Sixteenth Land Holdings Inc. Transportation Assessment 4134 16th Avenue Lands City of Markham

Transportation Assessment

4134 16th Avenue Internal Roadway Network Options

Preferred Roadway Network

Official Plan Amendment

October 2016



Sixteenth Land Holdings Inc. Transportation Assessment 4134 16th Avenue Lands City of Markham 4134 16th Avenue Internal Roadway Network Options Preferred Roadway Network Official Plan Amendment

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Introduction

Sixteenth Land Holdings Inc. has retained Poulos & Chung Limited (PC) to prepare this Transportation Assessment Report in support of an Official Plan Amendment ("OPA") application to permit the development of a residential community on the subject property.

The property is municipally known as 4134 16th. Avenue, in the City of Markham, Region of York. The property is located in Part lots 16, 17 and 18, Concession 5. Except for an area adjacent to Kennedy Road, the balance of the property is currently used by its former owner York Downs Golf & Country Club for a golf course.

The property is a total of 168.64 hectares (416.72 acres), and is located on the north side of 16th. Avenue, on the west side of Kennedy Road, and has a small amount of frontage onto the east side of Warden Avenue as well. There is existing residential development surrounding the property on all sides.

A tributary of the Berczy Creek crosses the western portion of the property, and the Bruce Creek traverses the property in a roughly north / south direction, bisecting the property into west and east tableland areas.

The current golf course use has been in operation since York Downs Golf & Country Club opened on site in the early 1970's. The current Official Plan designation of 'Private Open Space' for the areas outside of the valley lands reflects this historic golf course use.

Sixteenth Land Holdings Inc. intends to develop the property for a residential community and is submitting an OPA to redesignate the developable portion of the property from 'Private Open Space' to appropriate urban residential designations to permit the development of residential uses.

This report has been prepared in conjunction with the OPA application in support of the redesignation as proposed in the draft OPA and in the Planning Report (Gatzios Planning, September 2016). Please refer to the draft OPA and to the Planning Report for a description of the proposed Official Plan land use designations proposed for the property.

The proposed residential development is detailed in the two draft plan of subdivision applications that accompany this OPA application. There is one draft plan of subdivision for the east portion of the property and one for the west portion of the property. The west draft plan of subdivision also contains the valley lands associated with both the Berczy creek and the Bruce creek. References in this report to the two draft plans or to specific lots / blocks will include 'East' or 'West' to denote the appropriate area.

The East draft plan of subdivision contains a total of 1,257 dwelling units

The West draft plan of subdivision contains a total of 1,164 dwelling units.

On September 15, 2015 a meeting was held with York Region and the City of Markham. At this meeting a detailed discussion pertaining to all transportation matters took place. The strategic discussion verified that detailed analysis, equivalent to a Class Environmental Assessment Study had to be completed to identify the need and justify the internal roadway network pattern. Of prime importance was the need to respect environmental conditions and operation of bounding arterial roads. Thorough assessment and evaluation of all relevant criteria would result in the selection of a preferred internal roadway network and access pattern.

With the determination of a preferred roadway network and access pattern the detailed transportation components of the development plan can be provided.

A Terms of Reference detailing the analysis efforts and expected outputs was submitted on December 22, 2015.

This submission:

- Evaluates all critical modes of transportation for the 4134 16th Avenue lands;
- Forecasts total vehicle demands to horizon year 2021;
- Compares and evaluates four (4) different internal roadway network and access patterns;
- network and access pattern from a transportation perspective.

The following sections document the detailed analyses, assessments and evaluations conducted.

• Conducts a detailed assessment of transportation criteria and selects a preferred internal roadway

Basis of Analysis 2

The Terms of Reference dated December 22, 2015 is presented in Appendix A.

In accordance to this Terms of Reference, PC:

- Conducted turning movement counts at all identified intersections;
- Obtained available York Region Transit information;
- Obtained EMME II transportation model outputs from York Region;
- Used the Highway Capacity Manual and the Institute of Transportation Engineers (ITE), Trip Generation Manual 8th Edition to estimate travel demands by mode of transportation;
- Obtained existing signal timings;
- Used the Synchro Software Program to analyze and evaluate intersection performance.

One of the most important and primary inputs used in this submission is the EMME II Transportation Model Outputs provided by York Region. These outputs provided the critical information to permit assessment and evaluation of the internal roadway network and access Options. In addition these outputs permitted verification of the area boundary road AM peak hour intersection turning movements and boundary road traffic flows for horizon year 2021.

This was accomplished by:

- Using the forecast population and employment numbers in the planned growth areas in close proximity to the 4134 16th Avenue lands;
- Determining the vehicle travel demand generated by the planned growth areas (including the Markham Future Urban Area to the north);
- Identifying the changing modal split characteristics and AM peak hour directions of travel;
- Hand assigning the AM peak hour traffic flows to the boundary roads from the planned growth areas;
- Adding the existing traffic volumes to the traffic flows generated by the planned growth areas in the roadway AM peak hour;
- Comparing the hand analysis to the EMME II horizon year 2021 outputs.

The horizon year 2021 outputs are considered to be the most accurate and most useful to conduct the evaluation and assessment of internal roadway network Options. Although 2031 EMME II forecasts are available, it is evident that they do not reflect the final land use traffic zone allocation of population and employment for the Future Urban Area to the north.

Horizon year 2021 provides a sound basis for analyzing the 4134 16th Avenue internal roadway network and access Options and the Secondary Plan respectively. Continually increasing background traffic flows to 2031 does not alter the evaluation and comparison analysis outputs used in the assessment of Options to determine an acceptable internal roadway network and access pattern.

This calibration / verification analysis is presented in Appendix B.

Figure B1 presents the EMME II traffic zones and the population and employment numbers for the planned growth areas.

Figure B2 presents the changing usage of available modes of transportation between 2011 and 2021. In addition the 2021 AM peak hour distribution of vehicle trips for the 4134 16th Avenue lands and the planned growth areas is identified.

Figure B3 presents the vehicle trip generation characteristics for the 4134 16th Avenue lands and the planned growth areas. The Trip Generation Manual, 8th Edition published by the Institute of transportation Engineers was used to estimate vehicle characteristics generated by the 4134 16th Avenue lands. The vehicle trip generation characteristics of the West and East Villages of Angus Glen are based on actual traffic counts.

The total AM peak hour traffic flows resulting from the 4134 16th Avenue lands, West and East Villages of Angus Glen and the planned growth areas was distributed and hand assigned to the boundary road network.

This total development traffic flow was then compared to the EMME II outputs.

Figure B4 presents the comparison of the hand analysis (PC model) to the EMME II outputs. The comparison is done with each of the four (4) major Regional arterial roads bounding the 4134 16th Avenue lands.

It is evident when comparing segments of each arterial road that the forecasts determined by the hand analysis compare very well with the EMME II outputs. Therefore the projected traffic flows and intersection turning movements are considered to be accurate and acceptable for use in the analysis.

The Synchro Software program was used to assess intersection operations for conditions including:

- Existing conditions:
- Horizon year 2021 examining the four Options.

To assist in the review process all findings have been summarized and presented in the main body of the report. To assist the reviewing authorities all Synchro software program outputs have been provided in electronic format.

Transportation System 3

3.1 Transit

York Region Transit (YRT) provides extensive transit service throughout the City of Markham. A hierarchy of service exists including:

- Local transit services within neighbourhoods;
- Higher frequency transit service on arterial roads;
- Higher order transit service in the VIVA Highway 7 and Enterprise Drive corridors.

In addition to the above service, GO Transit provides a heavy rail commuter service on the Stouffville GO Rail corridor. The train service concentrated in the peak period peak direction of travel is complemented by all day GO Bus service. Metrolinx has announced within a ten year horizon period that all day two - way service will be introduced between Unionville GO Rail Station and Union Station in downtown Toronto.

Figure 3.1A identifies the existing York Region Transit service route structure. Also identified are the locations of the Unionville, Centennial and Mount Joy GO Rail Stations.

It is evident that route structure modifications and additions can connect the 4134 16th Avenue lands to:

- The GO Rail Service;
- The VIVA Highway 7 rapid transit line;
- The major area attractors and generators including Markham Stouffville Hospital, Markville Mall and the future York University Campus.

Available data from York Region Transit has been reviewed to ascertain existing area transit ridership and to assist in determining the appropriate transit modal split to use in the transportation assessments. Transportation for Tomorrow Survey results indicate in 2011 that during the roadway AM peak period that Ward 3 (Area immediately south of the 4134 16th Avenue lands) seven (7) per cent of all trips made by residents was on transit. Since 2011 it is evident that there has been on - going increase in transit usage such that about nine (9) percent of all trips made by residents are currently on transit in the same time period. It is estimated that future growth areas, such as the FUA in the City of Markham will achieve a transit modal split of 17%. It is very likely that the 4134 16th Avenue lands will also secure such a transit modal split level by 2031.

In recognition of the existing and forecast transit modal split as defined above it is reasonable to conclude that a transit modal split for the 4134 16th Avenue lands should be in the order of twelve (12) percent by the year 2021. Therefore this modal split has been applied to the analysis.

The exiting transit service can be modified to provide direct service to the 4134 16th Avenue lands. The available bounding arterial roads also represent an opportunity to modify / introduce new services to better serve existing neighbourhoods, 4134 16th Avenue lands and future growth areas.

Figure 3.1B presents an indication of how these services can be modified / added to enhance overall transit accessibility. It is evident that the 4134 16th Avenue lands would be well within a comfortable walk distance of 400 meters to either local transit or higher order transit on the arterial roads. Such a transit network has the capability to directly connect with other major transit services and major attractors and generators within the City. Figure 3.2 illustrates the potential transit through the subject lands and the bus stop locations.

3.2 Active Transportation

Active transportation is to play an ever increasing important role in the mobility of Markham residents.

The Transportation for Tomorrow Survey results indicate in 2011 that four (4) per cent of Ward 3 residents in the roadway AM peak period used walking and bicycling as their preferred modal choice for trip purpose.

It is expected that the walking and bicycle modes of transportation will continue to experience an increase in usage. This is especially true for the 4134 16th Avenue lands with their close proximity to major attractors such as the Angus Glen Community Centre, Pierre Elliott Trudeau High School and the near – by convenience grocery store and retail facilities.

The local active transportation setting is presented in Figure 3.3.

As shown in Figure 3.4 the 4134 16th Avenue lands will provide:

- A cohesive and connected active transportation system;
- Bicycle lanes on collector roads;
- Extensions and connections to the existing trail and path system;
- Efficient and direct connections to transit

This physical infrastructure will provide the viable Option and opportunity for 4134 16th Avenue residents to use these modes of transportation on a daily basis. In addition to connecting to the attractors and generators access to transit will be made available through the placement of strategic bus stops with the ability to secure bicycles.

3.3 Roads

As shown in Figure 1.1 the existing Major Collector Roads (outside of the 4134 16th Avenue Lands) are under the jurisdiction of the City of Markham. A series of Minor Collector Roads also exists. These are shown in a Figure in a further section of this report.

Major Arterial Roads (four lanes with exclusive turn lanes at intersections) form the regional road grid around the 4134 16th Avenue lands. These roads of Warden Avenue, 16th Avenue, Kennedy Road and Major Mackenzie Drive are under the jurisdiction of York Region.

The 2016 - 10 years Capital Road Program does not identify any improvements or additions to these arterial roads.

Please Note. As of August 2016 York Region in finalizing the 2016 Transportation Master Plan Update has published updated time lines for planned roadway improvements and additions. This Update Study now shows an acceleration of road improvements for 16th Avenue and Kennedy Road between 2021 and 2026. These updated planned improvements have not been reflected in this transportation assessment but will be evaluated when completing the Traffic Impact Study for the East and West Draft Plans of Subdivision for 4134 16th Avenue lands.

Figure 3.5 identifies the existing arterial grid and the location of existing traffic signal control devices.

This arterial grid as illustrated in Figure 3.6 provides excellent accessibility to the 4134 16th Avenue lands. Direct access is provided to Major Highways and the GO Stations, all of which are 4 to 6 kilometer distance.

PC undertook a comprehensive intersection vehicle turning movement count program in October 2015.

The existing roadway AM and PM peak hour intersection turning movements are shown in Figure 3.7.

The operational characteristic of each intersection was examined using the Synchro software program. The detailed intersection parameters and output analysis sheets are presented in electronic format. The description of intersection operations and performance characteristics are presented in Figure B5 of Appendix B.

The existing operational characteristic of each intersection is summarized in Figure 3.8. It should be noted that the intersection performance presented is intended to be used as a comparison and evaluation with the detailed information provided in the following sections.

This analysis is focused on evaluating and comparing internal roadway network and access Options. Evaluating and comparing the performance of the major boundary road intersections forms a key cornerstone of this process. As the detailed outputs are presented in the following sections, comparisons can be made with the existing performance characteristics.

4 Proposed 4134 16th Avenue Development

4.1 Anticipated Land Uses

The 4134 16th Avenue lands are to be primarily a residential development.

PC requested land use estimates (from the Project Team) for the subject lands and also to be identified in the areas west and east of the central open space area. This was done to assist in the distribution and assignment of development vehicles. Therefore the land use estimates contained in this assessment are slightly different than those finalized in the Draft Plans for the East and West sides.

The development yields used in this Transportation Assessment are as follows.

- West of the Open Space area:
 - Single family dwelling units 410 (695 in the Draft Plan);
 - Semis and Townhouse dwelling units 896 (594 in the Draft Plan):
 - Sub Total 1,306 dwelling units (1,257 in the Draft Plan);
 - Retail Commercial 107, 600 square feet. (Part of Mixed Use Block).
- East of the Open Space area:
 - Single family dwelling units -670 (695 in the Draft Plan);
 - Semis and Townhouse dwelling units 569 (562 in the Draft Plan);
 - Sub Total 1,239 (1,164 in the Draft Plan);
- Total Development:
 - Dwelling units 2,545 (2,421 in the Draft Plans);
 - Retail Commercial 107, 600 square feet. (Part of Mixed Use Block).

