existing conditions review will instead involve the following:

- Walking/Cycling Audit & Conditions;
- Pedestrian/Cycling Travel Behaviours; and,
- Synchro Analysis of High Tech Road & High Tech Road Driveways.

3.1 WALKING/CYCLING AUDIT & CONDITIONS

To complete a comprehensive review of the existing cycling/walking conditions, a walking/cycling audit was performed of the study area. This walking/cycling audit required on-site visits, walking the study area and identifying the existing conditions including existing infrastructure, as well as existing barriers. The two (2) transportation networks are reviewed and discussed individually.

3.1.1 Pedestrian Network

The existing pedestrian network provides a fair degree of connectivity while also presenting limitations and barriers to pedestrians. High Tech Road does contain sidewalks on both sides of the street, which are buffered and continuous, extending from Yonge Street to beyond Red Maple Road. Crosswalks are also present at the Yonge Street intersection, with pedestrian crossing controlled via the signal at this intersection. Furthermore, a sidewalk is present along the Cinema driveway, which ties into pathways and walkways on private property before connecting High Tech Road to the Cinema itself. This sidewalk is shown in **Figure 3-1**.

Figure 3-1: Sidewalk Connection, High Tech Road to Cinema

In addition, a secondary point of connectivity is provided between 30 High Tech Road and the Cinema via the High Tech Road underpass just west of the Canadian Rail Line. An unbuffered sidewalk is present along the west side of this underpass connection. However, the connection is located on private property. Even so, for pedestrians seeking to travel from 30 High Tech Road to the Cinema, this connection provides an alternate to crossing High Tech Road at the 30 High Tech Road driveway intersection with High Tech Road, which requires crossing 4-lanes of traffic lanes unprotected and uncontrolled. **Figure 3-2** shows this underpass connection.

Figure 3-2: Pedestrian Connection to Cinema via Underpass

If crossing High Tech Road mid-block is undesired by pedestrians, they must walk approximately 110m to the Yonge Street intersection, crossing High Tech Road before returning approximately 110m. Avoiding walking this extra distance would mean crossing High Tech Road at the 30 High Tech Road driveway. Crossing at this location would necessitate travelling across four (4) lanes of traffic without a crosswalk or a method of control such as a signal. Road signage is also absent to alert drivers on High Tech Road of pedestrian crossing activity at the driveway. Overall, pedestrian crossings at this location does present safety concerns. **Figure 3-3** displays a pedestrian's view waiting to cross from 30 High Tech Road to the Cinema.

Figure 3-3: Pedestrian Mid-Block Crossing, 30 High Tech Road & Cinema

The alternative to crossing High Tech Road as previously discussed is to use the underpass driveway connection. It is recognized that this option is a feasible means for pedestrians to travel between 30 High Tech Road and the Cinema within an acceptable walking distance. Travelling from 30 High Tech Road to the Cinema via crossing High Tech Road is an estimated 270m walk, whereas using the underpass connection is an estimated 400m walk. Comparatively, a pedestrian would be faced with a 520m walk if using Yonge Street to cross High Tech Road and backtrack toward the Cinema.

Figure 3-4 visually depicts the three (3) existing walking route options between 30 High Tech Road and the Cinema along with the required walking distances. Important to note is that desire-lines also exist between 30 High Tech Road and the Richmond Hill Centre Terminal. In this instance, the walking distance via the underpass is actually the shortest walking distance.

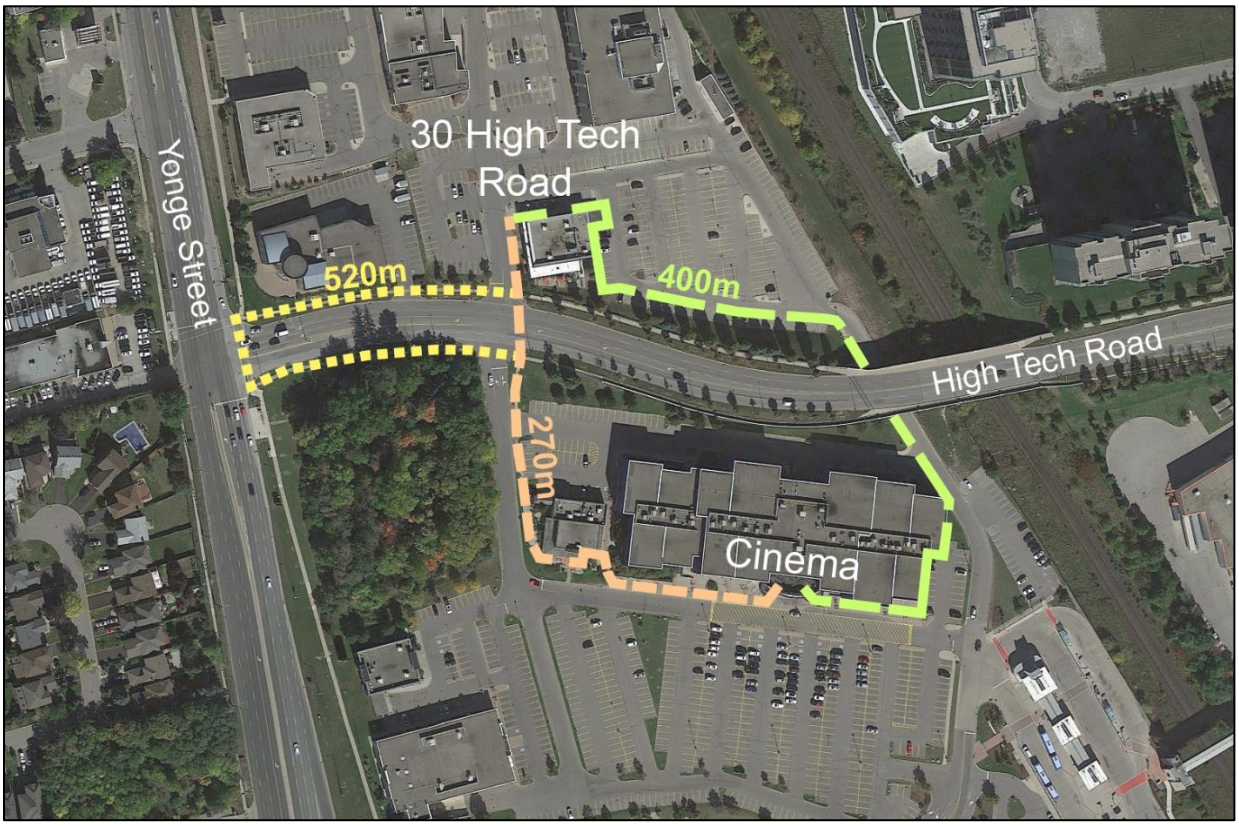


Figure 3-4: Pedestrian Route Options (30 High Tech Road to Cinema)

Along each route option, there are a number of barriers to pedestrian travel. The barriers encountered of each route options are outlined below.

3.1.1.1 Crossing High Tech Road

The most significant barrier to the route of crossing High Tech Road is the mid-block crossing of High Tech Road itself. While this option is the shortest and most direct route to the Cinema, pedestrians must cross 4-lanes of traffic without a marked crosswalk or a form of control. This is a significant safety risk. Aside from the crossing itself, another barrier that is present is a patchy unbuffered walkway from the High Tech Road to 30 High Tech Road along the driveway. This is shown in **Figure 3-5**.

Figure 3-5: Walkway from 30 High Tech Road to High Tech Road

The unbuffered walkway may present a perceived safety concern and barrier to pedestrians, while also presenting challenges to those with accessibility needs. **Figure 3-6** summarizes the major barriers encountered by pedestrians along this route option.

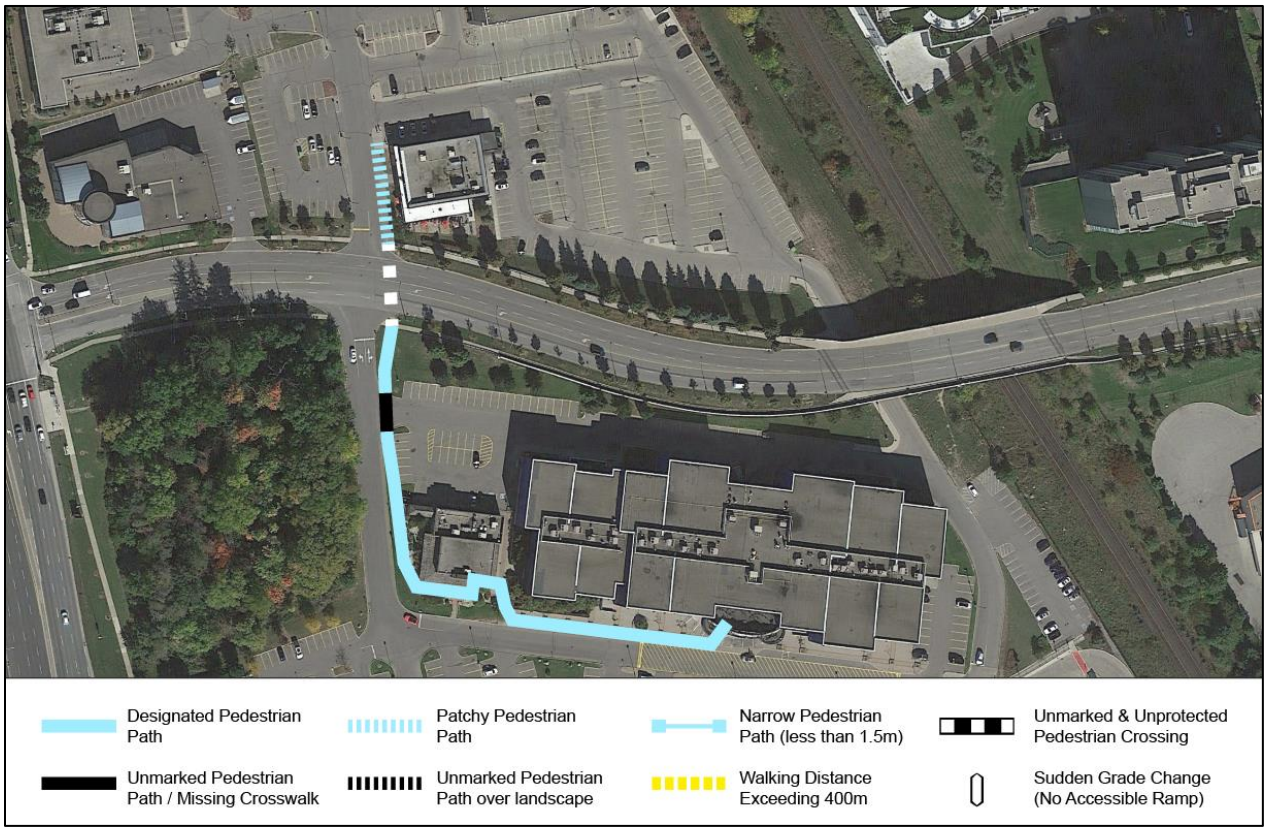


Figure 3-6: High Tech Road Crossing Route – Barriers

3.1.1.2 High Tech Road Underpass

A number of notable barriers are encountered by pedestrians travelling between 30 High Tech Road and the Cinema via the High Tech Road underpass. It is recognized this route option is a viable

alternative to providing pedestrian connectivity between the two properties, thereby avoiding the High Tech Road mid-block crossing. Significant barriers include:

- No delineated pedestrian pathway along the 30 High Tech Road parking lot toward the sidewalk present at the High Tech Road underpass;
- General lack of signage or pavement markings indicating connectivity to Richmond Hill Centre Terminal/Cinema/30 High Tech Road from either property;
- Narrow pathway at the 30 High Tech Road restaurant;
- Sudden changes in grade from parking lot to sidewalk without accessibility ramps; and,
- Disconnect in pedestrian pathway from the underpass to the Cinema pathways.

Figure 3-7 below depicts the lack of accessibility ramps at the underpass sidewalk, **Figure 3-8** depicts the disconnect between the underpass sidewalk and the Cinema pathways, and **Figure 3-9** shows the lack of signage or pavement markings at the 30 High Tech Road surface parking lot.

Figure 3-7: Sudden Change in Grade at Underpass Sidewalk

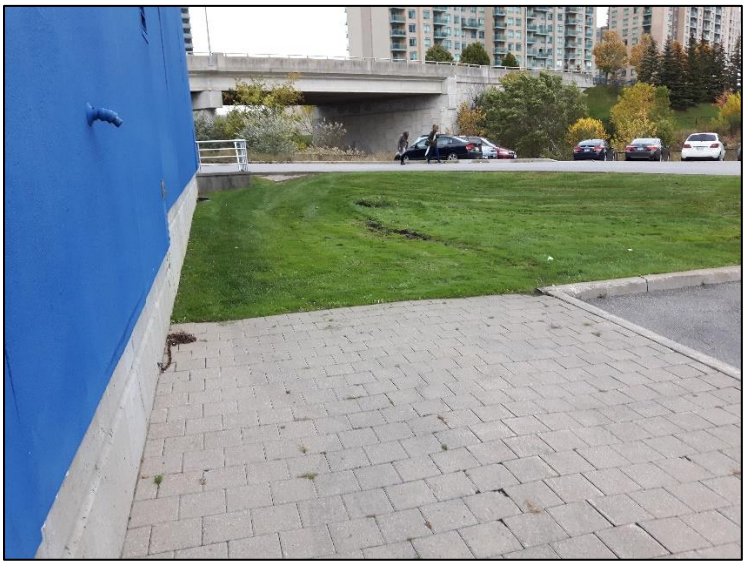


Figure 3-8: Disconnect between Cinema Pathway and Underpass Connection

Figure 3-9: Lack of Signage or Pavement Markings at 30 High Tech Road Parking Lot

Building upon the previously mentioned barriers along the High Tech Road underpass pedestrian route, **Figure 3-10** summarizes the encountered barriers along the entirety of the route.

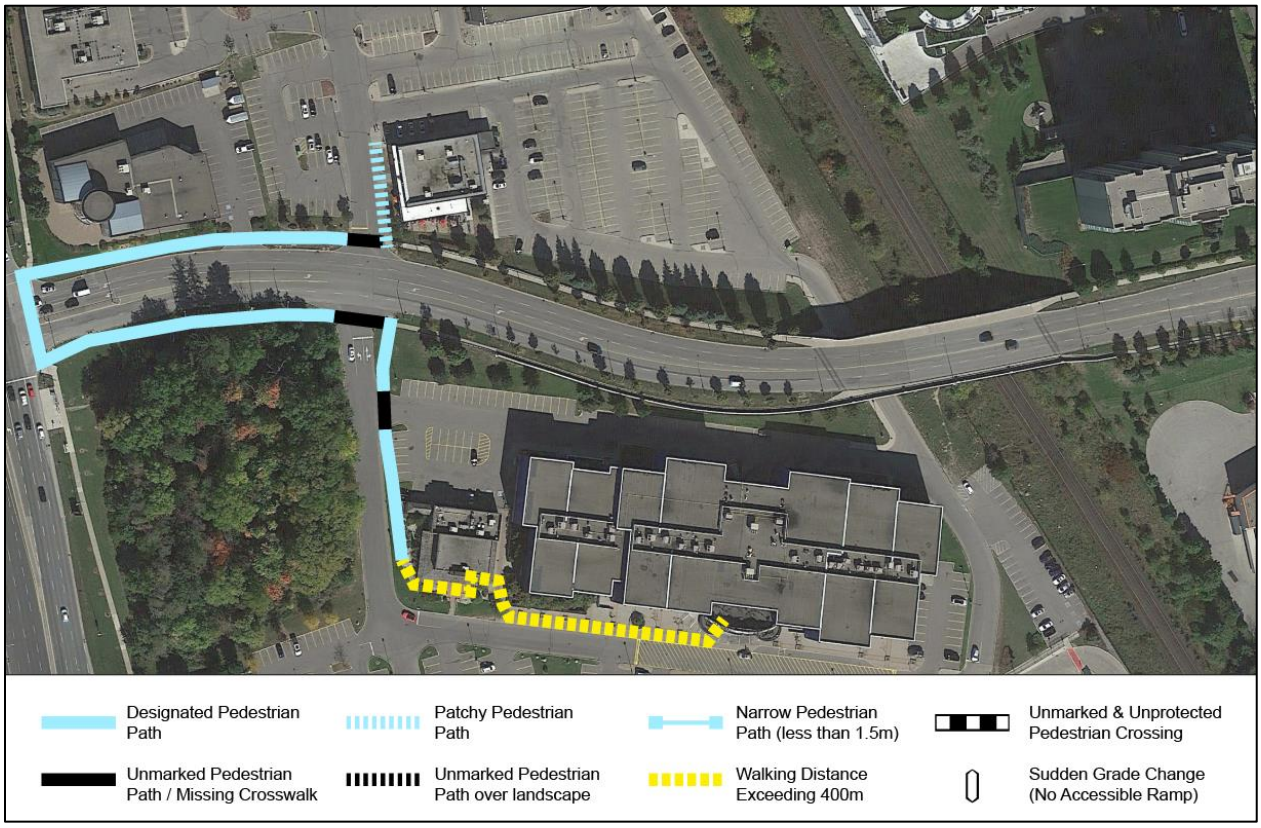


Figure 3-10: High Tech Road Underpass Route – Barriers

3.1.1.3 High Tech Road Crossing via Yonge Street

The final pedestrian route option is to cross High Tech Road via the marked and protected pedestrian crossing at Yonge Street. This requires pedestrians to backtrack on the north or south side of High Tech Road, introducing a physical and perceived barrier to pedestrian travel being an extra walking distance. In total, the route is considered to be slightly beyond a tolerable walking distance for most.

The walking distance is approximately 520m (400m is considered tolerable). Another barrier encountered along this route includes the patchy and unbuffered pathway on the 30 High Tech Road driveway. **Figure 3-11** summarizes the pedestrian barriers encountered along the entirety of the route.

Figure 3-11: High Tech Road Crossing via Yonge Street Option – Barriers

3.1.2 Cycling Network

The cycling network in the area is limited and cyclists must generally share the road with vehicles. The area lacks dedicated cycling infrastructure, as no bike lanes, trails, or sharrows have been identified on High Tech Road, Red Maple Road, or Yonge Street.

Despite the apparent lack of cycling infrastructure, the Town of Richmond Hill has designated High Tech Road as a Shared Roadway. Therefore, it is recognized that cycling activity does occur on this roadway. Road signage is also present along High Tech Road alerting both cyclists and drivers to share the road. This signage is present both ways on High Tech Road between the 30 High Tech Road driveway and Red Maple Road.

The lack of cycling infrastructure may also encourage cyclists to share the sidewalk with pedestrians to avoid mixing with vehicular traffic. In considering the pedestrian route options, similar barriers can be identified for cyclists. The mid-block crossing on High Tech Road poses a safety concern due to the absence of a marked and protected crossing across four (4) lanes of traffic.

As for the High Tech Road underpass, the lack of dedicated bike infrastructure will result in cyclists meandering through the parking lot and sharing the driveways with vehicles. Finally, the least direct route via Yonge Street provides a safer and more accessible option as a designated pedestrian pathway with gradual grade changes and marked crosswalks are present. Although long distances are a perceived barrier for pedestrians, as cyclists are generally more mobile, longer travel distances can be tolerated. Further to the mutual barriers, bicycle racks, parking, or storage is missing at both the Cinema and at 30 High Tech Road leading cyclists to park their bicycles in potentially unauthorized areas, or risk bicycle theft.

As longer travel distances are acceptable to cyclists, the cycling audit will extend beyond the vicinity of 30 High Tech Road and the Cinema. The extent will include Yonge Street and High Tech Road east of the Cinema. These roadways provide a connection between the residential communities in the area. One notable barrier for cyclists is the steep grade on High Tech Road over the Canada Rail Line. At this segment, cyclists have to balance sharing the roadway as well as riding uphill/downhill.

Figure 3-12 depicts the signage to instruct drivers and cyclists to share the road and the grade on High Tech Road.

Figure 3-12 Share the Road Signage on High Tech Road

As previously mentioned, no existing cycling infrastructure is present on Yonge Street. However, with the construction of the vivaNext bus rapid transit (BRT) along Yonge Street between Highway 7 and 19th Avenue/Gamble Road, major changes to the corridor will improve pedestrian and bicycle connections. Bike lanes painted in high-contrast green in the areas around intersections and side streets, with specific bike lane markings will be completed in conjunction with the rapidway construction. The expected completion date of the Yonge Street/Richmond Hill rapidway is scheduled for December 2020.

In summary, the barriers for cyclists in the area are the following:

- No cycling infrastructure on Yonge Street, High Tech Road and Underpass;
- No bicycle parking; and

- Grades on High Tech Road overpass.

3.2 PEDESTRIAN/CYCLING TRAVEL BEHAVIOURS

Building upon the walking and cycling audit, surveys were conducted at key points in the study area to observe and assess current pedestrian and cyclist behaviours. These surveys were conducted during the following time periods:

- Friday PM Peak Hour;
- Saturday PM Peak Hour;
- Weekday Midday Peak Hour; and,
- Weekday PM Peak Hour.

The key points in the study area that were surveyed are illustrated below in **Figure 3-13**. Detailed traffic data collection is available in **Appendix A**.

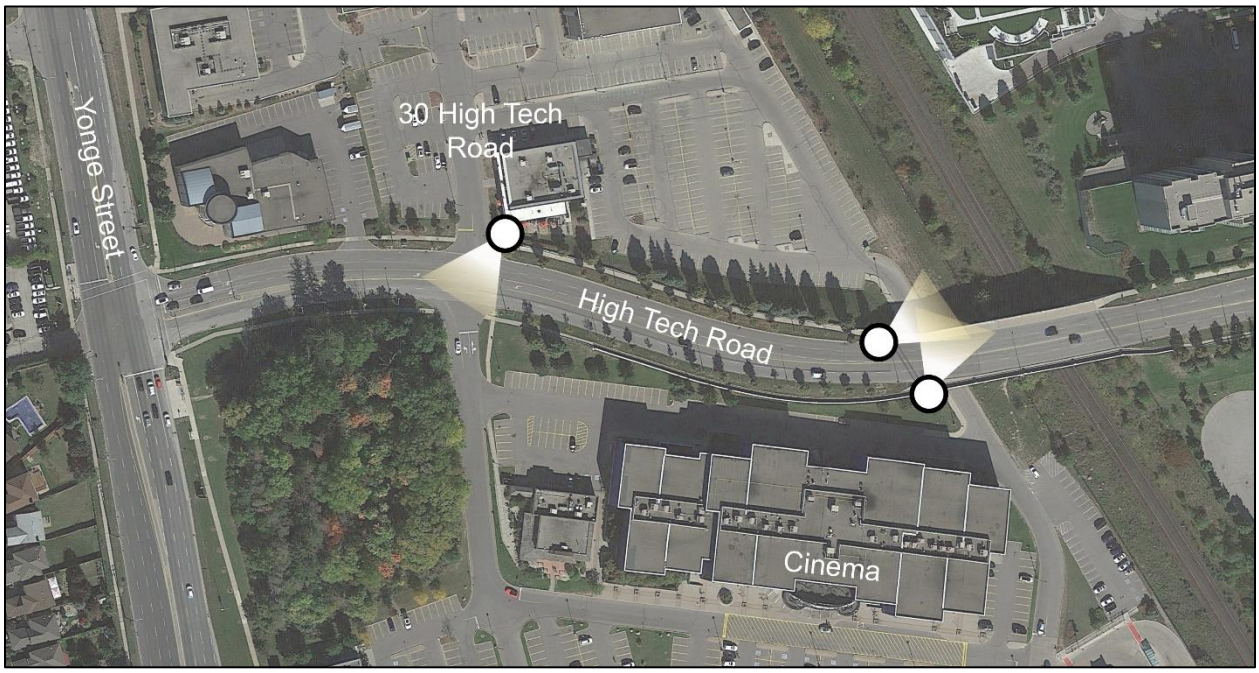


Figure 3-13: Pedestrian/Cyclist Survey Locations

The survey locations were selected to capture the following key points of interest with respect to pedestrian and cyclist behaviours:

- High Tech Road Mid-Block Crossing at the 30 High Tech Road/Cinema Driveways;
- High Tech Road Overpass Travel; and,
- High Tech Road Underpass Travel.

3.2.1 Pedestrian Behaviours

Pedestrian behaviours were primarily observed at the mid-block crossing between 30 High Tech Road and the Cinema across High Tech Road. However, observations were also made of the High

Tech Road underpass to understand the amount of pedestrians currently using this connection as well as how it is being used. **Figure 3-14** to **Figure 3-17** summarizes the pedestrian volumes observed at the various peak hours of analysis.

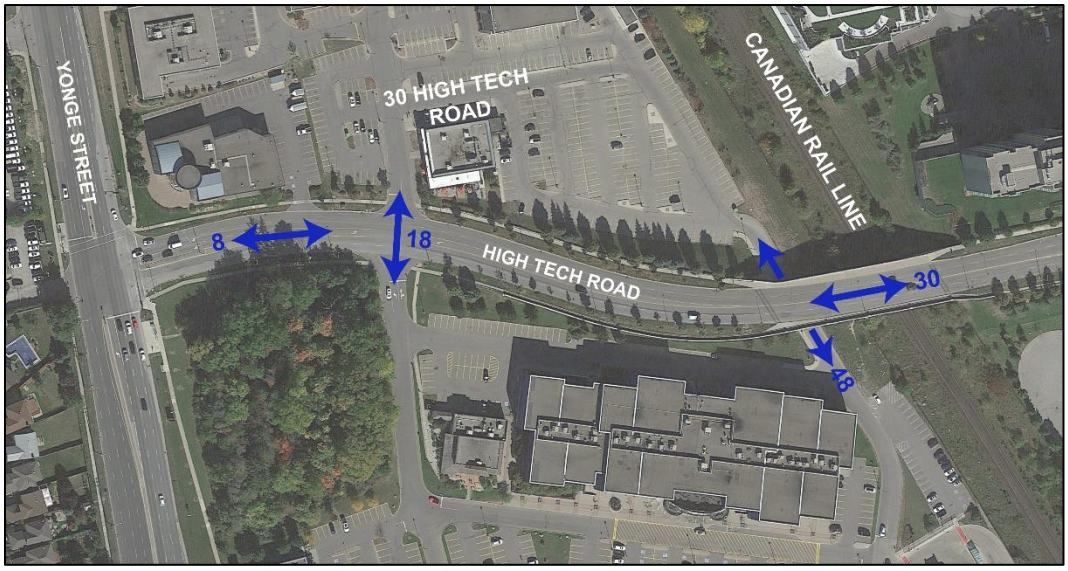


Figure 3-14: Friday PM Peak Hour Pedestrian Volumes (5:15 PM)

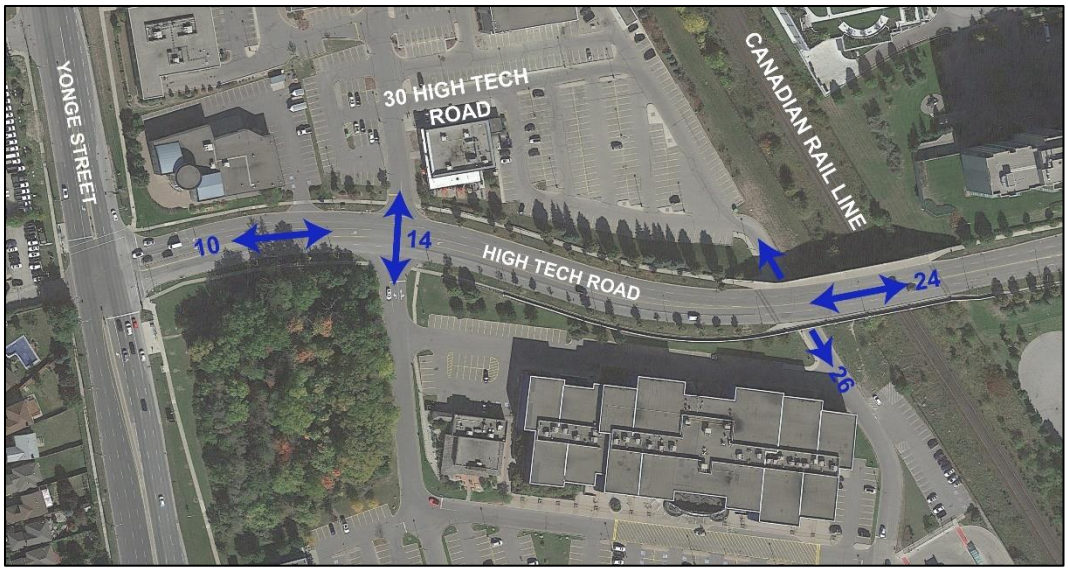


Figure 3-15: Saturday PM Peak Hour Pedestrian Volumes (4:30 PM)

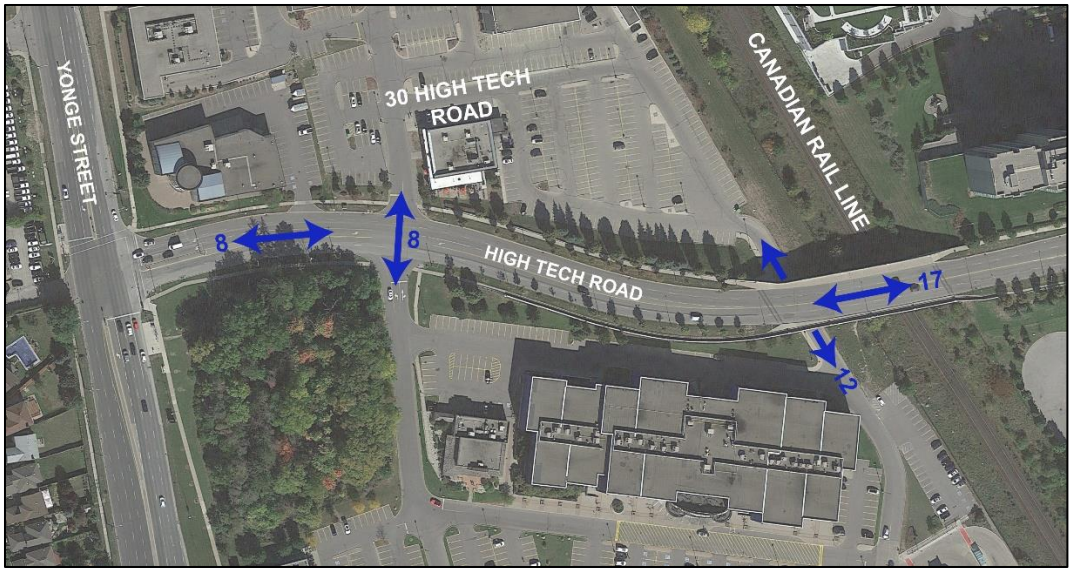


Figure 3-16: Weekday Midday Peak Hour Pedestrian Volumes (1:30 PM)

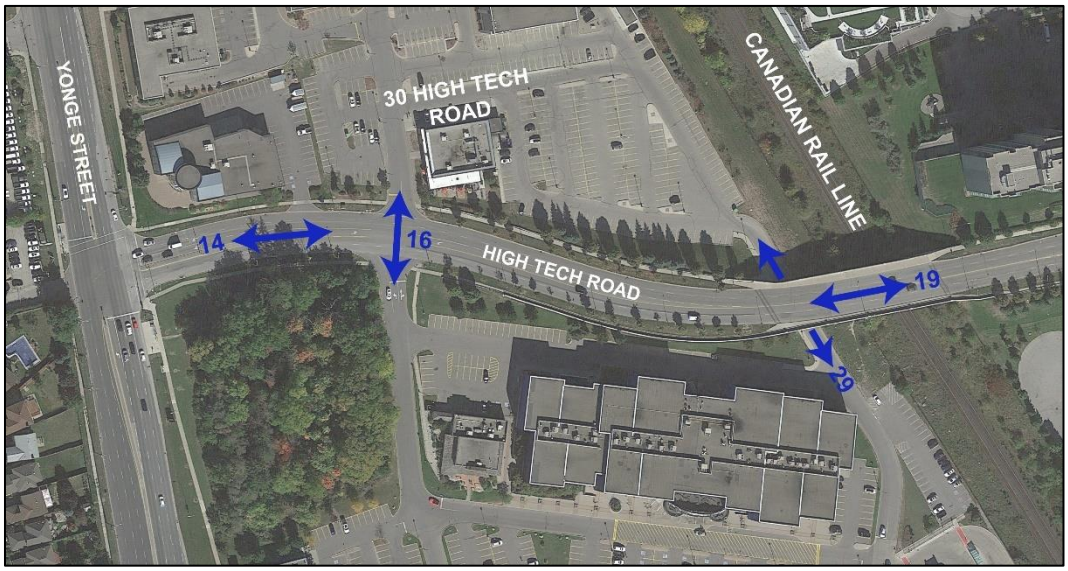


Figure 3-17: Weekday PM Peak Hour Pedestrian Volumes (5:15 PM)

Pedestrian activity was observed to be most significant on Friday during the PM peak hour which occurred at 5:15PM. Less pedestrian activity was observed during the Saturday PM peak hour and the Weekday PM peak hour, but these two (2) time periods presented comparable pedestrian activity. Overall, on Friday during the PM peak hour, pedestrian activity was most intense around dinner hours which is to be expected.

