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Mayfield Road Improvements

Airport Road to Coleraine Drive –
Class Environmental Assessment

ENVIRONMENTAL STUDY REPORT

Volume 4 of 5
Appendix N - U

April 18, 2013

Stantec

Region of Peel
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APPENDIX N

TRAFFIC & ROUNDABOUT STUDIES

transportation planning & engineering consultants

Regional Municipality of Peel

Mayfield Road EA (Airport Road to Coleraine Drive) Traffic Study

Brampton and Caledon, Ontario

May 2010

Regional Municipality of Peel

Mayfield Road EA (Airport Road to Coleraine Drive) Traffic Study

Brampton and Caledon, Ontario

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1. INTRODUCTION

1.1 Background and Study Purpose

This report documents the traffic study undertaken for the need and justification component of the Class Environmental Assessment for Mayfield Road between Airport Road and Coleraine Drive. Mayfield Road is the boundary road between City of Brampton and Town of Caledon within the Region of Peel. The traffic study was undertaken by iTRANS with the assistance and input from Stantec and Environment, Transportation and Planning Services staff from the Region of Peel.

Exhibit 1 illustrates the study area for the needs assessment undertaken for Mayfield Road.

The need for improvements and additional roadway capacity in the Mayfield Road corridor in the City of Brampton and the Town of Caledon had been previously identified in earlier studies, including the ***Mayfield Road Environmental Assessment and Preliminary Design Study (Hurontario Street to Heart Lake Road) 2002***, the ***Mayfield Road Corridor Feasibility Study (Hurontario Street to Dixie Road) 1999***, ***Mayfield Road EA (Heart Lake Road to Airport Road) 2004*** and the Region Long Range Transportation Plan. In 2009, the City of Brampton completed the Brampton Transportation and Transit Master Plan Update and the Region of Peel completed the Peel-Highway 427 Extension Area Transportation Master Plan Study.

These studies recommended the widening of Mayfield Road from its current 2-lane cross-section to 4 lanes. The Mayfield Road EA study (Hurontario Street to Heart Lake Road) also identified lands to be protected for an ultimate 6-lane cross-section between Hurontario Street and Heart Lake Road. The Mayfield Road EA study (Heart Lake Road to Airport Road) also identified the need to protect for 6 lanes in the future. The recently completed Region of Peel ***Peel-Highway 427 Extension Area Transportation Master Plan 2009*** and City of Brampton ***Transportation and Transit Study Update 2009*** identified the need for 6 lanes on Mayfield Road. The above-mentioned studies were reviewed to extract relevant traffic data, forecasts, analyses, and recommendations.

Findings from other ongoing studies, including the Peel-Highway 427 Extension Area Transportation Master Plan will influence recommended improvements.

As part of the Environmental Assessment for Mayfield Road between Airport Road and Coleraine Drive, this study assesses the transportation need and justification for improvements to Mayfield Road (between Airport Road and Coleraine Drive) based on updated information for horizon year 2031.

1.2 Traffic Analysis Approach

This study was undertaken concurrent with other strategic transportation planning studies. It has also been undertaken as infrastructure in the vicinity of the study area is changing. This study had regard for issues that will be addressed in the Peel-Highway 427 Extension Area Transportation Master Plan and the GTA West Corridor Environmental Assessment Study.

The traffic analysis was initiated in the fall of 2007 with existing traffic counts and travel patterns that reflected conditions at that time. The study does have regard for the changes in travel patterns associated with planned, committed, and recently completed infrastructure (such as the extension of Highway 410 to Mayfield Road).

In carrying out the needs assessment, iTRANS with the assistance of Regional staff has prepared traffic forecasts for the study area for the years 2007, 2012, 2017, and 2032. Traffic analyses were then undertaken to assess intersection operations for years 2012, 2017, and 2032 under various future road network scenarios.

The traffic conditions reflect the highest observed traffic volumes for each intersection and anticipated traffic growth:

- 2012 traffic on the existing 2 lanes of Mayfield to address the problem identification.
- 2012 traffic with Mayfield Road widened to 4 lanes and intersection improvements to confirm that any problems can be addressed.
- 2017 and 2032 traffic on Mayfield Road to confirm the ultimate road network and lane configurations.

Not To Scale

Study Area

Exhibit 1

Study Area

2. REGIONAL AND STUDY AREA CONTEXT

2.1 Background Studies

There are a number of related studies completed in the vicinity of the study area. These are briefly discussed as follows in regard to the transportation analysis and need for improvements to Mayfield Road:

Proposed Distribution Warehouse Development Transportation Study, March 2005
In establishing the need for improvements to Mayfield Road in this EA study, the analysis in the Distribution Warehouse study prepared by iTRANS Consulting in March 2005 addressed future development in the northeast quadrant of the Mayfield Road / Airport Road intersection. The study did not make any recommendations for future widening of Mayfield Road but traffic forecasts for the developments were identified by the Region of Peel for inclusion in the background development trip forecasting process. The subsequent addendum submitted in June 2005 was also included in the forecasting process.

The study analyzed existing 2005 and future 2010 daily peak hour turning movement volumes at the Mayfield Road and Airport Road intersection.

Mayfield Road Class Environment Assessment and Preliminary Design Study (Hurontario Street to Heart Lake Road), November 2002
Stantec prepared a Schedule "C" Class Environment Assessment and Preliminary Design Study for Mayfield Road, from Hurontario Street to Heart Lake Road. The study reviewed the Corridor Feasibility Study and used updated traffic forecasts from the Region of Peel to form the need and justification for widening Mayfield Road. The study documented forecasted 2011 volumes in the range of 1,700-1,800 vehicles per hour during the AM and PM peak periods. Stantec used these results and recommended a 4-lane cross section with turning lane improvements at signalized intersections to accommodate the 2011 forecasted volumes.

Mayfield Road Class Environment Assessment and Preliminary Design Study (Heart Lake Road to Airport Road), May 2004
Stantec prepared a Schedule "C" Class Environment Assessment and Preliminary Design Study for Mayfield Road, from Heart Lake Road to Airport Road. The study reviewed the Corridor Feasibility Study and used updated traffic forecasts from the Region of Peel to form the need and justification for widening Mayfield Road. The study documented forecasted 2012 volumes greater than 1,000 vehicles per hour per lane during the AM and PM peak periods. Stantec used these results and recommended a 4-lane cross section with turning lane improvements at signalized intersections to accommodate the 2012 forecasted volumes.

Vales North Special Study Area Draft Transportation Study, August 2007
The Vales North Secondary Plan (SP 49) comprises an area of approximately 185 hectares (462 acres) bounded by the valley west of Airport Road, Countryside Drive to the south, Goreway Drive to the east and Mayfield Road to the north. Two Special Study Areas were defined within the Secondary Plan.

This transportation study identifies and confirms the infrastructure necessary to accommodate development objectives of the Special Study Areas. It assesses the appropriateness of elements of the network such as the collector road system, right-of-way designations, timing of required arterial infrastructure, pedestrian/cyclist links, and accessibility to transit that the proposed network provides. The findings include the need for the widening of Mayfield Road east of Airport Road prior to the year 2016.

2.2 Recent and Ongoing Studies

Other ongoing studies may influence planning of infrastructure within the Mayfield Road corridor. These studies include:

Highway 427 Extension Environmental Assessment Study, Ministry of Transportation
The Ministry of Transportation has completed a study to carry out the EA of the Highway 427 Transportation Corridor. The EA study's Terms of Reference (TOR) provide for the possibility of extending Highway 427 to a point somewhere south of the Green Belt and Oak Ridges Moraine and the study findings include an extension of Highway 427 to Major Mackenzie Drive in the City of Vaughan. The Ministry has made no provision for formally considering new or realigned arterial connections (such as Mayfield Road) as a part of the Highway 427 EA except in the context of considering terminus options (i.e. the connecting road where the Highway 427 extension stops).

Peel-Highway 427 Extension Area Transportation Master Plan, Region of Peel, City of Brampton, Town of Caledon
This Study identified arterial roadway needs, in recognition of the future extension of Highway 427. It will identified appropriate new road links required to accommodate distribution of traffic to/from the Highway 427 extension and planned development in the adjacent area, while maintaining flexibility to accommodate longer term Provincial transportation, development, environmental, and sustainability objectives. Recommended solutions included a proposed new road alignment from Mayfield Road east of Clarkway Drive to Highway 50 at Major Mackenzie Drive and the widening of Mayfield Road to 6 lanes west of this new road and 4 lanes east of this new road.

GTA West Corridor Environmental Assessment

The Ministry of Transportation initiated an Individual EA process to study the long-term provincial transportation needs for a new GTA West Corridor. The terms of reference for this study was recently approved by the Ontario Ministry of the Environment. The GTA West Corridor could provide major potential linkages to Highways 400, 410, 427, 401 and Highways 6 and 7. There is also a need to integrate GTA West Corridor planning with other transportation initiatives currently underway (i.e. Hwy 427 Corridor EA, the potential North-South corridor at the Brampton / Halton boundary, Niagara-GTA EA, Highway 7 EA – Kitchener to Guelph, Highway 24 EA Study, and Highway 6 EA – Freelton to Guelph).

The GTA West Corridor has a relationship with meeting needs of municipal transportation systems, such as its impact upon planned local transportation corridors and proposed arterial road networks. From the Region of Peel's perspective, immediate steps need to be taken to protect portions of the GTA West Corridor that are under intense development pressures before the EA process is completed. The study must also address impacts to the local road network, while considering relevant local planning and policy documents. Other major environmental constraints include the Greenbelt, Niagara Escarpment, and the Oak Ridges Moraine; as well as traversing several major rivers and watersheds. The long-term needs of Mayfield Road may be affected by the ultimate recommendation of the GTA West Corridor EA.

No commitments have been made related to new infrastructure associated with the GTA West Corridor beyond the initiation of the environmental assessment study.

3. TRANSPORTATION ANALYSIS

A transportation analysis for the Study Area was carried out which utilized previous studies as well as updated information.

The tasks included:

- A review of existing traffic conditions
- Analyses of midblock road links and key intersections
- An assessment of existing transportation deficiencies and local traffic issues
- An assessment of the safety performance for Mayfield Road
- Preparation of travel forecasts for the 2007, 2012, 2017, and 2032 planning horizons
- An assessment of future corridor travel demands and deficiencies
- The identification of road improvements to accommodate future travel demands

3.1 Existing Road Network

Mayfield Road is an east-west arterial road under the jurisdiction of the Region of Peel (Regional Road 14). Mayfield Road has a two-lane paved cross section with gravel shoulders. Within the study area, Mayfield Road intersects with eight north-south roads (Airport Road, Maisonneuve Boulevard, Goreway Drive / Innis Lake Road, McVean Drive / Centreville Creek Road, The Gore Road, Marysfield Drive, Clarkway Drive / Humber Station Road, and Coleraine Drive). Mayfield Road forms signalized intersections with Airport Road, Goreway Drive / Innis Lake Road, and The Gore Road. In the vicinity of Airport Road and Goreway Drive, The Gore Road and Marysfield Drive, the posted speed on Mayfield Road is 60 km/h. Otherwise, the posted speed increases to 80 km/h.

Airport Road is a four-lane north-south arterial road, under the jurisdiction of the Region of Peel (Regional Road 7).

Maisonneuve Boulevard is a local, two-lane north-south road, which ends at Mayfield Road, and is approximately 0.6 km east of Airport Road. This 50 km/h road is under the jurisdiction of the City of Brampton.

Goreway Drive / Innis Lake Road is a 70 km/h two-lane north-south road, which intersects at Mayfield Road approximately 0.5 km east of Maisonneuve Boulevard. Goreway Drive has a posted speed of 70 km/h and it is under the jurisdiction of the City of Brampton south of Mayfield Road. Innis Lake Road has a posted speed of 80 km/h and it is under the jurisdiction of the Town of Caledon north of Mayfield Road.

McVean Drive / Centreville Creek Road is a 70km/h two-lane north-south road, which has an off-set intersection at Mayfield Road approximately 1.3 km east of Goreway Drive / Innis Lake Road. McVean Drive is under the jurisdiction of the City of Brampton south of Mayfield Road. Centreville Creek Road is under the jurisdiction of the Town of Caledon north of Mayfield Road.

The Gore Road is a two-lane north-south arterial road, which intersects at Mayfield Road approximately 1.3 km east of McVean Drive / Centreville Creek Road. This 60 km/h road is under the jurisdiction of the Region of Peel (Regional Road 8).

Marysfield Drive is a local, two-lane north-south road, with an unsignalized T-intersection at Mayfield Road approximately 0.4 km east of The Gore Road. Marysfield Drive is under the jurisdiction of the City of Brampton.

Clarkway Drive / Humber Station Road is a two-lane north-south road, which intersects at Mayfield Road approximately 1.6 km east of Marysfield Drive with an offset of 25 m. Clarkway Drive has a posted speed of 70 km/h and it is under the jurisdiction of the City of Brampton south of Mayfield Road. Humber Station Road is under the jurisdiction of the Town of Caledon.

Coleraine Drive is a north-south road, which intersects at Mayfield Road approximately 1.5 km east of Clarkway Drive / Humber Station Road. Coleraine Drive forms part of the Caledon Bolton Arterial Roads (BAR) environmental assessment network. Recent improvements include the widening of Coleraine Drive north of Mayfield Road to four lanes and removing the offset intersection. Coleraine Drive has a posted speed of 70 km/h and it is under the jurisdiction of the City of Brampton south of Mayfield Road, and the Town of Caledon north of Mayfield Road.

3.2 Existing Traffic

3.2.1 Weekday AM and PM Peak Hour Traffic Volumes

Recent turning movement counts were provided by the Region of Peel to develop representative existing traffic volumes in the Study Area. **Table 1** summarizes the sources and dates of the traffic count data used in the study.

Table 1: Traffic Counts – Date and Source

Location	Date	Source	Peak Hour	
			AM	PM
Mayfield Road and Airport Road	May 4, 2005	Region of Peel	7:00 – 8:00	4:30 – 5:30
Mayfield Road and Maisonneuve Boulevard	March 21, 2006	Region of Peel	7:30 – 8:30	4:30 – 5:30
Mayfield Road and Goreway Road / Innis Lake Road	June 8, 2005	Region of Peel	7:15 – 8:15	4:30 – 5:30
Mayfield Road and McVean Drive / Centreville Creek Road	June 7, 2005	Region of Peel	7:00 – 8:00	4:45 – 5:45
Mayfield Road and The Gore Road	May 16, 2006	Region of Peel	7:30 – 8:30	4:45 – 5:45
Mayfield Road and Marysfield Drive	June 21, 2006	Region of Peel	7:15 – 8:15	5:00 – 6:00
Mayfield Road and Clarkway Drive / Humber Station Road	May 31, 2005	Region of Peel	7:15 – 8:15	4:45 – 5:45
Mayfield Road and Coleraine Drive	May 31, 2005	Region of Peel	7:15 – 8:15	4:45 – 5:45

As shown in **Table 1**, the AM and PM peak hours correspond typically to the hours of 7:15 – 8:15 AM and 4:45 – 5:45 PM.

The existing weekday AM and PM peak hour turning movement volumes on Mayfield Road are shown in **Exhibit 2**. Existing volumes show that the peak direction during the AM peak hour is typically eastbound. The eastbound traffic decreases at Maisonneuve Boulevard and Marysfield Drive, then increases at The Gore Road. For the PM peak hour, existing volumes show that the peak direction is typically westbound.

The highest two-way peak hour volumes during both the AM and PM peak hours is just west of The Gore Road. Generally speaking, the volumes are lower in the eastern portion of the corridor.

3.2.2 AADT Volumes

Existing and historical Annual Average Daily Traffic (AADT) volumes on Mayfield Road were also provided by the Region from 1994 to 2006. **Table 2** presents the 2006 AADT volumes on Mayfield Road.

Table 2: 2006 AADT on Mayfield Road

Location	Eastbound AADT	Westbound AADT	Two-Way AADT
1.1 km East of Airport Road	5,870	5,790	11,660
0.6 km West of The Gore Road	5,730	5,750	11,480
2.1 km West of Highway 50	5,610	5,120	10,730

Source: Region of Peel – "Traffic, 13 Year AADT Summary – Mayfield Road"

As shown in **Table 2**, AADT volumes on Mayfield Road slightly decrease from west to east for eastbound traffic, and increase from east to west for westbound traffic. In terms of both directions, the two-way AADT also decreases from west to east, reflecting the role and function of Mayfield Road as a commuter route carrying traffic from the current urban envelope of Brampton (west of Airport Road) towards the rural areas of northeast Brampton and across the Peel boundary to York Region and the rest of the GTA.

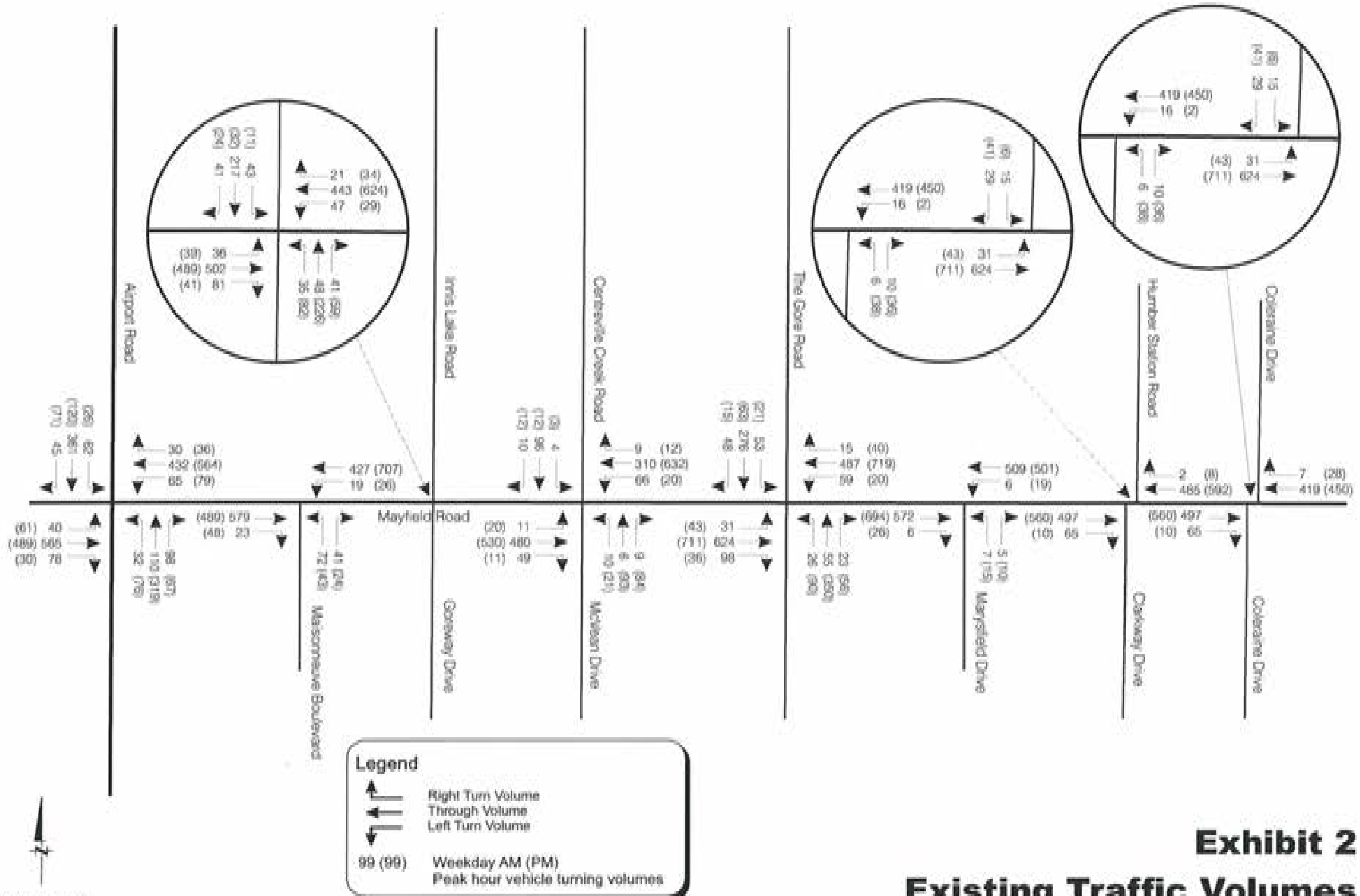

Exhibit 2
Existing Traffic Volumes

3.2.3 Future Growth Rates

Mayfield Road Corridor
Future growth rates along Mayfield Road were provided by the Region of Peel. The growth rates assumed a declining growth over the horizon periods, which reflect the long term build out of lands along the corridor, as well as a diversion of traffic to parallel routes as improvements to these facilities take place. Details of the growth rate application are discussed in **Section 3.4.3**.

3.2.4 Truck Percentages

Truck percentages were obtained through the most recent Peel Region Cordon Count data available. The 2006 Cordon Count data were used to determine the percentage of light and heavy trucks for the arterial roads that are intersecting Mayfield Road in between Airport Road to Coleraine Drive. **Table 3** shows the truck percentages from the 2006 Cordon Count.

Table 3: Truck Percentages (Roads South of Mayfield Road)

Location	2006 Cordon Count Station	Truck Percentage		
		AM Peak 7:15 – 8:15	PM Peak 16:45 – 17:45	15 Hours 5:30 – 20:30
Airport Road South of Mayfield Road	181	4.8%	10.3%	9.7%
Goreway Drive South of Mayfield Road	182	11.2%	11.2%	16.9%
McVean Drive South of Mayfield Road	169	8.2%	6.4%	9.2%
The Gore Road South of Mayfield Road	184	17.0%	5.3%	14.0%
Clarkway Drive South of Mayfield Road	185	6.1%	3.9%	8.1%
Coleraine Drive South of Mayfield Road	186	0.0%	0.0%	1.9%

Note: McVean Drive has been designated as a "no truck" route restricting heavy trucks

The 15 Hour period from 5:30 AM to 8:30 PM, and the AM and PM peak hour truck percentages were obtained. Truck percentages ranged from 0% on Coleraine Drive to 17% for Goreway Drive and The Gore Road.

The truck percentages on Mayfield Road between Airport Road and Coleraine Drive are lower than the percentages further west along Mayfield Road (outside of the study area). Although Mayfield Road is a trucking route, truck traffic originating in central and western Caledon may chose Highway 410 to access areas to the south and east. With the completion of Highway 410 to Highway 10 (in 2010), trucks are more likely to utilize the freeway system rather than Mayfield Road.

Based on the above truck percentages and volumes in the Region of Peel Cordon Count, Mayfield Road is currently carrying approximately 25-80 trucks during the AM and PM peak hours.

3.3 Existing Level of Service

3.3.1 Intersection Analysis

The operations of the study area intersections were analyzed on the basis of the existing turning movement volumes indicated in **Exhibit 2** and on the basis of the existing intersection lane configurations shown in **Exhibit 3**.

Analysis of the signalized intersection operations was conducted using the Synchro 6, Traffic Signal Coordination Software version 6, which employs the methodology from the ***Highway Capacity Manual*** (HCM 2000) published by the Transportation Research Board National Research Council. Synchro 6 can analyze both signalized and unsignalized intersections in a road corridor or network taking into account the spacing, interaction, queues and operations between intersections.

The unsignalized intersection operational analysis in this report was also completed using the Synchro 6 software, which employs the 2000 Highway Capacity Methodology for intersection analysis. Capacity and delay at unsignalized intersections are a function of gap availability in the traffic flow and driver acceptance of gaps in traffic.

The results of the signalized and unsignalized intersection operations along Mayfield Road are summarized in **Table 4** and **Table 5**, respectively. Detailed analysis is provided in **Appendix A**.

Table 4: Existing Level of Service at Signalized Intersections along Mayfield Road

Signalized Intersection	Time Period	V/C (1)	Overall V/C	LOS (2)
Mayfield Road and Airport Road	AM Peak	0.63	0.51	B
	PM Peak	0.61	0.48	B
Mayfield Road and Goreway Road / Innis Lake Road	AM Peak	0.54	0.52	A
	PM Peak	0.64	0.58	A
Mayfield Road and The Gore Road	AM Peak	0.80	0.74	B
	PM Peak	0.86	0.84	C

1 - V/C – maximum volume / capacity ratio for the critical movement
2 - LOS – overall intersection level of service

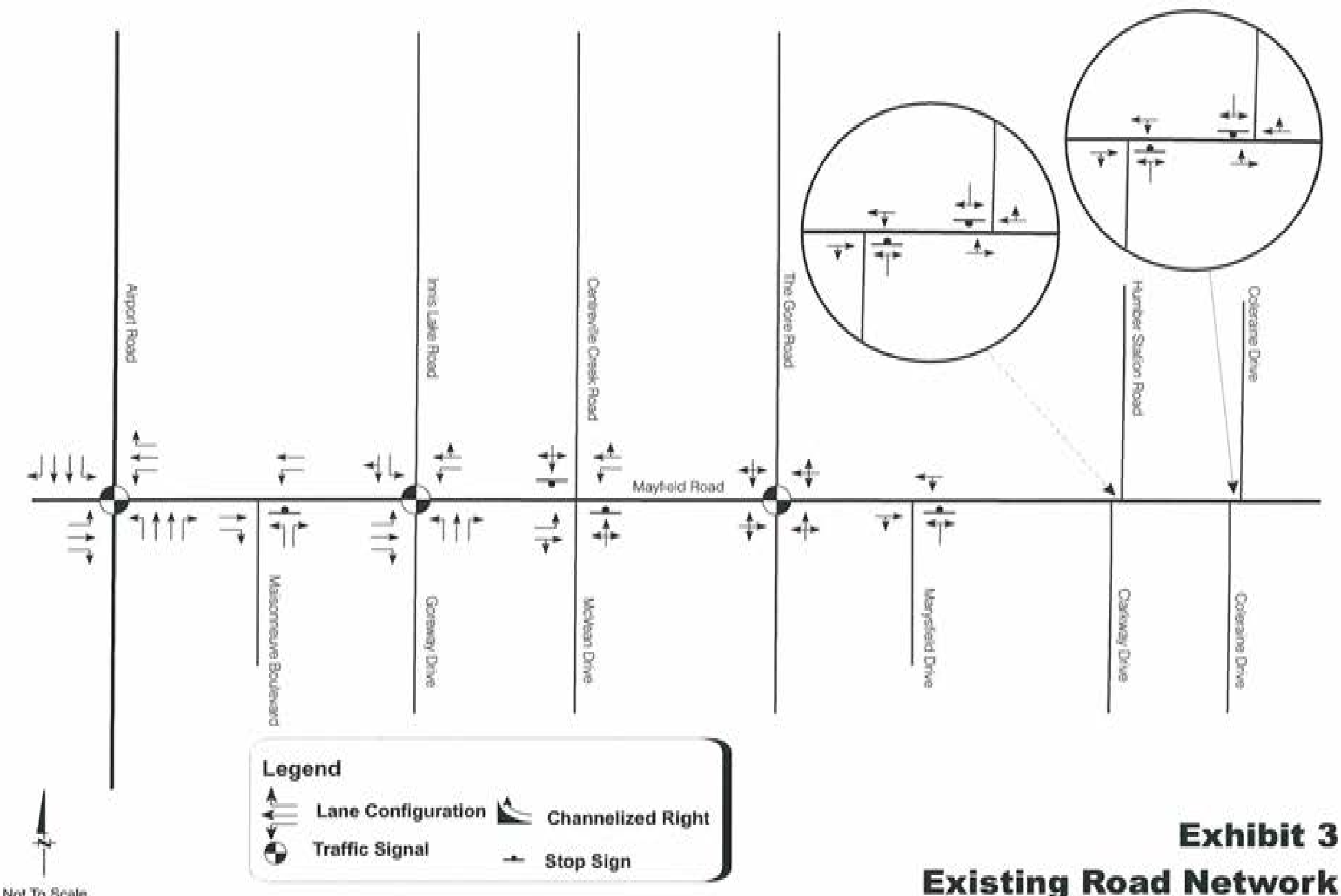

Exhibit 3
Existing Road Network

A discussion of the level of service analysis results is provided below:

Mayfield Road and Airport Road
This signalized intersection is currently operating at an overall Level of Service (LOS) of B during the AM and PM peak hour.

Mayfield Road and Goreway Road / Innis Lake Road
This signalized intersection is currently operating at a LOS of A during the AM and PM peak hour.

Mayfield Road and The Gore Road
This signalized intersection is currently operating at a LOS of B during the AM peak hour and a LOS of C during the PM peak hour.

Table 5: Existing Level of Service at Unsignalized Intersections along Mayfield Road

Unsignalized Intersection	Time Period	V/C (1)	LOS (2)
Mayfield Road and Maisonneuve Boulevard	AM Peak	0.29	D
	PM Peak	0.23	D
Mayfield Road and McVean Drive / Centreville Creek Road	AM Peak	0.46	D
	PM Peak	0.89	F
Mayfield Road and Marysfield Drive	AM Peak	0.04	C
	PM Peak	0.10	C
Mayfield Road and Clarkway Drive	AM Peak	0.04	C
	PM Peak	0.53	D
Mayfield Road and Humber Station Road	AM Peak	0.44	C
	PM Peak	0.17	C
Mayfield Road and Coleraine Drive (south leg)	AM Peak	0.20	C
	PM Peak	0.29	C
Mayfield Road and Coleraine Drive (north leg)	AM Peak	0.48	C
	PM Peak	0.29	C

1 - V/C – maximum volume / capacity ratio for the critical movement and not the average for the intersection
2 - LOS – maximum level of service for all the individual movements

A discussion of the level of service analysis results is provided below:

Mayfield Road and Maisonneuve Boulevard
This unsignalized intersection is currently operating with a maximum Level of Service (LOS) of D during the AM and PM peak hour. For the AM peak hour, the level of service is due to northbound left-turning vehicles turning onto Mayfield Road.

Mayfield Road and McVean Drive / Centreville Creek Road
This unsignalized intersection is currently operating with a maximum LOS of D during the AM peak hour and a LOS of F during the PM peak hour. The poor level of service in the AM and PM peak hours is due to the southbound left, through, and right-turning vehicles sharing one lane.

Mayfield Road and Marysfield Drive
This unsignalized intersection is currently operating with a maximum LOS of C during the AM and PM peak hour.

Mayfield Road and Clarkway Drive
This unsignalized intersection is currently operating with a maximum LOS of C during the AM peak hour and a LOS of D during the PM peak hour. For the PM peak hour, the level of service is due to the northbound left-turning vehicles turning onto Mayfield Road.

Mayfield Road and Humber Station Road
This unsignalized intersection is currently operating with a maximum LOS of C during the AM and PM peak hours.

Mayfield Road and Coleraine Drive (south leg)
This unsignalized intersection is currently operating with a maximum LOS of C during the AM and PM peak hour.

Mayfield Road and Coleraine Drive (north leg)
This unsignalized intersection is currently operating with a maximum LOS of C during the AM and PM peak hour.

It should also be noted that, given the jog in the intersection alignment, that eastbound and westbound left-turns conflict when occurring at the same time.

3.3.2 Link / Midblock Analysis

For the link analysis, a theoretical maximum link capacity of 1000 vehicles per hour per lane was applied to the existing volumes to assess a volume to capacity (v/c) ratio for each link of Mayfield Road. Link volume-to-capacity ratio of higher than 0.90 (or a volume of more than 900 per lane) indicates the need for additional link capacity. Based on the link analysis, Mayfield Road has an existing maximum link v/c ratio of 0.73 in the AM peak hour, which occurs just west of The Gore Road.

The existing PM peak hour has a maximum link v/c ratio of 0.90, also occurring just west of The Gore Road. Current v/c ratios indicate that volumes have reached acceptable levels

3.3.3 Existing Need for Mayfield Road Improvements

Based on the existing volumes and operations on Mayfield Road, the improvements identified for consideration in the immediate term include:

- Change the northbound left-through-right shared lane at the Mayfield Road and McVean Drive / Centreville Creek Road to an exclusive northbound left-turn lane and a shared through-right turn lane.
- Realign Clarkway Drive / Humber Station to remove the existing jog in alignment. However, it is recognized that jog elimination may be most cost effectively co-ordinated with other scheduled improvements.

With the proposed McVean Drive / Centreville Creek Road intersection improvement, the maximum v/c ratio in the PM peak hour will drop from 0.89 to 0.72 at this intersection. The average vehicle delay will remain marginally above the level of service 'F'.

3.4 Future Traffic Conditions

3.4.1 Highway 427 Corridor

Travel demands in Northeast Brampton, South Bolton, and Western Vaughan will be influenced by changes in the provincial transportation network. The 427 Transportation Corridor Environmental Assessment is a provincial study that will plan and design improvements to the transportation system north of the existing terminus of Highway 427 at Highway 7 to south of the greenbelt. Based on results of this study, the recommended solution includes an extension of Highway 427 to the vicinity of Major Mackenzie Drive prior to the year 2021. The Highway 427 extension is not currently programmed, but it could be in place by 2014. In anticipation of improvements in the Highway 427 corridor, municipalities in Peel Region and York Region are considering longer-term network improvements, including new road links and alignment changes.

3.4.2 Peel–427 Extension Area Transportation Master Plan

The Region of Peel, City of Brampton, and Town of Caledon have undertaken the Peel - Highway 427 Extension Area Transportation Master Plan Study to assess the long term strategy for the arterial road network between Castlemore Road and Healy Road and from The Gore Road to Highway 27.

The study recommends a new roadway connection extending from Major Mackenzie Drive at Highway 50 to Mayfield Road east of Clarkway Drive. It is anticipated that the timing of this new proposed link will be coordinated with the extension of Highway 427.

3.4.3 Projected Growth and Turning Movement Forecasts

To determine the future need for Mayfield Road improvements, and the future analysis of lane requirements, travel demand forecasts were prepared for this study for the 2012, 2017, and 2032 horizon years (reflecting 5, 10, and 25 year growth). The approach to travel demand forecasting involved developing turning movement volume forecasts on Mayfield Road at each study area intersection based on declining growth rates provided by the Region of Peel.

Historic and existing turning movement counts and AADT's were provided by the Region of Peel at the outset of the study.

The Region of Peel provided growth rates along Mayfield Road, which were applied are noted below:

- 4% from 2007 to 2012
- 3% from 2012 to 2017
- 2% from 2017 to 2032

iTRANS is of the opinion that these growth rates are reasonable. The ultimate anticipated traffic growth associated with these rates is comparable to traffic volumes identified in the Brampton TTMP Update Study.

For the growth rates on the north-south cross-streets, the Regional model forecasts, forecasts from the Highway 427 EA and work previously completed by iTRANS, were reviewed.

The following growth rates were applied:

- 3% from 2007 to 2012
- 2% from 2012 to 2017
- 1.5% from 2017 to 2032

The exceptions to the listed rates were Maisonneuve Boulevard and Marysfield Drive, which had no growth applied to them. All turning movements on the north-south cross-streets, and on Mayfield Road had a growth rate of half that of the through movement applied to it. For example, the left and right turns on Mayfield had a 2% growth rate applied to them from 2007 to 2012.

Coleraine Drive had 2% growth per annum applied from 2007 to 2032. Coleraine Drive is an arterial serving the west side of the Town of Bolton which is experiencing longer term development, and when additional capacity is provided within the corridor within Brampton, higher growth will likely be realized.

The 2012, 2017, and 2032 background traffic volumes (existing traffic volumes plus growth) are shown in **Exhibit 4**, **Exhibit 5**, and **Exhibit 6**.

Several background developments in the study area were identified by the Region of Peel. These developments include site traffic from the following sources:

- 'Proposed Distribution Warehouse Development Transportation Study' by iTRANS, March 2005.
- 'Addendum to Urbacon Proposed Distribution Warehouse Development Transportation Study' by iTRANS, June 13, 2005.
- 'Proposed Distribution Warehouse Development' by iTRANS, Jan 2006.
- 'TIS for Proposed Industrial Development' by BA Group, January 2006 (revised April 2006).
- 'Proposed Development at 7905 Mayfield Road' by Cole Engineering, April 18, 2007.
- 'Proposed Tullamore Plaza, Traffic Impact Study' by UMA Engineering, July 2007.
- 'Tullamore Secondary Plan Traffic Impact Study' by McCormick Rankin Corporation, February 2000.
- 'Vales North Special Study Area Transportation Study' by iTRANS Consulting Inc. August 2007.

The transportation study for the planned Secondary Plan Area 47 – Northeast Brampton has just been initiated.

The total of the background development traffic is shown in **Exhibit 7**, while the 2012 total traffic volumes, 2017 total traffic volumes, and the 2032 total traffic volumes are shown in **Exhibit 8**, **Exhibit 9**, and **Exhibit 10**. These values are appropriate for capacity analysis and assessment of intersection requirements along Mayfield Road.

If the proposed new road, Alignment A2 is implemented, then traffic volumes on Mayfield Road east of the new Alignment A2 intersection will be reduced. **Exhibit 10** illustrates the anticipated 2032 volumes associated with the implementation of Alignment A2.

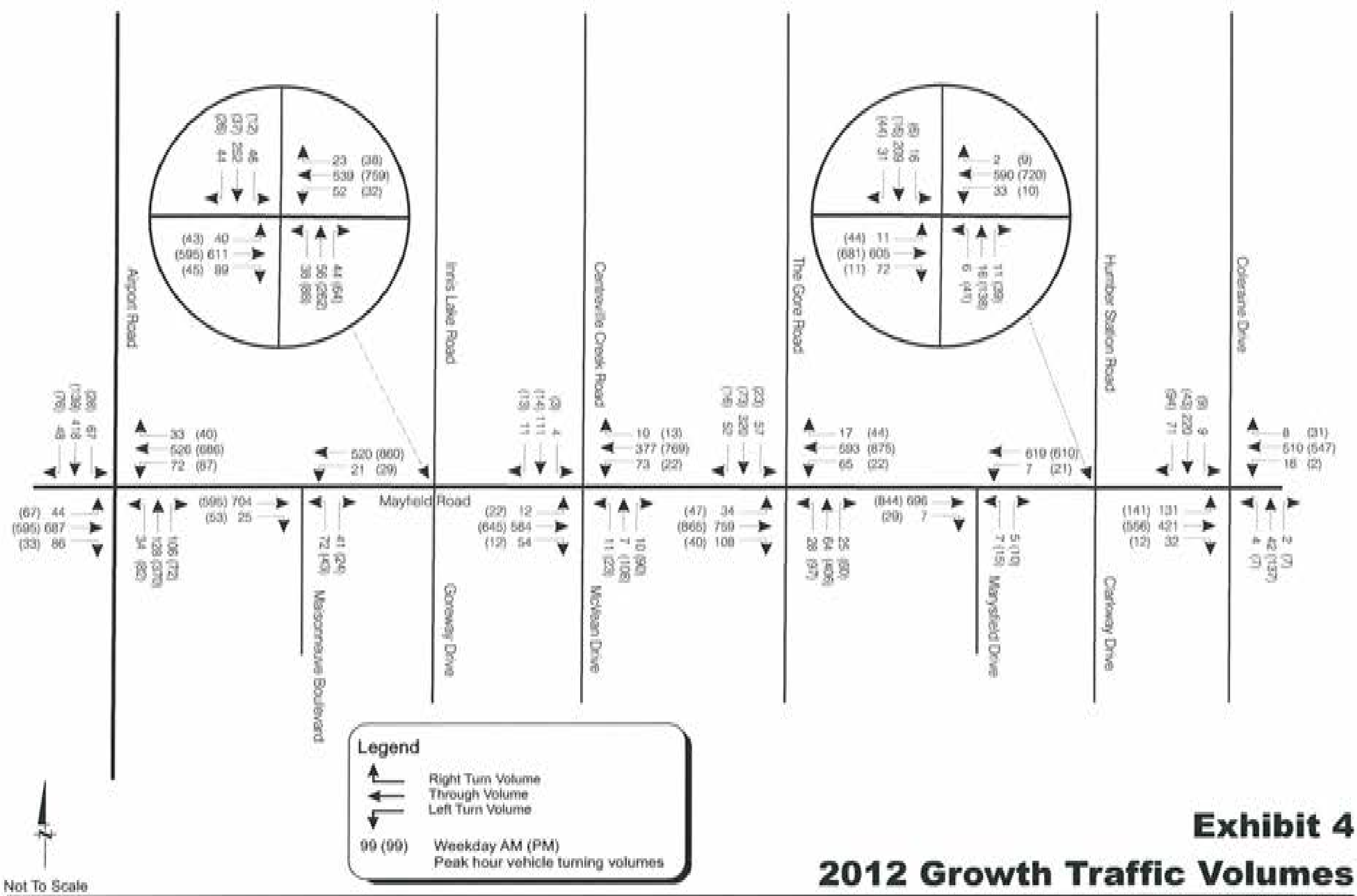

Exhibit 4
2012 Growth Traffic Volumes

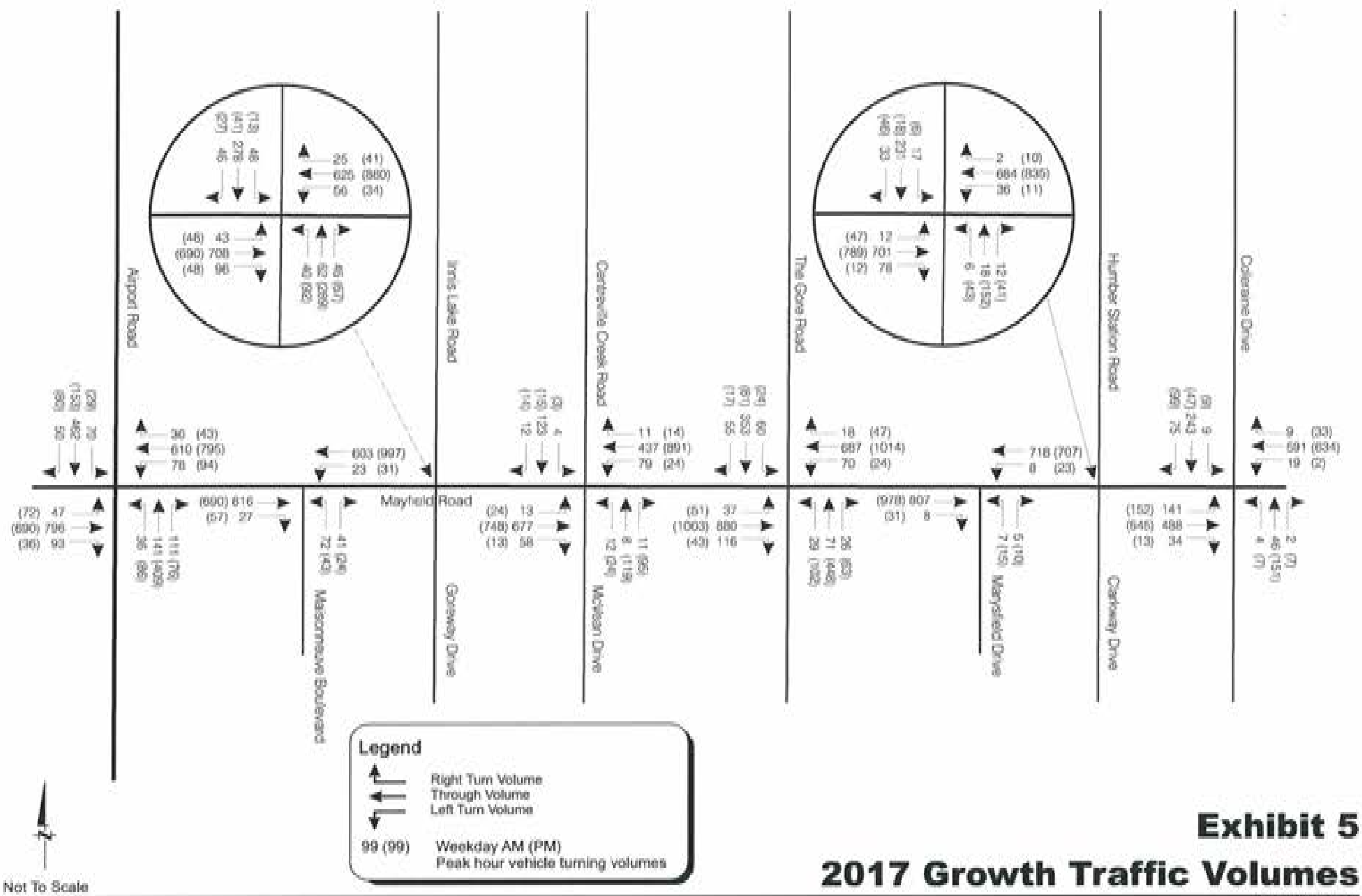

Exhibit 5
2017 Growth Traffic Volumes

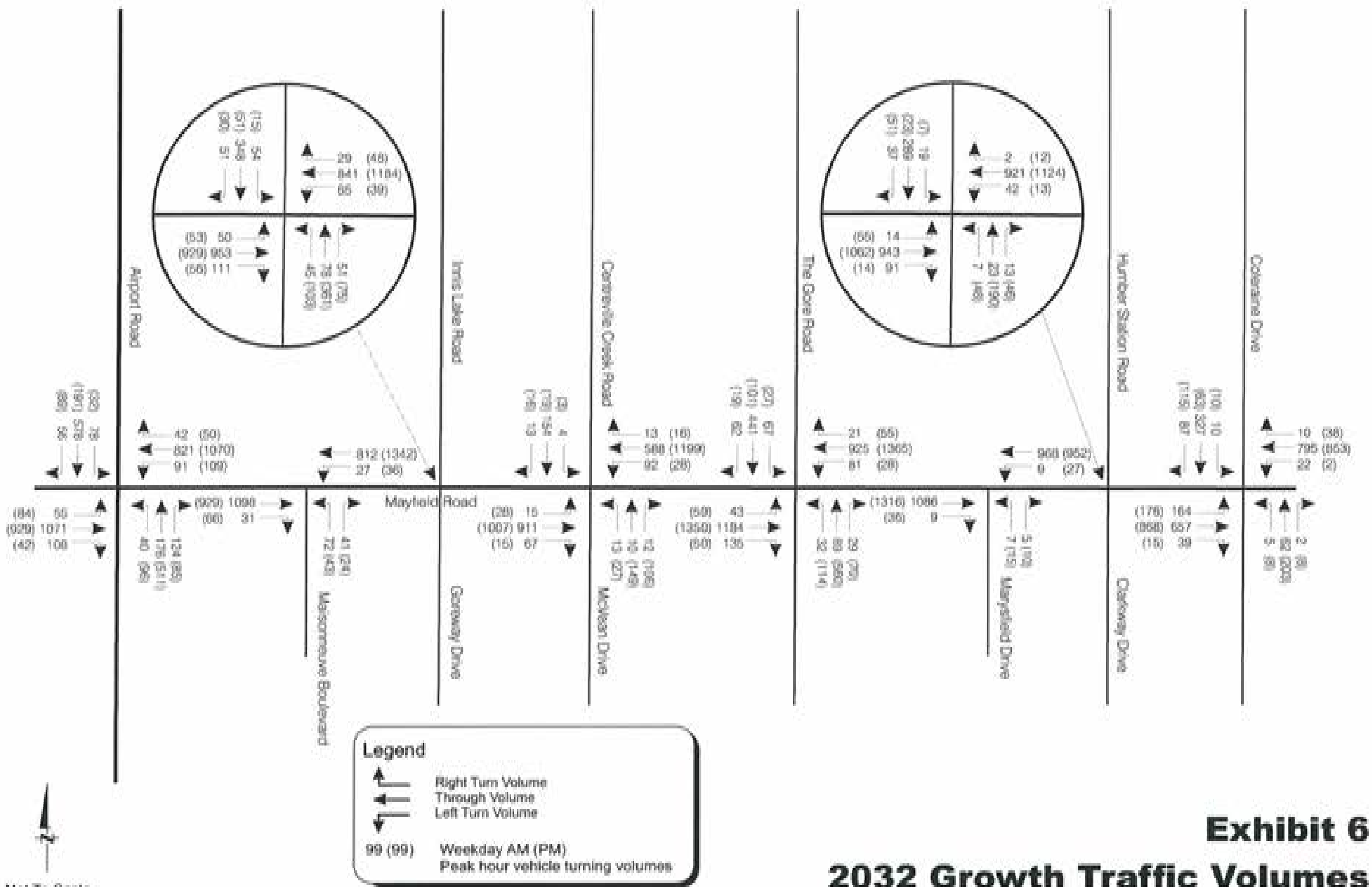

Exhibit 6
2032 Growth Traffic Volumes

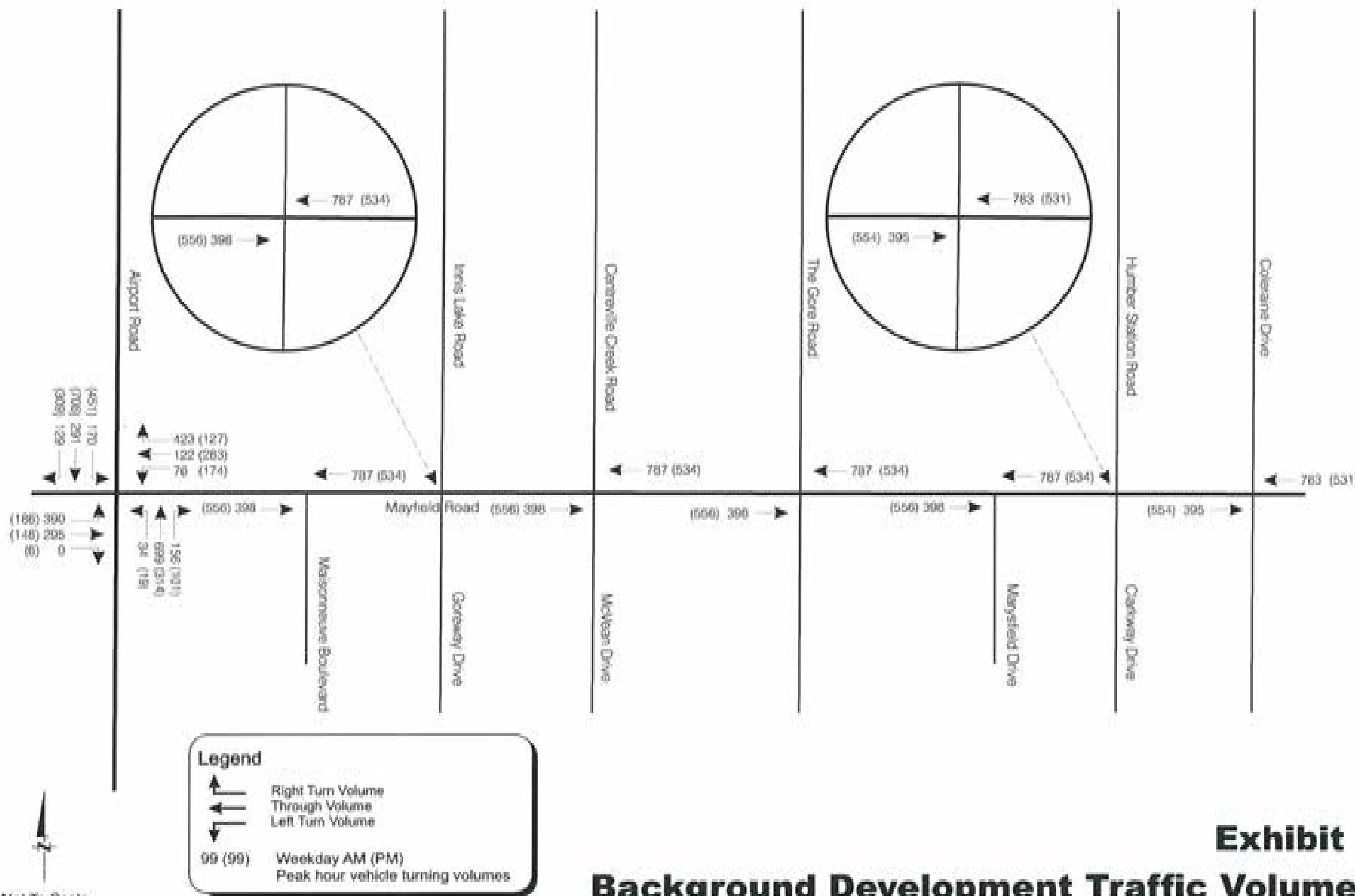

Exhibit 7
Background Development Traffic Volumes

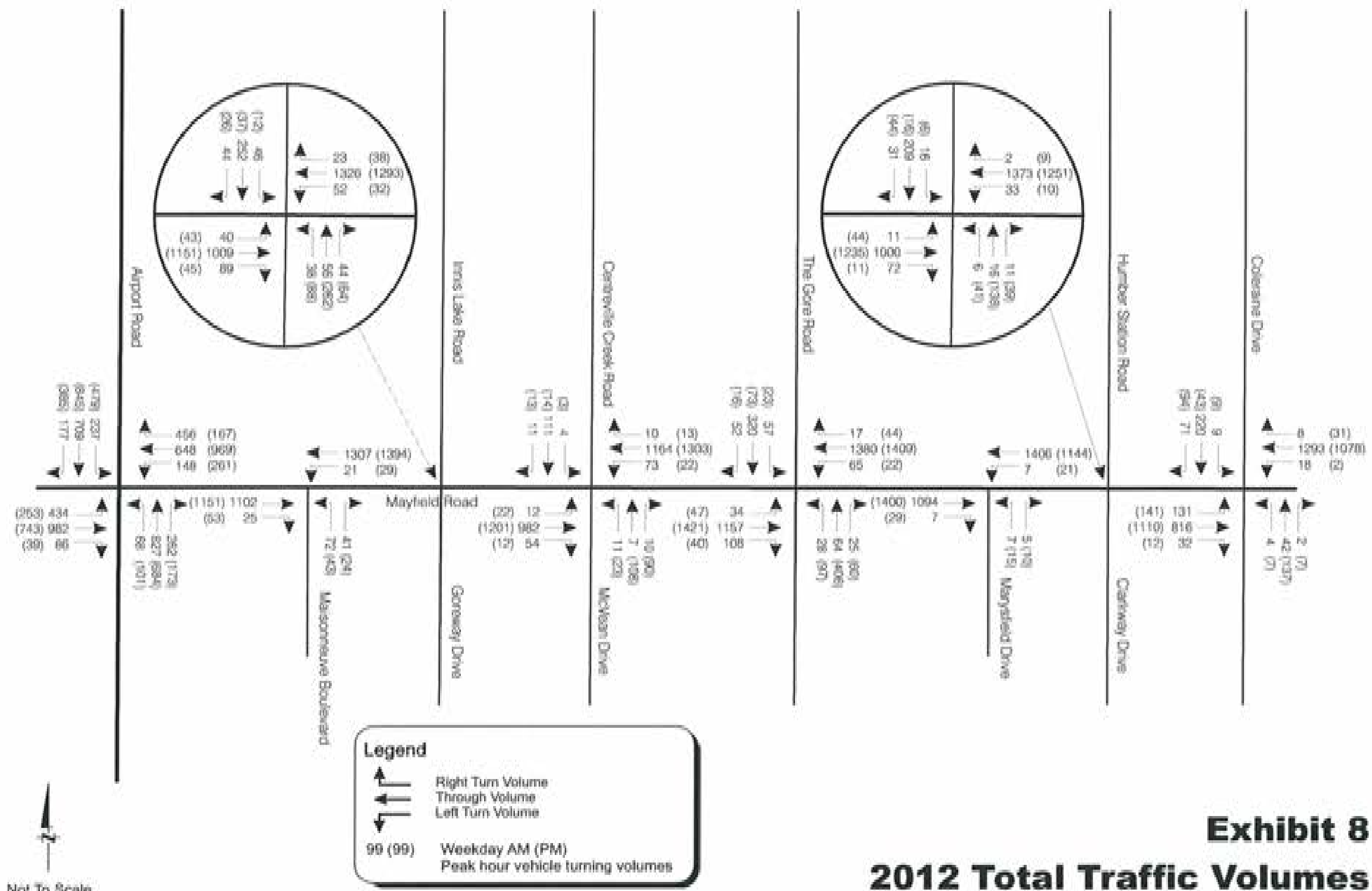

Exhibit 8
2012 Total Traffic Volumes

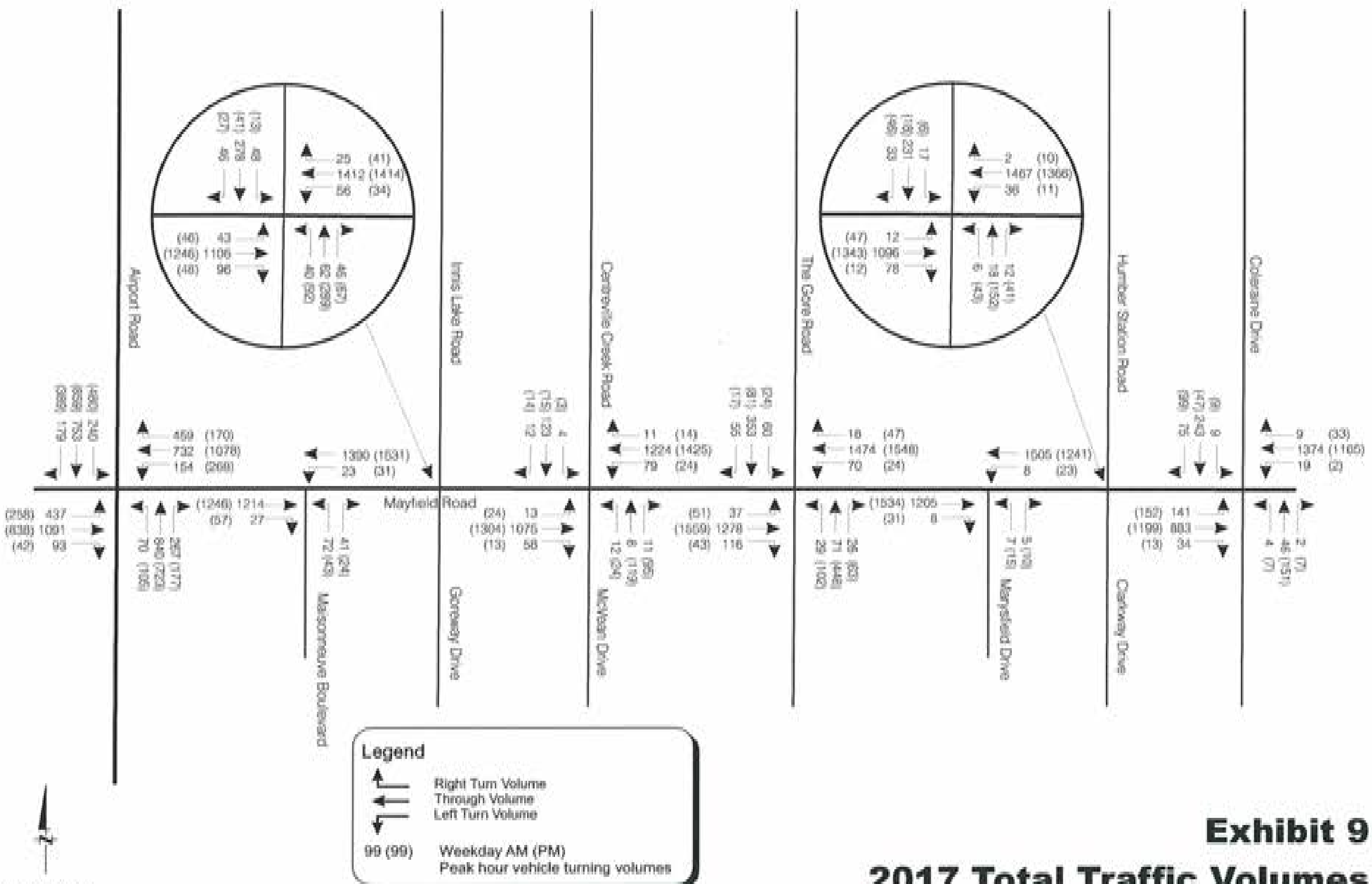

Exhibit 9
2017 Total Traffic Volumes

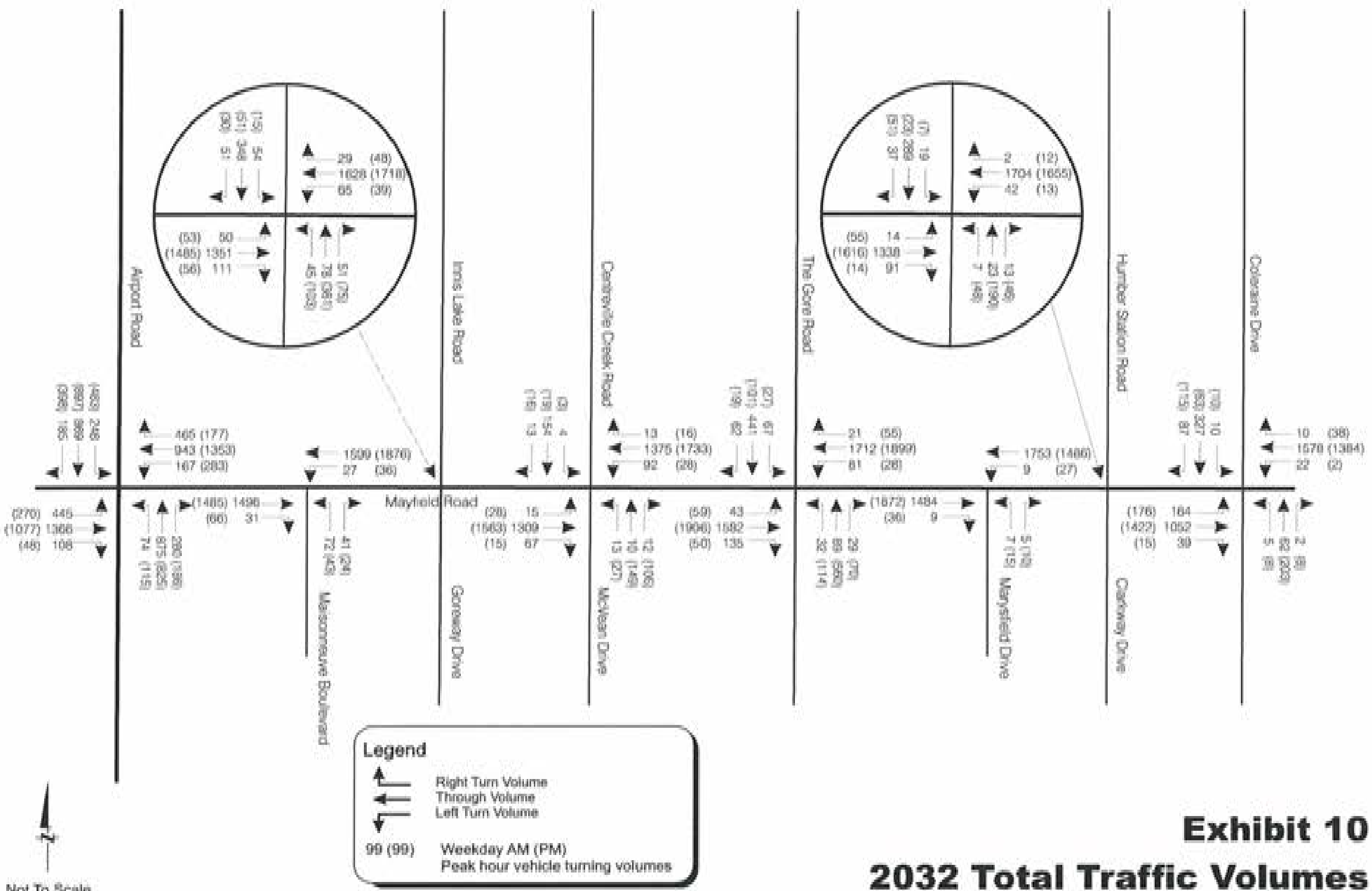

Exhibit 10
2032 Total Traffic Volumes

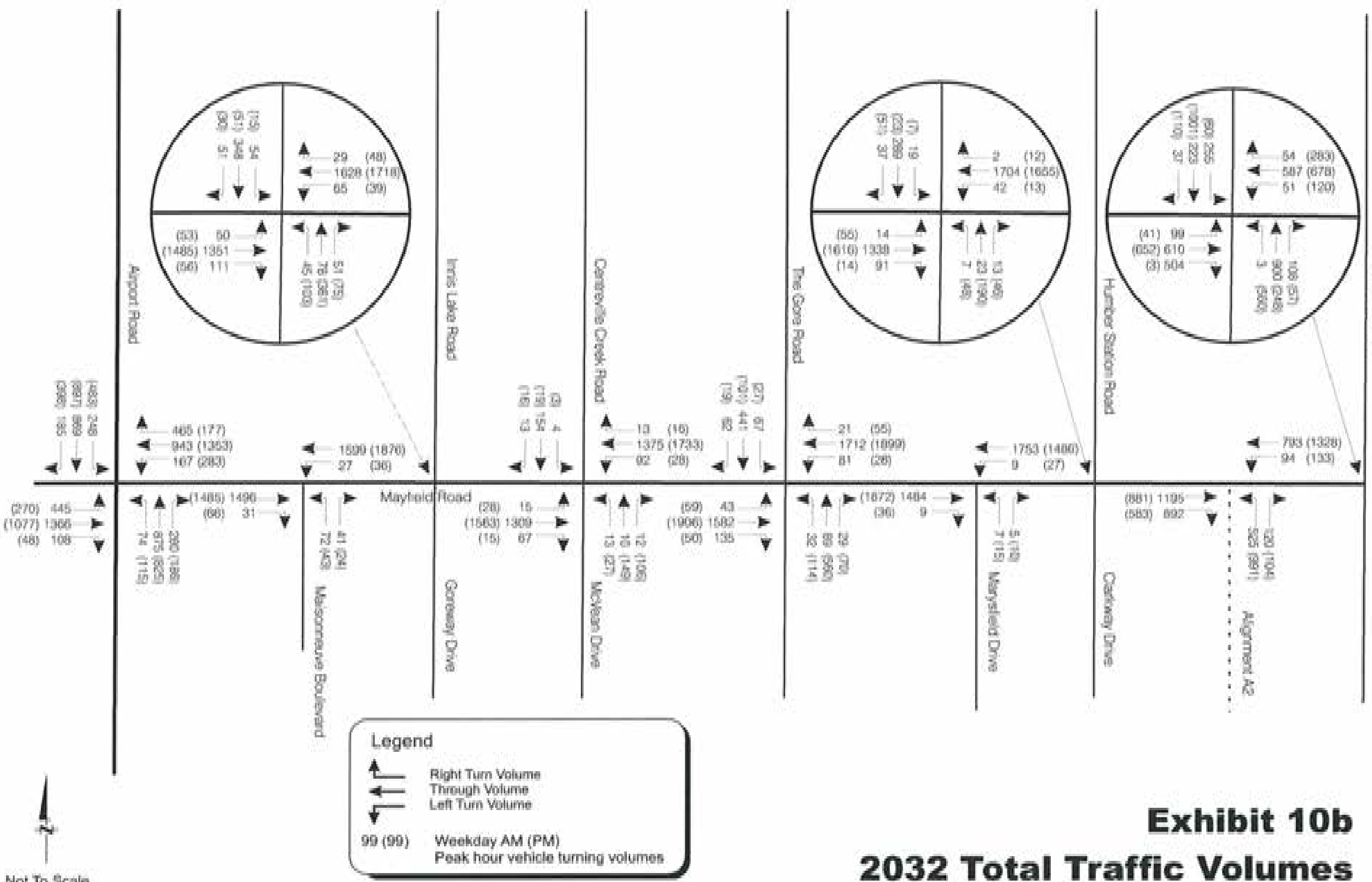

Exhibit 10b

2032 Total Traffic Volumes

3.4.4 Future Link Capacity Analysis

For the link analysis, a theoretical maximum link capacity of 1000 vehicles per hour per lane was applied to the existing volumes to assess a volume to capacity (v/c) ratio for each link of Mayfield Road. Link volume-to-capacity ratio of higher than 0.90 (or a volume of more than 900 per lane) indicates the need for additional link capacity.