There is a difference in dwelling units assumed in the Transportation Assessment and the numbers in the two Draft Plans. This Transportation Assessment used higher dwelling unit numbers. In effect this transportation assessment represents a conservative approach.

4.2 Forecast Development Travel Demands

The 4134 16th Avenue lands during the typical weekday roadway peak hours will generate person trips that will use all primary modes of transportation.

The determination of travel demand by mode of transportation is based upon:

• Vehicle trips – using the ITE Trip Generation Manual modified to reflect local transit usage for residential trips and vehicle pass – by reductions for retail commercial uses;

- Pedestrian trips general analysis based upon TTS data.

Bicycle and pedestrian trips are best estimates to help plan for infrastructure. Bicycle and pedestrian trips were not factored or used to reduce vehicle trip making.

Figure 4.1 illustrates the vehicle and transit travel demands generated by the 4134 16th Avenue lands in the roadway AM and PM peak hours of a typical weekday.

It is estimated that the 4134 16^{th} Avenue lands will generate approximately:

- 1,343 vehicle trips during the roadway AM peak hour;
- 1,652 vehicle trips during the roadway PM peak hour;
- of the typical weekday roadway peak periods;
- 25 bicycle trips primarily focused on school, shopping and work purposes during each of the typical weekday roadway peak periods.

4.3 Directional Distribution of Travel Demands

The directional distribution of all 4134 16th Avenue travel demands is illustrated in Figure B2 in Appendix Β.

The primary directions of travel are given for demands that are destined to areas to and from the City of Markham as well those that remain within the City of Markham boundary.

The vehicle trips generated by the 4134 16th Avenue land uses were assigned to the external roadway network based upon these primary directions of travel for each internal roadway network and access Option examined.

• Bicycle trips – general analysis based upon TTS data and Highway Capacity Manual techniques;

• 120 pedestrian trips focused primarily on school, shopping and recreational purposes during each

Boundary Road Access Opportunities 5

The existing area major and minor collector road network was examined in detail.

Figure 5.1 illustrates the existing major and minor collector road network which intersects with the 4134 16th Avenue bounding arterial roads.

Each of the 4134 16th Avenue bounding arterial roads and their collector road intersections was examined in detail.

The following is noted.

Kennedy Road

It is feasible and operationally acceptable to provide a 4134 16th Avenue access to Kennedy Road:

- At Bur Oak Avenue and create a full turning movement intersection controlled by existing traffic signals;
- At Wilfred Munson Avenue and create a full turning movement intersection controlled by the installation of a new traffic signal;
- Through Yorkton Boulevard and connect to Beckett Avenue and create a full turning movement intersection controlled by and existing traffic signal.

16th Avenue

It is feasible and operationally acceptable to provide 4134 16th Avenue access to 16th Avenue via:

- A connection to Yorkton Boulevard and the existing intersection on 16th Avenue controlled by an existing traffic signal, which in turn provides direct access to Kennedy Road via Beckett Avenue:
- A new 4134 16th Avenue access road created directly opposite the existing Normandale Road West intersection controlled by an existing traffic signal;
- A new 4134 16th Avenue access road created directly opposite the existing Normandale Road East intersection and controlled by a new traffic signal.

Major Mackenzie Drive

A feasible and operationally acceptable 4134 16th Avenue access to Major Mackenzie Drive via:

• A connection to Prospectors Drive which has a full vehicle unsignalized intersection with Major Mackenzie Drive. This Prospectors Drive intersection with Major Mackenzie Drive could be controlled by a future traffic signal;

• A connection to Angus Glen Boulevard in the East / West Villages of Angus Glen permitted Community Centre.

Warden Avenue

A narrow property corridor (23.0 meter wide space) is available from the 4134 16th Avenue lands westerly to Warden Avenue.

This corridor and its intersection with Warden Avenue are shown in Figure 5.2.

Using available plan and profile information it is concluded that:

- Avenue intersections:
- vehicles, however;

Horizontal and vertical conditions were examined at this location. It is evident based upon examining vertical conditions that:

- The potential road must be located on an elevated structure in order to match the grade of Warden Avenue;
- The elevated structure would be located directly over a meandering stream;
- The elevated structure would have to traverse through significant land contour changes, and;
- Through sensitive wooden and topographical areas.

The ability to secure this potential road connection to Warden Avenue will require significant engineering and environmental review and impact assessment. The evaluation process taking all factors into consideration will determine the ability to secure this connection. The engineering and environmental assessment has been undertaken by Stantec Engineering and Beacon Environmental Limited. Gatzios Planning + Development Consultants Inc. reviewed all of the assessment work including this transportation assessment and prepared the recommendation and conclusion.

This transportation assessment therefore, as part of this overall assessment, conducted an assessment of roadway network and access patterns that both included such a connection and alternatives that did not.

direct access to the existing signalized intersection at the south entrance to the Angus Glen

• The potential Warden Avenue access location does not adversely impact any existing Warden

• Satisfactory vehicle decision making criteria can be secured for the safe stopping and turning of

Internal Roadway Network and Access Options 6

Upon examining the available 4134 16th Avenue site boundary frontage, bounding arterial road and existing adjacent local road networks it became evident that:

- The maximum number of feasible collector road intersections with bounding arterial roads can be secured along 16th Avenue and Kennedy Road. In other words following acceptable regional road geometric standards and traffic operations criteria the maximum number of collector road intersections which can be feasibly secured by the 4134 16th Avenue lands is available along 16th Avenue and Kennedy Road;
- The only 4134 16th Avenue access variables that remain are:
 - Is it feasible to secure access to Warden Avenue via the defined space available;
 - Is it feasible to secure two access locations connecting to the existing East and West Villages of Angus Glen? The west end of Angus Glen Boulevard at Major Mackenzie Drive is controlled by a traffic signal. The Prospectors Drive intersection with Major Mackenzie Drive is not controlled by a traffic signal.

To assess this 4134 16th Avenue access variability four (4) distinct internal roadway network and access Options were formulated.

These four (4) Options are shown in Figure 6.1.

The Options can be described as follows.

Description of 4134 16th Avenue

Option	
A	Maximum number of access bounding arterial roads. • One access conn • Two access conn • Three access con • Three access con
В	Number of access connection roads. • Two access conn • Three access conn • Three access conn
С	Number of access connection roads. • One access conn • One access conn • Three access conn • Three access conn • Three access conn
D	Number of access connection roads. • One access connection • Three access connection • Three access connection • Three access connection

The four Options presented above encompass all feasible permutations and combinations to permit an accurate assessment and evaluation.

This assessment therefore provides the transportation inputs to be used as part of the overall evaluation process confirming the feasibility to secure the maximum accessibility for the 4134 16th Avenue lands.

Table 1

Internal Roadway Network and Access Options

Description connections made to all four (4) ection to Warden Avenue; ections to Major Mackenzie Drive; nections to Kennedy Road; nnections to 16th Avenue. ons made to three (3) bounding arterial ections to Major Mackenzie Drive; nections to Kennedy Road; nnections to 16th Avenue. ons made to four (4) bounding arterial ection to Warden Avenue: ections to Major Mackenzie Drive; nnections to Kennedy Road; nnections to 16th Avenue. ons made to three (3) bounding arterial ections to Major Mackenzie Drive;

nections to Kennedy Road; nnections to 16th Avenue.

7 Traffic Flows by Option

7.1 Verifying Internal Traffic Flows

The development of the 4134 16th Avenue lands in effect provides the opportunity to complete the internal roadway network not only for the southern half of the concession block but for the northern half which contains the Villages of Angus Glen.

The Options investigated provide a varying degree of accessibility and connectivity to Warden Avenue and 16th Avenue.

Such a degree of accessibility and connectivity directly influences existing travel demands and patterns, especially from:

- The East and West Villages of Angus Glen immediately to the north;
- The Berczy Community immediately to the east, and;
- Background traffic flows on Kennedy Road and Warden Avenue.

The York Region EMME II transportation model provided 2011 and 2021 traffic flow outputs. These outputs were reviewed in an attempt to understand the changing flow patterns resulting from both the inclusion of 4134 16th Avenue development and connections to either Warden Avenue or Major Mackenzie Drive.

Once the general traffic flow pattern was understood a hand analysis was conducted to determine traffic flows (non – 4134 16th Avenue traffic) that would find it convenient to use the internal available roadway network.

This permitted a comparison and validation of hand assigned traffic flows versus the EMME II outputs. The comparison and validation was done twice. The first time assuming a connection to 16th Avenue via the extension of Bur Oak Avenue and the second assuming a connection to both 16th Avenue and Warden Avenue.

Figure 7.1A examines the extension of Bur Oak Avenue to connect with 16th Avenue.

The EMME II outputs for 2011 and 2021 indicate that a total of approximately 621 vehicle trips would find it convenient to access 16th Avenue when the 4134 16th Avenue development is considered with a connection to 16th Avenue.

The lower right side of Figure 7.1A summarizes the hand assigned traffic flows taking into account the extension and connection to 16th Avenue. Although the hand assignment results in a slightly higher number, it is considered reasonable and serves as validation when compared to the EMME II forecasts.

It is therefore concluded that when considering the extension and connection of Bur Oak Avenue that all vehicle demand traffic flows including existing, cut through and 4134 16th Avenue development has been properly accounted for.

Figure 7.1B examines the extension of Bur Oak Avenue with an extension to 16th Avenue and a connection to Warden Avenue.

The EMME II outputs for 2011 and 2021 indicate that a total of approximately 1,054 vehicle trips would find it convenient to access Warden Avenue and 16th Avenue when the 4134 16th Avenue development is considered with connections to both 16th Avenue and Warden Avenue.

The lower right hand side of Figure 7.1B summarizes the hand assigned traffic flows taking into account both connections. Although the hand assignment results in a slightly higher number, it is considered reasonable and serves as validation when compared to the EMME II outputs.

The implication of such connection opportunities, of course means that:

- Intersections such as Kennedy Road with Major Mackenzie Drive and 16th Avenue will have traffic flows diverted away while intersections like Warden Avenue with 16th Avenue and Major Mackenzie Drive will accommodate increased diverted traffic flows, and;
- A connection to Warden Avenue will increase the amount of cut through and diverted traffic through the 4134 16th Avenue lands.

The fact that there is cut through traffic and its magnitude by direction is not considered unreasonable or undesirable. It is the result of completing a concession block road network and affording all residents alternate and more direct choices of travel direction.

7.2 **Option A Traffic Flows**

Figure 4.1 presents the vehicle travel demands generated by the 4134 16th Avenue lands during the roadway peak hours of a typical weekday.

This vehicle travel demand was assigned in accordance to the available roadway network and access pattern provided by Option A.

Appendix C contains:

- Figure C1 which presents the 4134 16th Avenue typical weekday AM and PM roadway peak hour vehicle demand assigned to the available roadway network;
- Figure C2 which presents the 2021 roadway background traffic flows during the typical weekday roadway AM and PM peak hours. The cut through traffic is included in both roadway peak hours.

Figure 7.2 presents the total 2021 roadway AM and PM traffic flows during a typical weekday.

These traffic flows were used to conduct the evaluation and assessment of all Options.

7.3 **Option B Traffic Flows**

Figure 4.1 presents the vehicle travel demands generated by the 4134 16th Avenue lands during the roadway peak hours of a typical weekday.

This vehicle travel demand was assigned in accordance to the available roadway network and access pattern provided by Option B.

Appendix C contains:

- Figure C3 which presents the 4134 16th Avenue typical weekday AM and PM roadway peak hour vehicle demand assigned to the available roadway network;
- Figure C4 which presents the 2021 roadway background traffic flows during the typical weekday roadway AM and PM peak hours. The cut through traffic is included in both roadway peak hours.

Figure 7.3 presents the total 2021 roadway AM and PM traffic flows during a typical weekday.

These traffic flows were used to conduct the evaluation and assessment of all Options.

7.4 Option C Traffic Flows

Figure 4.1 presents the vehicle travel demands generated by the 4134 16th Avenue lands during the roadway peak hours of a typical weekday.

This vehicle travel demand was assigned in accordance to the available roadway network and access pattern provided by Option C.

Appendix C contains:

- Figure C5 which presents the 4134 16th Avenue typical weekday AM and PM roadway peak hour vehicle demand assigned to the available roadway network;
- Figure C6 which presents the 2021 roadway background traffic flows during the typical weekday roadway AM and PM peak hours. The cut through traffic is included in both roadway peak hours.

Figure 7.4 presents the total 2021 roadway AM and PM traffic flows during a typical weekday. These traffic flows were used to conduct the evaluation and assessment of all Options.

7.5 **Option D Traffic Flows**

Figure 4.1 presents the vehicle travel demands generated by the 4134 16th Avenue lands during the roadway peak hours of a typical weekday.

This vehicle travel demand was assigned in accordance to the available roadway network and access pattern provided by Option D. Appendix C contains:

- hour vehicle demand assigned to the available roadway network;
- hours.

Figure 7.5 presents the total 2021 roadway AM and PM traffic flows during a typical weekday.

These traffic flows were used to conduct the evaluation and assessment of all Options.

• Figure C7 which presents the 4134 16th Avenue typical weekday AM and PM roadway peak

• Figure C8 which presents the 2021 roadway background traffic flows during the typical weekday roadway AM and PM peak hours. The cut through traffic is included in both roadway peak

Assessment of Internal Roadway Network and Access Options 8

8.1 Methodology and Parameters

Good transportation planning dictates that securing direct, convenient and continuous collector road connections to all available boundary roads is an important and critical objective. This is especially important when trying to secure sufficient modal capacity and connectivity in the primary directions of travel during the roadway peak hour peak directions of travel.