The pedestrian surveys reveal that the mid-block crossing at High Tech Road between 30 High Tech Road and the Cinema is used relatively consistently during each peak hour of analysis, in the range of 14 to 18 pedestrians per peak hour with the exception of the weekday midday peak hour. While this is not a large number of pedestrians, it is considered to be significant given the difficulty proposed to pedestrians at this crossing.

What is important to identify is that the underpass connection is consistently more used than the mid-block crossing on High Tech Road. During the Friday PM peak hour, 48 pedestrians were found to use the underpass connection versus the 18 pedestrians crossing at the High Tech Road mid-block crossing. This suggests that most pedestrians prefer to use the underpass connection.

Based on the observed pedestrian volumes, a pedestrian crossover (PXO) is not justified at this location. According to the Ontario Traffic Manual (OTM) Book 15, this device is intended for low to moderate volumes and a posted speed limit of 60 km/h or less, amongst other factors. OTM Book15 specifies that PXOs should be considered when the 8-hour pedestrian volume exceeds 100 pedestrians, and the closest crossing opportunity is greater than 200m away. The High Tech Road & 30 High Tech Road/Cinema driveway features an 8-hour pedestrian volume of 91 pedestrians, and is located 115m from a signalized intersection which provides signal-protected pedestrian crossing,. Therefore, a PXO is not warranted at this location.

3.2.2 Cyclist Behaviours

Cyclist behaviours were observed at the mid-block crossing between 30 High Tech Road and the Cinema across High Tech Road, in addition to cyclist behaviours along High Tech Road and at the High Tech Road underpass. **Figure 3-18** to **Figure 3-21** summarizes the cyclist volumes observed at the various peak hours of analysis.

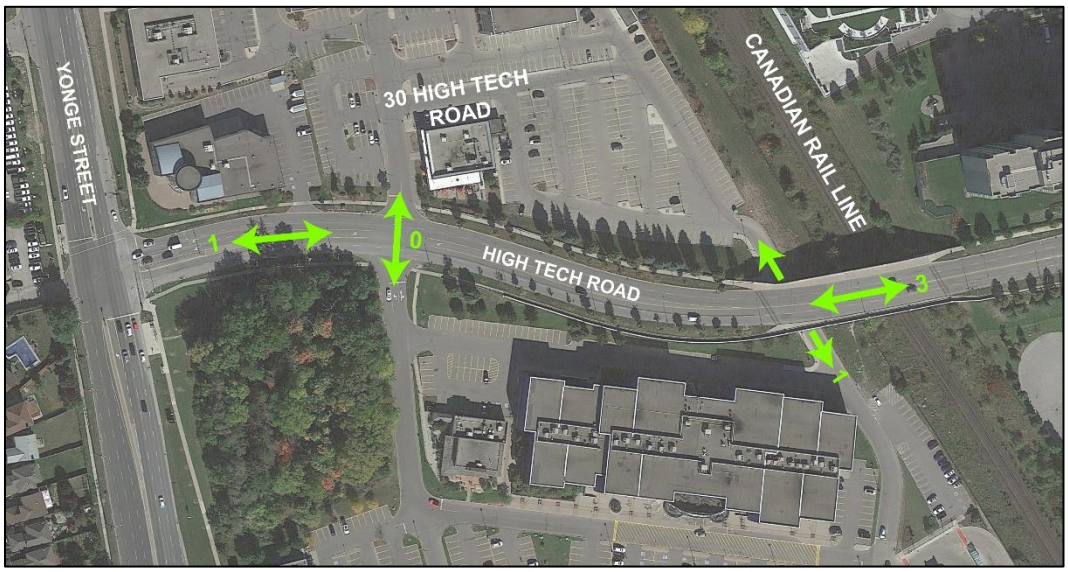


Figure 3-18: Friday PM Peak Hour Cyclist Volumes (5:15 PM)

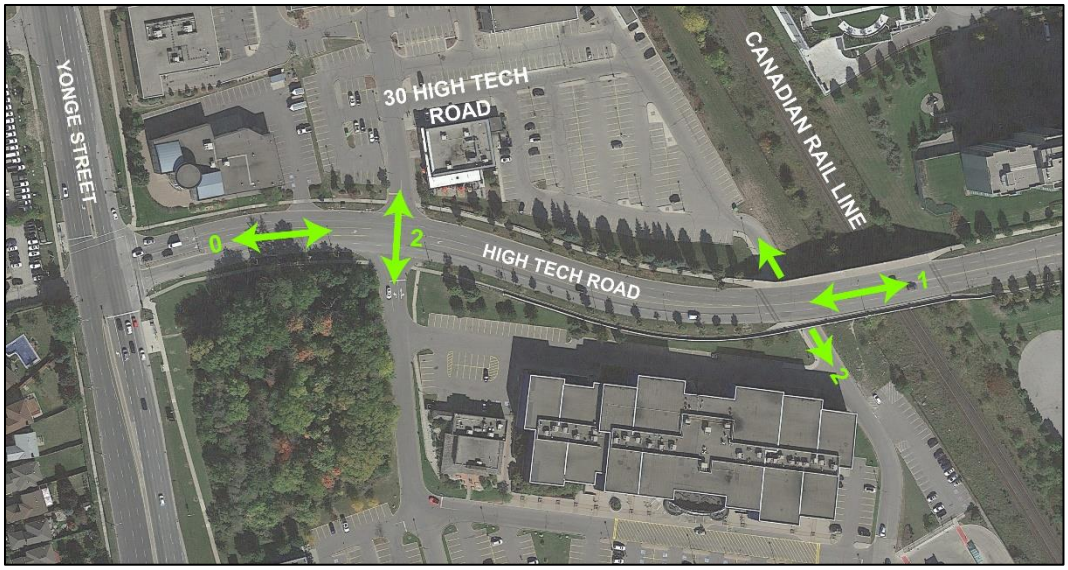


Figure 3-19: Saturday PM Peak Hour Cyclist Volumes (4:30 PM)

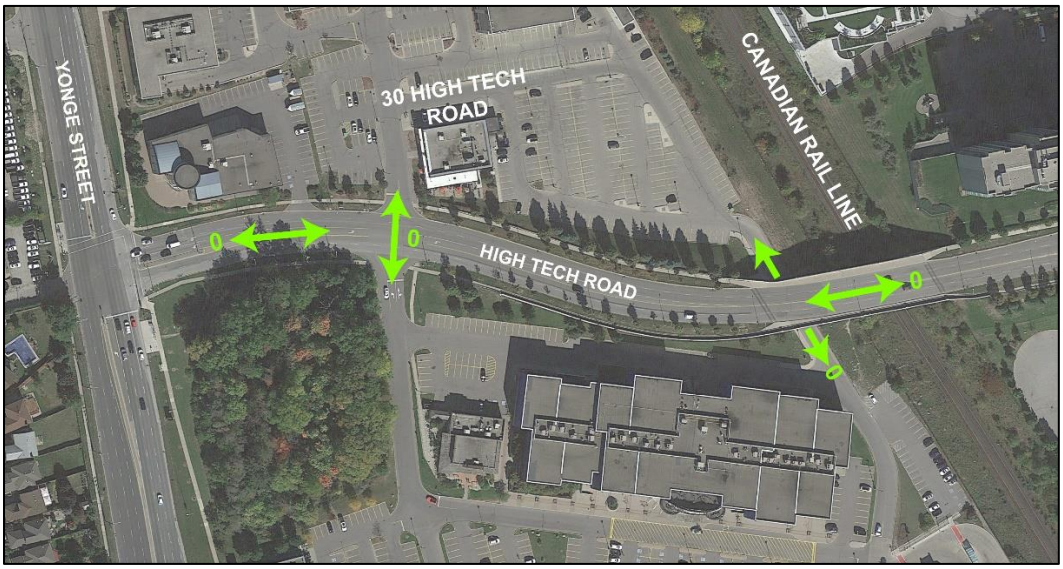


Figure 3-20: Weekday Midday Cyclist Volumes (1:30 PM)

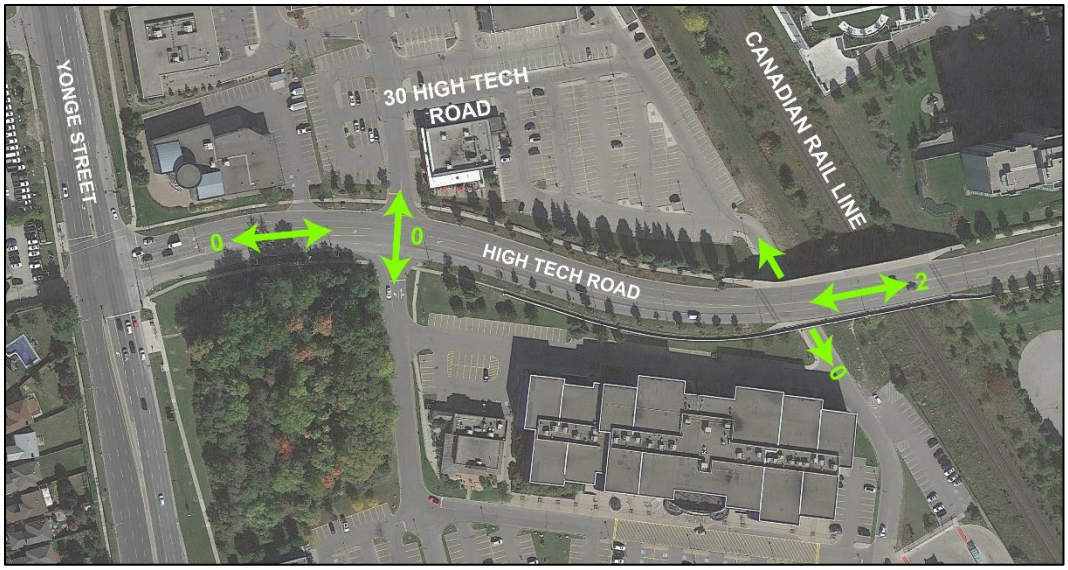


Figure 3-21: Weekday PM Peak Hour Cyclist Volumes (5:15 PM)

Overall observed cycling activity was low, and as a result difficult to establish any behavioural patterns. A number of cyclists were found to use the mid-block crossing during the Saturday PM peak hour, with no cycling activity observed at the mid-block crossing during any other peak hour. Some cyclists were also found to use the underpass connection during both the Friday PM and Saturday PM peak hours.

3.3 TRAFFIC OPERATIONS

Traffic operations have been assessed of the High Tech Road & 30 High Tech Road/Cinema driveway to understand the current operations and any existing constraints. Turning Movement Count (TMC) surveys were conducted of the intersection during the following time periods:

- Friday PM Peak Period;
- Saturday PM Peak Period;
- Weekday Midday Peak Period; and,
- Weekday PM Peak Period.

Detailed TMC data is available in **Appendix A**. Subsequently, peak hour intersection capacity analysis has been conducted to evaluate traffic operations during these peak hours.

3.3.1 Intersection Capacity Analysis

Intersection capacity analysis has been conducted using Synchro 9.1 software, adhering to the methodology of the Highway Capacity Manual (HCM) 2000. Peak hour factor has been calculated per movement and applied to each movement individually. Pedestrian and cyclist volumes have also been input, alongside heavy vehicle percentages as observed on-site. The following subsections discuss the capacity analysis results for each peak hour. All detailed Synchro outputs of the existing conditions are available in **Appendix B**.

3.3.1.1 Friday PM Peak Hour

Figure 3-22 below shows the peak hour traffic volumes observed during the Friday PM peak hour, which occurred between 5:30 PM and 6:30 PM. **Table 3-1** presents the intersection capacity analysis.

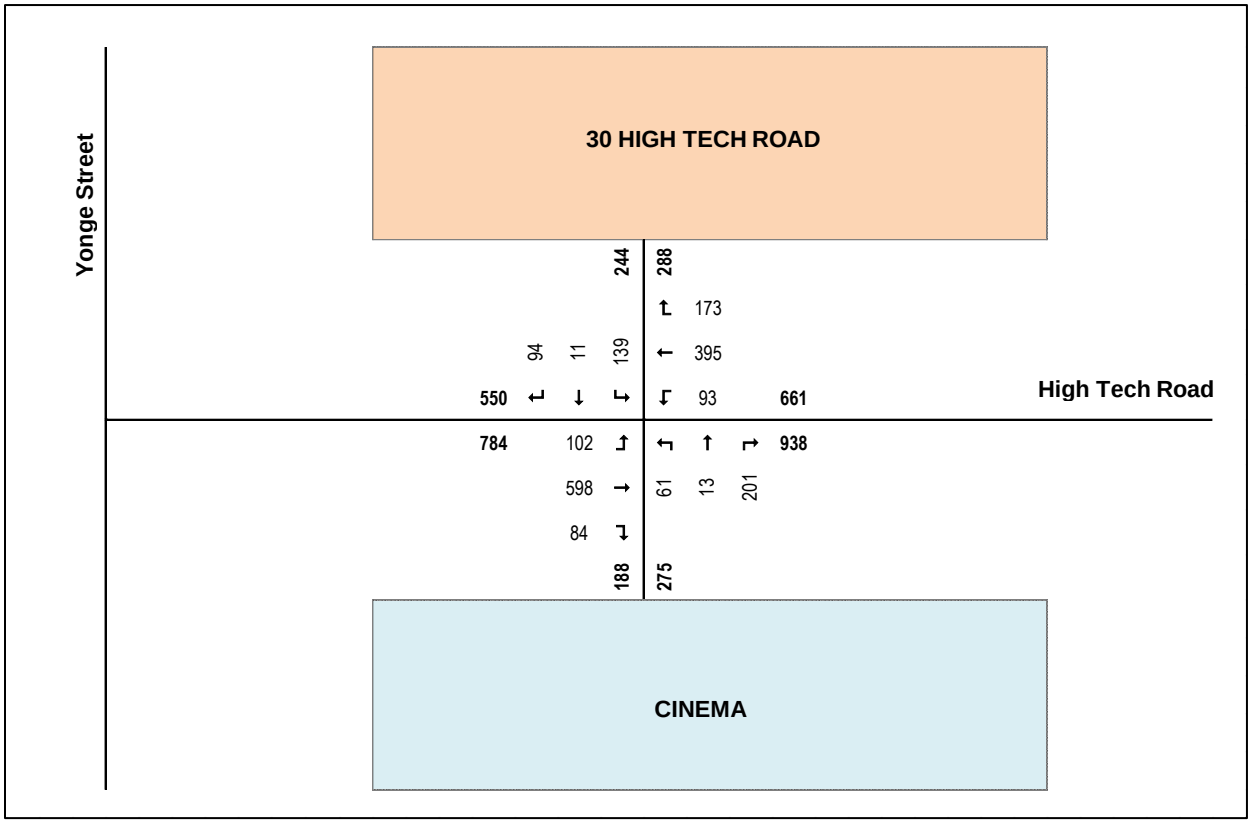


Figure 3-22 Friday PM Peak Hour Traffic Volumes

Intersection	Movement of Interest	Friday PM Peak Hour					
		Flow Rate (vph)	Capacity (vph)	Control Delay (s)	95th Queue (m)	V/C	LOS
30 High Tech Road/Cinema & High Tech Road	EBL	157	945	9.6	4.8	0.17	A
	WBL	127	865	9.9	4.1	0.15	A
	NBL	76	32	898.0	70.2	2.39	F
	NBTR	292	313	72.5	73.9	0.93	F
	SBLTR	296	27	Err	Err	11.00	F

Table 3-1 Intersection Capacity Analysis - Friday PM Peak Hour

The Friday PM peak hour analysis reveals the worst operations at the High Tech Road intersection of all survey periods. Both the northbound and southbound approaches are operating under constraint during the Friday PM peak hour. The southbound approach experiences incalculable delay and queuing in the Synchro software. This suggests drivers have no gaps to conduct either southbound left-turn or southbound through movements. As this approach operates as a single-lane, the right-turn movement is also affected. The results also suggest that northbound-left turning vehicles are experiencing delays of 15 minutes. Evidently, the calculated delays in Synchro are not consistent with actual observations as these waiting times are excessive and vehicles are being accommodated by courtesy gaps or failing to yield the right of way resulting in collisions as confirmed in **Section 3.4**. Operations at the northbound and southbound approaches are considered to be unacceptable during the Friday PM peak hour.

3.3.1.2 Saturday PM Peak Hour

Figure 3-23 below shows the peak hour traffic volumes observed during the Saturday PM peak hour, which occurred between 4:00 PM and 5:00 PM. **Table 3-2** presents the intersection capacity analysis.

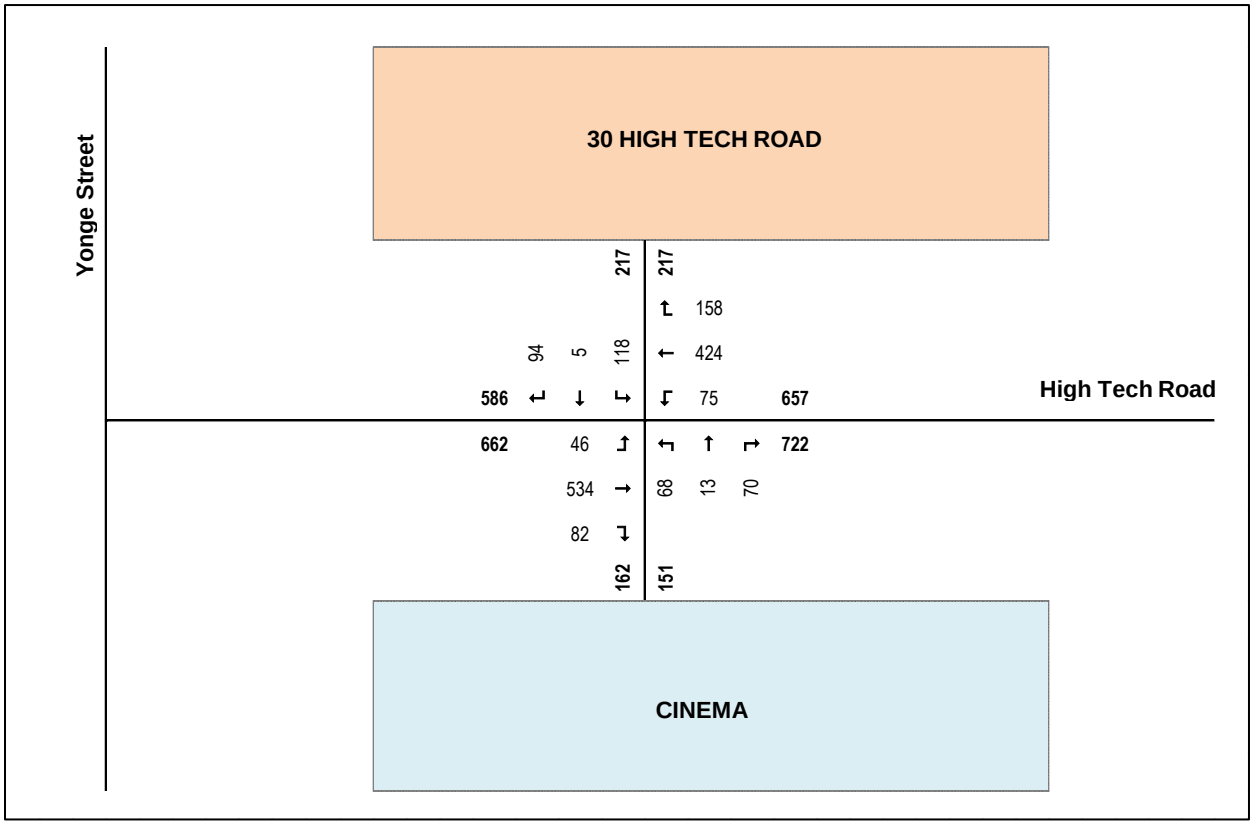


Figure 3-23 Saturday PM Peak Hour Traffic Volumes

Intersection	Movement of Interest	Saturday PM Peak Hour					
		Flow Rate (vph)	Capacity (vph)	Control Delay (s)	95th Queue (m)	V/C	LOS
30 High Tech Road/Cinema & High Tech Road	EBL	56	918	9.2	1.6	0.06	A
	WBL	80	914	9.3	2.3	0.09	A
	NBL	80	89	154.1	39.7	0.90	F
	NBTR	116	320	22.5	12.9	0.36	C
	SBLTR	244	134	451.8	149.0	1.82	F

Table 3-2 Intersection Capacity Analysis - Saturday PM Peak Hour

During the Saturday PM peak hour, the northbound left movement and southbound approach are operating under constraint, but not as severe as the Friday PM peak hour. The southbound approach operates notably over capacity and with significant delay, while the northbound left-turn operates within capacity, but with delay. Overall, southbound movements present unacceptable operations during the Saturday PM peak hour.

3.3.1.3 Weekday Midday Peak Hour

Figure 3-24 below shows the peak hour traffic volumes observed during the Weekday midday peak hour, which occurred between 1:30 PM and 2:30 PM. **Table 3-3** presents the intersection capacity analysis.

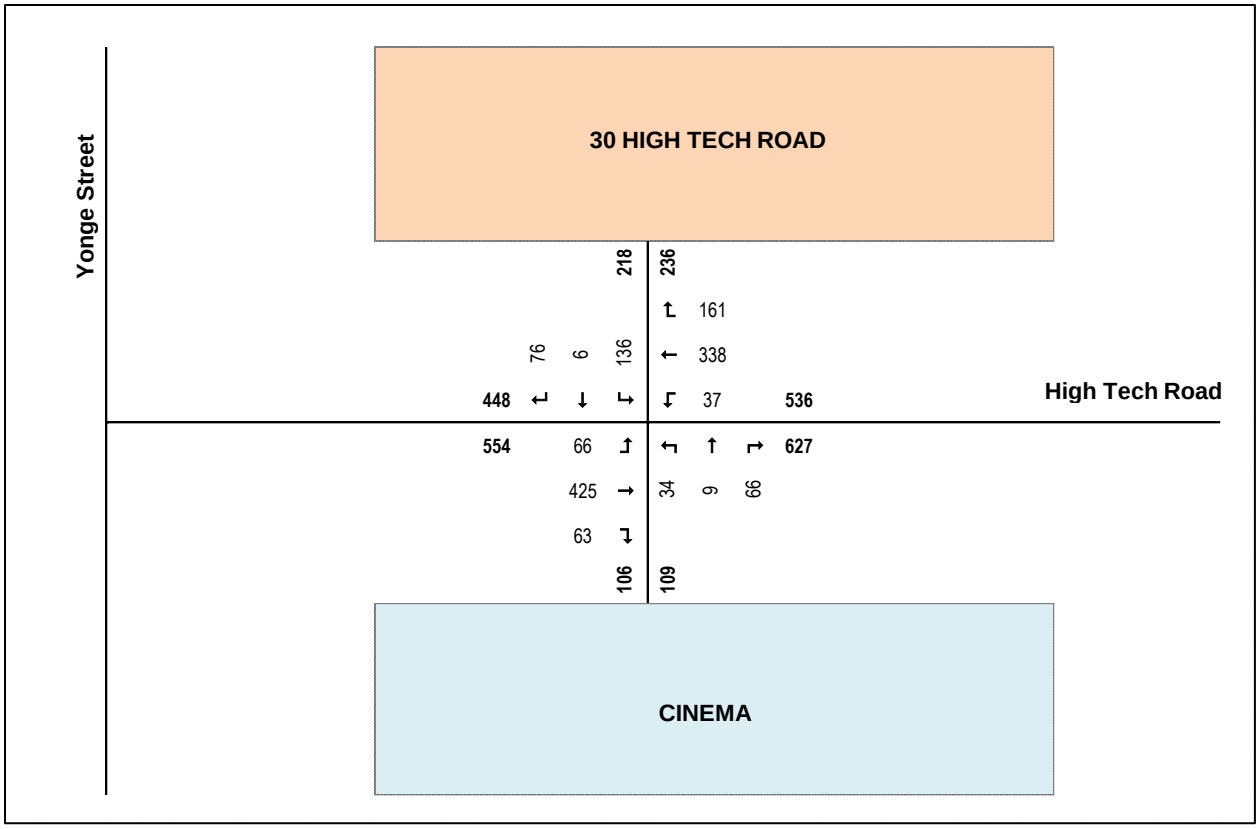


Figure 3-24: Weekday Midday Peak Hour Traffic Volumes

Intersection	Movement of Interest	Weekday PM Peak Hour					
		Flow Rate (vph)	Capacity (vph)	Control Delay (s)	95th Queue (m)	V/C	LOS
30 High Tech Road/Cinema & High Tech Road	EBL	84	971	9.1	2.3	0.09	A
	WBL	64	968	9.0	1.7	0.07	A
	NBL	40	101	62.1	12.9	0.40	F
	NBTR	100	342	19.8	9.5	0.29	C
	SBLTR	281	161	408.0	161.6	1.74	F

Table 3-3 Intersection Capacity Analysis – Weekday Midday Peak Hour

During the weekday midday peak hour, the southbound approach is operating over capacity with considerable delay. Similar to both the Friday PM and Saturday PM peak hour, southbound operations are unacceptable. However, during the weekday midday peak hour, the northbound left-turn does operate acceptably despite operating with level of service "F".

3.3.1.4 Weekday PM Peak Hour

Figure 3-25 below shows the peak hour traffic volumes observed during the Weekday PM peak hour, which occurred between 5:15 PM and 6:15 PM. **Table 3-4** presents the intersection capacity analysis.

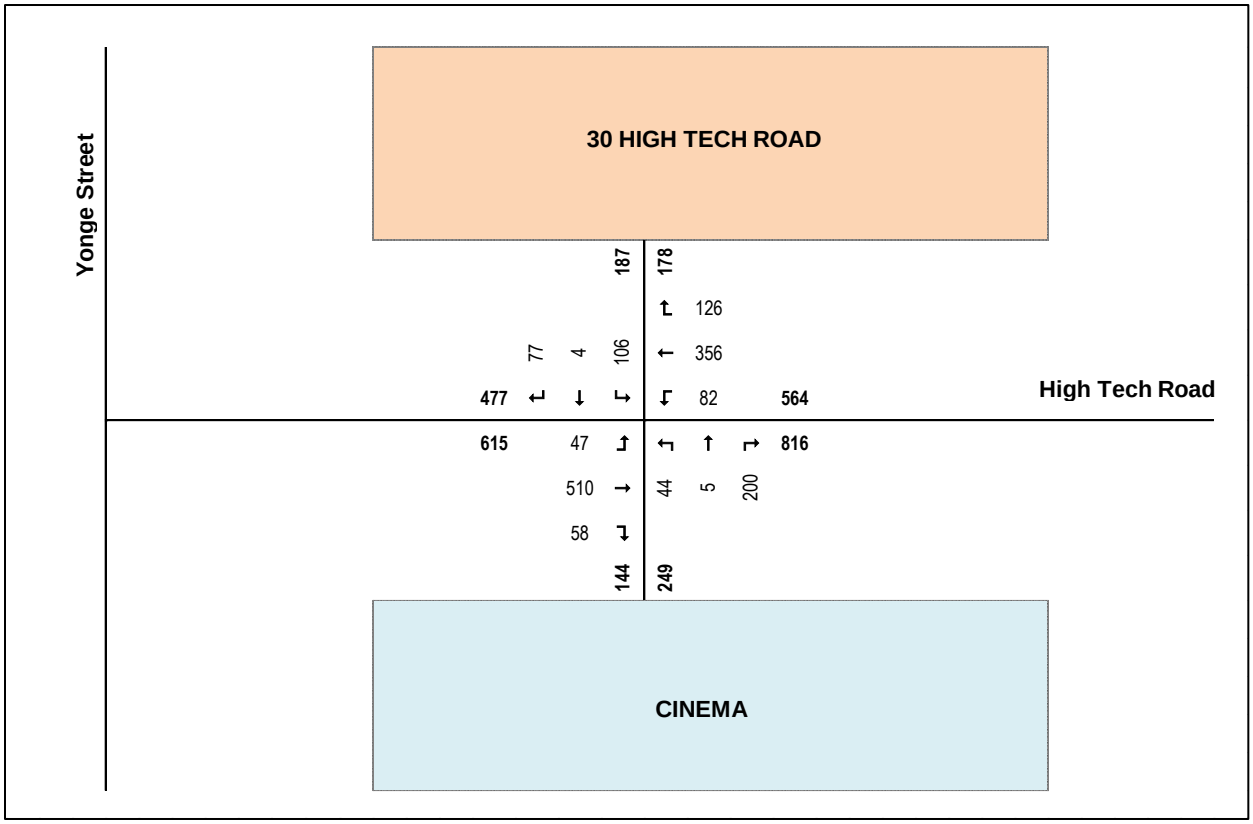


Figure 3-25 Weekday PM Peak Hour Traffic Volumes

Intersection	Movement of Interest	Weekday PM Peak Hour					
		Flow Rate (vph)	Capacity (vph)	Control Delay (s)	95th Queue (m)	V/C	LOS
30 High Tech Road/Cinema & High Tech Road	EBL	52	1012	8.8	1.3	0.05	A
	WBL	88	900	9.4	2.6	0.10	A
	NBL	56	94	88.5	22.3	0.60	F
	NBTR	235	548	16.4	17.1	0.43	C
	SBLTR	224	99	666.6	158.7	2.26	F

Table 3-4 Intersection Capacity Analysis – Weekday PM Peak Hour

During the weekday PM peak hour, the southbound approach is operating over capacity with considerable delay. Similar to all other peak hours, southbound operations are unacceptable. Similarly to the weekday midday peak hour, during the weekday PM peak hour, the northbound left-turn does operate acceptably despite operating with level of service "F".

3.3.2 Underpass Volumes

Traffic volumes were also surveyed at the High Tech Road underpass to understand the current usage of this underpass from a vehicular perspective, and to compare these volumes with those performing northbound or southbound through movements at the 30 High Tech Road/Cinema & High Tech Road intersections.