Table 6 summarizes the link capacity analysis.

Table 6: Link Capacity Analysis

Location	Volume (Peak Hour Peak Direction)			Need
	Year 2012	**Year 2017**	**Year 2032**	
Mayfield Road (Airport Road to Maisonneuve Boulevard)	1397	1574	1919	6 lanes Prior to 2032
Mayfield Road (Maisonneuve Boulevard to Goreway Drive)	1423	1562	1912	6 lanes Prior to 2032
Mayfield Road (Goreway Drive / Innis Lake to McVean Drive)	1339	1463	1776	6 lanes by to 2032
Mayfield Road (McVean Drive / Centreville to The Gore Road)	1508	1653	2015	6 lanes Prior to 2032
Mayfield Road (The Gore Road to Marysfield Drive)	1475	1619	1982	6 lanes Prior to 2032
Mayfield Road (Marysfield Drive to Clarkway Drive)	1413	1544	1882	6 lanes Prior to 2032
Mayfield Road (Clarkway Drive to Proposed Road)	1309	1477	1670	6 lanes by to 2032
Mayfield Road (Proposed Road to Coleraine Drive)	1309	1477	1670 (or 1461 with new arterial)	4 lanes (New proposed 4 lane arterial)

The link analysis shows the need for 4 lanes on Mayfield Road throughout the study area by prior to 2012. Based on the link analysis, Mayfield Road will need to be widened through most road sections to six lanes by 2032. A new roadway is proposed east of Clarkway Drive that would provide connectivity to Highway 427. It would be appropriate to provide six lanes of capacity from Coleraine Drive to this new roadway by 2032 to provide lane continuity.

The study findings are in keeping with the findings of the following studies:

- Brampton Transportation and Transit Master Plan – June 2009
- Peel -427 Extension Area Transportation Master Plan – June 2009 Final Draft Report

3.4.5 2012 Future Intersection Analysis without Mayfield Road Improvements

Based on the link forecasts presented in **Exhibit 8**, through **Exhibit 10**, it is evident that there will be capacity deficiencies on Mayfield Road well before the 10-year horizon. Intersection analyses using Synchro were also conducted to assess the capacity deficiencies. **Table** 7 and **Table 8** summarize the intersection operations analysis for 2012 traffic assigned to the existing road network (i.e. Mayfield at 2 lanes). Detailed analysis is provided in **Appendix B**.

Table 7: 2012 Overall Level of Service at Signalized Intersections (Existing Road Network)

Signalized Intersection	Time Period	V/C (1)	Overall V/C	LOS (2)
Mayfield Road and Airport Road	AM Peak	>1.00	>1.00	F
	PM Peak	>1.00	>1.00	F
Mayfield Road and Goreway Road / Innis Lake Road	AM Peak	>1.00	>1.00	D
	PM Peak	>1.00	0.95	D
Mayfield Road and The Gore Road	AM Peak	>1.00	>1.00	F
	PM Peak	>1.00	>1.00	F

1 - V/C – maximum volume / capacity ratio for critical movement and not the average for the intersection
2 - LOS – overall level of service

Table 8: 2012 Overall Level of Service at Unsignalized Intersections (Existing Road Network)

Unsignalized Intersection	Time Period	V/C (1)	LOS (2)
Mayfield Road and Maisonneuve Boulevard	AM Peak	>1.00	F
	PM Peak	>1.00	F
Mayfield Road and McVean Drive / Centreville Creek Road	AM Peak	>1.00	F
	PM Peak	>1.00	F
Mayfield Road and Marysfield Drive	AM Peak	0.25	F
	PM Peak	0.62	F
Mayfield Road and Clarkway Drive	AM Peak	0.97	F
	PM Peak	>1.00	F
Mayfield Road and Humber Station Road	AM Peak	>1.00	F
	PM Peak	0.81	F
Mayfield Road and Coleraine Drive (south leg)	AM Peak	0.53	F
	PM Peak	0.93	F
Mayfield Road and Coleraine Drive (north leg)	AM Peak	>1.00	F
	PM Peak	>1.00	F

1 - V/C – maximum volume / capacity ratio for the critical movement and not the average for the intersection
2 - LOS – maximum level of service for all the individual movements

As shown in **Table 7** and **Table 8**, several intersections on Mayfield Road between Airport Road and Coleraine Drive would be experiencing LOS F and have v/c ratios greater than 1.0 during both AM and PM peak hours.

Based on the results of the 2012 analysis, intersection analyses of 2017 forecasts on the existing road network were not required to assess the need for Mayfield Road improvements. However, intersection analysis for 2017 and 2032 was conducted to determine the long term lane requirements for any future widening of Mayfield Road.

The analysis of 2012 forecast volumes on existing Mayfield Road confirm that traffic levels will exceed the capacity of a 2-lane arterial road (1,000 vph). By 2012, vehicles will have limited alternative routes to travel east-west across eastern Brampton to access the rest of the GTA. Although constrained by the 2 lanes, vehicle demand (including trucks) on Mayfield Road will continue to grow based on developments proceeding.

3.4.6 2012 Future Intersection Analysis with Mayfield Road Improvements – No Widening

3.4.6.1 Exclusive Turn Lane Improvements

The Region of Peel has indicated that it is their practice to provide exclusive left-turn lanes for public street intersections. Based on the intersection analysis presented in **Table 7** and **Table 8**, turning-lane improvements were added to the existing network to develop a recommended 2012 road network. Mayfield Road remains as a 2-lane road in this scenario. The improvements to Mayfield Road include the signalization of the Mayfield Road / Maisonneuve Boulevard, Mayfield Road / McVean Drive & Centreville Creek Road, Mayfield Road / Clarkway Drive & Humber Station Road, and the Mayfield Road and Coleraine Drive intersections, as well as turning-lane improvements. Additional northbound and southbound through lanes were included at The Gore Road.

With Mayfield Road remaining as 2-lanes, and with signalization and turning-lane improvements added, the capacity problems could not be resolved. Further improvements, specifically the widening of Mayfield Road, will need to be explored.

3.4.6.2 Jog Elimination - Clarkway Drive / Humber Station Road

The Mayfield Road and Clarkway Drive / Humber Station Road intersection currently operates as three-legged unsignalized intersection with a jog in the north-south road alignment. A scenario was analyzed in which there was no widening to Mayfield Road, but the jog was eliminated and they aligned as a four-legged intersection. The elimination of the jog did not bring the v/c ratios under 1.00. Signalization of the intersection was also tested as an additional improvement. With signalization of both of the four-legged intersection, the v/c ratio was still greater than 1.00, with Mayfield Road operating as a 2-lane cross-section.

3.4.7 2012 Future Intersection Analysis with Mayfield Road Improvements – 4 Lane Widening

Based on the intersection analysis presented in **Table** 7 widening to a 4-lane cross-section and lane improvements were applied to the existing network to develop a recommended 2012 road network. Synchro analysis was conducted using the 2012 traffic forecast and the recommended lane configurations shown in **Exhibit 11**. The improvements to Mayfield Road also include the signalization of the Mayfield Road / Maisonneuve Boulevard, Mayfield Road / McVean Drive & Centreville Creek Road, Mayfield Road / Clarkway Drive & Humber Station Road, and the Mayfield Road and Coleraine Drive intersections. **Table 9** and **Table 10** summarize the intersection operations at the signalized and unsignalized intersections, respectively, based on 4 lanes between Airport Road and Coleraine Drive. Detailed analysis is provided in **Appendix C**.

Table 9: 2012 Overall Level of Service at Signalized Intersections (with Improvements – 4 lane widening)

Signalized Intersection	Time Period	V/C (1)	Overall V/C	LOS (2)
Mayfield Road and Airport Road	AM Peak	0.91	0.87	D
	PM Peak	0.92	0.87	D
Mayfield Road and Maisonneuve Boulevard	AM Peak	0.62	0.55	A
	PM Peak	0.62	0.53	A
Mayfield Road and Goreway Road / Innis Lake Road	AM Peak	0.75	0.68	B
	PM Peak	0.72	0.61	B
Mayfield Road and McVean Drive / Centreville Creek Road	AM Peak	0.58	0.54	A
	PM Peak	0.64	0.58	A
Mayfield Road and The Gore Road	AM Peak	0.59	0.61	A
	PM Peak	0.72	0.64	B
Mayfield Road and Clarkway Drive / Humber Station Road	AM Peak	0.70	0.67	A
	PM Peak	0.63	0.57	A
Mayfield Road and Coleraine Drive	AM Peak	0.80	0.72	B
	PM Peak	0.64	0.59	A

1 - V/C – maximum volume / capacity ratio for critical movement and not the average for the intersection
2 - LOS – overall level of service

Table 10: 2012 Overall Level of Service at Unsignalized Intersections (with Improvements– 4 lane widening)

Unsignalized Intersection	Time Period	V/C (1)	LOS (2)
Mayfield Road and Marysfield Drive	AM Peak	0.11	E
	PM Peak	0.33	F

1 - V/C – maximum volume / capacity ratio for the critical movement and not the average for the intersection
2 - LOS – maximum level of service for all the individual movements

Inclusion of a four-lane cross-section within the next 5 years demonstrates that the provision of an additional lane in each direction on Mayfield Road would result in acceptable operations and additional capacity which would be sufficient to accommodate the forecasted volumes beyond the 2012 horizon year (to 2016). While minor street (Marysfield Drive) left-turn movements will experience level of service E and F during peak hours, there will be sufficient capacity to accommodate all movements and delay will not exceed 76 seconds for any movement. This is common for minor street left-turn movements onto arterial roads. The volumes at the Marysfield Drive / Mayfield Road intersection will be well below the thresholds for traffic signal warrants.

Exhibit 11
2012 Recommended Road Network

3.4.8 2017 Future Intersection Analysis with 2012 Proposed Mayfield Road Improvements

A similar analysis with 2017 traffic forecasts assigned to Mayfield Road was also performed to help determine the lane requirements over the 10-year horizon. The 2017 total traffic volumes in **Exhibit 9** were analyzed using Synchro for the 2012 recommended lane configurations as shown in **Exhibit 11**. The 2017 analysis used the lane configurations recommended in 2012, to determine if any further improvements are required. **Table 11** and **Table 12** summarize the intersection operations at the signalized and unsignalized intersections, respectively. Detailed analysis is provided in **Appendix D**.

Table 11: 2017 Overall Level of Service at Signalized Intersections (with 2012 Proposed Improvements – 4 lane widening)

Signalized Intersection	Time Period	V/C (1)	Overall V/C	LOS (2)
Mayfield Road and Airport Road	AM Peak	0.93	0.91	D
	PM Peak	0.93	0.92	E
Mayfield Road and Maisonneuve Boulevard	AM Peak	0.64	0.57	A
	PM Peak	0.66	0.57	A
Mayfield Road and Goreway Road / Innis Lake Road	AM Peak	0.78	0.72	B
	PM Peak	0.74	0.66	B
Mayfield Road and McVean Drive / Centreville Creek Road	AM Peak	0.63	0.55	A
	PM Peak	0.68	0.63	A
Mayfield Road and The Gore Road	AM Peak	0.74	0.65	B
	PM Peak	0.75	0.68	B
Mayfield Road and Clarkway Drive / Humber Station Road	AM Peak	0.73	0.71	A
	PM Peak	0.67	0.61	A
Mayfield Road and Coleraine Drive	AM Peak	0.88	0.79	B
	PM Peak	0.66	0.60	A

1 - V/C – maximum volume / capacity ratio for critical movement and not the average for the intersection
2 - LOS – overall level of service

Table 12: 2017 Overall Level of Service at Unsignalized Intersections (with 2012 Proposed Improvements – 4 lane widening)

Unsignalized Intersection	Time Period	V/C (1)	LOS (2)
Mayfield Road and Marysfield Drive	AM Peak	0.14	F
	PM Peak	0.45	F

1 - V/C – maximum volume / capacity ratio for the critical movement and not the average for the intersection
2 - LOS – maximum level of service for all the individual movements

As shown in **Table 11** and **Table 12**, the widening of Mayfield Road to 4 lanes and the other intersection improvements recommended in 2012 provide sufficient capacity and maintain acceptable levels of service by 2017. While minor street (Marysfield Drive) left-turn movements will experience level of service F during peak hours, there will be sufficient capacity to accommodate all movements and delay will not exceed 113 seconds for any movement. All intersections are anticipated to operate with volume to capacity ratios less than 0.90, with the exception of the Mayfield Road and Airport Road intersection. Therefore, no further improvements are required to the 2017 road network beyond what was recommended in the 2012 horizon year.

3.4.9 2032 Future Intersection Analysis with 2017 Proposed Mayfield Road Improvements

A similar analysis with 2032 traffic forecasts assigned to Mayfield Road was also performed to help determine the long term lane requirements. The 2032 total traffic volumes in **Exhibit 10** were analyzed using Synchro for the 2017 recommended lane configurations as shown in **Exhibit 11**. The 2032 analysis uses the lane configurations recommended in 2017 (and 2012), to determine if any further improvements are required. **Table 13** and **Table 14** summarize the intersection operations at the signalized and unsignalized intersections, respectively. Detailed analysis is provided in **Appendix E**.

Table 13: 2032 Overall Level of Service at Signalized Intersections (with 2017 Proposed Improvements – 4 lane widening)

Signalized Intersection	Time Period	V/C (1)	Overall V/C	LOS (2)
Mayfield Road and Airport Road	AM Peak	>1.00	>1.00	F
	PM Peak	>1.00	>1.00	F
Mayfield Road and Maisonneuve Boulevard	AM Peak	0.70	0.63	A
	PM Peak	0.76	0.67	A
Mayfield Road and Goreway Road / Innis Lake Road	AM Peak	0.83	0.83	B
	PM Peak	0.81	0.78	B

Table 13: 2032 Overall Level of Service at Signalized Intersections (with 2017 Proposed Improvements – 4 lane widening) Cont'd

Signalized Intersection	Time Period	V/C (1)	Overall V/C	LOS (2)
Mayfield Road and McVean Drive / Centreville Creek Road	AM Peak	0.66	0.61	A
	PM Peak	0.83	0.74	B
Mayfield Road and The Gore Road	AM Peak	0.79	0.73	B
	PM Peak	0.83	0.82	B
Mayfield Road and Clarkway Drive / Humber Station Road	AM Peak	0.84	0.80	B
	PM Peak	0.76	0.72	A
Mayfield Road and Coleraine Drive	AM Peak	0.90	0.87	C
	PM Peak	0.76	0.73	B

1 - V/C – maximum volume / capacity ratio for critical movement and not the average for the intersection
2 - LOS – overall level of service

Table 14: 2032 Overall Level of Service at Unsignalized Intersections (with 2017 Proposed Improvements – 4 lane widening)

Unsignalized Intersection	Time Period	V/C (1)	LOS (2)
Mayfield Road and Marysfield Drive	AM Peak	0.26	F
	PM Peak	0.94	F

1 - V/C – maximum volume / capacity ratio for the critical movement and not the average for the intersection
2 - LOS – maximum level of service for all the individual movements

As shown in **Table 13** and **Table 14**, Mayfield Road at Airport Road would be experiencing LOS F and have v/c ratios greater than 1.0 during both AM and PM peak hours.

3.4.10 2032 Future Intersection Analysis with Additional Mayfield Road Improvements

Based on the intersection analysis presented in **Table 13** and **Table 14**, lane improvements were added to the 2017 road network to develop a recommended 2032 road network. There is a demonstrated need for additional east-west capacity through the Airport Road intersection and additional north-south capacity through The Gore Road intersection. Synchro analysis was conducted using the 2032 traffic forecast and the recommended lane configurations shown in **Exhibit 12**. Detailed analysis is provided in **Appendix F**.

Exhibit 12
2032 Recommended Road Network

Table 15: 2032 Overall Level of Service at Signalized Intersections (with Additional Improvements)

Signalized Intersection	Time Period	V/C (1)	Overall V/C	LOS (2)
Mayfield Road and Airport Road	AM Peak	0.94	0.89	D
	PM Peak	0.99	0.93	E
Mayfield Road and Maisonneuve Boulevard	AM Peak	0.70	0.63	A
	PM Peak	0.76	0.67	A
Mayfield Road and Goreway Road / Innis Lake Road	AM Peak	0.82	0.82	B
	PM Peak	0.80	0.77	B
Mayfield Road and McVean Drive / Centreville Creek Road	AM Peak	0.67	0.61	A
	PM Peak	0.83	0.74	B
Mayfield Road and The Gore Road	AM Peak	0.80	0.76	B
	PM Peak	0.83	0.80	B
Mayfield Road and Clarkway Drive / Humber Station Road	AM Peak	0.84	0.80	B
	PM Peak	0.76	0.72	A
Mayfield Road and Coleraine Drive	AM Peak	0.90	0.86	C
	PM Peak	0.74	0.72	B

1 - V/C – maximum volume / capacity ratio for critical movement and not the average for the intersection
2 - LOS – overall level of service

Table 16: 2032 Overall Level of Service at Unsignalized Intersections (with Additional Improvements)

Signalized Intersection	Time Period	V/C (1)	LOS (2)
Mayfield Road and Marysfield Drive	AM Peak	0.26	F
	PM Peak	0.94	F

1 - V/C – maximum volume / capacity ratio for the critical movement and not the average for the intersection
2 - LOS – maximum level of service for all the individual movements

As shown in **Table 15**, **Table 16**, and **Exhibit 12**, the widening of Mayfield Road to 6 lanes would be required from Airport Road through to Maisonneuve Boulevard to maintain acceptable intersection levels of service and v/c ratios by 2032. The other sections of Mayfield Road would require additional east-west capacity (a widening to 6 lanes) to meet the link demands as documented in Section 3.3.6. To be consistent with Region of Peel operational practice the addition, of exclusive turn lanes are recommended, as identified in **Exhibit 12**. In the long term, increase in traffic volumes on Mayfield Road will result in fewer gaps in traffic to accommodate left-turn movements from Marysfield Drive. Traffic volumes at the Marysfield Drive / Mayfield Road intersection should be monitored for traffic signal warrants.

Volumes are not expected to exceed capacity, but delay will increase to over 6 minutes for left-turns during peak hours. Volumes at the Marysfield Drive intersection are anticipated to remain well below warrants for traffic control signals, but volumes and driver behaviour should be monitored.

3.4.11 Queuing and Storage Requirements

Table 17, Table 18, Table 19, and **Table 20** summarize the critical peak hour storage lengths required by 2012, 2017, and 2032 forecast turning movement volumes for left turn lanes on Mayfield Road. The storage requirements are based on the worst case scenario of 95th percentile queues estimated by the Synchro analysis. The tables identify movements which in the future will require mitigation through design. Detailed analysis is provided in **Appendix G**.

Table 17: Existing Traffic Queue Lengths

Intersection & Movement		AM Peak Hour	PM Peak Hour	Mitigation Measures
	Existing Storage (m)	(queue m)	(queue m)	(storage m)
Airport Road / Mayfield Road				
Eastbound Left-turn	80	<10	11	
Eastbound Right-turn	80	<10	<10	
Westbound Left-turn	65	12	11	
Westbound Right-turn	75	<10	<10	
Northbound Left-turn	140	<10	16	
Northbound Right-turn	65	<10	<10	
Southbound Left-turn	125	15	<10	
Southbound Right-turn	65	<10	<10	
Maisonneuve Boulevard / Mayfield Road				
Eastbound Right-turn	30	<10	<10	
Westbound Left-turn	50	<10	<10	
Goreway Drive / Mayfield Road				
Eastbound Left-turn	35	<10	<10	
Eastbound Right-turn	30	<10	<10	
Westbound Left-turn	40	<10	<10	
Northbound Left-turn	60	<10	<10	
Northbound Right-turn	40	<10	<10	
Southbound Left-turn	45	<10	<10	

Table 17: Existing Traffic Queue Lengths Cont'd

Intersection & Movement		AM Peak Hour	PM Peak Hour	Mitigation Measures
	Existing Storage (m)	(queue m)	(queue m)	(storage m)
McVean Drive / Mayfield Road				
Eastbound Left-turn	50	<10	<10	
Westbound Left-turn	65	<10	<10	

None of the existing storage lanes are exceeded by the 95th percentile queue. There are no exclusive turning lanes for any of the intersections east of Mayfield Road / McVean Drive, so queuing analysis was not performed for this intersections in the existing traffic scenario.

Table 18: 2012 Total Traffic Queue Lengths

Intersection & Movement		AM Peak Hour	PM Peak Hour	Mitigation Measures
	Existing Storage (m)	(queue m)	(queue m)	(storage m)
Airport Road / Mayfield Road				
Eastbound Left-turn[1]	80	83	55	Lengthen to 85
Eastbound Right-turn	80	12	<10	
Westbound Left-turn	65	73	112	Lengthen to 115
Northbound Left-turn	140	32	53	
Northbound Right-turn	65	25	19	
Southbound Left-turn[1]	125	53	91	
Southbound Right-turn	65	16	44	
Maisonneuve Boulevard / Mayfield Road				
Eastbound Right-turn	30	<10	<10	
Westbound Left-turn	50	<10	<10	
Goreway Drive / Mayfield Road				
Eastbound Left-turn	35	<10	<10	
Eastbound Right-turn	30	<10	<10	
Westbound Left-turn	40	<10	<10	
Northbound Left-turn	60	14	21	
Northbound Right-turn	40	<10	<10	
Southbound Left-turn	45	14	<10	

[1] Dual left turn lane is proposed

Table 18: 2012 Total Traffic Queue Lengths Cont'd

Intersection & Movement		AM Peak Hour	PM Peak Hour	Mitigation Measures
	Existing Storage (m)	(queue m)	(queue m)	(storage m)
McVean Drive / Mayfield Road				
Eastbound Left-turn	50	<10	<10	
Westbound Left-turn	65	<10	<10	
Northbound Left-turn	-	<10	<10	Design as 15
Southbound Left-turn	-	<10	<10	Design as 15
The Gore Road / Mayfield Road				
Eastbound Left-turn	-	<10	11	Design as 15
Eastbound Right-turn	-	<10	<10	Design as 15
Westbound Left-turn	-	11	<10	Design as 15
Northbound Left-turn	-	<10	24	Design as 25
Southbound Left-turn	-	15	<10	Design as 15
Clarkway Drive / Mayfield Road				
Eastbound Left-turn	-	<10	<10	Design as 15
Westbound Left-turn	-	<10	<10	Design as 15
Northbound Left-turn	-	<10	<10	Design as 15
Southbound Left-turn	-	<10	<10	Design as 15
Coleraine Drive / Mayfield Road				
Eastbound Left-turn	-	15	13	Design as 15
Westbound Left-turn	-	<10	<10	Design as 15
Northbound Left-turn	-	<10	<10	Design as 15
Southbound Left-turn	-	<10	<10	Design as 15

[1] Dual left turn lane is proposed

In 2012, the eastbound and westbound left-turn lanes at the Airport Road / Mayfield Road intersection will need to be lengthened from their existing storage length. There are also several new exclusive turning lanes that will need to be designed to accommodate the 95th percentile queue length. The design storage lengths have been indicated in the mitigation measures column in the table above.

Table 19: 2017 Total Traffic Queue Lengths

Intersection & Movement	2012 Storage (m)	AM Peak Hour (queue m)	PM Peak Hour (queue m)	Mitigation Measures (storage m)
Airport Road / Mayfield Road				
Eastbound Left-turn[1]	85	82	57	
Eastbound Right-turn	80	13	<10	
Westbound Left-turn	115	77	117	Lengthen to 120
Northbound Left-turn	140	33	55	
Northbound Right-turn	65	27	21	
Southbound Left-turn	125	56	92	
Southbound Right-turn	65	17	47	
Maisonneuve Boulevard / Mayfield Road				
Eastbound Right-turn	30	<10	<10	
Westbound Left-turn	50	<10	<10	
Goreway Drive / Mayfield Road				
Eastbound Left-turn	35	11	11	
Eastbound Right-turn	30	<10	<10	
Westbound Left-turn	40	<10	<10	
Northbound Left-turn	60	18	24	
Northbound Right-turn	40	<10	<10	
Southbound Left-turn	45	15	<10	
McVean Drive / Mayfield Road				
Eastbound Left-turn	50	<10	<10	
Westbound Left-turn	65	12	<10	
Northbound Left-turn	15	<10	<10	
Southbound Left-turn	15	<10	<10	
The Gore Road / Mayfield Road				
Eastbound Left-turn	15	<10	23	Lengthen to 25
Eastbound Right-turn	15	<10	<10	
Westbound Left-turn	15	14	<10	
Northbound Left-turn	25	11	31	Lengthen to 35
Southbound Left-turn	15	17	11	Lengthen to 20

[1] Dual left turn lane is proposed

Table 19: 2017 Total Traffic Queue Lengths Cont'd

Intersection & Movement	2012 Storage (m)	AM Peak Hour (queue m)	PM Peak Hour (queue m)	Mitigation Measures (storage m)
Clarkway Drive / Mayfield Road				
Eastbound Left-turn	15	<10	<10	
Westbound Left-turn	15	<10	<10	
Northbound Left-turn	15	<10	11	
Southbound Left-turn	15	<10	<10	
Coleraine Drive / Mayfield Road				
Eastbound Left-turn	15	24	15	Lengthen to 25
Westbound Left-turn	15	<10	<10	
Northbound Left-turn	15	<10	<10	
Southbound Left-turn	15	<10	<10	

[1] Dual left turn lane is proposed

In 2017, the westbound left-turn lane at the Airport Road / Mayfield Road intersection, the eastbound, northbound, and southbound left-turn lanes at Mayfield Road / The Gore Road intersection, and the eastbound left-turn lane at the Coleraine Drive / Mayfield Road intersection will all need to be lengthened from their 2012 storage lengths indicated in the table above.

Table 20: 2032 Total Traffic Queue Lengths

Intersection & Movement	2017 Storage (m)	AM Peak Hour (queue m)	PM Peak Hour (queue m)	Mitigation Measures (storage m)
Airport Road / Mayfield Road				
Eastbound Left-turn[1]	85	84	55	
Eastbound Right-turn	80	14	<10	
Westbound Left-turn	120	82	125	Lengthen to 125
Northbound Left-turn	140	42	58	
Northbound Right-turn	65	29	25	
Southbound Left-turn[1]	125	56	97	
Southbound Right-turn	65	18	42	
Maisonneuve Boulevard / Mayfield Road				
Eastbound Right-turn	30	<10	<10	
Westbound Left-turn	50	<10	<10	

[1] Dual left turn lane is proposed

Table 20: 2032 Total Traffic Queue Lengths Cont'd

Intersection & Movement		AM Peak Hour	PM Peak Hour	Mitigation Measures
	2017 Storage (m)	(queue m)	(queue m)	(storage m)
Goreway Drive / Mayfield Road				
Eastbound Left-turn	35	21	22	
Eastbound Right-turn	30	<10	<10	
Westbound Left-turn	40	13	<10	
Westbound Right-turn	-	<10	<10	Design as 15
Northbound Left-turn	60	30	36	
Northbound Right-turn	40	<10	16	
Southbound Left-turn	45	21	<10	
McVean Drive / Mayfield Road				
Eastbound Left-turn	50	<10	<10	
Eastbound Right-turn	-	<10	<10	Design as 15
Westbound Left-turn	65	27	<10	
Northbound Left-turn	15	<10	<10	
Southbound Left-turn	15	<10	<10	
The Gore Road / Mayfield Road				
Eastbound Left-turn	25	15	32	Lengthen to 35
Eastbound Right-turn	15	<10	<10	
Westbound Left-turn	15	10	<10	
Westbound Right-turn	-	<10	<10	Design as 15
Northbound Left-turn	35	17	39	Lengthen to 40
Southbound Left-turn	20	25	16	Lengthen to 25
Clarkway Drive / Mayfield Road				
Eastbound Left-turn	15	<10	22	Lengthen to 25
Eastbound Right-turn	-	<10	<10	Design as 15
Westbound Left-turn	15	<10	<10	
Northbound Left-turn	15	<10	12	
Southbound Left-turn	15	<10	<10	

Table 20: 2032 Total Traffic Queue Lengths Cont'd

Intersection & Movement		AM Peak Hour	PM Peak Hour	Mitigation Measures
	2017 Storage (m)	(queue m)	(queue m)	(storage m)
Coleraine Drive / Mayfield Road				
Eastbound Left-turn	25	55	41	Lengthen to 55
Eastbound Right-turn	-	<10	<10	Design as 15
Westbound Left-turn	15	<10	<10	
Westbound Right-turn	-	<10	<10	Design as 15
Northbound Left-turn	15	<10	<10	
Southbound Left-turn	15	<10	<10	

In 2032, the westbound left-turn lane at the Airport Road / Mayfield Road intersection, the eastbound, northbound, and southbound left-turn lanes at Mayfield Road / The Gore Road intersection, the eastbound left-turn lane at Mayfield Road / Clarkway Drive, and the eastbound left-turn lane at the Coleraine Drive / Mayfield Road intersection will all need to be lengthened from their 2017 storage lengths indicated in the table above. Additionally, several exclusive right-turn lanes are proposed along Mayfield Road. The storage length required for all of these new lanes is 15 metres.

4. ULTIMATE NEEDS FOR MAYFIELD ROAD CORRIDOR

4.1 Region of Peel Official Plan

The Region of Peel Official Plan designates Mayfield Road as a 50 m right-of-way. The designated right-of-way will allow for an ultimate 6-lane (plus turn lanes) cross-section. The need for 6 lanes from Airport Road to the new proposed road link east of Clarkway Drive will be required prior to 2032 as identified in Section 3 of this report. The need for 6 lanes from the new proposed road link east of Clarkway Drive to Coleraine Drive may be realized beyond the year 2032.

4.2 GTA West Corridor Environmental Assessment

The GTA West Corridor Environmental Assessment (EA) Study is being conducted by the Ministry of Transportation to assess the need for and identify the location of a new east-west transportation corridor between Highway 400 in York Region and the Guelph area. The environmental Terms of Reference for the study were approved by the Ministry of the Environment, and clarification of a new transportation corridor is anticipated upon the completion of the study (beyond the next two years). A new corridor may confirm or lessen the need for six lanes on Mayfield Road. However the nature and timing of a GTA West Corridor may not be sufficient to address the short, medium and possibly even long term needs along Mayfield Road.

The GTA West Corridor EA will require an extensive public process to define a corridor for new infrastructure. Opportunities for new corridors are limited. The existing Mayfield Road will continue to be a key corridor alternative. It is recommended that the designated 50 meter right-of-way be retained.

5. SUMMARY OF NEEDS ASSESSMENT

iTRANS has assessed the short term and long term need for improvements on Mayfield Road and determined the ultimate lane requirements based on the 2012, 2017, and 2032 planning horizons.

The midblock future lane requirements for Mayfield Road are summarized below in **Table 21**, while the recommended future lane configurations at the study area intersections were illustrated in **Exhibit 11** and **Exhibit 12**.

Table 21: Recommended Number of Lanes on Mayfield Road (Based on Horizon Years)

From	To	Recommended Number of Lanes		
		2012	2017	2032
West of Airport Road		4	4	6
Airport Road	Maisonneuve Boulevard	4	4	6
Maisonneuve Boulevard	Goreway Road / Innis Lake Road	4	4	6
Goreway Road / Innis Lake Road	McVean Drive / Centreville Creek Road	4	4	6
McVean Drive / Centreville Creek Road	The Gore Road	4	4	6
The Gore Road	Marysfield Drive	4	4	6
Marysfield Drive	Clarkway Drive / Humber Station Road	4	4	6
Clarkway Drive / Humber Station Road	New Roadway	4	4	6
New Roadway	Coleraine Drive	4	4	4

The recommendations are based on a review of available data and reports and updated information provided by the Region of Peel. The Region of Peel provided appropriate traffic growth between 2012, 2017, and 2032 along Mayfield Road.

Findings from other ongoing studies, including the Peel-Highway 427 Extension Transportation Master Plan Study and Brampton Transportation and Transit Master Plan Study are consistent with recommended improvements. The Region of Peel Official Plan designates Mayfield Road as a 50 m right-of-way. The designated right-of-way will allow for an ultimate 6-lane (plus turn lanes) cross-section.

6. SAFETY PERFORMANCE REVIEW

The following sections document the comprehensive safety review of the existing conditions of Mayfield Road from Airport Road to Coleraine Drive. The safety review followed the same study area of Mayfield Road as the traffic analysis (**Exhibit 1**).

iTRANS conducted an office review of the data provided prior to undertaking a site investigation. The office investigation aims to bring a preliminary understanding of the area, the collision history and their causes, as well as the traffic movements in the study area (**Section 6.1**). The trends and patterns of collisions and related potential causes, in conjunction with the traffic operations, road geometry and adjacent land use provide the investigators with a list of concerns to consider during the site visit. These concerns are combined with issues observed and measured during the site investigation (**Section 6.2**). An understanding of these issues provided the background for identifying potential countermeasures to improve the safety performance of Mayfield Road (**Section 6.3**).

Possible road widening options that may be considered during the EA process were also considered from a safety perspective (**Section 6.3**).

6.1 Office Investigation

The office investigation began with an examination of the collision history of the road segments and intersections.

The following information was reviewed during the office investigation:
- 4 years of collision reports from 2003 to 2006
- Aerial photography of Mayfield Road

The Region provided police reports for 97 collisions, however 18 collisions were determined to be outside of the study area. The study area for this safety review included the functional area of each intersection from Airport Road to Coleraine Drive, and the road segments of Mayfield Road that lie in between those intersections. The functional area of each intersection was defined as the average length of the intersection turn lanes. Where the average turn lane length was less than 30 metres, the functional area was defined as 30 metres. These are the functional areas of intersections (by cross-street):

Airport Road	155 metres
Innis Lake Road / Goreway Drive	101 metres
Centreville Creek Road	86 metres
The Gore Road	30 meters
Humber Station Road	30 meters
Coleraine Drive	30 meters

Of the 97 collision reports provided by the Region, 18 collisions occurred on the cross-streets outside of the functional area of the intersection with Mayfield Road, and were excluded from this safety review.

From the 79 collisions remaining, summary tables were developed to determine possible trends, such as collision location, time of day, and environmental collisions. A summary of the collision history of the entire corridor is provided in **Table 22**. Specific findings for each intersection are provided in **Sections 6.1.1** to **6.1.6**. Collisions on road segments are discussed in **Section 6.1.7**.

Table 22: Summary of Reported Collisions along Mayfield Road from Airport Road to Coleraine Drive (2003 to 2006)

Location	Total	Injury	PDO	Collision types
Airport Road	32	3	29	9 Angle 1 Approaching 6 Rear-end 5 Sideswipe 8 Turning Movement 2 SMV Other 1 Other
Innis Lake Road/ Goreway Drive	13	1	12	3 Angle 8 Rear-end 1 Sideswipe 1 SMV Other
Centreville Creek Road	2	2	0	2 Angle
The Gore Road	5	0	5	2 Rear-end 1 Turning Movement 1 Sideswipe 1 SMV Other
Humber Station Road/ Clarkway Drive	9	1	8	2 Angle 4 Rear-end 1 Sideswipe 1 Turning Movement 1 SMV Other
Coleraine Drive	2	0	2	2 Turning Movement
All Road Segments	16	2	14	1 Angle 4 Rear-end 1 Sideswipe 8 SMV Other 2 Other
TOTAL	79	9	70	17 Angle 1 Approaching 24 Rear-end 9 Sideswipe 12 Turning Movement 13 SMV Other 3 Other

NOTE SMV = Single Motor Vehicle; PDO = Property Damage Only

The overall collision analysis findings for the entire corridor are:

- 46.8% of collisions during peak periods (6 to 9 AM and 3 to 6 PM) (37 of 79)
- 24.7% of collisions are rear-end (24 of 79)
- 21.5% of collisions are angle (17 of 79)
- Majority of collisions not caused by adverse environmental conditions (82.3% during daylight, 93.7% during clear weather, 70.9% with dry road surface)
- 82.3% of collisions occur in the functional area of intersections (65 of 79)
- No fatal collisions from 2003 to 2006

6.1.1 Airport Road at Mayfield Road

There were a total of 32 collisions reported for the four-year period at this signalized intersection. A collision summary by type is shown in **Table 23**. Of the 32 collisions, there were 3 injury collisions and no fatalities. Region of Peel staff have indicated that fatal crashes may have occurred in 2007.

Table 23: Collision Summary by Type – Airport Road at Mayfield Road

Collision Type	Total Collisions	NB	SB	EB	WB
Angle	9	5 (4 NB/EB, 1 NB/WB)	1 (SB/WB)	0	3 (1 WB/NB, 2 WB/SB)
Approaching	1	0	1 (SB/EB)	0	0
Rear End	6	2 (2 NB/NB)	0	0	4 (3 WB/WB, 1 WB/WB/WB)
Sideswipe	5	2 (NB/EB)	0	1 (EB/NB)	2 (2 WB/WB)
Turning Movement	8	4 (1 NB/SB, 3 NB/EB)	0	3 (2 EB/WB, EB/NB)	1 (WB/EB)
SMV Other	2	1	1	0	0
Other	1	1 (NB/SB)	0	0	0

Angle collisions are the most common type of collision at this intersection (nine recorded collisions). The directions of travel indicate six vehicles were travelling northbound, four westbound, four eastbound, and two southbound. The angle collisions may indicate an issue with sight distances, signal head visibility, or driver awareness of the intersection. Two angle collisions occurring on the east leg of the intersection involved cars using driveways colliding with cars travelling straight along Mayfield Road.

Turning movement collisions are the second most frequent type with eight collisions recorded at this intersection. Of the vehicles involved in these crashes, seven were travelling eastbound, five were travelling northbound, three were travelling westbound and one southbound. Turning movement collisions at this intersection were tied to driveways close to the intersection and the traffic leaving those private driveways. Four turning movement collisions occurred at driveways on the west leg of the intersection.

The large number of driveways within the functional area of this intersection, including three on the west leg and nine in total, should be addressed to decrease collisions. Three of the driveways are private and six are commercial driveways.

Four of six rear end collisions at this intersection involved vehicles travelling westbound. Two northbound rear ends occurred at the intersection. One possible factor contributing to the rear-end collisions may be the combination of signal timing and the dilemma zone. One definition of the dilemma zone is "Drivers are in the dilemma zone if, when they see the yellow indication, they lack adequate distance to stop before the intersection but are too far away to enter the intersection before the red indication". Rear end collisions that occur in clear dry conditions may also be related to congestion and queuing, access points near the intersection, road surface, intersection conspicuity or driver guidance.

Five sideswipe collisions were recorded at this intersection. Three of those collisions involved northbound and eastbound vehicles. The other two cases involved both vehicles travelling westbound.

Three collisions were recorded as SMV other or other. One of the single vehicle accidents occurred in the northbound direction and the other in the southbound direction. The accident recorded as "other" involved one vehicle travelling northbound and one southbound.

One approaching collision occurred at this intersection. According to the police report one vehicle was travelling southbound and the other travelling eastbound.

6.1.2 Innis Lake Road / Goreway Drive at Mayfield Road

There were a total of 13 collisions reported for the four-year period at this signalized intersection. No fatalities and one injury collision were recorded. A collision summary by type is shown in **Table 24**.

Table 24: Collision Summary by Type – Innis Lake Road / Goreway Drive at Mayfield Road

Collision Type	Total Collisions	NB	SB	EB	WB
Angle	3	1 (NB/SB)	0	0	2 (WB/SB, WB/NB)
Rear End	8	0	0	2 (EB/EB/EB, EB/EB)	6 (6 WB/WB)
Sideswipe	1	1 (NB/NB)	0	0	0
SMV Other	1	0	1	0	0

Rear end collisions were the most common type of collision at this intersection. Two collisions involved eastbound vehicles and the other six involved westbound vehicles. As noted previously, possible contributing factors to rear end collisions include the dilemma zone, road surface conditions, queuing, intersection conspicuity or driver guidance.

There were three angle collisions at this intersection. One collision involved a westbound vehicle striking a northbound vehicle, another involved a westbound vehicle striking a southbound vehicle and the third involved a vehicle travelling north and one travelling south. Possible contributing factors to angle collisions include sight distance, signal head visibility, driver awareness of the intersection, driveways in the intersection functional area, and red light running.

One sideswipe collision was recorded at this intersection. The vehicles were travelling northbound.

One collision was recorded as SMV other. This single vehicle collision occurred in the southbound direction and was an animal collision.

6.1.3 Centreville Creek Road at Mayfield Road

There were a total of two collisions reported for the four-year period at this two-way stop-controlled intersection. A collision summary by type is shown in **Table 25**. Both of the collisions resulted in injury.

Table 25: Collision Summary by Type – Centreville Creek Road at Mayfield Road

Collision Type	Total Collisions	NB	SB	EB	WB
Angle	2	1 (NB/WB)	0	1 (EB/SB)	0

Angle collisions are the only collision type recorded at this intersection. Two collisions over four years are not enough to establish a pattern.

6.1.4 The Gore Road at Mayfield Road

There were a total of two collisions reported for the four-year period at this signalized intersection. A collision summary by type is shown in **Table 26**. None of the collisions resulted in injury.

Table 26: Collision Summary by Type – The Gore Road at Mayfield Road

Collision Type	Total Collisions	NB	SB	EB	WB
Rear End	2	0	0	2 (EB/EB)	0
Turning Movement	1	0	0	1 (EB/NB)	0
Sideswipe	1	0	1 (SB/NB)	0	0
SMV Other	1	0	1	0	0

The two rear end collision at this intersection involved vehicles travelling in the eastbound direction.

One collision was a turning movement in which one vehicle travelling eastbound struck a vehicle travelling northbound. One collision was a sideswipe where one vehicle was travelling southbound and the other travelling northbound. There was on single motor vehicle collision involving a southbound direction of travel. No injuries were sustained in these collisions.

6.1.5 Humber Station Road / Clarkway Drive at Mayfield Road

There were a total of nine collisions recorded for the four-year period at this two-way stop-controlled offset intersection. A collision summary by type is shown in **Table 27**. One collision resulted in an injury.

Table 27: Collision Summary by Type – Humber Station Road/Clarkway Drive at Mayfield Road

Collision Type	Total Collisions	NB	SB	EB	WB
Angle	2	1 (NB/EB)	1 (SB/WB)		
Rear End	4	0	2 (2 SB/SB)	1 (EB/EB)	1 (WB/WB)
Turning Movement	1	1 (NB/WB)	0	0	0
Sideswipe	1	0	1 (SB/SB)	0	0
SMV Other	1	0	0	0	1

Four collisions at this intersection were rear end collisions. One collision involved vehicles travelling in the westbound direction, one involved vehicles travelling in the eastbound direction, and the other two were southbound collisions.

Two angle collisions occurred in the four-year period at this intersection: one involving a northbound and an eastbound vehicle, and one involving a southbound and a westbound vehicle.

The turning movement involved one vehicle heading northbound and the other heading westbound. One collision was a sideswipe with vehicles travelling in the southbound direction. One westbound single motor vehicle collision occurred at this intersection.

6.1.6 Coleraine Drive at Mayfield Road

There were a total of two collisions reported for the four-year period at this two-way stop-controlled offset intersection. A collision summary by type is shown in **Table 28**. Both of the collisions resulted in property damage only.

Table 28: Collision Summary by Type – Coleraine Drive at Mayfield Road

Collision Type	Total Collisions	NB	SB	EB	WB
Turning Movement	2	1 (NB/SB)	0	1 (EB/SB/EB)	0

Turning movement collisions are the only type that occurred at this intersection. Two collisions over four years are not enough to establish a pattern.

6.1.7 Road Segments

There were 18 collisions recorded on the road segments of this corridor. The collision summary is as follows: eight SMV other, four rear-end, one angle, one sideswipe and two other. Two injuries occurred in the road segment accidents over the four years.

These collisions are insufficient to establish trends for each individual segment. Some possible causes of the collisions recorded on the segments in the corridor are explored below.

Of the eight single motor vehicle collisions, four involved animals. Two animal related collisions were recorded on the segment between Centreville Creek Road and Innis Lake Road / Goreway Road during the four year period. Also, two animal related collisions were recorded on the section of road between The Gore Road and Centreville Creek Road. In some cases the car struck the animal, and in other cases the collision was a result of a vehicle taking measures to avoid hitting an animal. Animal collisions are often found in a rural setting such as Mayfield Road.

Loss of control is one possible cause of single motor vehicle accidents. Lost-control collisions may be the result of the condition of the driver and driver error. There are factors that do not necessarily make it onto the collision report that may be causes of these single motor vehicle accidents. Drivers can be drowsy and lose focus and could also be involved in talking on cell phones, adjusting the car sound system, picking up objects within the vehicle that have fallen, dressing and grooming themselves, and eating or drinking. Taking one's eyes off the road even for a couple seconds can lead to loss of control even in good weather conditions.

Rear-end collisions on road segments may be the result of vehicles slowing to turn into driveways, causing traffic behind them to slow or stop. Rear-end collisions may also be related to queues and congestion, driver inattention, or following too closely.

The one angle collision that occurred on the segments was related to a driveway access and the conflict of vehicles utilizing this accesses and drivers travelling along Mayfield Road.

6.1.8 Summary of Issues for Field Investigation

Upon completion of the office investigation, a list of concerns to examine further was compiled prior to visiting Mayfield Road. Due to the low frequency of collisions occurring on Mayfield Road with the exception of the Airport Road intersection, there are few site-specific trends identified through the office investigation. In general, rear-end collisions are the most common form of collision in the corridor, and westbound traffic is most frequently involved, particularly on the segments (75% of vehicles involved in segment collisions).

For the purposes of the site visit, issues for review have been summarized here based on the collision types observed. The items have been grouped by type of roadway element. Note that these lists are preliminary and that on-site observation is likely to introduce new factors that influence collisions that are not identifiable through an office investigation only.

General factors to investigate:
- Lane configuration and continuity, road surface conditions, pavement markings
- Signal head visibility, signage
- Horizontal and vertical curves, sight distances to intersections and driveways
- Offset intersections
- Left-turn lane offset, intersection alignment and sightlines
- Posted speed limits, general operating speeds
- Shoulder type and width, guide rails, sideslopes, clear zone

Rear End Collisions:
- Dilemma zone, intergreen period, congestion or queuing
- Potential driver distractions
- Access points within the intersection functional area

Angle Collisions:
- Inability to stop at intersection due to high speed
- Red light running
- Private driveway conspicuity and sight distances

SMV Other:
- Awareness of area wildlife crossings
- In-car driver distraction
- Driver drowsiness

Turning Movement Collisions:
- Red light running
- Gap acceptance by drivers
- Signal timing/operation, particularly for left-turns

6.2 Field Investigation

The field investigation was conducted on the morning of December 4, 2007. The weather was cold with light snow. Due to the weather and roadside conditions, the roadside observations were conducted from the car. The route was driven in both directions and filmed, and observations were recorded.

It should be noted that a nighttime investigation was not conducted since 82.3% of collisions occurred during daylight.

The following sections document the observations made while on site. These observations will lead to the potential countermeasures in **Section 6.3**.

6.2.1 Lane Configuration and Road Surface

The existing lane configuration in the corridor is a 2-lane road which widens to include turn lanes at the intersections. Passing is generally allowed throughout the corridor with the exception of a no passing zone (double yellow centreline) from about 200 metres east of Goreway Drive / Innis Lake Drive to Airport Road.

Most collisions along this corridor occur with a dry road surface. Minor polishing and wearing of the pavement surface was noted along the corridor. Geotechnical investigations will provide detailed pavement conditions as part of the environmental assessment.

6.2.2 Signs and Signals

Signal heads at all signalized intersections are adequately visible to approaching traffic. There are warning flashers at Coleraine Drive; these flashers are visible to approaching traffic, and intersection warning signs alert drivers of intersections where the north-south street is stop-controlled.

Street name signs are generally small in size and are not consistent throughout the corridor. Some of the intersections in the study area have advance street name signs, most of the intersections have street name signs at the intersection. All are mounted on short wooden posts.

Clearance intervals at the signalized intersections appear to be adequate based on field observations and a review of the existing signal timing plans. Based on the collisions recorded and field observations, the dilemma zone was not identified as a substantial issue at any of the signalized intersections.

Queuing was observed at Airport Road; however there were no queues that lasted after the red light changed to green and no queues of more than three vehicles observed.

6.2.3 Geometry and Sight Distance

The horizontal alignment of this portion of Mayfield Road is generally tangent, with a horizontal curve on the east leg of the intersection of Airport Road. The vertical alignment is gently rolling, with some vertical grades near the water crossings, at The Gore Road and on the approaches to Goreway Drive / Innis Lake Road.

The sight distances throughout the corridor appear to be sufficient for the design speed based on observations from the car. Specific sight distances were not measured during the field investigation. It is anticipated that any sight distance deficiencies will be addressed through the EA process.

There are two intersections in which the north and south legs are offset: Humber Station / Clarkway Drive, and Centreville Creek Road / McVean Road. At the Humber Station intersection there is a 27 metre offset, and at the Centreville Creek intersection there is a five metre offset.

The left-turn lanes along this corridor generally have a zero offset; that is, each dedicated left-turn lane is aligned directly with the opposite direction left-turn lane.

Sightlines for eastbound left-turning drivers at the intersection of Airport Road will have limited sightlines to oncoming westbound traffic if there is a vehicle in the westbound left-turn lane, due to the horizontal alignment on the east leg.

6.2.4 Intersections

Access points are located within the functional area of some intersections in the study area. Access points create additional conflict points, which is a point where the paths of two vehicles cross. Increasing the number of conflict points can decrease the safety performance of a road segment or intersection. Of particular note, the access points near Airport Road appear to be contributing to collisions, as noted in the office investigation, and based on observations during the field investigation.

Yellow or red light running was not observed at the signalized intersections during the field investigation.

6.2.5 Road Segments

The posted speed limit varies between 60 km/h and 80 km/h in the study area, as summarized in **Table 29**. Operating speeds were observed to be generally higher than the posted speed based on travelling on Mayfield Road at the speed of traffic (i.e. speed of traffic methodology). Average and 85th percentile speed measurements were not taken.

Table 29: Road Segment Speed Limits

From	To	Speed Limit
RR 50 Highway 50	805 metres east of RR 8 The Gore Road	80 km/h
805 metres east of RR 8 The Gore Road	315 metres west of RR 8 The Gore Road	60 km/h
315 metres west of RR 8 The Gore Road	100 metres east of Goreway Drive/Innis Lake Road	80 km/h
100 metres east of Goreway Drive / Innis Lake Road	490 metres west of RR 7 Airport Road	60 km/h
490 metres west of RR 7 Airport Road	760 metres east of Bramalea Road	80 km/h

Operating speeds were not available at the time of the study. Based on field observations and the rural nature of the roadway, it is likely that operating speeds on Mayfield Road are higher than the posted speed limit of 60 km/h or 80 km/h. Angle and turning movement collisions can occur due to high operating speeds or speed differentials among vehicles approaching an intersection or driveway

Along Mayfield Road, edgelines are generally provided. Beyond the edgeline, the shoulder typically consists of a narrow pavement width, and a 1.5 to 2 metre gravel shoulder. Beyond the shoulder, the roadside varies from recoverable ditches to steep side slopes that lead into fields, residences, and there are several watercourses. There are guide rails along the road at several locations throughout the corridor, as well as at the water crossings. Compliance with roadside safety practices should be investigated through the design process of the environmental assessment.

There is a line of utility poles along both sides of Mayfield Road for the length of this study area. The poles are approximately 10 metres from the edgeline.

Pavement markings along the corridor and at intersections are clear. They were fairly visible even with some snow coverage on the road.

No urban forms of external driver distractions are located in the corridor (e.g., billboards or commercial signage). For the most part, the surrounding land use is open field, with some residences and the occasional service station.

Although Mayfield Road is not illuminated, every intersection within the study area has at least one street light.

6.2.6 Village of Wildfield

In the area of The Gore Road intersection with Mayfield Road is the historic Village of Wildfield, a collection of farms, houses and businesses that are officially part of the Town of Caledon. There are several driveways on either side of Mayfield Road through the Village. Wildfield also contains a school for which there are fluorescent yellow-green school crossing signs visible as a vehicle approaches the intersection from either side.

6.3 Potential Countermeasures

This section outlines potential countermeasures to increase safety for all users throughout the corridor based on findings of the office and field investigations. These countermeasures may be considered for implementation through the EA process.

The expected effectiveness of a countermeasure requires information about the Accident Modification Factor or Function (AMF) for the specific conditions of the site. AMFs provide estimates of the change (decrease or increase) in the frequency and/or severity of collisions that occur after implementation of a countermeasure or combination of countermeasures. AMFs are often calculated separately by collision severity (e.g., fatal, injury, PDO) and/or collision type (e.g., nighttime collisions, pedestrian collisions, etc.). AMFs are expressed as a decimal factor. If the AMF for a countermeasure is 0.80, the implementation of the countermeasure is expected to reduce the number of collisions to 80% of the present number; that is, a collision reduction of 20%. AMFs are generally derived from before-and-after evaluations of similar installations undertaken. Where available, reliable AMFs are provided in the following discussion.

6.3.1 Village of Wildfield

During the development of design alternatives for Mayfield Road, consideration should be given to the accommodation of the existing driveways and the school crossing within the Town of Wildfield. The potential need for speed management within the transition from undeveloped area to the rural centre including, turning lanes, and the accommodation of pedestrians and other modes can be assessed as part of the alternatives for Mayfield Road.

6.3.2 Existing Conditions

1. There were few SMV collisions recorded in the study area (13 of 79, 16%). However, there are a number of shoulder and roadside treatments that could be considered along with the improvements for Mayfield Road. Shoulder and roadside improvements may increase safety by aiding errant vehicles to regain control and safely recover to the roadway. Some shoulder and roadside improvements for the entire corridor that can be assessed in the design alternatives include:
   - **Increasing the paved surface of the shoulders** to 0.5 metres (partially paved) will provide more stable recovery area for any errant vehicles. This additional width may also provide a place for vehicles to avoid rear-end collisions, and will provide a semi-

turning lane for vehicles turning right into driveways. The Region may wish to consider using a surfacing material of different appearance for the shoulder than the type of material used on the travel lanes. This dissimilar appearance will help drivers to differentiate between the travel lanes and shoulder.

- Other suggested roadside improvements would involve providing an **adequate clear zone and recoverable slopes** as part of other road improvements, following the MTO or AASHTO Roadside Design Guides.
- It is noted that shoulder rumble strips do not appear to be warranted at this time along this corridor; the reported collisions do not indicate drowsy or inattentive drivers leaving the roadway.

2. **Signs with larger letter heights**, and placed in more prominent locations would provide better guidance to drivers. All intersection street name signs at intersections could be placed on existing overhead signal arms. This prominent location improves the conspicuity of the sign. In addition, the letter size should be increased, and the font should have upper and lower case letters, to match the guidelines in OTM Book 1B. Advance signage may still be provided, however it is recommended that the current signs be replaced with signs with bigger font.

3. To increase awareness of certain driveways that may be considered hidden, **post-mounted delineators** could be provided to demarcate the driveway openings along Mayfield Road.

4. To increase awareness of the potential for wildlife crossings, **wildlife warning signs** could be placed at key wildlife crossing locations, or locations where wildlife are frequently involved in collisions, as determined by the Region.

5. Consider communicating the safety issues to Peel Region Police and Ontario Provincial Police – Caledon Detachment, and encourage increasing **enforcement** of speeding and the use of clearance intervals to mitigate the turning movement and angle collisions. Applications such as **Red light cameras** could be used as a potential tool that can be used to assist enforcement at signalized intersections to decrease right-angle collisions of all severities and injury severity, and increase rear-end collisions of all severities and injury severity, as shown in **Table 30**.[1] This option could be considered as a form of mitigation for any future collision trends.

[1] Persaud, B., Council, F. M., Lyon, C., Eccles, K., and Griffith, M., "A Multi-Jurisdictional Safety Evaluation of Red Light Cameras." 84th Transportation Research Board Annual Meeting, Washington, D.C., (2005) pp. 1-14.

Table 30: Accident Modification Factors for installing red-light cameras at intersections

Treatment	Setting Intersection type	Traffic Volume	Collision type Severity	AMF	Std. Error
Install red light cameras	Urban Unspecified	Entering AADTs Minor: 12,562 to 33,679 vpd Major: 52,625 to 109,067 vpd	Right-angle All severities	0.75	0.04
			Right-angle Injury	0.84	0.07
			Rear-end All severities	1.15	0.04
			Rear-end Injury	1.24	0.1

NOTE: "vpd" = vehicles per day, AMF = Accident Modification Factor

6. Driveway density along Mayfield Road is low; however, the Region may wish to monitor those accesses within the functional area of intersections. Access points within the functional area of an intersection increase the number of conflict points and may reduce the safety performance of the intersection, particularly if traffic volumes on the road or using the driveway increase. Through the EA process, the Region may wish to consider **implementing access management policies and guidelines** to minimize the potential for vehicle conflicts on intersection approaches.

6.3.3 Road Widening

Additional lanes for through traffic are not considered a potential measure to improve the safety performance of this section of Mayfield Road. However, it is recognized that road and intersection improvements may improve traffic flow and operations, therefore potentially reducing rear-end, angle, and turning movement collisions.

Left turn lanes were considered during the field investigation, in particular through the Town of Wildfield where driveway density is greatest. Options for introducing a TWLTL include a three-lane or five-lane cross-section. Some of the latest research suggests the following pros and cons for these options:

- Three-lane cross-section (two lanes plus TWLTL)
  - Expected to reduce driveway-turning collisions were driveway density is at least 3 driveways per kilometre
  - Generally favoured by residents with driveways
  - Permits two-stage turns - drivers turning left into driveways can wait for a gap in traffic without feeling pressured by following vehicles, and drivers turning left out of driveways can use the TWLTL as a refuge before merging with traffic
  - In the US, conversion from 4 lanes to 3 lanes is known as a "road diet" and studies to date have shown safety and operational benefits
- Five-lane cross-sections (four lanes plus TWLTL):
  - Less research is available; a threshold for driveway density was not found
  - Similar to 3-lane cross-section, permits two-stage turns
  - Road width can be a challenge for crossing pedestrians, and can generate negative reaction from residents unless traffic capacity is clearly needed
  - Operating speeds are a potential concern, particularly during off-peak

Auxiliary turn lanes are recommended where turning activity is anticipated. In addition to traffic turn lane warrants, auxiliary left turn lanes should be considered to address anticipated high speed conflicts. A fifth lane for a four lane widening and a seventh lane for the ultimate configuration should be considered in road sections with multiple accesses or intersections.