Several of the Options secure that objective while others do not. The consequences of securing the objective are entirely felt at the four arterial road intersections bounding the entire Concession Block. The four intersections are:

- Major Mackenzie Drive and 16th Avenue with Warden Avenue;
- Major Mackenzie Drive and 16th Avenue with Kennedy Road.

Therefore this assessment analyzed, compared and evaluated the delivered total vehicle demands at these four intersections. The total vehicle demand consisted of:

- Existing traffic flows;
- Traffic flows resulting from growth including the Markham FUA in horizon year 2021, and;
- The build out of the 4134 16th Avenue lands;
- The cut through and diverted traffic flows from existing development such as the East and West Villages of Angus Glen and background traffic.

The parameters used in the assessment and evaluation process consist of:

- Intersection performance;
- Vehicle travel times:
- Vehicle delays;
- Environmental performance;
- Vehicle queue length demands.

The focus of the analysis is to compare and evaluate roadway network and access Options. It is the difference in operation performance and parameter measures that is of importance.

Therefore:

- All existing roadway physical infrastructure was maintained as is, including;
 - Existing traffic signal operations and signal timing;
 - Lane configurations and existing exclusive turning lanes.
- had the opportunity to approach the available primary four concession boundary road intersections in a direct and efficient manner;
- intersection operations; instead existing signal timings were maintained.

The difference in performance and parameter measures was used as basis for comparison and evaluation.

8.2 Boundary Road Intersection Performance by Option

Figures 7.2, 7.3, 7.4 and 7.5 present the total traffic flows for each Option. The Synchro software program was used to analyze intersection performance.

The summary operating conditions are shown in Figure 8.1. The details include overall level of service, vehicle delay and volume to capacity ratio which are based upon the existing signal timing.

The summary operating conditions include all traffic flows in the AM and PM peak hours.

8.3 AM Peak Vehicle Flows by Boundary Road Segment

The AM and PM peak hour peak direction total vehicle flows were examined on each of the boundary roads. The total vehicle flows are by Option and segments on each of the boundary roads are examined.

Figure 8.2 and 8.3 present the total vehicle flows by boundary road segment in the AM and PM Peak Hour, respectively.

This Figure essentially illustrates the how the peak directional flows change (on the boundary road) based upon the connectivity and accessibility provided by each of the Options.

In effect it illustrates the insertion of 4134 16th Avenue, cut through and diverted traffic flows onto each of the boundary road segments which already contain background traffic (existing traffic plus planned area growth to 2021).

• 4134 16th Avenue, East and West Villages of Angus Glen traffic flows were not constrained and

• No attempt was made to introduce modified signal timing or signal synchronization to improve

8.4 Warden Avenue and Major Mackenzie Drive Traffic Flow Variance

The peak hour peak direction of travel was further examined. This included 4134 16th Avenue, cut through and diverted traffic flows.

Traffic flows by Option were compared along each road segment in order to determine the variance in vehicle flow demand.

It is evident upon examining the segment traffic flows on the boundary roads in Figures 8.2 and 8.3 that:

- Total traffic flows on the boundary roads by Option do not have a significant variation on 16th Avenue and Kennedy Road. The total traffic flows essentially remain the same no matter which Option is investigated;
- Variation in traffic flow does occur on Warden Avenue and Major Mackenzie Drive.

It is evident that Warden Avenue and Major Mackenzie Drive experience the greatest increase in total traffic flow based upon the ability of Options to provide strategic connections. These strategic connections include:

- Connection to Warden Avenue;
- Connection to Major Mackenzie Drive via Angus Glen Boulevard and the existing traffic signal at the Angus Glen Community Centre.

As a result a further review of the traffic flows was done. This review is illustrated in Figure 8.4.

The review identifies the traffic flow volume change (+ or -) between the Options. The review is for the key boundary roads of Major Mackenzie Drive and Warden Avenue in the peak hour peak directions of travel.

The traffic flow volume change between Options that provide a connection (to Warden Avenue and Major Mackenzie Drive) and those that do not can be compared.

8.5 Comparison to Maximum Connectivity

The analysis conducted in Section 8.1 permitted a further comparison to be produced.

The outputs for each Option were then rationalized against Option A. This was done since Option A represents the maximum connection capability for the concession block.

A graphical representation permitting a comparison between the Options is shown in the right hand side of Figure 8.4.

From each individual intersection operations analysis, key outputs such as signal delay and travel time taken was extracted and summarized. This further data extrapolation attempts to define a drivers experience travelling across any of the bounding arterial roads.

This extrapolation was conducted for the peak hour peak direction of travel. The totaled outputs are summarized in the left hand side of Figure 8.5.

8.6 Intersection Vehicle Queue Length Demand

The Synchro Software Program calculates the length of vehicles waiting to complete a turn or through movement at an intersection controlled by a traffic light.

Such output is used to design intersection lane configurations as well to ensure that a sufficient storage length can be introduced and that no other adverse impacts are caused to primary traffic flows or to upstream / downstream intersections. The AM and PM peak hour peak direction of travel was determined for each Option at the arterial boundary road intersections. The traffic flows examined included forecast background traffic and 4134 16th Avenue, cut through and diverted traffic flows. The 95th percentile demand is presented.

Figure 8.6 presents the results for the AM roadway peak hour peak direction and Figure 8.7 presents the results for the PM peak hour peak direction.

9 Evaluation of Internal Roadway Network and Access Options

9.1 Boundary Road Intersection Performance

Figure 8.1 summarizes the performance of the concession block intersections by Option.

As previously mentioned this study is not about optimizing the performance of the concession block intersections. This study uses the raw conservative numbers to ascertain differences in order to compare and evaluate alternative roadway network and access options.

Upon reviewing the raw intersection performance outputs at the four boundary arterial road intersections it is evident that:

- No matter the intersection examined vehicle flow demands will cause intersections to operate at capacity for numerous minutes beyond the peak hour;
- Numerous exclusive vehicle turning movements, especially left turns experience significant delay and congestion;
- Several through vehicle movements also experience significant delay and congestion.

It is also important to recognize that this evaluation has been done with total traffic flows. Since background traffic constitutes a significant portion of the total flow it is not just the 4134 16th Avenue, cut through and diverted traffic flows which impart the resultant described operating conditions. The descriptions provided below attempt to place the Options evaluated within the context of forecast conditions containing all traffic flow demands. The calculated boundary road operation descriptions will exist (assuming no boundary road improvements and additions until the updated York Region capital road program is approved) irrespective of the Option being examined. This assessment describes the ability of an Option to integrate within the given operating forecast.

Upon reviewing the Options and the performance of the four boundary road intersections the following descriptions can be provided:

16th Avenue and Kennedy Road

- In the AM peak hour it appears that the through vehicle movement in the southbound direction of travel experiences the highest degree of delay and congestion. This condition exists no matter the Option being considered. Every Option is affected by this operating condition;
- In the PM peak hour it appears that the through vehicle movement and left turns in the northbound direction of travel experience the highest degree of delay and congestion. This condition exists no matter the Option being considered. Every Option is affected by this operating condition.

Major Mackenzie Drive and Kennedy Road

- In the AM peak hour this intersection operates fairly well when compared to the other three is reasonably well accommodated;
- In the PM peak hour this intersection operates fairly well when compared to the other three reasonably well accommodated.

16th Avenue and Warden Avenue

- access opportunity made available by the Options it is evident that;
 - left turn lane;
 - primary direction of travel at the intersection:
- opportunity made available by the Options it is evident that:
 - but to use 16th Avenue and the westbound left turn lane;

arterial boundary road intersections. All traffic flow demands including from each of the Options

arterial road intersections. All traffic flow demands including those from each of the Options is

• In the AM peak hour it is evident that no matter which Option is considered the intersection will experience significant overall delay and congestion with southbound through traffic flows and exclusive left turn lanes experiencing delays and congestion. This operating condition is evident even without the Option traffic flow demands. Upon examining the roadway network pattern and

• Options B and D with no Warden Avenue connection increase the amount of vehicles having to use the westbound to southbound left turn movement at the intersection. The traffic flow demand from these Options have no choice but to use 16th Avenue and the

• Options A and C with a Warden Avenue connection reduce the amount of vehicles wanting to conduct a west to south left turn, but still the demand is above available capacity. Although the Options benefit by reaching Warden Avenue directly once they head in the southbound direction they have no choice but to orientate themselves in the

• In the PM peak hour it is evident that no matter which Option is considered the intersection will experience significant overall delay and congestion with northbound through traffic flows and exclusive left turn lanes experiencing delays and congestion. This operating condition is evident even without the Option traffic flow demands. Upon examining the roadway pattern and access

• Options B and D with no connection to Warden Avenue result in a slightly higher eastbound left turn demand. The traffic flow demand from these Options have no choice

o Options A and C with a Warden Avenue connection reduce the amount of vehicles wanting to conduct a west to south left turn but still demand is above available capacity.

Major Mackenzie Drive and Warden Avenue

- In the AM peak hour it is evident no matter which Option is considered the intersection will experience low operating capability congestion with delay and congestion occurring at the northbound exclusive left turn lane. The operating condition is evident with the traffic flows from the Options. Upon examining the roadway network pattern and access opportunity made available by the Options it is evident that:
 - Options B and D result in the best performing boundary road conditions amongst all Options examined. Although no Warden Avenue connection is provided concession block traffic flows can still orientate themselves to either Major Mackenzie Drive of 16th Avenue. This orientation is able to serve primary directions of travel and it does so without creating an overburden at the Warden Avenue and 16th Avenue intersection. The Warden Avenue connection is attractive, as demonstrated by cut through and diverted traffic flows. Physical constraints prevent the Warden Avenue connection from continuing west in a direct and continuous manner. The result without a continuous direct connection to the west causes an unnecessary increased traffic flow to overburden the 16th Avenue and Warden Avenue intersection;
 - Options A and C with a Warden Avenue connection reduces the westbound through traffic flows at the intersection. However the connection to Warden Avenue increases the vehicle demand wanting to proceed northbound and turn left at the intersection to complete primary direction of travel. No matter the positive ability to reach Warden Avenue it is negated by having to conduct a westbound left turn at Major Mackenzie Drive for Option traffic flows to orientate themselves in the primary direction of travel;
- In the PM peak hour it is evident that no matter which Option is considered the intersection will experience significant overall delay and congestion with exclusive left turn lanes experiencing delay and congestion. The operating condition is evident with the traffic flow from the Options. Upon examining the roadway network and access pattern made available by the Options it is evident that:
 - o Options B and D with no Warden Avenue connection result in increased eastbound traffic flows:
 - Options A and C with the Warden Avenue connection available have reduced through eastbound traffic flows.

Overall summary

Several things are evident when examining the performance of the four bounding arterial road intersections. These are:

- parallel roads of Major Mackenzie Drive and 16th Avenue;
- most heavily utilized of the four intersections during the roadway peak hours;
- go straight through in their attempt to secure their primary peak directions of travel;
- Investigation of travel demand patterns through the EMME II software model indicate little if either background traffic cut through traffic or traffic from 4134 16th Avenue;
- to the four boundary arterial road intersections;
- negates that and provide poorer operating conditions.

A further evaluation step was taken to compare the roadway network and access opportunities. It was decided to use a volume to capacity ratio of greater than 1.3 as the cut – off condition.

This condition was selected because it represents a reasonable accurate measurement:

- Respecting daily, weekly and monthly variances in peak hour traffic flows;
- shoulders of the peak hours.

The bottom portion of Figure 8.1 summarizes by Option both the number of arterial road intersections and individual lanes which have exceeded the 1.3 threshold condition.

The summary uses existing signal timing without optimization.

• The lack of a continuous mid – block east west collector road such as Bur Oak Avenue extending from McCowan Road to Woodbine Avenue and even crossing Highway 404 places a heavy vehicle travel demand burden especially during the peak hour peak directions of travel on the

• The Warden Avenue intersections with Major Mackenzie Drive and 16th Avenue appear to be the

• The lack of a continuous mid – block collector road, in this case west of Warden Avenue leaves no choice for total traffic flow demands but to use these intersections to either turn left / right or

any uptake of traffic flows in the peak direction of travel to use Calvert Road as a means to complete primary trip purposes. Calvert Road with no ability to secure a direct connection, reduced speed and no ability to cross Highway 404 accommodates very little of the demand from

• Some Options maximize local access to the 4134 16th Avenue and Villages of Angus Glen lands. However, even with this maximum local condition the benefit does not appear to equally accrue

• Certain Option roadway network and access patterns may provide better operating conditions during the AM peak hour peak direction of travel while in the PM peak Hour direction of travel

• Accepting people's choice in using the automobile during the roadway peak hours and often the

9.2 Boundary Road Segment

Figures 8.2 and 8.3 summarize the AM and PM total peak hour peak direction vehicle flows on the bounding arterial roads. The total traffic flow consists of 4134 16th Avenue traffic, cut through and diverted and background traffic.

What is important about this traffic flow is that:

- It illustrates how 4134 16th Avenue, cut through and diverted traffic inserts itself along the segments of the boundary arterial road being examined;
- At the beginning and at the end of each boundary road segment the total traffic flow is approximately the same no matter the Option being considered.

A brief evaluation is presented below by roadway peak hours.

AM Peak Hour Vehicle Flows by Roadway Segment

Kennedy Road

• All Options are mostly similar along each roadway segment.

16th Avenue

• All Options are mostly similar along each roadway segment.

The above similarity is not surprising since both Kennedy Road and 16th Avenue contain consistent access conditions for all Options.

Warden Avenue

• The influence of a connection to Warden Avenue is evident. The Options with the connection exhibit increased total traffic flows.

Major Mackenzie Drive

• The influence on total traffic flows due to the second connection to Major Mackenzie Drive is evident.

PM Peak Hour Vehicle Flows by Roadway Segment

Kennedy Road

• All Options are mostly similar along each roadway segment.