Table 3-5 below summaries the volumes observed travelling north-south along the underpass for each peak hour of analysis versus those travelling north-south through the intersection of 30 High Tech Road/Cinema & High Tech Road.

Vehicular Demand – 30 High Tech Road & Cinema		
	Underpass Volumes	**30 High Tech Road to Cinema Through Movement**
Friday PM Peak Hour	107	23
Saturday PM Peak Hour	63	18
Weekday Midday Peak Hour	54	15
Weekday PM Peak Hour	129	9

Table 3-5: Vehicular Demand – 30 High Tech Road & Cinema

The surveys found that a significant number of drivers use the underpass driveway to travel between the two (2) properties, while a notable number of drivers conduct the northbound or southbound through movement across High Tech Road between the two (2) properties. Underpass volumes were observed to be most intense during the weekday PM peak hour, followed by the Friday PM peak hour. The comparison suggests that most drivers are aware of the underpass and prefer to use this connection versus crossing High Tech Road.

3.4 COLLISION REVIEW

The collision history of 30 High Tech Road/Cinema & High Tech Road intersection was reviewed to understand existing collision patterns and determine countermeasures to reduce collision rates. Collision reports from the last five (5) years were reviewed, from January 1, 2013 to November 2, 2017. **Table 3-6** summarizes the number of collisions, the types of collisions and the weather conditions at the time of the collision.

Collision Type	**Frequency**	**Weather Conditions**	
		Clear	**Snow/Rain**
Loss of control	2	50%	50%
Pedestrian*	1	0%	100%
Right Angle	4	33%	67%
Side Swipe	3	67%	33%
Turning	11	33%	67%
Total	**21**	39%	61%

* The pedestrian struck was not crossing north-south between the Cinema & 30 High Tech Road. The pedestrian was struck while crossing the northbound driveway from an inbound left-turning vehicle.

Table 3-6: Collision Summary - 30 High Tech Road/Cinema & High Tech Road Intersection

The 5-year collision history reported a total of 21 collisions, where more than half of the collisions involved a vehicle making a turning movement. One accident involved a pedestrian crossing the Cinema driveway. Of note, no rear-end nor head-on accidents, and no fatalities were reported between 2013 and 2017. The analysis also reveals that weather may play an important role in the number and type of collisions. More than 60% of reported collisions occurred in adverse weather conditions (i.e. rain or snow). A graphical representation of the collision history, from most recent to oldest, at the intersection of 30 High Tech Road/Cinema & High Tech Road is illustrated in **Figure 3-26**.

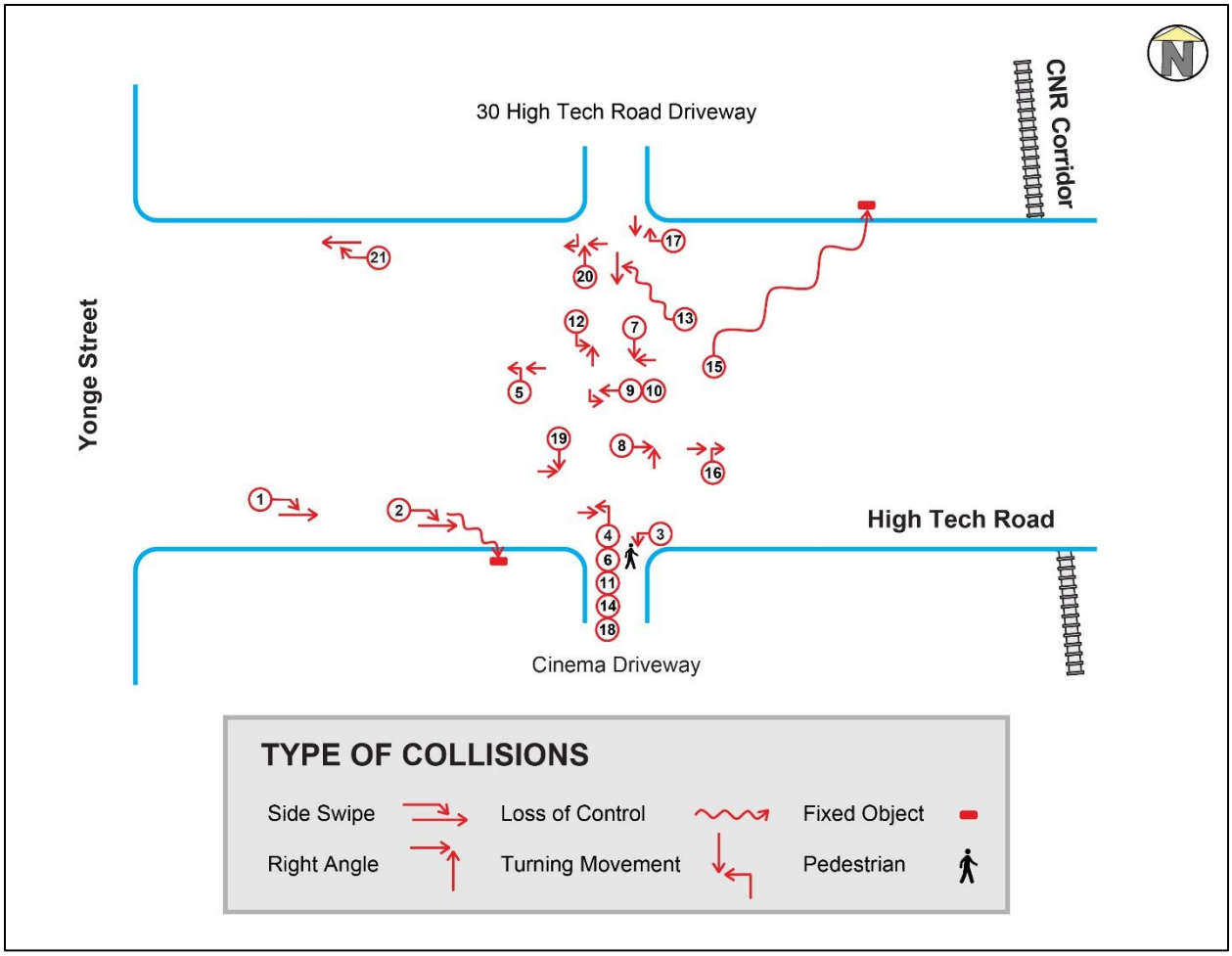


Figure 3-26: Collision History - 30 High Tech Road/Cinema & High Tech Road Intersection

It should be noted that over the previous 5-year period (2008 to 2013), a total of 44 collisions were observed along the same segment. This was previously documented in the RMHT Operations Review.

3.5 SIGHT LINE ANALYSIS

Due to the presence of the Canadian Rail Line in the study area, High Tech Road was constructed over the railway resulting in both horizontal and vertical sightline challenges. Given the vertical and horizontal profile of High Tech Road between Red Maple Road and the subject intersection, a sight line analysis was conducted at the intersection of the 30 High Tech Road/Cinema and High Tech Road to determine sight stopping distances.

Based on the posted speed limit of 50 km/h (design speed of 60 km/h), westbound vehicles require a minimum stopping distance of 85m to safely stop. However, as High Tech Road possesses a 5.8% grade transition between the crest of the overpass to the subject intersection, an additional 52m of stopping distance is required. This results in a total minimum distance of 137 meters required for a vehicle travelling at 60 km/h to come to a full-stop. These calculations have been conducted based on standards referenced from the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads.

The maximum available sight distance is 137m. However, at the top of the crest, the available sight stopping distance is 110m which is less than the minimum requirement of 137m according to TAC. Therefore, it has been determined that existing portion of the road along High Tech Road has reduced sightline visibility just prior to the commercial driveways, resulting in a "No-Zone" in which an approaching vehicle may not have sufficient sight stopping distance.

Based on the TAC guidelines, a reaction time of 2.5 seconds is accounted for in the required sight stopping distance calculations for a design speed of 60 km/h. The reaction time includes the time to perceive and to manoeuvre to avoid the potential obstacle. The limited visibility can be effectively managed by reducing reaction times and, consequently, stopping sight distances by the provision of an advanced warning system. With an advance warning system, westbound vehicle can begin to react and be prepared to stop in advance of the "No-zone". Of the 137m of required sight stopping distance, 41.7 meters can be attributed to reaction time. Given the critical sight distance availability of 110m, a reaction time reduction of 1.3 seconds (reaction time of 1.2 second) will yield sufficient sight stopping distance to avoid collision with a stopped vehicle within the "No-zone" for a vehicle traveling at 60 km/h.

Furthermore, it is recognized that a reduced speed would also result in a shorter stopping sight distance and mitigate the limited visibility. For example, a 10 km/h speed reduction will further reduce the stopping distance by 19.3m, and a 20 km/h speed reduction will reduce the stopping distance by 26.3 metres. Conversely, if the posted speed limit is reduced to 40 km/h (design speed is reduced to 50 km/h), the required sight stopping distance is reduced to 99m, with no reaction time adjustments. This is an acceptable sight stopping distance.

The limited visibility can be effectively managed by a speed reduction and/or an advanced warning system. Both options would decrease the minimum sight stopping distance requirement and the available sight distance would be sufficient for a vehicle to safely perceive and react to a potential obstacle. The horizontal and vertical sight line analyses are provided in **Appendix C**.

3.6 EXISTING CONDITIONS SUMMARY

Culminating the review of the existing conditions above, a summary of the key considerations of the existing conditions is summarized below. These key considerations will inform and compose the primary variables and factors in developing a series of access modification alternatives and the matrix for evaluation.

Active Transportation
• The mid-block crossing of High Tech Road presents a barrier to pedestrians/cyclists, and is a safety concern • An alternate underpass road is present to travel between the north/south side of High Tech Road, however a number of barriers exist along this route • The pedestrian network is acceptable in the public right-of-way, but is faced with some constraint at 30 High Tech Road and at the Cinema • The cycling network is generally lacking, however shared roadway signage is present on High Tech Road • Pedestrians are performing the mid-block crossing of High Tech Road today, but typically prefer the use of the underpass route • Cycling activity is low in the area
Vehicular
• The High Tech Road intersection with 30 High Tech Road/Cinema is faced with operational constraint, particularly with respect to outbound left-turning movements • Observed delays are high for left-turning and through vehicles at the northbound and southbound approaches, and the approaches consistently operate over capacity. • A number of drivers perform northbound/southbound through movements to travel between 30 High Tech Road and the Cinema, but more drivers prefer using the underpass • The underpass experiences notable traffic volumes under existing conditions under certain peak hours.
Collision
• More than half of the collisions reported in the last 5 years (2013-2017) involved vehicles making a turning movement. • About 60% of collisions occurred under adverse weather conditions.
Sight Line
• A minimum stopping sight distance of 137m is required for the segment of High Tech Road where the grade is 5.8% and a speed limit of 50 km/h. • The critical stopping sight distance, at the top of the crest, is 110m, resulting in limited visibility.

4 ACCESS MODIFICATION & ACTIVE TRANSPORTATION OPTIONS

The review of the existing conditions revealed that the High Tech Road & 30 High Tech Road/Cinema intersection is operating with constraint under all peak hours of analysis. Furthermore, that pedestrians are crossing the intersection across 4-lanes of traffic. Finally, significant collision activity has been observed at this intersection as well. As a result, this section explores four (4) potential options to modify the intersection in an effort to improve traffic operations, reduce safety concerns, and enhance active transportation connectivity. Functional designs of all options are provided in **Appendix D**.

4.1 OPTION 1 – SIGNAGE AND PAVEMENT MARKING

The first option is to reduce the speed limit from 50km/h to 40km/h on High Tech Road between Yonge Street and Red Maple Road, as well as to install signage instructing pedestrians to cross at Yonge Street or at the underpass. The speed reduction would improve the sightline condition when cresting the overpass in the westbound direction, allowing drivers to better perceive and react to potential obstacles, and therefore, reducing the severity and frequency of collisions. The wayfinding measures would redirect pedestrians to cross High Tech Road at safer points and reduce pedestrian-vehicle interactions at the unsignalized intersection where no protected pedestrian crossing exists. This option would also include separation of the southbound left-turn and southbound through-right turn movements. This would require additional pavement markings on the southbound approach to indicate the lane assignment.

This option is the least obtrusive as the traffic operations on High Tech Road or the site driveways are maintained since all movements are still permitted and there is no change in traffic patterns. It is recognized that signage would not guarantee full compliance but it is a preliminary step to improving conditions. This option should be regularly monitored to confirm that the incidence of collisions is being reduced, and that pedestrians are obeying the implemented signage. It is expected that if this option is found to have no affect on traffic collisions and pedestrian behaviours, that a more obtrusive option should be considered by the Town. These are outlined the following section.

Intersection capacity analysis has been conducted of the High Tech Road & 30 High Tech Road/Cinema intersection with the lane separation of the southbound approach and reduced speed. This is summarized in **Table 4-1** for all peak hours. Capacity analysis results are available in **Appendix E**.

Intersection	Movement of Interest	Flow Rate (vph)	Capacity (vph)	Control Delay (s)	95th Queue (m)	V/C	LOS
Friday PM Peak Hour							
30 High Tech Road/ Cinema Richmond Hill & High Tech Road	EBL	157	945	9.6	4.8	0.17	A
	WBL	127	865	9.9	4.1	0.15	A
	NBL	76	32	898.0	70.2	2.39	F
	NBTR	292	313	72.5	73.9	0.93	F
	SBL	160	15	Err	Err	10.44	F
	SBTR	136	245	36.6	24.5	0.56	E
Saturday PM Peak Hour							
30 High Tech Road/ Cinema Richmond Hill & High Tech Road	EBL	56	918	9.2	1.6	0.06	A
	WBL	80	914	9.3	2.3	0.09	A
	NBL	80	89	154.1	39.7	0.90	F
	NBTR	116	320	22.5	12.9	0.36	C
	SBL	128	82	395.8	83.3	1.57	F
	SBLTR	116	470	15.2	7.7	0.25	C
Weekday Midday Peak Hour							
30 High Tech Road/ Cinema Richmond Hill & High Tech Road	EBL	84	971	9.1	2.3	0.09	A
	WBL	64	968	9.0	1.7	0.07	A
	NBL	40	101	62.1	12.9	0.40	F
	NBTR	100	342	19.8	9.5	0.29	C
	SBL	160	107	335.1	93.7	1.49	F
	SBLTR	121	478	15.1	8.0	0.25	C
Weekday PM Peak Hour							
30 High Tech Road/ Cinema Richmond Hill & High Tech Road	EBL	52	1012	8.8	1.3	0.05	A
	WBL	88	900	9.4	2.6	0.10	A
	NBL	56	94	88.5	22.3	0.60	F
	NBTR	235	548	16.4	17.1	0.43	C
	SBL	128	62	632.6	97.3	2.06	F
	SBLTR	96	477	14.4	6.0	0.20	B

Table 4-1: Signage and Pavement Marking Option – Intersection Capacity Analysis (All Peak Hours)

Some improvement is expected resulting from the separation of the southbound movements. The southbound left-turn movement continues to operate under constraint. However, delay and queueing are expected to decrease by implementing this option.

4.2 OPTION 2 – RIGHT-IN, RIGHT-OUT (RIRO)

The second option is to limit turning movements at the High Tech Road & 30 High Tech Road/Cinema intersection to right-in, right-out (RIRO) only. This would eliminate all left-turns and through movements drastically reducing the opportunity for vehicle collision. Furthermore, limiting movements to RIRO will significantly improve traffic operations along High Tech Road, as the number of conflicting movements causing delay under existing conditions would be removed. The benefits of this option are therefore the improvements to vehicle safety and traffic operations. Modifying the intersection to RIRO is expected to involve implementing a centre median along High Tech Road. As a result, this option can occur entirely within the Town's right-of-way.

Two sub-options are examined: one where pedestrians are accommodated via a centre median refuge, and the other which discourages pedestrians crossing High Tech Road via a barrier fence.

Option 2A

Since a two-way left-turn is present and would now be occupied by a centre median, there is the opportunity to implement a pedestrian refuge area in the centre of the right-of-way. This refuge area could be accommodated by barriers enclosing the median, as well as "Wait for Gap" signage. This would require pedestrians to yield to vehicles. Furthermore, this form of pedestrian crossing is not protected, but is more formalized versus the existing condition, and would offer a greater degree of perceived safety to pedestrians crossing mid-block. An example of 4-lane cross-section with a centre refuge is Bathurst Street south of Sheppard Avenue West (**Figure 4-1**).

Figure 4-1: Centre Median Refuge Precedent

With a centre median refuge area implemented, it is recommended signage be provided to drivers on High Tech Road as well. This signage should warn drivers of the pedestrian crossing activity ahead, both ways on High Tech Road. In addition, it is recommended with this pedestrian crossing that the speed limit on High Tech Road be changed from the current condition of 50km/h to 40km/h. In reviewing the area, it has been found that Bantry Avenue, the east-west roadway to the north of High Tech Road, features a 40km/h speed limit. Reducing the speed limit to 40km/h and implementing signage to warn drivers of pedestrians will work to increase the safety of pedestrians crossing at the mid-block crossing using the centre median refuge.

Option 2B

Alternatively, the pedestrian activity may be removed altogether by installing a fence along the centre median. This barrier will ensure that no pedestrians are crossing High Tech Road which reduces pedestrian conflicts with vehicles.

Aside from the configuration of these sub-options, the effect this option will have on the change in traffic patterns should be considered, as most turning movements at the intersection would be restricted. **Figure 4-2**, **Figure 4-3**, and **Figure 4-4** depict the anticipated change in traffic patterns resulting from this option.

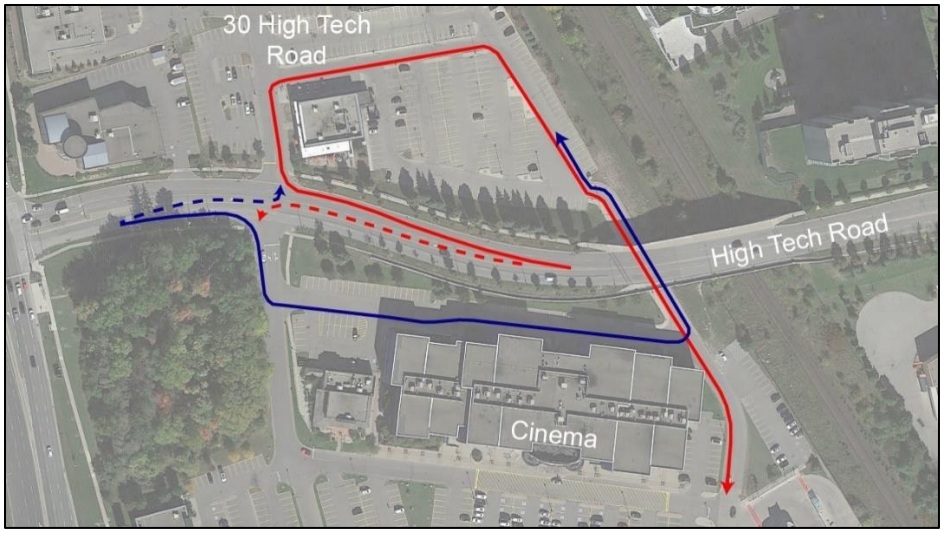


Figure 4-2: RIRO Option – Inbound Left-Turn Impact

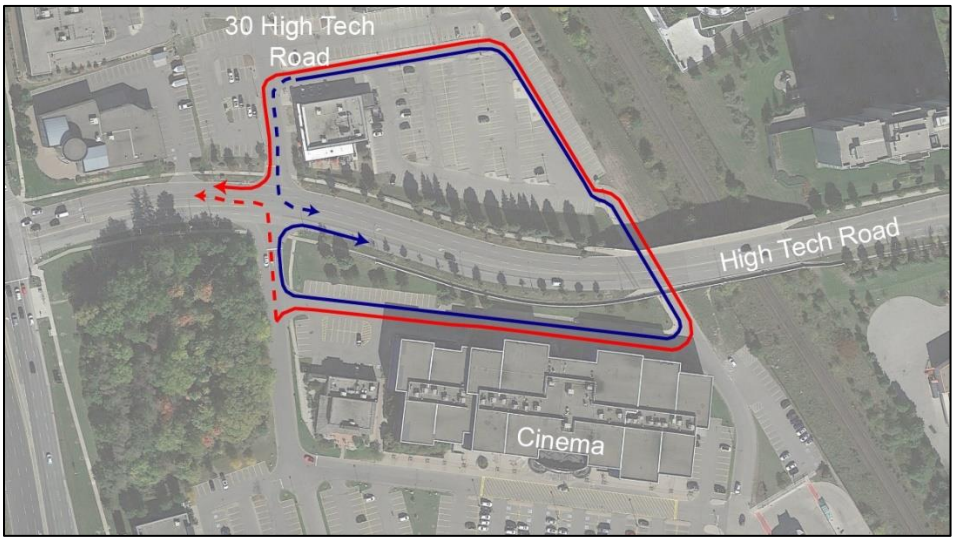


Figure 4-3: RIRO Option – Outbound Left-Turn Impact

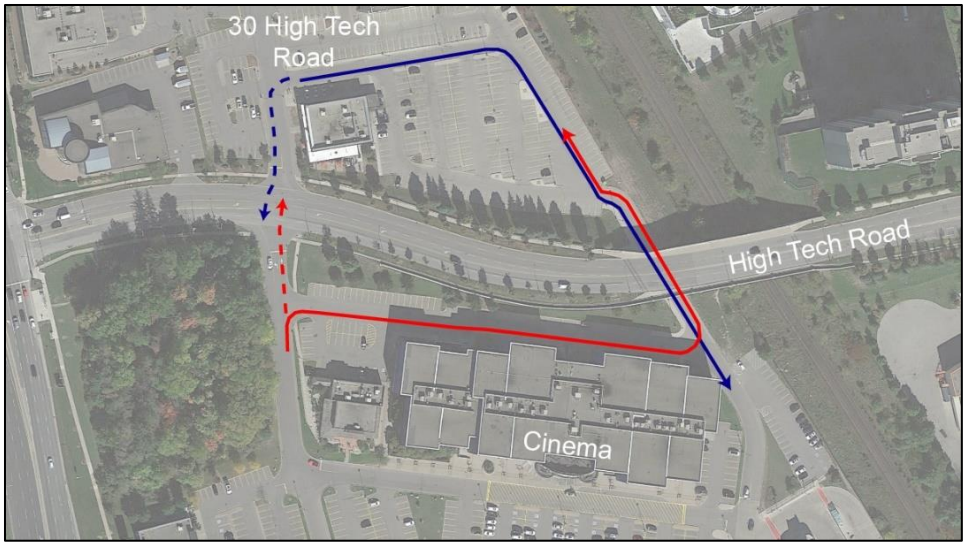


Figure 4-4: RIRO Option – Through Movement Impact

As left-turning movements would be restricted, drivers wishing to perform a northbound left-turn onto High Tech Road would instead need to use the underpass connection to travel to the opposite southbound approach and conduct a southbound right-turn. The inverse is also true for drivers wishing to conduct a southbound left-turn. As for drivers wishing to enter 30 High Tech Road via an eastbound left-turn from High Tech Road, they would instead need to enter the Cinema property via an eastbound right-turn and use the underpass connection to access 30 High Tech Road. This is inversely true for drivers wishing to enter the Cinema property via a westbound left-turn from High Tech Road. Finally, for those drivers either performing a northbound or southbound through movement between the two (2) properties, the underpass route would instead be used.

Figure 4-5 to **Figure 4-8** below depicts the change in traffic volumes at the High Tech Road & 30 High Tech Road/Cinema intersection that can be expected with conversion to RIRO during the studied peak hours.

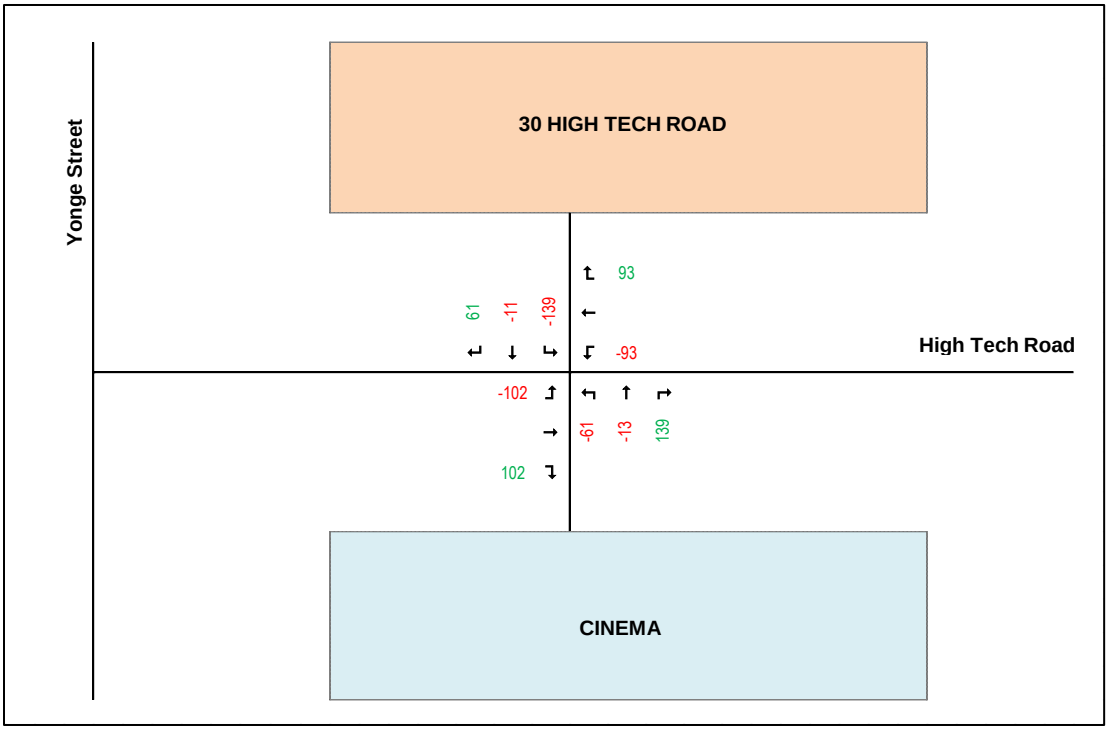


Figure 4-5: RIRO Option – Change in Traffic Volumes (Friday PM Peak Hour)

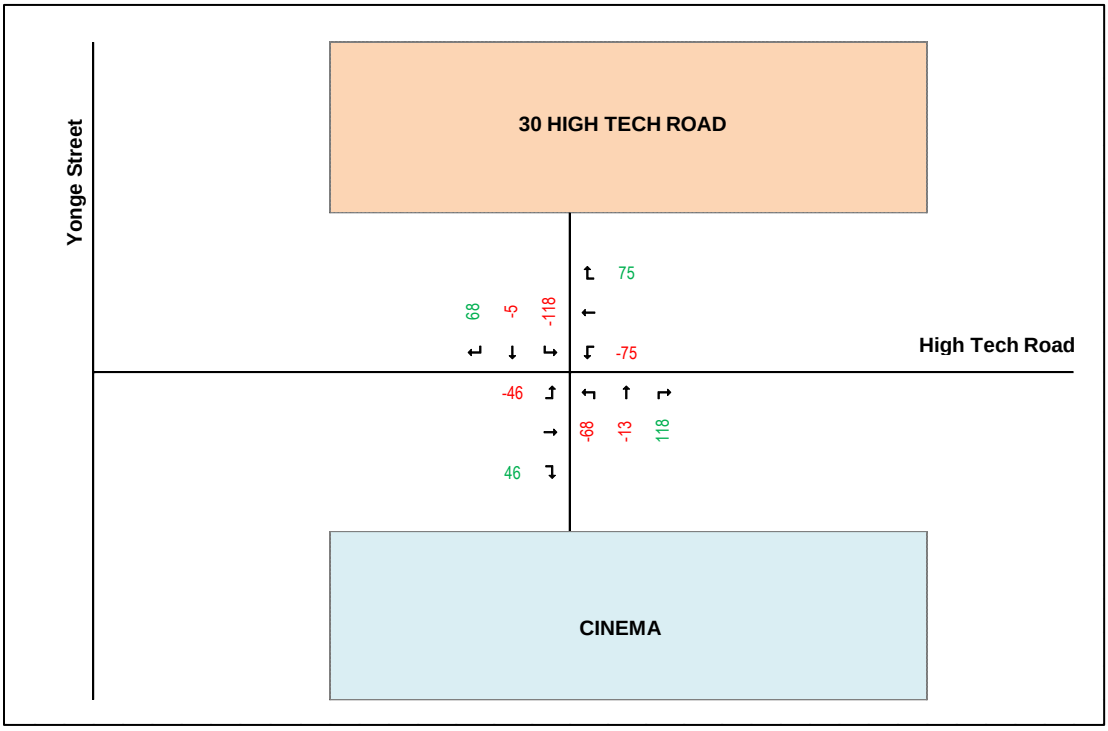


Figure 4-6: RIRO Option – Change in Traffic Volumes (Saturday PM Peak Hour)

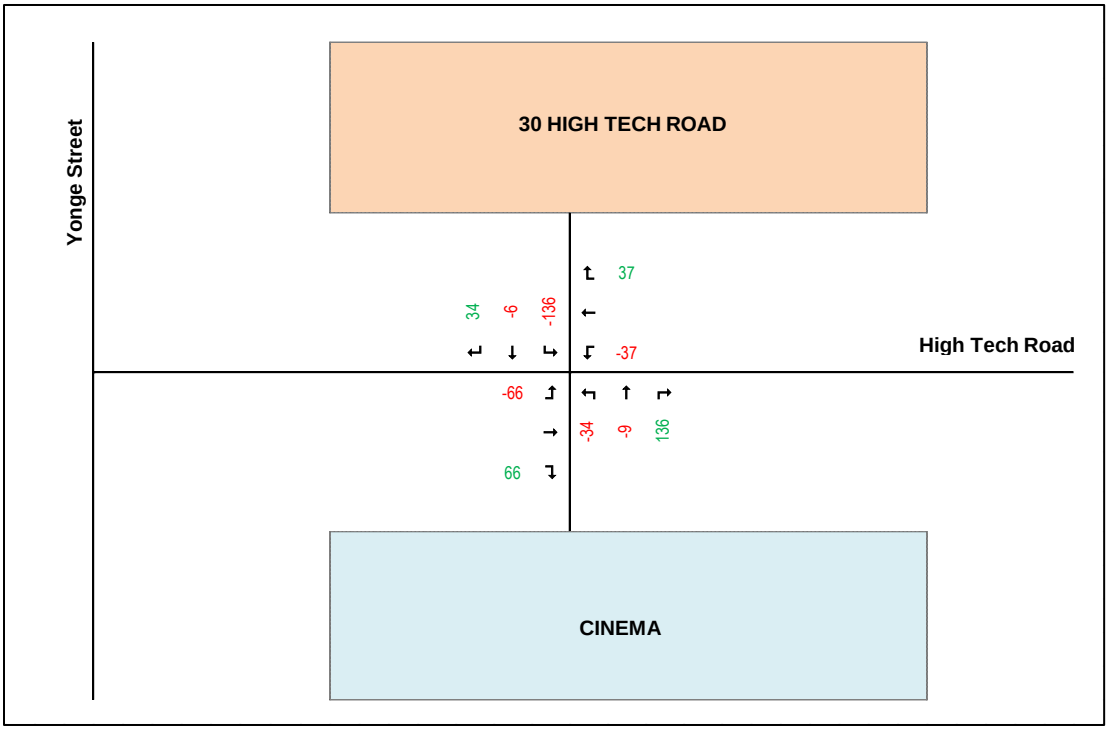


Figure 4-7: RIRO Option – Change in Traffic Volumes (Weekday Midday Peak Hour)

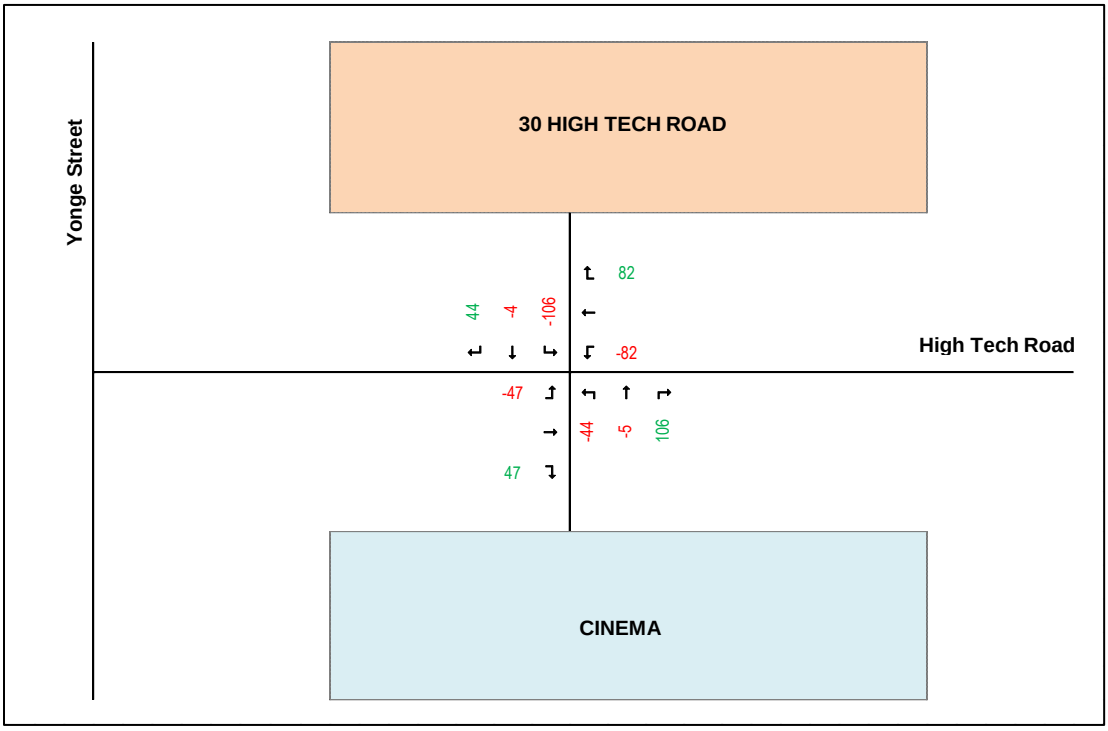


Figure 4-8: RIRO Option – Change in Traffic Volumes (Weekday PM Peak Hour)

Also resulting from the change in traffic patterns would be an increase in traffic volumes using the underpass connection. Since left-turning and through movements would be restricted at the High Tech Road & 30 High Tech Road/Cinema intersection, drivers would need to use the underpass

connection to maintain their origin-destination pattern. **Table 4-2** summarizes the existing underpass volumes, as well as the resulting underpass volumes during each peak hour of analysis with the intersection modified to RIRO.