Appendix A
Existing Traffic Intersection Operation Calculations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1352	1779	1512	1534	1731	1002	1615	2852	1445	1313	3259	1166
Flt Permitted	0.43	1.00	1.00	0.32	1.00	1.00	0.54	1.00	1.00	0.68	1.00	1.00
Satd. Flow (perm)	616	1779	1512	517	1731	1002	912	2852	1445	943	3259	1166
Volume (vph)	40	565	78	65	432	30	32	110	98	62	361	45
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	40	565	78	65	432	30	32	110	98	62	361	45
RTOR Reduction (vph)	0	0	39	0	0	15	0	0	65	0	0	30
Lane Group Flow (vph)	40	565	39	65	432	15	32	110	33	62	361	15
Heavy Vehicles (%)	35%	8%	8%	19%	11%	63%	13%	28%	13%	39%	12%	40%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	22.7	22.7	22.7	22.7	22.7	22.7	14.2	14.2	14.2	14.2	14.2	14.2
Effective Green, g (s)	25.6	25.6	25.6	25.6	25.6	25.6	17.1	17.1	17.1	17.1	17.1	17.1
Actuated g/C Ratio	0.50	0.50	0.50	0.50	0.50	0.50	0.34	0.34	0.34	0.34	0.34	0.34
Clearance Time (s)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	311	898	763	261	874	506	308	962	487	318	1099	393
v/s Ratio Prot		c0.32			0.25			0.04			c0.11	
v/s Ratio Perm	0.06		0.03	0.13		0.02	0.04		0.02	0.07		0.01
v/c Ratio	0.13	0.63	0.05	0.25	0.49	0.03	0.10	0.11	0.07	0.19	0.33	0.04
Uniform Delay, d1	6.6	9.1	6.4	7.1	8.3	6.3	11.5	11.6	11.4	11.9	12.5	11.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	1.4	0.0	0.5	0.4	0.0	0.1	0.1	0.1	0.3	0.2	0.0
Delay (s)	6.8	10.5	6.4	7.6	8.7	6.3	11.7	11.6	11.5	12.2	12.7	11.3
Level of Service	A	B	A	A	A	A	B	B	B	B	B	B
Approach Delay (s)		9.8			8.4			11.6			12.5	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	10.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	50.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑↱		↰	↑	↱	↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1285	1746	1555	1615	1666		1674	1671	1317	1706	1678	
Flt Permitted	0.42	1.00	1.00	0.39	1.00		0.53	1.00	1.00	0.73	1.00	
Satd. Flow (perm)	573	1746	1555	668	1666		933	1671	1317	1303	1678	
Volume (vph)	36	502	81	47	443	21	35	48	41	43	217	41
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	36	502	81	47	443	21	35	48	41	43	217	41
RTOR Reduction (vph)	0	0	38	0	2	0	0	0	29	0	11	0
Lane Group Flow (vph)	36	502	44	47	462	0	35	48	12	43	247	0
Heavy Vehicles (%)	42%	10%	5%	13%	15%	5%	9%	15%	24%	7%	7%	37%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1		1	1			2		2	2		
Actuated Green, G (s)	23.5	23.5	23.5	23.5	23.5		11.9	11.9	11.9	11.9	11.9	
Effective Green, g (s)	26.1	26.1	26.1	26.1	26.1		14.5	14.5	14.5	14.5	14.5	
Actuated g/C Ratio	0.54	0.54	0.54	0.54	0.54		0.30	0.30	0.30	0.30	0.30	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	308	938	835	359	895		278	499	393	389	501	
v/s Ratio Prot		c0.29			0.28			0.03			c0.15	
v/s Ratio Perm	0.06		0.03	0.07			0.04		0.01	0.03		
v/c Ratio	0.12	0.54	0.05	0.13	0.52		0.13	0.10	0.03	0.11	0.49	
Uniform Delay, d1	5.6	7.3	5.4	5.6	7.2		12.4	12.3	12.1	12.4	14.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	0.6	0.0	0.2	0.5		0.2	0.1	0.0	0.1	0.8	
Delay (s)	5.7	7.9	5.4	5.8	7.7		12.6	12.4	12.1	12.5	14.8	
Level of Service	A	A	A	A	A		B	B	B	B	B	
Approach Delay (s)		7.4			7.5			12.4			14.5	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	48.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.98			1.00			0.97			0.98	
Flt Protected		1.00			0.99			0.99			0.99	
Satd. Flow (prot)		1749			1741			1633			1811	
Flt Permitted		0.97			0.88			0.88			0.94	
Satd. Flow (perm)		1694			1548			1460			1722	
Volume (vph)	31	624	98	59	487	15	26	55	23	53	276	48
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	31	624	98	59	487	15	26	55	23	53	276	48
RTOR Reduction (vph)	0	5	0	0	1	0	0	11	0	0	6	0
Lane Group Flow (vph)	0	748	0	0	560	0	0	93	0	0	371	0
Heavy Vehicles (%)	10%	8%	5%	10%	9%	20%	28%	7%	9%	13%	2%	2%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1			1			2			2		
Actuated Green, G (s)		36.3			36.3			21.1			21.1	
Effective Green, g (s)		38.3			38.3			23.1			23.1	
Actuated g/C Ratio		0.55			0.55			0.33			0.33	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		935			854			486			573	
v/s Ratio Prot												
v/s Ratio Perm		c0.44			0.36			0.06			c0.22	
v/c Ratio		0.80			0.66			0.19			0.65	
Uniform Delay, d1		12.5			10.9			16.5			19.7	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		5.0			1.8			0.2			2.5	
Delay (s)		17.4			12.7			16.7			22.2	
Level of Service		B			B			B			C	
Approach Delay (s)		17.4			12.7			16.7			22.2	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	16.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	69.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	80.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	579	23	19	427	72	41
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	579	23	19	427	72	41
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			602		1044	579
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			602		1044	579
tC, single (s)			4.3		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			98		71	92
cM capacity (veh/h)			911		247	509

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	579	23	19	427	72	41
Volume Left	0	0	19	0	72	0
Volume Right	0	23	0	0	0	41
cSH	1700	1700	911	1700	247	509
Volume to Capacity	0.34	0.01	0.02	0.25	0.29	0.08
Queue Length 95th (m)	0.0	0.0	0.4	0.0	8.2	1.8
Control Delay (s)	0.0	0.0	9.0	0.0	25.4	12.7
Lane LOS			A		D	B
Approach Delay (s)	0.0		0.4		20.8	
Approach LOS					C	

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	41.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✥			✥	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	11	480	49	66	310	9	10	6	9	4	96	10
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	11	480	49	66	310	9	10	6	9	4	96	10
Pedestrians											1	
Lane Width (m)											3.7	
Walking Speed (m/s)											1.2	
Percent Blockage											0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	320			529			1026	978	504	962	998	316
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	320			529			1026	978	504	962	998	316
tC, single (s)	4.6			4.1			7.6	6.5	6.3	7.1	6.5	6.4
tC, 2 stage (s)												
tF (s)	2.7			2.2			4.0	4.0	3.4	3.5	4.0	3.5
p0 queue free %	99			94			91	97	98	98	58	99
cM capacity (veh/h)	993			1033			109	233	550	216	226	684

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	11	529	66	319	25	110
Volume Left	11	0	66	0	10	4
Volume Right	0	49	0	9	9	10
cSH	993	1700	1033	1700	186	240
Volume to Capacity	0.01	0.31	0.06	0.19	0.13	0.46
Queue Length 95th (m)	0.2	0.0	1.4	0.0	3.2	15.6
Control Delay (s)	8.7	0.0	8.7	0.0	27.3	32.0
Lane LOS	A		A		D	D
Approach Delay (s)	0.2		1.5		27.3	32.0
Approach LOS					D	D

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	48.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	572	6	6	509	7	5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	572	6	6	509	7	5
Pedestrians					2	
Lane Width (m)					3.7	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			580		1098	577
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			580		1098	577
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		97	99
cM capacity (veh/h)			1002		236	519

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	578	515	12
Volume Left	0	6	7
Volume Right	6	0	5
cSH	1700	1002	305
Volume to Capacity	0.34	0.01	0.04
Queue Length 95th (m)	0.0	0.1	0.9
Control Delay (s)	0.0	0.2	17.3
Lane LOS		A	C
Approach Delay (s)	0.0	0.2	17.3
Approach LOS			C

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	41.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	507	65	6	509	7	5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	507	65	6	509	7	5
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			572		1060	540
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			572		1060	540
tC, single (s)			4.1		6.9	6.4
tC, 2 stage (s)						
tF (s)			2.2		4.0	3.5
p0 queue free %			99		97	99
cM capacity (veh/h)			1011		201	509

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	572	515	12
Volume Left	0	6	7
Volume Right	65	0	5
cSH	1700	1011	269
Volume to Capacity	0.34	0.01	0.04
Queue Length 95th (m)	0.0	0.1	1.0
Control Delay (s)	0.0	0.2	19.0
Lane LOS		A	C
Approach Delay (s)	0.0	0.2	19.0
Approach LOS			C

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	41.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	24	507	515	2	15	209
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	24	507	515	2	15	209
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	517				1071	516
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	517				1071	516
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				94	63
cM capacity (veh/h)	1049				239	559

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	531	517	224
Volume Left	24	0	15
Volume Right	0	2	209
cSH	1049	1700	513
Volume to Capacity	0.02	0.30	0.44
Queue Length 95th (m)	0.5	0.0	15.3
Control Delay (s)	0.6	0.0	17.3
Lane LOS	A		C
Approach Delay (s)	0.6	0.0	17.3
Approach LOS			C

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱			↰	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	465	29	215	487	4	40
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	465	29	215	487	4	40
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			494		1396	480
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			494		1396	480
tC, single (s)			4.1		6.6	6.7
tC, 2 stage (s)						
tF (s)			2.2		3.7	3.8
p0 queue free %			80		96	92
cM capacity (veh/h)			1080		111	500

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	494	702	44
Volume Left	0	215	4
Volume Right	29	0	40
cSH	1700	1080	379
Volume to Capacity	0.29	0.20	0.12
Queue Length 95th (m)	0.0	5.2	2.7
Control Delay (s)	0.0	4.6	15.7
Lane LOS		A	C
Approach Delay (s)	0.0	4.6	15.7
Approach LOS			C

Intersection Summary			
Average Delay	3.2		
Intersection Capacity Utilization	77.1%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	157	384	435	7	9	267
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	157	384	435	7	9	267
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	442				1136	438
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	442				1136	438
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	86				95	57
cM capacity (veh/h)	1118				192	618

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	541	442	276
Volume Left	157	0	9
Volume Right	0	7	267
cSH	1118	1700	577
Volume to Capacity	0.14	0.26	0.48
Queue Length 95th (m)	3.4	0.0	18.0
Control Delay (s)	3.7	0.0	16.8
Lane LOS	A		C
Approach Delay (s)	3.7	0.0	16.8
Approach LOS			C

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	79.2%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1323	1746	1328	1630	1812	1150	1738	3318	1541	1352	3147	1328
Flt Permitted	0.33	1.00	1.00	0.39	1.00	1.00	0.68	1.00	1.00	0.56	1.00	1.00
Satd. Flow (perm)	455	1746	1328	666	1812	1150	1237	3318	1541	795	3147	1328
Volume (vph)	61	489	30	79	564	36	76	319	67	26	120	71
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	61	489	30	79	564	36	76	319	67	26	120	71
RTOR Reduction (vph)	0	0	15	0	0	18	0	0	45	0	0	48
Lane Group Flow (vph)	61	489	15	79	564	18	76	319	22	26	120	23
Heavy Vehicles (%)	38%	10%	23%	12%	6%	42%	5%	10%	6%	35%	16%	23%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	23.2	23.2	23.2	23.2	23.2	23.2	13.8	13.8	13.8	13.8	13.8	13.8
Effective Green, g (s)	26.1	26.1	26.1	26.1	26.1	26.1	16.7	16.7	16.7	16.7	16.7	16.7
Actuated g/C Ratio	0.51	0.51	0.51	0.51	0.51	0.51	0.33	0.33	0.33	0.33	0.33	0.33
Clearance Time (s)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	234	897	682	342	931	591	407	1091	507	261	1035	437
v/s Ratio Prot		0.28			c0.31			c0.10			0.04	
v/s Ratio Perm	0.13		0.01	0.12		0.02	0.06		0.01	0.03		0.02
v/c Ratio	0.26	0.55	0.02	0.23	0.61	0.03	0.19	0.29	0.04	0.10	0.12	0.05
Uniform Delay, d1	6.9	8.3	6.1	6.8	8.7	6.1	12.2	12.7	11.6	11.8	11.9	11.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.7	0.0	0.3	1.1	0.0	0.2	0.1	0.0	0.2	0.1	0.1
Delay (s)	7.5	9.0	6.1	7.2	9.8	6.1	12.4	12.8	11.6	12.0	11.9	11.7
Level of Service	A	A	A	A	A	A	B	B	B	B	B	B
Approach Delay (s)		8.7			9.3			12.6			11.9	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	10.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	50.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1547	1700	1484	1659	1785		1560	1847	1408	1825	1438	
Flt Permitted	0.29	1.00	1.00	0.42	1.00		0.72	1.00	1.00	0.55	1.00	
Satd. Flow (perm)	479	1700	1484	728	1785		1183	1847	1408	1065	1438	
Volume (vph)	39	489	41	29	624	34	82	226	59	11	32	24
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	39	489	41	29	624	34	82	226	59	11	32	24
RTOR Reduction (vph)	0	0	17	0	3	0	0	0	43	0	18	0
Lane Group Flow (vph)	39	489	24	29	655	0	82	226	16	11	38	0
Heavy Vehicles (%)	18%	13%	10%	10%	7%	3%	17%	4%	16%	0%	19%	33%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1		1	1			2		2	2		
Actuated Green, G (s)	27.2	27.2	27.2	27.2	27.2		11.4	11.4	11.4	11.4	11.4	
Effective Green, g (s)	29.8	29.8	29.8	29.8	29.8		14.0	14.0	14.0	14.0	14.0	
Actuated g/C Ratio	0.58	0.58	0.58	0.58	0.58		0.27	0.27	0.27	0.27	0.27	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	276	978	854	419	1027		320	499	381	288	389	
v/s Ratio Prot		0.29			c0.37			c0.12			0.03	
v/s Ratio Perm	0.08		0.02	0.04			0.07		0.01	0.01		
v/c Ratio	0.14	0.50	0.03	0.07	0.64		0.26	0.45	0.04	0.04	0.10	
Uniform Delay, d1	5.1	6.6	4.7	4.9	7.4		14.8	15.7	13.9	13.9	14.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	0.4	0.0	0.1	1.3		0.4	0.7	0.0	0.1	0.1	
Delay (s)	5.3	7.0	4.8	4.9	8.7		15.2	16.4	14.0	14.0	14.3	
Level of Service	A	A	A	A	A		B	B	B	B	B	
Approach Delay (s)		6.7			8.5			15.7			14.2	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	9.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	51.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.99			0.98			0.98	
Flt Protected		1.00			1.00			0.99			0.99	
Satd. Flow (prot)		1785			1801			1862			1736	
Flt Permitted		0.94			0.97			0.92			0.88	
Satd. Flow (perm)		1674			1756			1731			1549	
Volume (vph)	43	711	36	20	719	40	90	350	56	21	63	15
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	43	711	36	20	719	40	90	350	56	21	63	15
RTOR Reduction (vph)	0	1	0	0	2	0	0	5	0	0	7	0
Lane Group Flow (vph)	0	789	0	0	777	0	0	491	0	0	92	0
Heavy Vehicles (%)	2%	7%	6%	0%	6%	5%	0%	1%	0%	0%	5%	27%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1			1			2			2		
Actuated Green, G (s)		43.2			43.2			27.7			27.7	
Effective Green, g (s)		45.2			45.2			29.7			29.7	
Actuated g/C Ratio		0.55			0.55			0.36			0.36	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		913			957			620			555	
v/s Ratio Prot												
v/s Ratio Perm		c0.47			0.44			c0.28			0.06	
v/c Ratio		0.86			0.81			0.79			0.17	
Uniform Delay, d1		16.2			15.4			23.8			18.1	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		8.5			5.3			6.8			0.1	
Delay (s)		24.7			20.7			30.7			18.3	
Level of Service		C			C			C			B	
Approach Delay (s)		24.7			20.7			30.7			18.3	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM Average Control Delay	24.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	82.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	100.2%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	489	48	26	707	43	24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	489	48	26	707	43	24
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			537		1248	489
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			537		1248	489
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		77	96
cM capacity (veh/h)			1041		184	583

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	489	48	26	707	43	24
Volume Left	0	0	26	0	43	0
Volume Right	0	48	0	0	0	24
cSH	1700	1700	1041	1700	184	583
Volume to Capacity	0.29	0.03	0.02	0.42	0.23	0.04
Queue Length 95th (m)	0.0	0.0	0.5	0.0	6.1	0.9
Control Delay (s)	0.0	0.0	8.5	0.0	30.5	11.4
Lane LOS			A		D	B
Approach Delay (s)	0.0		0.3		23.6	
Approach LOS					C	

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	47.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	20	530	11	20	632	12	21	93	84	3	12	12
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	20	530	11	20	632	12	21	93	84	3	12	12
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	644			541			1266	1260	536	1378	1259	638
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	644			541			1266	1260	536	1378	1259	638
tC, single (s)	4.2			4.1			7.2	6.5	6.2	7.4	6.5	6.4
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.5	4.0	3.3	3.8	4.0	3.5
p0 queue free %	98			98			84	43	85	94	93	97
cM capacity (veh/h)	904			1013			128	163	545	47	165	438

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	20	541	20	644	198	27
Volume Left	20	0	20	0	21	3
Volume Right	0	11	0	12	84	12
cSH	904	1700	1013	1700	223	165
Volume to Capacity	0.02	0.32	0.02	0.38	0.89	0.16
Queue Length 95th (m)	0.5	0.0	0.4	0.0	50.3	4.0
Control Delay (s)	9.1	0.0	8.6	0.0	79.9	31.1
Lane LOS	A		A		F	D
Approach Delay (s)	0.3		0.3		79.9	31.1
Approach LOS					F	D

Intersection Summary			
Average Delay	11.7		
Intersection Capacity Utilization	55.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	694	26	19	501	15	10
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	694	26	19	501	15	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			720		1246	707
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			720		1246	707
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		92	98
cM capacity (veh/h)			891		190	439

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	720	520	25
Volume Left	0	19	15
Volume Right	26	0	10
cSH	1700	891	245
Volume to Capacity	0.42	0.02	0.10
Queue Length 95th (m)	0.0	0.5	2.4
Control Delay (s)	0.0	0.6	21.3
Lane LOS		A	C
Approach Delay (s)	0.0	0.6	21.3
Approach LOS			C

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	51.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	600	10	23	633	38	155
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	600	10	23	633	38	155
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			610		1284	605
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			610		1284	605
tC, single (s)			4.2		6.4	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.4
p0 queue free %			98		78	68
cM capacity (veh/h)			926		177	490

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	610	656	193
Volume Left	0	23	38
Volume Right	10	0	155
cSH	1700	926	363
Volume to Capacity	0.36	0.02	0.53
Queue Length 95th (m)	0.0	0.5	20.9
Control Delay (s)	0.0	0.7	25.6
Lane LOS		A	D
Approach Delay (s)	0.0	0.7	25.6
Approach LOS			D

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	70.3%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	159	596	601	8	6	55
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	159	596	601	8	6	55
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	609				1519	605
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	609				1519	605
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	84				95	89
cM capacity (veh/h)	970				109	498

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	755	609	61
Volume Left	159	0	6
Volume Right	0	8	55
cSH	970	1700	369
Volume to Capacity	0.16	0.36	0.17
Queue Length 95th (m)	4.1	0.0	4.1
Control Delay (s)	3.9	0.0	16.7
Lane LOS	A		C
Approach Delay (s)	3.9	0.0	16.7
Approach LOS			C

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	585	11	41	539	7	131
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	585	11	41	539	7	131
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			596		1212	590
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			596		1212	590
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		96	74
cM capacity (veh/h)			990		193	511

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	596	580	138
Volume Left	0	41	7
Volume Right	11	0	131
cSH	1700	990	472
Volume to Capacity	0.35	0.04	0.29
Queue Length 95th (m)	0.0	0.9	8.4
Control Delay (s)	0.0	1.1	15.8
Lane LOS		A	C
Approach Delay (s)	0.0	1.1	15.8
Approach LOS			C

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	77.3%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	252	464	452	28	9	128
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	252	464	452	28	9	128
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	480				1434	466
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	480				1434	466
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	77				92	79
cM capacity (veh/h)	1082				113	597

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	716	480	137
Volume Left	252	0	9
Volume Right	0	28	128
cSH	1082	1700	466
Volume to Capacity	0.23	0.28	0.29
Queue Length 95th (m)	6.3	0.0	8.5
Control Delay (s)	5.2	0.0	15.9
Lane LOS	A		C
Approach Delay (s)	5.2	0.0	15.9
Approach LOS			C

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		

Appendix B
2012 Total Traffic (with Existing Road Network) Intersection Operation Calculations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↑	↱	↰	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1352	1779	1512	1534	1731	1002	1615	2852	1445	1313	3259	1166
Flt Permitted	0.09	1.00	1.00	0.10	1.00	1.00	0.37	1.00	1.00	0.11	1.00	1.00
Satd. Flow (perm)	126	1779	1512	157	1731	1002	628	2852	1445	150	3259	1166
Volume (vph)	434	982	86	148	648	456	68	827	262	237	709	177
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	434	982	86	148	648	456	68	827	262	237	709	177
RTOR Reduction (vph)	0	0	32	0	0	141	0	0	106	0	0	108
Lane Group Flow (vph)	434	982	54	148	648	315	68	827	156	237	709	69
Heavy Vehicles (%)	35%	8%	8%	19%	11%	63%	13%	28%	13%	39%	12%	40%
Turn Type	pm+pt		Perm	pm+pt		Perm	Perm		Perm	pm+pt		Perm
Protected Phases	5	2		1	6			4		3	8	
Permitted Phases	2		2	6		6	4		4	8		8
Actuated Green, G (s)	62.2	54.2	54.2	43.2	38.2	38.2	30.0	30.0	30.0	44.0	44.0	44.0
Effective Green, g (s)	65.1	57.1	57.1	45.1	41.1	41.1	32.9	32.9	32.9	46.9	46.9	46.9
Actuated g/C Ratio	0.54	0.48	0.48	0.38	0.34	0.34	0.27	0.27	0.27	0.39	0.39	0.39
Clearance Time (s)	3.0	6.9	6.9	3.0	6.9	6.9	6.9	6.9	6.9	3.0	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	273	847	719	105	593	343	172	782	396	156	1274	456
v/s Ratio Prot	c0.27	0.55		0.05	0.37			0.29		c0.13	0.22	
v/s Ratio Perm	c0.60		0.04	0.48		0.31	0.11		0.11	c0.47		0.06
v/c Ratio	1.59	1.16	0.07	1.41	1.09	0.92	0.40	1.06	0.39	1.52	0.56	0.15
Uniform Delay, d1	38.7	31.4	17.1	60.2	39.4	37.8	35.5	43.6	35.4	30.6	28.5	23.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	282.1	84.8	0.0	231.3	64.8	28.3	1.5	48.5	0.6	263.6	0.5	0.2
Delay (s)	320.8	116.2	17.1	291.5	104.2	66.1	36.9	92.0	36.1	294.2	29.0	23.8
Level of Service	F	F	B	F	F	E	D	F	D	F	C	C
Approach Delay (s)		169.7			112.5			76.1			84.1	
Approach LOS		F			F			E			F	

Intersection Summary			
HCM Average Control Delay	114.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.53		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	109.2%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1285	1746	1555	1615	1669		1674	1671	1317	1706	1685	
Flt Permitted	0.05	1.00	1.00	0.17	1.00		0.23	1.00	1.00	0.72	1.00	
Satd. Flow (perm)	63	1746	1555	288	1669		411	1671	1317	1294	1685	
Volume (vph)	40	1009	89	52	1326	23	38	56	44	46	252	44
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	40	1009	89	52	1326	23	38	56	44	46	252	44
RTOR Reduction (vph)	0	0	14	0	1	0	0	0	35	0	6	0
Lane Group Flow (vph)	40	1009	75	52	1348	0	38	56	9	46	290	0
Heavy Vehicles (%)	42%	10%	5%	13%	15%	5%	9%	15%	24%	7%	7%	37%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)	83.8	83.8	83.8	83.8	83.8		21.8	21.8	21.8	21.8	21.8	
Effective Green, g (s)	86.4	86.4	86.4	86.4	86.4		24.4	24.4	24.4	24.4	24.4	
Actuated g/C Ratio	0.73	0.73	0.73	0.73	0.73		0.21	0.21	0.21	0.21	0.21	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	46	1270	1131	209	1214		84	343	270	266	346	
v/s Ratio Prot		0.58			c0.81			0.03			c0.17	
v/s Ratio Perm	0.64		0.05	0.18			0.09		0.01	0.04		
v/c Ratio	0.87	0.79	0.07	0.25	1.11		0.45	0.16	0.03	0.17	0.84	
Uniform Delay, d1	12.0	10.5	4.6	5.4	16.2		41.3	38.8	37.8	38.9	45.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	83.5	3.5	0.0	0.6	61.8		3.8	0.2	0.1	0.3	16.2	
Delay (s)	95.6	14.0	4.7	6.0	78.0		45.2	39.0	37.8	39.2	61.5	
Level of Service	F	B	A	A	E		D	D	D	D	E	
Approach Delay (s)		16.1			75.4			40.3			58.5	
Approach LOS		B			E			D			E	

Intersection Summary			
HCM Average Control Delay	49.5	HCM Level of Service	D
HCM Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	118.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	109.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			1.00			0.97			0.98	
Flt Protected		1.00			1.00			0.99			0.99	
Satd. Flow (prot)		1760			1753			1639			1814	
Flt Permitted		0.93			0.88			0.62			0.93	
Satd. Flow (perm)		1632			1552			1035			1705	
Volume (vph)	34	1157	108	65	1380	17	28	64	25	57	320	52
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	34	1157	108	65	1380	17	28	64	25	57	320	52
RTOR Reduction (vph)	0	3	0	0	0	0	0	8	0	0	4	0
Lane Group Flow (vph)	0	1296	0	0	1462	0	0	109	0	0	425	0
Heavy Vehicles (%)	10%	8%	5%	10%	9%	20%	28%	7%	9%	13%	2%	2%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		84.0			84.0			24.0			24.0	
Effective Green, g (s)		86.0			86.0			26.0			26.0	
Actuated g/C Ratio		0.72			0.72			0.22			0.22	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		1170			1112			224			369	
v/s Ratio Prot												
v/s Ratio Perm		0.79			c0.94			0.11			c0.25	
v/c Ratio		1.11			1.31			0.49			1.15	
Uniform Delay, d1		17.0			17.0			41.2			47.0	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		61.1			148.0			1.7			95.0	
Delay (s)		78.1			165.0			42.8			142.0	
Level of Service		E			F			D			F	
Approach Delay (s)		78.1			165.0			42.8			142.0	
Approach LOS		E			F			D			F	

Intersection Summary			
HCM Average Control Delay	123.6	HCM Level of Service	F
HCM Volume to Capacity ratio	1.28		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	137.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1102	25	21	1307	72	41
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1102	25	21	1307	72	41
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1127		2451	1102
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1127		2451	1102
tC, single (s)			4.3		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			96		0	84
cM capacity (veh/h)			571		33	254

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	1102	25	21	1307	72	41
Volume Left	0	0	21	0	72	0
Volume Right	0	25	0	0	0	41
cSH	1700	1700	571	1700	33	254
Volume to Capacity	0.65	0.01	0.04	0.77	2.21	0.16
Queue Length 95th (m)	0.0	0.0	0.8	0.0	57.5	4.0
Control Delay (s)	0.0	0.0	11.5	0.0	816.3	21.9
Lane LOS			B		F	C
Approach Delay (s)	0.0		0.2		528.1	
Approach LOS					F	

Intersection Summary			
Average Delay	23.3		
Intersection Capacity Utilization	79.4%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	12	982	54	73	1164	10	11	7	10	4	111	11
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	12	982	54	73	1164	10	11	7	10	4	111	11
Pedestrians											1	
Lane Width (m)											3.7	
Walking Speed (m/s)											1.2	
Percent Blockage											0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1175			1036			2410	2354	1009	2336	2376	1170
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1175			1036			2410	2354	1009	2336	2376	1170
tC, single (s)	4.6			4.1			7.6	6.5	6.3	7.1	6.5	6.4
tC, 2 stage (s)												
tF (s)	2.7			2.2			4.0	4.0	3.4	3.5	4.0	3.5
p0 queue free %	97			89			0	78	96	79	0	95
cM capacity (veh/h)	440			667			0	31	280	19	30	216

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1
Volume Total	12	1036	73	1174	11	17	126
Volume Left	12	0	73	0	11	0	4
Volume Right	0	54	0	10	0	10	11
cSH	440	1700	667	1700	0	66	32
Volume to Capacity	0.03	0.61	0.11	0.69	Err	0.26	3.95
Queue Length 95th (m)	0.6	0.0	2.6	0.0	Err	6.4	Err
Control Delay (s)	13.4	0.0	11.1	0.0	Err	78.0	Err
Lane LOS	B		B		F	F	F
Approach Delay (s)	0.2		0.6		Err		Err
Approach LOS					F		F

Intersection Summary			
Average Delay	Err		
Intersection Capacity Utilization	78.3%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1094	7	7	1406	7	5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1094	7	7	1406	7	5
Pedestrians					2	
Lane Width (m)					3.7	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1103		2520	1100
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1103		2520	1100
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		77	98
cM capacity (veh/h)			639		31	260

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	1101	1413	12
Volume Left	0	7	7
Volume Right	7	0	5
cSH	1700	639	49
Volume to Capacity	0.65	0.01	0.25
Queue Length 95th (m)	0.0	0.2	5.8
Control Delay (s)	0.0	0.7	101.3
Lane LOS		A	F
Approach Delay (s)	0.0	0.7	101.3
Approach LOS			F

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	89.6%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1011	72	242	1404	6	27
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1011	72	242	1404	6	27
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1083		2935	1047
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1083		2935	1047
tC, single (s)			4.1		6.9	6.4
tC, 2 stage (s)						
tF (s)			2.2		4.0	3.5
p0 queue free %			63		13	89
cM capacity (veh/h)			652		7	256

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	1083	1646	33
Volume Left	0	242	6
Volume Right	72	0	27
cSH	1700	652	34
Volume to Capacity	0.64	0.37	0.97
Queue Length 95th (m)	0.0	12.0	24.2
Control Delay (s)	0.0	27.0	320.0
Lane LOS		D	F
Approach Delay (s)	0.0	27.0	320.0
Approach LOS			F

Intersection Summary			
Average Delay	19.9		
Intersection Capacity Utilization	158.2%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	27	1011	1406	2	16	240
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	27	1011	1406	2	16	240
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1408				2472	1407
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1408				2472	1407
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	94				49	0
cM capacity (veh/h)	485				31	170

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	1038	1408	256
Volume Left	27	0	16
Volume Right	0	2	240
cSH	485	1700	133
Volume to Capacity	0.06	0.83	1.92
Queue Length 95th (m)	1.2	0.0	140.8
Control Delay (s)	2.1	0.0	497.1
Lane LOS	A		F
Approach Delay (s)	2.1	0.0	497.1
Approach LOS			F

Intersection Summary			
Average Delay	47.9		
Intersection Capacity Utilization	97.3%	ICU Level of Service	F
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	947	32	238	1364	4	44
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	947	32	238	1364	4	44
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			979		2803	963
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			979		2803	963
tC, single (s)			4.1		6.6	6.7
tC, 2 stage (s)						
tF (s)			2.2		3.7	3.8
p0 queue free %			67		64	83
cM capacity (veh/h)			713		11	253

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	979	1602	48
Volume Left	0	238	4
Volume Right	32	0	44
cSH	1700	713	90
Volume to Capacity	0.58	0.33	0.53
Queue Length 95th (m)	0.0	10.3	16.5
Control Delay (s)	0.0	19.9	83.4
Lane LOS		C	F
Approach Delay (s)	0.0	19.9	83.4
Approach LOS			F

Intersection Summary			
Average Delay	13.7		
Intersection Capacity Utilization	150.1%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	173	818	1311	8	9	291
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	173	818	1311	8	9	291
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1319				2479	1315
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1319				2479	1315
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	67				59	0
cM capacity (veh/h)	524				22	193

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	991	1319	300
Volume Left	173	0	9
Volume Right	0	8	291
cSH	524	1700	156
Volume to Capacity	0.33	0.78	1.92
Queue Length 95th (m)	10.0	0.0	160.1
Control Delay (s)	10.7	0.0	484.8
Lane LOS	B		F
Approach Delay (s)	10.7	0.0	484.8
Approach LOS			F

Intersection Summary			
Average Delay	59.8		
Intersection Capacity Utilization	150.6%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1323	1746	1328	1630	1812	1150	1738	3318	1541	1352	3147	1328
Flt Permitted	0.09	1.00	1.00	0.09	1.00	1.00	0.27	1.00	1.00	0.20	1.00	1.00
Satd. Flow (perm)	129	1746	1328	158	1812	1150	495	3318	1541	280	3147	1328
Volume (vph)	253	743	39	261	969	167	101	684	173	479	845	385
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	253	743	39	261	969	167	101	684	173	479	845	385
RTOR Reduction (vph)	0	0	18	0	0	55	0	0	120	0	0	110
Lane Group Flow (vph)	253	743	21	261	969	112	101	684	53	479	845	275
Heavy Vehicles (%)	38%	10%	23%	12%	6%	42%	5%	10%	6%	35%	16%	23%
Turn Type	pm+pt		Perm	pm+pt		Perm	Perm		Perm	pm+pt		Perm
Protected Phases	5	2		1	6			4		3	8	
Permitted Phases	2		2	6		6	4		4	8		8
Actuated Green, G (s)	47.5	40.4	40.4	47.5	40.4	40.4	29.0	29.0	29.0	39.1	39.1	39.1
Effective Green, g (s)	49.4	43.3	43.3	49.4	43.3	43.3	31.9	31.9	31.9	42.0	42.0	42.0
Actuated g/C Ratio	0.48	0.42	0.42	0.48	0.42	0.42	0.31	0.31	0.31	0.41	0.41	0.41
Clearance Time (s)	3.0	6.9	6.9	3.0	6.9	6.9	6.9	6.9	6.9	3.0	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	132	731	556	162	759	482	153	1024	475	177	1278	539
v/s Ratio Prot	c0.11	0.43		0.09	0.53			0.21		c0.16	0.27	
v/s Ratio Perm	c0.80		0.02	0.67		0.10	0.20		0.03	c0.94		0.21
v/c Ratio	1.92	1.02	0.04	1.61	1.28	0.23	0.66	0.67	0.11	2.71	0.66	0.51
Uniform Delay, d1	50.9	30.1	17.7	24.2	30.1	19.4	31.0	31.1	25.6	29.2	24.9	23.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	439.3	37.5	0.0	301.7	134.6	0.2	10.2	1.7	0.1	783.6	1.3	0.8
Delay (s)	490.1	67.5	17.8	325.9	164.7	19.6	41.2	32.8	25.7	812.8	26.2	23.7
Level of Service	F	E	B	F	F	B	D	C	C	F	C	C
Approach Delay (s)		168.9			177.5			32.4			246.1	
Approach LOS		F			F			C			F	

Intersection Summary			
HCM Average Control Delay	171.5	HCM Level of Service	F
HCM Volume to Capacity ratio	2.24		
Actuated Cycle Length (s)	103.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	123.8%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑↱		↰	↑	↱	↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1547	1700	1484	1659	1790		1560	1847	1408	1825	1444	
Flt Permitted	0.05	1.00	1.00	0.11	1.00		0.72	1.00	1.00	0.28	1.00	
Satd. Flow (perm)	75	1700	1484	189	1790		1176	1847	1408	539	1444	
Volume (vph)	43	1151	45	32	1293	38	88	262	64	12	37	26
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	43	1151	45	32	1293	38	88	262	64	12	37	26
RTOR Reduction (vph)	0	0	6	0	1	0	0	0	51	0	21	0
Lane Group Flow (vph)	43	1151	39	32	1330	0	88	262	13	12	42	0
Heavy Vehicles (%)	18%	13%	10%	10%	7%	3%	17%	4%	16%	0%	19%	33%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)	83.9	83.9	83.9	83.9	83.9		20.2	20.2	20.2	20.2	20.2	
Effective Green, g (s)	86.5	86.5	86.5	86.5	86.5		22.8	22.8	22.8	22.8	22.8	
Actuated g/C Ratio	0.74	0.74	0.74	0.74	0.74		0.19	0.19	0.19	0.19	0.19	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	55	1254	1094	139	1320		229	359	274	105	281	
v/s Ratio Prot		0.68			c0.74			c0.14			0.03	
v/s Ratio Perm	0.57		0.03	0.17			0.07		0.01	0.02		
v/c Ratio	0.78	0.92	0.04	0.23	1.01		0.38	0.73	0.05	0.11	0.15	
Uniform Delay, d1	9.5	12.5	4.2	4.9	15.4		41.1	44.4	38.4	38.9	39.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	50.5	10.7	0.0	0.8	26.7		1.1	7.3	0.1	0.5	0.2	
Delay (s)	60.0	23.2	4.2	5.7	42.1		42.2	51.6	38.5	39.4	39.5	
Level of Service	E	C	A	A	D		D	D	D	D	D	
Approach Delay (s)		23.8			41.2			47.6			39.4	
Approach LOS		C			D			D			D	

Intersection Summary			
HCM Average Control Delay	35.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	117.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	95.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⊕			⊕			⊕			⊕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			0.99			0.98	
Flt Protected		1.00			1.00			0.99			0.99	
Satd. Flow (prot)		1789			1806			1864			1741	
Flt Permitted		0.91			0.96			0.91			0.72	
Satd. Flow (perm)		1628			1735			1704			1272	
Volume (vph)	47	1421	40	22	1409	44	97	406	60	23	73	16
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	47	1421	40	22	1409	44	97	406	60	23	73	16
RTOR Reduction (vph)	0	1	0	0	1	0	0	4	0	0	5	0
Lane Group Flow (vph)	0	1507	0	0	1474	0	0	559	0	0	107	0
Heavy Vehicles (%)	2%	7%	6%	0%	6%	5%	0%	1%	0%	0%	5%	27%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		78.0			78.0			30.0			30.0	
Effective Green, g (s)		80.0			80.0			32.0			32.0	
Actuated g/C Ratio		0.67			0.67			0.27			0.27	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		1085			1157			454			339	
v/s Ratio Prot												
v/s Ratio Perm		c0.93			0.85			c0.33			0.08	
v/c Ratio		1.39			1.27			1.23			0.32	
Uniform Delay, d1		20.0			20.0			44.0			35.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		180.9			130.1			122.4			0.5	
Delay (s)		200.9			150.1			166.4			35.8	
Level of Service		F			F			F			D	
Approach Delay (s)		200.9			150.1			166.4			35.8	
Approach LOS		F			F			F			D	

Intersection Summary			
HCM Average Control Delay	170.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.34		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	147.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1151	53	29	1394	43	24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1151	53	29	1394	43	24
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1204		2603	1151
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1204		2603	1151
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		0	90
cM capacity (veh/h)			587		25	243

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	1151	53	29	1394	43	24
Volume Left	0	0	29	0	43	0
Volume Right	0	53	0	0	0	24
cSH	1700	1700	587	1700	25	243
Volume to Capacity	0.68	0.03	0.05	0.82	1.70	0.10
Queue Length 95th (m)	0.0	0.0	1.1	0.0	36.9	2.3
Control Delay (s)	0.0	0.0	11.5	0.0	670.8	21.4
Lane LOS			B		F	C
Approach Delay (s)	0.0		0.2		438.2	
Approach LOS					F	

Intersection Summary			
Average Delay	11.0		
Intersection Capacity Utilization	83.4%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	22	1201	12	22	1303	13	23	108	90	3	14	13
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	22	1201	12	22	1303	13	23	108	90	3	14	13
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1316			1213			2618	2611	1207	2742	2610	1310
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1316			1213			2618	2611	1207	2742	2610	1310
tC, single (s)	4.2			4.1			7.2	6.5	6.2	7.4	6.5	6.4
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.5	4.0	3.3	3.8	4.0	3.5
p0 queue free %	96			96			0	0	60	0	39	93
cM capacity (veh/h)	500			565			7	22	223	0	23	173

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1
Volume Total	22	1213	22	1316	23	198	30
Volume Left	22	0	22	0	23	0	3
Volume Right	0	12	0	13	0	90	13
cSH	500	1700	565	1700	7	38	0
Volume to Capacity	0.04	0.71	0.04	0.77	3.30	5.22	Err
Queue Length 95th (m)	1.0	0.0	0.8	0.0	Err	Err	Err
Control Delay (s)	12.5	0.0	11.6	0.0	Err	Err	Err
Lane LOS	B		B		F	F	F
Approach Delay (s)	0.2		0.2		Err		Err
Approach LOS					F		F

Intersection Summary			
Average Delay	Err		
Intersection Capacity Utilization	87.2%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1400	29	21	1144	15	10
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1400	29	21	1144	15	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1429		2600	1414
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1429		2600	1414
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		43	94
cM capacity (veh/h)			482		27	170

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	1429	1165	25
Volume Left	0	21	15
Volume Right	29	0	10
cSH	1700	482	40
Volume to Capacity	0.84	0.04	0.62
Queue Length 95th (m)	0.0	1.0	15.8
Control Delay (s)	0.0	1.9	190.1
Lane LOS		A	F
Approach Delay (s)	0.0	1.9	190.1
Approach LOS			F

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	87.0%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1279	11	26	1295	41	177
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1279	11	26	1295	41	177
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1290		2632	1284
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1290		2632	1284
tC, single (s)			4.2		6.4	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.4
p0 queue free %			95		0	10
cM capacity (veh/h)			508		25	197

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	1290	1321	218
Volume Left	0	26	41
Volume Right	11	0	177
cSH	1700	508	85
Volume to Capacity	0.76	0.05	2.57
Queue Length 95th (m)	0.0	1.1	144.2
Control Delay (s)	0.0	2.9	815.8
Lane LOS		A	F
Approach Delay (s)	0.0	2.9	815.8
Approach LOS			F

Intersection Summary			
Average Delay	64.2		
Intersection Capacity Utilization	108.9%	ICU Level of Service	G
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	182	1274	1261	9	6	60
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	182	1274	1261	9	6	60
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1270				2904	1266
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1270				2904	1266
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	67				48	71
cM capacity (veh/h)	547				12	206

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	1456	1270	66
Volume Left	182	0	6
Volume Right	0	9	60
cSH	547	1700	82
Volume to Capacity	0.33	0.75	0.81
Queue Length 95th (m)	10.1	0.0	28.6
Control Delay (s)	19.1	0.0	139.5
Lane LOS	C		F
Approach Delay (s)	19.1	0.0	139.5
Approach LOS			F

Intersection Summary			
Average Delay	13.2		
Intersection Capacity Utilization	158.1%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1251	12	45	1172	7	144
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1251	12	45	1172	7	144
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1263		2519	1257
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1263		2519	1257
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			92		76	32
cM capacity (veh/h)			557		29	211

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	1263	1217	151
Volume Left	0	45	7
Volume Right	12	0	144
cSH	1700	557	163
Volume to Capacity	0.74	0.08	0.93
Queue Length 95th (m)	0.0	1.8	47.7
Control Delay (s)	0.0	3.5	107.8
Lane LOS		A	F
Approach Delay (s)	0.0	3.5	107.8
Approach LOS			F

Intersection Summary			
Average Delay	7.8		
Intersection Capacity Utilization	114.1%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	278	1117	1080	31	9	137
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	278	1117	1080	31	9	137
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1111				2768	1096
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1111				2768	1096
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	56				24	47
cM capacity (veh/h)	629				12	260

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	1395	1111	146
Volume Left	278	0	9
Volume Right	0	31	137
cSH	629	1700	114
Volume to Capacity	0.44	0.65	1.29
Queue Length 95th (m)	15.8	0.0	67.9
Control Delay (s)	18.7	0.0	250.9
Lane LOS	C		F
Approach Delay (s)	18.7	0.0	250.9
Approach LOS			F

Intersection Summary			
Average Delay	23.7		
Intersection Capacity Utilization	151.9%	ICU Level of Service	H
Analysis Period (min)	15		

Appendix C
2012 Total Traffic (with Improvements – 4 lane widening) Intersection Operation Calculations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	2623	3380	1512	1534	3288	1002	1615	2852	1445	2547	3259	1166
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	2623	3380	1512	1534	3288	1002	1615	2852	1445	2547	3259	1166
Volume (vph)	434	982	86	148	648	456	68	827	262	237	709	177
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	434	982	86	148	648	456	68	827	262	237	709	177
RTOR Reduction (vph)	0	0	54	0	0	0	0	0	158	0	0	112
Lane Group Flow (vph)	434	982	32	148	648	456	68	827	104	237	709	65
Heavy Vehicles (%)	35%	8%	8%	19%	11%	63%	13%	28%	13%	39%	12%	40%
Turn Type	Prot		Perm	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2			Free			4			8
Actuated Green, G (s)	24.2	41.1	41.1	14.9	31.8	132.5	8.8	40.4	40.4	14.3	45.9	45.9
Effective Green, g (s)	24.2	44.0	44.0	14.9	34.7	132.5	8.8	43.3	43.3	14.3	48.8	48.8
Actuated g/C Ratio	0.18	0.33	0.33	0.11	0.26	1.00	0.07	0.33	0.33	0.11	0.37	0.37
Clearance Time (s)	4.0	6.9	6.9	4.0	6.9		4.0	6.9	6.9	4.0	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	479	1122	502	173	861	1002	107	932	472	275	1200	429
v/s Ratio Prot	c0.17	c0.29		0.10	0.20		0.04	c0.29		c0.09	0.22	
v/s Ratio Perm			0.02			0.46			0.07			0.06
v/c Ratio	0.91	0.88	0.06	0.86	0.75	0.46	0.64	0.89	0.22	0.86	0.59	0.15
Uniform Delay, d1	53.0	41.7	30.2	57.7	45.0	0.0	60.3	42.3	32.3	58.1	33.8	28.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	20.5	7.8	0.1	31.5	3.8	1.5	11.7	10.2	0.2	23.1	0.8	0.2
Delay (s)	73.5	49.5	30.2	89.3	48.7	1.5	72.0	52.5	32.6	81.2	34.6	28.2
Level of Service	E	D	C	F	D	A	E	D	C	F	C	C
Approach Delay (s)		55.3			36.3			49.1			43.4	
Approach LOS		E			D			D			D	

Intersection Summary			
HCM Average Control Delay	46.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	132.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3318	1633	1573	3288	1772	1555
Flt Permitted	1.00	1.00	0.23	1.00	0.95	1.00
Satd. Flow (perm)	3318	1633	383	3288	1772	1555
Volume (vph)	1102	25	21	1307	72	41
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1102	25	21	1307	72	41
RTOR Reduction (vph)	0	9	0	0	0	35
Lane Group Flow (vph)	1102	16	21	1307	72	6
Heavy Vehicles (%)	10%	0%	16%	11%	3%	5%
Turn Type		Perm	Perm			Perm
Protected Phases	2			6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	23.7	23.7	23.7	23.7	4.2	4.2
Effective Green, g (s)	25.7	25.7	25.7	25.7	6.2	6.2
Actuated g/C Ratio	0.64	0.64	0.64	0.64	0.16	0.16
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2137	1052	247	2118	275	242
v/s Ratio Prot	0.33			c0.40	c0.04	
v/s Ratio Perm		0.01	0.05			0.00
v/c Ratio	0.52	0.02	0.09	0.62	0.26	0.03
Uniform Delay, d1	3.8	2.6	2.7	4.2	14.8	14.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.0	0.1	0.5	0.5	0.0
Delay (s)	4.0	2.6	2.8	4.7	15.3	14.3
Level of Service	A	A	A	A	B	B
Approach Delay (s)	4.0			4.7	15.0	
Approach LOS	A			A	B	

Intersection Summary			
HCM Average Control Delay	4.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	39.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1285	3318	1555	1615	3171		1674	1671	1317	1706	1685	
Flt Permitted	0.12	1.00	1.00	0.22	1.00		0.44	1.00	1.00	0.72	1.00	
Satd. Flow (perm)	166	3318	1555	379	3171		776	1671	1317	1294	1685	
Volume (vph)	40	1009	89	52	1326	23	38	56	44	46	252	44
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	40	1009	89	52	1326	23	38	56	44	46	252	44
RTOR Reduction (vph)	0	0	39	0	2	0	0	0	30	0	5	0
Lane Group Flow (vph)	40	1009	50	52	1347	0	38	56	14	46	291	0
Heavy Vehicles (%)	42%	10%	5%	13%	15%	5%	9%	15%	24%	7%	7%	37%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)	35.7	35.7	35.7	35.7	35.7		18.7	18.7	18.7	18.7	18.7	
Effective Green, g (s)	38.3	38.3	38.3	38.3	38.3		21.3	21.3	21.3	21.3	21.3	
Actuated g/C Ratio	0.57	0.57	0.57	0.57	0.57		0.32	0.32	0.32	0.32	0.32	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	94	1880	881	215	1797		245	527	415	408	531	
v/s Ratio Prot		0.30			c0.42			0.03			c0.17	
v/s Ratio Perm	0.24		0.03	0.14			0.05		0.01	0.04		
v/c Ratio	0.43	0.54	0.06	0.24	0.75		0.16	0.11	0.03	0.11	0.55	
Uniform Delay, d1	8.4	9.1	6.6	7.4	11.0		16.7	16.4	16.0	16.4	19.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.1	0.3	0.0	0.6	1.8		0.3	0.1	0.0	0.1	1.2	
Delay (s)	11.5	9.4	6.6	7.9	12.8		17.0	16.5	16.1	16.6	20.3	
Level of Service	B	A	A	A	B		B	B	B	B	C	
Approach Delay (s)		9.3			12.6			16.5			19.8	
Approach LOS		A			B			B			B	

Intersection Summary			
HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	67.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SB
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.91		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1177	3347		1772	3243		1217	1645		1825	1845	
Flt Permitted	0.20	1.00		0.25	1.00		0.68	1.00		0.75	1.00	
Satd. Flow (perm)	254	3347		466	3243		869	1645		1434	1845	
Volume (vph)	12	982	54	73	1164	10	11	7	10	4	111	11
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	12	982	54	73	1164	10	11	7	10	4	111	11
RTOR Reduction (vph)	0	5	0	0	1	0	0	8	0	0	5	0
Lane Group Flow (vph)	12	1031	0	73	1173	0	11	9	0	4	117	0
Confl. Peds. (#/hr)	1					1						
Heavy Vehicles (%)	55%	8%	12%	3%	12%	56%	50%	0%	11%	0%	1%	20%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	21.8	21.8		21.8	21.8		4.5	4.5		4.5	4.5	
Effective Green, g (s)	23.8	23.8		23.8	23.8		6.5	6.5		6.5	6.5	
Actuated g/C Ratio	0.62	0.62		0.62	0.62		0.17	0.17		0.17	0.17	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	158	2080		290	2015		147	279		243	313	
v/s Ratio Prot		0.31			c0.36			0.01			c0.06	
v/s Ratio Perm	0.05			0.16			0.01			0.00		
v/c Ratio	0.08	0.50		0.25	0.58		0.07	0.03		0.02	0.37	
Uniform Delay, d1	2.9	4.0		3.3	4.3		13.4	13.3		13.2	14.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.2		0.5	0.4		0.2	0.0		0.0	0.8	
Delay (s)	3.1	4.2		3.7	4.7		13.6	13.3		13.3	14.8	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		4.1			4.7			13.4			14.8	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	5.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	38.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	59.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.96		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1659	3344		1659	3339		1426	1711		1615	1844	
Flt Permitted	0.11	1.00		0.14	1.00		0.34	1.00		0.70	1.00	
Satd. Flow (perm)	190	3344		248	3339		513	1711		1189	1844	
Volume (vph)	34	1157	108	65	1380	17	28	64	25	57	320	52
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	34	1157	108	65	1380	17	28	64	25	57	320	52
RTOR Reduction (vph)	0	6	0	0	1	0	0	13	0	0	5	0
Lane Group Flow (vph)	34	1259	0	65	1396	0	28	76	0	57	367	0
Heavy Vehicles (%)	10%	8%	5%	10%	9%	20%	28%	7%	9%	13%	2%	2%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	36.1	36.1		36.1	36.1		19.8	19.8		19.8	19.8	
Effective Green, g (s)	38.1	38.1		38.1	38.1		21.8	21.8		21.8	21.8	
Actuated g/C Ratio	0.56	0.56		0.56	0.56		0.32	0.32		0.32	0.32	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	107	1876		139	1874		165	549		382	592	
v/s Ratio Prot		0.38			c0.42			0.04			c0.20	
v/s Ratio Perm	0.18			0.26			0.05			0.05		
v/c Ratio	0.32	0.67		0.47	0.74		0.17	0.14		0.15	0.62	
Uniform Delay, d1	8.0	10.5		8.9	11.2		16.6	16.4		16.4	19.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.7	1.0		2.5	1.6		0.5	0.1		0.2	1.9	
Delay (s)	9.7	11.4		11.3	12.9		17.0	16.5		16.6	21.5	
Level of Service	A	B		B	B		B	B		B	C	
Approach Delay (s)		11.4			12.8			16.6			20.8	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	13.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	67.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	82.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.94		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1521	3164		1825	3120		1217	1668		1372	1844	
Flt Permitted	0.14	1.00		0.23	1.00		0.48	1.00		0.74	1.00	
Satd. Flow (perm)	228	3164		436	3120		620	1668		1068	1844	
Volume (vph)	11	1000	72	33	1373	2	6	16	11	16	209	31
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	11	1000	72	33	1373	2	6	16	11	16	209	31
RTOR Reduction (vph)	0	5	0	0	0	0	0	9	0	0	6	0
Lane Group Flow (vph)	11	1067	0	33	1375	0	6	18	0	16	234	0
Heavy Vehicles (%)	20%	15%	3%	0%	17%	0%	50%	0%	20%	33%	1%	10%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	31.9	31.9		31.9	31.9		9.9	9.9		9.9	9.9	
Effective Green, g (s)	33.9	33.9		33.9	33.9		11.9	11.9		11.9	11.9	
Actuated g/C Ratio	0.63	0.63		0.63	0.63		0.22	0.22		0.22	0.22	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	144	1994		275	1966		137	369		236	408	
v/s Ratio Prot		0.34			c0.44			0.01			c0.13	
v/s Ratio Perm	0.05			0.08			0.01			0.01		
v/c Ratio	0.08	0.54		0.12	0.70		0.04	0.05		0.07	0.57	
Uniform Delay, d1	3.9	5.6		4.0	6.6		16.5	16.5		16.6	18.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.3		0.2	1.1		0.1	0.1		0.1	1.9	
Delay (s)	4.1	5.8		4.2	7.7		16.6	16.6		16.7	20.6	
Level of Service	A	A		A	A		B	B		B	C	
Approach Delay (s)		5.8			7.6			16.6			20.4	
Approach LOS		A			A			B			C	

Intersection Summary			
HCM Average Control Delay	8.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	53.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	57.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.99		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1690	3138		1825	3166		1460	1736		1372	1720	
Flt Permitted	0.10	1.00		0.33	1.00		0.40	1.00		0.73	1.00	
Satd. Flow (perm)	180	3138		640	3166		621	1736		1052	1720	
Volume (vph)	131	816	32	18	1293	8	4	42	2	9	220	71
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	131	816	32	18	1293	8	4	42	2	9	220	71
RTOR Reduction (vph)	0	3	0	0	0	0	0	1	0	0	12	0
Lane Group Flow (vph)	131	845	0	18	1301	0	4	43	0	9	279	0
Heavy Vehicles (%)	8%	16%	7%	0%	15%	43%	25%	8%	50%	33%	1%	28%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	5	2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	44.2	44.2		36.8	36.8		19.1	19.1		17.1	17.1	
Effective Green, g (s)	46.2	46.2		38.8	38.8		21.1	21.1		21.1	21.1	
Actuated g/C Ratio	0.61	0.61		0.52	0.52		0.28	0.28		0.28	0.28	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		8.0	8.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	179	1925		330	1631		174	486		295	482	
v/s Ratio Prot	c0.03	0.27			c0.41			0.02			c0.16	
v/s Ratio Perm	0.42			0.03			0.01			0.01		
v/c Ratio	0.73	0.44		0.05	0.80		0.02	0.09		0.03	0.58	
Uniform Delay, d1	11.2	7.7		9.1	15.0		19.6	20.0		19.7	23.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	14.3	0.2		0.1	2.8		0.1	0.1		0.0	1.7	
Delay (s)	25.5	7.9		9.2	17.8		19.7	20.1		19.7	25.0	
Level of Service	C	A		A	B		B	C		B	C	
Approach Delay (s)		10.2			17.7			20.0			24.8	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	15.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	75.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↰	↑↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1094	7	7	1406	7	5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1094	7	7	1406	7	5
Pedestrians					2	
Lane Width (m)					3.7	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1103		1816	552
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1103		1816	552
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		90	99
cM capacity (veh/h)			639		70	481

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	729	372	7	703	703	12
Volume Left	0	0	7	0	0	7
Volume Right	0	7	0	0	0	5
cSH	1700	1700	639	1700	1700	109
Volume to Capacity	0.43	0.22	0.01	0.41	0.41	0.11
Queue Length 95th (m)	0.0	0.0	0.2	0.0	0.0	2.5
Control Delay (s)	0.0	0.0	10.7	0.0	0.0	42.2
Lane LOS			B			E
Approach Delay (s)	0.0		0.1			42.2
Approach LOS						E

Intersection Summary

Average Delay: 0.2

Intersection Capacity Utilization: 48.9% — ICU Level of Service: A

Analysis Period (min): 15

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	2566	3318	1328	1630	3444	1150	1738	3318	1541	2623	3147	1328
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	2566	3318	1328	1630	3444	1150	1738	3318	1541	2623	3147	1328
Volume (vph)	253	743	39	261	969	167	101	684	173	479	845	385
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	253	743	39	261	969	167	101	684	173	479	845	385
RTOR Reduction (vph)	0	0	29	0	0	0	0	0	127	0	0	197
Lane Group Flow (vph)	253	743	10	261	969	167	101	684	46	479	845	188
Heavy Vehicles (%)	38%	10%	23%	12%	6%	42%	5%	10%	6%	35%	16%	23%
Turn Type	Prot		Perm	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2			Free			4			8
Actuated Green, G (s)	15.2	32.3	32.3	23.2	40.3	131.8	10.3	28.3	28.3	26.2	44.2	44.2
Effective Green, g (s)	15.2	35.2	35.2	23.2	43.2	131.8	10.3	31.2	31.2	26.2	47.1	47.1
Actuated g/C Ratio	0.12	0.27	0.27	0.18	0.33	1.00	0.08	0.24	0.24	0.20	0.36	0.36
Clearance Time (s)	4.0	6.9	6.9	4.0	6.9		4.0	6.9	6.9	4.0	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	296	886	355	287	1129	1150	136	785	365	521	1125	475
v/s Ratio Prot	0.10	0.22		c0.16	c0.28		0.06	c0.21		c0.18	0.27	
v/s Ratio Perm			0.01			0.15			0.03			0.14
v/c Ratio	0.85	0.84	0.03	0.91	0.86	0.15	0.74	0.87	0.13	0.92	0.75	0.40
Uniform Delay, d1	57.2	45.6	35.7	53.3	41.4	0.0	59.5	48.4	39.6	51.8	37.2	31.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	20.7	7.0	0.0	30.3	6.6	0.3	19.5	10.4	0.2	21.3	2.9	0.5
Delay (s)	77.9	52.6	35.7	83.6	48.1	0.3	78.9	58.8	39.7	73.0	40.1	32.3
Level of Service	E	D	D	F	D	A	E	E	D	E	D	C
Approach Delay (s)		58.2			49.0			57.5			47.5	
Approach LOS		E			D			E			D	

Intersection Summary			
HCM Average Control Delay	52.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	131.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3444	1633	1825	3476	1738	1633
Flt Permitted	1.00	1.00	0.22	1.00	0.95	1.00
Satd. Flow (perm)	3444	1633	417	3476	1738	1633
Volume (vph)	1151	53	29	1394	43	24
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1151	53	29	1394	43	24
RTOR Reduction (vph)	0	18	0	0	0	20
Lane Group Flow (vph)	1151	35	29	1394	43	4
Heavy Vehicles (%)	6%	0%	0%	5%	5%	0%
Turn Type		Perm	Perm			Perm
Protected Phases	2			6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	24.0	24.0	24.0	24.0	4.0	4.0
Effective Green, g (s)	26.0	26.0	26.0	26.0	6.0	6.0
Actuated g/C Ratio	0.65	0.65	0.65	0.65	0.15	0.15
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2239	1061	271	2259	261	245
v/s Ratio Prot	0.33			c0.40	c0.02	
v/s Ratio Perm		0.02	0.07			0.00
v/c Ratio	0.51	0.03	0.11	0.62	0.16	0.01
Uniform Delay, d1	3.7	2.5	2.6	4.1	14.8	14.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.0	0.2	0.5	0.3	0.0
Delay (s)	3.9	2.5	2.8	4.6	15.1	14.5
Level of Service	A	A	A	A	B	B
Approach Delay (s)	3.8			4.6	14.9	
Approach LOS	A			A	B	

Intersection Summary			
HCM Average Control Delay	4.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑↱		↰	↑	↱	↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1547	3230	1484	1659	3400		1560	1847	1408	1825	1444	
Flt Permitted	0.12	1.00	1.00	0.17	1.00		0.72	1.00	1.00	0.51	1.00	
Satd. Flow (perm)	198	3230	1484	301	3400		1176	1847	1408	971	1444	
Volume (vph)	43	1151	45	32	1293	38	88	262	64	12	37	26
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	43	1151	45	32	1293	38	88	262	64	12	37	26
RTOR Reduction (vph)	0	0	19	0	3	0	0	0	43	0	18	0
Lane Group Flow (vph)	43	1151	26	32	1328	0	88	262	21	12	45	0
Heavy Vehicles (%)	18%	13%	10%	10%	7%	3%	17%	4%	16%	0%	19%	33%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)	30.7	30.7	30.7	30.7	30.7		17.1	17.1	17.1	17.1	17.1	
Effective Green, g (s)	33.3	33.3	33.3	33.3	33.3		19.7	19.7	19.7	19.7	19.7	
Actuated g/C Ratio	0.55	0.55	0.55	0.55	0.55		0.32	0.32	0.32	0.32	0.32	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	108	1763	810	164	1856		380	596	455	314	466	
v/s Ratio Prot		0.36			c0.39			c0.14			0.03	
v/s Ratio Perm	0.22		0.02	0.11			0.07		0.02	0.01		
v/c Ratio	0.40	0.65	0.03	0.20	0.72		0.23	0.44	0.05	0.04	0.10	
Uniform Delay, d1	8.0	9.8	6.4	7.0	10.3		15.1	16.3	14.2	14.2	14.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.4	0.9	0.0	0.6	1.3		0.3	0.5	0.0	0.1	0.1	
Delay (s)	10.4	10.7	6.4	7.6	11.7		15.4	16.8	14.2	14.2	14.5	
Level of Service	B	B	A	A	B		B	B	B	B	B	
Approach Delay (s)		10.5			11.6			16.1			14.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	11.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	61.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.93		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1659	3333		1738	3367		1738	1755		1372	1591	
Flt Permitted	0.16	1.00		0.18	1.00		0.74	1.00		0.61	1.00	
Satd. Flow (perm)	271	3333		335	3367		1353	1755		876	1591	
Volume (vph)	22	1201	12	22	1303	13	23	108	90	3	14	13
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	22	1201	12	22	1303	13	23	108	90	3	14	13
RTOR Reduction (vph)	0	1	0	0	1	0	0	45	0	0	10	0
Lane Group Flow (vph)	22	1212	0	22	1315	0	23	153	0	3	17	0
Heavy Vehicles (%)	10%	9%	45%	5%	8%	33%	5%	2%	2%	33%	0%	25%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	25.7	25.7		25.7	25.7		7.8	7.8		7.8	7.8	
Effective Green, g (s)	27.7	27.7		27.7	27.7		9.8	9.8		9.8	9.8	
Actuated g/C Ratio	0.61	0.61		0.61	0.61		0.22	0.22		0.22	0.22	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	165	2029		204	2050		291	378		189	343	
v/s Ratio Prot		0.36			c0.39			c0.09			0.01	
v/s Ratio Perm	0.08			0.07			0.02			0.00		
v/c Ratio	0.13	0.60		0.11	0.64		0.08	0.41		0.02	0.05	
Uniform Delay, d1	3.8	5.5		3.7	5.7		14.2	15.3		14.1	14.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.5		0.2	0.7		0.1	0.7		0.0	0.1	
Delay (s)	4.2	6.0		4.0	6.4		14.4	16.1		14.1	14.2	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		5.9			6.4			15.9			14.2	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	7.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	45.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	54.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.98		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3398		1825	3429		1825	1868		1825	1716	
Flt Permitted	0.09	1.00		0.09	1.00		0.70	1.00		0.24	1.00	
Satd. Flow (perm)	177	3398		180	3429		1343	1868		464	1716	
Volume (vph)	47	1421	40	22	1409	44	97	406	60	23	73	16
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	47	1421	40	22	1409	44	97	406	60	23	73	16
RTOR Reduction (vph)	0	2	0	0	2	0	0	5	0	0	7	0
Lane Group Flow (vph)	47	1459	0	22	1451	0	97	461	0	23	82	0
Heavy Vehicles (%)	2%	7%	6%	0%	6%	5%	0%	1%	0%	0%	5%	27%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	40.6	40.6		40.6	40.6		24.7	24.7		24.7	24.7	
Effective Green, g (s)	42.6	42.6		42.6	42.6		26.7	26.7		26.7	26.7	
Actuated g/C Ratio	0.55	0.55		0.55	0.55		0.35	0.35		0.35	0.35	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	98	1873		99	1890		464	645		160	593	
v/s Ratio Prot		c0.43			0.42			c0.25			0.05	
v/s Ratio Perm	0.27			0.12			0.07			0.05		
v/c Ratio	0.48	0.78		0.22	0.77		0.21	0.72		0.14	0.14	
Uniform Delay, d1	10.6	13.6		8.9	13.5		17.9	22.0		17.4	17.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.7	2.1		1.1	1.9		0.2	3.8		0.4	0.1	
Delay (s)	14.3	15.8		10.0	15.4		18.1	25.8		17.8	17.5	
Level of Service	B	B		B	B		B	C		B	B	
Approach Delay (s)		15.7			15.4			24.4			17.6	
Approach LOS		B			B			C			B	