16th Avenue

higher total traffic flows since a Warden Avenue connection is not available.

Warden Avenue

exhibit increased total traffic flows.

Major Mackenzie Drive

The influence on total traffic flows due to the second connection to Major Mackenzie Drive is evident.

The formation of land uses and environmental features limit the capability to provide continuous longer distance collector roads in this area of the City of Markham.

As a result of this inability to create meaningful long continuous collector roads the following key conclusions are reached by examining the total traffic flows:

- between Options;
- PM roadway peak hours.

9.3 Warden Avenue and Major Mackenzie Drive Traffic Flow Variance

Warden Avenue and Major Mackenzie Drive are the two boundary arterial roads which may or may not be able to accommodate a road connection to serve the travel demands of 4134 16th Avenue, cut through and diverted traffic flows.

Figure 8.4 summarizes the change in traffic flow demand on these two roads by comparing the direction traffic flow demand between two Options.

• All Options are mostly similar along each roadway segment. However, Options B and D exhibit

• The influence of a connection to Warden Avenue is evident. The Options with the connection

• Warden Avenue and Kennedy Road accommodate the AM peak hour travel demands in the peak southbound direction of travel. No matter the Option being considered once the total traffic volume reach a point immediately south of 16th Avenue the total volumes are virtually identical

• Major Mackenzie Drive and 16th Avenue accommodate the AM peak hour travel demands in the peak westbound direction of travel. No matter the Option being considered once the total traffic volumes reach a point immediately west of Warden Avenue the total volumes are virtually identical between Options. The lack of a continuous mid – block east west collector road means that 4134 16th Avenue, cut through and diverted traffic flows have to use internal roads to re – orientate themselves and then cause additional turning movements at the arterial boundary road intersections. Such re - orientation and additional turning movements occur in both the AM and

It is evident upon examining the change in traffic flow demand between Options that:

- The change in traffic flow demand is totally dependent upon the availability of direct access to either of the boundary roads of Warden Avenue and Major Mackenzie Drive;
- The maximum magnitude of change is approximately 150 to 200 vehicles.

9.4 Maximum Connectivity

Option A represents the maximum potential connectivity condition to serve the concession block consisting primarily of 4134 16th Avenue and the East and West Villages. As illustrated in Figure 8.5 a further analysis was conducted in order to evaluate Option A (representing the maximum potential connectivity condition) against the remaining Options.

The AM and PM peak hour peak direction of travel was examined.

The analysis incorporates total vehicle demands including forecast background traffic, 4134 16th Avenue, cut through and diverted traffic flows.

The Synchro outputs are summarized in the left hand side of Figure 8.5 while a graphical representation is provided on the right hand side.

Upon comparing to Option A (assuming that Option A provides the best opportunity to serve total demands) the following evaluation is brought forward:

In the roadway AM peak hour upon comparing peak directions of travel:

- Option C at least equals Option A at 16th Avenue westbound and slightly better at Major Mackenzie Drive westbound;
- Options B, C and D are somewhat better at Warden Avenue southbound;
- All Options are virtually identical at Kennedy Road southbound.

In the roadway PM peak hour upon comparing peak directions of travel:

- Option C at least equals Option A at 16th Avenue eastbound and slightly better at Major Mackenzie Drive eastbound;
- Options B, C and D are somewhat better at Warden Avenue northbound;
- All Options are virtually identical at Kennedy Road northbound.

It is evident that the lack of a continuous collector road west of Warden Avenue prevents a relief solution to be provided for the key block boundary road intersections of Warden Avenue with 16th Avenue and Major Mackenzie Drive. This is especially true for the peak hour peak directions of travel at the two Warden Avenue intersections.

9.5 Vehicle Queue Length Demand

9.5.1 AM Roadway Peak Hour Peak Direction

Figure 8.6 provides a schematic illustration of the calculated maximum vehicle queue length (in all cases the through vehicle queue length) at each of the bounding concession road intersections. The schematic queue length is shown in the left hand side of the Figure while the calculated length is shown on the right hand side.

It is evident upon comparing the vehicle queue lengths at each bounding arterial road intersection that:

Major Mackenzie Drive at Kennedy Road and Warden Avenue Intersections

- Very little variation occurs in the vehicle queue lengths by Option at these two intersections;
- a connection to Warden Avenue and / or a second connection to Maior Mackenzie Drive.

Warden Avenue and 16th Avenue Intersection

Southbound Peak Hour Peak Direction of Travel

reasonable share of 4134 16th Avenue, cut through and diverted traffic;

Westbound Peak Hour Peak Direction of Travel

- Warden Avenue connection is not available:
- Options A and C have the lowest vehicle queue lengths because the connection to Warden are reduced for these two Options.

The primary variation in the AM peak hour peak direction of travel occurs on the westbound Major Mackenzie Drive approach at Warden Avenue. The variation in length is dependent upon

• Option A produces the longest vehicle queue length demand in the AM peak hour peak direction of travel, this is not unexpected since the connection to Warden Avenue serve to accommodate a

• Options B and D produce the longest vehicle queue length demands. This is not unexpected since

Avenue and Major Mackenzie Drive splits the travel demand. Hence the vehicle queue lengths

Kennedy Road and 16th Avenue Intersection

• All Options exhibit similar vehicle queue length demands in both the southbound and eastbound peak directions of travel.

9.5.2 PM Roadway Peak Hour Peak Direction

Figure 8.7 provides a schematic illustration of the calculated maximum vehicle queue length (in all cases the through vehicle queue length) at each of the bounding concession road intersections. The schematic queue length is shown in the left hand side of the Figure while the calculated length is shown on the right hand side.

It is evident upon comparing the vehicle queue lengths at each bounding arterial road intersection that:

Kennedy Road at Major Mackenzie Drive and 16th Avenue Intersections

- Very little variation occurs in the vehicle queue lengths by Option at these two intersections;
- This is the case for both eastbound and northbound peak directions of travel.

Warden Avenue and 16th Avenue Intersection

Northbound Peak Hour Peak Direction of Travel

• As can be expected Option A produces the longest vehicle queue length demand in the PM peak hour peak direction of travel, this is not unexpected since the connection to Warden Avenue provides access to serve both 4134 16th Avenue, cut through and diverted traffic flows;

Eastbound Peak Hour Peak Direction of Travel

- This direction of travel, similar to eastbound Major Mackenzie Drive represents the only other route available to serve the peak travel demand in the peak direction of travel. As a result the maximum variation in vehicle queue lengths will occur reflecting the availability or non availability of connections. In summary:
 - Options D and B produce the longest vehicle queue length demand. This is not unexpected since 4134 16th Avenue, cut through and diverted traffic flows do not have a connection to Warden Avenue and only one access to Major Mackenzie Drive;

Warden Avenue and Major Mackenzie Drive Intersection

Northbound Peak Hour Peak Direction of Travel

• All Options exhibit similar vehicle queue length demands.

Eastbound Peak Hour Peak Direction of Travel

- summarized below:
 - traffic will take advantage of the connections to Major Mackenzie Drive:
 - availability of connections;
 - also use 16th Avenue.

9.6 Further Analyses

It is evident upon examining the above evaluation details for numerous parameters that no matter the Option being considered very little relief is accrued to the two key boundary road intersections of Warden Avenue with 16th Avenue and Major Mackenzie Drive. None of the Option's with their respective roadway network and access layout:

- flows generated by the planned area developments;
- Force continuous mid block connections and extensions.

It is evident that the 4134 16th Avenue, cut through and diverted traffic flows do secure advantages and benefits by having one or more additional connections to the boundary roads of Warden Avenue and Major Mackenzie Drive; however the unavailability of continuous mid – block collector roads especially in the peak hour peak directions of travel provide no relief to the key intersections of Warden Avenue with 16th Avenue and Major Mackenzie Drive no matter the Option being considered in the context of total traffic flows.

This direction of travel, similar to Warden Avenue eastbound represents the only other available route to serve peak travel demands. As a result there will be variances on the vehicle queue lengths resulting from the availability or non -availability of connections. These variances are

• Option B with no connection to Warden Avenue will result in the highest vehicle queue length demand. This is not unexpected since 4134 16th Avenue, cut through and diverted

• Options A and D have similar vehicle queue length demands which are influenced by the

• Option C produces the lowest vehicle queue length demand because 4134 16th Avenue, cut through and diverted traffic take advantage of the Warden Avenue connection and

• Can provide relief to the operating conditions generated by the existing traffic flows and traffic

As a result of this a further analysis evaluation was undertaken. This further analysis evaluation of boundary road intersection operations and concentrated on:

- A modification to existing signal timing by performing an optimization analysis;
- A safety evaluation;
- Evaluation of Intersection Measures of Effectiveness using Performance Index.

The results of these further analyses are summarized below.

Optimized Intersection Signal Timing

As mentioned throughout this assessment study no boundary road improvements and additions were considered nor were any signal timing adjustments done.

Typically a Traffic Engineer will use tools such as the Synchro Software Program to apply professional judgment to sequence an optimal signal timing condition for an intersection.

It was decided to conduct this additional analysis to assist in the comparison and evaluation of Options.

In this case, as opposed to a Traffic Engineer bracketing the signal timing, an optimized signal condition was run letting the Synchro Software Program calculate an optimal signal timing solution.

The results of this signal timing optimization is presented in Figure 9.1.

In order to conduct a comparison and evaluation it was decided to use a volume to capacity ratio of greater than 1.3 as the cut – off condition.

This condition was selected because it represents a reasonable accurate measurement:

- Respecting daily, weekly and monthly variances in peak hour traffic flows;
- Accepting people's choice in using the automobile during the roadway peak hours and often the shoulders of the peak hours.

The bottom portion of Figure 9.1 summarizes by Option both the number of arterial road intersections and individual lanes which have exceeded the 1.3 threshold condition.

Upon examining the volume to capacity ratios (greater than 1.3) for overall intersection operations and each critical movement that:

Option B although tied with Option A in overall intersection level of service has the highest number of traffic lanes performing well in both roadway AM and PM peak hours;

• Optimizing the traffic timing at each traffic signal results in measurable improvements to the improvements and additions can only significantly improve performance conditions.

Dilemma Zone Vehicles and Safety

The Synchro Software program enables several measurements of effectiveness to be calculated such as delays, stops and bandwidth maximization. These measures however, do not evaluate a measure of safety.

The Synchro Software Program does provide a calculation called "Dilemma Zone Vehicles" which measures the number of vehicles arriving while the signal is turning yellow. In effect the higher the number of vehicles in the dilemma zone the more likely to have accidents.

This calculation was completed and summarized in the table below for two (2) conditions. The conditions are for existing signal times and for an optimized signal condition.

Table 2 **Dilemma Zone Vehicles** Number of Vehicles Arriving While the Signal Is Turning Yellow

	Option A	Option B	Option C	Option D
Existing Signal Timing				
Vehicles In Dilemma Zone (AM Peak Hour)	1,444	1,330	1,869	1,350
Vehicles In Dilemma Zone (PM Peak Hour)	1,721	1,610	1,714	1,708
Optimized Signal Timing				
Vehicles In Dilemma Zone (AM Peak Hour)	1,216	1,120	1,171	1,497
Vehicles In Dilemma Zone (PM Peak Hour)	1,545	1,340	1,479	1,706

Upon evaluating the Vehicle Dilemma Zone calculation it can be concluded that:

- intersection operations and the number of vehicles in the dilemma zone;
- vehicles in the dilemma zone.

peak hour peak period of operation. However, it still apparent that only physical infrastructure

• Initiating optimized traffic signal timing over the existing signal timing does materially benefit

• Option B either with existing or optimized signal timing appears to have the lowest number of

Intersection Measures of Effectiveness

As mentioned above the Synchro Software Program does provide an ability to analyze several measurements of effectiveness such as delays, distance travelled, fuel economy, etc. Using the total traffic flows, an analysis was conducted to determine the numerical values of these measures. The numerical values are calculated using the total traffic flows in the peak hour at all of the four bounding arterial road intersections.

A final Performance Index is calculated by incorporating all of the measures of effectiveness.

This analysis and final output is summarized in Figure 9.2.

Upon examining the summary Performance Index it can be concluded that:

- In the AM peak hour Option A has the best Performance Index followed by Options C, D and B;
- In the PM peak hour Options A, B and C have the best performance followed by D.

Overall Evaluation 9.7

This assessment upon examining all modes of transportation concludes that:

- The transit, bicycle and pedestrian modes of transportation can be effectively and efficiently accommodated by any of the roadway network and access patterns examined. All Options can satisfactorily accommodate these modes of transportation;
- The total traffic flows examined in 2021 including existing traffic flows, 4134 16th Avenue, cut through and diverted traffic flows secure accessibility and circulation benefits by completing a connected internal roadway network by any of the Options examined for the majority of lands contained within the concession block, however:
 - The inability to directly connect to existing mid block collector roads such as Village Parkway and Calvert Road (in the path of peak hour peak directions of travel) for any of the Options examined result in;
 - Increased through and turning vehicle movements at the Warden Avenue intersections with Major Mackenzie Drive and 16th Avenue no matter the Option examined;
- The planned improvements and additions to 16th Avenue and Kennedy Road will provide the most significant benefit to total traffic flows no matter which Option is considered.

Not with - standing the above conclusions the transportation and traffic analysis, evaluation and comparison undertaken does permit a ranking of the Options examined.

This ranking simply takes each of the analysis segments and labels then as a criterion. Each criterion is ranked between Options and each criterion carries equal weight.

The results of the ranking process are shown in Figure 9.3.

The results shown in Figure 9.3 represent the transportation / traffic assessment results.