Underpass Traffic Volumes – RIRO Option			
Time Period	**Existing Vehicles**	**RIRO Option # of Vehicles**	**Net Change**
Friday PM Peak Hour	107	526	+419
Saturday PM Peak Hour	63	388	+325
Weekday Midday Peak Hour	54	342	+288
Weekday PM Peak Hour	129	417	+288

Table 4-2: RIRO Option – Underpass Volumes

The RIRO option will notably increase traffic volumes at the underpass. Traffic volumes are expected to increase most substantially during the Friday PM peak hour, with the underpass accommodating over 500 vehicles during the peak hour. This amount of two-way vehicle is significant for a driveway connection and is beyond the traffic volume driveways are typically to accommodate. Furthermore, this increase in traffic circulating the 30 High Tech Road and Cinema parking lots may impact the internal intersections.

Intersection capacity analysis has been conducted of the High Tech Road & 30 High Tech Road/Cinema intersection with the intersection modified to RIRO. This is summarized in **Table 4-3** for all peak hours. Capacity analysis results are available in **Appendix E**.

Intersection	Movement of Interest	Flow Rate (vph)	Capacity (vph)	Control Delay (s)	95th Queue (m)	V/C	LOS
Friday PM Peak Hour							
30 High Tech Road/Cinema & High Tech Road	NBR	157	945	9.6	4.8	0.17	A
	SBR	127	865	9.9	4.1	0.15	A
Saturday PM Peak Hour							
30 High Tech Road/Cinema & High Tech Road	NBR	157	945	9.6	4.8	0.17	A
	SBR	127	865	9.9	4.1	0.15	A
Weekday Midday Peak Hour							
30 High Tech Road/Cinema & High Tech Road	NBR	157	945	9.6	4.8	0.17	A
	SBR	127	865	9.9	4.1	0.15	A
Weekday PM Peak Hour							
30 High Tech Road/Cinema & High Tech Road	NBR	157	945	9.6	4.8	0.17	A
	SBR	127	865	9.9	4.1	0.15	A

Table 4-3: RIRO Option – Intersection Capacity Analysis (All Peak Hours)

The intersection capacity analysis reveals good operations at the intersection during all peak hours given RIRO operation. No constraints have been identified and all previous constraints observed under existing conditions have been eliminated.

4.3 OPTION 3 – LEFT-IN, RIGHT-IN, RIGHT-OUT (LI, RIRO)

The third option is to modify the High Tech Road & 30 High Tech Road/Cinema intersection to left-in, right-in, right-out (LI, RIRO), thereby restricting outbound left-turns and northbound/southbound through movements. This option has been developed as it was observed that the outbound left-turns and northbound/southbound through movements face the greatest constraint, while still permitting inbound left-turns would reduce the change in traffic patterns in the immediate area. This option is

anticipated to considerably improve traffic operations, as the most constrained movements will no longer be possible. Furthermore, the likelihood of vehicle collision is also expected to be reduced significantly, as the outbound left-turn movements will no longer be possible.

To enforce the movement restrictions of this option, half pork chops would be installed at the northbound and southbound approaches to restrict left-turn movements, but still permit left-in and right-in movements. Furthermore, left-turning lane medians would be installed along High Tech Road as to further restrict left-out and northbound/southbound through movements.

As the medians would not be continuous and not create a centre refuge area for pedestrians, it will not be possible to improve the pedestrian crossing condition mid-block on High Tech Road. Resultantly, this option would offer no improvement to the mid-block crossing, and it is suggested with this option that no-crossing signage be implemented on High Tech Road mid-block, and that pedestrians be more strongly encouraged to use the underpass connection. A 40km/h speed limit is recommended with this option to improve the sightline condition when cresting the overpass.

Given certain turning movements are being restricted, a change in travel patterns is expected in the immediate area related to the outbound left-turns and northbound/southbound through movements. **Figure 4-9** and **Figure 4-10** depict the change in traffic patterns.

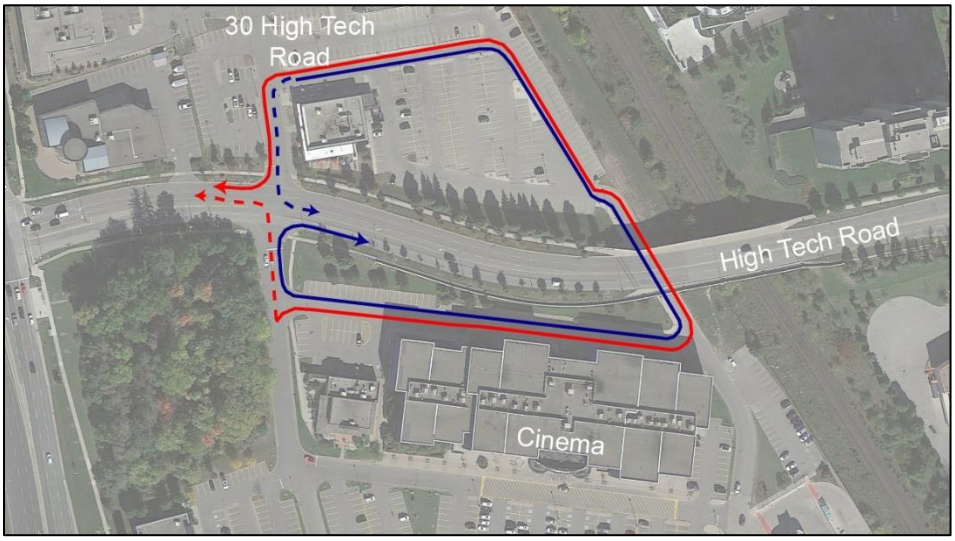


Figure 4-9: LI, RIRO Option – Outbound Left-Turn Impact

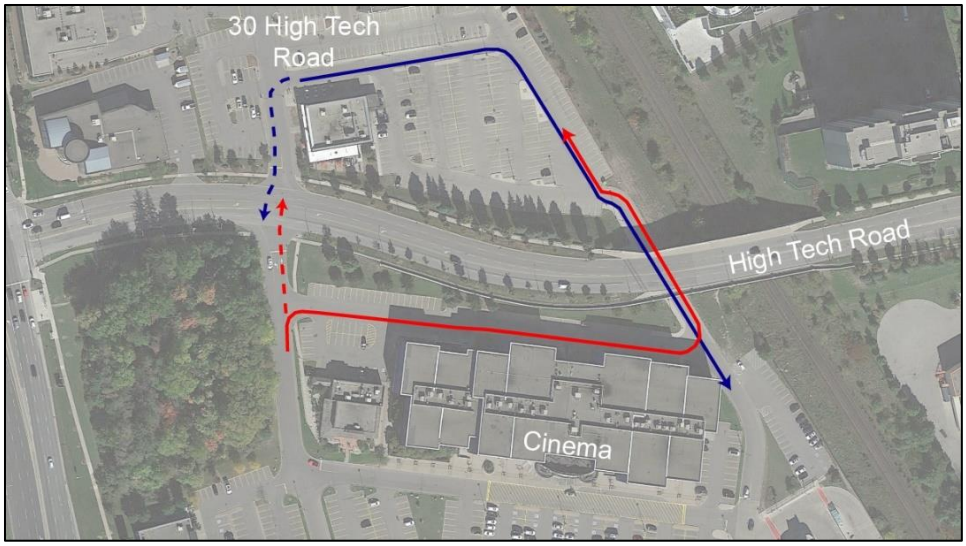


Figure 4-10: LI, RIRO Option – Through Movement Impact

As outbound left-turning movements would be restricted, drivers wishing to perform a northbound left-turn onto High Tech Road would instead need to use the underpass connection to travel to the opposite southbound approach and conduct a southbound right-turn. The inverse is also true for drivers wishing to conduct a southbound left-turn. For those drivers either performing a northbound or southbound through movement between the two (2) properties, the underpass route would instead be used.

Figure 4-11 to **Figure 4-14** below depicts the change in traffic volumes at the High Tech Road & 30 High Tech Road/Cinema intersection that can be expected with conversion to LI, RIRO during the studied peak hours.

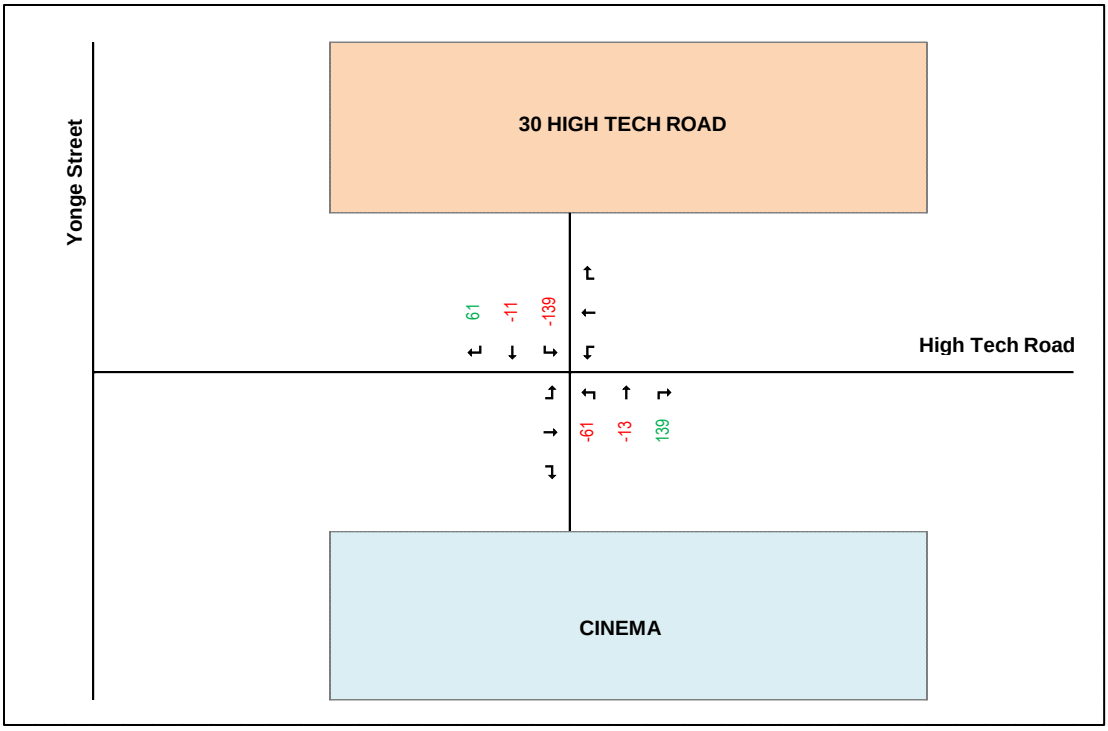


Figure 4-11: LI, RIRO Option – Change in Traffic Volumes (Friday PM Peak Hour)

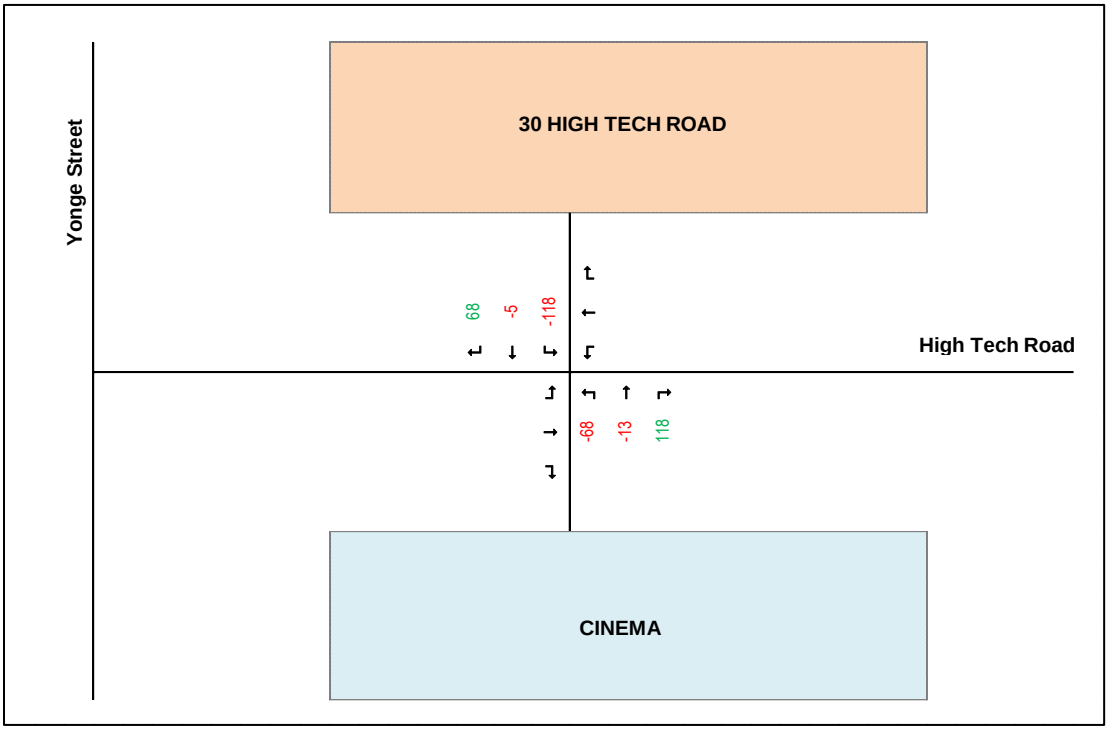


Figure 4-12: LI, RIRO Option – Change in Traffic Volumes (Saturday PM Peak Hour)

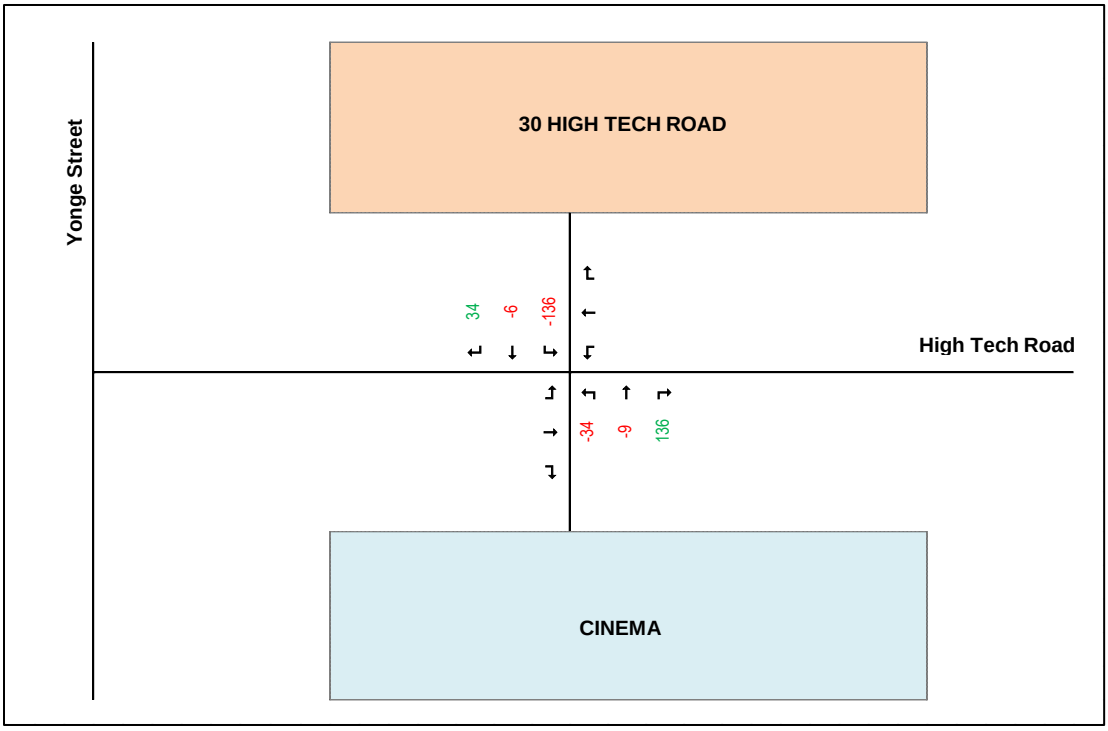


Figure 4-13: LI, RIRO Option – Change in Traffic Volumes (Weekday Midday Peak Hour)

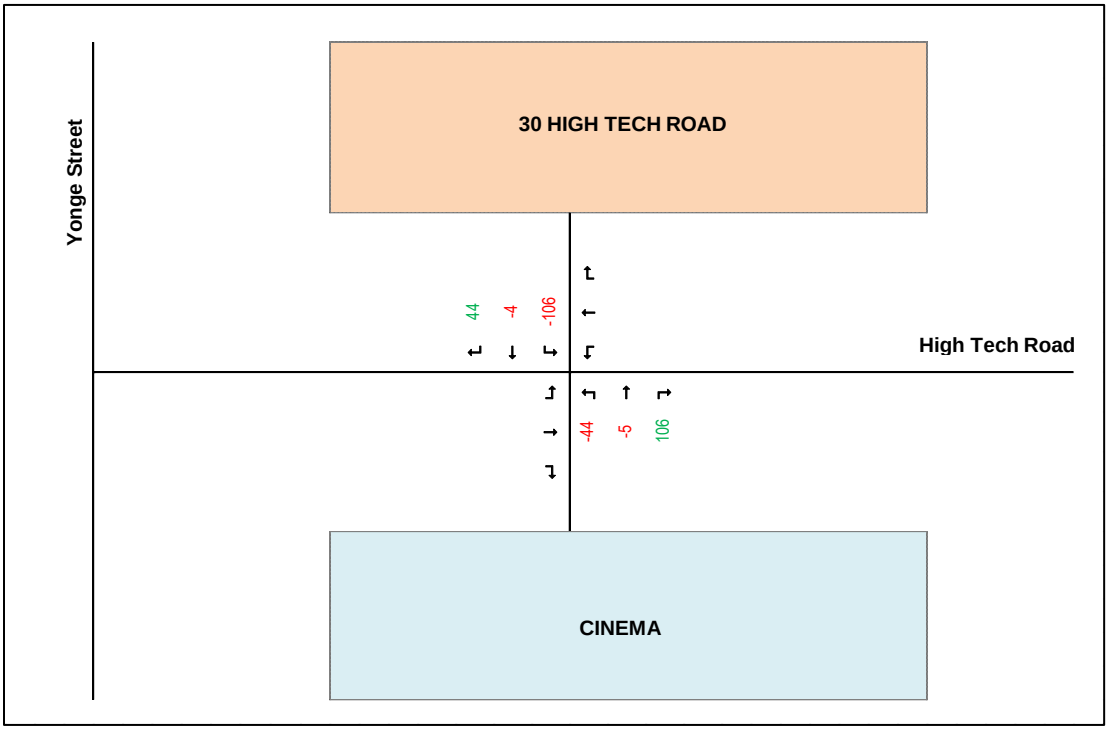


Figure 4-14: LI, RIRO Option – Change in Traffic Volumes (Weekday PM Peak Hour)

The change in traffic patterns is expected to increase traffic volumes at the underpass connection, as outbound left-turning movements and northbound/southbound through movements would not be permitted. Drivers would need to use the underpass connection to maintain their origin-destination

pattern. **Table 4-4** summarizes the existing underpass volumes, as well as the resulting underpass volumes during each peak hour of analysis with the intersection modified to LI, RIRO.

Underpass Traffic Volumes – LI, RIRO Option			
Time Period	**Existing Vehicles**	**LI, RIRO Option # of Vehicles**	**Net Change**
Friday PM Peak Hour	107	331	+224
Saturday PM Peak Hour	63	267	+204
Weekday Midday Peak Hour	54	239	+185
Weekday PM Peak Hour	129	288	+159

Table 4-4: LI, RIRO Option - Underpass Volumes

The LI, RIRO option will increase traffic volumes at the underpass, with volumes expected to increase most substantially during the Friday PM peak hour. Versus the RIRO option, under this option traffic volumes at the underpass will be within the typical design capacity for a driveway. While some impact is still expected to the intersections internal to 30 High Tech Road and the Cinema properties, this impact is expected to be less than that introduced by the RIRO option.

Intersection capacity analysis has been conducted of the High Tech Road & 30 High Tech Road/Cinema intersection with the intersection modified to LI, RIRO. This is summarized in **Table 4-5** for all peak hours. Capacity analysis results are available in **Appendix E**.

Intersection	Movement of Interest	Flow Rate (vph)	Capacity (vph)	Control Delay (s)	95th Queue (m)	V/C	LOS
Friday PM Peak Hour							
30 High Tech Road/Cinema & High Tech Road	EBL	157	945	9.6	4.8	0.17	A
	WBL	127	865	9.9	4.1	0.15	A
	NBR	453	605	26.5	53.0	0.75	D
	SBR	191	670	12.5	9.4	0.28	B
Saturday PM Peak Hour							
30 High Tech Road/Cinema & High Tech Road	EBL	56	918	9.2	1.6	0.06	A
	WBL	80	914	9.3	2.3	0.09	A
	NBR	258	644	14.3	15.4	0.40	B
	SBR	186	647	12.8	9.5	0.29	B
Weekday Midday Peak Hour							
30 High Tech Road/Cinema & High Tech Road	EBL	84	971	9.1	2.3	0.09	A
	WBL	64	968	9.0	1.7	0.07	A
	NBR	256	679	13.5	14.1	0.38	B
	SBR	157	695	11.7	6.9	0.23	B
Weekday PM Peak Hour							
30 High Tech Road/Cinema & High Tech Road	EBL	52	1012	8.8	1.3	0.05	A
	WBL	88	900	9.4	2.6	0.10	A
	NBR	348	644	17.0	25.9	0.54	C
	SBR	138	688	11.5	6.0	0.20	B

Table 4-5: LI, RIRO Option – Intersection Capacity Analysis (All Peak Hours)

Overall, as a LI, RIRO intersection, operations are acceptable during all peak hours. The inbound left-turn movements are forecasted to operate with minimal delay and well within capacity. The outbound right-turn movements are forecasted to operate acceptably and also within capacity. All existing operational constraints have been eliminated.

4.4 OPTION 4 – SIGNALIZATION

The final option is to signalize the High Tech Road & 30 High Tech Road/Cinema intersection. It is recognized that this option was also explored in the RMHT Operations Review, identifying concerns with drivers acquiring sight of the signal heads when travelling westbound over the High Tech Road overpass. The grade of the overpass would mean drivers may not acquire sight of the signal in order to stop safely at the intersection, compounded by icing conditions during the winter months. To address this concern, as recommended in the RMHT Operations Review, advance warning systems would be installed on the incline of the overpass in the westbound direction on High Tech Road. This warning system would flash in the event that drivers would need to stop at the red signal in the westbound direction on High Tech Road. This condition and this recommendation given the signalization of the intersection is unchanged in this study.

A signal warrant analysis as per OTM Book 12 was conducted to determine if signalization of this intersection is appropriate given the new traffic volumes observed. As concluded in the RMHT Operations Review, a signal is warranted at this intersection. The warrant analysis requires the highest 8-hour volumes as data input. Since the data collection was conducted during peak periods over multiple days, the highest 8-hour volumes were calculated using the Friday PM peak hour volumes for the highest hour volume and adjusted based on hourly variations for the other seven (7) highest hours. The hourly traffic distributions were extracted from the typical traffic profile for a local route illustrated in Figure B2-5 in MTO's Ontario Geometric Design Standards for Ontario Highways. Details of the signal warrant analysis is included in **Appendix F**.

To further reduce safety concerns with the introduction of the signal at this intersection, reducing the speed limit on High Tech Road to 40km/h is now proposed. In reviewing the area, it has been observed that Bantry Road, the east-west link to the north of High Tech Road also features a 40km/h speed limit, and therefore there is precedent for this recommendation. Reducing the speed limit to 40km/h would increase the reaction time drivers would have to react to the red signal on High Tech Road when cresting the overpass.

The signalization option is anticipated to alleviate all operational constraints at the intersection. Furthermore, the likelihood of turning collisions is anticipated to decrease significantly. However, the likelihood of collision would be changed from turning to rear-end. The signal will also offer a direct benefit to pedestrians and cyclists, providing them a formalized and fully protected means of crossing the intersection between 30 High Tech Road and the Cinema. Crosswalks would be provided on all four (4) approaches of the intersection. Finally, this option would not introduce any changes to the existing travel patterns in the area, thereby not increasing traffic volumes at the underpass and potentially impacting private property.

The configuration of the intersection would be to maintain the northbound left-turn lane and the westbound left-turn lane, as well as to provide eastbound and southbound left-turning lanes. In developing a signal timing, cycle length was kept in consistency with the cycle length at the Yonge Street & High Tech Road intersection. The signal timing plan is summarized in **Table 4-6**.

It is also recognized that this option may introduce some challenges as the intersection is closely spaced from the adjacent signalized intersection at Yonge Street & High Tech Road. A roadway distance of 115m separates these two intersections. With the speed limit reduced to 40 km/h and the cycle length of the adjacent traffic of 130-140 seconds, a desirable signal spacing would be approximately 800m according to TAC guidelines.

Timing	EB		WB		NB		SB	
	L	TR	L	TR	L	TR	L	TR
Yellow Time (sec)	-	4	-	4	-	4	3	4
All-Red Time (sec)	-	3	-	3	-	3	2	3
Friday PM Peak Hour								
Total Split (sec)	-	77	-	77	-	44	19	63
Cycle Length (sec)	140							
Saturday PM Peak Hour								
Total Split (sec)	-	65	-	65	-	47	18	65
Cycle Length (sec)	130							
Weekday Midday Peak Hour								
Total Split (sec)	-	62	-	62	-	45	23	68
Cycle Length (sec)	130							
Weekday PM Peak Hour								
Total Split (sec)	-	69	-	69	-	51	20	71
Cycle Length (sec)	140							

Table 4-6: Signal Timing Plans

The resulting intersection capacity analysis during all peak hours is summarized in **Table 4-7**. The capacity analysis results are available in **Appendix E**.

Intersection	Overall			Movements of Interest					
	V/C	Delay (s)	LOS	Movement	V/C	Delay (s)	LOS	Queue (m)	
								50th	95th
Friday PM Peak Hour									
30 High Tech Road/ Cinema & High Tech Road	0.42	24.7	C	EBL	0.34	14.2	B	19.6	30.2
				EBTR	0.34	12.6	B	47.8	82.6
				WBL	0.32	14.0	B	15.5	29.3
				WBTR	0.28	11.9	B	34.7	62.4
				NBL	0.58	65.7	E	21.8	32.4
				NBTR	0.60	65.6	E	21.6	4.8
				SBL	0.56	44.6	D	37.5	46.5
				SBTR	0.12	38.7	D	4.4	2.2
Saturday PM Peak Hour									
30 High Tech Road/ Cinema & High Tech Road	0.35	19.1	B	EBL	0.12	9.8	A	5.4	13.2
				EBTR	0.30	10.8	B	37.7	61.4
				WBL	0.18	10.4	B	8.1	20.2
				WBTR	0.30	10.8	B	35.6	57.2
				NBL	0.61	64.0	E	21.1	34.9
				NBTR	0.18	53.9	D	5.0	9.7
				SBL	0.40	40.0	D	27.5	39.9
				SBTR	0.09	37.2	D	1.6	4.4
Weekday Midday Peak Hour									
30 High Tech Road/ Cinema & High Tech Road	0.33	17.2	B	EBL	0.17	5.4	A	3.6	m5.1
				EBTR	0.27	6.4	A	12.6	14.4
				WBL	0.13	9.9	A	6.2	9.6
				WBTR	0.26	10.5	B	27.3	44.3
				NBL	0.40	59.0	E	10.5	21.3
				NBTR	0.18	56.1	E	4.1	5.2
				SBL	0.47	40.8	D	35.1	46.5
				SBTR	0.10	37.2	D	2.5	0.0
Weekday PM Peak Hour									
30 High Tech Road/ Cinema & High Tech Road	0.36	21.7	C	EBL	0.10	8.6	A	4.8	13.1
				EBTR	0.29	9.9	A	38.8	55.8
				WBL	0.19	9.7	A	8.8	21.5
				WBTR	0.24	9.4	A	27.5	43.6
				NBL	0.50	64.5	E	16.0	26.2
				NBTR	0.20	60.2	E	2.2	0.5
				SBL	0.51	46.8	D	30.9	40.5
				SBTR	0.08	42.2	D	1.8	0.2

Table 4-7: Signalization Option – Intersection Capacity Analysis (All Peak Hours)

The intersection capacity analysis results indicate that the signalization option is expected to improve the existing operational constraints. All movements are expected to operate acceptably and with minimal delay and queues. With the implementation of the VivaNext line on Yonge Street, it would be beneficial to coordinate the signal timing plan with the Yonge Street & High Tech Road intersection to minimize potential queuing at the driveways. Due to the uncertainty of traffic patterns and signal priority strategy prior to the completion of the VivaNext line, additional operational assessment (i.e. signal coordination) is deferred until all other options have been exhausted or when signalization becomes the preferred option.