Intersection Summary			
HCM Average Control Delay	17.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	77.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	72.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.97		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	3311		1644	3375		1772	1806		1560	1649	
Flt Permitted	0.17	1.00		0.17	1.00		0.72	1.00		0.65	1.00	
Satd. Flow (perm)	321	3311		296	3375		1339	1806		1060	1649	
Volume (vph)	44	1235	11	10	1251	9	41	138	39	6	16	44
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	44	1235	11	10	1251	9	41	138	39	6	16	44
RTOR Reduction (vph)	0	1	0	0	1	0	0	14	0	0	34	0
Lane Group Flow (vph)	44	1245	0	10	1259	0	41	163	0	6	26	0
Heavy Vehicles (%)	0%	10%	20%	11%	8%	13%	3%	2%	6%	17%	0%	5%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	23.9	23.9		23.9	23.9		7.7	7.7		7.7	7.7	
Effective Green, g (s)	25.9	25.9		25.9	25.9		9.7	9.7		9.7	9.7	
Actuated g/C Ratio	0.59	0.59		0.59	0.59		0.22	0.22		0.22	0.22	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	191	1967		176	2005		298	402		236	367	
v/s Ratio Prot		c0.38			0.37			c0.09			0.02	
v/s Ratio Perm	0.14			0.03			0.03			0.01		
v/c Ratio	0.23	0.63		0.06	0.63		0.14	0.41		0.03	0.07	
Uniform Delay, d1	4.2	5.8		3.7	5.7		13.6	14.5		13.3	13.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	0.7		0.1	0.6		0.2	0.7		0.0	0.1	
Delay (s)	4.8	6.4		3.9	6.4		13.8	15.2		13.3	13.5	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		6.4			6.3			14.9			13.5	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	7.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	43.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.99		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1560	3377		1825	3347		1825	1821		1496	1602	
Flt Permitted	0.16	1.00		0.25	1.00		0.67	1.00		0.67	1.00	
Satd. Flow (perm)	258	3377		488	3347		1286	1821		1048	1602	
Volume (vph)	141	1110	12	2	1078	31	7	137	7	9	43	94
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	141	1110	12	2	1078	31	7	137	7	9	43	94
RTOR Reduction (vph)	0	1	0	0	2	0	0	2	0	0	76	0
Lane Group Flow (vph)	141	1121	0	2	1107	0	7	142	0	9	61	0
Heavy Vehicles (%)	17%	8%	0%	0%	8%	29%	0%	5%	0%	22%	0%	11%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	5	2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	31.9	31.9		24.7	24.7		7.6	7.6		7.6	7.6	
Effective Green, g (s)	33.9	33.9		26.7	26.7		9.6	9.6		9.6	9.6	
Actuated g/C Ratio	0.66	0.66		0.52	0.52		0.19	0.19		0.19	0.19	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	251	2223		253	1735		240	339		195	299	
v/s Ratio Prot	0.03	c0.33			c0.33			c0.08			0.04	
v/s Ratio Perm	0.33			0.00			0.01			0.01		
v/c Ratio	0.56	0.50		0.01	0.64		0.03	0.42		0.05	0.20	
Uniform Delay, d1	5.4	4.5		6.0	8.9		17.1	18.5		17.2	17.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.9	0.2		0.0	0.8		0.0	0.8		0.1	0.3	
Delay (s)	8.2	4.7		6.0	9.7		17.2	19.3		17.3	18.0	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		5.1			9.7			19.2			18.0	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	8.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	51.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	56.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↰	↑↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1400	29	21	1144	15	10
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1400	29	21	1144	15	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1429		2028	714
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1429		2028	714
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		69	97
cM capacity (veh/h)			482		49	378

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	933	496	21	572	572	25
Volume Left	0	0	21	0	0	15
Volume Right	0	29	0	0	0	10
cSH	1700	1700	482	1700	1700	75
Volume to Capacity	0.55	0.29	0.04	0.34	0.34	0.33
Queue Length 95th (m)	0.0	0.0	1.0	0.0	0.0	8.8
Control Delay (s)	0.0	0.0	12.8	0.0	0.0	75.4
Lane LOS			B			F
Approach Delay (s)	0.0		0.2			75.4
Approach LOS						F

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	49.6%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix D
2017 Total Traffic (with 2012 Proposed Improvements – 4 lane widening)
Intersection Operation Calculations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	2623	3380	1512	1534	3288	1002	1615	2852	1445	2547	3259	1166
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	2623	3380	1512	1534	3288	1002	1615	2852	1445	2547	3259	1166
Volume (vph)	437	1091	93	154	732	459	70	840	267	240	753	179
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	437	1091	93	154	732	459	70	840	267	240	753	179
RTOR Reduction (vph)	0	0	53	0	0	0	0	0	159	0	0	114
Lane Group Flow (vph)	437	1091	40	154	732	459	70	840	108	240	753	65
Heavy Vehicles (%)	35%	8%	8%	19%	11%	63%	13%	28%	13%	39%	12%	40%
Turn Type	Prot		Perm	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2			Free			4			8
Actuated Green, G (s)	25.4	45.5	45.5	15.4	35.5	137.6	9.1	40.9	40.9	14.0	45.8	45.8
Effective Green, g (s)	25.4	48.4	48.4	15.4	38.4	137.6	9.1	43.8	43.8	14.0	48.7	48.7
Actuated g/C Ratio	0.18	0.35	0.35	0.11	0.28	1.00	0.07	0.32	0.32	0.10	0.35	0.35
Clearance Time (s)	4.0	6.9	6.9	4.0	6.9		4.0	6.9	6.9	4.0	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	484	1189	532	172	918	1002	107	908	460	259	1153	413
v/s Ratio Prot	c0.17	c0.32		0.10	0.22		0.04	c0.29		c0.09	0.23	
v/s Ratio Perm			0.03			0.46			0.07			0.06
v/c Ratio	0.90	0.92	0.08	0.90	0.80	0.46	0.65	0.93	0.24	0.93	0.65	0.16
Uniform Delay, d1	54.9	42.7	29.7	60.3	46.0	0.0	62.7	45.3	34.6	61.3	37.4	30.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	19.9	11.1	0.1	39.9	4.9	1.5	13.5	14.8	0.3	36.4	1.3	0.2
Delay (s)	74.8	53.8	29.8	100.2	50.9	1.5	76.2	60.1	34.8	97.7	38.7	30.6
Level of Service	E	D	C	F	D	A	E	E	C	F	D	C
Approach Delay (s)		58.1			39.7			55.4			49.5	
Approach LOS		E			D			E			D	

Intersection Summary			
HCM Average Control Delay	50.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	137.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3318	1633	1573	3288	1772	1555
Flt Permitted	1.00	1.00	0.20	1.00	0.95	1.00
Satd. Flow (perm)	3318	1633	330	3288	1772	1555
Volume (vph)	1214	27	23	1390	72	41
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1214	27	23	1390	72	41
RTOR Reduction (vph)	0	8	0	0	0	35
Lane Group Flow (vph)	1214	19	23	1390	72	6
Heavy Vehicles (%)	10%	0%	16%	11%	3%	5%
Turn Type		Perm	Perm			Perm
Protected Phases	2			6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	25.9	25.9	25.9	25.9	4.3	4.3
Effective Green, g (s)	27.9	27.9	27.9	27.9	6.3	6.3
Actuated g/C Ratio	0.66	0.66	0.66	0.66	0.15	0.15
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2194	1080	218	2174	265	232
v/s Ratio Prot	0.37			c0.42	c0.04	
v/s Ratio Perm		0.01	0.07			0.00
v/c Ratio	0.55	0.02	0.11	0.64	0.27	0.03
Uniform Delay, d1	3.8	2.5	2.6	4.2	15.9	15.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.0	0.2	0.6	0.6	0.0
Delay (s)	4.1	2.5	2.8	4.8	16.5	15.4
Level of Service	A	A	A	A	B	B
Approach Delay (s)	4.1			4.8	16.1	
Approach LOS	A			A	B	

Intersection Summary			
HCM Average Control Delay	4.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	42.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑↱		↰	↑	↱	↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1285	3318	1555	1615	3171		1674	1671	1317	1706	1690	
Flt Permitted	0.11	1.00	1.00	0.19	1.00		0.39	1.00	1.00	0.72	1.00	
Satd. Flow (perm)	143	3318	1555	329	3171		681	1671	1317	1287	1690	
Volume (vph)	43	1106	96	56	1412	25	40	62	46	48	278	46
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	43	1106	96	56	1412	25	40	62	46	48	278	46
RTOR Reduction (vph)	0	0	39	0	2	0	0	0	32	0	4	0
Lane Group Flow (vph)	43	1106	57	56	1435	0	40	62	14	48	320	0
Heavy Vehicles (%)	42%	10%	5%	13%	15%	5%	9%	15%	24%	7%	7%	37%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)	40.2	40.2	40.2	40.2	40.2		20.1	20.1	20.1	20.1	20.1	
Effective Green, g (s)	42.8	42.8	42.8	42.8	42.8		22.7	22.7	22.7	22.7	22.7	
Actuated g/C Ratio	0.58	0.58	0.58	0.58	0.58		0.31	0.31	0.31	0.31	0.31	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	83	1932	905	192	1847		210	516	407	397	522	
v/s Ratio Prot		0.33			c0.45			0.04			c0.19	
v/s Ratio Perm	0.30		0.04	0.17			0.06		0.01	0.04		
v/c Ratio	0.52	0.57	0.06	0.29	0.78		0.19	0.12	0.03	0.12	0.61	
Uniform Delay, d1	9.2	9.6	6.7	7.7	11.7		18.7	18.2	17.7	18.2	21.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	5.4	0.4	0.0	0.8	2.1		0.4	0.1	0.0	0.1	2.1	
Delay (s)	14.6	10.0	6.7	8.6	13.8		19.1	18.3	17.8	18.4	23.8	
Level of Service	B	B	A	A	B		B	B	B	B	C	
Approach Delay (s)		9.9			13.6			18.4			23.1	
Approach LOS		A			B			B			C	

Intersection Summary			
HCM Average Control Delay	13.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	73.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.91		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1177	3347		1772	3243		1217	1649		1825	1846	
Flt Permitted	0.18	1.00		0.21	1.00		0.67	1.00		0.75	1.00	
Satd. Flow (perm)	221	3347		389	3243		859	1649		1431	1846	
Volume (vph)	13	1075	58	79	1224	11	12	8	11	4	123	12
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	13	1075	58	79	1224	11	12	8	11	4	123	12
RTOR Reduction (vph)	0	4	0	0	1	0	0	9	0	0	6	0
Lane Group Flow (vph)	13	1129	0	79	1234	0	12	10	0	4	129	0
Confl. Peds. (#/hr)	1					1						
Heavy Vehicles (%)	55%	8%	12%	3%	12%	56%	50%	0%	11%	0%	1%	20%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	24.7	24.7		24.7	24.7		7.2	7.2		7.2	7.2	
Effective Green, g (s)	26.7	26.7		26.7	26.7		9.2	9.2		9.2	9.2	
Actuated g/C Ratio	0.61	0.61		0.61	0.61		0.21	0.21		0.21	0.21	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	134	2036		237	1972		180	346		300	387	
v/s Ratio Prot		0.34			c0.38			0.01			c0.07	
v/s Ratio Perm	0.06			0.20			0.01			0.00		
v/c Ratio	0.10	0.55		0.33	0.63		0.07	0.03		0.01	0.33	
Uniform Delay, d1	3.6	5.1		4.2	5.4		13.9	13.8		13.8	14.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.3		0.8	0.6		0.2	0.0		0.0	0.5	
Delay (s)	3.9	5.4		5.1	6.1		14.1	13.8		13.8	15.3	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		5.4			6.0			13.9			15.2	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	6.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	43.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.96		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1659	3345		1659	3339		1426	1715		1615	1845	
Flt Permitted	0.09	1.00		0.11	1.00		0.28	1.00		0.69	1.00	
Satd. Flow (perm)	161	3345		199	3339		416	1715		1180	1845	
Volume (vph)	37	1278	116	70	1474	18	29	71	26	60	353	55
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	37	1278	116	70	1474	18	29	71	26	60	353	55
RTOR Reduction (vph)	0	6	0	0	1	0	0	11	0	0	5	0
Lane Group Flow (vph)	37	1388	0	70	1491	0	29	86	0	60	403	0
Heavy Vehicles (%)	10%	8%	5%	10%	9%	20%	28%	7%	9%	13%	2%	2%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	41.9	41.9		41.9	41.9		21.9	21.9		21.9	21.9	
Effective Green, g (s)	43.9	43.9		43.9	43.9		23.9	23.9		23.9	23.9	
Actuated g/C Ratio	0.58	0.58		0.58	0.58		0.32	0.32		0.32	0.32	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	93	1937		115	1934		131	541		372	582	
v/s Ratio Prot		0.41			c0.45			0.05			c0.22	
v/s Ratio Perm	0.23			0.35			0.07			0.05		
v/c Ratio	0.40	0.72		0.61	0.77		0.22	0.16		0.16	0.69	
Uniform Delay, d1	8.7	11.5		10.4	12.1		19.1	18.7		18.7	22.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.8	1.3		8.8	2.0		0.9	0.1		0.2	3.6	
Delay (s)	11.5	12.8		19.2	14.1		20.0	18.8		18.9	26.3	
Level of Service	B	B		B	B		B	B		B	C	
Approach Delay (s)		12.7			14.3			19.1			25.4	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	15.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	75.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	85.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.94		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1521	3164		1825	3120		1217	1672		1372	1846	
Flt Permitted	0.12	1.00		0.20	1.00		0.41	1.00		0.74	1.00	
Satd. Flow (perm)	200	3164		380	3120		526	1672		1065	1846	
Volume (vph)	12	1096	78	36	1467	2	6	18	12	17	231	33
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	12	1096	78	36	1467	2	6	18	12	17	231	33
RTOR Reduction (vph)	0	6	0	0	0	0	0	9	0	0	5	0
Lane Group Flow (vph)	12	1168	0	36	1469	0	6	21	0	17	259	0
Heavy Vehicles (%)	20%	15%	3%	0%	17%	0%	50%	0%	20%	33%	1%	10%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	36.5	36.5		36.5	36.5		10.8	10.8		10.8	10.8	
Effective Green, g (s)	38.5	38.5		38.5	38.5		12.8	12.8		12.8	12.8	
Actuated g/C Ratio	0.65	0.65		0.65	0.65		0.22	0.22		0.22	0.22	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	130	2054		247	2026		114	361		230	398	
v/s Ratio Prot		0.37			c0.47			0.01			c0.14	
v/s Ratio Perm	0.06			0.09			0.01			0.02		
v/c Ratio	0.09	0.57		0.15	0.73		0.05	0.06		0.07	0.65	
Uniform Delay, d1	3.9	5.8		4.0	6.9		18.4	18.5		18.5	21.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.4		0.3	1.3		0.2	0.1		0.1	3.6	
Delay (s)	4.2	6.1		4.3	8.2		18.6	18.5		18.7	24.8	
Level of Service	A	A		A	A		B	B		B	C	
Approach Delay (s)		6.1			8.1			18.5			24.5	
Approach LOS		A			A			B			C	

Intersection Summary			
HCM Average Control Delay	9.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	59.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.99		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1690	3138		1825	3166		1460	1740		1372	1726	
Flt Permitted	0.09	1.00		0.31	1.00		0.35	1.00		0.73	1.00	
Satd. Flow (perm)	157	3138		598	3166		543	1740		1048	1726	
Volume (vph)	141	883	34	19	1374	9	4	46	2	9	243	75
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	141	883	34	19	1374	9	4	46	2	9	243	75
RTOR Reduction (vph)	0	3	0	0	0	0	0	1	0	0	11	0
Lane Group Flow (vph)	141	914	0	19	1383	0	4	47	0	9	307	0
Heavy Vehicles (%)	8%	16%	7%	0%	15%	43%	25%	8%	50%	33%	1%	28%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	5	2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	47.9	47.9		40.6	40.6		20.3	20.3		18.3	18.3	
Effective Green, g (s)	49.9	49.9		42.6	42.6		22.3	22.3		22.3	22.3	
Actuated g/C Ratio	0.62	0.62		0.53	0.53		0.28	0.28		0.28	0.28	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		8.0	8.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	161	1952		318	1682		151	484		291	480	
v/s Ratio Prot	c0.04	0.29			0.44			0.03			c0.18	
v/s Ratio Perm	c0.51			0.03			0.01			0.01		
v/c Ratio	0.88	0.47		0.06	0.82		0.03	0.10		0.03	0.64	
Uniform Delay, d1	13.1	8.1		9.1	15.6		21.1	21.5		21.1	25.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	37.4	0.2		0.1	3.4		0.1	0.1		0.0	2.8	
Delay (s)	50.5	8.3		9.2	19.0		21.1	21.6		21.1	28.2	
Level of Service	D	A		A	B		C	C		C	C	
Approach Delay (s)		13.9			18.9			21.5			28.0	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	18.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	80.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1205	8	8	1505	7	5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1205	8	8	1505	7	5
Pedestrians					2	
Lane Width (m)					3.7	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1215		1980	608
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1215		1980	608
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		87	99
cM capacity (veh/h)			580		54	443

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	803	410	8	752	752	12
Volume Left	0	0	8	0	0	7
Volume Right	0	8	0	0	0	5
cSH	1700	1700	580	1700	1700	86
Volume to Capacity	0.47	0.24	0.01	0.44	0.44	0.14
Queue Length 95th (m)	0.0	0.0	0.3	0.0	0.0	3.3
Control Delay (s)	0.0	0.0	11.3	0.0	0.0	53.8
Lane LOS			B			F
Approach Delay (s)	0.0		0.1			53.8
Approach LOS						F

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	51.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	2566	3318	1328	1630	3444	1150	1738	3318	1541	2623	3147	1328
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	2566	3318	1328	1630	3444	1150	1738	3318	1541	2623	3147	1328
Volume (vph)	258	838	42	268	1078	170	105	723	177	480	859	389
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	258	838	42	268	1078	170	105	723	177	480	859	389
RTOR Reduction (vph)	0	0	31	0	0	0	0	0	123	0	0	192
Lane Group Flow (vph)	258	838	11	268	1078	170	105	723	54	480	859	197
Heavy Vehicles (%)	38%	10%	23%	12%	6%	42%	5%	10%	6%	35%	16%	23%
Turn Type	Prot		Perm	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2			Free			4			8
Actuated Green, G (s)	15.6	34.4	34.4	24.1	42.9	136.7	10.5	29.5	29.5	26.9	45.9	45.9
Effective Green, g (s)	15.6	37.3	37.3	24.1	45.8	136.7	10.5	32.4	32.4	26.9	48.8	48.8
Actuated g/C Ratio	0.11	0.27	0.27	0.18	0.34	1.00	0.08	0.24	0.24	0.20	0.36	0.36
Clearance Time (s)	4.0	6.9	6.9	4.0	6.9		4.0	6.9	6.9	4.0	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	293	905	362	287	1154	1150	133	786	365	516	1123	474
v/s Ratio Prot	0.10	0.25		c0.16	c0.31		0.06	c0.22		c0.18	0.27	
v/s Ratio Perm			0.01			0.15			0.04			0.15
v/c Ratio	0.88	0.93	0.03	0.93	0.93	0.15	0.79	0.92	0.15	0.93	0.76	0.42
Uniform Delay, d1	59.6	48.4	36.5	55.5	44.0	0.0	62.0	50.9	41.2	54.0	38.9	33.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	25.0	15.0	0.0	35.7	13.5	0.3	26.0	15.7	0.2	23.6	3.2	0.6
Delay (s)	84.6	63.3	36.5	91.2	57.5	0.3	88.0	66.6	41.4	77.6	42.0	33.8
Level of Service	F	E	D	F	E	A	F	E	D	E	D	C
Approach Delay (s)		67.2			57.0			64.4			50.0	
Approach LOS		E			E			E			D	

Intersection Summary			
HCM Average Control Delay	58.3	HCM Level of Service	E
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	136.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3444	1633	1825	3476	1738	1633
Flt Permitted	1.00	1.00	0.19	1.00	0.95	1.00
Satd. Flow (perm)	3444	1633	369	3476	1738	1633
Volume (vph)	1246	57	31	1531	43	24
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1246	57	31	1531	43	24
RTOR Reduction (vph)	0	17	0	0	0	21
Lane Group Flow (vph)	1246	40	31	1531	43	3
Heavy Vehicles (%)	6%	0%	0%	5%	5%	0%
Turn Type		Perm	Perm			Perm
Protected Phases	2			6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	26.3	26.3	26.3	26.3	4.0	4.0
Effective Green, g (s)	28.3	28.3	28.3	28.3	6.0	6.0
Actuated g/C Ratio	0.67	0.67	0.67	0.67	0.14	0.14
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2304	1093	247	2326	247	232
v/s Ratio Prot	0.36			c0.44	c0.02	
v/s Ratio Perm		0.02	0.08			0.00
v/c Ratio	0.54	0.04	0.13	0.66	0.17	0.01
Uniform Delay, d1	3.6	2.4	2.5	4.1	16.0	15.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.0	0.2	0.7	0.3	0.0
Delay (s)	3.9	2.4	2.8	4.8	16.3	15.6
Level of Service	A	A	A	A	B	B
Approach Delay (s)	3.8			4.8	16.1	
Approach LOS	A			A	B	

Intersection Summary			
HCM Average Control Delay	4.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	42.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1547	3230	1484	1659	3400		1560	1847	1408	1825	1450	
Flt Permitted	0.10	1.00	1.00	0.15	1.00		0.71	1.00	1.00	0.44	1.00	
Satd. Flow (perm)	170	3230	1484	267	3400		1170	1847	1408	852	1450	
Volume (vph)	46	1246	48	34	1414	41	92	289	67	13	41	27
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	46	1246	48	34	1414	41	92	289	67	13	41	27
RTOR Reduction (vph)	0	0	17	0	3	0	0	0	41	0	17	0
Lane Group Flow (vph)	46	1246	31	34	1452	0	92	289	26	13	51	0
Heavy Vehicles (%)	18%	13%	10%	10%	7%	3%	17%	4%	16%	0%	19%	33%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)	35.7	35.7	35.7	35.7	35.7		17.7	17.7	17.7	17.7	17.7	
Effective Green, g (s)	38.3	38.3	38.3	38.3	38.3		20.3	20.3	20.3	20.3	20.3	
Actuated g/C Ratio	0.58	0.58	0.58	0.58	0.58		0.30	0.30	0.30	0.30	0.30	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	98	1857	853	154	1955		357	563	429	260	442	
v/s Ratio Prot		0.39			c0.43			c0.16			0.03	
v/s Ratio Perm	0.27		0.02	0.13			0.08		0.02	0.02		
v/c Ratio	0.47	0.67	0.04	0.22	0.74		0.26	0.51	0.06	0.05	0.11	
Uniform Delay, d1	8.2	9.8	6.1	6.9	10.5		17.5	19.1	16.4	16.3	16.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.5	1.0	0.0	0.7	1.6		0.4	0.8	0.1	0.1	0.1	
Delay (s)	11.8	10.8	6.2	7.6	12.1		17.9	19.9	16.5	16.4	16.8	
Level of Service	B	B	A	A	B		B	B	B	B	B	
Approach Delay (s)		10.6			12.0			18.9			16.7	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	12.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	66.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.93		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1659	3333		1738	3367		1738	1758		1372	1590	
Flt Permitted	0.13	1.00		0.16	1.00		0.74	1.00		0.55	1.00	
Satd. Flow (perm)	225	3333		290	3367		1351	1758		789	1590	
Volume (vph)	24	1304	13	24	1425	14	24	119	95	3	15	14
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	24	1304	13	24	1425	14	24	119	95	3	15	14
RTOR Reduction (vph)	0	1	0	0	1	0	0	41	0	0	11	0
Lane Group Flow (vph)	24	1316	0	24	1438	0	24	173	0	3	18	0
Heavy Vehicles (%)	10%	9%	45%	5%	8%	33%	5%	2%	2%	33%	0%	25%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	29.4	29.4		29.4	29.4		8.5	8.5		8.5	8.5	
Effective Green, g (s)	31.4	31.4		31.4	31.4		10.5	10.5		10.5	10.5	
Actuated g/C Ratio	0.63	0.63		0.63	0.63		0.21	0.21		0.21	0.21	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	142	2097		182	2119		284	370		166	335	
v/s Ratio Prot		0.39			c0.43			c0.10			0.01	
v/s Ratio Perm	0.11			0.08			0.02			0.00		
v/c Ratio	0.17	0.63		0.13	0.68		0.08	0.47		0.02	0.05	
Uniform Delay, d1	3.8	5.7		3.7	6.0		15.8	17.3		15.6	15.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	0.6		0.3	0.9		0.1	0.9		0.0	0.1	
Delay (s)	4.4	6.3		4.1	6.9		16.0	18.2		15.7	15.8	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		6.2			6.8			18.0			15.8	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	7.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	49.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	58.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.98		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3398		1825	3429		1825	1869		1825	1720	
Flt Permitted	0.08	1.00		0.08	1.00		0.69	1.00		0.16	1.00	
Satd. Flow (perm)	145	3398		148	3429		1332	1869		314	1720	
Volume (vph)	51	1559	43	24	1548	47	102	448	63	24	81	17
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	51	1559	43	24	1548	47	102	448	63	24	81	17
RTOR Reduction (vph)	0	2	0	0	2	0	0	4	0	0	6	0
Lane Group Flow (vph)	51	1600	0	24	1593	0	102	507	0	24	92	0
Heavy Vehicles (%)	2%	7%	6%	0%	6%	5%	0%	1%	0%	0%	5%	27%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	49.9	49.9		49.9	49.9		28.1	28.1		28.1	28.1	
Effective Green, g (s)	51.9	51.9		51.9	51.9		30.1	30.1		30.1	30.1	
Actuated g/C Ratio	0.58	0.58		0.58	0.58		0.33	0.33		0.33	0.33	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	84	1960		85	1977		445	625		105	575	
v/s Ratio Prot		c0.47			0.46			c0.27			0.05	
v/s Ratio Perm	0.35			0.16			0.08			0.08		
v/c Ratio	0.61	0.82		0.28	0.81		0.23	0.81		0.23	0.16	
Uniform Delay, d1	12.4	15.2		9.6	15.1		21.6	27.4		21.6	21.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	11.8	2.8		1.8	2.5		0.3	7.9		1.1	0.1	
Delay (s)	24.2	18.0		11.5	17.6		21.9	35.2		22.7	21.2	
Level of Service	C	B		B	B		C	D		C	C	
Approach Delay (s)		18.2			17.5			33.0			21.5	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	20.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	78.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.97		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	3311		1644	3375		1772	1808		1560	1655	
Flt Permitted	0.14	1.00		0.15	1.00		0.72	1.00		0.61	1.00	
Satd. Flow (perm)	270	3311		252	3375		1334	1808		996	1655	
Volume (vph)	47	1343	12	11	1366	10	43	152	41	6	18	46
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	47	1343	12	11	1366	10	43	152	41	6	18	46
RTOR Reduction (vph)	0	1	0	0	1	0	0	13	0	0	36	0
Lane Group Flow (vph)	47	1354	0	11	1375	0	43	180	0	6	28	0
Heavy Vehicles (%)	0%	10%	20%	11%	8%	13%	3%	2%	6%	17%	0%	5%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	27.3	27.3		27.3	27.3		8.4	8.4		8.4	8.4	
Effective Green, g (s)	29.3	29.3		29.3	29.3		10.4	10.4		10.4	10.4	
Actuated g/C Ratio	0.61	0.61		0.61	0.61		0.22	0.22		0.22	0.22	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	166	2034		155	2073		291	394		217	361	
v/s Ratio Prot		c0.41			0.41			c0.10			0.02	
v/s Ratio Perm	0.17			0.04			0.03			0.01		
v/c Ratio	0.28	0.67		0.07	0.66		0.15	0.46		0.03	0.08	
Uniform Delay, d1	4.3	6.0		3.7	6.0		15.1	16.2		14.7	14.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.9	0.8		0.2	0.8		0.2	0.8		0.1	0.1	
Delay (s)	5.2	6.8		3.9	6.8		15.3	17.0		14.7	14.9	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		6.8			6.8			16.7			14.9	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	7.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	47.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.99		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1560	3377		1825	3348		1825	1821		1496	1606	
Flt Permitted	0.14	1.00		0.23	1.00		0.66	1.00		0.64	1.00	
Satd. Flow (perm)	229	3377		446	3348		1276	1821		1002	1606	
Volume (vph)	152	1199	13	2	1165	33	7	151	7	9	47	99
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	152	1199	13	2	1165	33	7	151	7	9	47	99
RTOR Reduction (vph)	0	1	0	0	2	0	0	2	0	0	81	0
Lane Group Flow (vph)	152	1211	0	2	1196	0	7	156	0	9	65	0
Heavy Vehicles (%)	17%	8%	0%	0%	8%	29%	0%	5%	0%	22%	0%	11%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	5	2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	34.9	34.9		27.7	27.7		8.2	8.2		8.2	8.2	
Effective Green, g (s)	36.9	36.9		29.7	29.7		10.2	10.2		10.2	10.2	
Actuated g/C Ratio	0.67	0.67		0.54	0.54		0.19	0.19		0.19	0.19	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	231	2262		240	1805		236	337		185	297	
v/s Ratio Prot	0.04	c0.36			0.36			c0.09			0.04	
v/s Ratio Perm	c0.40			0.00			0.01			0.01		
v/c Ratio	0.66	0.54		0.01	0.66		0.03	0.46		0.05	0.22	
Uniform Delay, d1	6.1	4.7		5.9	9.1		18.4	20.0		18.5	19.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.6	0.2		0.0	0.9		0.1	1.0		0.1	0.4	
Delay (s)	12.7	4.9		5.9	10.0		18.4	21.0		18.6	19.4	
Level of Service	B	A		A	B		B	C		B	B	
Approach Delay (s)		5.8			10.0			20.9			19.4	
Approach LOS		A			B			C			B	

Intersection Summary			
HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	55.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↰	↑↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1534	31	23	1241	15	10
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1534	31	23	1241	15	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1565		2216	782
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1565		2216	782
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		58	97
cM capacity (veh/h)			428		36	341

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	1023	542	23	620	620	25
Volume Left	0	0	23	0	0	15
Volume Right	0	31	0	0	0	10
cSH	1700	1700	428	1700	1700	56
Volume to Capacity	0.60	0.32	0.05	0.37	0.37	0.45
Queue Length 95th (m)	0.0	0.0	1.2	0.0	0.0	11.8
Control Delay (s)	0.0	0.0	13.9	0.0	0.0	112.8
Lane LOS			B			F
Approach Delay (s)	0.0		0.3			112.8
Approach LOS						F

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	53.4%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix E
2032 Total Traffic (with 2017 Proposed Improvements – 4 lane widening) Intersection Operation Calculations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	2623	3380	1512	1534	3288	1002	1615	2852	1445	2547	3259	1166
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	2623	3380	1512	1534	3288	1002	1615	2852	1445	2547	3259	1166
Volume (vph)	445	1366	108	167	943	465	74	875	280	248	869	185
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	445	1366	108	167	943	465	74	875	280	248	869	185
RTOR Reduction (vph)	0	0	48	0	0	15	0	0	160	0	0	101
Lane Group Flow (vph)	445	1366	60	167	943	450	74	875	120	248	869	84
Heavy Vehicles (%)	35%	8%	8%	19%	11%	63%	13%	28%	13%	39%	12%	40%
Turn Type	Prot		Perm	Prot		pt+ov	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6	6 3	7	4		3	8	
Permitted Phases			2						4			8
Actuated Green, G (s)	24.0	47.1	47.1	16.0	39.1	61.0	10.0	40.9	40.9	15.0	45.9	45.9
Effective Green, g (s)	24.0	50.0	50.0	16.0	42.0	61.0	10.0	43.8	43.8	15.0	48.8	48.8
Actuated g/C Ratio	0.17	0.36	0.36	0.11	0.30	0.43	0.07	0.31	0.31	0.11	0.35	0.35
Clearance Time (s)	4.0	6.9	6.9	4.0	6.9		4.0	6.9	6.9	4.0	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	447	1200	537	174	981	434	115	887	450	271	1130	404
v/s Ratio Prot	c0.17	c0.40		0.11	0.29	c0.45	0.05	c0.31		0.10	0.27	
v/s Ratio Perm			0.04						0.08			0.07
v/c Ratio	1.00	1.14	0.11	0.96	0.96	1.04	0.64	0.99	0.27	0.92	0.77	0.21
Uniform Delay, d1	58.3	45.4	30.5	62.1	48.6	39.9	63.7	48.2	36.4	62.3	41.0	32.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	41.1	72.8	0.1	55.7	19.9	53.2	11.7	26.6	0.3	32.9	3.2	0.3
Delay (s)	99.5	118.2	30.6	117.8	68.5	93.1	75.4	74.8	36.8	95.2	44.2	32.6
Level of Service	F	F	C	F	E	F	E	E	D	F	D	C
Approach Delay (s)		108.9			81.0			66.2			52.3	
Approach LOS		F			F			E			D	

Intersection Summary			
HCM Average Control Delay	80.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	140.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	91.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3318	1633	1573	3288	1772	1555
Flt Permitted	1.00	1.00	0.14	1.00	0.95	1.00
Satd. Flow (perm)	3318	1633	226	3288	1772	1555
Volume (vph)	1496	31	27	1599	72	41
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1496	31	27	1599	72	41
RTOR Reduction (vph)	0	7	0	0	0	33
Lane Group Flow (vph)	1496	24	27	1599	72	8
Heavy Vehicles (%)	10%	0%	16%	11%	3%	5%
Turn Type		Perm	Perm			Perm
Protected Phases	2			6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	30.8	30.8	30.8	30.8	4.3	4.3
Effective Green, g (s)	32.8	32.8	32.8	32.8	6.3	6.3
Actuated g/C Ratio	0.70	0.70	0.70	0.70	0.13	0.13
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2311	1137	157	2290	237	208
v/s Ratio Prot	0.45			c0.49	c0.04	
v/s Ratio Perm		0.01	0.12			0.01
v/c Ratio	0.65	0.02	0.17	0.70	0.30	0.04
Uniform Delay, d1	4.0	2.2	2.5	4.2	18.4	17.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.0	0.5	0.9	0.7	0.1
Delay (s)	4.6	2.2	3.0	5.2	19.1	17.8
Level of Service	A	A	A	A	B	B
Approach Delay (s)	4.5			5.1	18.7	
Approach LOS	A			A	B	

Intersection Summary			
HCM Average Control Delay	5.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	47.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	58.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑↱		↰	↑	↱	↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1285	3318	1555	1615	3171		1674	1671	1317	1706	1700	
Flt Permitted	0.08	1.00	1.00	0.14	1.00		0.23	1.00	1.00	0.71	1.00	
Satd. Flow (perm)	104	3318	1555	235	3171		399	1671	1317	1268	1700	
Volume (vph)	50	1351	111	65	1628	29	45	78	51	54	348	51
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	50	1351	111	65	1628	29	45	78	51	54	348	51
RTOR Reduction (vph)	0	0	32	0	1	0	0	0	37	0	4	0
Lane Group Flow (vph)	50	1351	79	65	1656	0	45	78	14	54	395	0
Heavy Vehicles (%)	42%	10%	5%	13%	15%	5%	9%	15%	24%	7%	7%	37%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)	56.1	56.1	56.1	56.1	56.1		23.7	23.7	23.7	23.7	23.7	
Effective Green, g (s)	58.7	58.7	58.7	58.7	58.7		26.3	26.3	26.3	26.3	26.3	
Actuated g/C Ratio	0.63	0.63	0.63	0.63	0.63		0.28	0.28	0.28	0.28	0.28	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	66	2094	981	148	2001		113	473	372	359	481	
v/s Ratio Prot		0.41			c0.52			0.05			c0.23	
v/s Ratio Perm	0.48		0.05	0.28			0.11		0.01	0.04		
v/c Ratio	0.76	0.65	0.08	0.44	0.83		0.40	0.16	0.04	0.15	0.82	
Uniform Delay, d1	12.1	10.7	6.7	8.8	13.2		27.0	25.1	24.2	25.0	31.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	38.4	0.7	0.0	2.1	3.0		2.3	0.2	0.0	0.2	10.8	
Delay (s)	50.6	11.4	6.7	10.8	16.2		29.3	25.3	24.2	25.2	41.9	
Level of Service	D	B	A	B	B		C	C	C	C	D	
Approach Delay (s)		12.3			16.0			26.0			39.9	
Approach LOS		B			B			C			D	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	97.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.92		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1177	3349		1772	3242		1217	1664		1825	1853	
Flt Permitted	0.15	1.00		0.15	1.00		0.64	1.00		0.74	1.00	
Satd. Flow (perm)	180	3349		276	3242		814	1664		1427	1853	
Volume (vph)	15	1309	67	92	1375	13	13	10	12	4	154	13
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	1309	67	92	1375	13	13	10	12	4	154	13
RTOR Reduction (vph)	0	4	0	0	1	0	0	10	0	0	4	0
Lane Group Flow (vph)	15	1372	0	92	1387	0	13	12	0	4	163	0
Confl. Peds. (#/hr)	1					1						
Heavy Vehicles (%)	55%	8%	12%	3%	12%	56%	50%	0%	11%	0%	1%	20%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	31.6	31.6		31.6	31.6		8.3	8.3		8.3	8.3	
Effective Green, g (s)	33.6	33.6		33.6	33.6		10.3	10.3		10.3	10.3	
Actuated g/C Ratio	0.65	0.65		0.65	0.65		0.20	0.20		0.20	0.20	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	117	2168		179	2099		162	330		283	368	
v/s Ratio Prot		0.41			c0.43			0.01			c0.09	
v/s Ratio Perm	0.08			0.33			0.02			0.00		
v/c Ratio	0.13	0.63		0.51	0.66		0.08	0.04		0.01	0.44	
Uniform Delay, d1	3.5	5.5		4.8	5.6		16.9	16.8		16.7	18.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	0.6		2.5	0.8		0.2	0.0		0.0	0.9	
Delay (s)	4.0	6.1		7.3	6.4		17.2	16.8		16.7	19.1	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		6.1			6.5			17.0			19.1	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	7.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	51.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.96		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1659	3347		1659	3339		1426	1721		1615	1849	
Flt Permitted	0.07	1.00		0.07	1.00		0.12	1.00		0.64	1.00	
Satd. Flow (perm)	119	3347		124	3339		177	1721		1089	1849	
Volume (vph)	43	1582	135	81	1712	21	32	89	29	67	441	62
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	43	1582	135	81	1712	21	32	89	29	67	441	62
RTOR Reduction (vph)	0	5	0	0	1	0	0	10	0	0	4	0
Lane Group Flow (vph)	43	1712	0	81	1732	0	32	108	0	67	499	0
Heavy Vehicles (%)	10%	8%	5%	10%	9%	20%	28%	7%	9%	13%	2%	2%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	76.0	76.0		76.0	76.0		31.9	31.9		31.9	31.9	
Effective Green, g (s)	78.0	78.0		78.0	78.0		33.9	33.9		33.9	33.9	
Actuated g/C Ratio	0.65	0.65		0.65	0.65		0.28	0.28		0.28	0.28	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	77	2177		81	2172		50	487		308	523	
v/s Ratio Prot		0.51			0.52			0.06			c0.27	
v/s Ratio Perm	0.36			c0.65			0.18			0.06		
v/c Ratio	0.56	0.79		1.00	0.80		0.64	0.22		0.22	0.95	
Uniform Delay, d1	11.5	15.0		21.0	15.2		37.7	32.9		32.9	42.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.5	1.9		100.0	2.1		24.7	0.2		0.4	27.9	
Delay (s)	20.0	16.9		121.0	17.3		62.3	33.1		33.2	70.1	
Level of Service	C	B		F	B		E	C		C	E	
Approach Delay (s)		17.0			22.0			39.4			65.8	
Approach LOS		B			C			D			E	

Intersection Summary			
HCM Average Control Delay	26.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	119.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	95.0%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↑↱		↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.95		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1521	3165		1825	3120		1217	1695		1372	1851	
Flt Permitted	0.08	1.00		0.13	1.00		0.30	1.00		0.73	1.00	
Satd. Flow (perm)	126	3165		248	3120		385	1695		1060	1851	
Volume (vph)	14	1338	91	42	1704	2	7	23	13	19	289	37
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	14	1338	91	42	1704	2	7	23	13	19	289	37
RTOR Reduction (vph)	0	5	0	0	0	0	0	10	0	0	5	0
Lane Group Flow (vph)	14	1424	0	42	1706	0	7	26	0	19	321	0
Heavy Vehicles (%)	20%	15%	3%	0%	17%	0%	50%	0%	20%	33%	1%	10%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	48.8	48.8		48.8	48.8		17.3	17.3		17.3	17.3	
Effective Green, g (s)	50.8	50.8		50.8	50.8		19.3	19.3		19.3	19.3	
Actuated g/C Ratio	0.65	0.65		0.65	0.65		0.25	0.25		0.25	0.25	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	82	2059		161	2029		95	419		262	457	
v/s Ratio Prot		0.45			c0.55			0.02			c0.17	
v/s Ratio Perm	0.11			0.17			0.02			0.02		
v/c Ratio	0.17	0.69		0.26	0.84		0.07	0.06		0.07	0.70	
Uniform Delay, d1	5.4	8.7		5.7	10.5		22.5	22.5		22.5	26.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.0	1.0		0.9	3.3		0.3	0.1		0.1	4.9	
Delay (s)	6.4	9.7		6.6	13.9		22.9	22.5		22.7	31.7	
Level of Service	A	A		A	B		C	C		C	C	
Approach Delay (s)		9.7			13.7			22.6			31.2	
Approach LOS		A			B			C			C	

Intersection Summary			
HCM Average Control Delay	13.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	78.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	1.00		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1690	3138		1825	3166		1460	1749		1372	1744	
Flt Permitted	0.06	1.00		0.26	1.00		0.16	1.00		0.72	1.00	
Satd. Flow (perm)	108	3138		492	3166		240	1749		1033	1744	
Volume (vph)	164	1052	39	22	1578	10	5	62	2	10	327	87
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	164	1052	39	22	1578	10	5	62	2	10	327	87
RTOR Reduction (vph)	0	2	0	0	0	0	0	1	0	0	8	0
Lane Group Flow (vph)	164	1089	0	22	1588	0	5	63	0	10	406	0
Heavy Vehicles (%)	8%	16%	7%	0%	15%	43%	25%	8%	50%	33%	1%	28%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	5	2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	71.8	71.8		59.7	59.7		27.2	27.2		25.2	25.2	
Effective Green, g (s)	73.8	73.8		61.7	61.7		29.2	29.2		29.2	29.2	
Actuated g/C Ratio	0.66	0.66		0.56	0.56		0.26	0.26		0.26	0.26	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		8.0	8.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	187	2086		273	1760		63	460		272	459	
v/s Ratio Prot	c0.06	0.35			0.50			0.04			c0.23	
v/s Ratio Perm	c0.52			0.04			0.02			0.01		
v/c Ratio	0.88	0.52		0.08	0.90		0.08	0.14		0.04	0.88	
Uniform Delay, d1	30.4	9.5		11.5	22.0		30.8	31.3		30.4	39.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	33.8	0.2		0.1	6.8		0.5	0.1		0.1	18.0	
Delay (s)	64.1	9.8		11.6	28.8		31.3	31.4		30.5	57.3	
Level of Service	E	A		B	C		C	C		C	E	
Approach Delay (s)		16.9			28.6			31.4			56.6	
Approach LOS		B			C			C			E	

Intersection Summary			
HCM Average Control Delay	27.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	111.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	85.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↰	↑↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1484	9	9	1753	7	5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1484	9	9	1753	7	5
Pedestrians					2	
Lane Width (m)					3.7	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1495		2385	748
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1495		2385	748
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		76	99
cM capacity (veh/h)			454		29	359

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	989	504	9	876	876	12
Volume Left	0	0	9	0	0	7
Volume Right	0	9	0	0	0	5
cSH	1700	1700	454	1700	1700	46
Volume to Capacity	0.58	0.30	0.02	0.52	0.52	0.26
Queue Length 95th (m)	0.0	0.0	0.4	0.0	0.0	6.1
Control Delay (s)	0.0	0.0	13.1	0.0	0.0	107.7
Lane LOS			B			F
Approach Delay (s)	0.0		0.1			107.7
Approach LOS						F

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	58.5%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	2566	3318	1328	1630	3444	1150	1738	3318	1541	2623	3147	1328
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	2566	3318	1328	1630	3444	1150	1738	3318	1541	2623	3147	1328
Volume (vph)	270	1077	48	283	1353	177	115	825	186	483	897	398
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	270	1077	48	283	1353	177	115	825	186	483	897	398
RTOR Reduction (vph)	0	0	27	0	0	10	0	0	113	0	0	186
Lane Group Flow (vph)	270	1077	21	283	1353	167	115	825	73	483	897	212
Heavy Vehicles (%)	38%	10%	23%	12%	6%	42%	5%	10%	6%	35%	16%	23%
Turn Type	Prot		Perm	Prot		pt+ov	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6	6 3	7	4		3	8	
Permitted Phases			2						4			8
Actuated Green, G (s)	16.0	35.1	35.1	25.0	44.1	78.4	10.9	30.1	30.1	27.4	46.6	46.6
Effective Green, g (s)	16.0	38.0	38.0	25.0	47.0	78.4	10.9	33.0	33.0	27.4	49.5	49.5
Actuated g/C Ratio	0.11	0.27	0.27	0.18	0.34	0.56	0.08	0.24	0.24	0.20	0.36	0.36
Clearance Time (s)	4.0	6.9	6.9	4.0	6.9		4.0	6.9	6.9	4.0	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	295	904	362	292	1161	647	136	785	365	516	1117	472
v/s Ratio Prot	0.11	0.32		c0.17	c0.39	0.15	0.07	c0.25		c0.18	0.29	
v/s Ratio Perm			0.02						0.05			0.16
v/c Ratio	0.92	1.19	0.06	0.97	1.17	0.26	0.85	1.05	0.20	0.94	0.80	0.45
Uniform Delay, d1	61.0	50.7	37.5	56.8	46.2	15.6	63.4	53.2	42.6	55.1	40.6	34.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	31.1	97.1	0.1	43.7	84.1	0.2	35.6	46.3	0.3	24.5	4.3	0.7
Delay (s)	92.1	147.8	37.5	100.5	130.3	15.8	99.1	99.5	42.9	79.6	44.8	35.2
Level of Service	F	F	D	F	F	B	F	F	D	E	D	D
Approach Delay (s)		133.2			114.5			90.1			52.1	
Approach LOS		F			F			F			D	

Intersection Summary			
HCM Average Control Delay	96.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	139.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	95.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3444	1633	1825	3476	1738	1633
Flt Permitted	1.00	1.00	0.14	1.00	0.95	1.00
Satd. Flow (perm)	3444	1633	271	3476	1738	1633
Volume (vph)	1485	66	36	1876	43	24
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1485	66	36	1876	43	24
RTOR Reduction (vph)	0	14	0	0	0	21
Lane Group Flow (vph)	1485	52	36	1876	43	3
Heavy Vehicles (%)	6%	0%	0%	5%	5%	0%
Turn Type		Perm	Perm			Perm
Protected Phases	2			6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	34.3	34.3	34.3	34.3	4.6	4.6
Effective Green, g (s)	36.3	36.3	36.3	36.3	6.6	6.6
Actuated g/C Ratio	0.71	0.71	0.71	0.71	0.13	0.13
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2456	1165	193	2479	225	212
v/s Ratio Prot	0.43			c0.54	c0.02	
v/s Ratio Perm		0.03	0.13			0.00
v/c Ratio	0.60	0.04	0.19	0.76	0.19	0.01
Uniform Delay, d1	3.7	2.2	2.4	4.5	19.8	19.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.0	0.5	1.4	0.4	0.0
Delay (s)	4.1	2.2	2.9	5.9	20.2	19.3
Level of Service	A	A	A	A	C	B
Approach Delay (s)	4.0			5.9	19.9	
Approach LOS	A			A	B	

Intersection Summary			
HCM Average Control Delay	5.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	50.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑↱		↰	↑	↱	↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1547	3230	1484	1659	3401		1560	1847	1408	1825	1461	
Flt Permitted	0.07	1.00	1.00	0.11	1.00		0.70	1.00	1.00	0.26	1.00	
Satd. Flow (perm)	113	3230	1484	197	3401		1157	1847	1408	506	1461	
Volume (vph)	53	1485	56	39	1718	48	103	361	75	15	51	30
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	53	1485	56	39	1718	48	103	361	75	15	51	30
RTOR Reduction (vph)	0	0	15	0	2	0	0	0	39	0	16	0
Lane Group Flow (vph)	53	1485	41	39	1764	0	103	361	36	15	65	0
Heavy Vehicles (%)	18%	13%	10%	10%	7%	3%	17%	4%	16%	0%	19%	33%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)	54.8	54.8	54.8	54.8	54.8		21.4	21.4	21.4	21.4	21.4	
Effective Green, g (s)	57.4	57.4	57.4	57.4	57.4		24.0	24.0	24.0	24.0	24.0	
Actuated g/C Ratio	0.64	0.64	0.64	0.64	0.64		0.27	0.27	0.27	0.27	0.27	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	73	2074	953	126	2184		311	496	378	136	392	
v/s Ratio Prot		0.46			c0.52			c0.20			0.04	
v/s Ratio Perm	0.47		0.03	0.20			0.09		0.03	0.03		
v/c Ratio	0.73	0.72	0.04	0.31	0.81		0.33	0.73	0.10	0.11	0.17	
Uniform Delay, d1	10.7	10.6	5.9	7.1	11.9		26.3	29.7	24.6	24.7	25.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	29.9	1.2	0.0	1.4	2.3		0.6	5.3	0.1	0.4	0.2	
Delay (s)	40.6	11.8	5.9	8.6	14.2		26.9	35.0	24.7	25.0	25.2	
Level of Service	D	B	A	A	B		C	D	C	C	C	
Approach Delay (s)		12.6			14.1			32.0			25.2	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	16.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	89.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	76.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.94		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1659	3333		1738	3368		1738	1766		1372	1606	
Flt Permitted	0.10	1.00		0.10	1.00		0.73	1.00		0.45	1.00	
Satd. Flow (perm)	171	3333		179	3368		1344	1766		650	1606	
Volume (vph)	28	1563	15	28	1733	16	27	149	106	3	19	16
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	28	1563	15	28	1733	16	27	149	106	3	19	16
RTOR Reduction (vph)	0	1	0	0	1	0	0	23	0	0	12	0
Lane Group Flow (vph)	28	1577	0	28	1748	0	27	232	0	3	23	0
Heavy Vehicles (%)	10%	9%	45%	5%	8%	33%	5%	2%	2%	33%	0%	25%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	38.8	38.8		38.8	38.8		14.1	14.1		14.1	14.1	
Effective Green, g (s)	40.8	40.8		40.8	40.8		16.1	16.1		16.1	16.1	
Actuated g/C Ratio	0.63	0.63		0.63	0.63		0.25	0.25		0.25	0.25	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	108	2095		113	2117		333	438		161	398	
v/s Ratio Prot		0.47			c0.52			c0.13			0.01	
v/s Ratio Perm	0.16			0.16			0.02			0.00		
v/c Ratio	0.26	0.75		0.25	0.83		0.08	0.53		0.02	0.06	
Uniform Delay, d1	5.3	8.5		5.3	9.3		18.7	21.1		18.4	18.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.3	1.6		1.2	2.8		0.1	1.2		0.0	0.1	
Delay (s)	6.6	10.1		6.5	12.1		18.8	22.4		18.5	18.7	
Level of Service	A	B		A	B		B	C		B	B	
Approach Delay (s)		10.0			12.0			22.0			18.7	
Approach LOS		B			B			C			B	

Intersection Summary			
HCM Average Control Delay	12.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	64.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↑↱		↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3399		1825	3430		1825	1872		1825	1729	
Flt Permitted	0.06	1.00		0.06	1.00		0.65	1.00		0.10	1.00	
Satd. Flow (perm)	106	3399		108	3430		1254	1872		187	1729	
Volume (vph)	59	1906	50	28	1899	55	114	560	70	27	101	19
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	59	1906	50	28	1899	55	114	560	70	27	101	19
RTOR Reduction (vph)	0	2	0	0	2	0	0	4	0	0	6	0
Lane Group Flow (vph)	59	1954	0	28	1952	0	114	626	0	27	114	0
Heavy Vehicles (%)	2%	7%	6%	0%	6%	5%	0%	1%	0%	0%	5%	27%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	69.0	69.0		69.0	69.0		39.0	39.0		39.0	39.0	
Effective Green, g (s)	71.0	71.0		71.0	71.0		41.0	41.0		41.0	41.0	
Actuated g/C Ratio	0.59	0.59		0.59	0.59		0.34	0.34		0.34	0.34	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	63	2011		64	2029		428	640		64	591	
v/s Ratio Prot		c0.57			0.57			c0.33			0.07	
v/s Ratio Perm	0.56			0.26			0.09			0.14		
v/c Ratio	0.94	0.97		0.44	0.96		0.27	0.98		0.42	0.19	
Uniform Delay, d1	22.4	23.5		13.5	23.2		28.6	39.1		30.4	27.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	90.1	14.0		4.7	12.3		0.3	29.8		4.4	0.2	
Delay (s)	112.5	37.5		18.2	35.5		28.9	68.8		34.8	28.0	
Level of Service	F	D		B	D		C	E		C	C	
Approach Delay (s)		39.7			35.3			62.7			29.3	
Approach LOS		D			D			E			C	

Intersection Summary			
HCM Average Control Delay	41.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	94.7%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑		↰	↑↑↱		↰	↑↱		↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.97		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	3311		1644	3375		1772	1815		1560	1665	
Flt Permitted	0.11	1.00		0.11	1.00		0.71	1.00		0.47	1.00	
Satd. Flow (perm)	205	3311		185	3375		1322	1815		766	1665	
Volume (vph)	55	1616	14	13	1655	12	48	190	46	7	23	51
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	55	1616	14	13	1655	12	48	190	46	7	23	51
RTOR Reduction (vph)	0	1	0	0	1	0	0	13	0	0	21	0
Lane Group Flow (vph)	55	1629	0	13	1666	0	48	223	0	7	53	0
Heavy Vehicles (%)	0%	10%	20%	11%	8%	13%	3%	2%	6%	17%	0%	5%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	35.4	35.4		35.4	35.4		10.0	10.0		10.0	10.0	
Effective Green, g (s)	37.4	37.4		37.4	37.4		12.0	12.0		12.0	12.0	
Actuated g/C Ratio	0.65	0.65		0.65	0.65		0.21	0.21		0.21	0.21	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	134	2157		121	2199		276	379		160	348	
v/s Ratio Prot		0.49			c0.49			c0.12			0.03	
v/s Ratio Perm	0.27			0.07			0.04			0.01		
v/c Ratio	0.41	0.76		0.11	0.76		0.17	0.59		0.04	0.15	
Uniform Delay, d1	4.8	6.9		3.7	6.9		18.6	20.5		18.1	18.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.0	1.5		0.4	1.5		0.3	2.3		0.1	0.2	
Delay (s)	6.8	8.4		4.1	8.4		18.9	22.8		18.2	18.8	
Level of Service	A	A		A	A		B	C		B	B	
Approach Delay (s)		8.4			8.4			22.2			18.7	
Approach LOS		A			A			C			B	

Intersection Summary			
HCM Average Control Delay	9.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	57.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.99		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1560	3377		1825	3349		1825	1823		1496	1620	
Flt Permitted	0.09	1.00		0.18	1.00		0.52	1.00		0.43	1.00	
Satd. Flow (perm)	149	3377		355	3349		992	1823		684	1620	
Volume (vph)	176	1422	15	2	1384	38	8	203	8	10	63	115
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	176	1422	15	2	1384	38	8	203	8	10	63	115
RTOR Reduction (vph)	0	1	0	0	2	0	0	2	0	0	71	0
Lane Group Flow (vph)	176	1436	0	2	1420	0	8	209	0	10	107	0
Heavy Vehicles (%)	17%	8%	0%	0%	8%	29%	0%	5%	0%	22%	0%	11%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	5	2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	50.3	50.3		38.8	38.8		11.1	11.1		11.1	11.1	
Effective Green, g (s)	52.3	52.3		40.8	40.8		13.1	13.1		13.1	13.1	
Actuated g/C Ratio	0.71	0.71		0.56	0.56		0.18	0.18		0.18	0.18	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	250	2406		197	1862		177	325		122	289	
v/s Ratio Prot	c0.07	0.43			c0.42			c0.11			0.07	
v/s Ratio Perm	0.43			0.01			0.01			0.01		
v/c Ratio	0.70	0.60		0.01	0.76		0.05	0.64		0.08	0.37	
Uniform Delay, d1	13.8	5.3		7.3	12.6		25.0	28.0		25.1	26.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.7	0.4		0.0	1.9		0.1	4.3		0.3	0.8	
Delay (s)	22.5	5.7		7.3	14.5		25.1	32.3		25.4	27.3	
Level of Service	C	A		A	B		C	C		C	C	
Approach Delay (s)		7.5			14.5			32.1			27.2	
Approach LOS		A			B			C			C	

Intersection Summary			
HCM Average Control Delay	13.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	73.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1872	36	27	1486	15	10
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1872	36	27	1486	15	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1908		2687	954
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1908		2687	954
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		9	96
cM capacity (veh/h)			316		17	263

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	1248	660	27	743	743	25
Volume Left	0	0	27	0	0	15
Volume Right	0	36	0	0	0	10
cSH	1700	1700	316	1700	1700	26
Volume to Capacity	0.73	0.39	0.09	0.44	0.44	0.94
Queue Length 95th (m)	0.0	0.0	2.0	0.0	0.0	20.8
Control Delay (s)	0.0	0.0	17.5	0.0	0.0	368.6
Lane LOS			C			F
Approach Delay (s)	0.0		0.3			368.6
Approach LOS						F

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		

Appendix F
2032 Total Traffic (with Additional Improvements) Intersection Operation Calculations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	2623	4856	1512	1534	4725	1002	1615	2852	1445	2547	3259	1166
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	2623	4856	1512	1534	4725	1002	1615	2852	1445	2547	3259	1166
Volume (vph)	445	1366	108	167	943	465	74	875	280	248	869	185
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	445	1366	108	167	943	465	74	875	280	248	869	185
RTOR Reduction (vph)	0	0	69	0	0	0	0	0	161	0	0	107
Lane Group Flow (vph)	445	1366	39	167	943	465	74	875	119	248	869	78
Heavy Vehicles (%)	35%	8%	8%	19%	11%	63%	13%	28%	13%	39%	12%	40%
Turn Type	Prot		Perm	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2			Free			4			8
Actuated Green, G (s)	25.6	41.5	41.5	16.4	32.3	136.3	8.6	41.8	41.8	14.8	48.0	48.0
Effective Green, g (s)	25.6	44.4	44.4	16.4	35.2	136.3	8.6	44.7	44.7	14.8	50.9	50.9
Actuated g/C Ratio	0.19	0.33	0.33	0.12	0.26	1.00	0.06	0.33	0.33	0.11	0.37	0.37
Clearance Time (s)	4.0	6.9	6.9	4.0	6.9		4.0	6.9	6.9	4.0	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	493	1582	493	185	1220	1002	102	935	474	277	1217	435
v/s Ratio Prot	c0.17	c0.28		0.11	0.20		0.05	c0.31		c0.10	0.27	
v/s Ratio Perm			0.03			0.46			0.08			0.07
v/c Ratio	0.90	0.86	0.08	0.90	0.77	0.46	0.73	0.94	0.25	0.90	0.71	0.18
Uniform Delay, d1	54.1	43.1	31.8	59.2	46.8	0.0	62.7	44.4	33.6	60.0	36.5	28.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	19.6	5.2	0.1	39.7	3.1	1.5	22.4	16.0	0.3	28.5	2.0	0.2
Delay (s)	73.8	48.3	31.9	98.9	50.0	1.5	85.1	60.4	33.8	88.5	38.5	28.9
Level of Service	E	D	C	F	D	A	F	E	C	F	D	C
Approach Delay (s)		53.3			40.9			55.9			46.7	
Approach LOS		D			D			E			D	

Intersection Summary			
HCM Average Control Delay	49.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	136.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3318	1633	1573	3288	1772	1555
Flt Permitted	1.00	1.00	0.14	1.00	0.95	1.00
Satd. Flow (perm)	3318	1633	226	3288	1772	1555
Volume (vph)	1496	31	27	1599	72	41
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1496	31	27	1599	72	41
RTOR Reduction (vph)	0	9	0	0	0	33
Lane Group Flow (vph)	1496	22	27	1599	72	8
Heavy Vehicles (%)	10%	0%	16%	11%	3%	5%
Turn Type		Perm	Perm			Perm
Protected Phases	2			6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	30.8	30.8	30.8	30.8	4.3	4.3
Effective Green, g (s)	32.8	32.8	32.8	32.8	6.3	6.3
Actuated g/C Ratio	0.70	0.70	0.70	0.70	0.13	0.13
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2311	1137	157	2290	237	208
v/s Ratio Prot	0.45			c0.49	c0.04	
v/s Ratio Perm		0.01	0.12			0.01
v/c Ratio	0.65	0.02	0.17	0.70	0.30	0.04
Uniform Delay, d1	4.0	2.2	2.5	4.2	18.4	17.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.0	0.5	0.9	0.7	0.1
Delay (s)	4.6	2.2	3.0	5.2	19.1	17.8
Level of Service	A	A	A	A	B	B
Approach Delay (s)	4.5			5.1	18.7	
Approach LOS	A			A	B	