Upon taking into account all of the analytical criteria it can be concluded that:

• Options B ranks first and is considered to the best of all Options;

The reason for this is that Option B:

- With no connection to Warden Avenue reduces that number of vehicle trips that are attracted to the heavily burdened Warden Avenue intersections, especially the intersection with 16th Avenue;
- With the two connections to Major Mackenzie Drive provides an avoidance of the Warden Avenue / 16th Avenue intersection while permitting access towards the primary directions of travel, and;
- Better distribution and balancing of total concession block vehicle trips to and from their primary directions of travel.

This transportation assessment result has been incorporated into the overall evaluation and assessment process which takes into account engineering and environmental considerations.

The Stantec Engineering and Beacon Environmental Limited analysis and evaluation indicates that the connection to Warden Avenue from 4134 16th Avenue lands cannot be supported.

Upon taking into account the findings from this transportation assessment and incorporating it with the engineering and environmental findings it is evident that Option B is recommended.

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Report Figures

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City of Toronto Arterial Road Markham Arterial Road (up to 32.5 metre right-of-way width) COLLECTOR ROADS	Б	den Ave.	4134 16th Avro	Rd	RJ
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Existing Transit connections to Major Attractors Figure 3.1 A





Modifications to Routes 8 & 18 to provide Internal Transit Access Figure 3.1 B









Local Active Transportation Setting Figure 3.3





Regional Roads - 4 lanes of traffic with exclusive turning lanes at intersections

City Roads - 4 lanes of traffic

.....

City Roads - 2 lanes of traffic

• Exiting Traffic Signal Control







Boundary Road Network and Existing Traffic Signal Control Figure 3.5





Routes to Major Highways Transit Routes and Routes to GO Station



Transportation Accessibility Figure 3.6





Not To Scale

Summary of Major Intersection Operations Existing AM & PM Peak Hour Figure 3.8

Trip Generation

Residential Yields by Blocks

ITE Trip Generation Rates - 9th Edition

Land Uses	Units	ITE Code	Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
Single Detached Residential Condominium/Townhouse Commercial Retail	Dwelling units Dwelling units 1000 sq. ft.	210 230 820	0.19 0.07 0.27	0.56 0.37 0.69	0.75 0.44 0.96	0.63 0.35 0.25	0.37 0.17 3.46	1.00 0.52 3.71

Existing Mode of Choice : - Transit 6.6% and Other (Cycling, Walk etc..)4.3% Target Transit Modal Split (FUA Study): 17% - Increase 9% or 0.5% per year from 2011 to 2031 Assuming : Transit increased 2021 - Increase 6% and assumed an increased in Other Mode 1% Forecast Mode of Transit Modal split by 2021 : 12% - Shift from Auto to Other Mode of Travel 1%

Residential Vehicle Trip Reduction Employment Vehicle Trip Reduction

13%

7%

		ITE Code	Weekday AM Peak Hour			Weekday PM Peak Hour		
Land Uses	Units							
			In	Out	Total	In	Out	Total
Vehicle Trips								
Single Detached	169	230	28	83	110	93	54	147
Medium /Townhouse	129	210	8	41	49	39	19	58
Single Detached	84	230	14	41	55	46	27	73
Medium /Townhouse	64	210	4	20	24	19	10	29
Single Detached	157	230	26	77	102	86	51	137
Medium /Townhouse	703	210	46	223	269	213	105	318
Total Westside	1306		125	485	611	496	266	762
Single Detached	148	230	24	72	97	81	48	129
Medium /Townhouse	87	210	6	28	33	26	13	39
Single Detached	257	230	42	126	168	141	83	224
Medium /Townhouse	152	210	10	48	58	46	23	69
Single Detached	53	230	9	26	35	29	17	46
Medium /Townhouse	31	210	2	10	12	9	5	14
Single Detached	212	230	35	104	138	116	68	184
Medium /Townhouse	125	210	8	40	48	38	19	57
Medium /Townhouse	174	210	11	55	67	53	26	79
Total Eastside	1239		146	509	655	540	301	840
Commercial Trips	107,600		29	74	103	27	40	67
	15% Passby		-4	-11	-15	-4	-6	-10
	10% from Neigbourhood		-3	-7	-10	-3	-4	-7
Net Commercial Vehicle Trips	-		22	55	77	20	30	50
Total (Vehicle Trips)			294	1049	1343	1056	596	1652

4134 16th Avenue Lands will generated approximately

- 1,343vehicle trips during the roadway AM peak hour;
- 1,652 vehicle trips during the roadway PM peak hour;
- roadway peak periods;
- peak periods.

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Poulos

• 120 pedestrian trips focused primarily on school, shopping and recreational purposes during each of the typical weekday

• 25 bicycle trips primarily focused on school, shopping and work purposes during each of the typical weekday roadway



Figure 5.1









Legend: 1/3 Acre Estate. Lots 60-70fl Conventional Singles 32-Soft Conventional Singles 15-Zoft Conventional Townhomes/Laneway Singles High Pensity Block Medium Density Cluster Commercial use/ Mixed use D Natural Heritage Potential Road Entry EXIsting Road Entry Entry For Ascussion Park land School (barre) Pedestrian Connection

Internal Road Network and Access Options Figure 6.1

EMME II Output 2011 AM Peak Hour (No New Road Connections)



C1 - Centroid Review

2011 Output Indicates that approximately 200 vehicles are outbound. These are trips from Existing Development.

2021 Output Indicates that approximately 496 vehicles trips are outbound (includes Subject Lands)

The difference in 2011 and 2021 outputs is 296 vehicle trips which is attributed to Subject development.



2

-80 +50 Pore A +80-50

EMME II Output 2021 AM Peak Hour (with Bur Oak Avenue Extension and Connection to 16th Avenue

The extension identifies a traffic flows of 325 vehicle trips and when combined with the identified 296 Subject Land vehicle trips results in a total of 621 vehicle trips.

2021 Volume Change (with and without Bur Oak Avenue Extension to 16th Avenue)

3



Modal Centroid

XXX

Hand Assignment of 2021 AM Peak Hour Traffic Flows

The total estimated outbound traffic flows in the 2021 roadway AM Peak Hour is 673 vehicle trips, the vehicle trips assignment are closed to Figure 7.3

- Normandale West 397
- Normandale East -177 - 203
- Yorkton
- minus (-) Existing 104

Total outbound flows to Warden Avenue and 16th Avenue is 673 vehicle trips (includes vehicles trips cut through from Village, Bur Oak Avenue and Kennedy Road)

Verifying the Internal Traffic Flows with Bur Oak Extension to 16th Avenue

Figure 7.1A
EMME II Output 2011 AM Peak Hour (No New Road Connections)



C1 - Centroid Review

2011 Output Indicates that approximately 200 vehicles are outbound. These are trips from Existing Development.

2021 Output Indicates that approximately 496 vehicles trips are outbound (includes Subject Lands)

The difference in 2011 and 2021 outputs is 296 vehicle trips which is attributed to Subject Land development.





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Hand Assignment of 2021 AM Peak Hour Traffic Flows

The total estimated outbound traffic flows in the 2021 roadway AM Peak Hour is 1,106 vehicle trips, the vehicle trips assignment are closed to Figure 7.2

- Warden Avenue - 499
- Normandale West 388
- Normandale East -177 - 176
- Yorkton
- minus (-) Existing 104

Total outbound flows to Warden Avenue and 16th Avenue is <u>1,106</u> vehicle trips

Verifying the Internal Traffic Flows with Bur Oak Extension and Connection to 16th Avenue and Connection to Warden Avenue Figure 7.1B









Levels of Service Summary

	AM Peak H	our Levels of Se	ervice - (No Optim	izaed Signal Timi	ng)	PM Peak Hour Leve	els of Servic	e - (No Optii	mizaed Sign	al Timing)
Intersection	Option A	Option B	Option C	Option D		Intersection	Option A	Option B	Option C	Option D
1: Kennedy Rd. & Bur Oak/Bur Oak Ave.	C (22) 0.75	C (22) 0.72	C (22) 0.74	C (23) 0.73		1: Kennedy Rd. & Bur Oak/Bur Oak Ave.	B (18) 0.62 ebl- 0.86	B (14) 0.56	B (18) 0.62 ebl- 0.86	B (14) 0.56
4: Kennedy Rd. & 16th Ave.	F (101) 1.08	F (101) 1.08	F (101) 1.09	F (101) 1.08						
	ebl- 0.89	ebl- 0.89	ebl- 0.89	ebl- 0.89						
	wbt- 0.92	wbt- 0.91	wbt- 0.92	wbt- 0.91		4: Kennedy Rd. & 16th Ave.	F (104) 1.27	F (104) 1.27	F (103) 1.27	F (104) 1.27
	nbl- 1.23	nbl- 1.22	nbl- 1.24	nbl- 1.21			ebt- 1.01	ebl- 0.95	ebt- 1.02	ebl- 0.95
	sbt- 1.45	sbt- 1.45	sbt- 1.45	sbt- 1.45			WDI- 1.17	ept-1	WDI- 1.17	ebt- 1
							nul- 1.02	wbl-1.17	nul- 1.0	wbl-1.17
8: Warden Ave. & 16th Ave.	F (109) 1.27	F (122) 1.44	F (101) 1.29	F (129) 1.5			sbt- 0.88	nbt- 1.39	sbt- 0.88	nbt- 1.39
	ebl- 1.36	ebl- 1.29	ebl- 1.36	ebl- 1.28			301- 0.00	sht- 0.88	301- 0.00	sht- 0.88
	wbl- 1.3	WDI- 1.68	wbl- 1.42	WDI- 1.81				351- 0.00		301- 0.00
	WDt- 1.05	WDT- 1.14	WDt- 1.07	WDt- 1.18		8: Warden Ave. & 16th Ave.	F (133) 1.39	F (130) 1.27	F (118) 1.22	F (141) 1.34
	nbi- 1.07	nbl- 1.07	nbl- 1.07	nbl- 1.07			ebl- 1.6	ebt- 1.43	ebl- 1,37	ebl- 0.86
	SDI- 1.4	SDI- 1.20	SDI- 1.20	SDI- 1.20			ebt- 1.32	wbl- 1.45	ebt- 1.34	ebt- 1.48
							wbl- 1.16	nbt- 1.21	wbl- 1.16	wbl- 1.54
11: Warden Ave. & Major Mackenzie Dr.	F (104) 1 73	F (102) 1 22	F (161) 2 58	F (96) 1 38			nbt- 1.33	nbr- 0.85	nbt- 1.21	nbt- 1.18
	ebl- 0.97	ebl- 0.97	ebl- 0.97	ebl- 0.97						
	wbl- 0.98	wbl- 1.3	wbl- 0.94	wbl- 1 21		11: Warden Ave. & Major Mackenzie Dr.	F (89) 1.19	F (103) 1.4	E (79) 1.21	F (91) 1.3
	wbt- 1.21	wbt- 1.27	wbt- 1.12	wbt- 1.22			ebl- 1.21	ebl- 1.37	ebl- 1.03	ebl- 1.24
	nbl- 2.52	sbt- 1.1	nbl- 4.78	nbl- 1.62			ebt- 1.28	ebt- 1.36	ebt- 1.18	ebt- 1.3
	sbt- 1.1	0.01	sbt- 1.1	sbt- 1.1			nbl- 1.11	nbt- 0.92	nbl- 1.45	nbl- 0.96
							nbt- 0.93	sbl- 1.44	nbt- 0.93	nbt- 0.93
							sbl- 1.06		sbl- 1.06	sbl- 1.25
14: Kennedy Rd. & Major Mackenzie Dr.	E (79) 1.1	E (78) 1.08	E (78) 1.08	E (77) 1.06						
	wbt- 1.17	wbt- 1.17	wbt- 1.17	wbt- 1.17		14: Kennedy Rd. & Major Mackenzie Dr.	E (72) 1.05	E (72) 1.05	E (72) 1.05	E (72) 1.04
	nbl- 1.13	nbl- 1.08	nbl- 1.08	nbl- 1.04			ebt- 1.21	ebt- 1.21	ebt- 1.21	ebt- 1.21
	sbt- 1.07	sbt- 1.07	sbt- 1.07	sbt- 1.07			ndi- 1.02	ndi- 0.99	0.99 -Ian	ndi- 0.97
					l					
No. of Intersection with	3	1	2	2		No. of Intersection with $V/C > 1.3$	1	1	0	0
V/C > 1.3	Ū		_	_		V/O / 1.5				
	-		_	_		No of Movements with	5	7	5	5
No of Movements with	5	4	5	5		V/C >1.3	0			
V/C >1.3										



15.208 Base T2 May 2016

V/C Greater than 1.3

Summary of 2021 Intersection Levels of Service AM and PM Peak Hour (Existing Signal Timing - No Optimization) Figure 8.1





















See Change in Volumes between Option In Figure 8.4





15.208 Base T1 April 2016

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Arterial Levels of Service (Synchro Output)

	Signal Delays				Travel Times				
AM - Arterial LOS	Option A	Option B	Option C	Option D		Option A	Option B	Option C	Option D
16th Avenue (Peak Direction WB)	150	194	161	211		311	355	322	372
Major Mack Dr. (Peak Direction WB)	304	370	271	356		447	513	414	479
Warden Ave. (Peak Direction SB)	318	257	268	248		472	412	423	403
Kennedy Rd. (Peak Direction SB)	353	354	354	353		520	520	520	520
		Signal	Delays			Travel Times			
PM - Arterial LOS	Option A	Option B	Option C	Option D		Option A	Option B	Option C	Option D
16th Avenue (Peak Direction EB)	418	482	430	548		580	643	591	709
Major Mack Dr. (Peak Direction EB)	322	357	277	331		463	499	419	472
Warden Ave. (Peak Direction NB)	323	203	275	300		475	354	427	452
Kennedy Rd. (Peak Direction NB)	262	260	262	259		414	412	414	411

Results Compared to Option A

		Signa	Delays			Travel
	Ratio Opt A/A	Ratio Opt B/A	Ratio Opt C/A	Ratio Opt D/A	Ratio Opt A/A	Ratio Opt B/A
16th Avenue (Peak Direction WB)	100%	129%	107%	141%	100%	114%
Major Mack Dr. (Peak Direction WB)	100%	122%	89%	117%	100%	115%
Warden Ave. (Peak Direction SB)	100%	81%	84%	78%	100%	87%
Kennedy Rd. (Peak Direction SB)	100%	100%	100%	100%	100%	100%
		Signa	Delays		Trave	
	Ratio Opt					
	A/A	B/A	C/A	D/A	A/A	B/A
16th Avenue (Peak Direction EB)	100%	115%	103%	131%	100%	111%
Major Mack Dr. (Peak Direction EB)	100%	111%	86%	103%	100%	108%
Warden Ave. (Peak Direction NB)	100%	63%	85%	93%	100%	75%
Kennedy Rd. (Peak Direction NB)	100%	99%	100%	99%	100%	100%

Assessment

No Significant Change on Kennedy Road

Less Delays and travel time on the East Road 16th Avenue and Major Mackenzie Drive but longer Delays and travel time on Warden Avenue north of 16th Avenue

Comparison to Option A Signal Delays and Travel Time











Arterial Levels of Service- Signal Delays and Travel Time Figure 8.5

16th Land Holdings Inc. 4134 16th Avenue Land Internal Network Assessment



	2021 AM	Queue Ler	ngth (in met	res)
	Option A	Option B	Option C	Option D
EB	103	103	103	106
WB	319	361	327	377
NB	55	52	55	51
SB	320	285	283	275
EB	97	101	90	97
WB	357	384	320	360
NB	35	32	35	33
SB	217	216	217	215
EB	101	101	101	100
WB	330	330	330	328
NB	41	41	41	41
SB	177	177	177	177
EB	94	94	97	94
WB	220	217	221	215
NB	87	87	87	87
SB	319	319	319	318

95th Percentile Volumes exceeds capacity , queue may be longer -Queue shown is maximum after 2 cycles.