It should be noted that the high density residential development on Red Maple Road and completion of Red Cedar Road connecting Richmond Hill and Markham, south of Highway 7, would increase traffic on High Tech Road and potentially impact the signalized intersection at Yonge Street and

High Tech Road. This may change the anticipated traffic operations and recommended signal timing plans.

5 EVALUATION OF OPTIONS

Based on the review of the existing conditions, evaluation criteria were devised to assess the five (5) options and their impact or improvement to a number of considerations. The evaluation criteria are provided in **Table 5-1**.

Impact to Traffic Operations of Site Driveways	This criterion is concerned with the direct impact to traffic operations of 30 High Tech Road and Cinema driveways.
Impact to Traffic Operations on High Tech Road	This criterion is concerned with the direct impact to traffic operations on High Tech Road.
Impact to Traffic Operations of Underpass	This criterion is concerned with the direct impact to traffic operations of the Underpass.
Impact to Reducing Collisions at Driveways	This criterion is concerned with the direct impact to reducing the potential for collisions at High Tech Road & 30 High Tech Road/Cinema intersection.
Improvement to Active Transportation	This criterion is concerned with the direct benefit to improving active transportation connectivity and accessibility between 30 High Tech Road and the Cinema.
New Safety Considerations on High Tech Road	This criterion is concerned with the introduction of any new safety considerations that did not previously exist on High Tech Road.
Costs	This criterion is concerned with the cost of implementation.
General Considerations/ Feasibility	This criterion is concerned with other issues not considered in the preceding criteria.

Table 5-1: Evaluation Criteria

The five (5) options themselves and the changes that will implemented along with each option are outlined below in **Table 5-2**. This is a summary of the detailed description of the options as presented in **Section 4**.

Option	Mode of Operation	Changes within ROW	Active Transportation Infrastructure	Speed Limit
Signage + Pavement Marking	Unsignalized	None	Signage	40km/h
RIRO	Unsignalized	Add centre median	Centre refuge area	40km/h
RIRO	Unsignalized	Add centre median	None (Fence)	40km/h
LI, RIRO	Unsignalized	Add half pork-chops	None	40km/h
Signalization	Signalized	None	Crosswalks	40km/h

Table 5-2: Summary of Recommended Options

Upon applying the evaluation criteria to the five (5) options, the options have been evaluated with a "Good", "Fair", or "Poor" score. **Table 5-3** below summarizes the overall scoring of each option. The various sections to follow describe the reasoning of the scoring for each option under each criterion.

Criteria	Option 1 Signage + Pavement Marking	Option 2A RIRO	Option 2B RIRO	Option 3 LI, RIRO	Option 4 Signalization
Impact to Traffic Operations of Site Driveways	Fair	Fair	Fair	Fair	Good
Impact to Traffic Operations of High Tech Road	Fair	Good	Good	Fair	Poor
Impact to Traffic Operations of Underpass	Good	Poor	Poor	Fair	Good
Impact to Reducing Collisions	Fair	Good	Good	Fair	Fair
Improvement to Active Transportation	Fair	Fair	Poor	Poor	Good
Introduction of New Safety Considerations on High Tech Road	Good	Fair	Good	Good	Poor
Costs	Good	Fair	Fair	Poor	Poor
General Considerations/ Implementability	Good	Poor	Poor	Fair	Poor

Table 5-3: Scoring of Options

Preliminary cost estimates for each of the options are available in **Appendix G**.

5.1 OPTION 1 – SIGNAGE AND PAVEMENT MARKING

The scoring of the signage and pavement marking option is described below given the individual evaluation criteria.

Impact to Traffic Operations of Site Driveways
The additional signage and pavement marking will have minor impact to the traffic operations of the site driveways. The northbound and southbound movements will continue to be constrained; although, delays and queuing are expected to decrease by separating the southbound left-turn movement.

Impact to Traffic Operations of High Tech Road
The lower speed limit of 40km/h will have minimal impact to the traffic operations of High Tech Road. The eastbound and westbound movements will continue to operate with good levels of service.

Impact to Traffic Operations of Underpass
As this option maintains the traffic operations of the intersection, the traffic patterns are consistent with the existing conditions and no new safety considerations are introduced at the underpass driveway. Although the vehicular volumes are unchanged, an increase in pedestrian volumes is expected at the underpass.

Impact to Reducing Collisions at Driveways
This option will reduce the severity and the probability of collisions due to the reduced speed limit providing drivers on High Tech Road adequate time to perceive and react to vehicles.

Improvement to Active Transportation
Wayfinding signs will guide pedestrians to cross at locations with protected pedestrian crossings or lower vehicular volumes, minimizing mid-block pedestrian activity on High Tech Road.

Introduction of New Safety Considerations on High Tech Road
As this option maintains the traffic operations of the intersection, the traffic patterns are consistent with the existing conditions and no new safety considerations are introduced on High Tech Road.

Costs
In comparison to the other options, this will be the most affordable option. The cost includes the installation of up to five (5) signs, and painted pavement markings indicating the lane assignment on the southbound approach. Two (2) signs indicating the 40km/h speed limit to be placed just east of Yonge Street and prior the crest of the overpass, and another 2-3 signs for wayfinding. All signs will be posted on the public right-of-way.

General Considerations/Implementability
Since implementation can mostly be achieved within the right-of-way of High Tech Road, cooperation with private property owners is limited to the pavement markings.

5.2 OPTION 2A – RIRO

The scoring of the RIRO option is described below given the individual evaluation criteria.

Impact to Traffic Operations of Site Driveways
The RIRO option will significantly impact traffic operations of the site driveways, as all left-turning movements and through movements will be eliminated. Only right-turn movements will be allowed to enter and exit. Intersection capacity analysis reveals the intersection will operate within capacity and with acceptable delays for inbound and outbound right-turning movements. This is an improvement to traffic operations since the critical movements are eliminated; albeit, the properties have reduced accessibility as a result.

Impact to Traffic Operations of High Tech Road
The RIRO option will significantly improve traffic operations on High Tech Road by eliminating all left-turn movements.

Impact to Traffic Operations of Underpass
The poor score is received as all left-turning and through vehicles at the intersection are expected to be redirected to the underpass connection. While this is a viable alternative, traffic volumes during the peak hours as forecasted reveal that the two-way volumes at the underpass may exceed the typical design capacity for a driveway. In addition, the increase in traffic volumes using the drive aisles of the parking lots at the Cinema and 30 High Tech Road are anticipated to impact the ability of drivers to access parking spaces, as well as operations at the internal intersections. These impacts are furthermore, all anticipated to occur on private property.

Impact to Reducing Collisions at Driveways
The RIRO options will significantly reduce the probability of vehicle collisions at the intersection, as most conflicting movements will be eliminated including the outbound left-turning movements and through movements. The high incidence of turning collisions as revealed in the RMHT Operations Review is expected to be considerably reduced.

Improvement to Active Transportation
The RIRO option will implement a centre refuge area for pedestrians and cyclists, along with "Wait for Gap" signage. Pedestrian crossing activity signage will also be implemented along High Tech Road, and the speed limit will be dropped to 40km/h. These modifications are expected to provide pedestrians and cyclists a more formal opportunity to cross High Tech Road as oppose to the current condition. However, the "Fair" score is received as this improvement still does not offer a fully protected crossing to pedestrians.

Introduction of New Safety Considerations on High Tech Road
Since the mid-block crossing on High Tech Road will be formalized via a centre refuge, requiring pedestrians to yield to vehicles, there is the opportunity for pedestrians to fail to yield to vehicles, as well as the opportunity for drivers to fail to respond in time to avoid a pedestrian given the pedestrian fails to yield appropriately. The descent from the top of the overpass down toward the intersection and the sightline condition may also contribute to inhibiting a driver's ability to respond to pedestrians appropriately. A "Fair" score is received since pedestrian crossing signage and a 40km/h speed limit will be implemented, reducing pedestrian crossing concerns.

Costs
The costs include the installation of the concrete centre median and signage to indicate that left-turns are prohibited, as well as the pedestrian refuge infrastructure and signage.

General Considerations/Implementability
As access on High Tech Road will be limited once the RIRO configuration is implemented, some customers will have to reroute to use the alternative access on Yonge Street or detour around the parking lots. This option may impact businesses as the High Tech Road access will be restricted to right-turn movements and customers may find the path to enter or exit the site cumbersome.

5.3 OPTION 2B – RIRO WITH BARRIER FENCE

The scoring of the RIRO with a barrier fence preventing pedestrian crossings option is described below given the individual evaluation criteria.

Impact to Traffic Operations of Site Driveways
Same as Option 2A.

Impact to Traffic Operations of High Tech Road
Same as Option 2A.

Impact to Traffic Operations of Underpass
Similarly, this option also adds a significant number of vehicles to the underpass driveway, exceeding the typical design capacity of a driveway. Aside from the traffic impact to internal driveways, higher pedestrian volumes are expected at the underpass as they are prevented from crossing High Tech Road.

Impact to Reducing Collisions at Driveways
Same as Option 2A.

Improvement to Active Transportation
The main difference between Option 2A and 2B is the presence of pedestrian activity across High Tech Road. The installation of a fence will create a physical barrier discouraging pedestrians from crossing mid-block. Although this option reduces pedestrian conflicts with vehicles, no physical improvements are implemented that would benefit active transportation.

Introduction of New Safety Considerations on High Tech Road
Since pedestrians are prevented from crossing mid-block, no new safety considerations arise from this option.

Costs
The costs for this option is slightly higher than Option 2A with the addition of the barrier fence.

General Considerations/Implementability
Same as Option 2A.

5.4 OPTION 3 – LI, RIRO

The scoring of the LI, RIRO option is described below given the individual evaluation criteria.

Impact to Traffic Operations of Site Driveways
Traffic operations are expected to be impacted significantly, as the outbound left-turn and through movements will no longer be possible. These movements can use the underpass to conduct right-turn movements instead. These right-turn movements are forecasted to operate well during all peak hours.

Impact to Traffic Operations of High Tech Road
Elimination of the outbound left-turn and through movements, which face the greatest constraint, while permitting inbound left-turn movements will somewhat improve traffic operations on High Tech Road. The inbound left-turn movements are forecasted to operate without constraint during all peak hours.

Impact to Traffic Operations of Underpass
With the restriction of the outbound left-turn and through movements, traffic volumes at the underpass and within the parking lots of 30 High Tech Road and the Cinema are expected to increase. While this increase will not be as great as the RIRO option, volumes at the underpass are still expected to increase to approximately 300-400 vehicles per hour, which is at or slightly exceeds the typical design capacity for a driveway. This option does not bring any new active transportation considerations at the underpass that are not already present.

Impact to Reducing Collisions at Driveways
The probability of collision is anticipated to decrease considerably, as the outbound left-turn and through movements will no longer be possible. Inbound left-turns will still be possible and does create the chance for some collisions. However, overall, the probability of collision is significantly reduced.

Improvement to Active Transportation
This option will not provide any benefit to active transportation over the existing condition. Pedestrians crossing at the mid-block crossing of High Tech Road will still crossing unprotected. Pedestrians under this option should be encouraged to use the underpass connection. However, any improvements to the underpass connection to more strongly encourage its use will requirement improvements to private property.

Introduction of New Safety Considerations on High Tech Road
High Tech Road will not experience any new impacts to vehicular traffic or active transportation conditions.

Costs
The costs to implement the LI, RIRO option includes half pork-chop concrete islands and signage prohibiting left-turn movements. Although less material is required for the concrete islands than the RIRO options, the curb modifications will require relocation of light fixtures, fire hydrant and guardrail on the south side of High Tech Road. The need for retaining wall may also have to be investigated.

General Considerations/Implementability
Similarly, this option may have some impact to the surrounding businesses but to a lesser degree than the RIRO option. All inbound movements are permitted while outbound left-turn vehicles will have to use alternative egress points or detour around the parking lots to exit. Further, this option will have some design impact to private property as the curb radii at the northbound and southbound approach will have to be modified to accommodate the pork chop island and design vehicle turning paths.

5.5 OPTION 4 – SIGNALIZATION

The scoring of the signalization option is described below given the individual evaluation criteria.

Impact to Traffic Operations of Site Driveways
The forecasted traffic operations with this option reveal a considerable improvement to the site driveways by re-assigning the right-of-way from High Tech Road to all approaches. The site driveways are forecasted to operate within the roadway capacity and with acceptable delays. As a result of this improvement in operations, a "Good" score has been awarded.

Impact to Traffic Operations of High Tech Road
However, the improvement of the traffic operations of the site driveways comes at the expense of High Tech Road. The signalization changes the free flow traffic conditions and takes away the right-of-way from vehicles on High Tech Road. The intersection is also closely spaced from the High Tech Road & Yonge Street intersection.

Impact to Traffic Operations of Underpass
The underpass will not experience any new impacts to vehicular traffic or active transportation conditions as the traffic patterns are consistent with existing conditions.

Impact to Reducing Collisions at Driveways
Since the intersection will be signalized, the probability of turning collision will be significantly reduced. However, as all movements will still be permitted, the chance of collision is increased from the LI, RIRO option. Further, the probability of rear-end collisions is increased. For this reason, a "Fair" score is awarded.

Improvement to Active Transportation
Of all options, the signalization option provides the greatest benefit to active transportation, as crosswalk will be provided on all intersection approaches, with crossing activity controlled by the signal. This will offer pedestrians and cyclists a protected means of crossing High Tech Road without needing to yield to vehicles or needing to walk a longer distance to the underpass.

Introduction of New Safety Considerations on High Tech Road
A "Poor" score has been awarded as this option will introduce new vehicular considerations. As the signal will be located west of the overpass, and the end of downward slope if travelling in the westbound direction, drivers may be challenged to obtain sight of the red signal when cresting the overpass. This may result in drivers being faced with insufficient stopping distance when descending the slope. As recommended in the RMHT Operations Review, to mitigate this condition, an advance warning system is recommended. The system would warn drivers when a red signal is anticipated ahead. The system would be placed on the upward portion of the overpass to the east of the crest to communicate to drivers of the impending red signal well in advance of needing to decelerate. Furthermore, also recommended for this option is a decrease in the speed limit to 40km/h, further decreasing concerns of the availability of sufficient stopping distance.

Like the vehicular concerns, as drivers may face challenges in decelerating and stopping for a red signal in the westbound direction on High Tech Road, there is a risk that drivers would encroach into the westbound crosswalk where pedestrians would be crossing. The mitigation measures recommended with this option being the advance warning system and the reduction in speed limit to 40km/h are expected to reduce the newly introduced active transportation considerations.

Costs
This option will incur the highest costs to install the signal equipment and modify the lane configuration and pavement markings.

General Considerations/Implementability
The introduction of a traffic signal head at the intersection may affect the traffic and transit operations on Yonge Street. In order to manage potential queuing, the traffic signal is recommended to be coordinated with the signal on Yonge Street & High Tech Road intersection and the transit signal priority that will be implemented once the vivaNext BRT construction is completed in 2020. This will require coordination with York Region as the traffic signal on Yonge Street is under the Region's jurisdiction.

5.6 RECOMMENDATION

It is recommended that the Town implement Option 1 – Signage and Pavement Marking. Implementing this option is a relatively unobtrusive choice, and if it is found that the reduction in speed limit, the wayfinding signage and an exclusive southbound left-turn lane reduce the incidence of collision, mid-block crossing activity and delays, this option could be considered for a longer period of time. It is recommended with this option that the Town monitor the incidence of collisions as well as mid-block crossing activity to understand if the option is having the desired effect.

If it is discovered that Option 1 is not reducing the incidence of collisions, and that pedestrians are continuing to cross mid-block, Option 2 – 4 could be explored. Each of the Options 2 – 4 present their respective advantages and disadvantages, and score similarly as per the evaluation matrix. Following Option 1, the Town could then explore the impact Option 2A/B or Option 3 would have on reducing collisions and improving traffic operations. Option 4 could be considered if Options 1-3 are introducing new concerns which are unacceptable to the Town. However, Option 4 may need to be developed more comprehensively in coordination with York Region.

6 CONCLUSIONS

- A review of the existing conditions reveals a number of gaps and opportunities to improve traffic operations and safety for all road users at 30 High Tech Road/Cinema & High Tech Road intersection.

    - Pedestrians/cyclists – Absence of protected crossing mid-block on High Tech Road
    - Vehicles – Outbound left and through movements constrained during peak hours with considerable delay

- More than half of collisions reported between 2013 and 2017 are turning movements.

- The available sight stopping distance is not sufficient for a vehicle travelling on High Tech Road with a posted speed limit of 50 km/h and a grade of 5.8%. However, the limited visibility can be effectively managed by reducing the speed and providing an advanced warning system.

- Five options were formulated to address these concerns:

    - Option 1 – Signage and Pavement Marking
    - Option 2A – RIRO
    - Option 2B – RIRO with Barrier Fence
    - Option 3 – LI, RIRO
    - Option 4 – Signalization

- With the exception of Option 1, the intersection capacity analysis reveals that all options would be effective in improving capacity constraints and minimizing delay at the intersection, particularly the outbound movements during all peak hours.

- Based on the evaluation matrix, Option 1 is recommended as it has potential to reduce the severity and the probability of collisions, as well as reducing pedestrians crossing mid-block at a low cost. As this option does not significantly change traffic patterns in the area, this is an ideal solution to implement short-term.

- If the installation of signage is ineffective, substantial modification to the intersection configuration may be required which would eliminate left-turning movements via concrete median islands. Derivatives of right-in/right-out options would remove conflicting movements and reduce collisions at the intersection while introducing significant traffic volumes at the underpass driveway. This solution is recommended in the medium-term if the signage option is not successful.

- As a potential longer-term solution, it is recommended that the Town considers signalization of the intersection as traffic patterns would remain stable, traffic operations would be improved of the driveways, and a protected pedestrian crossing would be provided. Yet, this option would be the most significant impact to the traffic operations on High Tech Road, in addition to being the most costly. Further, coordination with the traffic signal and transit signal priority on Yonge Street with the future vivaNext bus rapidway may be required.

Table 6-1 summarizes the evaluation of the five options to improve traffic operations, reduce safety concerns, and enhance active transportation connectivity.

Impact to Traffic Operations of Site Driveways	Impact to Traffic Operations on High Tech Road	Impact to Traffic Operations of Underpass	Impact to Reducing Collisions	Improvement to Active Transportation	New Safety Considerations on High Tech Road	Costs	General Considerations/ Implementability
This criterion is concerned with the direct impact to traffic operations of 30 High Tech Road and Cinema driveways	This criterion is concerned with the direct impact to traffic operations on High Tech Road	This criterion is concerned with the direct impact to traffic operations of the underpass connection	This criterion is concerned with the direct impact to reducing the potential for collisions at High Tech Road & 30 High Tech Road/Cinema intersection	This criterion is concerned with the direct benefit to improving active transportation connectivity and accessibility between 30 High Tech Road and the Cinema	This criterion is concerned with the introduction of any new impact to vehicle operations or the introduction of new safety considerations that did not previously exist	This criterion is concerned with the cost of implementation	This criterion is concerned with other issues not considered in the preceding criteria, and was well as the implementability of the options

Option	Impact to Traffic Operations of Site Driveways	Impact to Traffic Operations of High Tech Road	Impact to Traffic Operations of Underpass	Impact to Reducing Collisions	Improvement to Active Transportation	New Safety Considerations on High Tech Road	Costs	General Considerations/ Implementability	SCORE
OPTION 1 - Signage + Pavement Marking	2 Minor improvement to traffic operations of the site driveways.	2 No impact to traffic operations	4 Increase of pedestrians at underpass is expected, but no increase in traffic volumes.	2 Will reduce the severity and probability of collisions resulting from the speed limit change	2 This option guides pedestrians to use the underpass path. No additional features to protect pedestrians crossing High Tech Road.	4 No new impacts to traffic safety or operations	4 Minimal costs - new traffic signage and pavement markings	4 Implementation can be mostly achieved within High Tech Road right-of-way, except for the southbound lane markings.	24
OPTION 2A - RIRO	3 Will impact traffic operations by eliminating all left-turning movements and N-S through movements. Will improve overall operations by eliminating all critical movements	4 Will significantly improve traffic operations on High Tech Road by eliminating all left-turn movements.	1 Will add a significant number of vehicles to the underpass driveway, exceeding the typical vph capacity for a driveway.	4 Will significantly reduce the probability of collisions.	2 A centre median refuge area could be provided for pedestrians with "Wait for Gap" signage, improving the existing condition. Still no protected crossing of High Tech Road.	3 Driver sightlines will be limited when cresting the overpass to view pedestrians crossing High Tech Road. A 40km/h speed limit can mitigate this consideration.	2 Moderate costs - modify existing pavement and markings, new traffic signage and pavement markings, new median	1 Will have an impact to businesses as access will be limited on High Tech Road.	20
OPTION 2B - RIRO	3 Will impact traffic operations by eliminating all left-turning movements and N-S through movements. Will improve overall operations by eliminating all critical movements	4 Will significantly impact traffic operations on High Tech Road by eliminating all left-turn movements.	1 Will add a significant number of vehicles to the underpass driveway, exceeding the typical vph capacity for a driveway, while also increasing pedestrian volumes	4 Will significantly reduce the probability of collisions.	1 A barrier will be installed to ensure that no pedestrians are able to cross High Tech Road. This option while reducing pedestrian conflicts with vehicles does not directly benefit active transportation.	4 No new impacts to traffic safety or operations	2 Moderate costs - modify existing pavement and markings, new traffic signage and pavement markings, new median, barrier fence	1 Will have an impact to businesses as access will be limited on High Tech Road.	20
OPTION 3 - LI, RIRO	2 Will impact traffic operations by eliminating all outbound left-turning movements and N-S through movements. Outbound movements can use underpass to conduct right-turn movement instead.	3 Will somewhat improve traffic operations on High Tech Road by eliminating outbound left-turn movements from site driveways.	2 Left-out restrictions will add a considerable number of vehicles to the underpass driveway, but these volumes will be more appropriate to the vph capacity of a driveway.	3 Will significantly reduce the probability of collisions, but inbound left-turns will still be possible presenting some collision probability versus the RIRO option.	1 No improvement to the crossing condition of High Tech Road will be possible.	4 No new impacts to traffic safety or operations	1 High costs - Curb and pavement modification, modify guardrail, relocate utility box, streetlight, and hydrant, new traffic signage and pavement markings	1 Will have an impact to businesses as drivers will have to use alternative points for outbound left movements. Will have impacts to private property	17
OPTION 4 - Signalization	4 Will significantly improve traffic operations for site driveways by re-assigning right-of-way from High Tech Road to all approaches via signalized intersection.	1 Will deteriorate traffic operations on High Tech Road by controlling traffic flow and taking the right-of-way from vehicles on High Tech Road.	4 No new considerations at underpass.	2 Will affect the probability of collision from right-angle to rear-end.	4 Protected crosswalks will be provided for pedestrians across High Tech Road.	1 Driver sightlines will be limited when cresting the overpass to via the red signal when travelling westbound. Advance warning systems and a 40km/h speed limit can mitigate this consideration.	1 High costs - Curb and pavement modification, traffic signal equipment, tactile plates, pavement markings and traffic signage	1 May have impact to traffic/transit operations at Yonge Street, requiring coordination with the Region.	18

TABLE 6-1: Evaluation Matrix

APPENDIX A

Turning Movement Counts (TMC) Surveys

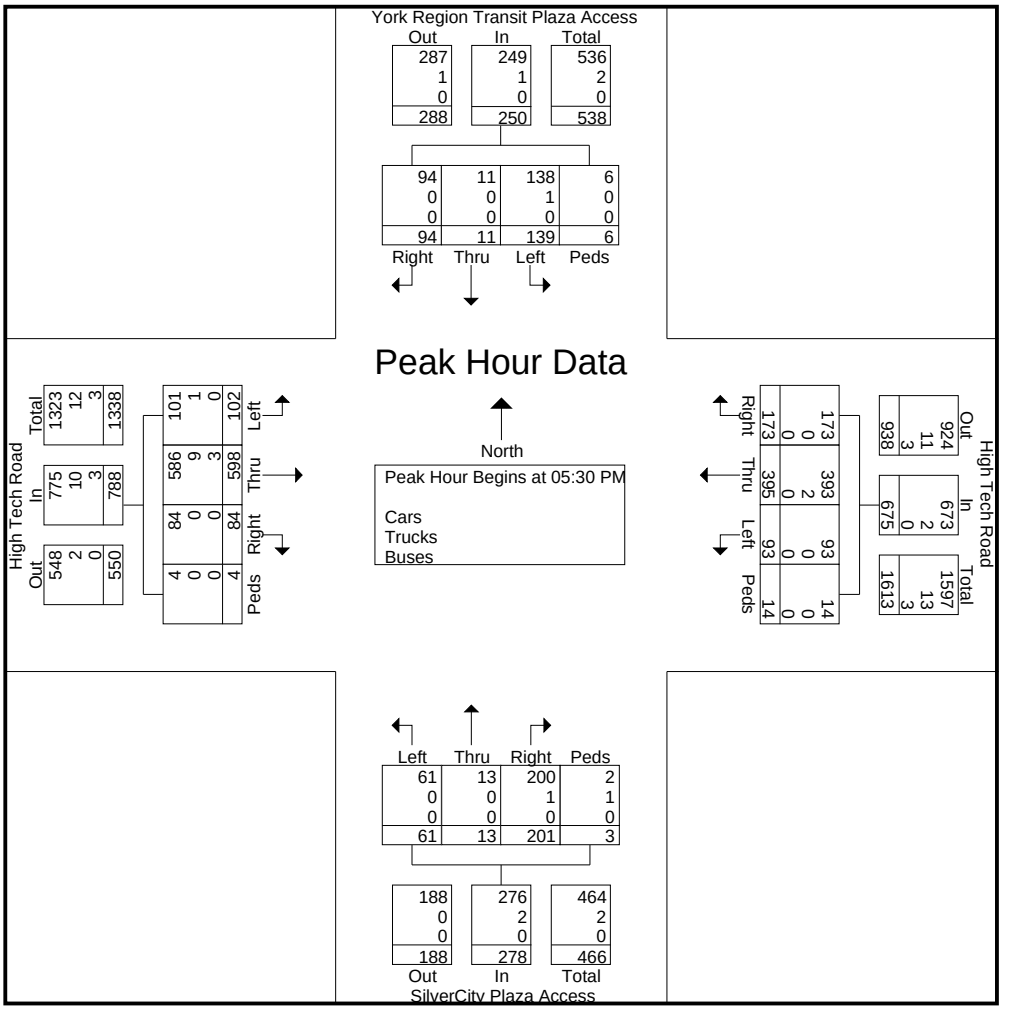
LEA CONSULTING LTD

625 Cochrane Drive 9th Floor
Markham, Ontario, L3R 9R9

Project No.: 18081
Location: High Tech Rd & Plaza Access
Weather: Clear
Surveyor(s): May Yue & Belinda Wong

File Name : HighTech&Plaza-MERGED-FRI
Site Code : 18081026
Start Date : 20/10/2017
Page No : 3

	York Region Transit Plaza Access Southbound					High Tech Road Westbound					SilverCity Plaza Access Northbound					High Tech Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 10:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:30 PM																					
05:30 PM	**40**	3	**29**	2	**74**	19	81	**48**	1	149	14	1	**67**	0	**82**	25	**162**	18	0	205	**510**
05:45 PM	33	2	23	**4**	62	**32**	100	47	4	**183**	16	0	41	**2**	59	23	136	**25**	1	185	489
06:00 PM	39	**5**	21	0	65	20	104	32	**6**	162	**19**	**6**	53	1	79	15	153	22	1	191	497
06:15 PM	27	1	21	0	49	22	**110**	46	3	181	12	6	40	0	58	**39**	147	19	**2**	**207**	495
Total Volume	139	11	94	6	250	93	395	173	14	675	61	13	201	3	278	102	598	84	4	788	1991
% App. Total	55.6	4.4	37.6	2.4		13.8	58.5	25.6	2.1		21.9	4.7	72.3	1.1		12.9	75.9	10.7	0.5		
PHF	.869	.550	.810	.375	.845	.727	.898	.901	.583	.922	.803	.542	.750	.375	.848	.654	.923	.840	.500	.952	.976
Cars	138	11	94	6	249	93	393	173	14	673	61	13	200	2	276	101	586	84	4	775	1973
% Cars	99.3	100	100	100	99.6	100	99.5	100	100	99.7	100	100	99.5	66.7	99.3	99.0	98.0	100	100	98.4	99.1
Trucks	1	0	0	0	1	0	2	0	0	2	0	0	1	1	2	1	9	0	0	10	15
% Trucks	0.7	0	0	0	0.4	0	0.5	0	0	0.3	0	0	0.5	33.3	0.7	1.0	1.5	0	0	1.3	0.8
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	3
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0.4	0.2



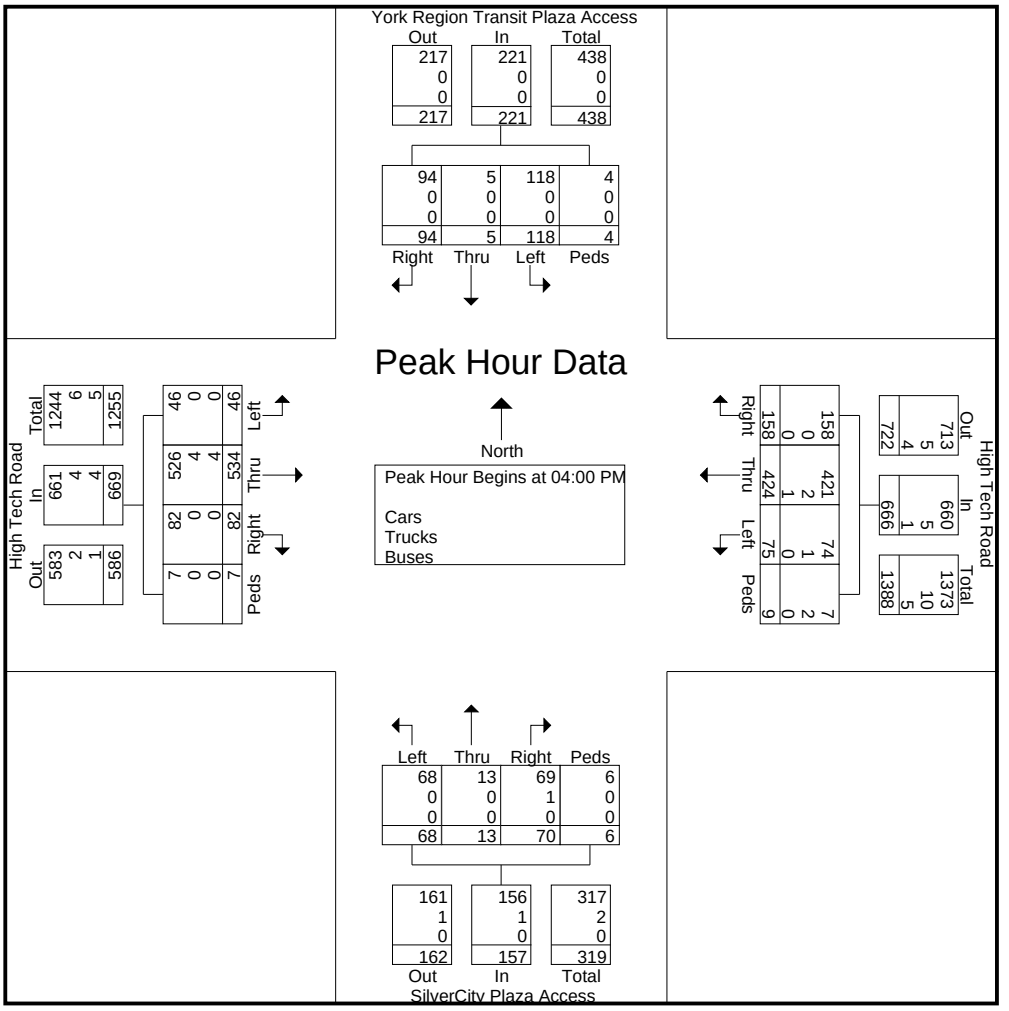
LEA CONSULTING LTD

625 Cochrane Drive 9th Floor
Markham, Ontario, L3R 9R9

Project No.: 18081
Location: High Tech Rd & Plaza Access
Weather: Clear
Surveyor(s): May Yue & Belinda Wong