Intersection Summary			
HCM Average Control Delay	5.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	47.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	58.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑↱		↰	↑	↱	↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1285	3318	1555	1615	3171		1674	1671	1317	1706	1700	
Flt Permitted	0.08	1.00	1.00	0.14	1.00		0.23	1.00	1.00	0.71	1.00	
Satd. Flow (perm)	104	3318	1555	235	3171		399	1671	1317	1268	1700	
Volume (vph)	50	1351	111	65	1628	29	45	78	51	54	348	51
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	50	1351	111	65	1628	29	45	78	51	54	348	51
RTOR Reduction (vph)	0	0	32	0	1	0	0	0	37	0	4	0
Lane Group Flow (vph)	50	1351	79	65	1656	0	45	78	14	54	395	0
Heavy Vehicles (%)	42%	10%	5%	13%	15%	5%	9%	15%	24%	7%	7%	37%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)	56.1	56.1	56.1	56.1	56.1		23.7	23.7	23.7	23.7	23.7	
Effective Green, g (s)	58.7	58.7	58.7	58.7	58.7		26.3	26.3	26.3	26.3	26.3	
Actuated g/C Ratio	0.63	0.63	0.63	0.63	0.63		0.28	0.28	0.28	0.28	0.28	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	66	2094	981	148	2001		113	473	372	359	481	
v/s Ratio Prot		0.41			c0.52			0.05			c0.23	
v/s Ratio Perm	0.48		0.05	0.28			0.11		0.01	0.04		
v/c Ratio	0.76	0.65	0.08	0.44	0.83		0.40	0.16	0.04	0.15	0.82	
Uniform Delay, d1	12.1	10.7	6.7	8.8	13.2		27.0	25.1	24.2	25.0	31.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	38.4	0.7	0.0	2.1	3.0		2.3	0.2	0.0	0.2	10.8	
Delay (s)	50.6	11.4	6.7	10.8	16.2		29.3	25.3	24.2	25.2	41.9	
Level of Service	D	B	A	B	B		C	C	C	C	D	
Approach Delay (s)		12.3			16.0			26.0			39.9	
Approach LOS		B			B			C			D	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	97.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↑↱		↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.92		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1177	3349		1772	3242		1217	1664		1825	1853	
Flt Permitted	0.15	1.00		0.15	1.00		0.64	1.00		0.74	1.00	
Satd. Flow (perm)	180	3349		276	3242		814	1664		1427	1853	
Volume (vph)	15	1309	67	92	1375	13	13	10	12	4	154	13
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	1309	67	92	1375	13	13	10	12	4	154	13
RTOR Reduction (vph)	0	4	0	0	1	0	0	10	0	0	4	0
Lane Group Flow (vph)	15	1372	0	92	1387	0	13	12	0	4	163	0
Confl. Peds. (#/hr)	1					1						
Heavy Vehicles (%)	55%	8%	12%	3%	12%	56%	50%	0%	11%	0%	1%	20%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	31.6	31.6		31.6	31.6		8.3	8.3		8.3	8.3	
Effective Green, g (s)	33.6	33.6		33.6	33.6		10.3	10.3		10.3	10.3	
Actuated g/C Ratio	0.65	0.65		0.65	0.65		0.20	0.20		0.20	0.20	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	117	2168		179	2099		162	330		283	368	
v/s Ratio Prot		0.41			c0.43			0.01			c0.09	
v/s Ratio Perm	0.08			0.33			0.02			0.00		
v/c Ratio	0.13	0.63		0.51	0.66		0.08	0.04		0.01	0.44	
Uniform Delay, d1	3.5	5.5		4.8	5.6		16.9	16.8		16.7	18.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	0.6		2.5	0.8		0.2	0.0		0.0	0.9	
Delay (s)	4.0	6.1		7.3	6.4		17.2	16.8		16.7	19.1	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		6.1			6.5			17.0			19.1	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	7.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	51.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↑↑↱		↰	↑↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	0.99		1.00	1.00		1.00	0.96		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1659	3347		1659	3339		1426	3271		1615	3512	
Flt Permitted	0.09	1.00		0.07	1.00		0.28	1.00		0.68	1.00	
Satd. Flow (perm)	165	3347		116	3339		418	3271		1151	3512	
Volume (vph)	43	1582	135	81	1712	21	32	89	29	67	441	62
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	43	1582	135	81	1712	21	32	89	29	67	441	62
RTOR Reduction (vph)	0	6	0	0	1	0	0	22	0	0	9	0
Lane Group Flow (vph)	43	1711	0	81	1732	0	32	96	0	67	494	0
Heavy Vehicles (%)	10%	8%	5%	10%	9%	20%	28%	7%	9%	13%	2%	2%
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	54.1	54.1		62.6	62.6		19.1	19.1		19.1	19.1	
Effective Green, g (s)	56.1	56.1		64.6	64.6		21.1	21.1		21.1	21.1	
Actuated g/C Ratio	0.60	0.60		0.69	0.69		0.23	0.23		0.23	0.23	
Clearance Time (s)	6.0	6.0		3.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	99	2004		154	2302		94	737		259	791	
v/s Ratio Prot		c0.51		0.03	c0.52			0.03			c0.14	
v/s Ratio Perm	0.26			0.34			0.08			0.06		
v/c Ratio	0.43	0.85		0.53	0.75		0.34	0.13		0.26	0.62	
Uniform Delay, d1	10.2	15.4		15.1	9.4		30.5	29.0		29.9	32.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.0	3.8		3.2	1.4		2.2	0.1		0.5	1.5	
Delay (s)	13.2	19.2		18.3	10.8		32.6	29.1		30.4	34.3	
Level of Service	B	B		B	B		C	C		C	C	
Approach Delay (s)		19.1			11.2			29.8			33.8	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	18.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	93.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.95		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1521	3165		1825	3120		1217	1695		1372	1851	
Flt Permitted	0.08	1.00		0.13	1.00		0.30	1.00		0.73	1.00	
Satd. Flow (perm)	126	3165		248	3120		385	1695		1060	1851	
Volume (vph)	14	1338	91	42	1704	2	7	23	13	19	289	37
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	14	1338	91	42	1704	2	7	23	13	19	289	37
RTOR Reduction (vph)	0	5	0	0	0	0	0	10	0	0	5	0
Lane Group Flow (vph)	14	1424	0	42	1706	0	7	26	0	19	321	0
Heavy Vehicles (%)	20%	15%	3%	0%	17%	0%	50%	0%	20%	33%	1%	10%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	48.8	48.8		48.8	48.8		17.3	17.3		17.3	17.3	
Effective Green, g (s)	50.8	50.8		50.8	50.8		19.3	19.3		19.3	19.3	
Actuated g/C Ratio	0.65	0.65		0.65	0.65		0.25	0.25		0.25	0.25	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	82	2059		161	2029		95	419		262	457	
v/s Ratio Prot		0.45			c0.55			0.02			c0.17	
v/s Ratio Perm	0.11			0.17			0.02			0.02		
v/c Ratio	0.17	0.69		0.26	0.84		0.07	0.06		0.07	0.70	
Uniform Delay, d1	5.4	8.7		5.7	10.5		22.5	22.5		22.5	26.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.0	1.0		0.9	3.3		0.3	0.1		0.1	4.9	
Delay (s)	6.4	9.7		6.6	13.9		22.9	22.5		22.7	31.7	
Level of Service	A	A		A	B		C	C		C	C	
Approach Delay (s)		9.7			13.7			22.6			31.2	
Approach LOS		A			B			C			C	

Intersection Summary			
HCM Average Control Delay	13.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	78.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	1.00		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1690	3138		1825	3166		1460	1749		1372	1744	
Flt Permitted	0.06	1.00		0.26	1.00		0.16	1.00		0.72	1.00	
Satd. Flow (perm)	108	3138		492	3166		240	1749		1033	1744	
Volume (vph)	164	1052	39	22	1578	10	5	62	2	10	327	87
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	164	1052	39	22	1578	10	5	62	2	10	327	87
RTOR Reduction (vph)	0	2	0	0	0	0	0	1	0	0	8	0
Lane Group Flow (vph)	164	1089	0	22	1588	0	5	63	0	10	406	0
Heavy Vehicles (%)	8%	16%	7%	0%	15%	43%	25%	8%	50%	33%	1%	28%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	5	2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	71.8	71.8		59.7	59.7		27.2	27.2		25.2	25.2	
Effective Green, g (s)	73.8	73.8		61.7	61.7		29.2	29.2		29.2	29.2	
Actuated g/C Ratio	0.66	0.66		0.56	0.56		0.26	0.26		0.26	0.26	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		8.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	187	2086		273	1760		63	460		272	459	
v/s Ratio Prot	c0.06	0.35			0.50			0.04			c0.23	
v/s Ratio Perm	c0.52			0.04			0.02			0.01		
v/c Ratio	0.88	0.52		0.08	0.90		0.08	0.14		0.04	0.88	
Uniform Delay, d1	30.4	9.5		11.5	22.0		30.8	31.3		30.4	39.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	33.8	0.2		0.1	6.8		0.5	0.1		0.1	18.0	
Delay (s)	64.1	9.8		11.6	28.8		31.3	31.4		30.5	57.3	
Level of Service	E	A		B	C		C	C		C	E	
Approach Delay (s)		16.9			28.6			31.4			56.6	
Approach LOS		B			C			C			E	

Intersection Summary			
HCM Average Control Delay	27.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	111.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	85.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	↰↱	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1484	9	9	1753	7	5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1484	9	9	1753	7	5
Pedestrians					2	
Lane Width (m)					3.7	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1495		2385	748
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1495		2385	748
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		76	99
cM capacity (veh/h)			454		29	359

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	989	504	9	876	876	12
Volume Left	0	0	9	0	0	7
Volume Right	0	9	0	0	0	5
cSH	1700	1700	454	1700	1700	46
Volume to Capacity	0.58	0.30	0.02	0.52	0.52	0.26
Queue Length 95th (m)	0.0	0.0	0.4	0.0	0.0	6.1
Control Delay (s)	0.0	0.0	13.1	0.0	0.0	107.7
Lane LOS			B			F
Approach Delay (s)	0.0		0.1			107.7
Approach LOS						F

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	58.5%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑↑	↱	↰	↑↑↑	↱	↰	↑↑	↱	↰↰	↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	2566	4768	1328	1630	4948	1150	1738	3318	1541	2623	3147	1328
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	2566	4768	1328	1630	4948	1150	1738	3318	1541	2623	3147	1328
Volume (vph)	270	1077	48	283	1353	177	115	825	186	483	897	398
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	270	1077	48	283	1353	177	115	825	186	483	897	398
RTOR Reduction (vph)	0	0	35	0	0	0	0	0	113	0	0	209
Lane Group Flow (vph)	270	1077	13	283	1353	177	115	825	73	483	897	189
Heavy Vehicles (%)	38%	10%	23%	12%	6%	42%	5%	10%	6%	35%	16%	23%
Turn Type	Prot		Perm	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2			Free			4			8
Actuated Green, G (s)	17.3	33.4	33.4	25.0	41.1	139.3	11.5	33.1	33.1	26.0	47.6	47.6
Effective Green, g (s)	17.3	36.3	36.3	25.0	44.0	139.3	11.5	36.0	36.0	26.0	50.5	50.5
Actuated g/C Ratio	0.12	0.26	0.26	0.18	0.32	1.00	0.08	0.26	0.26	0.19	0.36	0.36
Clearance Time (s)	4.0	6.9	6.9	4.0	6.9		4.0	6.9	6.9	4.0	6.9	6.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	319	1242	346	293	1563	1150	143	857	398	490	1141	481
v/s Ratio Prot	0.11	0.23		c0.17	c0.27		0.07	c0.25		c0.18	0.29	
v/s Ratio Perm			0.01			0.15			0.05			0.14
v/c Ratio	0.85	0.87	0.04	0.97	0.87	0.15	0.80	0.96	0.18	0.99	0.79	0.39
Uniform Delay, d1	59.7	49.2	38.4	56.7	44.9	0.0	62.8	51.0	40.2	56.5	39.6	33.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	18.3	6.6	0.0	42.9	5.3	0.3	26.9	22.0	0.2	36.6	3.6	0.5
Delay (s)	78.0	55.8	38.5	99.6	50.2	0.3	89.7	73.0	40.4	93.1	43.2	33.5
Level of Service	E	E	D	F	D	A	F	E	D	F	D	C
Approach Delay (s)		59.5			53.0			69.3			54.6	
Approach LOS		E			D			E			D	

Intersection Summary			
HCM Average Control Delay	58.0	HCM Level of Service	E
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	139.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3444	1633	1825	3476	1738	1633
Flt Permitted	1.00	1.00	0.14	1.00	0.95	1.00
Satd. Flow (perm)	3444	1633	271	3476	1738	1633
Volume (vph)	1485	66	36	1876	43	24
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1485	66	36	1876	43	24
RTOR Reduction (vph)	0	19	0	0	0	21
Lane Group Flow (vph)	1485	47	36	1876	43	3
Heavy Vehicles (%)	6%	0%	0%	5%	5%	0%
Turn Type		Perm	Perm			Perm
Protected Phases	2			6	8	
Permitted Phases		2	6			8
Actuated Green, G (s)	34.3	34.3	34.3	34.3	4.6	4.6
Effective Green, g (s)	36.3	36.3	36.3	36.3	6.6	6.6
Actuated g/C Ratio	0.71	0.71	0.71	0.71	0.13	0.13
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2456	1165	193	2479	225	212
v/s Ratio Prot	0.43			c0.54	c0.02	
v/s Ratio Perm		0.03	0.13			0.00
v/c Ratio	0.60	0.04	0.19	0.76	0.19	0.01
Uniform Delay, d1	3.7	2.2	2.4	4.5	19.8	19.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.0	0.5	1.4	0.4	0.0
Delay (s)	4.1	2.2	2.9	5.9	20.2	19.3
Level of Service	A	A	A	A	C	B
Approach Delay (s)	4.0			5.9	19.9	
Approach LOS	A			A	B	

Intersection Summary			
HCM Average Control Delay	5.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	50.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↱		↰	↑	↱	↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1547	3230	1484	1659	3401		1560	1847	1408	1825	1461	
Flt Permitted	0.07	1.00	1.00	0.11	1.00		0.70	1.00	1.00	0.26	1.00	
Satd. Flow (perm)	113	3230	1484	197	3401		1157	1847	1408	506	1461	
Volume (vph)	53	1485	56	39	1718	48	103	361	75	15	51	30
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	53	1485	56	39	1718	48	103	361	75	15	51	30
RTOR Reduction (vph)	0	0	15	0	2	0	0	0	39	0	16	0
Lane Group Flow (vph)	53	1485	41	39	1764	0	103	361	36	15	65	0
Heavy Vehicles (%)	18%	13%	10%	10%	7%	3%	17%	4%	16%	0%	19%	33%
Turn Type	Perm		Perm	Perm			Perm		Perm	Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)	54.8	54.8	54.8	54.8	54.8		21.4	21.4	21.4	21.4	21.4	
Effective Green, g (s)	57.4	57.4	57.4	57.4	57.4		24.0	24.0	24.0	24.0	24.0	
Actuated g/C Ratio	0.64	0.64	0.64	0.64	0.64		0.27	0.27	0.27	0.27	0.27	
Clearance Time (s)	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	73	2074	953	126	2184		311	496	378	136	392	
v/s Ratio Prot		0.46			c0.52			c0.20			0.04	
v/s Ratio Perm	0.47		0.03	0.20			0.09		0.03	0.03		
v/c Ratio	0.73	0.72	0.04	0.31	0.81		0.33	0.73	0.10	0.11	0.17	
Uniform Delay, d1	10.7	10.6	5.9	7.1	11.9		26.3	29.7	24.6	24.7	25.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	29.9	1.2	0.0	1.4	2.3		0.6	5.3	0.1	0.4	0.2	
Delay (s)	40.6	11.8	5.9	8.6	14.2		26.9	35.0	24.7	25.0	25.2	
Level of Service	D	B	A	A	B		C	D	C	C	C	
Approach Delay (s)		12.6			14.1			32.0			25.2	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	16.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	89.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	76.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.94		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1659	3333		1738	3368		1738	1766		1372	1606	
Flt Permitted	0.10	1.00		0.10	1.00		0.73	1.00		0.45	1.00	
Satd. Flow (perm)	171	3333		179	3368		1344	1766		650	1606	
Volume (vph)	28	1563	15	28	1733	16	27	149	106	3	19	16
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	28	1563	15	28	1733	16	27	149	106	3	19	16
RTOR Reduction (vph)	0	1	0	0	1	0	0	23	0	0	12	0
Lane Group Flow (vph)	28	1577	0	28	1748	0	27	232	0	3	23	0
Heavy Vehicles (%)	10%	9%	45%	5%	8%	33%	5%	2%	2%	33%	0%	25%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	38.8	38.8		38.8	38.8		14.1	14.1		14.1	14.1	
Effective Green, g (s)	40.8	40.8		40.8	40.8		16.1	16.1		16.1	16.1	
Actuated g/C Ratio	0.63	0.63		0.63	0.63		0.25	0.25		0.25	0.25	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	108	2095		113	2117		333	438		161	398	
v/s Ratio Prot		0.47			c0.52			c0.13			0.01	
v/s Ratio Perm	0.16			0.16			0.02			0.00		
v/c Ratio	0.26	0.75		0.25	0.83		0.08	0.53		0.02	0.06	
Uniform Delay, d1	5.3	8.5		5.3	9.3		18.7	21.1		18.4	18.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.3	1.6		1.2	2.8		0.1	1.2		0.0	0.1	
Delay (s)	6.6	10.1		6.5	12.1		18.8	22.4		18.5	18.7	
Level of Service	A	B		A	B		B	C		B	B	
Approach Delay (s)		10.0			12.0			22.0			18.7	
Approach LOS		B			B			C			B	

Intersection Summary			
HCM Average Control Delay	12.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	64.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↑↑↱		↰	↑↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frt	1.00	1.00		1.00	1.00		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3399		1825	3430		1825	3558		1825	3285	
Flt Permitted	0.06	1.00		0.06	1.00		0.68	1.00		0.19	1.00	
Satd. Flow (perm)	114	3399		116	3430		1299	3558		356	3285	
Volume (vph)	59	1906	50	28	1899	55	114	560	70	27	101	19
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	59	1906	50	28	1899	55	114	560	70	27	101	19
RTOR Reduction (vph)	0	2	0	0	2	0	0	8	0	0	12	0
Lane Group Flow (vph)	59	1954	0	28	1952	0	114	622	0	27	108	0
Heavy Vehicles (%)	2%	7%	6%	0%	6%	5%	0%	1%	0%	0%	5%	27%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	64.2	64.2		64.2	64.2		19.6	19.6		19.6	19.6	
Effective Green, g (s)	66.2	66.2		66.2	66.2		21.6	21.6		21.6	21.6	
Actuated g/C Ratio	0.69	0.69		0.69	0.69		0.23	0.23		0.23	0.23	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	79	2349		80	2370		293	802		80	741	
v/s Ratio Prot		c0.57			0.57			c0.17			0.03	
v/s Ratio Perm	0.52			0.24			0.09			0.08		
v/c Ratio	0.75	0.83		0.35	0.82		0.39	0.78		0.34	0.15	
Uniform Delay, d1	9.4	10.8		6.0	10.6		31.5	34.8		31.1	29.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	31.4	2.7		2.6	2.5		0.9	4.7		2.5	0.1	
Delay (s)	40.9	13.4		8.7	13.1		32.4	39.6		33.6	29.8	
Level of Service	D	B		A	B		C	D		C	C	
Approach Delay (s)		14.2			13.0			38.5			30.5	
Approach LOS		B			B			D			C	

Intersection Summary			
HCM Average Control Delay	17.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	95.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	83.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.97		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	3311		1644	3375		1772	1815		1560	1665	
Flt Permitted	0.11	1.00		0.11	1.00		0.71	1.00		0.47	1.00	
Satd. Flow (perm)	205	3311		185	3375		1322	1815		766	1665	
Volume (vph)	55	1616	14	13	1655	12	48	190	46	7	23	51
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	55	1616	14	13	1655	12	48	190	46	7	23	51
RTOR Reduction (vph)	0	1	0	0	1	0	0	13	0	0	21	0
Lane Group Flow (vph)	55	1629	0	13	1666	0	48	223	0	7	53	0
Heavy Vehicles (%)	0%	10%	20%	11%	8%	13%	3%	2%	6%	17%	0%	5%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	35.4	35.4		35.4	35.4		10.0	10.0		10.0	10.0	
Effective Green, g (s)	37.4	37.4		37.4	37.4		12.0	12.0		12.0	12.0	
Actuated g/C Ratio	0.65	0.65		0.65	0.65		0.21	0.21		0.21	0.21	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	134	2157		121	2199		276	379		160	348	
v/s Ratio Prot		0.49			c0.49			c0.12			0.03	
v/s Ratio Perm	0.27			0.07			0.04			0.01		
v/c Ratio	0.41	0.76		0.11	0.76		0.17	0.59		0.04	0.15	
Uniform Delay, d1	4.8	6.9		3.7	6.9		18.6	20.5		18.1	18.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.0	1.5		0.4	1.5		0.3	2.3		0.1	0.2	
Delay (s)	6.8	8.4		4.1	8.4		18.9	22.8		18.2	18.8	
Level of Service	A	A		A	A		B	C		B	B	
Approach Delay (s)		8.4			8.4			22.2			18.7	
Approach LOS		A			A			C			B	

Intersection Summary			
HCM Average Control Delay	9.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	57.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.99		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1560	3377		1825	3349		1825	1823		1496	1620	
Flt Permitted	0.09	1.00		0.18	1.00		0.52	1.00		0.43	1.00	
Satd. Flow (perm)	149	3377		355	3349		992	1823		684	1620	
Volume (vph)	176	1422	15	2	1384	38	8	203	8	10	63	115
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	176	1422	15	2	1384	38	8	203	8	10	63	115
RTOR Reduction (vph)	0	1	0	0	2	0	0	2	0	0	71	0
Lane Group Flow (vph)	176	1436	0	2	1420	0	8	209	0	10	107	0
Heavy Vehicles (%)	17%	8%	0%	0%	8%	29%	0%	5%	0%	22%	0%	11%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	5	2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	50.3	50.3		38.8	38.8		11.1	11.1		11.1	11.1	
Effective Green, g (s)	52.3	52.3		40.8	40.8		13.1	13.1		13.1	13.1	
Actuated g/C Ratio	0.71	0.71		0.56	0.56		0.18	0.18		0.18	0.18	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	250	2406		197	1862		177	325		122	289	
v/s Ratio Prot	c0.07	0.43			c0.42			c0.11			0.07	
v/s Ratio Perm	0.43			0.01			0.01			0.01		
v/c Ratio	0.70	0.60		0.01	0.76		0.05	0.64		0.08	0.37	
Uniform Delay, d1	13.8	5.3		7.3	12.6		25.0	28.0		25.1	26.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.7	0.4		0.0	1.9		0.1	4.3		0.3	0.8	
Delay (s)	22.5	5.7		7.3	14.5		25.1	32.3		25.4	27.3	
Level of Service	C	A		A	B		C	C		C	C	
Approach Delay (s)		7.5			14.5			32.1			27.2	
Approach LOS		A			B			C			C	

Intersection Summary			
HCM Average Control Delay	13.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	73.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1872	36	27	1486	15	10
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1872	36	27	1486	15	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			1908		2687	954
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1908		2687	954
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		9	96
cM capacity (veh/h)			316		17	263

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	1248	660	27	743	743	25
Volume Left	0	0	27	0	0	15
Volume Right	0	36	0	0	0	10
cSH	1700	1700	316	1700	1700	26
Volume to Capacity	0.73	0.39	0.09	0.44	0.44	0.94
Queue Length 95th (m)	0.0	0.0	2.0	0.0	0.0	20.8
Control Delay (s)	0.0	0.0	17.5	0.0	0.0	368.6
Lane LOS			C			F
Approach Delay (s)	0.0		0.3			368.6
Approach LOS						F

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		

Appendix G
Queuing Reports

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	40	565	78	65	432	30	32	110	98	62	361	45
v/c Ratio	0.16	0.63	0.10	0.37	0.50	0.06	0.11	0.12	0.18	0.20	0.33	0.11
Control Delay	8.4	12.7	2.2	14.3	10.4	3.0	17.0	15.3	5.5	17.8	16.0	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.4	12.7	2.2	14.3	10.4	3.0	17.0	15.3	5.5	17.8	16.0	7.0
Queue Length 50th (m)	1.5	27.3	0.0	2.6	18.9	0.0	1.7	3.1	0.0	3.4	11.0	0.0
Queue Length 95th (m)	6.1	62.3	4.2	11.3	44.0	2.7	8.5	10.3	8.7	14.2	28.6	6.0
Internal Link Dist (m)		566.5			643.7			363.2			387.9	
Turn Bay Length (m)	80.0		80.0	65.0		75.0	140.0		65.0	125.0		65.0
Base Capacity (vph)	311	1128	988	225	1098	646	519	1695	899	561	1937	711
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.50	0.08	0.29	0.39	0.05	0.06	0.06	0.11	0.11	0.19	0.06

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	36	502	81	47	464	35	48	41	43	258
V/c Ratio	0.12	0.49	0.08	0.13	0.47	0.10	0.08	0.08	0.09	0.41
Control Delay	8.8	11.1	2.4	8.8	10.9	14.7	13.8	6.1	14.1	15.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.8	11.1	2.4	8.8	10.9	14.7	13.8	6.1	14.1	15.8
Queue Length 50th (m)	1.5	26.9	0.0	1.9	24.2	1.8	2.4	0.0	2.2	14.1
Queue Length 95th (m)	6.1	58.9	4.8	7.4	54.2	8.2	9.7	5.1	9.1	39.0
Internal Link Dist (m)		686.6			1363.3		594.9			410.7
Turn Bay Length (m)	35.0		30.0	40.0		60.0		40.0	45.0	
Base Capacity (vph)	347	1159	1059	401	1107	423	770	629	600	781
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.43	0.08	0.12	0.42	0.08	0.06	0.07	0.07	0.33

Intersection Summary

Lane Group	→ EBT	← WBT	↑ NBT	↓ SBT
Lane Group Flow (vph)	753	561	104	377
v/c Ratio	0.81	0.69	0.21	0.66
Control Delay	22.5	17.8	18.2	27.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	22.5	17.8	18.2	27.9
Queue Length 50th (m)	63.3	42.4	8.0	40.3
Queue Length 95th (m)	#156.0	103.5	20.0	75.6
Internal Link Dist (m)	1329.3	408.8	427.7	408.9
Turn Bay Length (m)				
Base Capacity (vph)	1064	939	704	836
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.71	0.60	0.15	0.45

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	61	489	30	79	564	36	76	319	67	26	120	71
v/c Ratio	0.39	0.55	0.04	0.31	0.61	0.06	0.19	0.29	0.12	0.10	0.12	0.15
Control Delay	15.6	10.7	2.7	10.6	11.7	2.6	17.5	16.1	6.1	17.7	15.6	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.6	10.7	2.7	10.6	11.7	2.6	17.5	16.1	6.1	17.7	15.6	6.2
Queue Length 50th (m)	2.5	22.4	0.0	3.1	26.9	0.0	4.3	9.8	0.0	1.4	3.4	0.0
Queue Length 95th (m)	11.0	48.6	2.6	10.9	57.8	2.8	16.0	25.4	7.3	7.5	11.0	7.6
Internal Link Dist (m)		566.5			643.7			363.2			387.9	
Turn Bay Length (m)	80.0		80.0	65.0		75.0	140.0		65.0	125.0		65.0
Base Capacity (vph)	197	1115	859	317	1157	748	731	1961	938	457	1860	814
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.44	0.03	0.25	0.49	0.05	0.10	0.16	0.07	0.06	0.06	0.09

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	39	489	41	29	658	82	226	59	11	56
v/c Ratio	0.16	0.46	0.04	0.07	0.58	0.20	0.36	0.11	0.03	0.11
Control Delay	9.2	9.9	2.7	7.2	11.7	17.2	17.8	5.9	15.6	11.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.2	9.9	2.7	7.2	11.7	17.2	17.8	5.9	15.6	11.1
Queue Length 50th (m)	1.7	26.2	0.0	1.2	39.3	5.5	15.9	0.0	0.7	2.0
Queue Length 95th (m)	6.8	54.0	3.3	4.6	80.5	15.4	35.0	6.3	3.7	8.9
Internal Link Dist (m)		686.6			1363.3		594.9			410.7
Turn Bay Length (m)	35.0		30.0	40.0		60.0		40.0	45.0	
Base Capacity (vph)	253	1134	1004	425	1193	514	803	645	468	639
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.43	0.04	0.07	0.55	0.16	0.28	0.09	0.02	0.09

Intersection Summary

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	790	779	496	99
v/c Ratio	0.88	0.82	0.80	0.18
Control Delay	31.6	26.6	35.2	18.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	31.6	26.6	35.2	18.6
Queue Length 50th (m)	101.7	94.7	71.6	9.8
Queue Length 95th (m)	#204.0	#190.3	105.9	19.4
Internal Link Dist (m)	1329.3	408.8	427.7	408.9
Turn Bay Length (m)				
Base Capacity (vph)	970	1020	779	693
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.81	0.76	0.64	0.14

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	S[illegible]
Lane Group Flow (vph)	434	982	86	148	648	456	68	827	262	237	709	177
v/c Ratio	0.90	0.87	0.15	0.86	0.75	0.46	0.54	0.90	0.42	0.86	0.59	0.33
Control Delay	76.5	51.1	8.1	97.7	51.3	1.5	77.5	57.8	8.3	86.9	38.1	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.5	51.1	8.1	97.7	51.3	1.5	77.5	57.8	8.3	86.9	38.1	6.2
Queue Length 50th (m)	56.2	121.8	0.8	37.6	79.2	0.0	17.0	106.1	4.8	31.1	78.8	0.0
Queue Length 95th (m)	#82.7	147.2	11.5	#72.2	99.5	0.0	31.3	#139.6	24.4	#52.5	100.3	15.2
Internal Link Dist (m)		566.5			643.7			363.2			387.9	
Turn Bay Length (m)	80.0		80.0	65.0		75.0	140.0		65.0	125.0		65.0
Base Capacity (vph)	515	1202	590	187	932	1002	155	960	643	292	1208	543
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.82	0.15	0.79	0.70	0.46	0.44	0.86	0.41	0.81	0.59	0.33

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	1102	25	21	1307	72	41
V/c Ratio	0.43	0.02	0.08	0.51	0.15	0.09
Control Delay	4.6	1.8	4.9	5.3	17.9	8.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	4.6	1.8	4.9	5.3	17.9	8.1
Queue Length 50th (m)	22.0	0.0	0.6	28.9	4.2	0.0
Queue Length 95th (m)	34.6	1.6	2.6	45.7	14.7	6.0
Internal Link Dist (m)	643.7			686.6	389.3	
Turn Bay Length (m)		30.0	50.0			
Base Capacity (vph)	2743	1354	271	2718	769	698
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.02	0.08	0.48	0.09	0.06

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	40	1009	89	52	1349	38	56	44	46	296
v/c Ratio	0.33	0.54	0.10	0.22	0.76	0.28	0.11	0.10	0.11	0.55
Control Delay	16.4	10.3	1.9	9.8	14.2	29.0	21.5	8.3	22.0	26.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.4	10.3	1.9	9.8	14.2	29.0	21.5	8.3	22.0	26.6
Queue Length 50th (m)	2.1	32.3	0.0	2.5	52.2	3.2	4.5	0.0	3.7	27.1
Queue Length 95th (m)	9.1	53.3	4.4	8.3	86.0	13.6	15.0	6.9	13.2	65.4
Internal Link Dist (m)		686.6			1363.3		594.9			410.7
Turn Bay Length (m)	35.0		30.0	40.0		60.0		40.0	45.0	
Base Capacity (vph)	162	2484	1187	319	2374	159	605	505	468	615
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.41	0.07	0.16	0.57	0.24	0.09	0.09	0.10	0.48

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	12	1036	73	1174	11	17	4	122
v/c Ratio	0.07	0.41	0.24	0.48	0.04	0.04	0.01	0.23
Control Delay	5.8	4.9	7.3	5.5	16.8	12.2	16.2	16.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.8	4.9	7.3	5.5	16.8	12.2	16.2	16.3
Queue Length 50th (m)	0.3	19.6	2.3	24.5	0.6	0.4	0.2	6.2
Queue Length 95th (m)	2.1	35.4	8.7	44.1	4.0	4.2	2.1	20.7
Internal Link Dist (m)		1363.3		1329.3		352.5		290.3
Turn Bay Length (m)	50.0		65.0		15.0		15.0	
Base Capacity (vph)	180	2751	335	2665	388	743	642	830
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.38	0.22	0.44	0.03	0.02	0.01	0.15

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	34	1265	65	1397	28	89	57	372
v/c Ratio	0.37	0.68	0.52	0.76	0.16	0.16	0.15	0.63
Control Delay	23.7	13.2	29.0	15.1	24.8	18.0	22.3	27.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.7	13.2	29.0	15.1	24.8	18.0	22.3	27.8
Queue Length 50th (m)	1.8	44.2	3.8	52.9	2.2	5.4	4.4	33.5
Queue Length 95th (m)	11.8	100.1	22.0	119.0	10.6	20.2	16.9	88.7
Internal Link Dist (m)		1329.3		408.8		427.7		408.9
Turn Bay Length (m)	20.0		25.0		30.0		20.0	
Base Capacity (vph)	115	2316	155	2308	275	879	603	940
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.55	0.42	0.61	0.10	0.10	0.09	0.40

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	11	1072	33	1375	6	27	16	240
v/c Ratio	0.08	0.49	0.12	0.64	0.04	0.06	0.05	0.46
Control Delay	7.4	7.5	7.1	9.6	22.2	16.5	21.8	23.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.4	7.5	7.1	9.6	22.2	16.5	21.8	23.8
Queue Length 50th (m)	0.4	26.1	1.1	40.3	0.4	1.1	1.1	17.8
Queue Length 95th (m)	2.7	56.4	5.5	86.6	3.4	7.5	6.4	51.1
Internal Link Dist (m)		475.9		1355.6		435.4		513.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	154	2442	305	2405	273	748	476	826
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.44	0.11	0.57	0.02	0.04	0.03	0.29

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	131	848	18	1301	4	44	9	291
V/c Ratio	0.58	0.45	0.05	0.80	0.03	0.09	0.03	0.59
Control Delay	17.3	8.5	10.4	19.7	26.5	25.0	26.2	31.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.3	8.5	10.4	19.7	26.5	25.0	26.2	31.7
Queue Length 50th (m)	6.6	28.1	1.2	74.3	0.4	4.4	0.9	33.2
Queue Length 95th (m)	#14.8	43.0	4.3	106.6	3.0	13.5	4.8	68.8
Internal Link Dist (m)		1355.6		587.9		353.0		336.1
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	226	2191	395	1956	183	588	356	592
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.58	0.39	0.05	0.67	0.02	0.07	0.03	0.49

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	253	743	39	261	969	167	101	684	173	479	845	385
v/c Ratio	0.86	0.84	0.10	0.91	0.86	0.15	0.75	0.87	0.35	0.92	0.75	0.57
Control Delay	85.3	56.1	11.8	89.4	50.8	0.3	93.2	62.7	9.2	76.7	43.1	11.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	85.3	56.1	11.8	89.4	50.8	0.3	93.2	62.7	9.2	76.7	43.1	11.5
Queue Length 50th (m)	33.1	94.1	0.0	65.9	120.1	0.0	25.6	89.1	1.4	62.3	99.3	13.7
Queue Length 95th (m)	#54.6	116.4	8.3	#111.4	145.0	0.0	#52.3	#117.2	18.6	#91.0	121.9	43.2
Internal Link Dist (m)		566.5			643.7			363.2			387.9	
Turn Bay Length (m)	80.0		80.0	65.0		75.0	140.0		65.0	125.0		65.0
Base Capacity (vph)	313	943	405	307	1199	1150	146	825	508	554	1173	687
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.81	0.79	0.10	0.85	0.81	0.15	0.69	0.83	0.34	0.86	0.72	0.56

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	1151	53	29	1394	43	24
v/c Ratio	0.43	0.04	0.12	0.51	0.10	0.05
Control Delay	4.4	1.4	5.1	5.1	17.7	9.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	4.4	1.4	5.1	5.1	17.7	9.3
Queue Length 50th (m)	23.0	0.0	0.8	31.0	2.6	0.0
Queue Length 95th (m)	32.8	2.2	3.1	44.1	9.7	4.4
Internal Link Dist (m)	643.7			686.6	389.3	
Turn Bay Length (m)		30.0	50.0			
Base Capacity (vph)	2755	1317	257	2781	748	717
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.04	0.11	0.50	0.06	0.03

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	43	1151	45	32	1331	88	262	64	12	63
v/c Ratio	0.30	0.66	0.05	0.16	0.72	0.23	0.44	0.13	0.06	0.13
Control Delay	13.7	11.7	2.7	9.1	12.8	20.7	21.8	6.9	19.9	13.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.7	11.7	2.7	9.1	12.8	20.7	21.8	6.9	19.9	13.4
Queue Length 50th (m)	2.0	35.8	0.1	1.4	43.6	6.2	20.0	0.1	0.8	2.5
Queue Length 95th (m)	8.9	66.7	3.5	5.9	80.1	20.5	51.3	7.8	4.9	11.9
Internal Link Dist (m)		686.6			1363.3		594.9			410.7
Turn Bay Length (m)	35.0		30.0	40.0		60.0		40.0	45.0	
Base Capacity (vph)	203	2452	1136	277	2583	455	714	583	234	574
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.21	0.47	0.04	0.12	0.52	0.19	0.37	0.11	0.05	0.11

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	22	1213	22	1316	23	198	3	27
v/c Ratio	0.15	0.54	0.12	0.58	0.06	0.38	0.01	0.06
Control Delay	8.0	7.3	6.8	7.7	18.0	15.5	18.0	13.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.0	7.3	6.8	7.7	18.0	15.5	18.0	13.3
Queue Length 50th (m)	0.6	25.3	0.6	28.7	1.3	8.6	0.2	0.8
Queue Length 95th (m)	3.9	53.5	3.6	60.4	6.8	29.0	1.9	6.2
Internal Link Dist (m)		1363.3		1329.3		352.5		290.3
Turn Bay Length (m)	50.0		65.0		15.0		15.0	
Base Capacity (vph)	164	2478	208	2503	602	812	368	714
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.49	0.11	0.53	0.04	0.24	0.01	0.04

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	47	1461	22	1453	97	466	23	89
v/c Ratio	0.49	0.79	0.23	0.78	0.21	0.73	0.15	0.15
Control Delay	34.4	18.6	18.7	18.2	23.6	32.4	26.1	20.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.4	18.6	18.7	18.2	23.6	32.4	26.1	20.4
Queue Length 50th (m)	3.4	71.7	1.4	70.5	8.8	51.4	2.0	7.0
Queue Length 95th (m)	19.5	143.0	7.6	140.4	26.4	118.7	9.4	22.2
Internal Link Dist (m)		1329.3		408.8		427.7		408.9
Turn Bay Length (m)	20.0		25.0		30.0		20.0	
Base Capacity (vph)	117	2272	117	2291	631	881	210	811
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.64	0.19	0.63	0.15	0.53	0.11	0.11

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	44	1246	10	1260	41	177	6	60
v/c Ratio	0.23	0.57	0.06	0.57	0.11	0.34	0.02	0.12
Control Delay	9.2	7.8	5.9	7.7	17.1	17.0	16.8	9.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.2	7.8	5.9	7.7	17.1	17.0	16.8	9.1
Queue Length 50th (m)	1.3	26.7	0.3	27.0	2.2	9.1	0.3	0.9
Queue Length 95th (m)	6.9	55.3	2.0	55.3	9.7	28.7	2.8	8.4
Internal Link Dist (m)		475.9		1355.6		435.4		513.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	222	2501	205	2549	573	783	414	731
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.50	0.05	0.49	0.07	0.23	0.01	0.08

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	141	1122	2	1109	7	144	9	137
v/c Ratio	0.50	0.46	0.01	0.56	0.02	0.32	0.04	0.29
Control Delay	11.7	5.9	8.0	11.6	20.6	22.7	20.9	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.7	5.9	8.0	11.6	20.6	22.7	20.9	10.9
Queue Length 50th (m)	4.1	23.2	0.1	38.0	0.5	11.0	0.7	3.2
Queue Length 95th (m)	#12.3	44.3	0.9	64.4	3.4	28.5	4.1	16.2
Internal Link Dist (m)		1355.6		587.9		353.0		336.1
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	284	2548	296	2181	483	703	389	675
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.44	0.01	0.51	0.01	0.20	0.02	0.20

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SB
Lane Group Flow (vph)	437	1091	93	154	732	459	70	840	267	240	753	179
v/c Ratio	0.90	0.91	0.16	0.89	0.79	0.46	0.57	0.94	0.43	0.92	0.65	0.34
Control Delay	76.8	54.8	8.8	104.9	53.3	1.5	79.6	64.3	9.1	99.0	41.7	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.8	54.8	8.8	104.9	53.3	1.5	79.6	64.3	9.1	99.0	41.7	6.9
Queue Length 50th (m)	56.2	138.5	2.0	39.3	91.5	0.0	17.5	109.6	6.1	31.9	87.5	0.5
Queue Length 95th (m)	#81.0	#174.4	12.9	#76.4	113.5	0.0	32.2	#146.4	26.8	#55.8	110.5	16.6
Internal Link Dist (m)		566.5			643.7			363.2			387.9	
Turn Bay Length (m)	85.0		80.0	115.0		75.0	140.0		65.0	125.0		65.0
Base Capacity (vph)	512	1222	598	179	937	1002	149	911	620	262	1162	529
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.85	0.89	0.16	0.86	0.78	0.46	0.47	0.92	0.43	0.92	0.65	0.34

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	1214	27	23	1390	72	41
V/c Ratio	0.47	0.02	0.12	0.54	0.16	0.10
Control Delay	4.7	1.9	5.6	5.4	19.3	8.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	4.7	1.9	5.6	5.4	19.3	8.6
Queue Length 50th (m)	25.5	0.1	0.6	32.2	4.6	0.0
Queue Length 95th (m)	40.7	1.8	3.1	51.2	15.4	6.2
Internal Link Dist (m)	643.7			686.6	389.3	
Turn Bay Length (m)		30.0	50.0			
Base Capacity (vph)	2714	1340	207	2689	793	719
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.02	0.11	0.52	0.09	0.06

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	43	1106	96	56	1437	40	62	46	48	324
v/c Ratio	0.39	0.58	0.10	0.26	0.78	0.38	0.12	0.11	0.12	0.62
Control Delay	20.1	10.8	1.9	10.9	15.2	38.2	23.9	8.9	24.4	31.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.1	10.8	1.9	10.9	15.2	38.2	23.9	8.9	24.4	31.0
Queue Length 50th (m)	2.9	44.8	0.2	3.4	70.9	4.1	5.8	0.0	4.5	35.2
Queue Length 95th (m)	10.8	59.9	4.7	9.2	95.1	#17.4	17.6	7.6	14.7	#80.0
Internal Link Dist (m)		686.6			1363.3		594.9			410.7
Turn Bay Length (m)	35.0		30.0	40.0		60.0		40.0	45.0	
Base Capacity (vph)	142	2457	1176	279	2348	118	571	480	439	581
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.45	0.08	0.20	0.61	0.34	0.11	0.10	0.11	0.56

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	13	1133	79	1235	12	19	4	135
v/c Ratio	0.11	0.50	0.36	0.57	0.05	0.04	0.01	0.27
Control Delay	6.8	6.4	11.1	7.2	18.2	12.9	17.5	18.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.8	6.4	11.1	7.2	18.2	12.9	17.5	18.1
Queue Length 50th (m)	0.4	22.5	2.6	26.5	0.7	0.5	0.3	7.5
Queue Length 95th (m)	2.4	42.1	11.7	49.7	4.5	4.8	2.2	24.0
Internal Link Dist (m)		1363.3		1329.3		352.5		290.3
Turn Bay Length (m)	50.0		65.0		15.0		15.0	
Base Capacity (vph)	137	2515	248	2436	382	749	644	835
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.45	0.32	0.51	0.03	0.03	0.01	0.16

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	37	1394	70	1492	29	97	60	408
v/c Ratio	0.35	0.73	0.56	0.78	0.28	0.18	0.17	0.70
Control Delay	20.5	14.4	31.2	16.1	35.2	21.9	26.1	34.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.5	14.4	31.2	16.1	35.2	21.9	26.1	34.0
Queue Length 50th (m)	2.3	60.6	5.0	69.3	2.7	7.3	5.5	44.3
Queue Length 95th (m)	11.1	112.0	24.0	127.6	13.4	25.2	19.7	111.5
Internal Link Dist (m)		1329.3		408.8		427.7		408.9
Turn Bay Length (m)	20.0		25.0		30.0		20.0	
Base Capacity (vph)	131	2371	156	2361	141	732	486	782
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.59	0.45	0.63	0.21	0.13	0.12	0.52

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	12	1174	36	1469	6	30	17	264
v/c Ratio	0.09	0.53	0.14	0.67	0.05	0.07	0.06	0.52
Control Delay	7.2	7.9	7.2	10.2	25.3	18.1	24.5	27.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.2	7.9	7.2	10.2	25.3	18.1	24.5	27.6
Queue Length 50th (m)	0.4	33.2	1.4	50.4	0.5	1.4	1.3	23.3
Queue Length 95th (m)	2.7	63.2	5.7	95.6	3.8	8.6	7.1	60.6
Internal Link Dist (m)		475.9		1355.6		435.4		513.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	158	2473	294	2435	172	614	387	674
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.08	0.47	0.12	0.60	0.03	0.05	0.04	0.39

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	141	917	19	1383	4	48	9	318
V/c Ratio	0.70	0.48	0.06	0.82	0.03	0.10	0.03	0.65
Control Delay	29.6	9.1	10.7	21.2	27.5	26.0	26.9	34.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.6	9.1	10.7	21.2	27.5	26.0	26.9	34.9
Queue Length 50th (m)	8.0	35.0	1.4	89.7	0.5	5.4	1.0	42.1
Queue Length 95th (m)	#23.3	49.4	4.6	121.8	3.0	14.1	4.7	75.2
Internal Link Dist (m)		1355.6		587.9		353.0		336.1
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	201	2152	361	1917	164	578	348	582
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.70	0.43	0.05	0.72	0.02	0.08	0.03	0.55

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	258	838	42	268	1078	170	105	723	177	480	859	389
v/c Ratio	0.88	0.92	0.11	0.93	0.93	0.15	0.78	0.92	0.36	0.93	0.76	0.58
Control Delay	90.0	65.3	11.3	94.4	59.1	0.3	98.7	69.0	10.4	79.8	44.6	12.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	90.0	65.3	11.3	94.4	59.1	0.3	98.7	69.0	10.4	79.8	44.6	12.4
Queue Length 50th (m)	33.9	110.1	0.0	68.0	139.7	0.0	26.7	95.5	3.2	62.4	101.5	16.0
Queue Length 95th (m)	#56.2	#145.0	8.5	#116.1	#177.8	0.0	#54.4	#128.3	20.9	#91.2	124.7	46.8
Internal Link Dist (m)		566.5			643.7			363.2			387.9	
Turn Bay Length (m)	85.0		80.0	115.0		75.0	140.0		65.0	125.0		65.0
Base Capacity (vph)	300	920	398	297	1175	1150	140	799	493	534	1142	673
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.91	0.11	0.90	0.92	0.15	0.75	0.90	0.36	0.90	0.75	0.58

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	1246	57	31	1531	43	24
v/c Ratio	0.46	0.04	0.15	0.56	0.10	0.06
Control Delay	4.4	1.4	5.7	5.3	18.9	9.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	4.4	1.4	5.7	5.3	18.9	9.6
Queue Length 50th (m)	25.9	0.2	0.9	36.4	2.9	0.0
Queue Length 95th (m)	37.0	2.4	3.7	52.0	9.7	4.4
Internal Link Dist (m)	643.7			686.6	389.3	
Turn Bay Length (m)		30.0	50.0			
Base Capacity (vph)	2755	1317	215	2781	721	691
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.04	0.14	0.55	0.06	0.03

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	46	1246	48	34	1455	92	289	67	13	68
v/c Ratio	0.36	0.68	0.06	0.18	0.75	0.26	0.52	0.14	0.08	0.15
Control Delay	16.7	11.8	2.7	9.5	13.2	24.1	26.1	9.0	23.8	16.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.7	11.8	2.7	9.5	13.2	24.1	26.1	9.0	23.8	16.1
Queue Length 50th (m)	2.2	40.7	0.3	1.5	50.6	7.5	25.7	0.6	1.0	3.3
Queue Length 95th (m)	10.4	74.3	3.7	6.2	91.5	23.8	63.9	9.6	5.8	14.5
Internal Link Dist (m)		686.6			1363.3		594.9			410.7
Turn Bay Length (m)	35.0		30.0	40.0		60.0		40.0	45.0	
Base Capacity (vph)	170	2439	1131	244	2570	423	668	547	182	540
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.51	0.04	0.14	0.57	0.22	0.43	0.12	0.07	0.13

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	24	1317	24	1439	24	214	3	29
v/c Ratio	0.19	0.57	0.14	0.62	0.07	0.42	0.01	0.07
Control Delay	9.9	7.8	7.7	8.4	19.5	17.9	19.3	14.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.9	7.8	7.7	8.4	19.5	17.9	19.3	14.1
Queue Length 50th (m)	0.8	31.4	0.7	36.2	1.6	11.4	0.2	1.0
Queue Length 95th (m)	5.0	64.8	4.3	74.8	7.2	33.8	2.1	6.7
Internal Link Dist (m)		1363.3		1329.3		352.5		290.3
Turn Bay Length (m)	50.0		65.0		15.0		15.0	
Base Capacity (vph)	137	2477	183	2502	545	741	315	651
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.18	0.53	0.13	0.58	0.04	0.29	0.01	0.04

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	51	1602	24	1595	102	511	24	98
v/c Ratio	0.65	0.83	0.30	0.82	0.24	0.82	0.26	0.17
Control Delay	56.0	20.6	23.4	20.1	28.0	42.6	36.5	24.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.0	20.6	23.4	20.1	28.0	42.6	36.5	24.6
Queue Length 50th (m)	5.7	112.3	2.0	110.5	12.5	78.5	3.0	10.6
Queue Length 95th (m)	#28.1	157.9	8.8	155.1	28.9	#148.3	11.2	25.3
Internal Link Dist (m)		1329.3		408.8		427.7		408.9
Turn Bay Length (m)	20.0		25.0		30.0		20.0	
Base Capacity (vph)	91	2234	92	2255	539	772	115	712
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.56	0.72	0.26	0.71	0.19	0.66	0.21	0.14

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	47	1355	11	1376	43	193	6	64
v/c Ratio	0.29	0.61	0.07	0.60	0.12	0.38	0.02	0.13
Control Delay	11.8	8.3	6.5	8.2	19.1	19.4	18.8	10.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.8	8.3	6.5	8.2	19.1	19.4	18.8	10.0
Queue Length 50th (m)	1.6	32.8	0.3	33.2	2.6	11.6	0.4	1.1
Queue Length 95th (m)	9.0	68.2	2.3	68.7	11.0	34.5	3.1	9.6
Internal Link Dist (m)		475.9		1355.6		435.4		513.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	179	2475	168	2522	548	746	377	701
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.55	0.07	0.55	0.08	0.26	0.02	0.09

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	152	1212	2	1198	7	158	9	146
v/c Ratio	0.53	0.50	0.01	0.59	0.02	0.35	0.04	0.31
Control Delay	12.2	6.2	8.0	12.0	22.6	25.0	22.9	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.2	6.2	8.0	12.0	22.6	25.0	22.9	11.8
Queue Length 50th (m)	4.7	27.4	0.1	44.1	0.6	13.4	0.7	3.8
Queue Length 95th (m)	#14.5	53.2	1.0	74.8	3.6	33.6	4.3	18.3
Internal Link Dist (m)		1355.6		587.9		353.0		336.1
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	289	2707	292	2415	435	695	343	673
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.45	0.01	0.50	0.02	0.23	0.03	0.22

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	445	1366	108	167	943	465	74	875	280	248	869	185
v/c Ratio	0.90	0.86	0.19	0.90	0.77	0.46	0.73	0.94	0.44	0.90	0.71	0.34
Control Delay	77.1	50.2	7.6	104.8	52.3	1.5	100.1	62.3	9.2	93.5	40.9	7.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	77.1	50.2	7.6	104.8	52.3	1.5	100.1	62.3	9.2	93.5	40.9	7.2
Queue Length 50th (m)	57.4	119.1	0.9	42.7	82.2	0.0	18.8	113.7	7.2	32.7	99.4	2.4
Queue Length 95th (m)	#83.5	136.9	13.1	#81.9	97.5	0.0	#41.9	#150.7	28.5	#55.7	121.7	17.7
Internal Link Dist (m)		566.5			643.7			363.2			387.9	
Turn Bay Length (m)	85.0		80.0	120.0		75.0	140.0		65.0	125.0		65.0
Base Capacity (vph)	515	1621	573	191	1242	1002	107	954	642	281	1234	547
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.84	0.19	0.87	0.76	0.46	0.69	0.92	0.44	0.88	0.70	0.34

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	1496	31	27	1599	72	41
v/c Ratio	0.56	0.02	0.21	0.60	0.17	0.10
Control Delay	5.2	1.4	8.5	5.7	22.4	10.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.2	1.4	8.5	5.7	22.4	10.4
Queue Length 50th (m)	36.3	0.0	0.8	41.4	5.5	0.3
Queue Length 95th (m)	58.1	1.7	4.6	66.9	16.6	6.8
Internal Link Dist (m)	643.7			686.6	389.3	
Turn Bay Length (m)			50.0			
Base Capacity (vph)	2739	1354	134	2714	691	629
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.02	0.20	0.59	0.10	0.07

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	50	1351	111	65	1657	45	78	51	54	399
v/c Ratio	0.58	0.65	0.11	0.38	0.83	0.58	0.17	0.12	0.15	0.82
Control Delay	38.7	11.8	2.0	14.6	16.9	67.4	32.3	10.8	32.9	49.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.7	11.8	2.0	14.6	16.9	67.4	32.3	10.8	32.9	49.8
Queue Length 50th (m)	4.2	64.5	1.3	4.6	97.9	6.2	9.5	0.0	6.5	59.3
Queue Length 95th (m)	#24.2	78.7	5.6	12.2	121.0	#29.7	26.7	9.5	20.3	#152.3
Internal Link Dist (m)		686.6			1363.3		594.9			410.7
Turn Bay Length (m)	35.0		30.0	40.0		60.0		40.0	45.0	
Base Capacity (vph)	99	2389	1144	196	2283	78	472	409	355	485
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.51	0.57	0.10	0.33	0.73	0.58	0.17	0.12	0.15	0.82

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	15	1376	92	1388	13	22	4	167
v/c Ratio	0.14	0.58	0.56	0.61	0.07	0.05	0.01	0.35
Control Delay	8.5	7.4	25.4	7.8	22.2	15.5	21.2	23.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.5	7.4	25.4	7.8	22.2	15.5	21.2	23.0
Queue Length 50th (m)	0.5	32.9	4.1	34.5	0.9	0.7	0.3	12.1
Queue Length 95th (m)	3.2	64.4	#29.1	68.1	5.1	5.6	2.4	32.0
Internal Link Dist (m)		1363.3		1329.3		352.5		290.3
Turn Bay Length (m)	50.0		65.0		15.0		15.0	
Base Capacity (vph)	113	2511	175	2429	297	645	547	713
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.55	0.53	0.57	0.04	0.03	0.01	0.23

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	1717	81	1733	32	118	67	503
V/c Ratio	0.40	0.86	0.48	0.76	0.38	0.15	0.26	0.62
Control Delay	24.9	21.1	21.4	12.1	53.4	28.4	39.7	39.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.9	21.1	21.4	12.1	53.4	28.4	39.7	39.5
Queue Length 50th (m)	3.7	118.3	3.8	85.1	5.0	6.8	10.1	42.8
Queue Length 95th (m)	14.9	174.6	16.7	126.0	16.1	15.6	24.4	68.4
Internal Link Dist (m)		1329.3		408.8		427.7		408.9
Turn Bay Length (m)	30.0		25.0		30.0		20.0	
Base Capacity (vph)	119	2245	200	2506	103	929	319	985
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.76	0.41	0.69	0.31	0.13	0.21	0.51

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	14	1429	42	1706	7	36	19	326
v/c Ratio	0.16	0.70	0.25	0.85	0.08	0.08	0.07	0.71
Control Delay	11.0	11.1	10.7	16.1	32.0	21.2	29.4	39.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.0	11.1	10.7	16.1	32.0	21.2	29.4	39.5
Queue Length 50th (m)	0.7	64.1	2.4	93.6	0.8	2.7	2.2	44.3
Queue Length 95th (m)	3.6	87.5	7.6	129.7	4.5	10.4	8.1	#82.1
Internal Link Dist (m)		475.9		1355.6		435.4		513.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	95	2264	184	2228	101	516	317	558
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.63	0.23	0.77	0.07	0.07	0.06	0.58

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	164	1091	22	1588	5	64	10	414
V/c Ratio	0.85	0.52	0.08	0.90	0.09	0.14	0.04	0.89
Control Delay	59.3	10.4	12.0	30.2	39.8	34.8	34.6	62.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.3	10.4	12.0	30.2	39.8	34.8	34.6	62.3
Queue Length 50th (m)	18.6	54.3	2.0	143.5	0.8	10.4	1.6	83.8
Queue Length 95th (m)	#55.2	67.5	5.6	176.8	4.2	21.2	5.8	#141.0
Internal Link Dist (m)		1355.6		587.9		353.0		336.1
Turn Bay Length (m)	25.0		15.0		15.0		15.0	
Base Capacity (vph)	193	2166	288	1862	55	473	279	478
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.85	0.50	0.08	0.85	0.09	0.14	0.04	0.87

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	270	1077	48	283	1353	177	115	825	186	483	897	398
v/c Ratio	0.85	0.87	0.13	0.97	0.87	0.15	0.80	0.96	0.36	0.99	0.79	0.58
Control Delay	83.2	57.7	11.0	101.4	51.9	0.3	98.4	73.7	12.0	93.6	45.9	10.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	83.2	57.7	11.0	101.4	51.9	0.3	98.4	73.7	12.0	93.6	45.9	10.5
Queue Length 50th (m)	35.1	96.1	0.0	72.6	119.4	0.0	29.2	110.1	6.4	64.0	107.8	12.1
Queue Length 95th (m)	#54.8	112.8	9.2	#124.6	137.2	0.0	#58.0	#148.2	24.9	#96.9	132.0	41.4
Internal Link Dist (m)		566.5			643.7			363.2			387.9	
Turn Bay Length (m)	85.0		80.0	120.0		75.0	140.0		65.0	125.0		65.0
Base Capacity (vph)	330	1260	386	293	1563	1150	149	857	512	490	1140	690
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.85	0.12	0.97	0.87	0.15	0.77	0.96	0.36	0.99	0.79	0.58

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	1485	66	36	1876	43	24
v/c Ratio	0.54	0.05	0.22	0.67	0.12	0.07
Control Delay	5.0	1.2	8.2	6.8	20.0	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.0	1.2	8.2	6.8	20.0	9.5
Queue Length 50th (m)	34.8	0.0	1.1	54.2	3.4	0.0
Queue Length 95th (m)	49.7	2.4	5.3	79.7	9.7	4.4
Internal Link Dist (m)	643.7			686.6	389.3	
Turn Bay Length (m)			50.0			
Base Capacity (vph)	2755	1320	162	2781	622	600
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.54	0.05	0.22	0.67	0.07	0.04

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	53	1485	56	39	1766	103	361	75	15	81
V/c Ratio	0.62	0.72	0.06	0.27	0.81	0.34	0.73	0.18	0.19	0.20
Control Delay	43.2	12.7	2.5	11.6	15.2	36.7	44.0	15.8	41.2	26.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.2	12.7	2.5	11.6	15.2	36.7	44.0	15.8	41.2	26.3
Queue Length 50th (m)	4.7	77.5	0.8	2.5	103.4	13.2	52.1	2.6	1.8	7.2
Queue Length 95th (m)	#26.4	95.2	4.0	7.4	125.9	35.5	#127.3	15.6	9.1	23.4
Internal Link Dist (m)		686.6			1363.3		594.9			410.7
Turn Bay Length (m)	35.0		30.0	40.0		60.0		40.0	45.0	
Base Capacity (vph)	99	2369	1099	169	2495	328	534	445	87	438
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.54	0.63	0.05	0.23	0.71	0.31	0.68	0.17	0.17	0.18

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	28	1578	28	1749	27	255	3	35
v/c Ratio	0.30	0.76	0.29	0.83	0.08	0.55	0.02	0.09
Control Delay	17.4	12.1	16.1	14.7	21.2	25.1	20.3	14.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.4	12.1	16.1	14.7	21.2	25.1	20.3	14.7
Queue Length 50th (m)	1.2	56.0	1.2	68.2	2.6	24.6	0.3	1.8
Queue Length 95th (m)	8.1	103.1	7.6	125.9	7.8	43.5	2.0	7.5
Internal Link Dist (m)		1363.3		1329.3		352.5		290.3
Turn Bay Length (m)	50.0		65.0		15.0		15.0	
Base Capacity (vph)	98	2204	103	2227	460	625	237	560
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.72	0.27	0.79	0.06	0.41	0.01	0.06

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	59	1956	28	1954	114	630	27	120
v/c Ratio	0.75	0.84	0.35	0.83	0.39	0.78	0.38	0.16
Control Delay	65.9	14.6	19.4	14.2	43.1	45.8	57.0	32.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.9	14.6	19.4	14.2	43.1	45.8	57.0	32.4
Queue Length 50th (m)	6.1	122.2	1.9	120.4	18.8	59.6	4.5	8.5
Queue Length 95th (m)	#14.3	149.5	8.2	146.7	38.7	#96.6	#15.8	17.6
Internal Link Dist (m)		1329.3		408.8		427.7		408.9
Turn Bay Length (m)	30.0		25.0		30.0		20.0	
Base Capacity (vph)	86	2555	88	2580	330	911	81	847
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.77	0.32	0.76	0.35	0.69	0.33	0.14

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	55	1630	13	1667	48	236	7	74
v/c Ratio	0.49	0.70	0.13	0.70	0.14	0.48	0.03	0.16
Control Delay	29.1	10.5	9.5	10.5	21.9	24.2	21.0	15.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.1	10.5	9.5	10.5	21.9	24.2	21.0	15.9
Queue Length 50th (m)	2.8	55.5	0.5	57.0	4.2	21.0	0.6	4.1
Queue Length 95th (m)	#21.8	107.1	3.4	109.3	12.0	42.4	3.4	13.4
Internal Link Dist (m)		475.9		1355.6		435.4		513.8
Turn Bay Length (m)	15.0		15.0		15.0		15.0	
Base Capacity (vph)	116	2416	105	2462	479	668	296	620
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.67	0.12	0.68	0.10	0.35	0.02	0.12

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	176	1437	2	1422	8	211	10	178
v/c Ratio	0.61	0.56	0.01	0.69	0.03	0.49	0.06	0.40
Control Delay	28.6	7.5	12.0	18.4	30.0	35.3	30.8	20.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.6	7.5	12.0	18.4	30.0	35.3	30.8	20.3
Queue Length 50th (m)	13.6	49.4	0.1	90.5	1.0	29.9	1.3	12.4
Queue Length 95th (m)	#40.1	83.7	1.2	136.8	4.5	52.3	5.3	30.6
Internal Link Dist (m)		1355.6		587.9		353.0		336.1
Turn Bay Length (m)	25.0		15.0		15.0		15.0	
Base Capacity (vph)	355	2619	217	2140	318	573	231	568
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.55	0.01	0.66	0.03	0.37	0.04	0.31

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Regional Municipality of Peel

Mayfield Road Roundabout Feasibility Study (Airport Road to Coleraine Drive)

Brampton and Caledon, Ontario

March 2010

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Brampton and Caledon, Ontario

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Project # 4113

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Appendices

Tables

1.0 INTRODUCTION

The need for traffic capacity and structural improvements in the Mayfield Road corridor, in the City of Brampton and the Town of Caledon, has been the subject of various studies and reconstruction projects over the last several years. Since Mayfield Road is under the jurisdiction of the Region of Peel, the Region has been the proponent of all studies and contracts extending east of Hurontario Street (Highway 10) in the last several years.

The most recent study on Mayfield Road is a Class Environmental Assessment for the corridor section from Airport Road to Coleraine Drive. This study, which is currently on-going, will examine alternative improvement concepts that will align with projected traffic volume increases, address safety issues, examine utility and property impacts, propose mitigative measures to protect and preserve natural and social environmental conditions, and be consistent with previous study design proposals for Mayfield Road, from Hurontario Street to Airport Road.

As part of the current Class Environmental Study process, the Region of Peel requested that additional analysis be undertaken to determine the feasibility of installing modern roundabouts at four (4) existing intersections and at one (1) proposed intersection. The roundabouts would take the place of traditional signalized intersections, if justified, and would have the potential of being the first and only roundabouts on the Mayfield Road corridor.