> 2021 95th Queue Length (in Metres) AM Peak Hour Figure 8.6

16th Land Holdings Inc. 4134 16th Avenue Land Internal Network Assessment



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Option B

Option C Option D

	2021 PM C	Jueue Leng	th (in metr	es)
	Option A	Option B	Option C	Option D
EB	360	402	367	419
WB	143	143	141	130
NB	299	263	263	253
SB	77	69	77	67
EB	365	396	321	368
WB	107	115	94	107
NB	175	171	175	171
SB	63	59	63	61
EB	327	327	327	326
WB	90	90	90	89
NB	81	81	81	81
SB	66	66	66	66
EB	294	290	297	288
WB	123	123	126	123
NB	300	300	300	299
SB	152	152	152	148

95th Percentile Volumes exceeds capacity , queue may be longer -Queue shown is maximum after 2 cycles.

> 2021 95th Queue Length (in Metres) PM Peak Hour Figure 8.7

	AM Peak	Hour Levels of S	Service - (Optimiz	aed Signal Timing)	PM Peak Hour	Levels of Servi	ice - (Optimi	izaed Signal	Timing)
Intersection	Option A	Option B	Option C	Option D	Intersection	Option A	Option B	Option C	Option D
1: Kennedy Rd. & Bur Oak/Bur Oak Ave.	B (18) 0.72	B (17) 0.7	B (18) 0.71	B (20) 0.7	1: Kennedy Rd. & Bur Oak/Bur Oak Ave.	B (17) 0.62 ebl- 0.92	B (12) 0.53	B (17) 0.61 ebl- 0.92	B (15) 0.53
4: Kennedy Rd. & 16th Ave.	E (69) 1.21 ebl- 1 12	E (69) 1.22 ebl- 1 12	E (69) 1.21 ebl- 1 12	E (69) 1.22 ebl- 1 12	4 [.] Kennedy Rd & 16th Ave	F (81) 1 07	F (81) 1 1	F (81) 1 08	F (81) 1 1
	wbt- 1.11	wbt- 1.13	wbt- 1.12	wbt- 1.13		ebl- 0.85	ebt- 1.17	ebl- 0.87	ebt- 1.17
	nbl- 1.37	nbl- 1.37	nbl- 1.37	nbl- 1.37		ebt- 1.18	wbl- 1.19	ebt- 1.19	wbl- 1.19
	sbt- 1.06	sbt- 1.04	sbt- 1.06	sbt- 1.04		wbl- 1.19	wbt- 0.86	wbl- 1.19	wbt- 0.88
8: Warden Ave. & 16th Ave.	F (96) 1.29	F (104) 1.29	F (92) 1.29	F (112) 1.38		nbt- 1.14	nbt- 1.14	nbt- 1.14	nbt- 1.14
	ebl- 1.36	ebl- 1.29	ebl- 1.36	ebl- 1.28					
	wbl- 1.39	wbl- 1.41	wbl- 1.42	wbl- 1.59	8: Warden Ave. & 16th Ave.	F (111) 1.17	F (123) 1.18	F (100) 1.16	F (161) 1.39
	wbt- 1.09	wbt- 1.14	wbt- 1.07	wbt- 1.18		ebl- 1.02	ebt- 1.34	ebl- 0.9	ebt- 1.54 wbl- 1 14
	nbl- 1.07	nbl- 1.07 sht- 1.28	ndi- 1.07 sht- 1.28	nbi- 1.07 sht- 1.26		wbl- 1.39	nbl- 1.06	wbl- 1.39	nbl- 0.95
	351 1.00	351 1.20	351 1.20	351 1.20		wbt- 0.92	nbt- 1.26	nbt- 1.21	nbt- 1.41
11: Warden Ave. & Major Mackenzie Dr.	F (119) 1.21	F (87) 1.17	F (128) 1.31	F (119 1.23		nbt- 1.27	sbl- 1.10	sbl- 1	sbl- 0.96
	ebl- 1.16	ebl- 1.16	ebl- 1.24	ebl- 1.24		sbl- 1			
	wbl- 1.2	wbl- 1.15 wbt_1.17	wbl- 1.20 wbt_1.24	wbl- 1.22	11: Warden Ave. & Major Mackenzie Dr.	E (79) 1.08	F (98) 1.12	E (72) 1.15	F (96) 1.31
	nbl- 1.18	nbl- 0.9	nbl- 1.49	nbl- 1.21	,	ebl- 0.85	ebl- 0.99	ebl- 1	ebl- 0.99
	sbt- 1.27	sbt- 1.17	sbt- 1.27			ebt- 1.17	ebt- 1.22	ebt- 1.11	ebt- 1.32
						nbl- 1.14	wbl- 0.98	wbl- 0.85	wbl- 1.03
14: Kennedy Rd. & Major Mackenzie Dr.	E (73) 1.14	E (71) 1.11	E (70) 1.11	E (66) 1.09		sbl- 1.2	sbl- 0.87	nbt- 0.94	sbl- 1.22
	wbt- 1.08	wpt- 1.08 nbl- 1.27	wbt- 1.08 nbl- 1.27	nbl- 1.08				sbl- 1.2	
	sbt- 1.11	sbt- 1.11	sbt- 1.11	sbt- 1.11					- //-> / - /
					14: Kennedy Rd. & Major Mackenzie Dr.	D (54) 1.06	D (53) 1.05	D (53) 1.05	D (48) 1.04
						nbl- 1.15	wbl- 0.9	wbl- 0.9	wbl- 0.9
No. of Intersection with V/C > 1.3	0	0	1	1			nbl- 1.12	nbl- 1.12	nbl- 1.1
No of Movements with V/C >1.3	4	2	4	2	No. of Intersection with V/C > 1.3	0	0	1	2
					No of Movements with V/C >1.3	1	2	2	3

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SB,WB,NB,EB ; Southbound, Westbound, Northbound and Eastbound F(20) 0.89 : Level of Service, (vehicle Delays in Seconds) Volume/ Capacity Ratio

V/C Greater than 1.3

Summary of 2021 Intersection Levels of Service AM and PM Peak Hour (Optimum Signal Timing) Figure 9.1

	Detailed Mea	sures of Effect	tiveness	
		Synchro	Output	
		Synchro		
AM Peak Hour	Option A	Option B	Option C	Option D
Total Delay (hr.)	1238	1384	1319	1351
Stop (#)	29497	28768	29632	28825
Average Speed (km/hr.)	16	15	16	16
Total Travel Time (hr.)	1685	1830	1771	1804
Distance Traveled (km)	27977	27742	27930	28195
Fuel Consumption (I)	6847	7236	7098	7182
Fue Economy(I)	4	3.8	3.9	3.9
CO Emission (km/l)	127.35	134.59	132.02	133.59
Nox Emission (kg)	24.58	25.98	25.48	25.78
VOC Emission (kg)	29.37	31.04	30.45	30.81
Vehicle in dilemma Zone	1444	1330	1869	1350
Performance Index	1319.8	1464.1	1401.3	1430.7
		Synchro	Output	
PM Peak Hour	Option A	Option B	Option C	Option D
Total Delay (hr.)	826	838	819	955
Stop/veh	0.59	0.59	0.59	0.59
Stop (#)	31053	30260	31116	31452
Fuel Consumption (I)	5787	5776	5797	6220
Fue Economy(I)	4.9	4.8	4.9	4.6
CO Emission (km/l)	107.64	107.44	107.83	115.7
Nox Emission (kg)	20.78	20.74	20.81	22.33
VOC Emission (kg)	24.83	24.78	24.87	26.69
Vehicle in dilemma Zone	1721	1610	1714	1708
Performance Index	912.7	921.6	905.3	1042.2

Performance Index

is the total balanced accumulation of the respective measures. It is an attempt to produce an overall performance index for the total traffic flows using all of the bounding arterial road intersections. The lower the index is the better the performance of the network.

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Detailed Measure of Effectiveness Figure 9.2

Evaluation Criteria	Figure No.	Option A	Option B	Option C	Option D
TRANSPORTATION					
Overall AM Intersection and Critical Movement with V/C > 1.3 (Existing Signal Phasing) ¹	8.1	4	1	2	2
Overall PM Intersection and Critical Movement with V/C > 1.3 (Existing Signal Phasing) ¹	8.1	3	4	1	1
Total Signal Delays on 4 Boundary Road (AM)	8.5	3	2	1	4
Total Signal Delays on 4 Boundary Road (PM)	8.5	3	2	1	4
Total Travel Time on 4 Boundary Road(AM)	8.5	2	4	1	3
Total Travel Time on 4 Boundary Road(PM)	8.5	3	2	1	4
Total Queue Length (AM) ¹	8.6	1	2	4	3
Total Queue Length (PM) 1	8.6	3	4	2	1
Performance Index (AM)	Figure 9.3	1	4	2	3
Performance Index (PM)	Figure 9.3	2	3	1	4
Overall AM Intersection and Critical Movement with V/C > 1.3 (Optimized Signal Phasing) ¹	9.1	3	1	4	2
OverallPM Intersection and Critical Movement with V/C > 1.3 (Optimized Signal Phasing) ¹	9.1	1	2	3	4
<u> </u>					

			i	1	1
Evaluation Criteria	Figure No.	Option A	Option B	Option C	Option D
TRANSPORTATION (Continued)					
Dilemma Zone Vehicle (AM - Existing Signal)	Table 2	3	1	4	2
Dilemma Zone Vehicle (PM - Existing Signal)	Table 2	4	1	3	2
Dilemma Zone Vehicle (AM - Optimum)	Table 2	3	1	4	2
Dilemma Zone Vehicle (AM - Existing Signal)	Table 2	3	1	2	4
Dilemma Zone Vehicle (PM - Existing Signal)	Table 2	3	1	2	4
Overall Score (Lower Value - the Better)		45	36	38	49
Overall		3	1	2	4



Ranking

1 ----- 4

Best

Worst

Evaluation of Options Figure 9.3

Appendix A Terms of Reference



Terms of Reference for a Master Environmental Servicing Plan (MESP) For York Downs

March 2016

Preamble

The following provides an overview of the City of Markham's Submission Requirements for Master Environmental Servicing Plans (MESP's). The MESP is to be prepared in support of Secondary Plans for specific development areas, and is to be completed in conformance with the requirements outlined in the City's Official Plan. These submission requirements are intended to be generic and summarize the information requirements for an MESP completed anywhere within the City of Markham. Nevertheless, it is recognized that the submission requirements may be tailored to be specific to the available information and/or guidance from higher level studies (such as the Subwatershed Study for the City's Future Urban Area).

In circumstances where a Subwatershed Study (for instance) precedes a Secondary Plan and MESP process, some of the data/analyses listed herein may not require new work or it may be appropriate to build upon the technical analyses and assessments conducted in the primary or parent studies, subject to scope concurrence with the City and its partners. References in the table below to the need to refine SWS recommendations are intended to apply to circumstances where refinement may be needed if there are substantive differences in land use assumptions between the MESP and the SWS and/or legislative requirements, policies or engineering standards that have arisen since the completion of the SWS (e.g. Species At Risk (SAR), Climate Change, etc.).

These Submission Requirements summarize only the information and content which is required for an MESP. Further details of the scope of work required for MESP's (i.e. analytical tools and methodology, monitoring, field investigations, mapping and reporting formats and requirements, etc.) are to be defined in the Terms of Reference for each specific MESP. Development proponents are required to consult with the City of Markham and the City's Study Partners (e.g., TRCA, MNRF, Region of York, adjacent municipalities, as appropriate) to establish and prepare the Terms of Reference for each MESP, prior to initiation.