File Name : HighTech&Plaza-MERGED-SAT
Site Code : 18081126
Start Date : 21/10/2017
Page No : 3

	York Region Transit Plaza Access Southbound					High Tech Road Westbound					SilverCity Plaza Access Northbound					High Tech Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 10:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	**32**	1	**27**	0	**60**	19	**120**	**49**	**4**	**192**	15	4	13	1	33	10	139	19	0	168	**453**
04:15 PM	31	1	25	**2**	59	16	98	25	2	141	13	2	18	**3**	36	13	**143**	15	**5**	**176**	412
04:30 PM	29	1	26	0	56	**20**	92	41	3	156	**20**	**5**	15	2	42	9	120	**24**	2	155	409
04:45 PM	26	**2**	16	2	46	20	114	43	0	177	20	2	**24**	0	**46**	**14**	132	24	0	170	439
Total Volume	118	5	94	4	221	75	424	158	9	666	68	13	70	6	157	46	534	82	7	669	1713
% App. Total	53.4	2.3	42.5	1.8		11.3	63.7	23.7	1.4		43.3	8.3	44.6	3.8		6.9	79.8	12.3	1		
PHF	.922	.625	.870	.500	.921	.938	.883	.806	.563	.867	.850	.650	.729	.500	.853	.821	.934	.854	.350	.950	.945
Cars	118	5	94	4	221	74	421	158	7	660	68	13	69	6	156	46	526	82	7	661	1698
% Cars	100	100	100	100	100	98.7	99.3	100	77.8	99.1	100	100	98.6	100	99.4	100	98.5	100	100	98.8	99.1
Trucks	0	0	0	0	0	1	2	0	2	5	0	0	1	0	1	0	4	0	0	4	10
% Trucks	0	0	0	0	0	1.3	0.5	0	22.2	0.8	0	0	1.4	0	0.6	0	0.7	0	0	0.6	0.6
Buses	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	4	0	0	4	5
% Buses	0	0	0	0	0	0	0.2	0	0	0.2	0	0	0	0	0	0	0.7	0	0	0.6	0.3



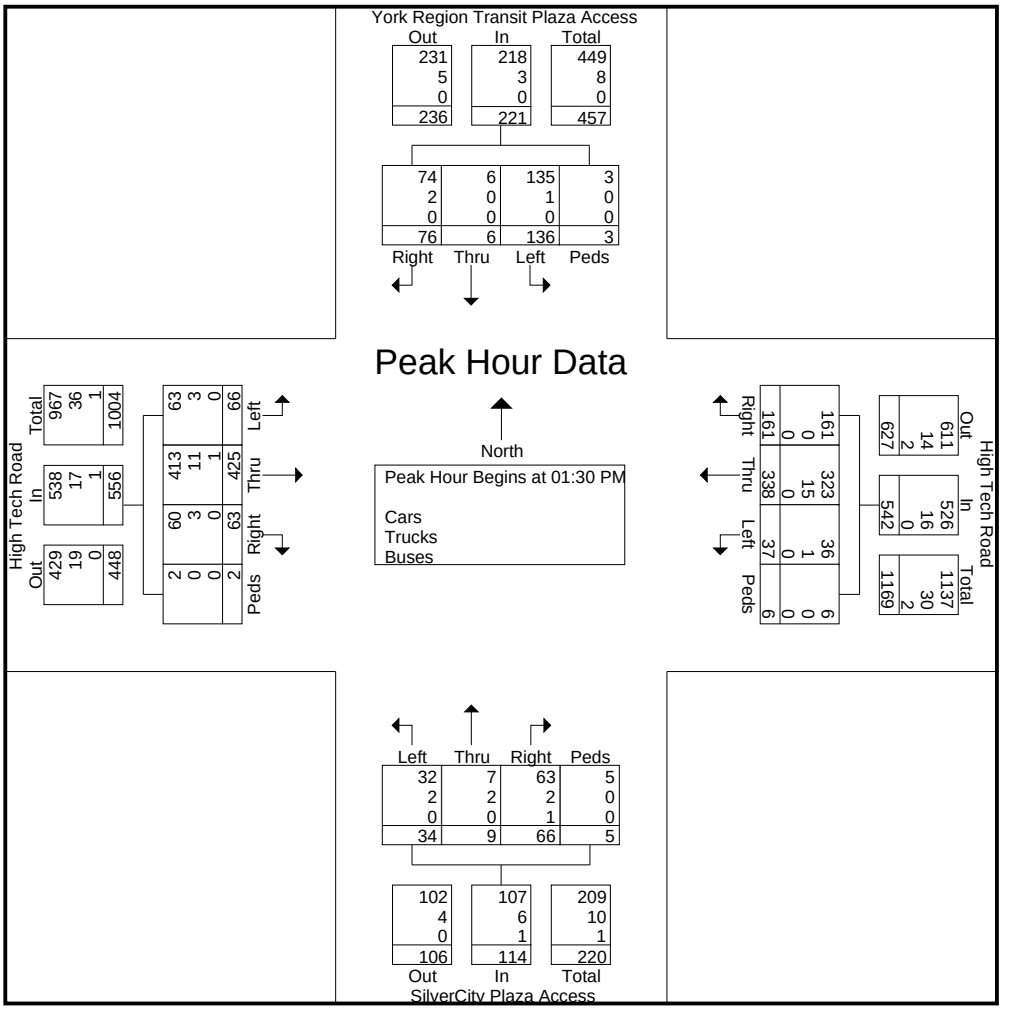
LEA CONSULTING LTD

625 Cochrane Drive 9th Floor
Markham, Ontario, L3R 9R9

Project No.: 18081
Location: High Tech Rd & Plaza Access
Weather: Clear
Surveyor(s): Belinda Wong & Michael Loo

File Name : HighTech&Plaza-MERGED-TUES
Site Code : 18081031
Start Date : 07/11/2017
Page No : 3

	York Region Transit Plaza Access Southbound					High Tech Road Westbound					SilverCity Plaza Access Northbound					High Tech Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 03:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 01:30 PM																					
01:30 PM	38	**3**	10	**1**	52	**16**	67	37	**4**	124	7	**4**	**21**	0	**32**	13	**125**	**22**	0	**160**	**368**
01:45 PM	29	1	16	0	46	6	**96**	47	1	**150**	**10**	1	16	1	28	14	108	17	**2**	141	365
02:00 PM	29	2	23	1	55	8	86	**49**	1	144	9	4	15	0	28	18	90	16	0	124	351
02:15 PM	**40**	0	**27**	1	**68**	7	89	28	0	124	8	0	14	**4**	26	**21**	102	8	0	131	349
Total Volume	136	6	76	3	221	37	338	161	6	542	34	9	66	5	114	66	425	63	2	556	1433
% App. Total	61.5	2.7	34.4	1.4		6.8	62.4	29.7	1.1		29.8	7.9	57.9	4.4		11.9	76.4	11.3	0.4		
PHF	.850	.500	.704	.750	.813	.578	.880	.821	.375	.903	.850	.563	.786	.313	.891	.786	.850	.716	.250	.869	.974
Cars	135	6	74	3	218	36	323	161	6	526	32	7	63	5	107	63	413	60	2	538	1389
% Cars	99.3	100	97.4	100	98.6	97.3	95.6	100	100	97.0	94.1	77.8	95.5	100	93.9	95.5	97.2	95.2	100	96.8	96.9
Trucks	1	0	2	0	3	1	15	0	0	16	2	2	2	0	6	3	11	3	0	17	42
% Trucks	0.7	0	2.6	0	1.4	2.7	4.4	0	0	3.0	5.9	22.2	3.0	0	5.3	4.5	2.6	4.8	0	3.1	2.9
Buses	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1	2
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	1.5	0	0.9	0	0.2	0	0	0.2	0.1



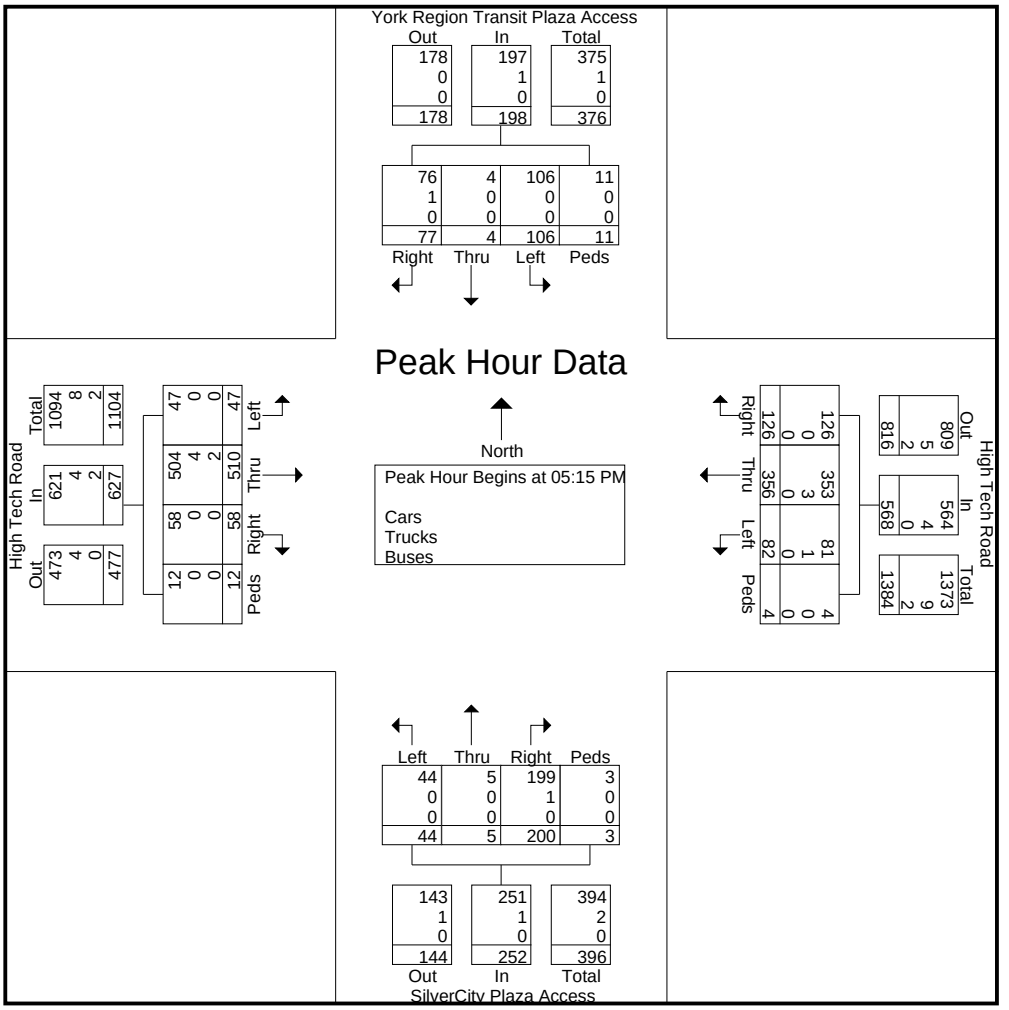
LEA CONSULTING LTD

625 Cochrane Drive 9th Floor
Markham, Ontario, L3R 9R9

Project No.: 18081
Location: High Tech Rd & Plaza Access
Weather: Windy
Surveyor(s): May Yue & Belinda Wong

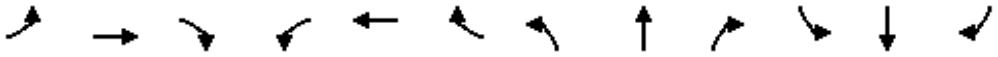
File Name : HighTech&Plaza-MERGED-WED
Site Code : 18081226
Start Date : 25/10/2017
Page No : 3

	York Region Transit Plaza Access Southbound					High Tech Road Westbound					SilverCity Plaza Access Northbound					High Tech Road Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 10:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:15 PM																					
05:15 PM	26	0	21	2	49	19	94	**34**	0	147	**14**	0	**57**	**1**	**72**	**13**	125	**18**	1	157	425
05:30 PM	26	1	15	1	43	21	76	34	1	132	10	1	41	1	53	9	117	12	**4**	142	370
05:45 PM	22	1	**22**	3	48	20	**104**	26	0	**150**	12	**2**	52	0	66	13	113	14	3	143	407
06:00 PM	**32**	**2**	19	**5**	**58**	**22**	82	32	**3**	139	8	2	50	1	61	12	**155**	14	4	**185**	**443**
Total Volume	106	4	77	11	198	82	356	126	4	568	44	5	200	3	252	47	510	58	12	627	1645
% App. Total	53.5	2	38.9	5.6		14.4	62.7	22.2	0.7		17.5	2	79.4	1.2		7.5	81.3	9.3	1.9		
PHF	.828	.500	.875	.550	.853	.932	.856	.926	.333	.947	.786	.625	.877	.750	.875	.904	.823	.806	.750	.847	.928
Cars	106	4	76	11	197	81	353	126	4	564	44	5	199	3	251	47	504	58	12	621	1633
% Cars	100	100	98.7	100	99.5	98.8	99.2	100	100	99.3	100	100	99.5	100	99.6	100	98.8	100	100	99.0	99.3
Trucks	0	0	1	0	1	1	3	0	0	4	0	0	1	0	1	0	4	0	0	4	10
% Trucks	0	0	1.3	0	0.5	1.2	0.8	0	0	0.7	0	0	0.5	0	0.4	0	0.8	0	0	0.6	0.6
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0	0	0.3	0.1



APPENDIX B

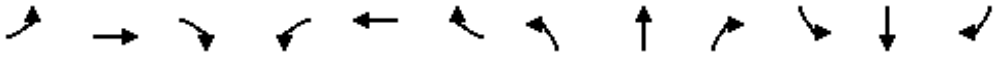
Existing Intersection Capacity Analysis



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	102	598	84	93	395	173	61	13	201	139	11	94
Future Volume (Veh/h)	102	598	84	93	395	173	61	13	201	139	11	94
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.65	0.92	0.84	0.73	0.90	0.90	0.80	0.54	0.75	0.87	0.55	0.81
Hourly flow rate (vph)	157	650	100	127	439	192	76	24	268	160	20	116
Pedestrians		4			14			2			6	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			1			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	637			752			1620	1907	391	1728	1861	326
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	637			752			1620	1907	391	1728	1861	326
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	83			85			0	51	56	0	62	83
cM capacity (veh/h)	945			865			32	49	605	15	52	670

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1
Volume Total	157	433	317	127	293	338	76	292	296
Volume Left	157	0	0	127	0	0	76	0	160
Volume Right	0	0	100	0	0	192	0	268	116
cSH	945	1700	1700	865	1700	1700	32	313	27
Volume to Capacity	0.17	0.25	0.19	0.15	0.17	0.20	2.39	0.93	11.00
Queue Length 95th (m)	4.8	0.0	0.0	4.1	0.0	0.0	70.2	73.9	Err
Control Delay (s)	9.6	0.0	0.0	9.9	0.0	0.0	898.0	72.5	Err
Lane LOS	A			A			F	F	F
Approach Delay (s)	1.7			1.7			243.0		Err
Approach LOS							F		F

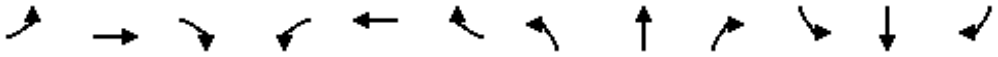
Intersection Summary				
Average Delay	1310.4			
Intersection Capacity Utilization	66.3%	ICU Level of Service		C
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	46	534	82	75	424	158	68	13	70	118	5	94
Future Volume (Veh/h)	46	534	82	75	424	158	68	13	70	118	5	94
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.82	0.93	0.85	0.94	0.88	0.81	0.85	0.65	0.73	0.92	0.63	0.87
Hourly flow rate (vph)	56	574	96	80	482	195	80	20	96	128	8	108
Pedestrians		7			7			6			4	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			1			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	681			676			1260	1581	348	1256	1532	350
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	681			676			1260	1581	348	1256	1532	350
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			91			10	79	85	0	92	83
cM capacity (veh/h)	918			914			89	93	644	82	100	647

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1
Volume Total	56	383	287	80	321	356	80	116	244
Volume Left	56	0	0	80	0	0	80	0	128
Volume Right	0	0	96	0	0	195	0	96	108
cSH	918	1700	1700	914	1700	1700	89	320	134
Volume to Capacity	0.06	0.23	0.17	0.09	0.19	0.21	0.90	0.36	1.82
Queue Length 95th (m)	1.6	0.0	0.0	2.3	0.0	0.0	39.7	12.9	149.0
Control Delay (s)	9.2	0.0	0.0	9.3	0.0	0.0	154.1	22.5	451.8
Lane LOS	A			A			F	C	F
Approach Delay (s)	0.7			1.0			76.3		451.8
Approach LOS							F		F

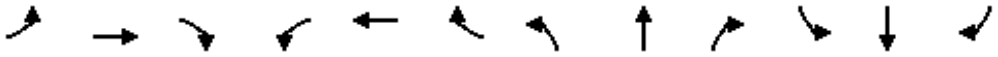
Intersection Summary				
Average Delay	65.7			
Intersection Capacity Utilization	51.2%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	66	425	63	37	338	161	34	9	66	136	6	76
Future Volume (Veh/h)	66	425	63	37	338	161	34	9	66	136	6	76
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.79	0.85	0.72	0.58	0.88	0.82	0.85	0.56	0.79	0.85	0.50	0.70
Hourly flow rate (vph)	84	500	88	64	384	196	40	16	84	160	12	109
Pedestrians		2			6			5			3	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	583			593			1154	1428	305	1129	1374	295
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	583			593			1154	1428	305	1129	1374	295
tC, single (s)	4.2			4.2			7.6	6.9	7.0	7.5	6.5	7.0
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.2	3.3	3.5	4.0	3.3
p0 queue free %	91			93			60	83	88	0	90	84
cM capacity (veh/h)	971			968			101	95	679	107	124	695

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1
Volume Total	84	333	255	64	256	324	40	100	281
Volume Left	84	0	0	64	0	0	40	0	160
Volume Right	0	0	88	0	0	196	0	84	109
cSH	971	1700	1700	968	1700	1700	101	342	161
Volume to Capacity	0.09	0.20	0.15	0.07	0.15	0.19	0.40	0.29	1.74
Queue Length 95th (m)	2.3	0.0	0.0	1.7	0.0	0.0	12.9	9.5	161.6
Control Delay (s)	9.1	0.0	0.0	9.0	0.0	0.0	62.1	19.8	408.0
Lane LOS	A			A			F	C	F
Approach Delay (s)	1.1			0.9			31.9		408.0
Approach LOS							D		F

Intersection Summary				
Average Delay	69.3			
Intersection Capacity Utilization	47.5%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	47	510	58	82	356	126	44	5	200	106	4	77
Future Volume (Veh/h)	47	510	58	82	356	126	44	5	200	106	4	77
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.82	0.81	0.93	0.86	0.93	0.79	0.63	0.88	0.83	0.50	0.88
Hourly flow rate (vph)	52	622	72	88	414	135	56	8	227	128	8	88
Pedestrians		12			4			3			11	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	560			697			1252	1501	354	1318	1470	298
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	560			697			1252	1501	354	1318	1470	298
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	95			90			40	92	65	0	93	87
cM capacity (veh/h)	1012			900			94	104	644	62	109	688

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1
Volume Total	52	415	279	88	276	273	56	235	224
Volume Left	52	0	0	88	0	0	56	0	128
Volume Right	0	0	72	0	0	135	0	227	88
cSH	1012	1700	1700	900	1700	1700	94	548	99
Volume to Capacity	0.05	0.24	0.16	0.10	0.16	0.16	0.60	0.43	2.26
Queue Length 95th (m)	1.3	0.0	0.0	2.6	0.0	0.0	22.3	17.1	158.7
Control Delay (s)	8.8	0.0	0.0	9.4	0.0	0.0	88.5	16.4	666.6
Lane LOS	A			A			F	C	F
Approach Delay (s)	0.6			1.3			30.3		666.6
Approach LOS							D		F

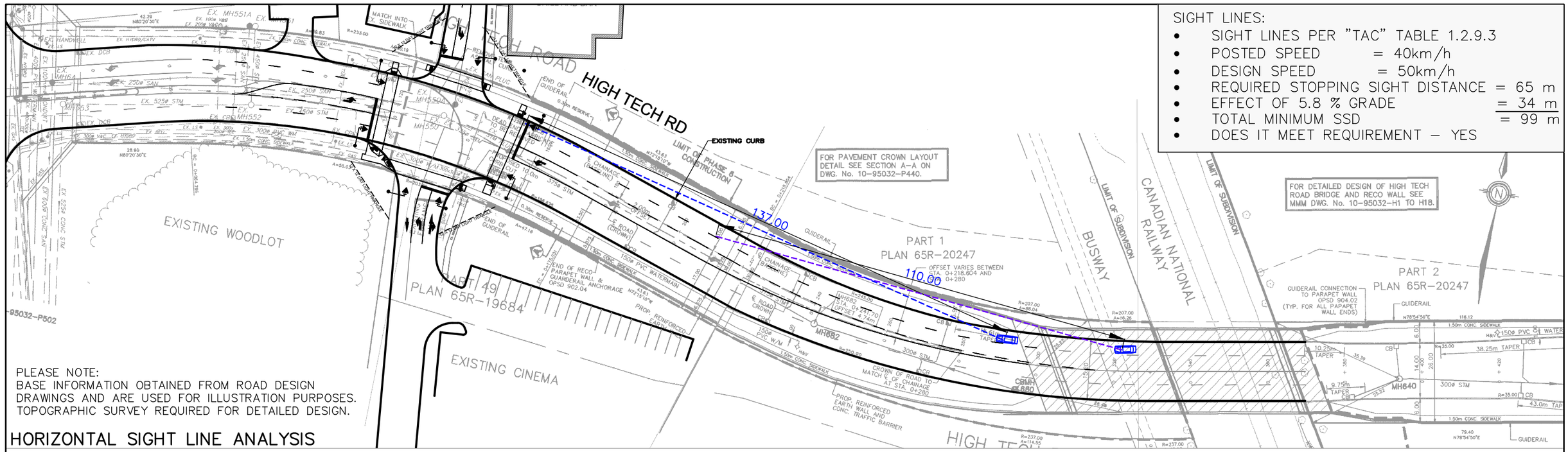
Intersection Summary				
Average Delay	84.0			
Intersection Capacity Utilization	58.9%	ICU Level of Service		B
Analysis Period (min)	15			

APPENDIX C

Sight Line Analysis

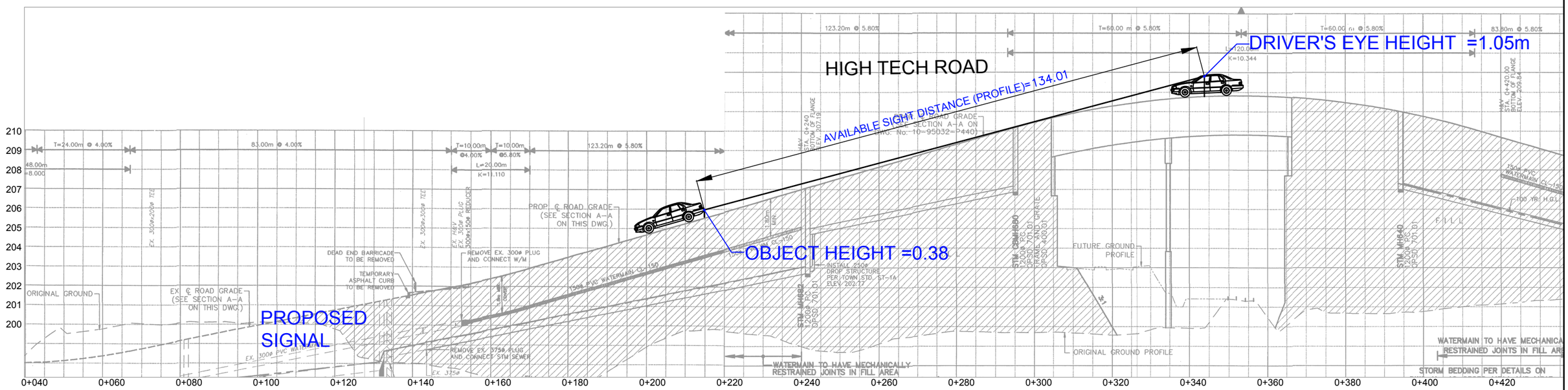
SIGHT LINES:

- SIGHT LINES PER "TAC" TABLE 1.2.9.3
- POSTED SPEED = 40km/h
- DESIGN SPEED = 50km/h
- REQUIRED STOPPING SIGHT DISTANCE = 65 m
- EFFECT OF 5.8 % GRADE = 34 m
- TOTAL MINIMUM SSD = 99 m
- DOES IT MEET REQUIREMENT – YES



PLEASE NOTE:
BASE INFORMATION OBTAINED FROM ROAD DESIGN DRAWINGS AND ARE USED FOR ILLUSTRATION PURPOSES. TOPOGRAPHIC SURVEY REQUIRED FOR DETAILED DESIGN.

HORIZONTAL SIGHT LINE ANALYSIS



VERTICAL SIGHT LINE ANALYSIS

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Date FEB. 07, 2018

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YONGE ST. & HIGH TECH RD.
RICHMOND HILL ONTARIO

10 0 10 20 30m
1:1000

HIGH TECH ROAD
SIGHT LINE ANALYSIS

Drawing No. 006

DRAWING NAME: F:\18081\Drafting\18081WF05.dwg

APPENDIX D

Access Modification Options
Functional Designs

Option 1
Signage and Pavement Marking

PAVEMENT MARKING LEGEND:

1. 10cm SOLID YELLOW LINE
2. 10cm SOLID WHITE LINE
3. 50cm SOLID YELLOW LINE
4. ARROWS AS SHOWN

LIMITS OF PAINT LINE

SIGNAGE LEGEND:

POST-MOUNTED SIGN

(1) SIGN NUMBER

TRAFFIC SIGNS SCHEDULE

SIGN	LOCATION	NEW QUANTITY REQUIRED	COLOURS
MAXIMUM 40	1,2	1	RB-1 (600X750)- MAXIMUM SPEED SIGN BLACK LEGEND & BORDER, WHITE REFL. BACKGROUND.
PEDESTRIAN CROSS HIGH TECH ROAD VIA UNDERPASS ←	3,4,	2	(300x450) BLACK LEGEND & BORDER, YELLOW REFL. BACKGROUND.
PEDESTRIAN CROSS HIGH TECH ROAD VIA UNDERPASS →	5,6	2	(300x450) BLACK LEGEND & BORDER, YELLOW REFL. BACKGROUND.