Typically, roundabouts have greater capacity than signalized intersections and have the potential of reducing traffic queuing lengths and delays on approaching intersection legs. As an extension to these benefits, therefore, is the potential that roundabouts can also delay the need for widening an existing roadway. The additional study requested by Peel Region was to provide answers to these questions.

The Mayfield Road Traffic Study Report (November 2009) was used as a source of relevant traffic data, forecasts, analyses and recommendations for the roundabout feasibility study. The corridor study limits are highlighted in **Exhibit 1**.

2.0 STUDY PURPOSE

The purpose of this study is to determine the feasibility of providing roundabouts at selected study area intersections along the Mayfield Road corridor. The intersections include:

- Innis Lake Road / Goreway Drive (existing)
- Centreville Creek Road / McVean Drive (existing)
- The Gore Road (existing)
- Humber Station Road / Clarkway Drive (existing)
- Major Mackenzie Drive Extension (proposed)

General approach and work program activities were presented in a proposal by Stantec Consulting Ltd., dated October 7, 2007, and are briefly summarized as follows:

- Develop preliminary roundabout concepts for the five (5) intersection study locations;
- Provide an analysis (using RODEL and SIDRA) of the 5 roundabout intersection concepts;
- Compare the results of the roundabout analyses with the operations of the same locations as conventional intersections;
- In comparing the roundabout and signalized intersection design concepts, include an analysis of the level of service for midblock links in the study area;
- Provide commentary on operational safety aspects of roundabouts for the identified intersections.
- Ascertain the feasibility of implementing roundabouts at some or all of the studied intersections based on the analysis and comparisons with conventional signalized intersections;
- Provide a summary report with technical conclusions, and recommendations where appropriate.

3.0 WORK PROGRAM

In all previous Mayfield Road (Hurontario Street to Airport Road), Environmental Assessment Studies, it was concluded that the Region of Peel should protect right-of-way (ROW) for a future 6-lane roadway in addition to corridor space for intersection turn lanes, utilities and landscaping. To-date, a 50 metre right-of-way has been designated in the Region of Peel Official Plan.

The November 2009 Mayfield Road Traffic Study Report, which provides the "Need and Justification" for the current Class Environmental Assessment Study, identifies a need to protect for an ultimate 6-lane roadway on Mayfield Road, between Airport Road and Coleraine Drive, beyond 2031. These findings are consistent with the Brampton Transportation and Transit Master Plan Update (TTMP), dated November 2009. On this basis, a minimum 50 metre ROW is being proposed for this section of Mayfield Road.

Although Modern Roundabouts are not totally new in North America, the concept of implementing one or more roundabouts on a major corridor in Peel Region is relatively new. Further, the thought of introducing such facilities on a corridor that will ultimately carry 6 lanes of traffic may be potentially controversial. However, Peel Region is considered technologically innovative and believed in the need to at least assess intersection design options on Mayfield Road, from Airport Road to Coleraine Drive, as part of the ongoing Class Environmental Study. In exploring alternatives to improve the movement of goods and people on their Regional Road System, one of the innovative alternatives available to Peel Region is the use of modern roundabouts.

Approval to proceed with the Roundabout Study, based on the October 2007 proposal, was provided to Stantec Consulting Ltd. in August 2009. HDR | iTRANS was engaged as a subconsulant to complete the technical analysis and reporting, because of their involvement with the Mayfield Road Traffic Study Report.

Study Area

Not To Scale

March 2010

Exhibit 1

Study Area

4.0 ROUNDABOUT ANALYSIS

4.1 General

Preliminary design concepts were created by Stantec Consulting Ltd. for the five (5) intersections, and are provided in the **Appendix C**. (Exhibits 1 – 5 inclusive). The functional details of these concepts were based on the general principals of modern roundabout design and were considered suitable for the operational analyses applied in this study. Adjustments to the preliminary concepts would be required during detailed design of the roundabouts (if approved), to fine tune inscribed circle diameters, entry lane widths and angles, circulating roadway widths, centre island configurations, splitter island details, pedestrian crossing treatments, and other parameters. Change to the speed limit is not required with this design.

It is noted that the attached preliminary roundabout concepts have been developed as "Two Lane Roundabouts on a 4 lane Mayfield Road platform". This approach was selected on the premise that Peel Region would not extend beyond two lane roundabouts (i.e.: 3 lane roundabouts), which would, in turn, limit the corridor widening to 4 lanes under the Roundabout scenario.

Previous studies have indicated that roundabouts may delay the need for widening roadway corridors because of their improved operational efficiency when compared to signalized intersections for certain traffic conditions. Therefore, analysis was undertaken to assess the merits of constructing the two lane roundabout on the existing 2-lane Mayfield Road, and stage its widening to 4 lanes based on operational need, all of which is subject to the results of this study and approval by the Region, of roundabouts on Mayfield Road.

At each of the five intersections under consideration for a roundabout, a conceptual design has been developed for a signalized intersection based on its ultimate configuration on a 6 lane Mayfield Road corridor. These concepts are provided in the **Appendix C** (Exhibits 1A to 5A inclusive). It is noted that these intersection concepts may also be suitable for an interim 4 lane cross-section on Mayfield Road.

4.2 Traffic and Roundabout Volumes

Volumes for the four existing intersections were applied to the roundabout analysis using data from the Mayfield Road Traffic Study Report - November 2009. Volumes for the proposed intersection at Mayfield Road and the Major Mackenzie Drive Extension were forecasted using the EMME/2 model used for the Brampton TTMP study. Link volumes were obtained and then compared to the volumes used in the Traffic Report, in order to validate the volumes. Turning movements were forecasted using adjacent link and turning movement volumes for the future horizon year.

Since the model is a PM only model, future AM peak hour volumes for the proposed Major Mackenzie Drive Extension intersection were determined by reversing the PM volumes and applying a factor of 90% (consistent with AM/PM volume differences calculated at the other study area intersections). Truck percentages are anticipated to remain constant over time.

The approach volumes for each of the subject intersections are summarized in **Table 1** below:

Table 1 - Two-Way Intersection Link Volumes

Intersection	**Base Year AM(PM)**	**2031 AM(PM)**
Innis Lake Road/Goreway Drive	1555(1690)	3861(**4034**)
Centreville Creek Road / McVean Drive	1060(1450)	3077(3703)
The Gore Road	1795(2164)	**4294(4888)**
Humber Station Road / Clarkway Drive	1109(1291)	3579(3730)
Major Mackenzie Drive extension	N/A	*3618(**4020**)

*PM volumes factored by 90%

Typical capacity parameters for roundabouts are 2000 veh/hr for a single lane and 4000 veh/hr for a double lane roundabout based on other roundabout data. It should be noted that the mix of turning movements, as well as geometry, will influence the final outcome of capacity considerations.

Comparing the base preliminary parameters highlighted in the paragraph above to the approach volumes in **Table 1**, a single lane roundabout would be sufficient to accommodate the existing traffic volumes for four of the five intersections, with the exception of The Gore Road at Mayfield Road intersection which would require a two lane roundabout to accommodate the PM peak hour volume.

For the 2032 horizon year, approach volumes for three of the five intersections are close to, or above, the 4000 vehicle threshold capacity for a two lane roundabout. The two exceptions are the Centreville/McVean and Humber Station/Clarkway Drive intersections which peak at just below the 4000 threshold, at close to 3700 vehicles/hr each in the PM peak.

4.3 2032 Horizon Year Analysis

To determine the feasibility on a more detailed level, analysis was undertaken using roundabout modelling software in the form of RODEL and SIDRA software. RODEL and SIDRA are considered to be appropriate 'micro-scale' modelling tools to determine the operations for prospective roundabout locations. SIDRA also allows for modelling of conventional intersections, and can provide comparisons between operations of a traffic signal and a roundabout using similar operational parameters.

For each of the five roundabouts, conceptual designs for 4-lane roundabouts were developed by Stantec Consulting Inc and have been included in **Appendix C**. These designs were used as a base in order to provide input parameters to both RODEL and SIDRA in the assessment of future operations. As mentioned, in SIDRA, the intersection was also modelled as a traffic signal in order to obtain a comparison with roundabout operations. The signal timings for SIDRA were first optimized in SYNCHRO and then the timings were transferred to the SIDRA signalized intersection analysis.

It should be noted that some adjustments to the conceptual designs were made in SIDRA in order to ensure the best level of service (LOS) was obtained for the ultimate 2032 horizon year. If, based on the results of the analysis, the design of the roundabouts were to proceed, HDR | iTRANS recommends that a refined set of functional design parameters be developed that would maximize the level of service at the intersections while providing the most efficient design of the roundabout.

Recent research by the Transportation Research Board (NCHRP Report 572 on "Roundabouts in the United Sates") found that both the Australian (SIDRA) and United Kingdom (RODEL) methodology currently over-estimates the capacity of roundabouts in the US. There is still varying industry beliefs as to whether this is a temporary phenomenon while US drivers get used to driving roundabouts or whether it reveals a permanent difference in driver behaviour between the schools of thought.

4.4 Analysis Results

Each intersection was analyzed in both RODEL and SIDRA. The results of the analyses have been summarized for both RODEL and SIDRA on an intersection by intersection basis.

4.4.1 Innis Lake Road/Goreway Drive

Results of the analysis in RODEL for the AM and PM peak hours indicate level of service (LOS) of 'B' and 'C' respectively. The largest average vehicular delay is 31 seconds on the Innis Lake Road leg in the AM peak. The longest (average) queue is 77m (11 vehicles) shown to be on the Mayfield Road East leg. The average vehicular delay is shown to be 10 and 16 seconds in the AM and PM peaks respectively.

The results of the RODEL analysis for this intersection indicate that the intersection appears to operate well with a 2-lane roundabout in the 2032 horizon year.

The results of the SIDRA analysis show an improved LOS compared to RODEL with results of LOS 'B' in both peaks. The longest 95%ile queue is estimated to be 220m in the PM peak on Mayfield Road.

The comparison of the roundabout results compared to the conventional intersection analysis identify that both the traffic signal and roundabout options provide a LOS 'B' in both peaks. However, the roundabout queues as shown in **Table 2** are less than the traffic signal option for all 4 legs.

In addition, the overall average delay for the roundabout option is better than the traffic signal option in both peak periods.

Table 2 - Innis Lake Road / Goreway Drive Intersection

Sidra Comparison	Traffic signal	Roundabout
AM Pk Overall average delay (secs)	18 sec	14 sec
PM Pk Overall average delay (secs)	17 sec	17 sec
Longest 95%ile queue (m)	303 (AM)	220 (PM)
LOS (AM)	B	B
LOS (PM)	B	B

From a traffic delay perspective, the results of the analysis suggest that a 2-lane roundabout appears to be a feasible alternative for the 2032 planning horizon year for this intersection.

4.4.2 Centreville Creek Road/McVean Drive

Results for the analysis in RODEL indicate a LOS of 'A' for both peak periods. The largest average vehicular delay is 31 seconds on the Centreville Creek Road leg in the AM peak. The longest (average) queue is 28m (4 vehicles) shown to be on the Mayfield Road East leg. The average vehicular delay is shown to be 4 and 6 seconds in the AM and PM peaks respectively.

The results of the RODEL analysis for this intersection indicate that the intersection appears to operate well with a 2-lane roundabout in the 2032 horizon year.

The results of the SIDRA analysis show an improved LOS compared to RODEL with results of LOS 'A' in both peaks. The longest 95%ile queue is estimated to be 79m in the PM peak on Mayfield Road.

The comparison of the roundabout results compared to the conventional intersection analysis identify that both the traffic signal and roundabout options provide a LOS 'A' in both peaks. In addition, the roundabout queues as shown in **Table 3** are less than the traffic signal option for all 4 legs.

In addition, the overall average delay for the roundabout option is marginally better than the traffic signal option in both peak periods.

Table 3 - Centreville Creek Road / McVean Drive Intersection

Sidra Comparison	Traffic signal	Roundabout
AM Pk Overall average delay (secs)	9 sec	6 sec
PM Pk Overall average delay (secs)	6 sec	6 sec
Longest 95%ile queue (m)	136m (PM)	79m (PM)
LOS (AM)	A	A
LOS (PM)	A	A

From a traffic operations perspective, the results of the analysis suggest that a 2-lane roundabout appears to be feasible for the 2032 planning horizon year for this intersection.

4.4.3 The Gore Road

Results for the analysis in RODEL for the AM and PM peak hours indicate LOS of 'D' and 'F' respectively. The largest average vehicular delay is 479 seconds on The Gore Road south leg in the PM peak. The longest (average) queue is 77m (123 vehicles) shown to be on the Mayfield Road East leg. The average vehicular delay is shown to be 30 and 101 seconds in the AM and PM peaks respectively.

The results of the RODEL analysis for this intersection indicate that the intersection overall would operate with significant delay in the PM peak period in the 2032 horizon year as a 2-lane roundabout.

The results of the SIDRA analysis show an improved LOS compared to RODEL with results of LOS 'D' and 'F' in the AM and PM peaks respectively. The longest 95%ile queue is estimated to be 1149m in the PM peak on Mayfield Road.

The comparison of the roundabout results to the conventional intersection analysis identify the traffic signal option would provide a better level of service than a roundabout option and therefore a roundabout would not be a feasible alternative for this intersection. The results are summarized in **Table 4**.

In addition, the overall average delay for the traffic signal option is less than the roundabout in both peaks.

Table 4 - The Gore Road Intersection

Sidra Comparison	Traffic signal	Roundabout
AM Pk Overall average delay (secs)	19 sec	26 sec
PM Pk Overall average delay (secs)	52 sec	112 sec
Longest 95%ile queue (m)	1149 (PM)	1201m (PM)
LOS (AM)	B	C
LOS (PM)	D	F

From a traffic operations perspective, the results of the analysis a 2-lane roundabout does not appear to be a good option for the 2032 planning horizon year.

While 3-lane roundabouts are known to exist in Europe, none are known to exist in North America at this time, although a number have been considered. The addition of a third lane would not increase the capacity to sufficiently service the demand. Furthermore, the additional weaving results in a decrease in safety benefit afforded by a typical roundabout.

Given the absence of available data for 3-lane North American roundabouts, it would not be recommended for the Region to assume that a 3-lane roundabout could be proven and acceptable by the forecast horizon year of 2032.

4.4.4 Humber Station Road/Clarkway Drive

Results of the analysis in RODEL for the AM and PM peak hours indicate LOS 'A' in both peak periods. The largest average vehicular delay is 31 seconds on the Humber Station Road north leg in the AM peak. The longest (average) queue is 28m (4 vehicles) shown to be on the Mayfield Road east leg. The average vehicular delay is shown to be 9 and 7 seconds in the AM and PM peaks respectively.

The results of the RODEL analysis for this intersection indicate that the intersection appears to operate well with a 2-lane roundabout in the 2032 horizon year.

The results of the SIDRA analysis show an improved LOS compared to RODEL with results of LOS 'A' in both peaks. The longest 95%ile queue is estimated to be 88m in the AM peak.

The comparison of the roundabout results to the conventional intersection analysis identify that both the traffic signal and roundabout options provide a LOS 'A' in both peaks. However, the roundabout queues as shown in **Table 5** are less than the traffic signal option for all 4 legs.

In addition, the overall average delay for the roundabout option is better than the traffic signal option in both peak periods.

Table 5 - Humber Station Road/Clarkway Drive Intersection

Sidra Comparison	Traffic signal	Roundabout
AM Pk Overall average delay (secs)	14 sec	8 sec
PM Pk Overall average delay (secs)	11 sec	7 sec
Longest 95%ile queue (m)	263 (AM)	87 (AM)
LOS (AM)	A	A
LOS (PM)	A	A

From a traffic operations perspective, the results of the analysis suggest that a 2-lane roundabout appears to be a feasible option for the 2032 planning horizon year for this intersection

4.4.5 Major MacKenzie Drive Extension

In presenting results for this future intersection, it should be noted that the turning movement forecasts developed for this intersection were developed based on the model link volume outputs alone, with some manual rebalancing of the data to forecast future turning movement counts. The turning movement projections for the other 4 intersections were developed on the basis of existing turning movements.

Results of the analysis in RODEL for the AM and PM peak hours indicate LOS 'A' and 'B' respectively. The largest average vehicular delay is 31 seconds on the Mayfield Road north leg in the AM peak. The longest (average) queue is 91m (13 vehicles) shown to be on the same leg. The average vehicular delay is shown to be 9 and 14 seconds in the AM and PM peaks respectively.

The results of the RODEL analysis for this intersection indicate that the intersection appears to operate well with a 2-lane roundabout in the 2032 horizon year.

The results of the SIDRA analysis show a lower LOS compared to RODEL with results of LOS 'C' and 'E" in the AM and PM peaks respectively. The longest 95%ile queue is estimated to be 613m in the PM peak on Mayfield Road.

The comparison of the roundabout results compared to the conventional intersection analysis identify that a traffic signal would provide a better LOS in both peaks. Roundabout queues are shown to be greater with the largest 95%ile queue at 613m compared to 215m for the traffic signal.

In addition, the overall average delay for the traffic signal option is less than the roundabout in the AM (20 vs. 24 seconds) and similarly in the PM peak (28 vs. 69 seconds). The results are summarized in **Table 6**.

Table 6 - Major MacKenzie Drive Extension Intersection

	Traffic signal	Roundabout	Roundabout (with channelized E to W turn lane)
Overall average delay (AM)	20 sec	24 sec	28 sec
Overall average delay (PM)	28 sec	69 sec	23 sec
Longest queue	215m (AM)	613m (PM)	187m (AM)
LOS (AM)	B	C	C
LOS (PM)	C	E	C

From a traffic operations perspective, the results of the analysis suggest that a 2-lane roundabout does not appear to be a good option for the 2032 planning horizon year. The main reason for this appears to be the large traffic movements between Mayfield Road west and Mayfield Road east.

It was decided to simulate another roundabout option in SIDRA, this time incorporating a channelized right turn between Mayfield Road east to Mayfield Road west. This has the effect of excluding 793 vehicles in the AM peak and 1328 vehicles in the PM peak from circulating in the roundabout. A revised analysis shows this scenario to work much better.

With this scenario, the roundabout performs better, particularly if a full day's worth of delay were to be considered.

4.4.6 Future Mayfield Road Mid-Block Access Intersections

The above analysis focuses on existing major intersections along the Mayfield Road corridor, corresponding to the intersections analyzed in the Mayfield Road Traffic Study Report and the Class Environmental Assessment Study. Further planning of additional 'mid-block' intersections should be addressed by proponents of adjacent future developments and reviewed in conjunction with the development application process. Any proposed future accesses onto Mayfield Road will require traffic impact studies by the respective developers, confirming that the location and design of such accesses do not negatively affect the operation of potential roundabouts outlined in this report.

New access points will be subject to the Region of Peel Access Management Policy. Access control (left turn prohibitions) may be necessary in close proximity to roundabouts or signalized intersections. This may contribute to more circuitous routing for land access.

5.0 SAFETY ASSESSMENT

5.1 General

The design of modern roundabouts takes into account the interaction of vehicular traffic and pedestrians / cyclists. Current practice provides for the strategic location of pedestrian and cyclist crossings on each of the approach and exit lanes of a roundabout "leg", which contribute to the safe movement of pedestrians and cyclists without the need for traffic signals and other warning lights. In addition to the designated crossing locations on each roundabout "leg", cyclists are also discouraged from entering the roundabout by providing wider sidewalks at the roundabout and corresponding ramps for cyclists to exit the roadway and travel on the boulevard towards the crossing points.

5.2 Operations Safety: Vehicles

5.2.1 Collision History

In 2008, HDR | iTRANS conducted a safety review of the Mayfield Road corridor, which was summarized in the November 2009 iTRANS report *Mayfield Road EA (Airport Road to Coleraine Drive) Traffic Study*. The review included an office review of collision data provided by the Region of Peel. The office investigation provided a preliminary understanding of the area, the collision history and their causes, as well as the traffic movements in the study area.

The study findings included an assessment of summary of reported collisions within the study area. The number of collisions over a four-year period (January 2003 to December 2006) is summarized in **Table 7**.

Table 7: Summary of Reported Collisions along Mayfield Road (2003 to 2006)

Location	Total	Injury	PDO	Traffic Control
Airport Road	32	3	29	Signal
Innis Lake Road/ Goreway Drive	13	1	12	Signal
Centreville Creek Road	2	2	0	Stop
The Gore Road	5	0	5	Signal
Humber Station Road/ Clarkway Drive	9	1	8	Stop
Coleraine Drive	2	0	2	Stop
All Road Segments	16	2	14	
TOTAL	79	9	70	

NOTE SMV = Single Motor Vehicle; PDO = Property Damage Only

The Region of Peel does not have calibrated safety performance functions with which to assess the collision history with statistical significance based on the state of the practice. However, the average number of collisions per year for the Airport Road intersection (8) is notable. Based on an estimate of approximately 4 million vehicles entering the intersection per year, we would consider the collision rate of approximately 2 collisions per million vehicles entering the intersection to be high for a rural/suburban arterial in the GTA.

For other intersections within the corridor, the overall number of collisions and rate of collisions are typical of rural/suburban arterials. Furthermore the severity of collisions, 11% injury collisions is typical or low for a rural/suburban arterial road. No significant collision trends by collision type have been identified.

5.2.2 Collision Prediction

As noted, the Region of Peel has not developed calibrated safety performance functions as a collision prediction tool. Furthermore, rural/suburban arterial roundabouts do not currently exist within the Region to provide a basis for Regional experience. Data is not readily available in Ontario for roundabouts on 4 lane rural or suburban arterial roadways to provide a statistically significant comparison of safety performance.

The most comprehensive source for before and after roundabout collision data in North America was documented in the National Cooperative Highway Research Program (NCHRP) *Report 572, Roundabouts in the United States*. The conclusions of the report state "with the exception of conversions from all-way-stop–controlled intersections, where crash experience remains statistically unchanged, roundabouts have improved both overall crash rates and, particularly, injury crash rates in a wide range of settings (urban, suburban, and rural) and previous forms of traffic control (two-way stop and signal)." However Table 28 of the NCHRP Report 572 notes that there is insufficient collision data for suburban signalized intersections (before condition) to estimate effectiveness of roundabouts for reduction of injury related crashes. Mayfield Road will have a suburban arterial environment.

While a predictive model for Mayfield Road is not available, findings of NCHRP Report 572 do document reduced approach speeds, which is commonly identified as a safety benefit for roundabouts. It is anticipated that reduced speed for roundabouts on Mayfield Road could contribute to lower severity of crashes.

5.3 Pedestrian and Cyclist Safety

Projected traffic volumes on Mayfield Road are expected to reach 2,000 vehicles per hour in the peak direction. This level of traffic will offer limited gap opportunities for pedestrians to cross Mayfield Road even crossing one direction at a time. The alternative of traffic signals will provide pedestrian priority during the north-south signal phase.

The NCHRP Report 572 documents the driver yielding behaviour for pedestrians at roundabout intersections. The percent of drivers that did not yield was documented at approximately 30% overall (38% at the exit point). These values are higher than observations made in the greater Toronto area for signalized intersections (Bacquie, Ray, Ing, Lisa, "We are All Pedestrians Program - First Steps in Pedestrian Safety", 2004)

Appropriate provisions would need to be made for pedestrians and cyclists, at the detailed design stage of any recommended roundabouts, to provide the necessary separation from vehicular traffic within the roundabout for the future safety of pedestrians and cyclists.

6.0 CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions:

Based on the results of the analysis of the 5 intersections using RODEL and SIDRA roundabout modelling software, the following conclusions have been determined related to the feasibility of implementing roundabouts on Mayfield Road:

Two Lane Roundabouts are practical alternatives at three (3) existing intersections, up to the study horizon year of 2031, based on the technical parameters of the analysis. The Three intersections include:

- Innis Lake Road/Goreway Drive;
- Centreville Creek Road / McVean Drive; and
- Humber Station Road / Clarkway Drive.

A Two Lane Roundabout, with an additional by-pass lane, is a practical alternative for one (1) future intersection, up to the study horizon year of 2031, based on the technical parameters of the analysis. The future intersection is:

- Major MacKenzie Drive Extension at Mayfield Road

A Roundabout is not a suitable alternative for one (1) of the existing intersections, up to the study horizon year of 2031, based on the technical parameters of the analysis. The subject intersection is:

- The Gore Road

It should be noted that the forecasted turning movements for the Major MacKenzie Drive extension intersection cannot be taken with the same level of confidence as the other intersections due to the nature of the future forecasting and the available data. It is for this reason that property for a channelized turn for the Mayfield East to West movement would more reasonably be protected for, rather than constructed at this time.

From an overall 24 hour delay perspective, four of the five intersections could feasibly benefit from the implementation of a roundabout since the analysis has focussed on the peak hours. In the off-peak hours the delay benefits of a roundabout are greater since traffic signals will always impose delay on traffic regardless of volume, whereas the delay imposed by a roundabout reduces as volume decreases.

With respect to an overall strategy for developing intersections along this corridor, there are three immediate options that could feasibly be considered:

1. Install Traffic Signals at all 5 intersections
   - This option would provide the largest delay of any of the options over the short and long term but may be the preferred alternative if demand exceeds forecasted volumes in the future and signals become the ultimate improvement.

2. Construct roundabouts at all 5 intersections
   - This option would be feasible for 4 of the 5 intersections up to the horizon year 2032; however, the Gore Road would have to be re-constructed as a larger capacity signalized intersection prior to the horizon year. Current traffic volumes would have to double before the need to re-construct would occur.

3. Construct four roundabouts and a signalized intersection at Gore Road
   - This option would be feasible up to the 2032 horizon year and would not require reconstruction of the Gore Road intersection in the future. . While traffic signals benefit from platooning of traffic, roundabouts do not; however, traffic progression along Mayfield Road should not be an issue given the 1+km spacing of intersections.

6.2 Recommendations

The Roundabout Analysis presented in this report indicates that the construction of two-lane roundabouts, on a 4-lane Mayfield Road corridor, would be suitable from a traffic delay and queuing perspective, at four intersections including three existing intersections. A roundabout is not deemed to be suitable for the intersection of Mayfield Road at The Gore Road. Other considerations, such as pedestrian accommodation and safety may not be well served as traffic volumes on Mayfield Road reach 2,000 peak hour peak direction vehicles.

The conclusion that roundabouts could service the traffic operational needs on Mayfield Road, to 2031, is valuable information to Peel Region. The data illustrates that Regional corridors may be candidates for modern roundabouts, based on current evaluation techniques.

However, after careful consideration and discussions with Regional Staff, it is recommended that the Region not proceed to implement modern roundabouts in this section of Mayfield Road, for the following reasons:

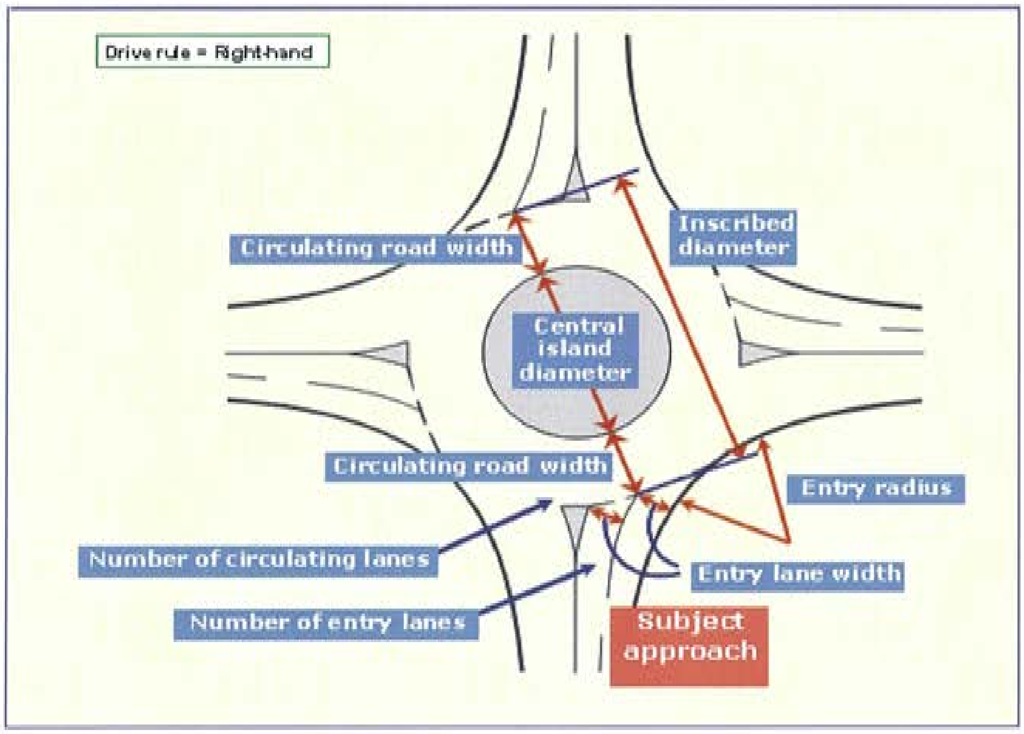
- Two-lane roundabouts, although suitable at four (4) intersections to the horizon year of 2031 and on a four-lane Mayfield Road corridor, will not be satisfactory in the distant future. Widening of Mayfield Road to six lanes, which is inevitable, will necessitate either upgrading the roundabouts or removal and replacement with signalized intersections.

- It is highly unlikely that Peel Region would opt for upgraded triple-lane roundabouts on Mayfield Road, once the corridor is ultimately widened to six lanes. Therefore, installation of "temporary" 2 lane roundabouts would not be cost effective.
- Signalized intersections can be constructed to suit an ultimate 6 lane corridor during an interim 4 lane program. This planning reduces the throwaway costs not available with the design and construction of roundabouts.
- Providing 3 or 4 roundabouts at the furthest (east) end of the Mayfield Road corridor, where no other roundabouts exist or are planned, over its entire 24.8 km length, may not represent strategic transportation planning. The consistency provided by signalized intersections within the entire Mayfield Road corridor makes good sense, despite the technical analysis presented herein.

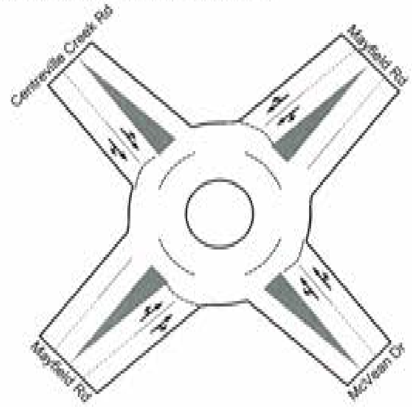
In conclusion, it is recommended that full capacity signalized intersections be presented as the preferred design concept in the current Municipal Class Environmental Assessment Study for Mayfield Road, Airport Road to Coleraine Drive. The results of this Roundabout Study, along with its Conclusions and Recommendations, should form a part of the Class EA Public and Study Reports processes.

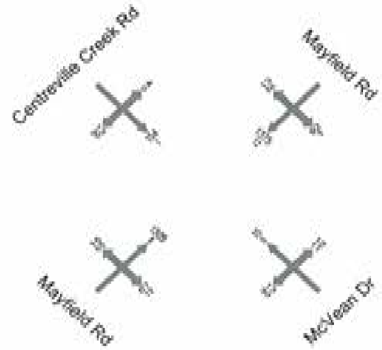
Appendix A
SIDRA Analysis

Geometric Elements of a Modern Roundabouts (SIDRA INPUTS)



2032 AM Total Road Network - Roundabout Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 AM Total Mayfield 6 lanes (at airport) v4 - excl RTs sy7

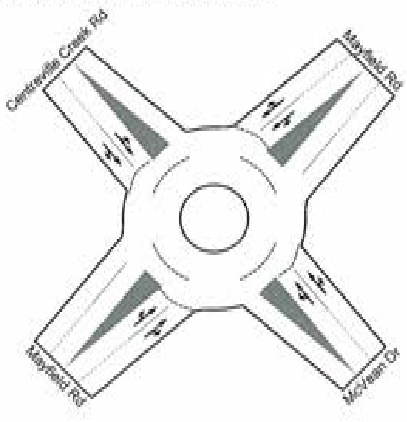
Table 5.14 - Summary of Input and Output Data

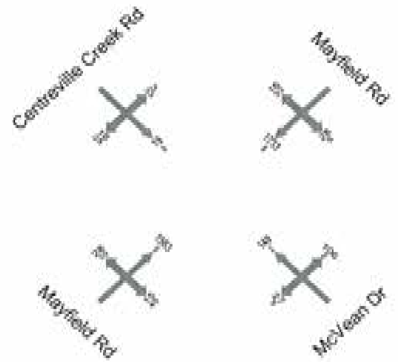
[illegible]

Table 5.15 - Capacity and Level of Service

[illegible]

2032 PM Total Road Network - Roundabout Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
[illegible]

Table 5.14 - Summary of Input and Output Data

Mayfield Rd at Centreville Creek Rd
2032 PM Total
Intersection ID: [illegible]
Roundabout

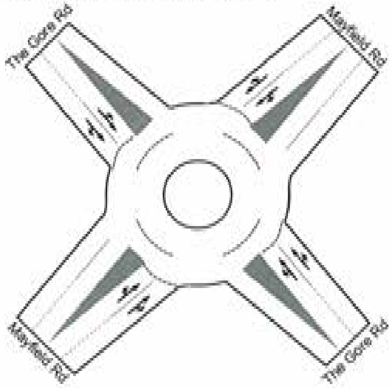
[illegible]

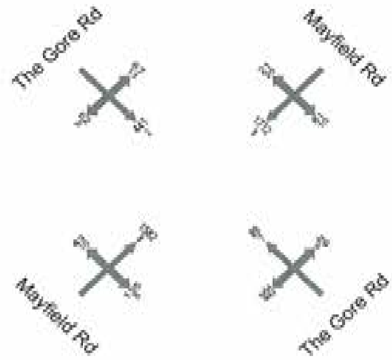
Table 5.15 - Capacity and Level of Service

Mayfield Rd at Centreville Creek Rd
2032 PM Total
Intersection ID: [illegible]
Roundabout

[illegible]

2032 AM Total Road Network - Roundabout Capacity Analysis





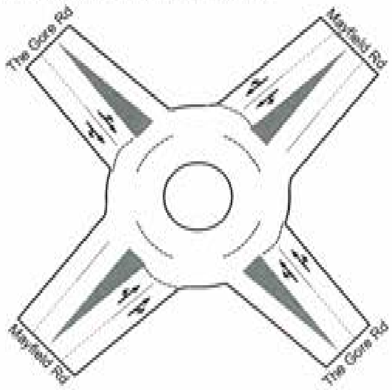
Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

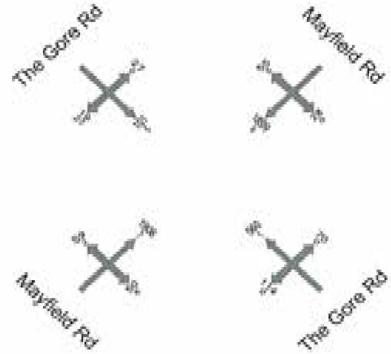
Heavy Vehicle Percentages

Table 5.14 - Summary of Input and Output Data

Table 5.15 - Capacity and Level of Service

2032 PM Total Road Network - Roundabout Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Reel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 PM Total-Mayfield 6 lanes (at airport) v4 - excl RTs.sy7

Table 8.14 - Summary of Input and Output Data

Mayfield Rd at The Gore Rd
2032 PM Total
Intersection ID: 7
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Sat Flow (veh/h) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Short Lane (m)
SouthEast: The Gore Rd												
1 LT	120	185		305	1				0.991	74.2	115	500
2 TR		405	74	479	1				0.991	63.2	258	500
	120	590	74	784	1				0.991	68.7	258	
NorthEast: Mayfield Rd												
1 LT	29	902		931	6				1.155	244.9	981	500
2 TR		1097	58	1155	6				1.155	242.5	1201	500
	29	1999	58	2086	6				1.155	243.4	1201	
NorthWest: The Gore Rd												
1 LT	18	104		[illegible]	4				0.179	11.7	16	500
2 R			10	10	25				0.079	15.2	4	500
	18	104	10	[illegible]	6				0.179	11.2	16	
SouthWest: Mayfield Rd												
1 LT	42	925		967	7				0.789	6.4	91	500
2 TR		1081	51	1132	7				0.789	5.5	89	500
	42	2006	51	[illegible]	7				0.789	6.0	91	

ALL VEHICLES	Total Flow	%HV	Max X	Aver. Delay	Max Queue
	5344	6	1.155	112.8	1201

Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table 8.15 - Capacity and Level of Service

Mayfield Rd at The Gore Rd
2032 PM Total
Intersection ID: 7
Roundabout

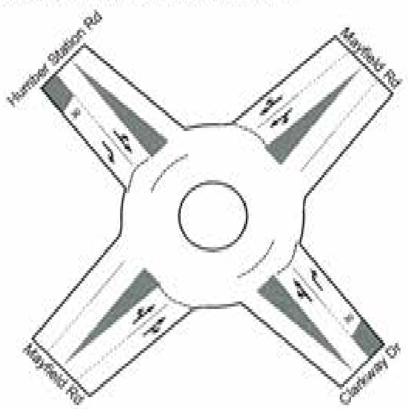
Mov ID	Mov Typ	Total Flow (veh/h)	Total Cap. (veh/h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS	Longest Queue 95% Back (vehs)	(m)
SouthEast: The Gore Rd								
21	L	120	122	0.984	80.8	F	14.3	115
22	T	590	595	0.990	66.2	E	22.5	258
23	R	74	75	0.987	66.2	E	22.5	258
NorthEast: Mayfield Rd								
24	L	29	25	1.155*	251.8	F	135.6	981
25	T	1999	1731	1.155	243.5	F	165.2	1201
26	R	58	50	1.155*	243.7	F	165.2	1201
NorthWest: The Gore Rd								
27	L	18	100	0.180	17.5	B	2.2	16
28	T	104	579	0.180	10.2	B	2.2	16
29	R	10	127	0.079	15.2	B	0.5	4
SouthWest: Mayfield Rd								
30	L	42	53	0.789	11.3	B	12.4	91
31	T	2006	2541	0.789	5.7	A	12.4	91
32	R	51	65	0.788	6.7	A	11.9	89
ALL VEHICLES:		5344		1.155	112.8	F	165.2	1201

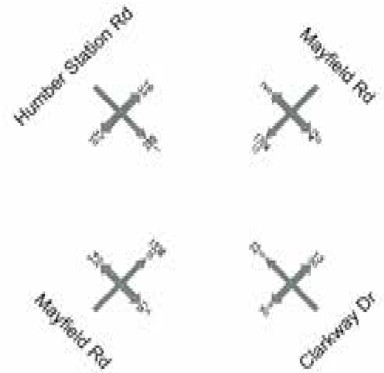
Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used. For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the On-line help.

* Maximum v/c ratio, or critical green periods

\# Movement Level of Service has been determined using adjacent lane v/c ratio rather than short lane v/c ratio (x>=1.0)

2032 AM Total Road Network - Roundabout Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 AM Total-Mayfield 6 lanes (at airport) v4 - excl RTs.sy7

Table 5.14 - Summary of Input and Output Data

Mayfield Rd at Humber Station Road
2032 AM Total
Intersection ID: 7
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Short Lane (m)
SouthEast: Clarkway Dr												
1 LT	8	24		32	13				0.059	10.5	3	500
2 R			14	14	13				0.041	11.9	1	500
	8	24	14	46	13				0.043	10.9	3	
NorthEast: Mayfield Rd												
1 LT	44	812		856	18				0.663	5.1	88	500
2 TR		982	2	984	17				0.663	4.4	65	500
	44	1794	2	1840	17				0.663	4.7	88	
NorthWest: Humber Station Rd												
1 LT	20	117		137	2				0.148	10.7	12	500
2 TR		187	39	226	3				0.148	12.9	19	500
	20	304	39	363	4				0.148	12.0	19	
SouthWest: Mayfield Rd												
1 LT	15	678		693	15				0.747	8.4	77	500
2 TR		730	96	826	14				0.747	8.4	78	500
	15	1408	96	1519	14				0.747	8.4	78	
ALL VEHICLES				Total Flow 3768	% HV 14				Max X 0.750	Aver. Delay 7.1	Max Queue 78	

Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

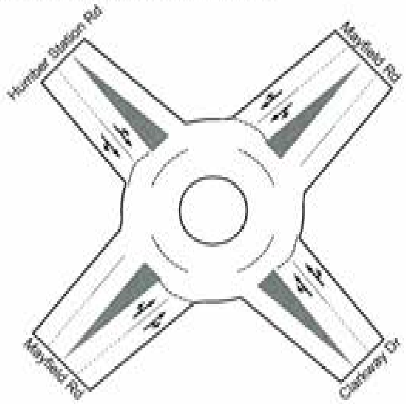
Table 5.15 - Capacity and Level of Service

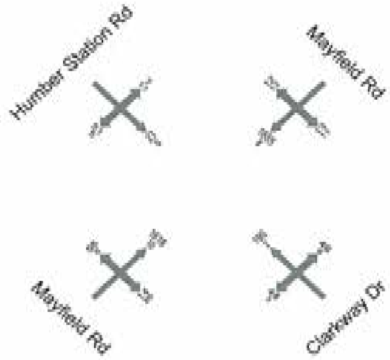
Mayfield Rd at Humber Station Road
2032 AM Total
Intersection ID: 7
Roundabout

Mov ID	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS	Longest Queue 95% Back (vehs)	(m)
SouthEast: Clarkway Dr								
21	L	8	128	0.062	11.9	B	0.1	3
22	T	24	381	0.063	8.5	A	0.4	3
23	R	14	335	0.042	11.9	B	0.1	1
NorthEast: Mayfield Rd								
24	L	44	66	0.667	11.9	B	9.5	69
25	T	1794	2706	0.663	4.7	A	9.4	69
26	R	2	3	0.667	5.6	A	9.4	69
NorthWest: Humber Station Rd								
27	L	20	58	0.345	22.7	C	1.2	16
28	T	304	879	0.347	12.2	B	2.8	19
29	R	39	111	0.348	21.1	B	2.4	19
SouthWest: Mayfield Rd								
30	L	15	20	0.750*	16.9	B	9.7	77
31	T	1408	1884	0.747	8.8	A	10.0	78
32	R	96	128	0.748	9.0	A	10.2	78
ALL VEHICLES:		3768		0.750	7.1	A	10.5	78

Level of Service calculations are based on
average control delay including geometric delay (HCM criteria),
independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the
SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods
\# Movement Level of Service has been determined using adjacent lane
v/c ratio rather than short lane v/c ratio (x<=1.0)

2032 PM Total Road Network - Roundabout Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 PM Total-Mayfield 6 lanes (at airport) v4 - exit RTs.sy7

Table 8.14 - Summary of Input and Output Data

Mayfield Rd at Humber Station Road
2032 PM Total
Intersection ID: 7
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Satn x	Aver. Delay (sec)	Longest Queue (m)	Short Lane (m)
SouthEast: Clarkway Dr												
1 LT	51	69		120	3				0.239	13.5	10	500
2 TR		131	49	180	3				0.239	9.1	11	500
	51	200	49	300	3				0.239	11.1	11	
NorthEast: Mayfield Rd												
1 LT	14	801		815	8				0.757	8.1	78	500
2 TR		935	15	950	8				0.757	7.1	78	500
	14	1736	15	1765	8				0.757	7.6	78	
NorthWest: Humber Station Rd												
1 LT	7	14		21	7				0.089	12.1	4	500
2 R			54	54	6				0.151	10.1	4	500
	7	14	54	75	6				0.151	11.1	4	
SouthWest: Mayfield Rd												
1 LT	58	760		818	8				0.597	5.0	51	500
2 TR		941	15	956	10				0.597	4.1	51	500
	58	1701	15	1774	10				0.597	4.7	51	
ALL VEHICLES				Total Flow 3828	% HV 8				Max X 0.778	Aver. Delay 6.7	Max Queue 78	

Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

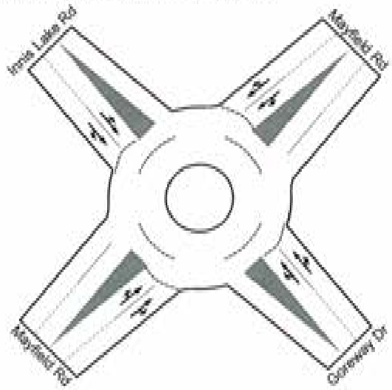
Table 8.15 - Capacity and Level of Service

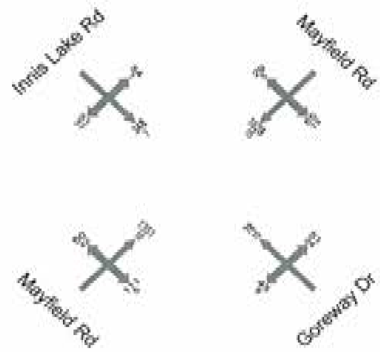
Mayfield Rd at Humber Station Road
2032 PM Total
Intersection ID: 7
Roundabout

Mov ID	Mov Typ	Total Flow (veh/h)	Total Cap. (veh/h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS	Longest Queue 95% Back (vehs)	(m)
SouthEast: Clarkway Dr								
21	L	51	214	0.238	18.1	B	1.4	10
22	T	200	838	0.239	9.5	A	1.6	11
23	R	49	205	0.239	10.1	B	1.6	11
NorthEast: Mayfield Rd								
24	L	14	18	0.778*	15.6	B	10.5	78
25	T	1736	2300	0.757	7.7	A	10.5	78
26	R	15	20	0.745	8.7	A	10.5	78
NorthWest: Humber Station Rd								
27	L	7	78	0.089	18.4	B	0.6	4
28	T	14	170	0.089	10.7	B	0.6	4
29	R	54	531	0.151	10.1	B	0.6	4
SouthWest: Mayfield Rd								
30	L	58	97	0.598	12.0	B	6.9	51
31	T	1701	2849	0.597	4.4	A	6.9	51
32	R	15	25	0.600	6.0	A	6.9	51
ALL VEHICLES:		3828		0.778	6.7	A	10.5	78

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods
\# Movement Level of Service has been determined using adjusted lane v/c ratio rather than short lane v/c ratio (x/xe).

2032 AM Total Road Network - Roundabout Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 AM Total-Mayfield 6 lanes (at airport) v4 - excl RTs.sy7

Table 8.14 - Summary of Input and Output Data

Mayfield Rd at Innis Lake Rd
2032 AM Total
Intersection ID: 3
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Short Lane (m)
SouthEast: Goreway Dr												
1 LT	47	82		129	12				0.258	11.0	18	500
2 R			54	54	13				0.189	13.5	9	500
	47	82	54	183	10				0.258	12.4	18	
NorthEast: Mayfield Rd												
1 LT	69	773		842	15				0.768	8.1	91	500
2 TR		941	31	972	15				0.768	7.9	91	500
	69	1714	31	1814	15				0.768	7.7	92	
NorthWest: Innis Lake Rd												
1 LT	57	141		198	7				0.617	11.8	38	500
2 TR		166	54	220	13				0.627	17.1	44	500
	57	307	54	418	10				0.627	15.3	44	
SouthWest: Mayfield Rd												
1 LT	53	655		708	11				0.833	11.5	97	500
2 TR		747	117	864	9				0.835	10.9	99	500
	53	1402	117	1572	11				0.835	12.0	99	
ALL VEHICLES				Total Flow 4007	% HV 13				Max X 0.836	Aver. Delay 11.0	Max Queue 99	

Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

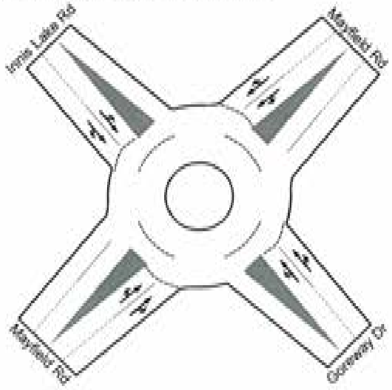
Table 8.15 - Capacity and Level of Service

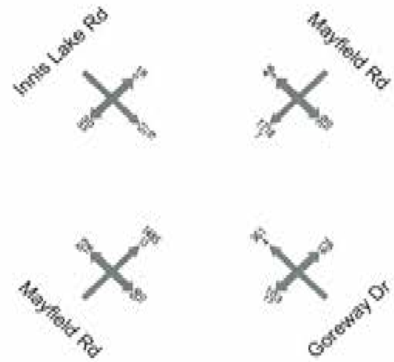
Mayfield Rd at Innis Lake Rd
2032 AM Total
Intersection ID: 3
Roundabout

Mov ID	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS	Longest Queue 95% Back (vehs)	(m)
SouthEast: Goreway Dr								
21	L	47	182	0.258	16.8	B	1.8	14
22	T	82	318	0.258	5.4	A	1.9	14
23	R	54	288	0.188	11.5	B	1.1	9
NorthEast: Mayfield Rd								
24	L	69	90	0.767	15.3	B	11.7	92
25	T	1714	2233	0.768	7.4	A	11.7	92
26	R	31	40	0.775	8.1	A	11.5	91
NorthWest: Innis Lake Rd								
27	L	57	91	0.626	17.8	C	4.9	38
28	T	307	489	0.627	16.2	B	5.7	44
29	R	54	86	0.628	15.8	B	5.7	44
SouthWest: Mayfield Rd								
30	L	53	64	0.828	11.0	C	12.5	97
31	T	1402	1700	0.834	11.7	B	13.2	99
32	R	117	140	0.836*	11.5	B	13.2	99
ALL VEHICLES:		4007		0.836	11.0	B	13.2	99

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods.
\# Movement level of service has been determined using adjacent lane v/c ratio rather than short lane v/c ratio (x/x0.8).

2032 PM Total Road Network - Roundabout Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 PM Total Mayfield 6 lanes (at airport) v4 - excl RTs.sy7

Table 8.14 - Summary of Input and Output Data

Mayfield Rd at Innis Lake Rd
2032 PM Total
Intersection ID: 3
Roundabout

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Short Lane (m)
SouthEast: Goreway Dr												
1 LT	108	114		222	10				0.515	17.9	17	500
2 TR		282	75	305	7				0.515	11.3	41	500
	108	396	75	527	8				0.515	13.9	41	
NorthEast: Mayfield Rd												
1 LT	41	820		861	7				0.974	29.8	237	500
2 TR		988	51	1040	7				0.976	15.6	229	500
	41	1808	51	1901	7				0.976	17.5	229	
NorthWest: Innis Lake Rd												
1 LT	16	53		69	11				0.136	14.4	11	500
2 R			31	31	22				0.169	19.2	8	500
	16	53	31	100	16				0.136	15.9	11	
SouthWest: Mayfield Rd												
1 LT	56	718		774	13				0.638	5.7	57	500
2 TR		840	59	899	13				0.638	5.1	58	500
	56	1563	59	1678	13				0.638	5.4	58	
ALL VEHICLES				Total Flow 4248	% HV 10				Max X 0.981	Aver. Delay 15.7	Max Queue 237	

Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table 8.15 - Capacity and Level of Service

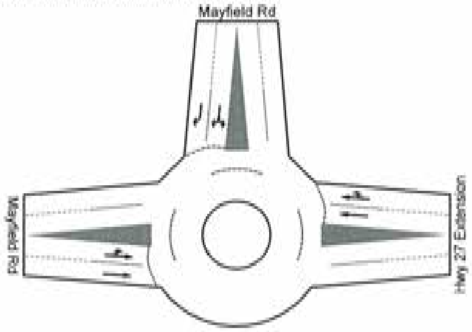
Mayfield Rd at Innis Lake Rd
2032 PM Total
Intersection ID: 3
Roundabout

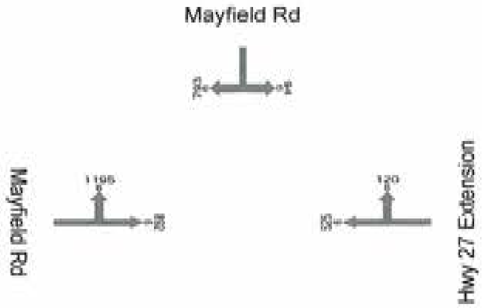
Mov ID	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (secs)	LOS	Longest Queue 95% Back (vehs)	(m)
SouthEast: Goreway Dr								
21 L		108	210	0.514	21.9	C	3.6	27
22 T		396	769	0.515	11.5	B	4.2	31
23 R		75	153	0.516	12.5	B	4.2	31
NorthEast: Mayfield Rd								
24 L		41	42	0.976	44.9	D	17.9	137
25 T		1808	1854	0.976	27.3	C	29.7	229
26 R		51	52	0.981*	46.7	D	29.7	229
NorthWest: Innis Lake Rd								
27 L		16	81	0.198	15.8	B	1.5	11
28 T		53	266	0.198	12.8	B	1.5	11
29 R		31	183	0.168	19.1	B	1.0	8
SouthWest: Mayfield Rd								
30 L		56	88	0.636	12.7	B	7.3	57
31 T		1563	2449	0.638	5.1	A	7.4	58
32 R		59	92	0.641	6.3	A	7.4	58
ALL VEHICLES:		4248		0.981	15.7	B	29.7	229

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used. For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the On-line help.

* Maximum v/c ratio, or critical green periods
\# Movement Level of Service has been determined using adjacent lane v/c ratio rather than short lane v/c ratio (v/c>0.8)

2032 AM Total Road Network - Roundabout Capacity Analysis





Upper value : volumes
Lower value : heavy vehicle % assumed

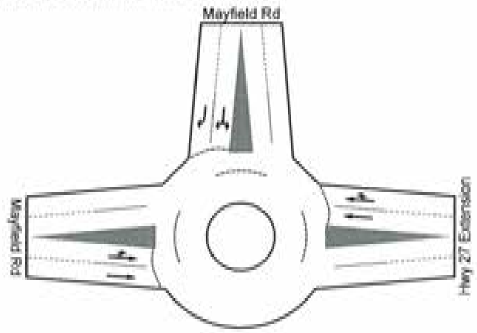
Table 8.14 - Summary of Input and Output Data

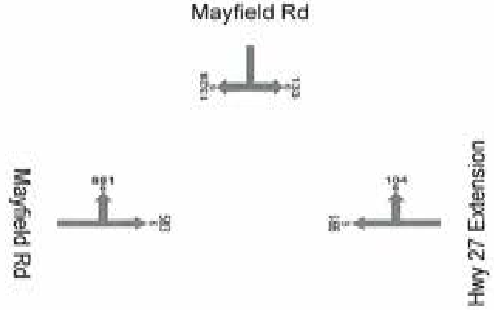
[illegible]

Table 8.15 - Capacity and Level of Service

[illegible]

2032 PM Total Road Network - Roundabout Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % assumed

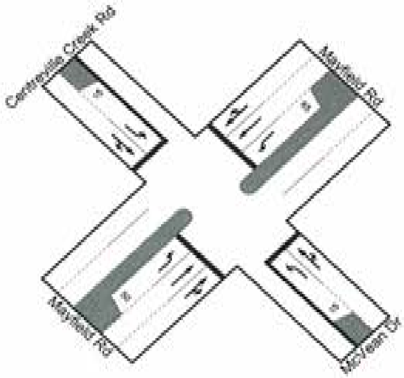
Table 5.14 - Summary of Input and Output Data

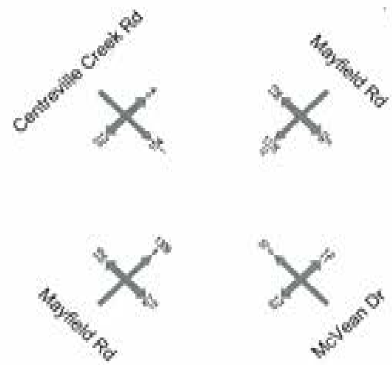
[illegible]

Table 5.15 - Capacity and Level of Service

[illegible]

2032 AM Total Road Network - Signalized Intersection Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 AM Total-Mayfield 6 lanes (at airport) v4 - excl RTs.sy7

Table 5.14 - Summary of Input and Output Data

Mayfield Rd at Centreville Creek Rd
2032 AM Total
Intersection ID: 4
Actuated Coordinated Signals, Cycle Time = 80 (User-given Cycle Time)

Lane No.	Demand Flow (veh/h) L	T	R	Tot	HV %	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Short Lane (m)
SouthEast: McVean Dr												
1 L	14			14	50	1944	23		0.161	35.2	5	15
2 TR		11	11	13	4	1944	48	20	0.015	4.5	0	500
	14	11	12	37	22				0.161	16.1	5	
NorthEast: Mayfield Rd												
1 L	97			97	1	1944	48		0.105	12.8	7	85
2 T		733		733	12	1944	49		0.078	7.0	111	500
3 TR		715	14	729	13	1944	48	1	0.078	7.1	107	500
	97	1448	14	1559	11				0.078	7.3	111	
NorthWest: Centreville Creek Rd												
1 L	4			4	0	1944	15		0.031	31.7	1	15
2 TR		161	14	176	3	1944	1	20	0.368	27.7	48	500
	4	161	14	180	3				0.368	27.8	48	
SouthWest: Mayfield Rd												
1 L	15			15	54	1944	48		0.018	14.0	1	55
2 T		725		725	9	1944	48		0.054	6.8	103	500
3 TR		653	70	723	8	1944	48	1	0.054	7.2	98	500
	15	1378	70	1464	9				0.054	7.1	103	

ALL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	3160	10	80	0.391	8.5	111

Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grades, lane widths, parking manoeuvres and bus stops.

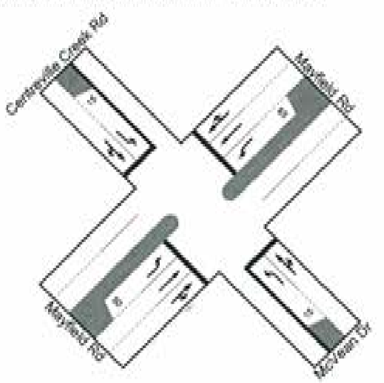
Table 5.15 - Capacity and Level of Service

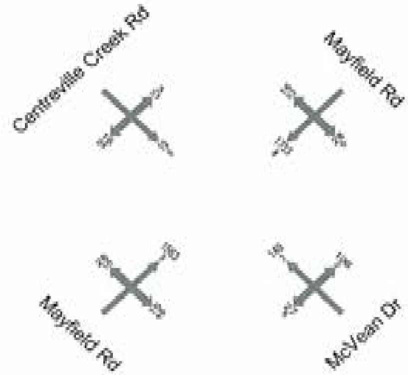
Mayfield Rd at Centreville Creek Rd
2032 AM Total
Intersection ID: 4
Actuated Coordinated Signals, Cycle Time = 80 (User-given Cycle Time)

Mov ID	Mov Typ	Green Time Ratio (g/C) 1st grn	2nd grn	Total Flow (veh/h)	Total Cap. (veh/h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS	Longest Queue 95% Back (vehs)	(m)
SouthEast: McVean Dr										
21	L	0.250		14	87	0.161	35.2	D	0.5	5
22	T	0.600	0.250	11	766	0.015	8.2	A	0.0	0
23	R	0.600	0.275	12	811	0.015	8.4	A	0.0	0
NorthEast: Mayfield Rd										
24	L	0.600		97	923	0.105	12.8	B	1.0	7
25	T	0.600*		1448	1137	0.078	6.9	A	14.5	111
26	R	0.600	0.188	14	13	0.081*	17.1	B	13.8	107
NorthWest: Centreville Creek Rd										
27	L	0.150		4	110	0.031	31.7	C	0.1	1
28	T	0.150*		161	441	0.368	27.8	C	6.3	48
29	R	0.600	0.225	14	38	0.367	25.9	C	6.3	48
SouthWest: Mayfield Rd										
30	L	0.600		15	574	0.028	14.0	B	0.2	1
31	T	0.600		1378	1307	0.054	6.8	A	15.8	111
32	R	0.600	0.150	70	107	0.652	25.5	C	15.0	98
ALL VEHICLES:				3160		0.391	8.5	A	14.5	111
INTERSECTION (persons):				4866			8.5		14.5	111

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the on-line help.
? Reduced capacity due to a short lane effect
* Maximum v/c ratio, or critical green periods
\# Movement Level of Service has been determined using adjacent lane v/c ratio rather than short lane v/c ratio (v/c<1.0)

2032 PM Total Road Network - Signalized Intersection Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 PM Total Mayfield 6 lanes (at airport) v4 - excl RTs.sy7

Table 5.14 - Summary of Input and Output Data

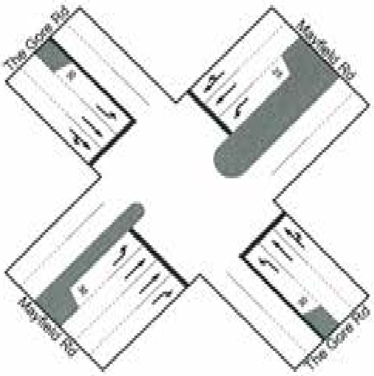
[illegible]

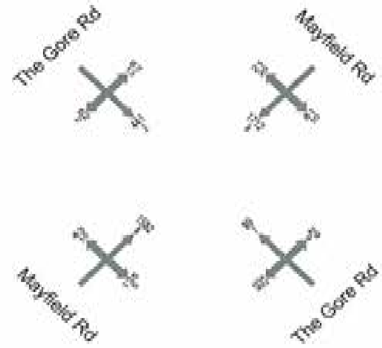
grade, lane widths, parking manoeuvres and bus stops.

Table 5.15 - Capacity and Level of Service

[illegible]

2032 AM Total Road Network - Signalized Intersection Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 AM Total Mayfield 6 lanes (at airport) v4 - excl RTs sy7

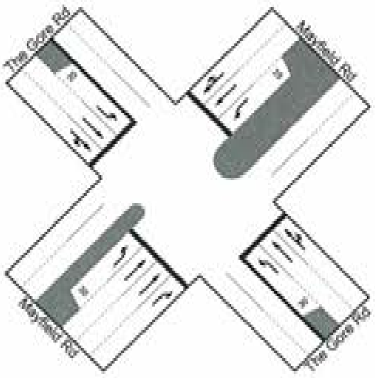
Table 5.14 - Summary of Input and Output Data

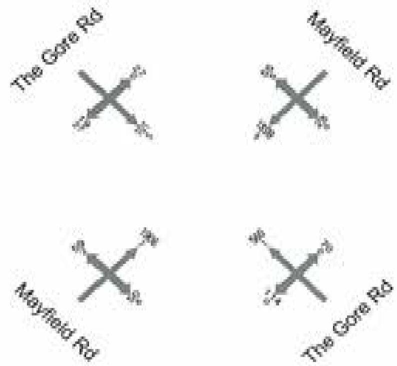
[illegible]

Table 5.15 - Capacity and Level of Service

[illegible]

2032 PM Total Road Network - Signalized Intersection Capacity Analysis





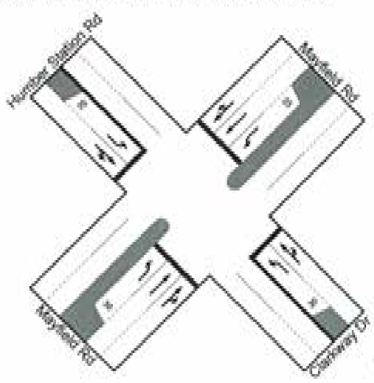
Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

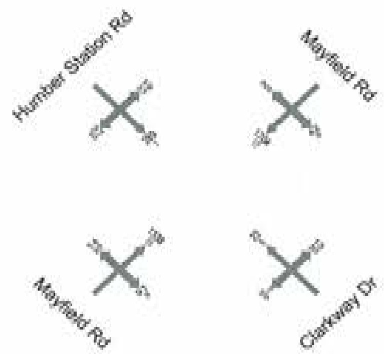
Heavy Vehicle Percentages

Table 8.14 - Summary of Input and Output Data

Table 8.15 - Capacity and Level of Service

2032 AM Total Road Network - Signalized Intersection Capacity Analysis





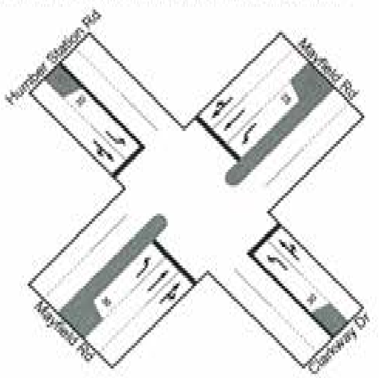
Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 AM Total-Mayfield 6 lanes (at airport) v4 - excl RTs.sy7

Table 5.14 - Summary of Input and Output Data

Table 5.15 - Capacity and Level of Service

2032 PM Total Road Network - Signalized Intersection Capacity Analysis



Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 PM Total Mayfield 6 lanes (at airport) v4 - excl RTs.sy7

Table 8.14 - Summary of Input and Output Data

Mayfield Rd at Humber Station Rd
2032 PM Total
Intersection ID: 7
Actuated Coordinated Signals, Cycle Time = 80 (User-given Cycle Time)

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Short Lane (m)
SouthEast: Clarkway Dr												
1 L	51			51	4	1944	22		0.218	31.3	11	25
2 TR		100	49	149	3	1944	3	12	0.469	18.7	41	500
	51	100	49	200	3				0.469	2?.2	41	
NorthEast: Mayfield Rd												
1 L	18			18	14	1944	49		0.032	13.4	1	25
2 T		878		878	9	1944	46		0.826	9.4	179	500
3 TR		864	13	877	8	1944	46	1	0.826	9.8	178	500
	18	1742	13	1769	8				0.826	8.8	179	
NorthWest: Humber Station Rd												
1 L	7			7	14	1944	11		0.044	31.7	2	25
2 TR		24	54	78	4	1944	9	12	0.129	13.4	15	600
	7	24	54	85	5				0.129	22.4	15	
SouthWest: Mayfield Rd												
1 L	58			58	9	1944	46		0.100	11.2	5	30
2 T		859		859	10	1944	46		0.818	4.7	175	500
3 TR		842	15	857	10	1944	46	1	0.818	9.8	171	500
	58	1701	15	1774	10				0.818	5.8	175	

ALL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	3528	8	80	0.828	11.4	179

Peak flow period = 15 minutes.