Required Components	Study Team Work Plan Sumr
Executive Summary	Executive Summary
The Executive Summary shall include the following:	To be implemented as noted.
• Integrated summary of the work completed and conclusions of the individual sections	
• Identification of inter-relationship between the various sections	
• Concise summary of the significance and implications of the findings of the MESP	
• Summary of the overall conclusions reached	
	Required Components Executive Summary The Executive Summary shall include the following: • Integrated summary of the work completed and conclusions of the individual sections • Identification of inter-relationship between the various sections • Concise summary of the significance and implications of the findings of the MESP • Summary of the overall conclusions reached

mary

	Introduction	Introduction
	The MESP shall include the following, subject to consultation with City and Study Partners:	Define Study Area
	• Purpose of the MESP including its relationship to the Subwatershed Study, where applicable, and other relevant Studies, and its relationship to neighbouring lands in terms of servicing, transportation etc.; Terms of Reference for the MESP are to include a section clearly outlining the purpose and requirements of the MESP	• Highlight project purpose
	• Relevant information from Subwatershed Studies or other relevant studies which addresses the submission requirements of the MESP	 Summarize existing topo; Illustrate existing surface
	• Study area location, attributes, descriptions, figures and boundaries, including rationale for determination of study extent	features
	• Setting (existing land use, natural features, etc.)	• Provide ownership & par
	• Study objectives; the MESP is to:	
	o be completed in support of proposed land development within the corresponding Secondary Planning Area	Summarize pre-consultat
	 be completed to advance detail and be consistent with the recommendations from the governing Subwatershed Study and Watershed Plan, as applicable 	• Identify previous and con
	 describe and evaluate opportunities and constraints and conceptual mitigation related to the hierarchy of protection, enhancement, or if required, compensation, for the natural heritage resources within the study area; to evaluate these resources in terms of opportunities and constraints for the management of the natural heritage resources in the context of the development, specifically to determine the potential implications to the natural heritage resources and natural hazards 	
2.	 outline site design or management techniques that may be required to mitigate, enhance or compensate for the potential adverse effects to the natural heritage resources 	
	 provide sufficient level of site investigation, servicing investigation and conceptual design, in recognition of potential access restrictions to some locations, to ensure that significant natural heritage resources and their functions are protected and to build upon the natural heritage strategy and services provided in the governing studies, where applicable, as part of the completion of the MESP 	
	o identify opportunities to reduce servicing and transportation crossings of the Greenway System	
	[Note: more detailed investigations will be required in support of individual development applications; however, those study requirements will be appropriately scoped as a result of this investigation.]	
	Scope Outline	
	• Study team that include an inter-disciplinary team with expertise including but not limited to environmental, hydrogeological/geotechnical, engineering, planning and public consultation and transportation.	
	• Maps depicting land ownership and participation in the study	
	Report structure outline	
	Technical Work Plan and schedule	
	• Summary of pre-consultation with City, TRCA, MNRF, Region of York, and others as required regarding scope; pre- consultation to include review of existing relevant studies (e.g. transportation studies, approved watershed, subwatershed, drainage studies, fisheries management plans, best management practices guides, natural heritage systems planning guides, flood and stormwater management studies, etc.)	

e, location and context and study team

ography

e drainage patterns and key drainage

rticipation map

tion

ncurrent studies

		
	Planning and Environmental Policy Context	Planning and Environmental Policy Context
	• Define applicable Federal, Provincial, Regional, TRCA and Municipal planning and environmental policies including existing 1987 City of Markham Official Plan and City of Markham 2014 Official Plan (as partially approved on October 30, 2015) in entirety and as related to topic areas listed in Section 4	
3.	• Reference existing relevant studies (e.g. approved watershed, subwatershed, drainage studies, fisheries management plans, best management practices guides, natural heritage systems planning guides, flood and stormwater management studies, urban design studies, transportation studies, trail studies, etc.) which represent the parent studies and governing documents for the MESP. Identify, list and summarize applicable sections of each document as they relate to the MESP	
	• Define requirements for compliance with the Subwatershed and other applicable studies	
	Characterization of Existing Conditions: Constraints and Opportunities	Characterization of <u>Existing</u> Conditions: Constraints and Opportunities
	The MESP will include assessment/identification (as applicable) of constraints and opportunities to the Greenway System related to:	Physiography
	Pre-development monitoring of adequate duration established consultatively with City staff and Study Partners	
	 Minimum 3 years for watercourses, features (wetlands) and PPT gauge (we will discuss this further on Wednesday – As discussed and agreed on, this should not have any impacts on approval of the Draft Plan of the subdivision) 	Surface Water Resources
	Physiography	• Obtain available hydraulics modeling, review and update with
	• Physiography, topography and geology	downstream risk areas.
	• Surficial soils description and location mapping	
	Surface Water Resources	• Provide updated existing land use floodplain mapping based on revised modeling
	• Surface water hydrology and hydraulics including:	Tevised modeling
	• Existing land use drainage conditions (boundaries and patterns)	Illustrate existing surface drainage patterns and key drainage footures
	 Existing land use hydrologic modelling 	leatures
4.	• Existing land use floodplain mapping (supported with hydraulic modelling)	• Obtain available hydrology modeling and review and update
	 Flood hazards within downstream risk areas 	with existing land use information and topography
	 Water budget for existing conditions, based upon water balance for surface water with input from the groundwater component 	
	• Surface water quality including:	
	 Documentation of water quality monitoring findings for area watercourses 	
	 Outline of recommendations from Stormwater Management Retrofit Study/Plan including specifically any retrofit and restoration opportunities 	

 Identify features and provide information on how each feature is fed within their catchment areas; Prepare stage/storage/discharge information for storage based features using survey and monitoring data:
• Prepare stage/storage/discharge information for storage based features using survey and monitoring data:
• Prepare and calibrate hydrologic/hydrogelogic modeling or calculations using monitoring data;
• Provide discussion on features, including how each fed (groundwater/surface water), hydroperiod, and expected timing to return to "normal" conditions;
Groundwater Resources
 Hydrogeological investigations including:
o groundwater levels, flow direction and gradients
• Aquifer locations and vulnerability
 Groundwater recharge and discharge zones
 Baseflow contribution to wetlands and watercourses
• Major groundwater users in the area from MOECC water well and water taking permits and other relevant information
• Water budget for existing conditions, based upon water balance for groundwater with input from the surface water component
 Annual infiltration with input from field tests related hydraulic conductivity and infiltration rates Refining/defining targets for overall water balance and local groundwater recharge as necessary based on scale of assessment and extent of guidance provided by higher level studies (to ensure the sustainability of wetlands, woodlands, etc. and to manage runoff)
• Source Water Protection
• Wellhead Protection Area – Quantity
• Wellhead Protection Areas – A, B, C, and D
• Groundwater Vulnerability – 8 and 10
 Significant Groundwater Recharge Areas
 Ecologically Significant Groundwater Recharge Areas
 Surface Water Intake Protection Zones



Fluvial Geomorphology

- Existing land use fluvial geomorphologic conditions including:
- Reach delineation
- Rapid assessments
- Detailed geomorphic field assessment
- o Erosion hazard delineation, including erosion hazard within downstream risk areas
- Meander belt width assessments for major tributaries throughout the study area, using approved assessment protocols
- o Meander belt width delineation in support of Redside Dace habitat limits, where present in consultation with MNRF
- Erosion threshold determination

Aquatic Resources

- Habitat conditions assessment including:
- o headwater drainage feature assessment based on TRCA's guidelines.
- Water quality including oxygen, Total Suspended Solids (TSS), etc.
- Physical conditions including channel form, in-stream cover, spawning habitat, refuge habitat, riparian cover, etc.
- Fisheries community composition and significant/sensitive species including aquatic species or communities that have designations under the Endangered Species Act or the Species At Risk Act
- Benthics (where appropriate)



Т	errestrial and Wetland Resources	
0	Vegetation community description and floral inventories including:	
0	Ecosystem context	
0	Community description (acceptable methods should be clarified)	
0	Natural heritage features	
0	Significant communities and species including local, Regional, Provincial significant woodlots and communities of conservation concern as per TRCA rankings	
0	Build upon findings from Subwatershed Studies regarding provincially significant wetlands and candidate provincially significant wetlands. Wetland evaluation should be undertaken if not already complete or part of Subwatershed study.	
0	Preliminary functional connections (i.e. linkages)	
0	Setbacks and vegetation protection zones (i.e. buffers). Programming allowed in buffers should be clarified in the MESP (ie. Trails, LID's, etc.)	
0	Wildlife and related habitat assessment including:	
0	Habitat conditions and species. Acceptable methods should be clarified for birds, amphibians/reptiles and mammals.	
0	Significant Wildlife Habitat	
0	Significant species including local, Regional, Provincial significant species, communities of conservation concern as per TRCA rankings, and species or communities that have designations under the Endangered Species Act or the Species At Risk Act	
0	Connectivity	
0	Hydrologically sensitive features and key hydrologic features	
0	Natural features' dependencies on surface water and/or groundwater based upon features-based water balance. Acceptable methods should be clarified.	



Greenway System and Hazard Lands (Further changes will be provided by the City in accordance to the new OP)
 Integrated characterization of how the existing Greenway System is interconnected, including groundwater, surface water, wetlands, woodlands, and other natural heritage features
 Complete mapping of Greenway System boundary, including opportunities and constraints, consisting of the following:
• Long term slope stability limits, where applicable
• Erosion and flood hazard lands
 Locations of significant groundwater recharge areas (SGRA's) and ecologically significant groundwater recharge areas (EGRA's)
• Headwater drainage features requiring protection or conservation as per the Headwater Drainage Features Assessment
 Greenbelt and Oak Ridges Moraine Boundaries
 Rouge Watershed Protection Area Boundary (as appropriate)
• Key natural heritage features
• Key hydrologic features
• Valleylands (timing of staking exercise should be clarified)
• Woodlands (acceptable evaluation methods should be clarified. Timing of staking exercise should be clarified)
• Wetlands (timing of staking exercise should be clarified for entire site)
• Vegetation protection zones
 Natural heritage enhancement and compensation lands
 Naturalized stormwater management facilities (where appropriate)
• Significant topographic features



	Proposed Dev	elopment Plan and Municipal Servicing	
	Note: The timi Framework de	ing of this section of the MESP coincides with the timing of the Community Design Plan and Sustainability evelopment.	
	The MESP wil	ll include:	
	0	Summary description of development, including proposed development areas, types of development, and maps	
	0	Study area ownership	
	0	Summary description of proposed future Greenway System, including complementary land uses, enhancements, buffers, limits, and dimensions in relation to the existing NHS as characterized in Section 4	
	0	Stormwater Management (SWM) servicing including:	
	0	Functional stormwater and environmental management plan and associated hydrologic modelling (pre and post development) complete with boundaries as required	
	0	Updated hydrologic analysis and verification that stormwater management plan addresses criteria and requirements of Subwatershed Study and other parent documents as appropriate	
	0	Post development water budget to inform stormwater management plan for water quality, quantity, infiltration, groundwater and erosion control	
	0	Refine infiltration targets (for each landowner to meet) based on post development infiltration deficit (particularly in potentially significant recharge areas) based upon refined land uses and other technical information	
5.	0	Refine stormwater runoff control rates and/or design targets based upon refined land uses and other technical information	
	0	Hydraulic analysis – major infrastructure (floodplain, culverts, other crossings etc.)	
	0	Apply fluvial geomorphology recommendations for the design of open watercourses including: meander belt, erosion thresholds etc.	
	0	Outline best management practices/stormwater management recommendations/alternatives	
	0	Size and site general footpint of proposed stormwater management facilities and outfalls; where required, complete site visits with relevant agencies to review stormwater management facility/outfall locations	
	0	Delineate future land use catchment area boundaries	
	0	Delineate major and minor drainage systems	
	0	Preliminary grading plans/facility design elements, including preliminary storage-discharge relationships for stormwater management facilities	
	0	Screening and assessment of long list of low impact development (LID) techniques to be considered at detailed design stage including assessment of function and feasibility based upon proposed conditions	
	0	Complete review of alternatives for Regulatory Event management and recommend preferred management strategy, We are more interested in developments impact on flood levels (not peak flows) within sensitive areas such as SPAs?	
	0	Integrate stormwater management plan requirements with future specific water budget analysis to identify appropriate mitigation measures to manage runoff volumes to specific features	
	0	Consultation summary with MNRF to address implications on aquatic SAR (i.g. Redside Dace)	



Feature Based Water Balance

Proposed Conditions

o Analysis of proposed conditions unmitigated modeling or calculations, including impact to hydroperiod of features

Water supply servicing including:

- Existing infrastructure
- Availability of external services
- Expected population and demands
- o Future Population (Ultimate Scenario) within the catchment area in accordance with the current Official Plan (OP)
- o Identification of proposed/permitted connection points to existing water supply systems
- Pressure districts
- o Design criteria (average, daily, hourly, fire demand, pressure, and pipe roughness)
- o Proposed infrastructure and servicing plan
- Water distribution modelling and pressures during maximum day, peak hour, minimum hour and maximum day plus fire conditions
- Servicing constraints (Regional and Municipal scale), expansion, and upgrade requirements to support the proposed development
- Internal servicing constraints

Wastewater/sanitary servicing including:

- Existing infrastructure
- o Identification of proposed/permitted connection points to existing wastewater servicing systems
- o Existing service areas and flows
- o Design criteria (generation rates and infiltration contribution) for growth
- o Proposed infrastructure and servicing plan
- o Expected population and wastewater generation
- o Future Population (Ultimate Scenario) within the catchment area in accordance with the current OP
- Expected sanitary flow from the proposed and future developments within the area
- o Prepare and implement monitoring plan at key locations as required
- o Wastewater servicing model inclusive of existing and proposed service areas
- Servicing constraints (Regional and Municipal scale), expansion, and upgrade requirements to support the proposed development