NOTE:
- RB-1 ON THE EAST SIDE TO BE MOUNTED ON THE STREETLIGHT POLE
- ALL SIGNS ARE STEEL POST-MOUNTED, UNLESS OTHERWISE INDICATED.
- UNDERSIDES OF ALL SIGNS TO BE LOCATED 2.0m MINIMUM ABOVE TOP OF PAVEMENT OR TOP OF SIDEWALK, AS THE CASE MAY BE. ALL SIGNS ARE PER "ONTARIO TRAFFIC MANUAL", LATEST EDITION.
- ALL PAVEMENT MARKINGS SHALL BE MADE IN ACCORDANCE WITH "ONTARIO TRAFFIC MANUAL, BOOK 11"

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Project No. 18081

Date FEB. 07, 2018

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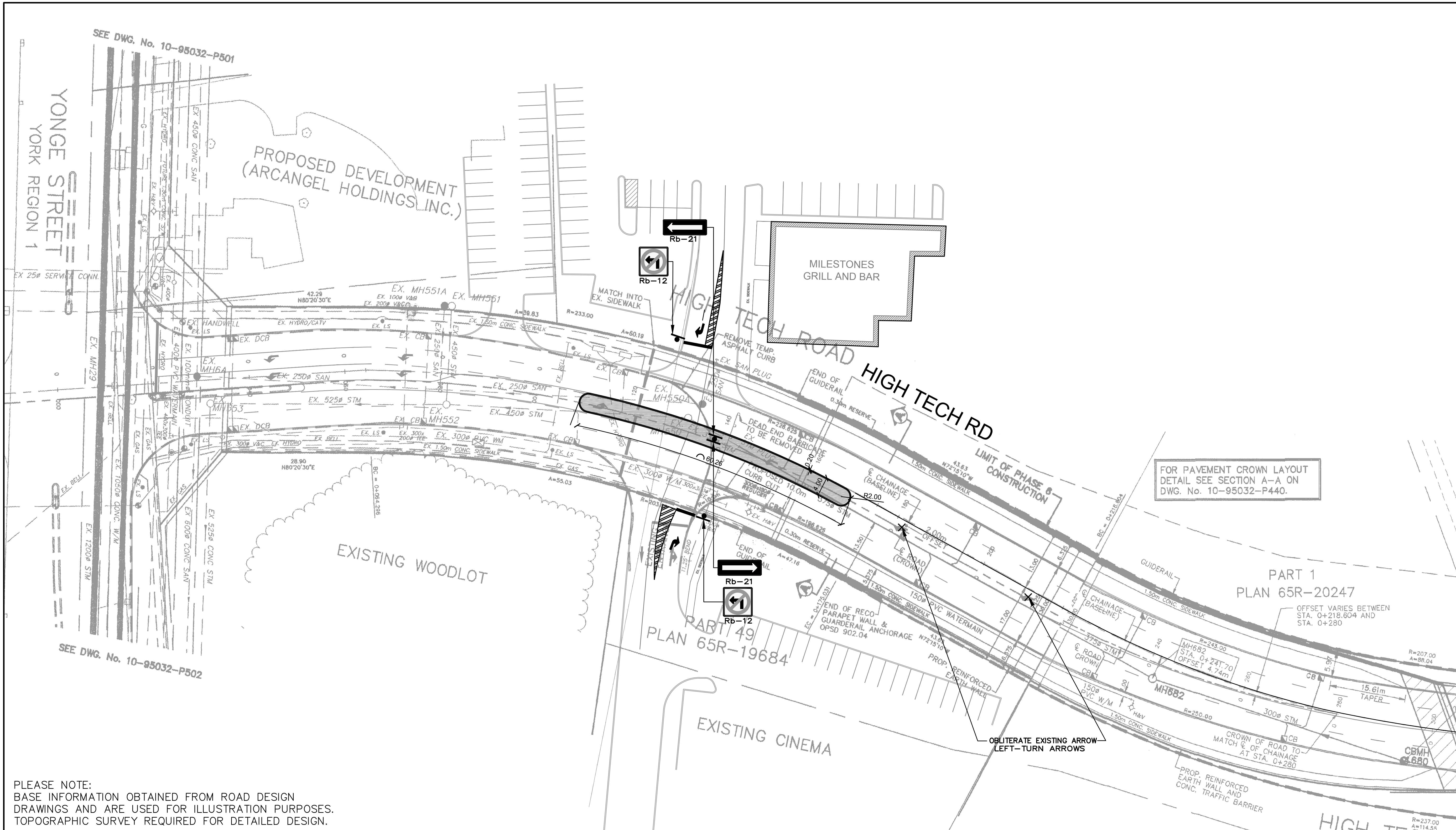
YONGE ST. & HIGH TECH RD.
RICHMOND HILL ONTARIO
7.5 0 7.5 15 22.5m
1:750

FUNCTIONAL DESIGN REVIEW
OPTION 1 – SIGNAGE AND PAVEMENT MARKING

Drawing No. 001

DRAWING NAME: F:\18081\Drafting\18081WF05.dwg

Option 2A
RIRO



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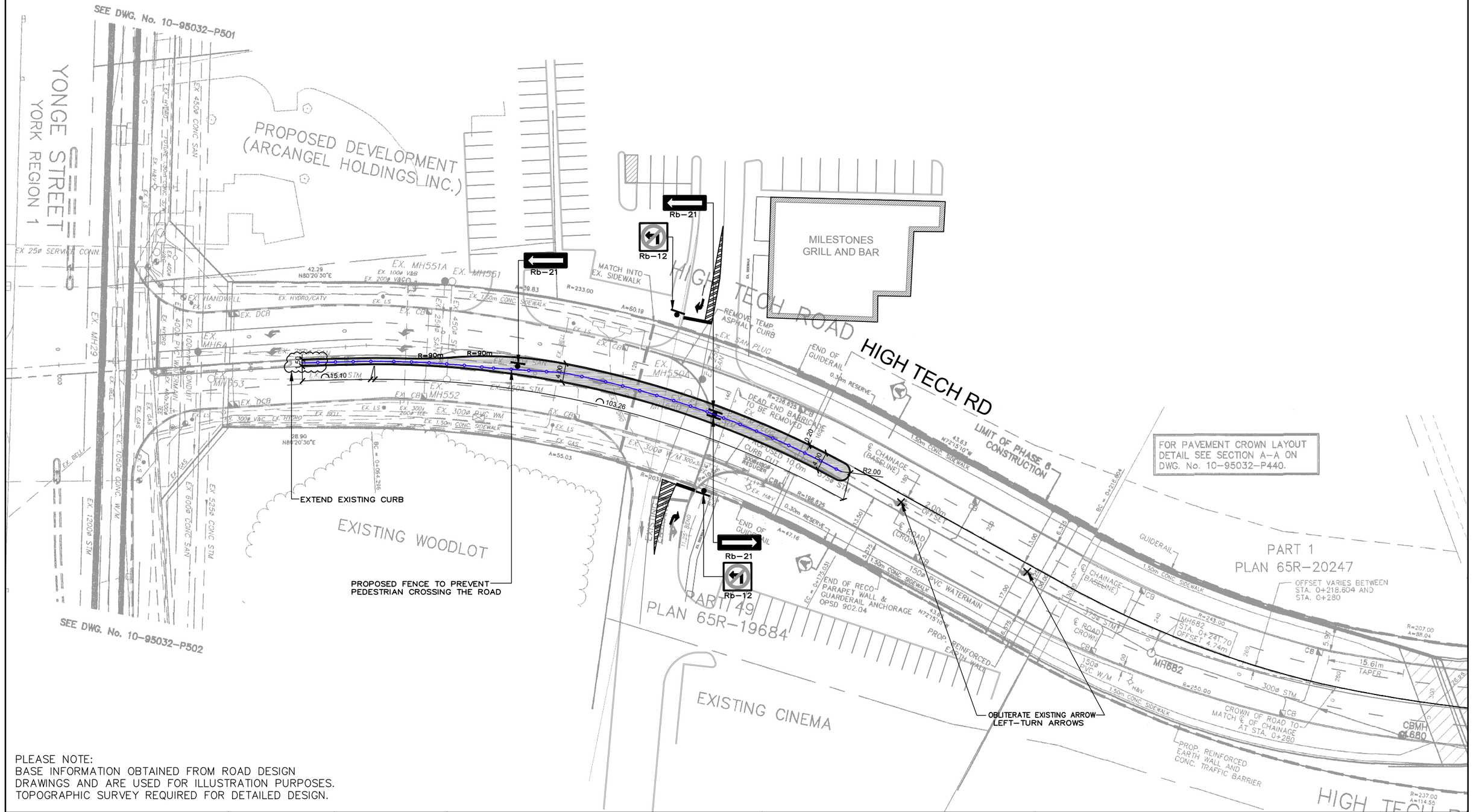
		Date FEB. 07, 2018		7.5 0 7.5 15 22.5m 1:750	Drawing No. 002

DRAWING NAME: F:\18081\Drafting\18081WF05.dwg

Option 2B
RIRO with Barrier Fence



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Project No. 18081

Date FEB. 07, 2018

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YONGE ST. & HIGH TECH RD.
RICHMOND HILL ONTARIO

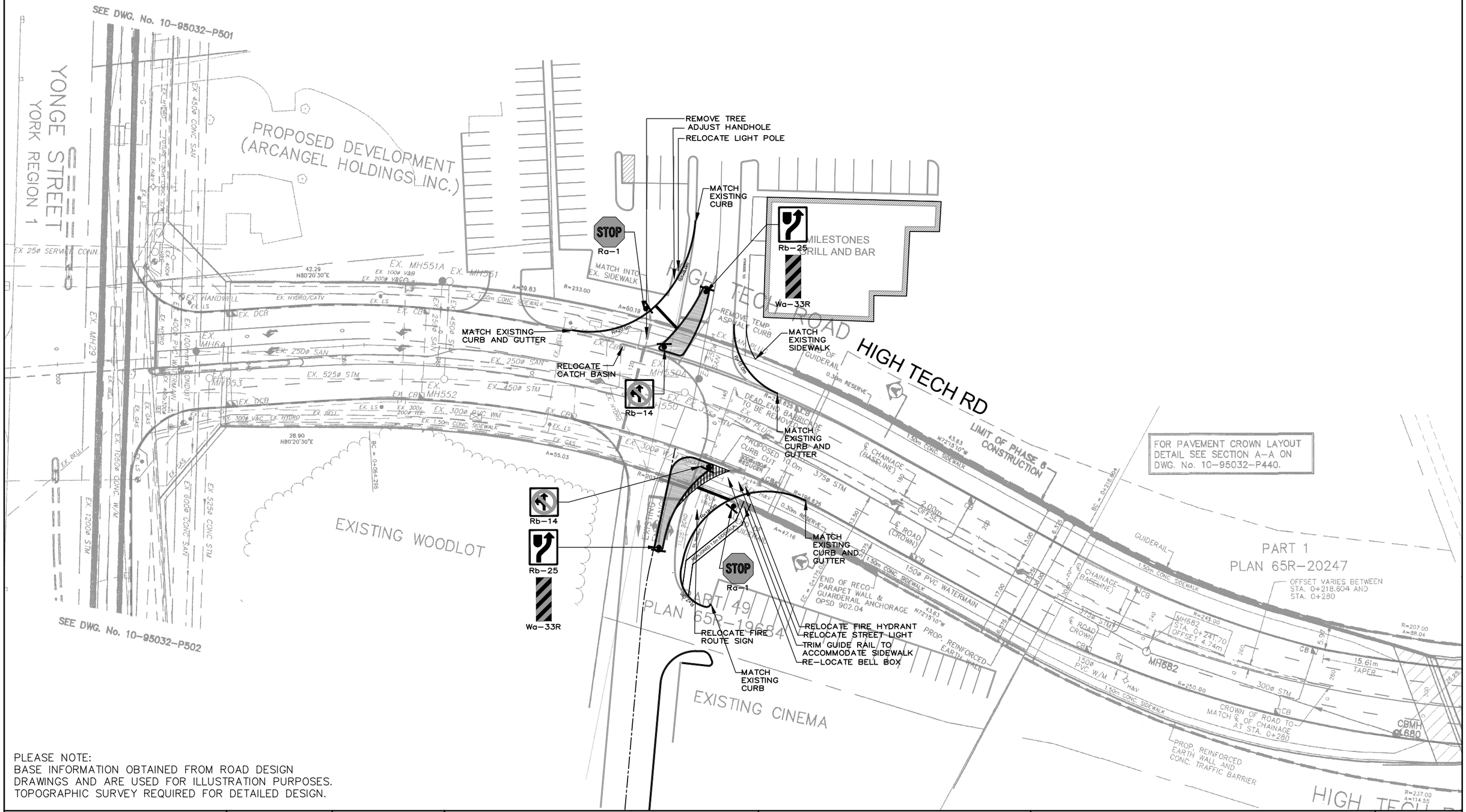
7.5 0 7.5 15 22.5m
1:750

FUNCTIONAL DESIGN REVIEW
OPTION 2B – RIGHT IN/RIGHT OUT (RIRO) WITH BARRIER FENCE

Drawing No. 003

DRAWING NAME: F:\18081\Drafting\18081WF05.dwg

Option 3
LI, RIRO



PLEASE NOTE:
BASE INFORMATION OBTAINED FROM ROAD DESIGN DRAWINGS AND ARE USED FOR ILLUSTRATION PURPOSES. TOPOGRAPHIC SURVEY REQUIRED FOR DETAILED DESIGN.

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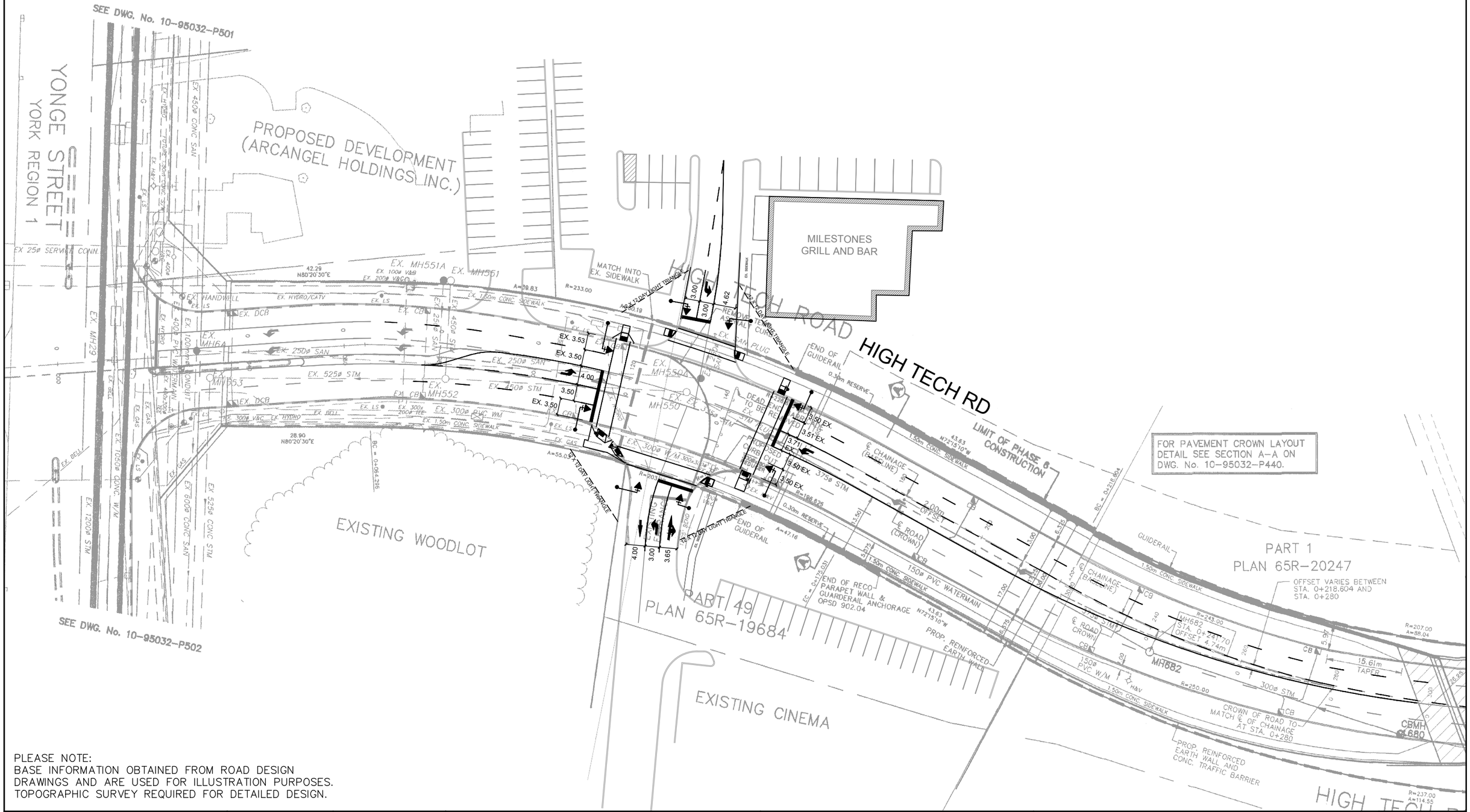
DRAWING NAME: F:\18081\Drafting\18081WF05.dwg

Option 4
Signalization



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Project No. 18081

Date FEB. 07, 2018

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YONGE ST. & HIGH TECH RD.
RICHMOND HILL ONTARIO

7.5 0 7.5 15 22.5m
1:750

FUNCTIONAL DESIGN REVIEW
OPTION 4 – SIGNALIZATION

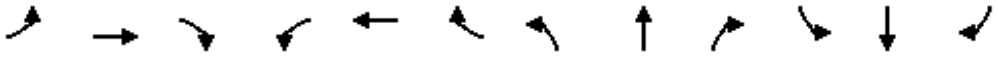
Drawing No. 005

DRAWING NAME: F:\18081\Drafting\18081WF05.dwg

APPENDIX E

Access Modification Options
Intersection Capacity Analysis

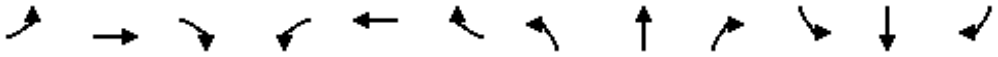
Option 1
Signage and Pavement Marking



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	102	598	84	93	395	173	61	13	201	139	11	94
Future Volume (Veh/h)	102	598	84	93	395	173	61	13	201	139	11	94
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.65	0.92	0.84	0.73	0.90	0.90	0.80	0.54	0.75	0.87	0.55	0.81
Hourly flow rate (vph)	157	650	100	127	439	192	76	24	268	160	20	116
Pedestrians		4			14			2			6	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			1			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	637			752			1620	1907	391	1728	1861	326
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	637			752			1620	1907	391	1728	1861	326
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	83			85			0	51	56	0	62	83
cM capacity (veh/h)	945			865			32	49	605	15	52	670

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	157	433	317	127	293	338	76	292	160	136
Volume Left	157	0	0	127	0	0	76	0	160	0
Volume Right	0	0	100	0	0	192	0	268	0	116
cSH	945	1700	1700	865	1700	1700	32	313	15	245
Volume to Capacity	0.17	0.25	0.19	0.15	0.17	0.20	2.39	0.93	10.44	0.56
Queue Length 95th (m)	4.8	0.0	0.0	4.1	0.0	0.0	70.2	73.9	Err	24.5
Control Delay (s)	9.6	0.0	0.0	9.9	0.0	0.0	898.0	72.5	Err	36.6
Lane LOS	A			A			F	F	F	E
Approach Delay (s)	1.7			1.7			243.0		5421.7	
Approach LOS							F		F	

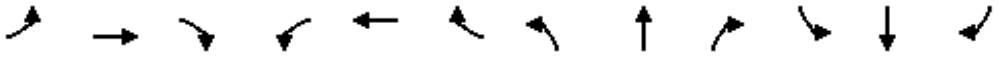
Intersection Summary				
Average Delay	728.6			
Intersection Capacity Utilization	59.9%	ICU Level of Service		B
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	46	534	82	75	424	158	68	13	70	118	5	94
Future Volume (Veh/h)	46	534	82	75	424	158	68	13	70	118	5	94
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.82	0.93	0.85	0.94	0.88	0.81	0.85	0.65	0.73	0.92	0.63	0.87
Hourly flow rate (vph)	56	574	96	80	482	195	80	20	96	128	8	108
Pedestrians		7			7			6			4	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			1			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	681			676			1260	1581	348	1256	1532	350
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	681			676			1260	1581	348	1256	1532	350
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			91			10	79	85	0	92	83
cM capacity (veh/h)	918			914			89	93	644	82	100	647

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	56	383	287	80	321	356	80	116	128	116
Volume Left	56	0	0	80	0	0	80	0	128	0
Volume Right	0	0	96	0	0	195	0	96	0	108
cSH	918	1700	1700	914	1700	1700	89	320	82	470
Volume to Capacity	0.06	0.23	0.17	0.09	0.19	0.21	0.90	0.36	1.57	0.25
Queue Length 95th (m)	1.6	0.0	0.0	2.3	0.0	0.0	39.7	12.9	83.3	7.7
Control Delay (s)	9.2	0.0	0.0	9.3	0.0	0.0	154.1	22.5	395.8	15.2
Lane LOS	A			A			F	C	F	C
Approach Delay (s)	0.7			1.0			76.3		214.9	
Approach LOS							F		F	

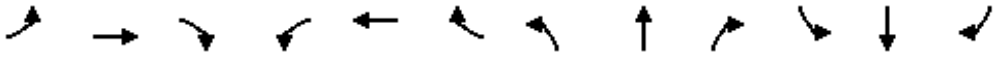
Intersection Summary				
Average Delay	35.7			
Intersection Capacity Utilization	44.8%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	66	425	63	37	338	161	34	9	66	136	6	76
Future Volume (Veh/h)	66	425	63	37	338	161	34	9	66	136	6	76
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.79	0.85	0.72	0.58	0.88	0.82	0.85	0.56	0.79	0.85	0.50	0.70
Hourly flow rate (vph)	84	500	88	64	384	196	40	16	84	160	12	109
Pedestrians		2			6			5			3	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			1			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	583			593			1154	1428	305	1129	1374	295
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	583			593			1154	1428	305	1129	1374	295
tC, single (s)	4.2			4.2			7.6	6.9	7.0	7.5	6.5	7.0
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.2	3.3	3.5	4.0	3.3
p0 queue free %	91			93			60	83	88	0	90	84
cM capacity (veh/h)	971			968			101	95	679	107	124	695

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	84	333	255	64	256	324	40	100	160	121
Volume Left	84	0	0	64	0	0	40	0	160	0
Volume Right	0	0	88	0	0	196	0	84	0	109
cSH	971	1700	1700	968	1700	1700	101	342	107	478
Volume to Capacity	0.09	0.20	0.15	0.07	0.15	0.19	0.40	0.29	1.49	0.25
Queue Length 95th (m)	2.3	0.0	0.0	1.7	0.0	0.0	12.9	9.5	93.7	8.0
Control Delay (s)	9.1	0.0	0.0	9.0	0.0	0.0	62.1	19.8	335.1	15.1
Lane LOS	A			A			F	C	F	C
Approach Delay (s)	1.1			0.9			31.9		197.3	
Approach LOS							D		F	

Intersection Summary			
Average Delay	35.3		
Intersection Capacity Utilization	42.5%	ICU Level of Service	A
Analysis Period (min)	15		

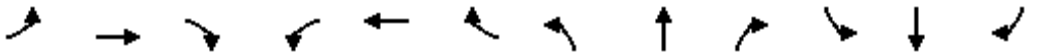


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	47	510	58	82	356	126	44	5	200	106	4	77
Future Volume (Veh/h)	47	510	58	82	356	126	44	5	200	106	4	77
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.82	0.81	0.93	0.86	0.93	0.79	0.63	0.88	0.83	0.50	0.88
Hourly flow rate (vph)	52	622	72	88	414	135	56	8	227	128	8	88
Pedestrians		12			4			3			11	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	560			697			1252	1501	354	1318	1470	298
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	560			697			1252	1501	354	1318	1470	298
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	95			90			40	92	65	0	93	87
cM capacity (veh/h)	1012			900			94	104	644	62	109	688

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	52	415	279	88	276	273	56	235	128	96
Volume Left	52	0	0	88	0	0	56	0	128	0
Volume Right	0	0	72	0	0	135	0	227	0	88
cSH	1012	1700	1700	900	1700	1700	94	548	62	477
Volume to Capacity	0.05	0.24	0.16	0.10	0.16	0.16	0.60	0.43	2.06	0.20
Queue Length 95th (m)	1.3	0.0	0.0	2.6	0.0	0.0	22.3	17.1	97.3	6.0
Control Delay (s)	8.8	0.0	0.0	9.4	0.0	0.0	88.5	16.4	632.6	14.4
Lane LOS	A			A			F	C	F	B
Approach Delay (s)	0.6			1.3			30.3		367.7	
Approach LOS							D		F	

Intersection Summary				
Average Delay	48.7			
Intersection Capacity Utilization	52.8%	ICU Level of Service		A
Analysis Period (min)	15			

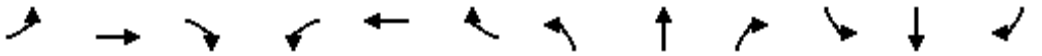
Option 2
RIRO



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	598	186	0	395	266	0	0	340	0	0	155
Future Volume (Veh/h)	0	598	186	0	395	266	0	0	340	0	0	155
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.65	0.92	0.84	0.73	0.90	0.90	0.80	0.54	0.75	0.87	0.55	0.81
Hourly flow rate (vph)	0	650	221	0	439	296	0	0	453	0	0	191
Pedestrians		4			14			2			6	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			1			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	741			873			1177	1504	452	1385	1466	378
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	741			873			1177	1504	452	1385	1466	378
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	18	100	100	69
cM capacity (veh/h)	864			780			102	122	553	18	128	621

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	433	438	293	442	453	191
Volume Left	0	0	0	0	0	0
Volume Right	0	221	0	296	453	191
cSH	1700	1700	1700	1700	553	621
Volume to Capacity	0.25	0.26	0.17	0.26	0.82	0.31
Queue Length 95th (m)	0.0	0.0	0.0	0.0	65.6	10.4
Control Delay (s)	0.0	0.0	0.0	0.0	34.5	13.4
Lane LOS					D	B
Approach Delay (s)	0.0		0.0		34.5	13.4
Approach LOS					D	B

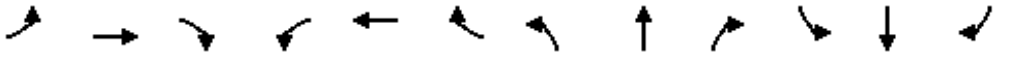
Intersection Summary				
Average Delay	8.1			
Intersection Capacity Utilization	51.7%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	534	128	0	424	233	0	0	188	0	0	162
Future Volume (Veh/h)	0	534	128	0	424	233	0	0	188	0	0	162
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.82	0.93	0.85	0.94	0.88	0.81	0.85	0.65	0.73	0.92	0.63	0.87
Hourly flow rate (vph)	0	574	151	0	482	288	0	0	258	0	0	186
Pedestrians		7			7			6			4	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			1			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	774			731			1090	1430	376	1182	1361	396
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	774			731			1090	1430	376	1182	1361	396
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	58	100	100	69
cM capacity (veh/h)	848			871			117	135	618	85	148	603

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	383	342	321	449	258	186
Volume Left	0	0	0	0	0	0
Volume Right	0	151	0	288	258	186
cSH	1700	1700	1700	1700	618	603
Volume to Capacity	0.23	0.20	0.19	0.26	0.42	0.31
Queue Length 95th (m)	0.0	0.0	0.0	0.0	16.4	10.4
Control Delay (s)	0.0	0.0	0.0	0.0	14.9	13.6
Lane LOS					B	B
Approach Delay (s)	0.0		0.0		14.9	13.6
Approach LOS					B	B

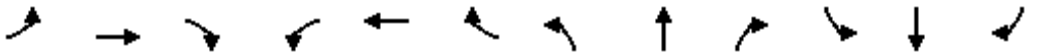
Intersection Summary				
Average Delay	3.3			
Intersection Capacity Utilization	38.2%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	425	129	0	338	198	0	0	202	0	0	110
Future Volume (Veh/h)	0	425	129	0	338	198	0	0	202	0	0	110
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.79	0.85	0.72	0.58	0.88	0.82	0.85	0.56	0.79	0.85	0.50	0.70
Hourly flow rate (vph)	0	500	179	0	384	241	0	0	256	0	0	157
Pedestrians		2			6			5			3	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	628			684			946	1222	350	1020	1192	318
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	628			684			946	1222	350	1020	1192	318
tC, single (s)	4.2			4.2			7.6	6.9	7.0	7.5	6.5	7.0
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.2	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	60	100	100	77
cM capacity (veh/h)	934			895			160	151	634	113	188	672

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	333	346	256	369	256	157
Volume Left	0	0	0	0	0	0
Volume Right	0	179	0	241	256	157
cSH	1700	1700	1700	1700	634	672
Volume to Capacity	0.20	0.20	0.15	0.22	0.40	0.23
Queue Length 95th (m)	0.0	0.0	0.0	0.0	15.6	7.2
Control Delay (s)	0.0	0.0	0.0	0.0	14.5	12.0
Lane LOS					B	B
Approach Delay (s)	0.0		0.0		14.5	12.0
Approach LOS					B	B

Intersection Summary				
Average Delay	3.3			
Intersection Capacity Utilization	35.8%	ICU Level of Service	A	
Analysis Period (min)	15			

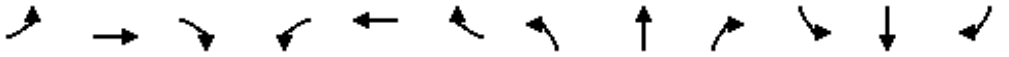


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	510	105	0	356	208	0	0	306	0	0	121
Future Volume (Veh/h)	0	510	105	0	356	208	0	0	306	0	0	121
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.82	0.81	0.93	0.86	0.93	0.79	0.63	0.88	0.83	0.50	0.88
Hourly flow rate (vph)	0	622	130	0	414	224	0	0	348	0	0	138
Pedestrians		12			4			3			11	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	649			755			1047	1339	383	1200	1292	342
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	649			755			1047	1339	383	1200	1292	342
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	44	100	100	79
cM capacity (veh/h)	938			856			142	152	617	61	163	644

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	415	337	276	362	348	138
Volume Left	0	0	0	0	0	0
Volume Right	0	130	0	224	348	138
cSH	1700	1700	1700	1700	617	644
Volume to Capacity	0.24	0.20	0.16	0.21	0.56	0.21
Queue Length 95th (m)	0.0	0.0	0.0	0.0	28.1	6.5
Control Delay (s)	0.0	0.0	0.0	0.0	18.1	12.1
Lane LOS					C	B
Approach Delay (s)	0.0		0.0		18.1	12.1
Approach LOS					C	B

Intersection Summary				
Average Delay	4.2			
Intersection Capacity Utilization	43.5%	ICU Level of Service		A
Analysis Period (min)	15			

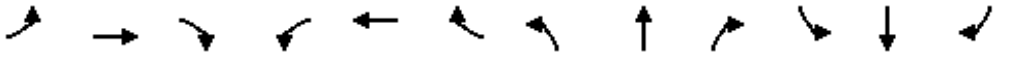
Option 3
LI, RIRO



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	102	598	84	93	395	173	0	0	340	0	0	155
Future Volume (Veh/h)	102	598	84	93	395	173	0	0	340	0	0	155
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.65	0.92	0.84	0.73	0.90	0.90	0.80	0.54	0.75	0.87	0.55	0.81
Hourly flow rate (vph)	157	650	100	127	439	192	0	0	453	0	0	191
Pedestrians		4			14			2			6	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			1			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	637			752			1684	1907	391	1901	1861	326
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	637			752			1684	1907	391	1901	1861	326
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	83			85			100	100	25	100	100	72
cM capacity (veh/h)	945			865			34	49	605	8	52	670

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	157	433	317	127	293	338	453	191
Volume Left	157	0	0	127	0	0	0	0
Volume Right	0	0	100	0	0	192	453	191
cSH	945	1700	1700	865	1700	1700	605	670
Volume to Capacity	0.17	0.25	0.19	0.15	0.17	0.20	0.75	0.28
Queue Length 95th (m)	4.8	0.0	0.0	4.1	0.0	0.0	53.0	9.4
Control Delay (s)	9.6	0.0	0.0	9.9	0.0	0.0	26.5	12.5
Lane LOS	A			A			D	B
Approach Delay (s)	1.7			1.7			26.5	12.5
Approach LOS							D	B

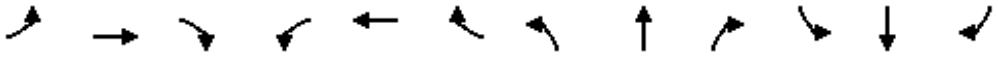
Intersection Summary				
Average Delay	7.4			
Intersection Capacity Utilization	48.4%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	46	534	82	75	424	158	0	0	188	0	0	162
Future Volume (Veh/h)	46	534	82	75	424	158	0	0	188	0	0	162
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.82	0.93	0.85	0.94	0.88	0.81	0.85	0.65	0.73	0.92	0.63	0.87
Hourly flow rate (vph)	56	574	96	80	482	195	0	0	258	0	0	186
Pedestrians		7			7			6			4	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	681			676			1334	1581	348	1408	1532	350
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	681			676			1334	1581	348	1408	1532	350
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			91			100	100	60	100	100	71
cM capacity (veh/h)	918			914			71	93	644	53	100	647

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	56	383	287	80	321	356	258	186
Volume Left	56	0	0	80	0	0	0	0
Volume Right	0	0	96	0	0	195	258	186
cSH	918	1700	1700	914	1700	1700	644	647
Volume to Capacity	0.06	0.23	0.17	0.09	0.19	0.21	0.40	0.29
Queue Length 95th (m)	1.6	0.0	0.0	2.3	0.0	0.0	15.4	9.5
Control Delay (s)	9.2	0.0	0.0	9.3	0.0	0.0	14.3	12.8
Lane LOS	A			A			B	B
Approach Delay (s)	0.7			1.0			14.3	12.8
Approach LOS							B	B

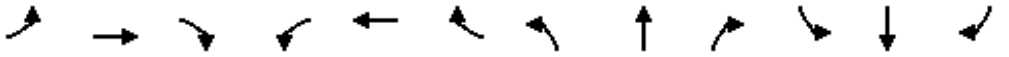
Intersection Summary				
Average Delay	3.8			
Intersection Capacity Utilization	36.7%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	66	425	63	37	338	161	0	0	202	0	0	110
Future Volume (Veh/h)	66	425	63	37	338	161	0	0	202	0	0	110
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.79	0.85	0.72	0.58	0.88	0.82	0.85	0.56	0.79	0.85	0.50	0.70
Hourly flow rate (vph)	84	500	88	64	384	196	0	0	256	0	0	157
Pedestrians		2			6			5			3	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		0			1			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	583			593			1196	1428	305	1293	1374	295
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	583			593			1196	1428	305	1293	1374	295
tC, single (s)	4.2			4.2			7.6	6.9	7.0	7.5	6.5	7.0
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.2	3.3	3.5	4.0	3.3
p0 queue free %	91			93			100	100	62	100	100	77
cM capacity (veh/h)	971			968			93	95	679	66	124	695