Queue values in this table are 95% back of queue (metres).

Given Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

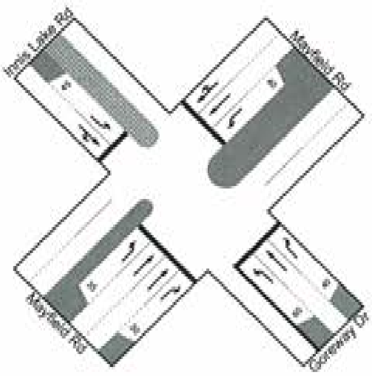
Table 8.15 - Capacity and Level of Service

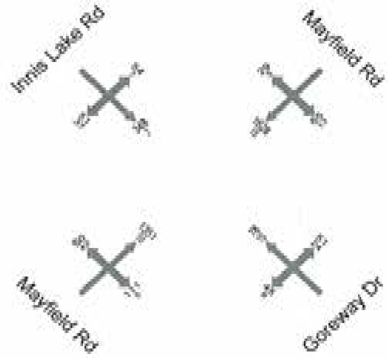
Mayfield Rd at Humber Station Rd
2032 PM Total
Intersection ID: 7
Actuated Coordinated Signals, Cycle Time = 80 (User-given Cycle Time)

Mov ID	Mov Typ	Green Time Ratio (g/C) 1st grn	2nd grn	Total Flow (veh/h)	Total Cap. (veh/h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS	Longest Queue 95% Back (vehs)	(m)
SouthEast: Clarkway Dr										
22	L	0.175		51	234+	0.218	31.3	C	1.7	11
22	T	0.275*		105	416	0.479	18.8	C	5.8	41
23	R	0.575	0.175	49	105	0.468	27.5	C	5.8	41
NorthEast: Mayfield Rd										
24	L	0.575		18	832+	0.022	13.4	B	0.2	1
25	T	0.575*		1742	2109	0.826	9.7	A	23.9	179
26	R	0.575	0.275	13	16	0.812*	38.4	B	23.3	176
NorthWest: Humber Station Rd										
27	L	0.175		7	159+	0.044	31.7	C	0.2	2
28	T	0.275		24	186	0.129	15.8	B	1.6	15
29	R	0.575	0.275	54	418	0.129	14.1	C	1.6	15
SouthWest: Mayfield Rd										
30	L	0.575		58	545+	0.100	11.2	B	0.7	5
31	T	0.575		1701	2075	0.818	9.0	A	23.1	175
31	R	0.575	0.275	15	19	0.806	18.5	B	22.5	171
ALL VEHICLES:				3528		0.826	11.4	B	23.9	179
INTERSECTION (persons):				5292			11.4		23.9	179

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the online help.
\+ Reduced capacity due to a short lane effect
* Maximum v/c ratio, or critical green periods
\# Movement Level of service has been determined using adjacent lane v/c ratio rather than short lane v/c ratio (x>x+t.3)

2032 AM Total Road Network - Signalized Intersection Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.1 Assessment\2032 Total\2032 AM Total-Mayfield 6 lanes (at airport) v4 - excl RTs.sy7

Table 5.14 - Summary of Input and Output Data

Mayfield Rd at Innis Lake Rd
2032 AM Total
Intersection ID: 3
Actuated Coordinated Signals, Cycle Time = 120 ([illegible] Cycle Time)

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Short Lane (m)
SouthEast: Goreway Dr												
1 L	47			47	9	1944	41		0.145	54.0	15	60
2 T		81		81	16	1944	41		0.135	28.8	17	500
3 R			54	54	24	1944	47	41	0.044	9.3	3	60
	47	81	54	182	16				0.145	28.9	17	
NorthEast: Mayfield Rd												
1 L	89			89	19	1944	67		0.163	17.2	11	60
2 T		872		872	15	1944	67		0.882	17.3	303	500
3 TR		842	31	873	15	1944	67	1	0.882	17.0	299	500
	89	1714	31	1834	15				0.882	17.0	303	
NorthWest: Innis Lake Rd												
1 L	57			57	7	1944	41		0.214	36.3	28	45
2 TR		367	54	421	11	1944	1	41	0.481	35.1	103	500
	57	367	54	478	10				0.481	35.1	103	
SouthWest: Mayfield Rd												
1 L	53			53	12	1944	67		0.109	18.3	10	35
2 T		711		711	16	1944	67		0.698	18.1	182	500
3 T		711		711	16	1944	67		0.698	18.1	182	500
4 R			117	117	5	1944	67	41	0.095	8.6	2	35
	53	1422	117	1592	15				0.698	17.8	182	

ALL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	4087	13	120	0.884	18.4	303

Peak flow period = 15 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

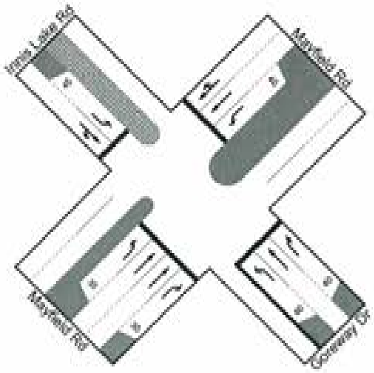
Table 5.15 - Capacity and Level of Service

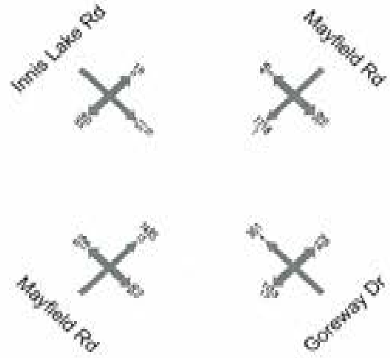
Mayfield Rd at Innis Lake Rd
2032 AM Total
Intersection ID: 3
Actuated Coordinated Signals, Cycle Time = 120 ([illegible] Cycle Time)

Mov ID	Mov Typ	Green Time Ratio (g/C) 1st grn	2nd grn	Total Flow (veh/h)	Total Cap. (veh/h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS	Longest Queue 95% Back (vehs)	(m)
SouthEast: Goreway Dr										
21	L	0.342		47	332	0.142	54.0	E	1.9	15
22	T	0.342		81	599	0.135	28.8	C	5.5	17
23	R	0.558	0.342	54	1218	0.044	9.3	A	0.3	3
NorthEast: Mayfield Rd										
24	L	0.558		89	624-	0.143	17.2	B	1.4	11
25	T	0.558*		1714	1944	0.882	16.9	B	38.4	303
26	R	0.558	0.342	31	35	0.884*	25.3	C	38.0	299
NorthWest: Innis Lake Rd										
27	L	0.342		57	266-	0.214	36.3	D	3.4	28
28	T	0.342*		367	959	0.481	35.3	D	13.2	103
29	R	0.558	0.342	54	80	0.675	48.5	D	13.2	103
SouthWest: Mayfield Rd										
30	L	0.558		53	456-	0.109	18.3	B	1.0	10
31	T	0.558		1422	2038	0.698	18.1	B	23.8	182
32	R	0.558	0.342	117	1232-	0.095	8.6	A	0.2	2
ALL VEHICLES:				4087		0.884	18.4	B	38.4	303
INTERSECTION (persons):				4905			18.4		38.4	303

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the On-line help.
- Reduced capacity due to a short lane effect
* Maximum v/c ratio, or critical green periods
# Movement Level of service has been determined using adjusted lane v/c ratio rather than short lane v/c ratio (x=1.0)

2032 PM Total Road Network - Signalized Intersection Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

Heavy Vehicle Percentages
M:\Peel Region\4113 Mayfield Road EA (Airport to Coleraine)\4.0 Analysis\4.3 Assessment\2032 Total\2032 PM Total Mayfield 6 lanes (at airport) v4 - excl RTs.sy7

Table 5.14 - Summary of Input and Output Data

Mayfield Rd at Innis Lake Rd
2032 PM Total
Intersection ID: 3
Actuated Coordinated Signals, Cycle Time = 120 (User-given Cycle Time)

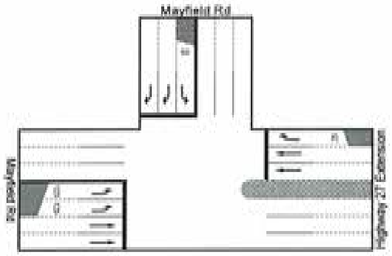
[illegible]

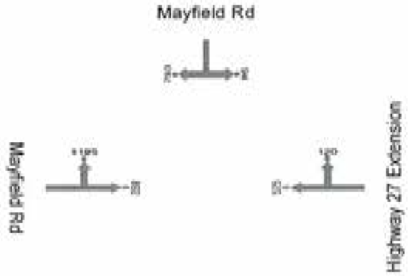
Table 5.15 - Capacity and Level of Service

Mayfield Rd at Innis Lake Rd
2032 PM Total
Intersection ID: 3
Actuated Coordinated Signals, Cycle Time = 120 (User-given Cycle Time)

[illegible]

2032 AM Total Road Network - Signalized Intersection Capacity Analysis





Upper value - volumes
Lower value - heavy vehicle % as per Synchro analysis

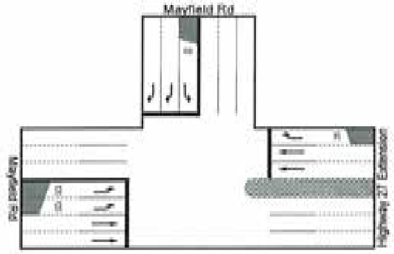
Table 5.14 - Summary of Input and Output Data

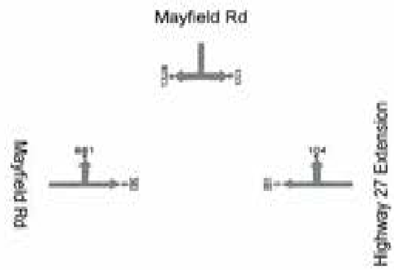
[illegible]

Table 5.15 - Capacity and Level of Service

[illegible]

2032 PM Total Road Network - Signalized Intersection Capacity Analysis





Upper value : volumes
Lower value : heavy vehicle % as per Synchro analysis

Table 8.14 - Summary of Input and Output Data

[illegible]

Table 8.15 - Capacity and Level of Service

[illegible]

Appendix B
RODEL Analysis

2032 Total Road Network - Roundabout Capacity Analysis

Intersection: Mayfield Road at Centreville Creek Road/McVean Drive

	INPUT GEOMETRY (in meters)					
Geometry Used:	Entry Width, E	Flare Length, L'	Half Width, V	Radius, R	Entry Angle (degrees)	Inscribed Circle
Centreville Creek Road	8.49	18.55	3.75	30.8	21.05	55
Mayfield Road W	8.38	9.75	7.5	28	16.53	55
McVean Drive S	8.26	16.05	3.75	30.8	16.17	55
Mayfield Road E	8.38	9.71	7.5	28	12.16	55

2032 AM Total Traffic Volume

	OUTPUT RESULTS								
Approaches	Flow	Capacity	V/C	Avg. Delay (min/veh)	Avg. Delay (sec/veh)	Max Delay (min/veh)	Max Delay (sec/veh)	Avg. Queue	Max Queue
Centreville Creek Road	171	905	0.19	0.08	31	0.12	7	0	0
Mayfield Road W	1,391	2,225	0.63	0.07	4	0.11	7	2	2
McVean Drive S	35	839	0.04	0.07	4	0.1	6	0	0
Mayfield Road E	1,480	2,350	0.63	0.07	4	0.1	6	2	2
Overall LOS	A								

2032 PM Total Traffic Volume

	OUTPUT RESULTS								
Approaches	Flow	Capacity	V/C	Avg. Delay (min/veh)	Avg. Delay (sec/veh)	Max Delay (min/veh)	Max Delay (sec/veh)	Avg. Queue	Max Queue
Centreville Creek Road	38	668	0.06	0.1	31	0.14	8	0	0
Mayfield Road W	1,606	2,374	0.68	0.08	5	0.12	7	2	3
McVean Drive S	282	827	0.34	0.12	7	0.18	11	1	1
Mayfield Road E	1,777	2,318	0.77	0.12	7	0.2	12	4	5
Overall LOS	A								

2032 Total Road Network - Roundabout Capacity Analysis

Intersection: Mayfield Road at The Gore Road

Geometry Used:	INPUT GEOMETRY (in meters) Entry Width, E	Flare Length, L'	Half Width, V	Radius, R	Entry Angle (degrees)	Inscribed Circle
The Gore Road N	8.49	16	3.75	30.8	26.81	55
Mayfield Road W	8.52	9	7.5	26	17.61	55
The Gore Road S	8.49	15.93	3.75	30.8	27.03	55
Mayfield Road E	8.42	7.66	7.5	26	18.6	55

2032 AM Total Traffic Volume

Approaches	OUTPUT RESULTS Flow	Capacity	V/C	Avg. Delay (min/veh)	Avg. Delay (sec/veh)	Max Delay (min/veh)	Max Delay (sec/veh)	Avg. Queue	Max Queue
The Gore Road N	570	647	0.88	2.28	31	5.22	313	22	55
Mayfield Road W	1,760	1,991	0.88	0.33	20	0.63	38	10	17
The Gore Road S	150	689	0.22	0.11	7	0.17	10	0	0
Mayfield Road E	1,814	2,258	0.80	0.16	10	0.27	16	5	8
Overall LOS	D								

2032 PM Total Traffic Volume

Approaches	OUTPUT RESULTS Flow	Capacity	V/C	Avg. Delay (min/veh)	Avg. Delay (sec/veh)	Max Delay (min/veh)	Max Delay (sec/veh)	Avg. Queue	Max Queue
The Gore Road N	147	551	0.27	0.15	31	0.23	14	0	1
Mayfield Road W	2,015	2,327	0.87	0.27	16	0.54	32	9	17
The Gore Road S	744	571	1.30	7.98	479	16.8	1008	123	193
Mayfield Road E	1,982	2,044	0.97	0.86	52	1.8	108	30	58
Overall LOS	F								

RODEL SCREEN CAPTURE

2032 Total Road Network - Roundabout Capacity Analysis

Intersection: Mayfield Road at Humber Station Road/Clarkway Drive

	INPUT GEOMETRY (in meters)					
Geometry Used:	Entry Width, E	Flare Length, L'	Half Width, V	Radius, R	Entry Angle (degrees)	Inscribed Circle
Humber Station Road N	8.39	12.96	3.75	32	17.17	55
Mayfield Road W	8.47	9.75	7.5	28	16.68	55
Clarkway Drive S	7.91	12.7	3.75	32	16.78	55
Mayfield Road E	8.41	9.77	7.5	28	16.47	55

2032 AM Total Traffic Volume

	OUTPUT RESULTS								
Approaches	Flow	Capacity	V/C	Avg. Delay		Max Delay		Avg. Queue	Max Queue
				(min/veh)	(sec/veh)	(min/veh)	(sec/veh)		
Humber Station Road N	345	572	0.60	0.45	31	0.89	53	3	5
Mayfield Road W	1,443	2,071	0.70	0.1	6	0.16	10	2	3
Clarkway Drive S	43	770	0.06	0.08	5	0.11	7	0	0
Mayfield Road E	1,748	2,220	0.79	0.14	8	0.24	14	4	6
Overall LOS	A								

2032 PM Total Traffic Volume

	OUTPUT RESULTS								
Approaches	Flow	Capacity	V/C	Avg. Delay		Max Delay		Avg. Queue	Max Queue
				(min/veh)	(sec/veh)	(min/veh)	(sec/veh)		
Humber Station Road N	81	688	0.12	0.1	31	0.15	9	0	0
Mayfield Road W	1,685	2,373	0.71	0.09	5	0.14	8	3	4
Clarkway Drive S	284	678	0.42	0.17	10	0.28	17	1	1
Mayfield Road E	1,680	2,223	0.76	0.13	7	0.2	12	4	5
Overall LOS	A								

2032 Total Road Network - Roundabout Capacity Analysis

Intersection: Mayfield Road at Innis Lake Road/Goreway Drive

Geometry Used:	INPUT GEOMETRY (in meters) Entry Width, E	Flare Length, L'	Half Width, V	Radius, R	Entry Angle (degrees)	Inscribed Circle
Innis Lake Road N	8.49	18.55	3.75	30.8	19.08	55
Mayfield Road W	8.38	9.67	7.5	28	16.16	55
Goreway Drive S	8.49	17.41	3.75	30.8	16.46	55
Mayfield Road E	8.38	9.67	7.5	28	14.35	55

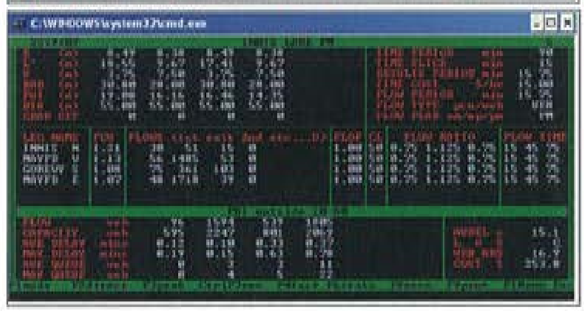
2032 AM Total Traffic Volume

Approaches	OUTPUT RESULTS Flow	Capacity	V/C	Avg. Delay		Max Delay		Avg. Queue	Max Queue
				(min/veh)	(sec/veh)	(min/veh)	(sec/veh)		
Innis Lake Road N	453	649	0.70	0.61	31	1.28	77	5	9
Mayfield Road W	1,512	2,013	0.75	0.13	8	0.22	13	3	5
Goreway Drive S	174	827	0.21	0.09	5	0.13	8	0	0
Mayfield Road E	1,722	2,169	0.79	0.15	9	0.26	16	5	7
Overall LOS	B								

2032 PM Total Traffic Volume

Approaches	OUTPUT RESULTS Flow	Capacity	V/C	Avg. Delay		Max Delay		Avg. Queue	Max Queue
				(min/veh)	(sec/veh)	(min/veh)	(sec/veh)		
Innis Lake Road N	96	595	0.16	0.12	31	0.19	11	0	0
Mayfield Road W	1,594	2,247	0.71	0.1	6	0.15	9	3	4
Goreway Drive S	539	801	0.67	0.33	20	0.63	38	3	3
Mayfield Road E	1,805	2,069	0.87	0.37	22	0.78	47	11	22
Overall LOS	C								

RODEL SCREEN CAPTURE



__2031 Total Road Network - Roundabout Capacity Analysis__

Intersection: Mayfield Road at Mayfied Road/Major Mackenzie

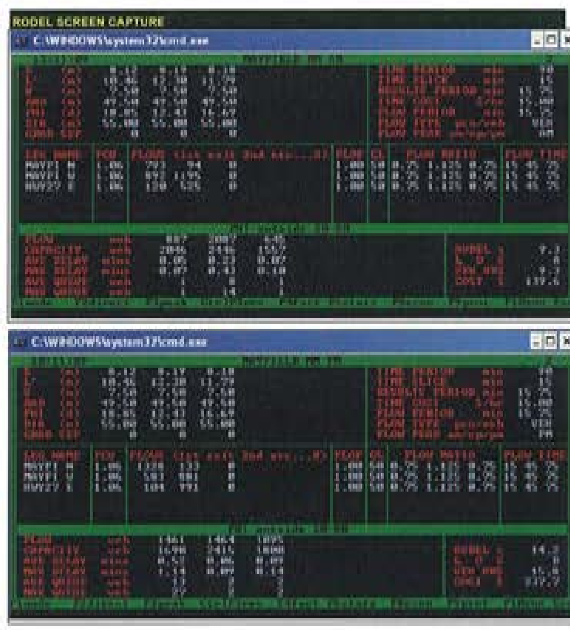
	INPUT GEOMETRY (in meters)					
Geometry Used:	Entry Width, E	Flare Length, L'	Half Width, V	Radius, R	Entry Angle (degrees)	Inscribed Circle
Mayfield Road N	8.12	10.46	7.5	49.5	18.85	55
Mayfield Road W	8.19	12.3	7.5	49.5	12.43	55
Major Mackenzie E	8.18	11.79	7.5	49.5	16.69	55

2031 AM Total Traffic Volume

	OUTPUT RESULTS								
Approaches	Flow	Capacity	V/C	Avg. Delay (min/veh)	Avg. Delay (sec/veh)	Max Delay (min/veh)	Max Delay (sec/veh)	Avg. Queue	Max Queue
Mayfield Road N	887	2,046	0.43	0.05	31	0.07	4	1	1
Mayfield Road W	2,087	2,446	0.85	0.23	14	0.43	26	6	14
Major Mackenzie E	645	1,557	0.41	0.07	4	0.1	6	1	1
Overall LOS	A								

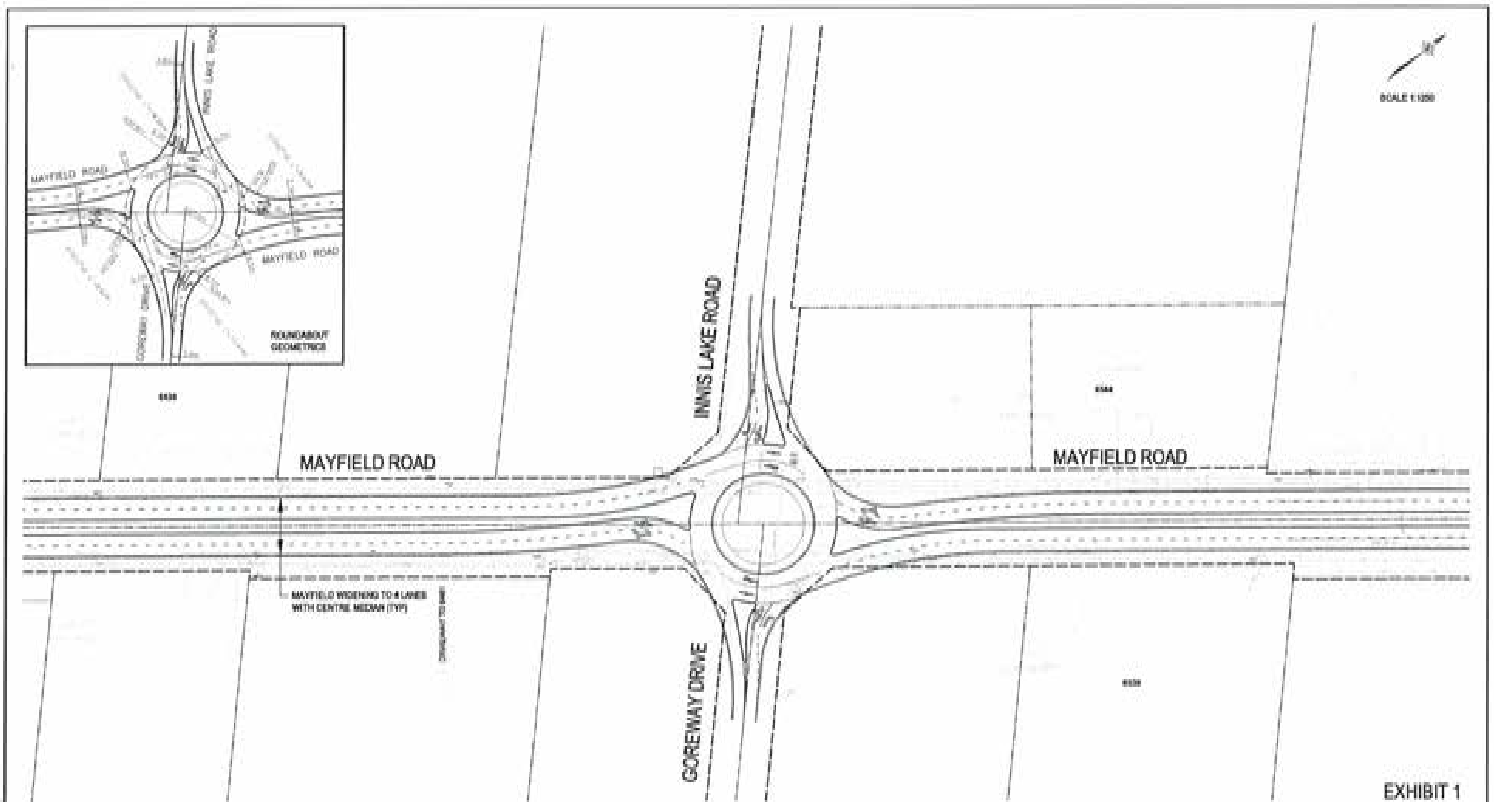
2031 PM Total Traffic Volume

	OUTPUT RESULTS								
Approaches	Flow	Capacity	V/C	Avg. Delay (min/veh)	Avg. Delay (sec/veh)	Max Delay (min/veh)	Max Delay (sec/veh)	Avg. Queue	Max Queue
Mayfield Road N	1,461	1,690	0.86	0.52	31	1.14	68	13	27
Mayfield Road W	1,464	2,415	0.61	0.06	4	0.09	5	2	2
Major Mackenzie E	1,095	1,800	0.61	0.09	5	0.14	8	2	2
Overall LOS	B								

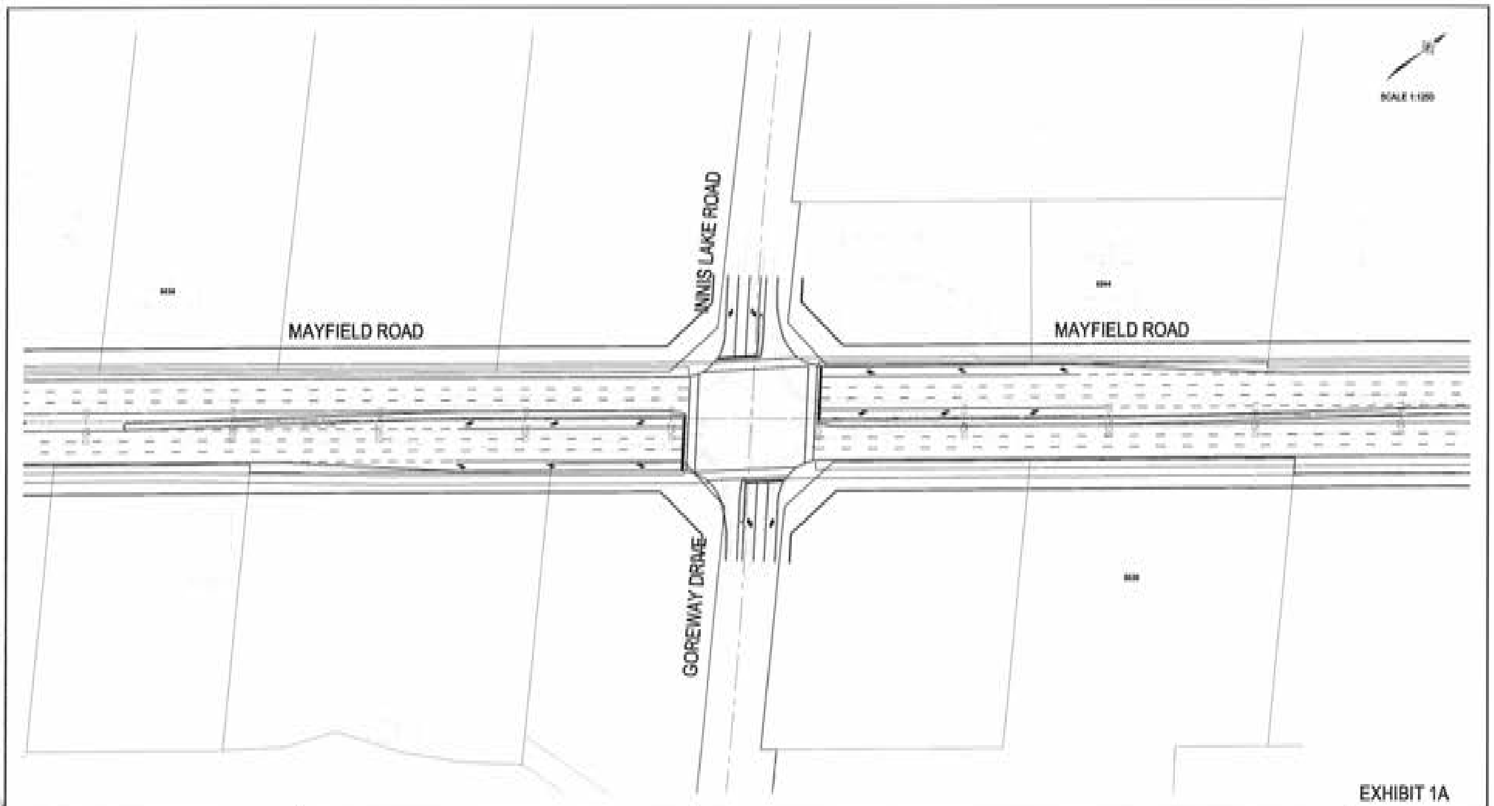


Appendix C

Roundabout and Signalized Intersection Design Concepts



Region of Peel *Working for you*	MAYFIELD ROAD ROUNDABOUT FEASIBILITY STUDY: AIRPORT ROAD TO COLERAINE	PRELIMINARY ROUNDABOUT CONCEPT ROUNDABOUT AT MAYFIELD ROAD AND GOREWAY DRIVE / INNIS LAKE ROAD INTERIM 4-LANE CORRIDOR DESIGN	HDR | iTRANS | Stantec



Region of Peel
Working for you

MAYFIELD ROAD ROUNDABOUT FEASIBILITY STUDY: AIRPORT ROAD TO COLERAINE

PRELIMINARY SIGNALIZED INTERSECTION CONCEPT
INTERSECTION AT MAYFIELD ROAD AND GOREWAY DRIVE / INNIS LAKE ROAD

ULTIMATE 6-LANE CORRIDOR DESIGN

Stantec

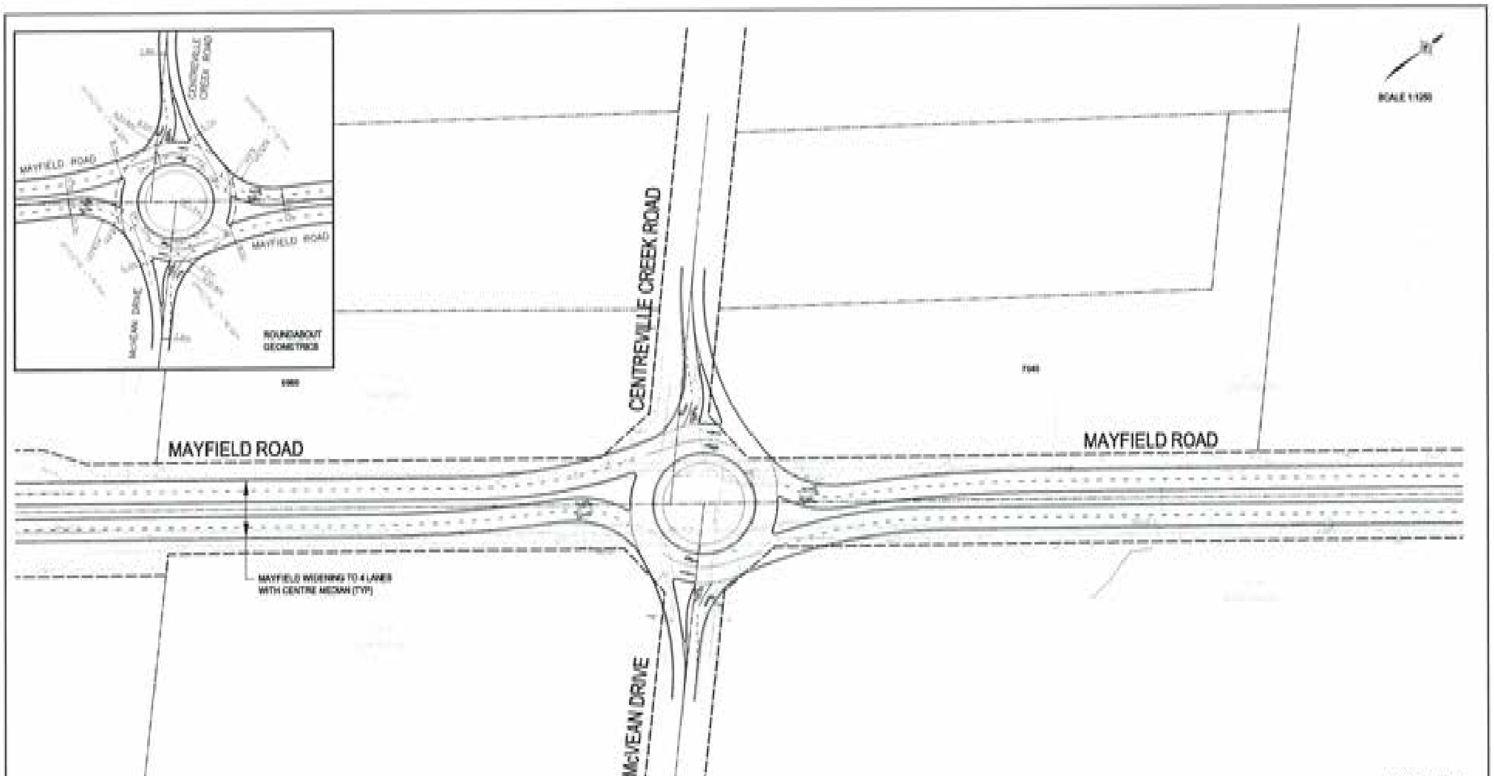


EXHIBIT 2

Region of Peel Working for you	MAYFIELD ROAD ROUNDABOUT FEASIBILITY STUDY: AIRPORT ROAD TO COLERAINE	PRELIMINARY ROUNDABOUT CONCEPT ROUNDABOUT AT MAYFIELD ROAD AND McVEAN DRIVE / CENTREVILLE CREEK ROAD INTERIM 4-LANE CORRIDOR DESIGN	HDR | iTRANS | Stantec

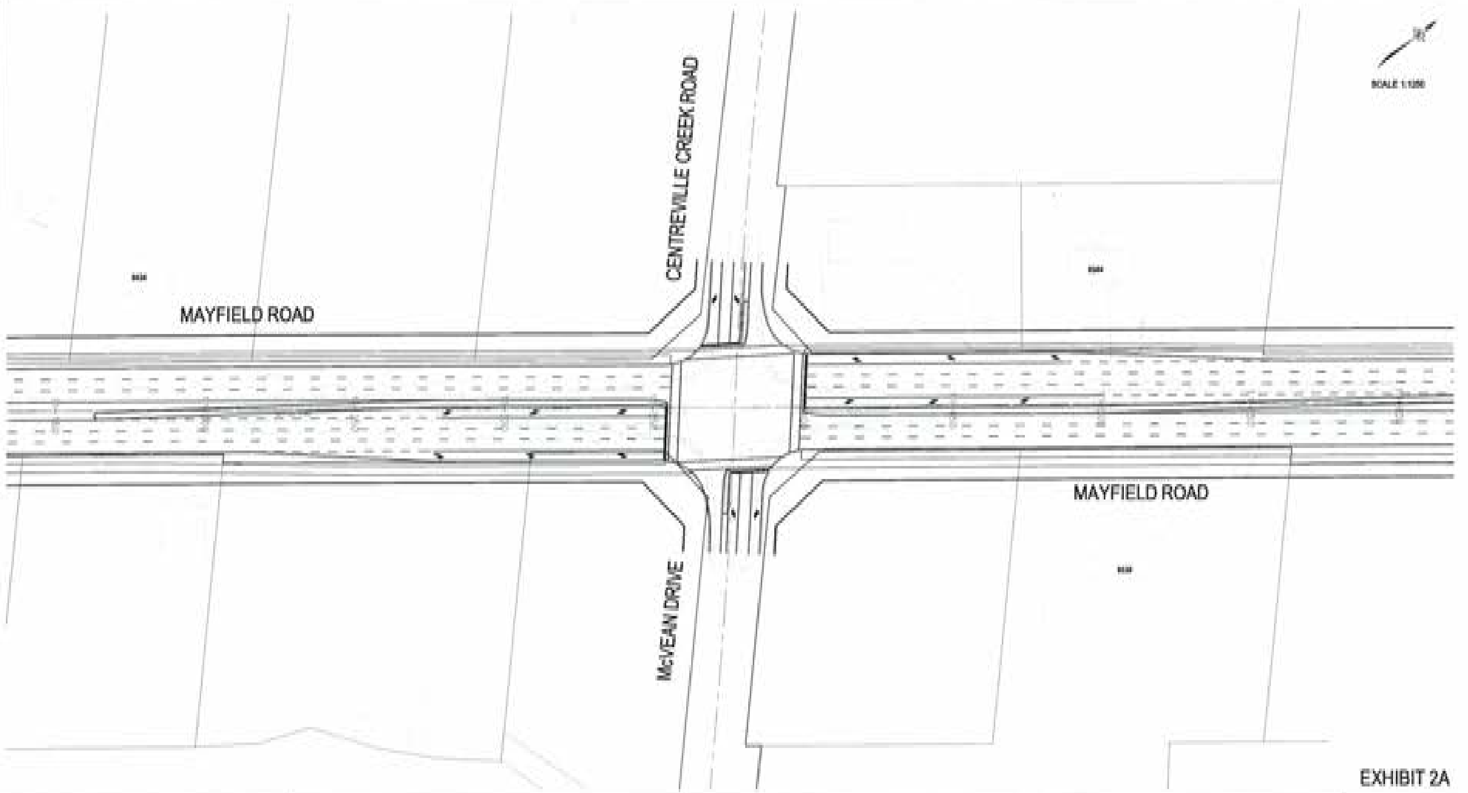


EXHIBIT 2A

Region of Peel *Working for you*	MAYFIELD ROAD ROUNDABOUT FEASIBILITY STUDY: AIRPORT ROAD TO COLERAINE	PRELIMINARY SIGNALIZED INTERSECTION CONCEPT INTERSECTION AT MAYFIELD ROAD AND McVEAN DRIVE / CENTREVILLE CREEK ROAD ULTIMATE 6-LANE CORRIDOR DESIGN	Stantec

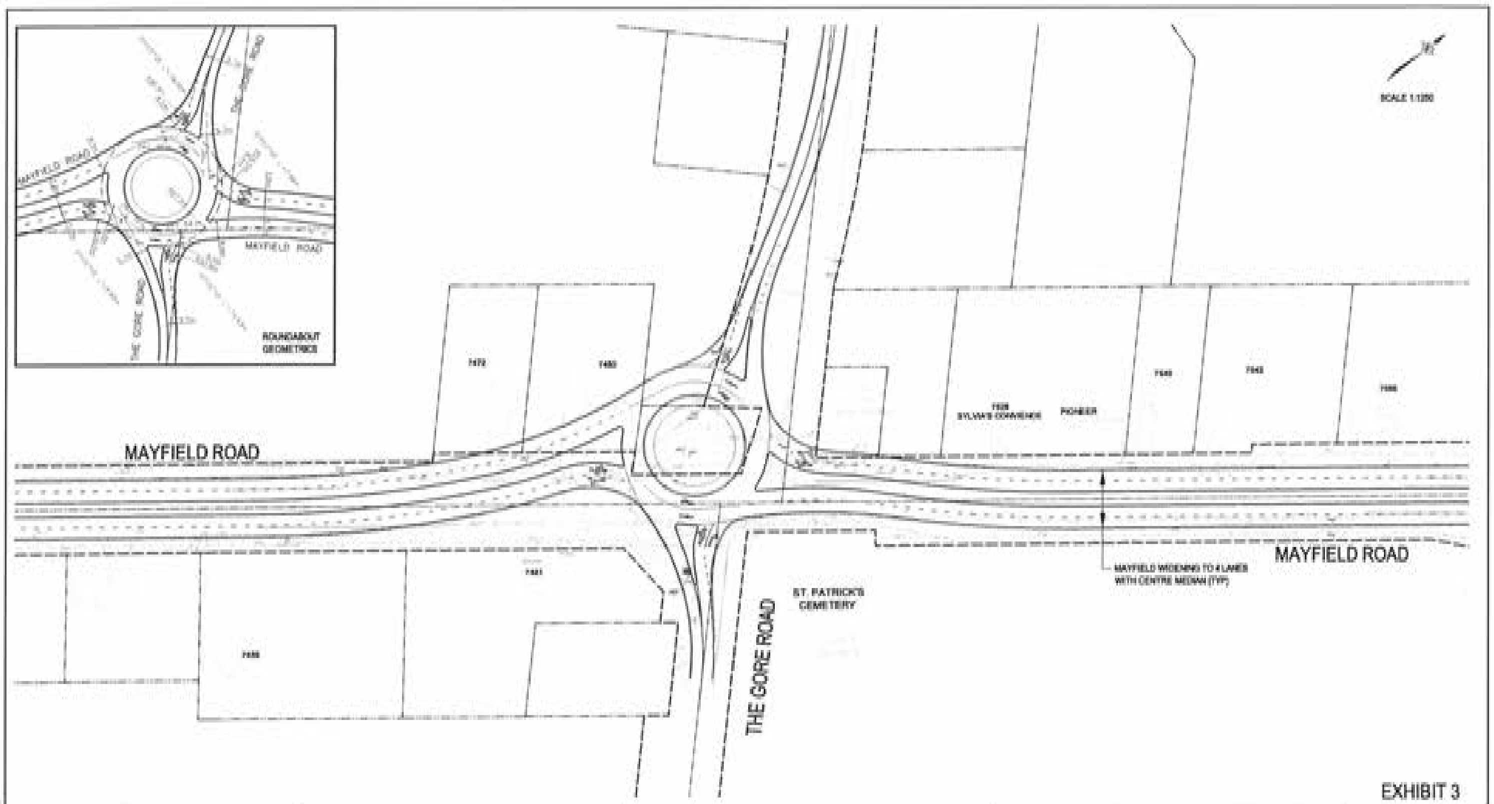


EXHIBIT 3

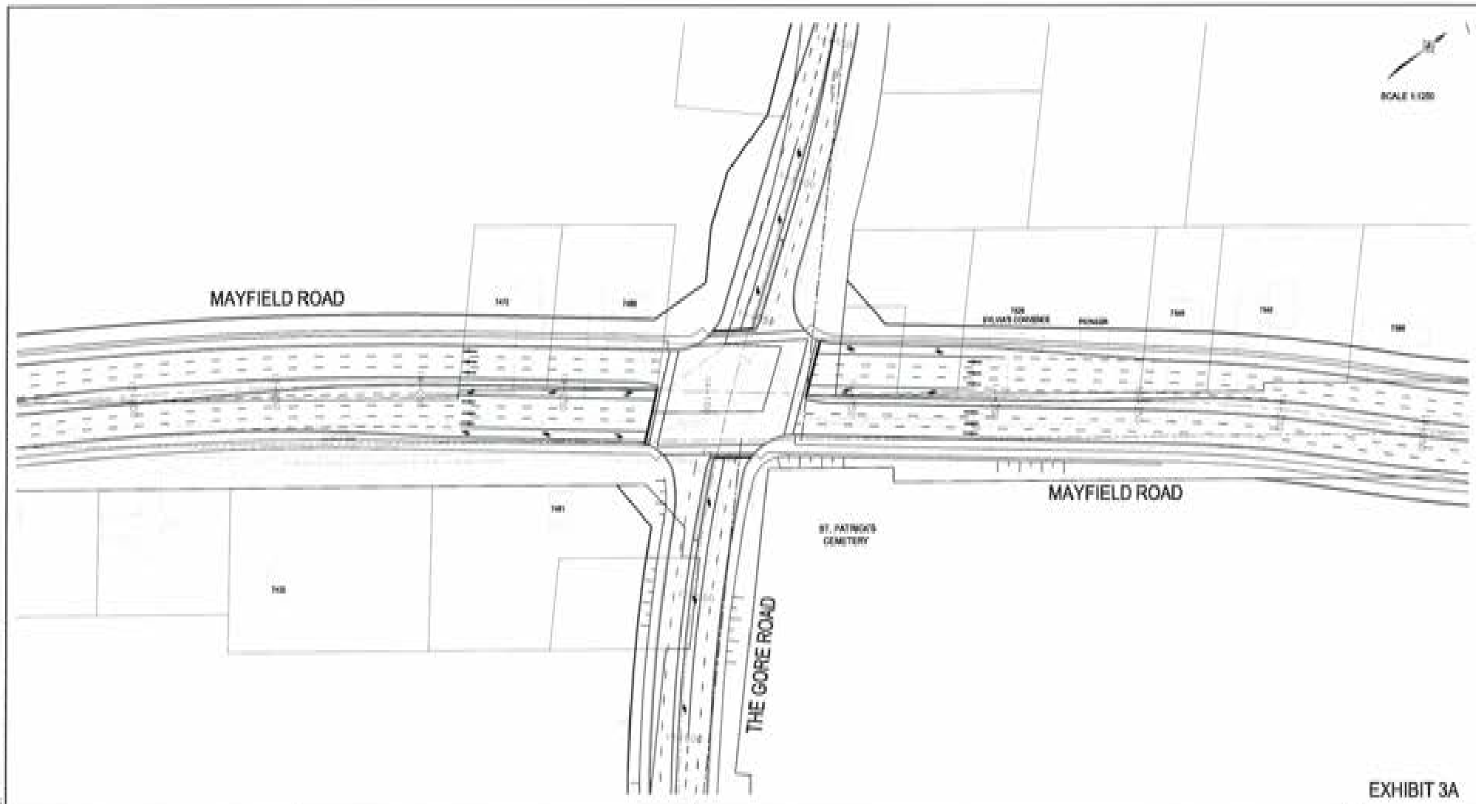
Region of Peel
Working for you

MAYFIELD ROAD ROUNDABOUT FEASIBILITY STUDY: AIRPORT ROAD TO COLERAINE

PRELIMINARY ROUNDABOUT CONCEPT
ROUNDABOUT AT MAYFIELD ROAD AND THE GORE ROAD

INTERIM 4-LANE CORRIDOR DESIGN

HDR | iTRANS | Stantec



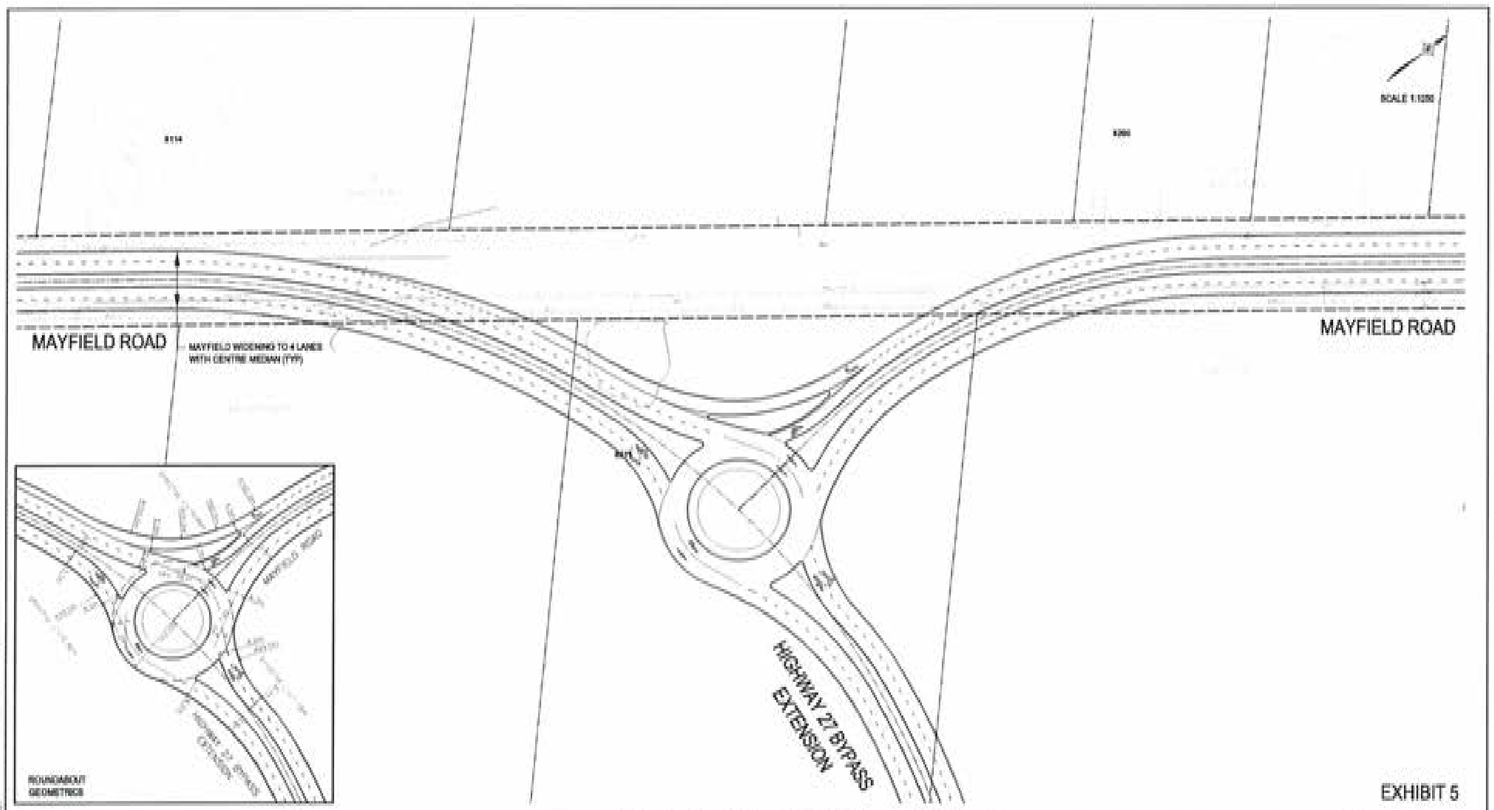
Region of Peel Working for you	MAYFIELD ROAD ROUNDABOUT FEASIBILITY STUDY: AIRPORT ROAD TO COLERAINE	PRELIMINARY SIGNALIZED INTERSECTION CONCEPT INTERSECTION AT MAYFIELD ROAD AND THE GORE ROAD ULTIMATE 6-LANE CORRIDOR DESIGN	Stantec

EXHIBIT 4

Region of Peel *Working for you*	MAYFIELD ROAD ROUNDABOUT FEASIBILITY STUDY: AIRPORT ROAD TO COLERAINE	PRELIMINARY ROUNDABOUT CONCEPT ROUNDABOUT AT MAYFIELD ROAD AND CLARKWAY DRIVE / HUMBER STATION ROAD INTERIM 4-LANE CORRIDOR DESIGN	HDR | iTRANS | Stantec

EXHIBIT 4A

Region of Peel Working for you	MAYFIELD ROAD ROUNDABOUT FEASIBILITY STUDY: AIRPORT ROAD TO COLERAINE	PRELIMINARY SIGNALIZED INTERSECTION CONCEPT INTERSECTION AT MAYFIELD ROAD AND CLARKWAY DRIVE / HUMBER STATION ROAD ULTIMATE 6-LANE CORRIDOR DESIGN	Stantec



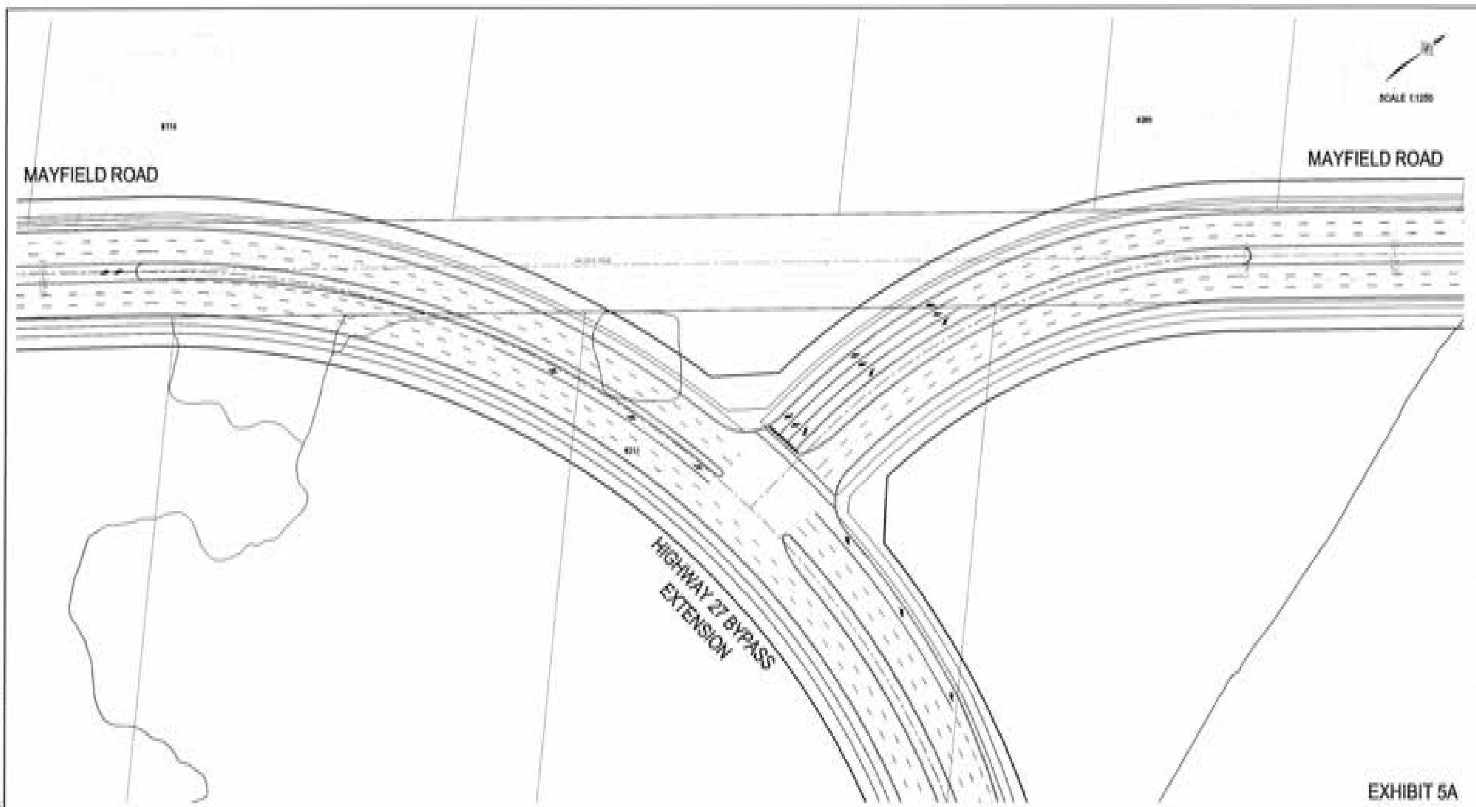
Region of Peel
Working for you

MAYFIELD ROAD ROUNDABOUT
FEASIBILITY STUDY:
AIRPORT ROAD TO COLERAINE

PRELIMINARY ROUNDABOUT CONCEPT
ROUNDABOUT AT MAYFIELD ROAD AND
HIGHWAY 27 BYPASS EXTENSION

INTERIM 4-LANE CORRIDOR DESIGN

HDR | iTRANS | Stantec



Region of Peel
Working for you

MAYFIELD ROAD ROUNDABOUT
FEASIBILITY STUDY:
AIRPORT ROAD TO COLERAINE

PRELIMINARY SIGNALIZED INTERSECTION CONCEPT
INTERSECTION AT MAYFIELD ROAD AND HIGHWAY 27 BYPASS EXTENSION

ULTIMATE 6-LANE CORRIDOR DESIGN

Stantec

APPENDIX O

DRIVEWAY SIGHT DISTANCE REVIEW

Table 5.5.1 – Driveway Turning Sight Distance Review

			ORIGINAL DESIGN				REVISED DESIGN (K60 CREST 11+890 to 12+190)				REVISED DESIGN NO. 2 (K80 CREST 11+890 to 12+190)			
					MEETS DESIGN SPEED OF (km/hr)				MEETS DESIGN SPEED OF (km/hr)				MEETS DESIGN SPEED OF (km/hr)	
DRIVEWAY ACCESS	DRIVEWAY STATION	NORTH (N) SIDE OR SOUTH (S) SIDE	LEFT TURN SIGHT DIST (m)	RIGHT TURN SIGHT DIST (m)	LEFT TURN kph	RIGHT TURN kph	LEFT TURN SIGHT DIST (m)	RIGHT TURN SIGHT DIST (m)	LEFT TURN kph	RIGHT TURN kph	LEFT TURN SIGHT DIST (m)	RIGHT TURN SIGHT DIST (m)	LEFT TURN kph	RIGHT TURN kph
6524	11+505	N	OK	OK	90	90	OK	OK	90	90	OK	OK	90	90
ENTRANCE	11+565	S	OK	OK	90	90	OK	OK	90	90	OK	OK	90	90
6544	11+613	N	OK	OK	90	90	OK	OK	90	90	OK	OK	90	90
6607	11+678	S	OK	275	90	85	OK	OK	90	90	OK	OK	90	85
6600	11+688	N	260	OK	80	90	OK	OK	90	90	OK	OK	90	90
ENTRANCE	11+825	N	OK	280	90	85	OK	285	90	85	OK	OK	90	90
6688	11+875	N	OK	230	90	75	OK	245	90	75	OK	270	90	80
6716	11+970	N	OK	215	90	70	OK	255	90	80	OK	290	90	85
6734	12+030	N	OK	210	90	70	OK	OK	90	90	OK	OK	90	90
6737	12+036	S	OK	OK	90	90	OK	OK	90	90	OK	OK	90	90
FUT. DEV. ACCESS	12+125	S	OK	220	90	70	OK	245	90	75	OK	OK	90	90
6791	12+185	S	OK	210	90	70	OK	240	90	75	OK	275	90	85
6788/6774	12+187	N	OK	OK	90	90	OK	OK	90	90	OK	OK	90	90
6875	12+405	S	OK	OK	90	90	OK	OK	90	90	OK	OK	90	90
6902	12+460	N	OK	OK	90	90	OK	OK	90	90	OK	OK	90	90

Table 5.5.1 – Driveway Turning Sight Distance Review

			ORIGINAL DESIGN				REVISED DESIGN (K70 CREST 15+625 to 15+809)			
					MEETS DESIGN SPEED OF (km/hr)				MEETS DESIGN SPEED OF (km/hr)	
DRIVEWAY ACCESS	DRIVEWAY STATION	NORTH (N) SIDE OR SOUTH (S) SIDE	LEFT TURN SIGHT DIST (m)	RIGHT TURN SIGHT DIST (m)	LEFT TURN kph	RIGHT TURN kph	LEFT TURN SIGHT DIST (m)	RIGHT TURN SIGHT DIST (m)	LEFT TURN kph	RIGHT TURN kph
8026	15+588	N	OK	OK	90	90	OK	OK	90	90
8036	15+622	N	OK	250	90	80	OK	OK	90	90
8040	15+632	N	OK	245	90	75	OK	OK	90	90
8070	15+730	N	OK	OK	90	90	OK	OK	90	90
8082	15+764	N	OK	OK	90	90	OK	OK	90	90
ENTRANCE	15+829	N	260	OK	80	90	285	OK	85	90
8114	15+865	N	250	OK	80	90	280	OK	85	90
8211	16+069	S	OK	OK	90	90	OK	OK	90	90
ENTRANCE	16+100	N	OK	285	90	85	OK	295	90	85
ENTRANCE	16+187	N	OK	OK	90	90	OK	OK	90	90
8260	16+230	N	OK	OK	90	90	OK	OK	90	90
6282	16+300	N	OK	OK	90	90	OK	OK	90	90
ENTRANCE	16+335	N	OK	OK	90	90	OK	OK	90	90
ENTRANCE	16+470	S	OK	OK	90	90	OK	OK	90	90

TURNING SIGHT DISTANCE REQUIREMENTS - TAC FIGURE 2.3.3.4

DESIGN SPEED	TURN SIGHT DISTANCE
90	305
85	275
80	250
75	225
70	200
65	177.5
60	160

MEETS LESS THAN 80KMH DESIGN SPEED (pink)

MEETS LESS THAN 90KMH DESIGN SPEED (yellow)

APPENDIX P

TRAFFIC NOISE IMPACT

Road Traffic Noise Assessment for Mayfield Road Improvements Class EA Study Airport Road to Coleraine Drive

Prepared for:
Region of Peel

Prepared by:
Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7

April 4, 2013

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1.0 Introduction

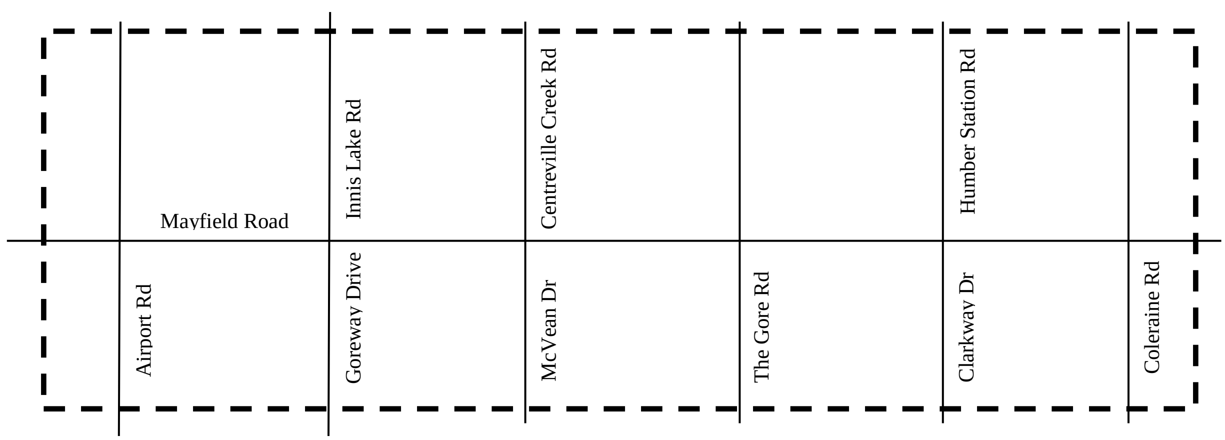
Stantec Consulting Limited (Stantec) was retained by the Region of Peel to prepare a road traffic noise assessment for dwellings along Mayfield Road between Airport Road and Coleraine Drive. This work was completed in support of a Class Environmental Assessment (EA) for the planned widening of Mayfield Road from 2 lanes to 6 lanes.