Prelim	ninary site grading including:
0	Existing grading including existing topography and general grading/sloping direction(s) of site, location of high and low areas
0	Grading criteria including consideration of positive drainage of sewers and overland flow by gravity to receiving systems; ensure acceptable grading of site and roads
0	Proposed grading including proposed preliminary grading concept plan, location of future high and low areas, grading constraints in relation to existing and proposed servicing infrastructure and environmental/ecological features, potential requirements for cut/fill, consideration of existing and future grades of surrounding areas outside of TRCA buffers, interface with natural heritage and hydrological features
0	High level recommendations and principles to be applied for site management and phasing, related to minimizing erosion and sediment discharge to receiving watercourses during construction, consistent with City Engineering Standards
Conce	ptual natural channel design (if required) for relocated watercourses including:
0	Base mapping
0	Design criteria (hydrology, hydraulics, channel dimensions, terrestrial and aquatic habitat)
ο	Geomorphic field assessment
0	Design constraints
0	Corridor requirements (flood conveyance, erosion hazard limits, aquatic habitat, terrestrial habitat)
0	Fish habitat impacts and mitigation, enhancement or if appropriate, compensation opportunities
0	Design concepts (plan view, profile, typical sections, etc.)
0	Barrier removal opportunities
0	Consultation summary with MNRF where Redside Dace (and/or other species at risk) habitats may be affected
Road o Bas cyc	crossing, cycling and pedestrian bridge crossing, and trail system conceptual designs sed on Subwatershed Study recommendations (where available), complete conceptual design of road crossings, cling and pedestrian bridge crossing, and trail system including consideration of requirements related to hydraulics, vial geomorphology and wildlife passage



Transportation	
The MESP at minimum will include:	
 Introduction Study assumptions Rationale and location of crossings as related to the Greenway System Intersection operation methodology Verification of crossing role and function Transportation Association of Canada crossing vehicle capacities 	
 Existing Conditions Site and area description Study area road network (including transit, bike and pedestrian) Transit service Existing traffic volumes Existing traffic intersection operations 	
 Future background traffic conditions Planned network improvements Traffic growth Other area developments Background traffic volumes Background traffic intersection operations 	Utilize City of Markham and Yoı traffic flows
 Proposed development Development statistics Vehicular trip generation Non-auto trip generation Trip distribution and assignment 	Determine development travel de transportation
 Total traffic conditions Total traffic volumes Total traffic intersection operations Assesment, comparison and evaluation of alternative road networks Transportation demand management Recommended transportation network Road classification Non-auto facilities (Including transit, bike and pedestrian) Future transit service Right of way 	Compare and evaluate performan network / connection pattern With input form all disciplines ev internal / connection roadway net
Cross sections	

ork Region horizon year background emands and assess each key mode or nce of each alternative internal roadway valuate all options and select preferred twork.

	Phasing	
	The MESP will include:	
7	Construction phasing and staging	
	Mobility connectivity - internal and external	
	• Requirements for interim stormwater and environmental management and servicing, and associated recommendations	
	Potential Development Impacts and Proposed Mitigation/Enhancements	
	The MESP will include:	
	Assessment of impacts on surface and groundwater resources	
	• Development footprint and site grading	
	 Assessment of the impacts of the development on the surface water and groundwater systems and any mitigation measures required prior to construction 	
	 Define impacts of buried services and roads 	
	• List mitigation and enhancement techniques to achieve subwatershed study recommendations (as available)	
	• Recommend list of acceptable LID techniques to maintain water budget, based upon long list of general mitigation techniques previously advanced (see Section 5); final LID and Best Management Practices (BMPs) to be established at the detailed design stage. Provide target information values for landowners.	
	• Apply and advance the recommendations from the Subwatershed Study (as available) related to headwater drainage features completed as part of the subwatershed studies or related studies as available. The MESP shall recommend management scenarios for each feature based on established protocols and management scenarios in the subwatershed studies (as available)	
8	• Characterization of groundwater quality where potential exists for development to alter conditions (e.g., individual septic systems)	
	• Characterization of groundwater quantity where potential exists for development to alter conditions (e.g., impervious surfaces and recharge reduction)	
	• Mitigation measures to match pre-development water balance conditions for features including hydrologic model or calculations and hydroperiod, including peak flows, volume, and hydrologic timing on feature.	
	Assessment of impacts on natural vegetation communities including enhancement and compensation where applicable	
	• Assess impact on fish and wildlife habitat and recommend suitable mitigation, enhancement, and compensation measures where applicable	
	• Apply and advance the recommendations from the Subwatershed Study (as available) related to Greenway System corridors/linkages	
	• Apply and advance the recommendations from the subwatershed study (as available) related to channel protection, buffers and/or setback delineation in accordance with criteria established in the current Official Plan and related Official Plan Amendments (OPAs)	
	• Identify enhancement and compensation requirements based on recommendations from higher level studies	
	• Complete a feature specific water budget analyses and identify mitigation, enhancement and compensation measures as applicable	
	Assess impacts to, and identify protection, enhancement and compensation approaches as applicable for the management	



	of species at risk based on the federal Species At Risk Act (SARA) and/or the Provincial Endangered Species Act (ESA)	
	• Description of how the recommended watercourse and stormwater management strategy and Greenway System address requirements of higher level studies	
	• Integrated assessment of impacts to interconnection between the existing Greenway System with groundwater, surface water, wetlands, woodlands, and other natural heritage featuresSummarize impacts on the natural environment and natural processes to protect, enhance or if appropriate, compensate, the natural environment and natural processes from the impacts of development	
	General and Public Consultation	
	The MESP will:	
10	• Outline how all consultation requirements have been met for the Planning Act and the Municipal Class EA for the first two phases in the Planning and Design Process of the Class EA for all major road, water and wastewater projects at a minimum, where applicable	
	Include appropriate consultation within the context of the Planning Process	
L		



	Monitoring	-
	Monitoring requirements must be included in the MESP in accordance with Subwatershed Study and/or other higher level documentation recommendations, where applicable. This may include:	
	Terrestrial and aquatic system	
	Creek system	
11	Groundwater system	
	Stormwater management/water quality and quantity	
	Sediment and erosion control	
	Water balance to natural features	
	During construction and post-construction monitoring activities	
12	Future Study Requirements (Draft plan stage, detailed design stage, etc.)	
12	Native soil preservation	
13	Conclusions/Recommendations	

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Appendix B Model Calibration

16th Land Holdings Inc. 4134 16th Avenue Land Internal Network Assessment



YDL Site Area Development in-corporated in the Assessment

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Markham Population and Employment Figure B1



Existing Transit Modal Split (Including GO): 6.6% Other Mode of Travel (Walk & Cycle): 4.3% Target Transit Modal Split by 2031 (based on FUA Study): 17% (or an increase of 0.5% per Year)

Estimated Transit	Modal Split by 2021 :	12%
Estimated Shift to	Other Mode of Travel :	1%





4134 16th Avenue Lands Trip Generation

Residential Yields by Blocks

ITE Trip Generation Rates - 9th Edition

Land Uses	Land Uses Units		Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
Single Detached Residential Condominium/Townhouse Commercial Retail	Dwelling units Dwelling units 1000 sq. ft.	210 230 820	0.19 0.07 0.27	0.56 0.37 0.69	0.75 0.44 0.96	0.63 0.35 0.25	0.37 0.17 3.46	1.00 0.52 3.71

Existing Mode of Choice : - Transit 6.6% and Other (Cycling, Walk etc..)4.3% Target Transit Modal Split (FUA Study): 17% - Increase 9% or 0.5% per year from 2011 to 2031 Assuming : Transit increased 2021 - Increase 6% and assumed an increased in Other Mode 1% Forecast Mode of Transit Modal split by 2021 : 12% - Shift from Auto to Other Mode of Travel 1%

Residential Vehicle Trip Reduction

Employment Vehicle Trip Reduction

13%

7%

				Weekda	у	Weekday		
Land Uses	Units	ITE Code	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Vehicle Trips					_			
Single Detached	169	230	28	83	110	93	54	147
Medium /Townhouse	129	210	8	41	49	39	19	58
Single Detached	84	230	14	41	55	46	27	73
Medium /Townhouse	64	210	4	20	24	19	10	29
Single Detached	157	230	26	77	102	86	51	137
Medium /Townhouse	703	210	46	223	269	213	105	318
Total Westside	1306		125	485	611	496	266	762
Single Detached	148	230	24	72	97	81	48	129
Medium /Townhouse	87	210	6	28	33	26	13	39
Single Detached	257	230	42	126	168	141	83	224
Medium /Townhouse	152	210	10	48	58	46	23	69
Single Detached	53	230	9	26	35	29	17	46
Medium /Townhouse	31	210	2	10	12	9	5	14
Single Detached	212	230	35	104	138	116	68	184
Medium /Townhouse	125	210	8	40	48	38	19	57
Medium /Townhouse	174	210	11	55	67	53	26	79
Total Eastside	1239		146	509	655	540	301	840
Commercial Trips	107,600		29	74	103	27	40	67
	15% Passby		-4	-11	-15	-4	-6	-10
	10% from Neigbourhood		-3	-7	-10	-3	-4	-7
Net Commercial Vehicle Trips	Reigbournoou		22	55	77	20	30	50
Total (Vehicle Trips)			294	1049	1343	1056	596	1652

Area Development Trip Generation by Traffic Zones

Blend ITE Trip Generation for Residential and Population

ITE Trip Generation Rates - 9th Edition								
			Weekday AM Peak Hour		Weekday			
Land Uses	ITE Code	Units			our	PM Peak Hour		
			In	Out	Total	In	Out	Total
Residential								
Single Detached	210	Dwelling units	0.19	0.56	0.75	0.63	0.37	1.00
Residential Condominium/Townhouse	230	Dwelling units	0.07	0.37	0.44	0.35	0.17	0.52
Average Residential Trip Rates		Dwelling units	0.14	0.48	0.63	0.52	0.29	0.81
(60% Single and 40% Low Rise Condominium)								
Employment								
General Light Industrial	110	Employment	0.37	0.07	0.44	0.09	0.33	0.42
Hotel	310	Employment	0.48	0.21	0.69	0.43	0.37	0.80
High School	530	Employment	0.48	0.06	0.54	0.07	0.34	0.41
Building Materials and Lumber Store	812	Employment	1.50	0.92	2.42	1.41	1.36	2.77
Single Tenant Office Building	715	Employment	0.47	0.06	0.53	0.08	0.43	0.51
Medical-Dental Office Building	720	Employment	0.42	0.11	0.53	0.36	0.70	1.06
General Office Building	710	Employment	0.42	0.06	0.48	0.21	0.25	0.46
Average General Employment Trip Rates		Employment	0.59	0.21	0.80	0.38	0.54	0.92
						1		

Existing Mode of Choice : - Transit 6.6% and Other (Cycling, Walk etc..)4.3% Target Transit Modal Split (FUA Study): 17% - Increase 9% or 0.5% per year from 2011 to 2031 Assuming : Transit increased 2021 - Increase 6% and assumed an increased in Other Mode 1% Forecast Mode of Transit Modal split by 2021 : 12% - Shift from Auto to Other Mode of Travel 1%

Employment Vehicle Trip Reduction

2021 Area Development Trips Estimation

			Weekday Weekday			у		
Traffic Zone	Population	Units	AM	I Peak He	our	PM	Peak He	our
	(from 2016 to 2021)	(from 2016 to 2021)	In	Out	Total	In	Out	Total
Residential								
1167	71	217	27	91	118	98	55	153
1169	3114	1,021	127	430	556	460	258	718
1191	3968	1,301	161	547	709	586	329	915
1193	0	0	0	0	0	0	0	0
1209,1210,1212,1213	945	310	38	130	169	139	78	218
Employment	Employment							
1167	3306		1,817	656	2,473	1,164	1,660	2,824
1169	703		386	139	526	248	353	601
1191	1050		577	208	785	370	527	897
1193	280		154	56	209	99	141	239
1209,1210,1212,1213	684		352	127	479	225	321	547
	Total 2021	2,849	3,639	2,385	6,024	3,388	3,722	7,110

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Poulos

Residential Vehicle Trip	Reduction
mploymont Vahiela Trir	Poduction

13% 7%

Subject Lands and Area Development Traffic Figure B3



15.208 Base T3 May 2016

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2021 Model Calibration and Comparison to EMME Outputs Figure B4

Levels of Service Definition

Levels of Service – Highway Capacity Manual

SIGNALIZED INTERSECTIONS

Level of Service	Stopped Delay per Vehicle (sec)	Expected delay to Minor Street traffic from the Major Street
А	< 5.1	Most vehicles arrive during the green phase and do not stop; traffic progression is extremely favourable.
В	5.1 - 15.0	More vehicles stop than for LOS A; traffic progression is good.
С	15.1 - 25.0	Individual cycle failures may appear and the number of vehicles stopping is significant; traffic progression is fair.
D	25.1 - 40.0	Individual cycle failures are noticeable, many vehicles stop; traffic progression is unfavourable.
Е	40.1 - 60.0	Individual cycle failures are frequent; traffic progression is poor, acceptable delay is at its limit.
F	> 60	Many individual cycle failures, arrival flow rate exceeds capacity, delay is unacceptable to most drivers.

Levels of Service Definition

Levels of Service – Highway Capacity Manual

UNSIGNALIZED INTERSECTIONS

Level of Service	Reserve Capacity (passenger cars/hr.)
А	< 400
В	300 - 399
С	200 - 299
D	100 - 199
Е	0 - 99
F	

Source: Highway Capacity Manual, TRB Special Report 209, 1994

Source: Highway Capacity Manual, TRB Special Report 209, 1994



Expected delay to Minor Street traffic from the Major Street

Expected delay to Minor Street traffic from the Major Street.

Little or no delay.

Short Traffic delay.

Average traffic delay.

Very long traffic delay.

Extreme delay encountered with queuing which may cause severe congestion affecting other traffic movement in the intersection.

> Levels of Service Definition Figure B5
Appendix C 4134 16th Avenue Lands Traffic Assignment (Options A, B, C and D)