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	84	333	255	64	256	324	256	157
Volume Left	84	0	0	64	0	0	0	0
Volume Right	0	0	88	0	0	196	256	157
cSH	971	1700	1700	968	1700	1700	679	695
Volume to Capacity	0.09	0.20	0.15	0.07	0.15	0.19	0.38	0.23
Queue Length 95th (m)	2.3	0.0	0.0	1.7	0.0	0.0	14.1	6.9
Control Delay (s)	9.1	0.0	0.0	9.0	0.0	0.0	13.5	11.7
Lane LOS	A			A			B	B
Approach Delay (s)	1.1			0.9			13.5	11.7
Approach LOS							B	B

Intersection Summary				
Average Delay	3.8			
Intersection Capacity Utilization	33.7%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	47	510	58	82	356	126	0	0	306	0	0	121
Future Volume (Veh/h)	47	510	58	82	356	126	0	0	306	0	0	121
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.82	0.81	0.93	0.86	0.93	0.79	0.63	0.88	0.83	0.50	0.88
Hourly flow rate (vph)	52	622	72	88	414	135	0	0	348	0	0	138
Pedestrians		12			4			3			11	
Lane Width (m)		3.6			3.6			3.6			3.6	
Walking Speed (m/s)		1.2			1.2			1.2			1.2	
Percent Blockage		1			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		124										
pX, platoon unblocked												
vC, conflicting volume	560			697			1298	1501	354	1436	1470	298
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	560			697			1298	1501	354	1436	1470	298
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	95			90			100	100	46	100	100	80
cM capacity (veh/h)	1012			900			84	104	644	38	109	688

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	52	415	279	88	276	273	348	138
Volume Left	52	0	0	88	0	0	0	0
Volume Right	0	0	72	0	0	135	348	138
cSH	1012	1700	1700	900	1700	1700	644	688
Volume to Capacity	0.05	0.24	0.16	0.10	0.16	0.16	0.54	0.20
Queue Length 95th (m)	1.3	0.0	0.0	2.6	0.0	0.0	25.9	6.0
Control Delay (s)	8.8	0.0	0.0	9.4	0.0	0.0	17.0	11.5
Lane LOS	A			A			C	B
Approach Delay (s)	0.6			1.3			17.0	11.5
Approach LOS							C	B

Intersection Summary				
Average Delay	4.7			
Intersection Capacity Utilization	42.0%	ICU Level of Service	A	
Analysis Period (min)	15			

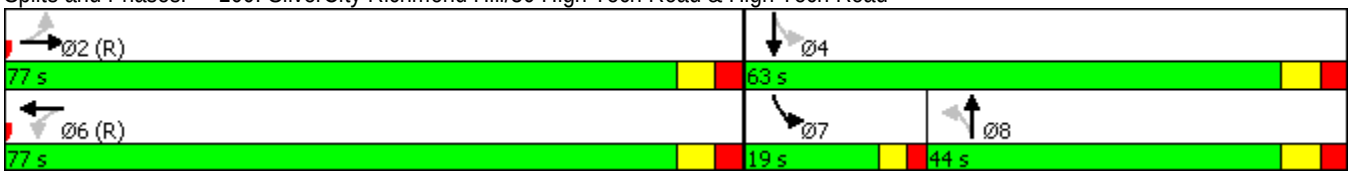
Option 4
Signalization

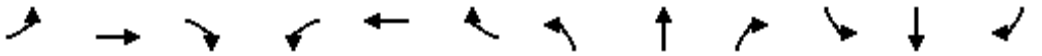
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	102	598	93	395	61	13	139	11
Future Volume (vph)	102	598	93	395	61	13	139	11
Lane Group Flow (vph)	157	750	127	631	76	292	160	136
Turn Type	Perm	NA	Perm	NA	Perm	NA	pm+pt	NA
Protected Phases		2		6		8	7	4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	7	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	7.0	10.0
Minimum Split (s)	37.5	37.5	37.5	37.5	37.5	37.5	12.0	37.5
Total Split (s)	77.0	77.0	77.0	77.0	44.0	44.0	19.0	63.0
Total Split (%)	55.0%	55.0%	55.0%	55.0%	31.4%	31.4%	13.6%	45.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.0
Lead/Lag					Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	C-Min	C-Min	C-Min	C-Min	None	None	None	None
v/c Ratio	0.34	0.34	0.32	0.29	0.58	0.82	0.55	0.26
Control Delay	17.2	13.7	17.2	11.8	76.1	34.9	45.0	9.1
Queue Delay	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.2	14.8	17.2	11.8	76.1	34.9	45.0	9.1
Queue Length 50th (m)	19.6	47.8	15.5	34.7	21.8	21.6	37.5	4.4
Queue Length 95th (m)	30.2	82.6	29.3	62.4	32.4	4.8	46.5	2.2
Internal Link Dist (m)		100.0		196.6		78.3		136.4
Turn Bay Length (m)	30.0		70.0					
Base Capacity (vph)	458	2192	401	2172	334	579	295	722
Starvation Cap Reductn	0	1132	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.34	0.71	0.32	0.29	0.23	0.50	0.54	0.19

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 100: SilverCity Richmond Hill/30 High Tech Road & High Tech Road





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	102	598	84	93	395	173	61	13	201	139	11	94
Future Volume (vph)	102	598	84	93	395	173	61	13	201	139	11	94
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0		7.0	7.0		7.0	7.0		5.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.97		1.00	0.99	
Flpb, ped/bikes	0.99	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.95		1.00	0.86		1.00	0.87	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1773	3465		1801	3403		1797	1588		1785	1632	
Flt Permitted	0.39	1.00		0.34	1.00		0.67	1.00		0.20	1.00	
Satd. Flow (perm)	729	3465		637	3403		1267	1588		383	1632	
Peak-hour factor, PHF	0.65	0.92	0.84	0.73	0.90	0.90	0.80	0.54	0.75	0.87	0.55	0.81
Adj. Flow (vph)	157	650	100	127	439	192	76	24	268	160	20	116
RTOR Reduction (vph)	0	6	0	0	26	0	0	193	0	0	85	0
Lane Group Flow (vph)	157	744	0	127	605	0	76	99	0	160	51	0
Confl. Peds. (#/hr)	6		2	2		6	4		14	14		4
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	1%	2%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		2			6			8		7	4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	88.3	88.3		88.3	88.3		14.6	14.6		37.7	37.7	
Effective Green, g (s)	88.3	88.3		88.3	88.3		14.6	14.6		37.7	37.7	
Actuated g/C Ratio	0.63	0.63		0.63	0.63		0.10	0.10		0.27	0.27	
Clearance Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		5.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	459	2185		401	2146		132	165		284	439	
v/s Ratio Prot		0.21			0.18			0.06		c0.07	0.03	
v/s Ratio Perm	c0.22			0.20			0.06			c0.08		
v/c Ratio	0.34	0.34		0.32	0.28		0.58	0.60		0.56	0.12	
Uniform Delay, d1	12.2	12.2		11.9	11.6		59.7	59.9		42.0	38.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.0	0.4		2.1	0.3		6.0	5.7		2.6	0.1	
Delay (s)	14.2	12.6		14.0	11.9		65.7	65.6		44.6	38.7	
Level of Service	B	B		B	B		E	E		D	D	
Approach Delay (s)		12.9			12.3			65.6			41.9	
Approach LOS		B			B			E			D	

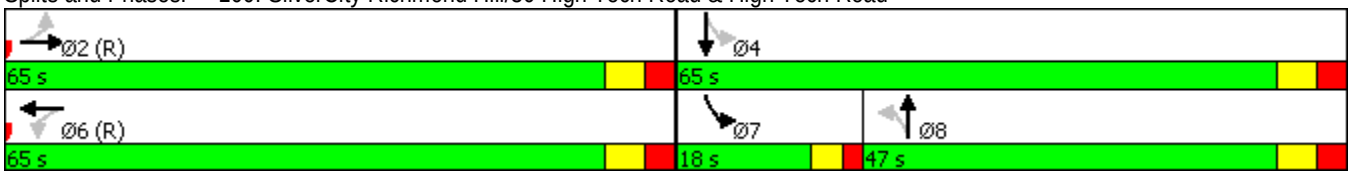
Intersection Summary			
HCM 2000 Control Delay	24.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	75.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

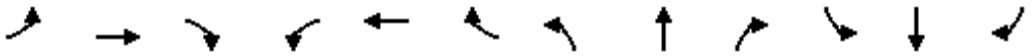
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	46	534	75	424	68	13	118	5
Future Volume (vph)	46	534	75	424	68	13	118	5
Lane Group Flow (vph)	56	670	80	677	80	116	128	116
Turn Type	Perm	NA	Perm	NA	Perm	NA	pm+pt	NA
Protected Phases		2		6		8	7	4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	7	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	7.0	10.0
Minimum Split (s)	37.5	37.5	37.5	37.5	37.5	37.5	12.0	37.5
Total Split (s)	65.0	65.0	65.0	65.0	47.0	47.0	18.0	65.0
Total Split (%)	50.0%	50.0%	50.0%	50.0%	36.2%	36.2%	13.8%	50.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.0
Lead/Lag					Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	C-Min	C-Min	C-Min	C-Min	None	None	None	None
v/c Ratio	0.12	0.30	0.18	0.31	0.61	0.46	0.38	0.24
Control Delay	12.1	11.4	12.6	10.8	75.0	20.5	39.1	8.2
Queue Delay	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.1	12.2	12.6	10.8	75.0	20.5	39.1	8.2
Queue Length 50th (m)	5.4	37.7	8.1	35.6	21.1	5.0	27.5	1.6
Queue Length 95th (m)	13.2	61.4	20.2	57.2	34.9	9.7	39.9	4.4
Internal Link Dist (m)		100.0		196.6		78.3		136.4
Turn Bay Length (m)	30.0		70.0					
Base Capacity (vph)	450	2236	449	2194	395	565	343	774
Starvation Cap Reductn	0	1174	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.63	0.18	0.31	0.20	0.21	0.37	0.15

Intersection Summary

Cycle Length: 130
Actuated Cycle Length: 130
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 100: SilverCity Richmond Hill/30 High Tech Road & High Tech Road





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	46	534	82	75	424	158	68	13	70	118	5	94
Future Volume (vph)	46	534	82	75	424	158	68	13	70	118	5	94
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0		7.0	7.0		7.0	7.0		5.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.98		1.00	0.98	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		0.99	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.96		1.00	0.88		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1797	3483		1775	3396		1791	1622		1800	1603	
Flt Permitted	0.37	1.00		0.38	1.00		0.68	1.00		0.46	1.00	
Satd. Flow (perm)	705	3483		702	3396		1286	1622		866	1603	
Peak-hour factor, PHF	0.82	0.93	0.85	0.94	0.88	0.81	0.85	0.65	0.73	0.92	0.63	0.87
Adj. Flow (vph)	56	574	96	80	482	195	80	20	96	128	8	108
RTOR Reduction (vph)	0	7	0	0	22	0	0	86	0	0	81	0
Lane Group Flow (vph)	56	663	0	80	655	0	80	30	0	128	35	0
Confl. Peds. (#/hr)	4		6	6		4	7		7	7		7
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	0%	1%	0%	1%	1%	0%	0%	0%	1%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		2			6			8		7	4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	83.1	83.1		83.1	83.1		13.3	13.3		32.9	32.9	
Effective Green, g (s)	83.1	83.1		83.1	83.1		13.3	13.3		32.9	32.9	
Actuated g/C Ratio	0.64	0.64		0.64	0.64		0.10	0.10		0.25	0.25	
Clearance Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		5.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	450	2226		448	2170		131	165		324	405	
v/s Ratio Prot		0.19			c0.19			0.02		c0.04	0.02	
v/s Ratio Perm	0.08			0.11			c0.06			0.06		
v/c Ratio	0.12	0.30		0.18	0.30		0.61	0.18		0.40	0.09	
Uniform Delay, d1	9.2	10.5		9.6	10.5		55.9	53.4		39.2	37.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	0.3		0.9	0.4		8.2	0.5		0.8	0.1	
Delay (s)	9.8	10.8		10.4	10.8		64.0	53.9		40.0	37.2	
Level of Service	A	B		B	B		E	D		D	D	
Approach Delay (s)		10.7			10.8			58.0			38.7	
Approach LOS		B			B			E			D	

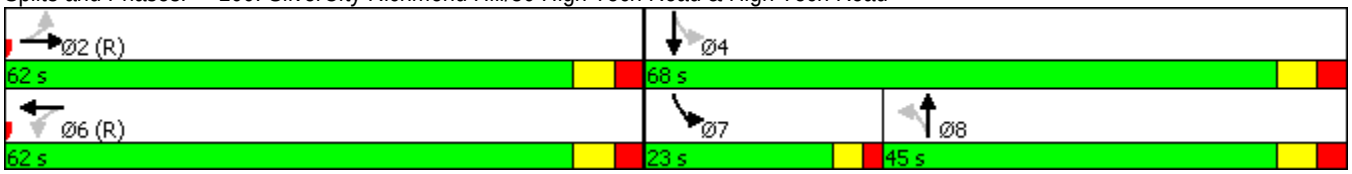
Intersection Summary			
HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	59.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

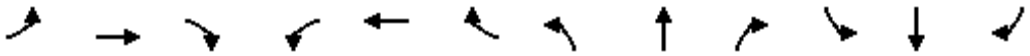
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	66	425	37	338	34	9	136	6
Future Volume (vph)	66	425	37	338	34	9	136	6
Lane Group Flow (vph)	84	588	64	580	40	100	160	121
Turn Type	Perm	NA	Perm	NA	Perm	NA	pm+pt	NA
Protected Phases		2		6		8	7	4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	7	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	7.0	10.0
Minimum Split (s)	37.5	37.5	37.5	37.5	37.5	37.5	12.0	37.5
Total Split (s)	62.0	62.0	62.0	62.0	45.0	45.0	23.0	68.0
Total Split (%)	47.7%	47.7%	47.7%	47.7%	34.6%	34.6%	17.7%	52.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.0
Lead/Lag					Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	C-Min	C-Min	C-Min	C-Min	None	None	None	None
v/c Ratio	0.17	0.27	0.13	0.27	0.38	0.48	0.44	0.25
Control Delay	6.4	6.8	12.0	9.8	66.6	23.6	40.6	8.7
Queue Delay	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.4	7.1	12.0	9.8	66.6	23.6	40.6	8.7
Queue Length 50th (m)	3.6	12.6	6.2	27.3	10.5	4.1	35.1	2.5
Queue Length 95th (m)	m5.2	14.7	9.7	45.2	21.2	5.2	46.0	0.0
Internal Link Dist (m)		100.0		196.6		78.3		136.4
Turn Bay Length (m)	30.0		70.0					
Base Capacity (vph)	485	2168	484	2132	354	506	377	798
Starvation Cap Reductn	0	886	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.17	0.46	0.13	0.27	0.11	0.20	0.42	0.15

Intersection Summary

Cycle Length: 130
Actuated Cycle Length: 130
Offset: 41 (32%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 100: SilverCity Richmond Hill/30 High Tech Road & High Tech Road





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	66	425	63	37	338	161	34	9	66	136	6	76
Future Volume (vph)	66	425	63	37	338	161	34	9	66	136	6	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0		7.0	7.0		7.0	7.0		5.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.98		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.95		1.00	0.87		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1729	3398		1741	3305		1699	1528		1782	1579	
Flt Permitted	0.42	1.00		0.42	1.00		0.68	1.00		0.48	1.00	
Satd. Flow (perm)	763	3398		761	3305		1215	1528		898	1579	
Peak-hour factor, PHF	0.79	0.85	0.72	0.58	0.88	0.82	0.85	0.56	0.79	0.85	0.50	0.70
Adj. Flow (vph)	84	500	88	64	384	196	40	16	84	160	12	109
RTOR Reduction (vph)	0	7	0	0	31	0	0	77	0	0	81	0
Lane Group Flow (vph)	84	581	0	64	549	0	40	23	0	160	40	0
Confl. Peds. (#/hr)	3		5	5		3	2		6	6		2
Heavy Vehicles (%)	4%	3%	5%	3%	4%	0%	6%	22%	4%	1%	0%	3%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		2			6			8		7	4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	82.6	82.6		82.6	82.6		11.2	11.2		33.4	33.4	
Effective Green, g (s)	82.6	82.6		82.6	82.6		11.2	11.2		33.4	33.4	
Actuated g/C Ratio	0.64	0.64		0.64	0.64		0.09	0.09		0.26	0.26	
Clearance Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		5.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	484	2159		483	2099		104	131		347	405	
v/s Ratio Prot		c0.17			0.17			0.02		c0.06	0.03	
v/s Ratio Perm	0.11			0.08			0.03			c0.06		
v/c Ratio	0.17	0.27		0.13	0.26		0.38	0.18		0.46	0.10	
Uniform Delay, d1	9.7	10.4		9.4	10.4		56.1	55.1		39.5	36.8	
Progression Factor	0.50	0.60		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.7	0.3		0.6	0.3		2.4	0.7		1.0	0.1	
Delay (s)	5.5	6.5		10.0	10.7		58.5	55.8		40.5	36.9	
Level of Service	A	A		B	B		E	E		D	D	
Approach Delay (s)		6.4			10.6			56.6			39.0	
Approach LOS		A			B			E			D	

Intersection Summary			
HCM 2000 Control Delay	17.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		

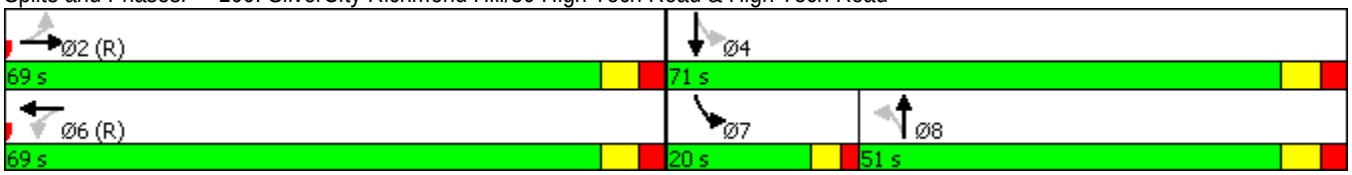
c Critical Lane Group

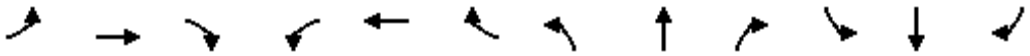
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	47	510	82	356	44	5	106	4
Future Volume (vph)	47	510	82	356	44	5	106	4
Lane Group Flow (vph)	52	694	88	549	56	235	128	96
Turn Type	Perm	NA	Perm	NA	Perm	NA	pm+pt	NA
Protected Phases		2		6		8	7	4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	7	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	7.0	10.0
Minimum Split (s)	37.5	37.5	37.5	37.5	37.5	37.5	12.0	37.5
Total Split (s)	69.0	69.0	69.0	69.0	51.0	51.0	20.0	71.0
Total Split (%)	49.3%	49.3%	49.3%	49.3%	36.4%	36.4%	14.3%	50.7%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.0
Lead/Lag					Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	C-Min	C-Min	C-Min	C-Min	None	None	None	None
v/c Ratio	0.10	0.30	0.19	0.24	0.50	0.68	0.50	0.22
Control Delay	10.5	10.5	11.6	9.5	75.9	18.7	48.1	10.0
Queue Delay	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.5	11.5	11.6	9.5	75.9	18.7	48.1	10.0
Queue Length 50th (m)	4.8	38.8	8.8	27.5	16.0	2.2	30.9	1.8
Queue Length 95th (m)	13.1	55.8	21.5	43.6	26.2	0.5	40.5	0.2
Internal Link Dist (m)		100.0		196.6		78.3		136.4
Turn Bay Length (m)	30.0		70.0					
Base Capacity (vph)	545	2350	461	2286	408	657	272	770
Starvation Cap Reductn	0	1310	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.67	0.19	0.24	0.14	0.36	0.47	0.12

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 100: SilverCity Richmond Hill/30 High Tech Road & High Tech Road





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	47	510	58	82	356	126	44	5	200	106	4	77
Future Volume (vph)	47	510	58	82	356	126	44	5	200	106	4	77
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0		7.0	7.0		7.0	7.0		5.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.98		1.00	0.97	
Flpb, ped/bikes	0.98	1.00		1.00	1.00		0.99	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.96		1.00	0.86		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1774	3511		1781	3402		1778	1597		1804	1581	
Flt Permitted	0.44	1.00		0.37	1.00		0.69	1.00		0.23	1.00	
Satd. Flow (perm)	818	3511		689	3402		1301	1597		444	1581	
Peak-hour factor, PHF	0.90	0.82	0.81	0.93	0.86	0.93	0.79	0.63	0.88	0.83	0.50	0.88
Adj. Flow (vph)	52	622	72	88	414	135	56	8	227	128	8	88
RTOR Reduction (vph)	0	4	0	0	13	0	0	207	0	0	68	0
Lane Group Flow (vph)	52	690	0	88	536	0	56	28	0	128	28	0
Confl. Peds. (#/hr)	11		3	3		11	12		4	4		12
Heavy Vehicles (%)	0%	1%	0%	1%	1%	0%	0%	0%	0%	0%	0%	1%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		2			6			8		7	4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	93.6	93.6		93.6	93.6		12.1	12.1		32.4	32.4	
Effective Green, g (s)	93.6	93.6		93.6	93.6		12.1	12.1		32.4	32.4	
Actuated g/C Ratio	0.67	0.67		0.67	0.67		0.09	0.09		0.23	0.23	
Clearance Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		5.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	546	2347		460	2274		112	138		251	365	
v/s Ratio Prot		c0.20			0.16			0.02		c0.06	0.02	
v/s Ratio Perm	0.06			0.13			0.04			c0.06		
v/c Ratio	0.10	0.29		0.19	0.24		0.50	0.20		0.51	0.08	
Uniform Delay, d1	8.2	9.6		8.8	9.1		61.1	59.5		45.2	42.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.3		0.9	0.2		3.5	0.7		1.6	0.1	
Delay (s)	8.6	9.9		9.7	9.4		64.5	60.2		46.8	42.2	
Level of Service	A	A		A	A		E	E		D	D	
Approach Delay (s)		9.8			9.4			61.0			44.8	
Approach LOS		A			A			E			D	

Intersection Summary			
HCM 2000 Control Delay	21.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	70.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX F

Signal Warrant Analysis

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Site Driveways / High Tech Road Count Date: 2017-10-20

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%	☑	☐
	B	Crossing Volume	100	%		
2. Delay to Cross Traffic	A	Main Road	99	%	☐	☑
	B	Crossing Road	100	%		
3. Combination	A	Justificaton 1	100	%	☑	☐
	B	Justification 2	99	%		
4. 4-Hr Volume			99	%	☐	☑
5. Collision Experience			53	%	☐	☑
6. Pedestrians	A	Volume	Justification not met		☐	☑
	B	Delay	Justification not met			

APPENDIX G

Preliminary Cost Estimates

YONGE STREET AND HIGH TECH ROAD, RICHMOND HILL, ONTARIO

Preliminary Construction Cost Estimate

Option 1 - SIGNAGE AND PAVEMENT MARKING

(Feb. 06, 2018) - (LEA reference 18081WF05.dwg)

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Removals				
Remove Existing Traffic Sign	ea.	1	$250	$250.00
New				
New Traffic Signs	ea.	6	$750	$4,500.00
Pavement Markings / 10 cm Paint lines	ea.	145	$30	$4,350.00
Pavement Symbol (Arrows)	ea.	4	$600	$2,400.00
SUBTOTAL 1				**12,000**
Contingency Allowance (20%)				2,000
TOTAL				**14,000**

Note 1: Unit rates used are similar to other Private Development projects. The costs are calculated under the assumption that the Main on-site contractor undertaking the off-site works. This would result in a potential more efficient and better coordinated construction schedule with optimum utilization of the equipment. Should the works be undertaken by a separate contractor, higher unit rates/ cost are to be expected due to the relatively small contract size.

Note 2: Costs do not include items related to the relocation of existing underground utilities and services.

YONGE STREET AND HIGH TECH ROAD, RICHMOND HILL, ONTARIO
Preliminary Construction Cost Estimate
Option 2A - RIGHT IN / RIGHT OUT (RIRO)

(Feb. 06, 2018) - (LEA reference 18081WF05.dwg)

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Removals				
Saw Cut Existing Pavement	m	70	$20	$1,400.00
Remove Asphalt (Half Depth) - Saw Cut	m^3	57	$50	$2,856.00
Grind Existing Pavement Markings Lines	m	223	$20	$4,460.00
Obliterate Existing Pavement Marking Arrow	ea.	2	$200	$400.00
New				
New Traffic Signs	ea.	4	$750	$3,000.00
Pavement Markings / 10 cm Paint lines	ea.	132	$30	$3,960.00
Pavement Symbol (Arrows)	ea.	2	$600	$1,200.00
New Median				
150mm Concrete	m^2	238	$110	$26,180.00
Granular A- 300mm	t	171	$84	$14,394.24
Curb	m	125	$135	$16,875.00
SUBTOTAL 1				**75,000**
Contingency Allowance (20%)				15,000
TOTAL				**90,000**

Note 1: Unit rates used are similar to other Private Development projects. The costs are calculated under the assumption that the Main on-site contractor undertaking the off-site works. This would result in a potential more efficient and better coordinated construction schedule with optimum utilization of the equipment. Should the works be undertaken by a separate contractor, higher unit rates/ cost are to be expected due to the relatively small contract size.

Note 2: Costs do not include items related to the relocation of existing underground utilities and services.

YONGE STREET AND HIGH TECH ROAD, RICHMOND HILL, ONTARIO
Preliminary Construction Cost Estimate
Option 2B - RIGHT IN / RIGHT OUT (RIRO) WITH BARRIER FENCE

(Feb. 06, 2018) - (LEA reference 18081WF05.dwg)

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Removals				
Saw Cut Existing Pavement	m	70.00	$20	$1,400.00
Remove Asphalt (Half Depth) - Saw Cut	m^3	81.00	$50	$4,050.00
Grind Existing Pavement Markings Lines	m	223	$20	$4,460.00
Obliterate Existing Pavement Marking Arrow	ea.	2	$200	$400.00
New				
New Traffic Signs	ea.	4	$750	$3,000.00
Pavement Markings / 10 cm Paint lines	ea.	132	$30	$3,960.00
Pavement Symbol (Arrows)	ea.	2	$600	$1,200.00
Fence (1.0 m)	m	116	$100	$11,600.00
New Median				
150mm Concrete	m^2	238	$110	$26,180.00
Granular A- 300mm	t	241	$84	$20,260.80
Curb	m	250	$135	$33,750.00
SUBTOTAL 1				**110,000**
Contingency Allowance (20%)				22,000
TOTAL				**132,000**

Note 1: Unit rates used are similar to other Private Development projects. The costs are calculated under the assumption that the Main on-site contractor undertaking the off-site works. This would result in a potential more efficient and better coordinated construction schedule with optimum utilization of the equipment. Should the works be undertaken by a separate contractor, higher unit rates/ cost are to be expected due to the relatively small contract size.

Note 2: Costs do not include items related to the relocation of existing underground utilities and services.

YONGE STREET AND HIGH TECH ROAD, RICHMOND HILL, ONTARIO
Preliminary Construction Cost Estimate
Option 3 - LEFT-IN, RIGHT IN / RIGHT-OUT (LI,RIRO)

(Feb. 06, 2018) - (LEA reference 18081WF05.dwg)

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Removals				
Earth Excavation	m^3	371	$38	$14,080.14
Remove Existing Concrete Curb	m	78	$100	$7,800.00
Remove Curb & Gutter	m	33	$100	$3,300.00
Remove Existing Concrete Sidewalk	m^2	32	$50	$1,600.00
Grind Existing Pavement Markings Lines	m	52	$20	$1,040.00
Remove Tree	ea.	1	$500	$500.00
Remove/Relocate Fire Hydrant	ea.	1	$8,000	$8,000.00
Relocate Street light	ea.	2	$1,500	$3,000.00
Re-Locate Bell Box	ea.	1	$1,500	$1,500.00
Trim Guide Rail	m	10	$100	$1,000.00
Re-locate Existing Traffic Signs (2 Stop signs and Fire Route sign)	ea.	3	$250	$750.00
Remove Hand Hole	ea.	1	$500	$500.00
Remove/Relocate Catchbasin	ea.	1	$2,000	$2,000.00
New				
New Traffic Signs	ea.	6	$750	$4,500.00
Pavement Markings / 10 cm Paint lines	ea.	92	$30	$2,760.00
Pavement Symbol (Arrows)	ea.	2	$600	$1,200.00
Access Widening				
Surface Asphalt - 40mm - HL1	t	55	$205	$11,228.67
Base Asphalt - 50mm - HDBC	t	66	$170	$11,183.03
150mm - Granular A	t	193	$42	$8,119.44
450mm - Granular B	t	483	$30	$14,499.00
150mm Concrete	m^2	115	$110	$12,650.00
Curb	m	215	$135	$29,025.00
Curb & Gutter	m	55	$135	$7,425.00
200 mm Concrete Sidewalk	m^2	7	$150	$1,080.00
SUBTOTAL 1				**149,000**
Contingency Allowance (20%)				30,000
TOTAL				**179,000**

Note 1: Unit rates used are similar to other Private Development projects. The costs are calculated under the assumption that the Main on-site contractor undertaking the off-site works. This would result in a potential more efficient and better coordinated construction schedule with optimum utilization of the equipment. Should the works be undertaken by a separate contractor, higher unit rates/ cost are to be expected due to the relatively small contract size.

Note 2: Costs do not include items related to the relocation of existing underground utilities and services (unless noted above).

YONGE STREET AND HIGH TECH ROAD, RICHMOND HILL, ONTARIO

Preliminary Construction Cost Estimate

Option 4 - SIGNALIZATION

(Feb. 06, 2018) - (LEA reference 18081WF05.dwg)

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Removals				
Earth Excavation	m^3	11	$38	$410.40
Remove Existing Concrete Curb	m	26	$100	$2,584.02
Grind Existing Pavement Markings Lines	m	240	$20	$4,800.00
Grind Existing Pavement Markings Arrows	ea.	5	$20	$100.00
Remove Existing Traffic Signs	ea.	2	$250	$500.00
Adjust Catch basin	ea.	1	$1,000	$1,000.00
New				
Traffic Signal Equipments (Including ped pole)				$160,000.00
Tactile Plates	ea.	16	$200	$3,200.00
Pavement Markings / 10 cm Paint lines	ea.	747	$30	$22,410.00
Pavement Symbol (Arrows)	ea.	5	$600	$3,000.00
200 mm Concrete (Ped ramps)	m^2	11	$600	$6,600.00
Depressed Curb (Ped ramps)	m	30	$135	$4,050.00
SUBTOTAL 1				**209,000**
Contingency Allowance (20%)				42,000
TOTAL				**251,000**

Note 1: Unit rates used are similar to other Private Development projects. The costs are calculated under the assumption that the Main on-site contractor undertaking the off-site works. This would result in a potential more efficient and better coordinated construction schedule with optimum utilization of the equipment. Should the works be undertaken by a separate contractor, higher unit rates/ cost are to be expected due to the relatively small contract size.

Note 2: Costs do not include items related to the relocation of existing underground utilities and services (unless noted above).