This report summarizes the expected noise impacts from the proposed improvements at identified noise sensitive receptors, including the potential impact of construction noise. The need for noise mitigation was assessed based on the requirements of the Regional Municipality of Peel (References 3 and 4) and the Ontario Ministry of Transportation (MTO)/Ministry of the Environment (MOE) noise protocol (Reference 1).

1.1 SITE DESCRIPTION

Mayfield Road is a regional road under the jurisdiction of the Region of Peel. Mayfield Road is on the boundary between the City of Brampton (south) and the Town of Caledon (north). The proposed Mayfield Road widening is planned along an approximately 10km section between Airport Road and Coleraine Drive. A schematic of the Class EA study area is provided as **Figure 1**.

Figure 1 Schematic of Study Area



2.0 Environmental Noise Guidelines

Environmental noise is typically assessed based on noise or sound levels. The term “noise level” refers to the equivalent continuous sound pressure level (L_{EQ}) expressed in A-weighted decibels (dBA referenced to 20µPa) having the same total sound energy as a time-varying sound pressure level over a specified time period. It is also worth noting that, although environmental noise is reported in A-weighted decibels (dBA), the difference between two A-weighted values is reported in decibels (dB).

Road traffic noise assessments for road widenings (under the Class EA process) typically consider outdoor noise levels only. This limitation is a result of the fact that the only practical noise mitigation measure under such circumstances are retrofit noise barriers as alterations to existing residential building envelopes is not considered practically feasible. Therefore this road traffic noise assessment is limited to assessing outdoor living areas.

The following sections describe the applicable noise guidelines and criteria used in the road traffic noise assessment.

2.1 PROVINCIAL – MOE/MTO PROTOCOL

The MOE does not have a specific noise guideline for the assessment of regional or municipal road improvements, widenings or expansions. However, the MOE does have a protocol with the MTO which relates to road traffic noise assessments of provincial highway improvements (Reference 1). This guideline is typically adopted within Ontario to assess regional and municipal road improvement projects.

The MOE/MTO noise protocol (February 1986) states that if the expected noise impact of implementing the roadway improvements is 5 dB or less, then no mitigation effort is required. If the noise impact is expected to be greater than 5 dB, an investigation into possible noise mitigation measures is required. Noise impact is defined as the difference between the future noise level with and without the proposed roadway improvements. To be economically feasible (cost effective), the protocol states that noise control measures should achieve a minimum attenuation of 5 dB at the outdoor living areas when averaged over the first row of receivers.

The MOE/MTO protocol does not outline the detailed requirements of the noise assessment. However, the protocol does refer to the Ontario Ministry of Transportation and Communication (MTC) Directive A-1, which does outline the specific requirements of noise assessment.

According to Directive A-1 the noise assessment should be based on the 24-hour L_{EQ} noise level. This is appropriate for provincial highways since the day-time (07:00 to 23:00) traffic volume typically accounts for roughly 66 percent of the total daily traffic with the remainder of the traffic occurring during night-time (23:00 to 07:00). However, for regional and municipal roads the majority of the traffic occurs during day-time hours. Thus it is more conservative to assess regional and municipal roads based on the day-time 16-hour L_{EQ} (07:00 to 23:00).

2.2 PROVINCIAL – LU131

The MOE publication LU-131 "Noise Assessment Criteria in Land Use Planning" also provides guidelines for acceptable levels of road traffic noise impacting indoor and outdoor living areas. The acceptable noise level for an outdoor living area as defined in this document is 55 dBA (day-time, 16-hour L_{EQ}), which is consistent with the goal of the original MOE/MTO joint protocol. The MOE guidelines allow an exceedance of up to 5 dB without any mitigation required. When the OLA sound levels exceed 60 dBA (day-time, 16-hour L_{EQ}), physical mitigation will be required to reduce the sound level. There are no night-time sound level criteria for the OLA, as the MOE considers the OLA to be used in the daytime only.

The guidance within LU-131 pertaining to plane of window and interior noise level criteria are not applicable to the Class EA process since mitigation measures are practically limited to consideration of sound barrier walls. These additional criteria are relevant when proposing a new development and noise mitigation can be built into the building envelope via upgraded construction.

2.3 REGION OF PEEL – GUIDELINES FOR ACOUSTICAL REPORTS

The Region of Peel guideline for preparing acoustical reports specifies a criterion for sound level limits at the OLA between the hours of 07:00 and 23:00 (16-hour L_{EQ}) of 55 dBA. The sound level limit may be exceeded by up to 5 dB as noise mitigation costs for reductions less than 5 dB are not considered economically feasible. However, when designing noise barrier walls, the design criteria is 55 dBA and the design should provide the maximum amount of attenuation that is aesthetically, technically, administratively and economically practical.

The guidance within the Region of Peel document pertaining to plane of window and interior noise level criteria are not applicable to the Class EA process since mitigation measures are practically limited to consideration of sound barrier walls. These additional criteria are relevant when proposing a new residential development (as mentioned in Section 1 of the document) and noise mitigation can be built into the building envelope via upgraded construction.

2.4 REGION OF PEEL – NOISE ATTENUATION BARRIERS

The Region of Peel corporate policy W30-04 outlines the specific circumstances under which the Region will consider the construction of noise barriers for existing reverse frontage dwellings. Generally the technical requirements are that the proposed noise barrier would provide at minimum a 5dB reduction in sound levels, and that all dwellings considered must be reverse frontage onto a regional road.

2.5 CITY OF BRAMPTON – NOISE ATTENUATION POLICY

The City of Brampton released a report in October 2007 entitled 'Noise Attenuation – Retrofit Policy and Road Widenings'. This document specifically addresses the noise levels calculated from proposed road widening within the City. According to this document, noise attenuation will be considered for OLAs for existing residential properties when the noise levels are predicted to be above 60 dBA (16-hour L_{EQ}) and only if a reduction of 5 dB or more can be achieved for the 16 hour period between 07:00 and 23:00.

In the event that a noise wall is proposed to attenuate levels at residential properties adjacent to the road widening, the funding would be provided as part of the Capital Road project (per the City's six-lane widening policy).

2.6 PERCEPTION OF INCREASE IN SOUND LEVEL

Increases in noise level can be ranked as shown in **Table 1** below. This ranking information is based on general practice and is documented within the draft MOE/GO Transit noise and vibration protocol (Reference 8).

Table 1 Perception of Changes in Noise Level

Change in Noise Level (dB)	Perception of Change
0 to less than 3	Insignificant
3 to less than 5	Noticeable
5 to less than 10	Significant
Over 10	Very Significant

3.0 Noise Assessment Methodology

3.1 ROAD AND TRAFFIC DATA

Existing 2006 traffic volumes and future 'build' traffic volumes for the years 2012, 2017 and 2032, for Mayfield Road and Airport Road were provided by iTRANS Consulting Inc. These volumes were supplied in the form of Average Annual Daily Traffic (AADT) counts. The daytime and nighttime traffic splits (90% and 10% respectively) as well as truck percentages were supplied by the Region of Peel. The expected ultimate (design limit) future 'build' AADT for Mayfield Road was also provided by the Region of Peel. The posted speed limit on Mayfield Road is 60kph from Airport Road to Goreway Drive, 80kph from Goreway Drive to The Gore Road, 60kph from The Gore Road to Clarkway Drive and 80kph from Clarkway Drive to Coleraine Drive. The speed limit on Airport Road is 60kph in the vicinity of the Class EA area.

Since future 'no-build' information was not available, the future 'no-build' traffic volumes were based on the 2006 existing traffic volumes projected to the date 2032 using the Region's provided annual growth rates. Additional traffic due to proposed developments in the area was not included in the 'no-build' scenario.

The collected road traffic data is summarized in **Table 2** and the detailed data is included in **Appendix B**. Future 'build' traffic volumes include increases from the road expansion as well as other planned improvements along the corridor.

Table 2 Summary of AADT Road Traffic Data

Roadway	Existing Traffic Volumes	Projected Current Traffic Volumes*	Projected No-Build Traffic Volumes (excl. development traffic) *			Predicted Build Traffic Volumes (incl. development traffic)**			
	2006	2010	2012	2017	**2032**	2012	2017	**2032**	**Ultimate**
Mayfield Road	11660	13641	14754	17103	**23019**	27920	30110	**35590**	**48100**
Airport Road	7214	8119	8614	9510	**11890**	28336	29038	**30855**	-

* Projected future traffic volumes calculated using Region's provided growth rates and exclude proposed development traffic.

** Predicted future traffic volumes from iTrans estimations and include proposed development traffic.

3.2 NOISE MODEL

Road traffic noise levels were assessed using STAMSON V5.04. STAMSON is a computerized implementation of the road and rail traffic noise prediction methods described in ORNAMENT (Ontario Road Noise Analysis Method for Environment and Transportation) and STEAM (Sound from Trains Environmental Analysis Method). STAMSON is an approved noise prediction methodology of the MOE and MTO.

Based on the provided traffic data, daytime noise levels were calculated in the OLAs. The OLA location was selected in the rear yard in accordance with the guideline requirements. Reverse-frontage and side-frontage exposures to Mayfield Road were assessed. Existing noise barriers along Mayfield Road were included in the noise predictions.

The following factors were taken into account in the analysis: Traffic volumes; Vehicle speeds; Truck percentages; Horizontal road-receiver geometry; existing sound barriers; and Ground absorption.

The source-receptor distances were obtained from provided plan drawings as well as aerial imagery. The elevation difference between the road and the receptors was considered to be negligible based on provided cross sections of the road.

Mayfield Road was the dominant source of noise considered in the traffic noise assessment. The noise level contributions from roads crossing Mayfield were neglected (with the exception of R1 which has rear yard exposures to Airport Rd). This is a conservative approach as these secondary noise sources would reduce the significance of noise level changes (impact) due to the widening of Mayfield Road. Mayfield also has the greatest future traffic volume when compared to the roads which cross it. As a further justification of this approach note that since the Mayfield crossings are at grade, traffic can only flow at speed on one of the crossing roadways at any given time.

3.3 LOCATION OF NOISE SENSITIVE AREAS

The focus of this assessment was to predict the noise levels at properties that back onto or side onto Mayfield Road between Airport Road and Coleraine Drive.

Fourteen representative receptors were selected to predict the future noise levels as a result of the proposed Mayfield Road widening. These locations are expected to be the most affected by the noise associated with the roadway improvements. Predicted noise levels were assessed in the OLA of each receptor location. The OLA locations were modelled as 1.5 m high and 3 m horizontally from the rear wall of the residence. Other residences with similar setback and orientation to the noise source will receive similar sound exposure and noise impacts. **Table 3** summarizes the receptor numbers and their locations and illustrations of their locations are provided in **Appendix A**.

Table 3 Receptor Locations

Location	Datum	Zone	Northing (m)	Easting (m)
R1	WGS84	17T	4,849,543	599,946
R2	WGS84	17T	4,849,704	600,074
R3	WGS84	17T	4,849,736	600,116
R4	WGS84	17T	4,849,812	600,162
R5	WGS84	17T	4,849,866	600,207
R6	WGS84	17T	4,849,976	600,294
R7	WGS84	17T	4,850,077	600,375
R8	WGS84	17T	4,850,467	600,739
R9	WGS84	17T	4,851,570	601,381
R10	WGS84	17T	4,851,691	601,467
R11A	WGS84	17T	4,852,555	602,352
R11B	WGS84	17T	4,852,745	602,317
R12	WGS84	17T	4,852,905	602,626
R13	WGS84	17T	4,852,961	602,716
R14	WGS84	17T	4,854,888	604,027

4.0 Results

4.1 MODELLING RESULTS

The future 'no-build' traffic volumes were based on the existing 2006 traffic volumes projected to the year 2032 using annual growth rates supplied by the Region of Peel. The future 'build' traffic volume for Mayfield Road was the ultimate traffic volume provided by the Region of Peel. The future 'build' traffic volume for Airport Road was based on the predicted worst-case value for the year 2032 (supplied by iTrans). The predicted average sound levels for the 'no-build' and 'build' scenarios are summarized in **Table 4**. Sample model output files are included in **Appendix C**.

Table 4 Noise Level Predictions

Location	Future 'No-build' Daytime (16-hr) L_{EQ} (dBA)	Future 'Build' Daytime (16-hr) L_{EQ} (dBA)	Change in Sound Level (dB)	5 dB or Greater Increase? (Yes/No)	Above 60 dBA Criterion? (Yes/No)
R1	61.80	65.15	3.35	No	Yes
R2	61.50	64.81	3.31	No	Yes
R3	59.91	63.18	3.27	No	Yes
R4	61.45	64.76	3.31	No	Yes
R5	61.29	64.59	3.30	No	Yes
R6	61.45	64.76	3.31	No	Yes
R7	61.21	64.51	3.30	No	Yes
R8	63.08	66.31	3.23	No	Yes
R9	61.52	64.74	3.22	No	Yes
R10	61.52	64.74	3.22	No	Yes
R11A	66.62	69.90	3.28	No	Yes
R11B	62.11	65.33	3.22	No	Yes
R12	64.62	67.90	3.28	No	Yes
R13	60.68	63.91	3.23	No	Yes
R14	63.72	66.96	3.24	No	Yes

Note: Future 'no-build' traffic volumes were based on growth projected 2032 AADT values. Future 'build' scenario traffic volumes were based on the ultimate AADT for Mayfield and the 2032 estimated volume for Airport Rd.

As the predicted change in noise levels are less than 5 dB in all cases, mitigation does not need to be investigated according to the MOE/MTO protocol. However, the predicted future 'build' levels do exceed 60dBA and in accordance with the Region of Peel Guidelines and City of Brampton policies noise mitigation (noise attenuation barriers) should be considered.

The predicted future 'build' increases in noise levels at the OLAs associated with increased traffic on Mayfield Road would result in at most a just noticeable (under 5dB) increase in noise levels at the assessed receptors when compared to the future 'no build' predicted noise levels.

4.2 MITIGATION RECOMMENDATIONS

Mitigation is not required on the basis of the predicted change in noise levels (i.e., predicted change is less than 5dB). The changes predicted at most represent a just noticeable change in sound levels. However, given the predicted excess over 60dBA, it is recommended that noise mitigation be considered where feasible. The table below (**Table 5**) shows the noise barrier height required to achieve: a 5db reduction, 60dBA noise level and 55dBA noise level. The noise barrier location was assumed to be the existing noise barrier location for R1 to R7 (reverse-frontage) and within the Mayfield right-of-way for R8 to R14 (side-frontage).

Table 5 Noise Barrier Table

Location	Future 'Build' Daytime (16-hr) L_{EQ} (dBA)	Barrier Height (m) to achieve 5dB reduction	Barrier Height (m) to achieve 60dBA noise level	Barrier Height (m) to achieve 55dBA noise level	Noise Exposure
R1	65.15	5.0	5.0	more than 9.0	Rev. Frontage
R2	64.81	4.0	4.0	more than 9.0	Rev. Frontage
R3	63.18	5.0	4.0	more than 9.0	Rev. Frontage
R4	64.76	4.0	4.0	more than 9.0	Rev. Frontage
R5	64.59	4.5	4.0	more than 9.0	Rev. Frontage
R6	64.76	4.0	4.0	more than 9.0	Rev. Frontage
R7	64.51	4.5	4.0	more than 9.0	Rev. Frontage
R8	66.31	3.0	3.5	8.0	Side Frontage
R9	64.74	3.5	3.0	6.5	Side Frontage
R10	64.74	3.5	3.0	6.5	Side Frontage
R11A	69.90	2.5	5.0	more than 9.0	Side Frontage
R11B	65.33	3.0	3.0	7.0	Side Frontage
R12	67.90	2.5	4.0	8.0	Side Frontage
R13	63.91	3.0	2.0	5.0	Side Frontage
R14	66.96	3.0	4.0	more than 9.0	Side Frontage

4.2.1 Reverse-Frontage Lots (R1 to R7)

Since noise levels in the OLAs of R1 to R7 are predicted to exceed 60 dBA, consideration should be given to modifying the existing noise barrier fence for these reverse-frontage homes as part of the road widening.

The existing 2.0m high noise barrier located along the rear of the reverse-frontage properties on Mayfield Road is predicted to be providing a 3-5dB reduction in sound levels in the OLAs. This model assumes that this is an appropriately constructed noise wall to achieve noise attenuation at the receptors (i.e., free of gaps and holes, and of sufficient mass – 20kg/m^2).

The results from **Table 5** indicate that increasing the existing noise barrier height to approximately 4.0m is predicted to decrease average noise levels in the OLAs of these reverse-frontage homes to less than 60 dBA and provide an additional 5dB of attenuation over existing conditions. Therefore, replacement or retrofit of the existing noise barrier with a 4.0m high noise barrier would result in noise level decreases of approximately 5dB for the area represented by R1 to R7. Noise mitigation achieving more than 5dB of attenuation are generally considered economically feasible according to both the MOE/MTO noise protocol and the Region of Peel guidelines. However, the predicted impacts of 3dB do not warrant consideration of noise mitigation according to the MOE/MTO protocol. Under the Region of Peel corporate policy W30-04 these locations may qualify under the noise technical criteria for the local improvement process. However, the local improvement process has other non-technical requirements to initiate construction and funding of retrofit noise barriers.

A noise barrier higher than 9.0m is necessary to approach the provincial policy objective of 55 dBA. Noise barriers of this height (greater than 9.0m) are not considered to be practically or economically feasible.

4.2.2 Side-Frontage Lots (R8 to R14)

Since noise levels in the OLAs of R8 to R14 are predicted to exceed 60 dBA, consideration should be given to incorporating noise barriers into the proposed road widening to reduce noise levels.

The results from **Table 5** indicate that noise barriers located within the Mayfield right-of-way (ROW) with heights of 4.0m are predicted to decrease average noise levels in the OLAs of these side-frontage homes to less than 60 dBA (with the exception of R11A) and provide an additional 5dB of attenuation over existing conditions. In order to be effective barrier returns into the subject properties or adjacent rights-of-way may be required particularly at intersections, the details of which should be assessed during the detailed design of the road widening and adjacent developments. Noise mitigation achieving more than 5dB of attenuation are generally considered economically feasible according to both the MOE/MTO noise protocol and the Region of Peel guidelines. However, the predicted impacts of 3dB do not warrant consideration of noise mitigation according to the MOE/MTO protocol. Under the Region of Peel corporate policy W30-04 these properties may qualify under the noise technical criteria for the local improvement process. However, the local improvement process has other non-technical requirements to initiate construction and funding of retrofit noise barriers.

Noise barriers with heights in excess of 5.0m would be required to approach the provincial policy objective of 55 dBA. Noise barriers in excess of 4.0m are not considered to be feasible according to the Peel Region noise guidelines, except in “extreme” situations.

4.2.3 Mitigation Verification and Detailed Design

At this stage recommendations for noise mitigation are conceptual in nature. The results presented in **Table 5** should be used as a guide during detailed design. During detailed design the feasible locations, extents and heights shall be determined and the noise mitigation benefit should be re-assessed using detailed information from the design process.

5.0 Construction Noise

5.1 LOCAL BY-LAWS

The Brampton Noise By-Law 93-84 of the Corporation of the City of Brampton states that any sound arising from road work and road improvements undertaken by or on behalf of the Ministry of Transportation (Ontario) or the Region of Peel (202-2006) are specifically permitted and the presence of these sounds and noises is not to be considered a contravention of the By-Law.

The Caledon Noise By-Law 86-110, Section 3, Act 15 prohibits the operation of any equipment in connection with construction between the hours of 11:00pm and 6:00am the following day.

5.2 MOE SOUND EMISSION STANDARDS

MOE Publication NPC-115 provides sound emission standards for various types of construction equipment. Due to the temporary and unavoidable nature of construction, these MOE guidelines stipulate limits on individual pieces of equipment instead of a site limit. **Table 5** illustrates maximum noise emission levels which should be adhered to for typical construction equipment per NPC-115.

Table 6 NPC-115 Noise Emission Limits for Construction Equipment

Type of Equipment	Maximum Sound Level (dBA) *	Power Rating (kW)
Excavation equipment, bulldozers, loaders, backhoes or other equipment	83	less than 75
	85	75 and greater
Pneumatic Pavement Breakers	85	-
Portable Air Compressors	70	-

* Maximum Sound Level (dBA) as determined using Publication NPC – 103 – Procedures, Section 6

6.0 Conclusions

The results of the noise assessment indicated that the reverse-frontage and side-frontage dwellings assessed on Mayfield Road **(see Appendix A)** are predicted to experience noise level increases of less than 5dB. Therefore, in accordance with the MOE/MTO protocol consideration of noise mitigation is not a requirement under that guideline. Further the predicted change in noise levels would result in a 'noticeable' (**see Table 1**) change between the future 'no-build' and 'build' scenarios.

However, the noise assessment also indicated that the noise levels would exceed 60dBA for the future 'build' scenario. Therefore, according to the Region of Peel and the City of Brampton noise guidelines, noise mitigation should be considered during detailed design of the Mayfield Road widening.

7.0 Closure

This report has been prepared on behalf of the Region of Peel by Stantec Consulting Ltd. The assessment represents the conditions of the subject property at the time of assessment, and is based on the information referenced and contained in the report. Stantec Consulting Ltd. attests that to the best of our knowledge, the information presented in this report is accurate.

Respectfully Submitted,

STANTEC CONSULTING LTD.

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2. Ontario Ministry of Transportation and Communications. Directive A-1: Noise Policy and Acoustic Standards for Provincial Highways. February 1992.

3. Region of Peel. General Guidelines for the Preparation of Acoustical Reports in the Region of Peel. December 2002.

4. Region of Peel. Noise Attenuation Barriers. Policy No: W30-04. June 1996.

5. The Corporation of the City of Brampton. Noise Attenuation – Retrofit Policy and Road Widenings. October 2007.

6. The Corporation of the City of Brampton. Noise By-Law 93-84, April 25, 1984.

7. The Corporation of the Town of Caledon. By-Law No. 86-110, September 2005.

8. MOEE/GO Transit. Noise and Vibration Protocol. January 1995 (Draft #9).

9. Ontario Ministry of the Environment. Ontario Road Noise Analysis Method for Environment and Transportation, ORNAMENT. October 1989.iTrans. Regional Municipality of Peel: Mayfield Road EA (Airport Road to Coleraine Drive) Traffic Study. June 2009.

Appendix A Receptor Locations Maps

Google Earth Pro

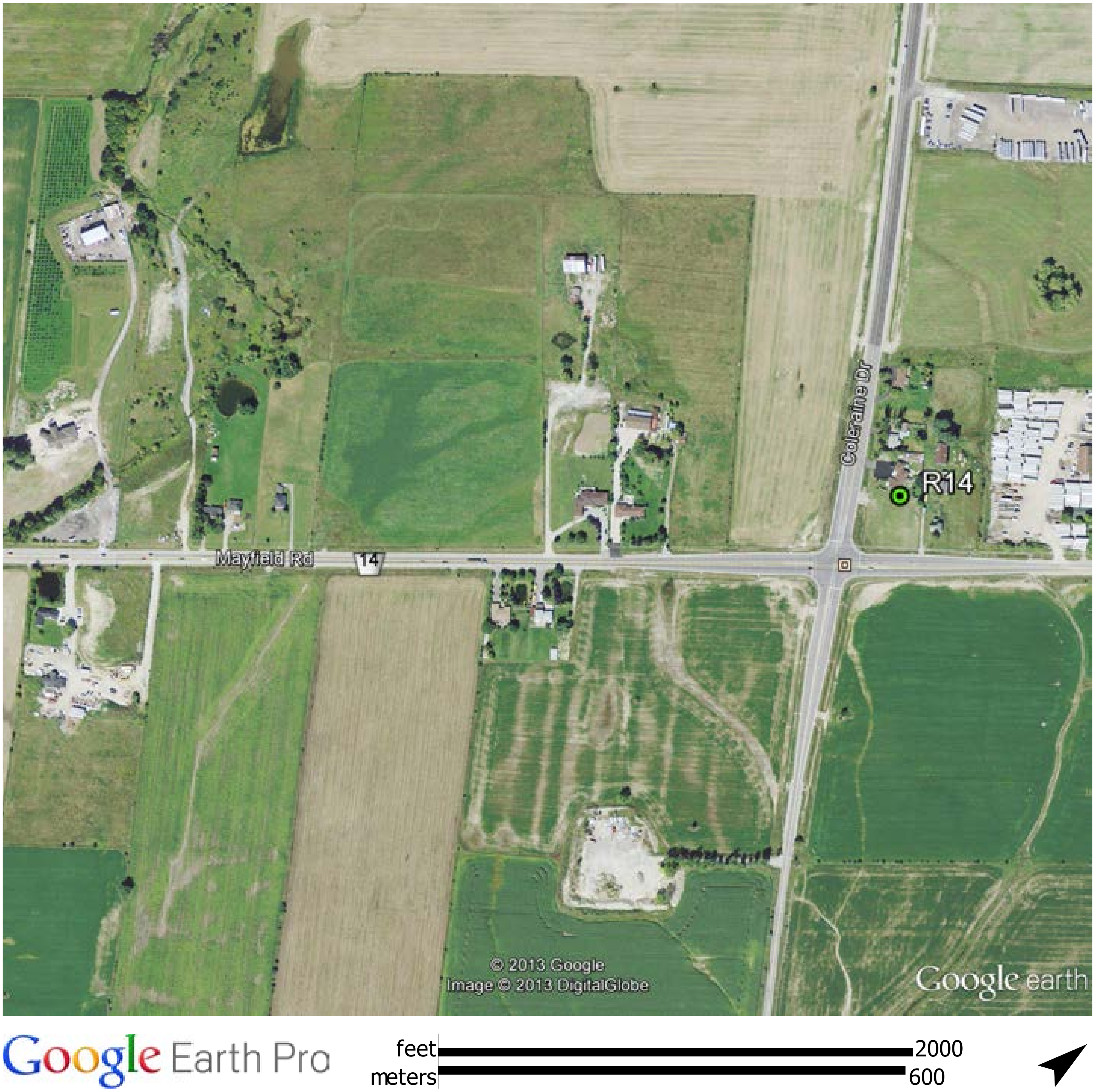
feet 2000
meters 600


Innis Lake Rd
R7
Mayfield Rd
14
R8
St Hubert Dr
Lucinda Ct
Goreway Dr
Billancourt Crescent
Odeon St
© 2013 Google
Image © 2013 DigitalGlobe
Google earth
Google Earth Pro
feet 2000
meters 600

Google Earth Pro

feet 2000
meters 600

The Gore Rd
R11B
Wildfield
Mayfield Rd
R12
R11A
8
R13
© 2013 Google
Image © 2013 DigitalGlobe
Google earth
Google Earth Pro
feet
2000
meters
600


Mayfield Rd
14
Coleraine Dr
R14
© 2013 Google
Image © 2013 DigitalGlobe
Google earth
feet
2000
meters
600

Appendix B Stamson Input Data and Results

AADT TRAFFIC DATA (From iTRANS Report)

		Existing Traffic Numbers *	Projected Current Traffic Numbers	Future No Build ** (Growth Rates Only)			Future Build*** (iTrans Total Traffic incl. Developments)			Data from Peel Region
	Speed Limit (km/h)	**2006**	**2010**	**2012**	**2017**	**2032**	**2012**	**2017**	**2032**	**Ultimate**
Mayfield Road ***	60 - 80	11660	13641	14754	17103	**23019**	27920	30110	35590	**48100**
Airport Road	60	7214	8119	8614	9510	**11890**	28336	29038	**30855**	-

* 2006 Airport Road numbers calculated from exhibit 2 of the iTrans traffic study

** Future 'No Build' traffic calculated using provided growth rates

*** Mayfield road EB and WB traffic assumed split 50/50 from total AADT

Mayfield ultimate AADT provided by the Region of peel

Growth Rates from Region of Peel

Years	Mayfield	N-S junctions
2007-2012	4.0%	3.0%
2012-2017	3.0%	2.0%
2017-2032	2.0%	1.5%

Data from iTrans report

TRUCK PERCENTAGES (from Region of Peel)

		2006	**2010**	**2012**	**2017**	**2032**	**2012**	**2017**	**2032**	**Ultimate**
Mayfield Road	% Trucks	17.0%	17.0%	19.0%	19.0%	**19.0%**	19.0%	19.0%	**19.0%**	**19.0%**
	Medium Truck %	11.1%	11.1%	5.7%	5.7%	**5.7%**	5.7%	5.7%	**5.7%**	**5.7%**
	Heavy Truck %	6.0%	6.0%	13.3%	13.3%	**13.3%**	13.3%	13.3%	**13.3%**	**13.3%**
Airport Road	% Trucks	8.0%	8.0%	10.0%	10.0%	**10.0%**	10.0%	10.0%	**10.0%**	**10.0%**
	Medium Truck %	2.4%	2.4%	3.0%	3.0%	**3.0%**	3.0%	3.0%	**3.0%**	**3.0%**
	Heavy Truck %	5.6%	5.6%	7.0%	7.0%	**7.0%**	7.0%	7.0%	**7.0%**	**7.0%**

Airport Road per Region of Peel: Total Trucks now: 8% future: 10% ratio of medium to heavy trucks (30/70)

Mayfield Road per Region of Peel: Total Trucks now: 17% future: 19% ratio of medium to heavy trucks (65/35 then 30/70)

FUTURE 'NO BUILD' NOISE LEVEL PREDICTIONS

RECEIVER	SCENARIO	FILE	SOURCE	Road Gradient %	Road Pavement Type	Speed (kph)	θ1	θ2	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Receiver Distance (m)	Existing Barrier Height (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)			Barrier Table - Barrier Height (m) and Resultant Noise Levels (dBA)														
																								EX	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0
R1	Future 'No Build'	fnbr1.te	Mayfield Rd	<2	1	60	-90	90	-	-	-	1	1.5	40	-90	90	14	2	-	-	-	-	Seg Leq (dBA):	61.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Airport Road	<2	1	60	-90	90	-	-	-	1	1.5	211	-	-	-	-	-	-	-	-	Seg Leq (dBA):	48.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**61.80**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R2	Future 'No Build'	fnbr2.te	Mayfield Rd	<2	1	60	-90	90	-	-	-	1	1.5	39.5	-90	90	9	2	-	-	-	-	Seg Leq (dBA):	61.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**61.50**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R3	Future 'No Build'	fnbr3.te	Mayfield Rd	<2	1	60	-90	90	-	-	-	1	1.5	52	-90	90	22	2	-	-	-	-	Seg Leq (dBA):	59.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**59.91**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R4	Future 'No Build'	fnbr4.te	Mayfield Rd	<2	1	60	-90	90	-	-	-	1	1.5	40	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	61.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**61.45**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R5	Future 'No Build'	fnbr5.te	Mayfield Rd	<2	1	60	-90	90	-	-	-	1	1.5	41	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	61.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**61.29**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R6	Future 'No Build'	fnbr6.te	Mayfield Rd	<2	1	60	-90	90	-	-	-	1	1.5	40	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	61.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**61.45**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R7	Future 'No Build'	fnbr7.te	Mayfield Rd	<2	1	60	-90	90	-	-	-	1	1.5	41.5	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	61.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**61.21**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																									-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R8	Future 'No Build'	fnbr8.te	Mayfield Rd	<2	1	80	-90	90	-	-	-	1	1.5	82	-90	90	69.5	0	-	-	-	-	Seg Leq (dBA):	63.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**63.08**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R9	Future 'No Build'	fnb9.te	Mayfield Rd	<2	1	80	-90	90	-	-	-	1	1.5	102	-90	90	89.5	0	-	-	-	-	Seg Leq (dBA):	61.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(R10 same as R9)																							**Total Leq (dBA):**	**61.52**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R11A	Future 'No Build'	fnb11A.te	Mayfield Rd	<2	1	80	-90	90	-	-	-	1	1.5	50	-90	90	37.5	0	-	-	-	-	Seg Leq (dBA):	66.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**66.62**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R11B	Future 'No Build'	fnb11B.te	Mayfield Rd	<2	1	80	-90	90	-	-	-	1	1.5	94	-90	90	86	0	-	-	-	-	Seg Leq (dBA):	62.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**62.11**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R12	Future 'No Build'	fnb12.te	Mayfield Rd	<2	1	60	-90	90	-	-	-	1	1.5	49	-90	90	36.5	0	-	-	-	-	Seg Leq (dBA):	64.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**64.62**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R13	Future 'No Build'	fnb13.te	Mayfield Rd	<2	1	60	-90	90	-	-	-	1	1.5	85	-90	90	72.5	0	-	-	-	-	Seg Leq (dBA):	60.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**60.68**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R14	Future 'No Build'	fnb14.te	Mayfield Rd	<2	1	80	-90	90	-	-	-	1	1.5	75	-90	90	62.5	0	-	-	-	-	Seg Leq (dBA):	63.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Total Leq (dBA):	**63.72**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																							Delta (dB):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

FUTURE 'BUILD' NOISE LEVEL PREDICTIONS

RECEIVER	SCENARIO	FILE	SOURCE	Road Gradient %	Road Pavement Type	Speed (kph)	θ1	θ2	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Receiver Distance (m)	Existing Barrier Height (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)			Barrier Table - Barrier Height (m) and Resultant Noise Levels (dBA)														
																								EX	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0
R1	Future Build	fbr1BA.te	MF Rd WB	<2	1	60	-90	90	-	-	-	1	1.5	44.5	-90	90	14	2	-	-	-	-	Seg Leq (dBA):	61.04	61.04	60.33	59.29	58.22	57.23	56.37	55.62	54.96	54.39	53.88	53.42	53.13	52.87	52.70	52.58
			MF Rd EB	<2	1	60	-90	90	-	-	-	1	1.5	35.5	-90	90	14	2	-	-	-	-	Seg Leq (dBA):	62.56	62.56	61.75	60.59	59.42	58.35	57.42	56.62	55.91	55.29	54.73	54.23	53.97	53.71	53.53	53.40
			Airport Road	<2	1	60	-90	90	-	-	-	1	1.5	211	-	-	-	-	-	-	-	-	Seg Leq (dBA):	53.01	53.01	53.01	53.01	53.01	53.01	53.01	53.01	53.01	53.01	53.01	53.01	53.01	53.01	53.01	53.01
																							Total Leq (dBA):	**65.15**	**65.15**	**64.43**	**63.41**	**62.40**	**61.50**	**60.74**	**60.10**	**59.56**	**59.10**	**58.70**	**58.35**	**58.16**	**57.98**	**57.86**	**57.78**
																							Delta (dB):	**-**	**0.00**	**-0.72**	**-1.74**	**-2.75**	**-3.65**	**-4.41**	**-5.05**	**-5.59**	**-6.05**	**-6.45**	**-6.80**	**-6.99**	**-7.17**	**-7.29**	**-7.37**
R2	Future Build	fbr2BA.te	MF Rd WB	<2	1	60	-90	90	-	-	-	1	1.5	44	-90	90	9	2	-	-	-	-	Seg Leq (dBA):	60.97	60.97	59.95	58.68	57.47	56.41	55.51	54.73	54.06	53.48	52.96	52.68	52.43	52.26	52.15	52.09
			MF Rd EB	<2	1	60	-90	90	-	-	-	1	1.5	35	-90	90	9	2	-	-	-	-	Seg Leq (dBA):	62.50	62.50	61.41	60.06	58.77	57.66	56.71	55.89	55.17	54.55	53.99	53.72	53.46	53.27	53.13	53.05
																							Total Leq (dBA):	**64.81**	**64.81**	**63.75**	**62.43**	**61.18**	**60.09**	**59.16**	**58.36**	**57.66**	**57.06**	**56.52**	**56.24**	**55.99**	**55.80**	**55.68**	**55.61**
																							Delta (dB):	**-**	**0.00**	**-1.06**	**-2.38**	**-3.63**	**-4.72**	**-5.65**	**-6.45**	**-7.15**	**-7.75**	**-8.30**	**-8.57**	**-8.83**	**-9.01**	**-9.13**	**-9.21**
R3	Future Build	fbr3BA.te	MF Rd WB	<2	1	60	-90	90	-	-	-	1	1.5	56.5	-90	90	22	2	-	-	-	-	Seg Leq (dBA):	59.55	59.55	59.12	58.37	57.52	56.69	55.93	55.26	54.67	54.16	53.70	53.30	52.93	52.61	52.32	52.27
			MF Rd EB	<2	1	60	-90	90	-	-	-	1	1.5	47.5	-90	90	22	2	-	-	-	-	Seg Leq (dBA):	60.71	60.71	60.21	59.36	58.41	57.50	56.68	55.96	55.32	54.76	54.27	53.82	53.43	53.07	52.93	52.77
																							Total Leq (dBA):	**63.18**	**63.18**	**62.71**	**61.90**	**61.00**	**60.12**	**59.33**	**58.63**	**58.02**	**57.48**	**57.00**	**56.58**	**56.20**	**55.86**	**55.65**	**55.54**
																							Delta (dB):	**-**	**0.00**	**-0.47**	**-1.28**	**-2.18**	**-3.05**	**-3.85**	**-4.54**	**-5.16**	**-5.70**	**-6.17**	**-6.60**	**-6.98**	**-7.32**	**-7.53**	**-7.64**
R4	Future Build	fbr4BA.te	MF Rd WB	<2	1	60	-90	90	-	-	-	1	1.5	44.5	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	60.93	60.93	60.00	58.79	57.61	56.58	55.69	54.92	54.26	53.67	53.16	52.83	52.56	52.37	52.24	52.17
			MF Rd EB	<2	1	60	-90	90	-	-	-	1	1.5	35.5	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	62.44	62.44	61.44	60.14	58.89	57.80	56.85	56.04	55.33	54.70	54.15	53.83	53.54	53.34	53.19	53.10
																							Total Leq (dBA):	**64.76**	**64.76**	**63.79**	**62.53**	**61.31**	**60.24**	**59.32**	**58.53**	**57.84**	**57.23**	**56.69**	**56.37**	**56.09**	**55.89**	**55.75**	**55.67**
																							Delta (dB):	**-**	**0.00**	**-0.97**	**-2.23**	**-3.45**	**-4.52**	**-5.44**	**-6.23**	**-6.92**	**-7.53**	**-8.07**	**-8.39**	**-8.67**	**-8.87**	**-9.01**	**-9.09**
R5	Future Build	fbr5BA.te	MF Rd WB	<2	1	60	-90	90	-	-	-	1	1.5	45.5	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	60.78	60.78	59.86	58.66	57.49	56.46	55.57	54.81	54.15	53.57	53.06	52.73	52.46	52.27	52.15	52.08
			MF Rd EB	<2	1	60	-90	90	-	-	-	1	1.5	36.5	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	62.26	62.26	61.27	59.98	58.74	57.65	56.71	55.90	55.20	54.58	54.03	53.71	53.42	53.22	53.08	52.99
																							Total Leq (dBA):	**64.59**	**64.59**	**63.63**	**62.38**	**61.17**	**60.11**	**59.19**	**58.40**	**57.72**	**57.11**	**56.58**	**56.26**	**55.98**	**55.78**	**55.65**	**55.57**
																							Delta (dB):	**-**	**0.00**	**-0.96**	**-2.21**	**-3.42**	**-4.49**	**-5.41**	**-6.19**	**-6.88**	**-7.48**	**-8.01**	**-8.34**	**-8.62**	**-8.81**	**-8.94**	**-9.02**
R6	Future Build	fbr6BA.te	MF Rd WB	<2	1	60	-90	90	-	-	-	1	1.5	44.5	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	60.93	60.93	60.00	58.79	57.61	56.58	55.69	54.92	54.26	53.67	53.16	52.83	52.56	52.37	52.24	52.17
			MF Rd EB	<2	1	60	-90	90	-	-	-	1	1.5	35.5	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	62.44	62.44	61.44	60.14	58.89	57.80	56.85	56.04	55.33	54.70	54.15	53.83	53.54	53.34	53.19	53.10
																							Total Leq (dBA):	**64.76**	**64.76**	**63.79**	**62.53**	**61.31**	**60.24**	**59.32**	**58.53**	**57.84**	**57.23**	**56.69**	**56.37**	**56.09**	**55.89**	**55.75**	**55.67**
																							Delta (dB):	**-**	**0.00**	**-0.97**	**-2.23**	**-3.45**	**-4.52**	**-5.44**	**-6.23**	**-6.92**	**-7.53**	**-8.07**	**-8.39**	**-8.67**	**-8.87**	**-9.01**	**-9.09**
R7	Future Build	fbr7BA.te	MF Rd WB	<2	1	60	-90	90	-	-	-	1	1.5	46	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	60.71	60.71	59.79	58.59	57.42	56.39	55.51	54.75	54.09	53.52	53.01	52.68	52.41	52.22	52.10	52.03
			MF Rd EB	<2	1	60	-90	90	-	-	-	1	1.5	37	-90	90	10	2	-	-	-	-	Seg Leq (dBA):	62.17	62.17	61.18	59.90	58.66	57.58	56.64	55.84	55.14	54.52	53.97	53.65	53.37	53.16	53.02	52.93
																							Total Leq (dBA):	**64.51**	**64.51**	**63.55**	**62.30**	**61.09**	**60.04**	**59.12**	**58.34**	**57.66**	**57.06**	**56.53**	**56.20**	**55.93**	**55.73**	**55.59**	**55.51**
																							Delta (dB):	**-**	**0.00**	**-0.96**	**-2.21**	**-3.42**	**-4.48**	**-5.39**	**-6.17**	**-6.85**	**-7.45**	**-7.98**	**-8.31**	**-8.58**	**-8.79**	**-8.92**	**-9.00**
R8	Future Build	fbr8BA.te	MF Rd WB	<2	1	80	-90	90	-	-	-	1	1.5	86.5	-90	90	69.5	-	-	-	-	-	Seg Leq (dBA):	62.89	58.98	58.78	58.18	57.41	56.63	55.90	55.27	54.71	54.23	53.82	53.46	53.15	52.88	52.64	52.58
			MF Rd EB	<2	1	80	-90	90	-	-	-	1	1.5	77.5	-90	90	69.5	-	-	-	-	-	Seg Leq (dBA):	63.68	59.70	59.17	58.06	56.87	55.80	54.89	54.13	53.49	52.94	52.47	52.07	51.94	51.81	51.75	51.74
			Sum																				**Total Leq (dBA):**	**66.31**	**62.37**	**61.99**	**61.13**	**60.16**	**59.25**	**58.43**	**57.75**	**57.15**	**56.64**	**56.21**	**55.83**	**55.60**	**55.39**	**55.23**	**55.19**
																							Delta (dB):	**-**	**-3.95**	**-4.32**	**-5.18**	**-6.15**	**-7.07**	**-7.88**	**-8.57**	**-9.16**	**-9.67**	**-10.11**	**-10.48**	**-10.72**	**-10.93**	**-11.09**	**-11.12**
R9	Future Build	fb9BA.te	MF Rd WB	<2	1	80	-90	90	-	-	-	1	1.5	97.5	-90	90	89.5	-	-	-	-	-	Seg Leq (dBA):	62.04	58.19	57.71	56.66	55.51	54.48	53.61	52.88	52.27	51.75	51.32	50.95	50.83	50.72	50.68	50.70
(R10 same as R9)			MF Rd EB	<2	1	80	-90	90	-	-	-	1	1.5	106.5	-90	90	89.5	-	-	-	-	-	Seg Leq (dBA):	61.40	57.61	57.47	56.93	56.22	55.49	54.81	54.20	53.68	53.23	52.85	52.52	52.24	52.00	51.80	51.74
																							Total Leq (dBA):	**64.74**	**60.92**	**60.60**	**59.81**	**58.89**	**58.02**	**57.26**	**56.60**	**56.04**	**55.56**	**55.16**	**54.82**	**54.60**	**54.42**	**54.29**	**54.26**
																							Delta (dB):	**-**	**-3.82**	**-4.14**	**-4.93**	**-5.85**	**-6.72**	**-7.48**	**-8.14**	**-8.70**	**-9.18**	**-9.58**	**-9.93**	**-10.14**	**-10.32**	**-10.46**	**-10.48**
R11A	Future Build	fb11ABA.te	MF Rd WB	<2	1	80	-90	90	-	-	-	1	1.5	54.5	-90	90	37.5	-	-	-	-	-	Seg Leq (dBA):	66.20	62.01	61.62	60.82	59.89	58.98	58.16	57.44	56.81	56.25	55.77	55.33	54.95	54.61	54.47	54.32
			MF Rd EB	<2	1	80	-90	90	-	-	-	1	1.5	45.5	-90	90	37.5	-	-	-	-	-	Seg Leq (dBA):	67.49	63.21	62.49	61.22	59.90	58.74	57.75	56.91	56.19	55.56	55.01	54.70	54.43	54.25	54.14	54.07
																							Total Leq (dBA):	**69.90**	**65.66**	**65.09**	**64.03**	**62.91**	**61.87**	**60.97**	**60.19**	**59.52**	**58.93**	**58.42**	**58.04**	**57.71**	**57.44**	**57.32**	**57.21**
																							Delta (dB):	**-**	**-4.24**	**-4.82**	**-5.87**	**-7.00**	**-8.03**	**-8.93**	**-9.71**	**-10.38**	**-10.97**	**-11.49**	**-11.87**	**-12.19**	**-12.46**	**-12.58**	**-12.70**
R11B	Future Build	fb11BBA.te	MF Rd WB	<2	1	80	-90	90	-	-	-	1	1.5	89.5	-90	90	81.5	-	-	-	-	-	Seg Leq (dBA):	62.65	58.75	58.26	57.18	56.02	54.97	54.09	53.35	52.72	52.20	51.75	51.37	51.25	51.13	51.08	51.09
			MF Rd EB	<2	1	80	-90	90	-	-	-	1	1.5	98.5	-90	90	81.5	-	-	-	-	-	Seg Leq (dBA):	61.96	58.12	57.96	57.40	56.67	55.92	55.22	54.61	54.07	53.61	53.22	52.88	52.59	52.34	52.12	52.06

FUTURE 'BUILD' NOISE LEVEL PREDICTIONS

RECEIVER	SCENARIO	FILE	SOURCE	Road Gradient %	Road Pavement Type	Speed (kph)	θ1	θ2	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Receiver Distance (m)	Existing Barrier Height (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)			Barrier Table - Barrier Height (m) and Resultant Noise Levels (dBA)														
																								EX	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0
																							Total Leq (dBA):	**65.33**	**61.46**	**61.12**	**60.30**	**59.37**	**58.48**	**57.70**	**57.04**	**56.46**	**55.97**	**55.56**	**55.20**	**54.98**	**54.79**	**54.64**	**54.61**
																							Delta (dB):	**-**	**-3.87**	**-4.21**	**-5.03**	**-5.96**	**-6.85**	**-7.63**	**-8.29**	**-8.87**	**-9.36**	**-9.77**	**-10.13**	**-10.35**	**-10.54**	**-10.69**	**-10.72**
R12	Future Build	fb12BA.te	MF Rd WB	<2	1	60	-90	90	-	-	-	1	1.5	53.5	-90	90	36.5	-	-	-	-	-	**Seg Leq (dBA):**	64.18	59.99	59.59	58.78	57.84	56.92	56.10	55.37	54.74	54.18	53.69	53.26	52.87	52.52	52.39	52.24
			MF Rd EB	<2	1	60	-90	90	-	-	-	1	1.5	44.5	-90	90	36.5	-	-	-	-	-	**Seg Leq (dBA):**	65.50	61.21	60.48	59.20	57.88	56.71	55.72	54.87	54.15	53.52	52.97	52.66	52.39	52.20	52.09	52.02
																							Total Leq (dBA):	**67.90**	**63.65**	**63.07**	**62.01**	**60.87**	**59.83**	**58.92**	**58.14**	**57.47**	**56.87**	**56.36**	**55.98**	**55.65**	**55.37**	**55.25**	**55.14**
																							Delta (dB):	**-**	**-4.25**	**-4.83**	**-5.89**	**-7.03**	**-8.07**	**-8.98**	**-9.76**	**-10.43**	**-11.03**	**-11.55**	**-11.92**	**-12.25**	**-12.53**	**-12.65**	**-12.76**
R13	Future Build	fb13BA.te	MF Rd WB	<2	1	60	-90	90	-	-	-	1	1.5	89.5	-90	90	72.5	-	-	-	-	-	**Seg Leq (dBA):**	60.50	56.61	56.42	55.83	55.07	54.30	53.58	52.95	52.40	51.93	51.52	51.16	50.86	50.59	50.36	50.30
			MF Rd EB	<2	1	60	-90	90	-	-	-	1	1.5	80.5	-90	90	72.5	-	-	-	-	-	**Seg Leq (dBA):**	61.26	57.31	56.78	55.68	54.50	53.43	52.53	51.78	51.14	50.60	50.14	49.74	49.62	49.49	49.43	49.42
																							Total Leq (dBA):	**63.91**	**59.98**	**59.61**	**58.77**	**57.80**	**56.90**	**56.10**	**55.41**	**54.83**	**54.33**	**53.89**	**53.52**	**53.29**	**53.09**	**52.93**	**52.89**
																							Delta (dB):	**-**	**-3.92**	**-4.29**	**-5.14**	**-6.10**	**-7.01**	**-7.81**	**-8.49**	**-9.08**	**-9.58**	**-10.01**	**-10.39**	**-10.61**	**-10.82**	**-10.98**	**-11.01**
R14	Future Build	fb14BA.te	MF Rd WB	<2	1	80	-90	90	-	-	-	1	1.5	70.5	-90	90	62.5	-	-	-	-	-	**Seg Leq (dBA):**	64.36	60.33	59.77	58.63	57.42	56.33	55.41	54.64	53.98	53.42	52.94	52.52	52.40	52.25	52.18	52.16
			MF Rd EB	<2	1	80	-90	90	-	-	-	1	1.5	79.5	-90	90	62.5	-	-	-	-	-	**Seg Leq (dBA):**	63.50	59.53	59.31	58.67	57.88	57.08	56.34	55.69	55.12	54.63	54.20	53.83	53.50	53.22	52.97	52.92
																							Total Leq (dBA):	**66.96**	**62.96**	**62.56**	**61.66**	**60.67**	**59.73**	**58.91**	**58.21**	**57.60**	**57.08**	**56.63**	**56.23**	**56.00**	**55.77**	**55.60**	**55.57**
																							Delta (dB):	**-**	**-4.00**	**-4.41**	**-5.30**	**-6.30**	**-7.23**	**-8.05**	**-8.75**	**-9.36**	**-9.88**	**-10.34**	**-10.73**	**-10.97**	**-11.19**	**-11.36**	**-11.39**

Appendix C Sample Stamson Output Files

Naming Convention:

fnbR# - future 'no build' receptor #
fbR# - future 'build' receptor #

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 16:21:57
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr1.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :  10.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  40.00 / 40.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: Airport Road (day/night)
------------------------------------------------
Car traffic volume  :  9631/1070  veh/TimePeriod  *
Medium truck volume :   321/36    veh/TimePeriod  *
Heavy truck volume  :   749/83    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  11890
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :  10.00
    Medium Truck % of Total Volume     :   3.00
    Heavy Truck  % of Total Volume     :   7.00
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: Airport Road (day/night)
----------------------------------------------
```

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 211.00 / 211.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.64 !         1.64

ROAD (0.00 + 61.57 + 0.00) = 61.57 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.53  74.53   0.00  -6.51  -1.23   0.00   0.00  -5.23  61.57
-----------------------------------------------------------------------------

Segment Leq : 61.57 dBA

♀
Results segment # 2: Airport Road (day)
---------------------------------------

Source height = 1.63 m

ROAD (0.00 + 48.86 + 0.00) = 48.86 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.66  69.33   0.00 -19.02  -1.45   0.00   0.00   0.00  48.86
-----------------------------------------------------------------------------

Segment Leq : 48.86 dBA

Total Leq All Segments: 61.80 dBA

♀
Results segment # 1: Mayfield Rd (night)
----------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        4.50 !        3.59 !         3.59

ROAD (0.00 + 60.08 + 0.00) = 60.08 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.44  67.99   0.00  -6.12  -1.06   0.00   0.00  -0.65  60.16*
```

```
   -90     90   0.56  67.99   0.00  -6.64  -1.28   0.00   0.00   0.00  60.08
-----------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 60.08 dBA

♀
Results segment # 2: Airport Road (night)
-----------------------------------------

Source height = 1.63 m

ROAD (0.00 + 42.33 + 0.00) = 42.33 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.66  62.79   0.00 -19.02  -1.45   0.00   0.00   0.00  42.33
-----------------------------------------------------------------------------

Segment Leq : 42.33 dBA

Total Leq All Segments: 60.15 dBA

♀


TOTAL Leq FROM ALL SOURCES (DAY): 61.80
                         (NIGHT): 60.15
♀
♀
```

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 16:21:07
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr2.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :  10.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  39.50 / 39.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :   9.00 / 9.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.59 !         1.59

ROAD (0.00 + 61.50 + 0.00) = 61.50 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.53  74.53   0.00  -6.42  -1.23   0.00   0.00  -5.38  61.50
-----------------------------------------------------------------------------

Segment Leq : 61.50 dBA
```

Total Leq All Segments: 61.50 dBA

♀
Results segment # 1: Mayfield Rd (night)
```
---------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        4.50 !        3.91 !         3.91

ROAD (0.00 + 60.16 + 0.00) = 60.16 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.44  67.99   0.00  -6.05  -1.06   0.00   0.00  -0.33  60.56*
   -90     90   0.56  67.99   0.00  -6.55  -1.28   0.00   0.00   0.00  60.16
----------------------------------------------------------------------------

 * Bright Zone !
```

Segment Leq : 60.16 dBA

Total Leq All Segments: 60.16 dBA

♀

```
TOTAL Leq FROM ALL SOURCES (DAY): 61.50
                         (NIGHT): 60.16
```
♀
♀

```
STAMSON 5.0        NORMAL REPORT        Date: 31-03-2013 16:20:41
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr3.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :  10.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  52.00 / 52.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  22.00 / 22.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        1.50 !        1.67 !         1.67

ROAD (0.00 + 59.91 + 0.00) = 59.91 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90     90   0.53  74.53   0.00  -8.25  -1.23   0.00   0.00  -5.14  59.91
--------------------------------------------------------------------------------

Segment Leq : 59.91 dBA
```

Total Leq All Segments: 59.91 dBA

♀
Results segment # 1: Mayfield Rd (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	3.40	3.40

ROAD (0.00 + 58.30 + 0.00) = 58.30 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.44	67.99	0.00	-7.76	-1.06	0.00	0.00	-1.35	57.82*
-90	90	0.56	67.99	0.00	-8.41	-1.28	0.00	0.00	0.00	58.30

* Bright Zone !

Segment Leq : 58.30 dBA

Total Leq All Segments: 58.30 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 59.91
(NIGHT): 58.30

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 16:20:09
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr4.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :  10.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  40.00 / 40.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.60 !         1.60

ROAD (0.00 + 61.45 + 0.00) = 61.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.53   0.00  -6.51  -1.23   0.00   0.00  -5.34  61.45
----------------------------------------------------------------------------

Segment Leq : 61.45 dBA
```

Total Leq All Segments: 61.45 dBA

♀
Results segment # 1: Mayfield Rd (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	3.85	3.85

ROAD (0.00 + 60.08 + 0.00) = 60.08 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.44	67.99	0.00	-6.12	-1.06	0.00	0.00	-0.38	60.43*
-90	90	0.56	67.99	0.00	-6.64	-1.28	0.00	0.00	0.00	60.08

* Bright Zone !

Segment Leq : 60.08 dBA

Total Leq All Segments: 60.08 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 61.45
(NIGHT): 60.08

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 31-03-2013 16:19:40
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr5.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Mayfield Rd (day/night)

Car traffic volume	: 16781/1865	veh/TimePeriod	*
Medium truck volume	: 1181/131	veh/TimePeriod	*
Heavy truck volume	: 2755/306	veh/TimePeriod	*
Posted speed limit	: 60 km/h		
Road gradient	: 0 %		
Road pavement	: 1 (Typical asphalt or concrete)		

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT)	: 23019
Percentage of Annual Growth	: 0.00
Number of Years of Growth	: 10.00
Medium Truck % of Total Volume	: 5.70
Heavy Truck % of Total Volume	: 13.30
Day (16 hrs) % of Total Volume	: 90.00

Data for Segment # 1: Mayfield Rd (day/night)

Angle1 Angle2	: -90.00 deg	90.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 1	(Absorptive ground surface)
Receiver source distance	: 41.00 / 41.00 m	
Receiver height	: 1.50 / 4.50 m	
Topography	: 2	(Flat/gentle slope; with barrier)
Barrier angle1	: -90.00 deg	Angle2 : 90.00 deg
Barrier height	: 2.00 m	
Barrier receiver distance	: 10.00 / 10.00 m	
Source elevation	: 0.00 m	
Receiver elevation	: 0.00 m	
Barrier elevation	: 0.00 m	
Reference angle	: 0.00	

♀
Results segment # 1: Mayfield Rd (day)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.60	1.60

ROAD (0.00 + 61.29 + 0.00) = 61.29 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	74.53	0.00	-6.67	-1.23	0.00	0.00	-5.34	61.29

Segment Leq : 61.29 dBA

```
Total Leq All Segments: 61.29 dBA

♀
Results segment # 1: Mayfield Rd (night)
----------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        4.50 !        3.87 !         3.87

ROAD (0.00 + 59.91 + 0.00) = 59.91 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.44  67.99   0.00  -6.28  -1.06   0.00   0.00  -0.38  60.28*
   -90     90   0.56  67.99   0.00  -6.80  -1.28   0.00   0.00   0.00  59.91
-----------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 59.91 dBA

Total Leq All Segments: 59.91 dBA

♀



TOTAL Leq FROM ALL SOURCES (DAY): 61.29
                         (NIGHT): 59.91
♀
♀
```

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 16:19:11
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr6.te             Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :  10.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  40.00 / 40.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.60 !        1.60

ROAD (0.00 + 61.45 + 0.00) = 61.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.53  74.53   0.00  -6.51  -1.23   0.00   0.00  -5.34  61.45
-----------------------------------------------------------------------------

Segment Leq : 61.45 dBA
```

Total Leq All Segments: 61.45 dBA

♀
Results segment # 1: Mayfield Rd (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	3.85	3.85

ROAD (0.00 + 60.08 + 0.00) = 60.08 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.44	67.99	0.00	-6.12	-1.06	0.00	0.00	-0.38	60.43*
-90	90	0.56	67.99	0.00	-6.64	-1.28	0.00	0.00	0.00	60.08

* Bright Zone !

Segment Leq : 60.08 dBA

Total Leq All Segments: 60.08 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 61.45
(NIGHT): 60.08

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 16:23:24
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr7.te             Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :  10.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  41.50 / 41.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.60 !         1.60

ROAD (0.00 + 61.21 + 0.00) = 61.21 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.53   0.00  -6.75  -1.23   0.00   0.00  -5.34  61.21
----------------------------------------------------------------------------

Segment Leq : 61.21 dBA
```

Total Leq All Segments: 61.21 dBA

♀
Results segment # 1: Mayfield Rd (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	3.88	3.88

ROAD (0.00 + 59.83 + 0.00) = 59.83 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.44	67.99	0.00	-6.35	-1.06	0.00	0.00	-0.38	60.21*
-90	90	0.56	67.99	0.00	-6.88	-1.28	0.00	0.00	0.00	59.83

* Bright Zone !

Segment Leq : 59.83 dBA

Total Leq All Segments: 59.83 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 61.21
(NIGHT): 59.83

♀
♀

```
STAMSON 5.0        NORMAL REPORT        Date: 31-03-2013 17:02:02
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr8.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :  10.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  82.00 / 82.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

ROAD (0.00 + 63.08 + 0.00) = 63.08 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.65  76.67   0.00 -12.16  -1.44   0.00   0.00   0.00  63.08
----------------------------------------------------------------------------

Segment Leq : 63.08 dBA

Total Leq All Segments: 63.08 dBA

♀
Results segment # 1: Mayfield Rd (night)
----------------------------------------

Source height = 1.91 m

ROAD (0.00 + 57.37 + 0.00) = 57.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.56  70.14   0.00 -11.49  -1.28   0.00   0.00   0.00  57.37
----------------------------------------------------------------------------
```

Segment Leq : 57.37 dBA

Total Leq All Segments: 57.37 dBA

♀

```
TOTAL Leq FROM ALL SOURCES (DAY): 63.08
                         (NIGHT): 57.37
```

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 18:03:08
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr9.te             Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :  10.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 102.00 / 102.00 m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

ROAD (0.00 + 61.52 + 0.00) = 61.52 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.65  76.67   0.00 -13.72  -1.44   0.00   0.00   0.00  61.52
-----------------------------------------------------------------------------

Segment Leq : 61.52 dBA

Total Leq All Segments: 61.52 dBA

♀
Results segment # 1: Mayfield Rd (night)
----------------------------------------

Source height = 1.91 m

ROAD (0.00 + 55.89 + 0.00) = 55.89 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.56  70.14   0.00 -12.97  -1.28   0.00   0.00   0.00  55.89
-----------------------------------------------------------------------------
```

Segment Leq : 55.89 dBA

Total Leq All Segments: 55.89 dBA

♀

```
TOTAL Leq FROM ALL SOURCES (DAY): 61.52
                        (NIGHT): 55.89
```

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 31-03-2013 22:01:55
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr11a.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Mayfield Rd (day/night)

```
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

* Refers to calculated road volumes based on the following input:

```
    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :  10.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00
```

Data for Segment # 1: Mayfield Rd (day/night)

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  50.00 / 50.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

♀
Results segment # 1: Mayfield Rd (day)

Source height = 1.91 m

ROAD (0.00 + 66.62 + 0.00) = 66.62 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.65	76.67	0.00	-8.62	-1.44	0.00	0.00	0.00	66.62

Segment Leq : 66.62 dBA

Total Leq All Segments: 66.62 dBA

♀
Results segment # 1: Mayfield Rd (night)

Source height = 1.91 m

ROAD (0.00 + 60.72 + 0.00) = 60.72 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.56	70.14	0.00	-8.14	-1.28	0.00	0.00	0.00	60.72

Segment Leq : 60.72 dBA

Total Leq All Segments: 60.72 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 66.62
(NIGHT): 60.72

♀
♀

```
STAMSON 5.0        NORMAL REPORT        Date: 31-03-2013 22:18:44
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr11b.te           Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :  10.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  94.00 / 94.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

ROAD (0.00 + 62.11 + 0.00) = 62.11 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.65  76.67   0.00 -13.13  -1.44   0.00   0.00   0.00  62.11
----------------------------------------------------------------------------

Segment Leq : 62.11 dBA

Total Leq All Segments: 62.11 dBA

♀
Results segment # 1: Mayfield Rd (night)
----------------------------------------

Source height = 1.91 m

ROAD (0.00 + 56.44 + 0.00) = 56.44 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.56  70.14   0.00 -12.42  -1.28   0.00   0.00   0.00  56.44
----------------------------------------------------------------------------
```

Segment Leq : 56.44 dBA

Total Leq All Segments: 56.44 dBA

♀

```
TOTAL Leq FROM ALL SOURCES (DAY): 62.11
                         (NIGHT): 56.44
```

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 31-03-2013 16:16:00
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr12.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Mayfield Rd (day/night)

```
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

* Refers to calculated road volumes based on the following input:

```
    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :  10.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00
```

Data for Segment # 1: Mayfield Rd (day/night)

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  49.00 / 49.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

♀
Results segment # 1: Mayfield Rd (day)

Source height = 1.91 m

ROAD (0.00 + 64.62 + 0.00) = 64.62 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.65	74.53	0.00	-8.47	-1.44	0.00	0.00	0.00	64.62

Segment Leq : 64.62 dBA

Total Leq All Segments: 64.62 dBA

♀
Results segment # 1: Mayfield Rd (night)

Source height = 1.91 m

ROAD (0.00 + 58.71 + 0.00) = 58.71 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.56	67.99	0.00	-8.01	-1.28	0.00	0.00	0.00	58.71

Segment Leq : 58.71 dBA

Total Leq All Segments: 58.71 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 64.62
(NIGHT): 58.71

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 16:14:40
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr13.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :  10.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  85.00 / 85.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

ROAD (0.00 + 60.68 + 0.00) = 60.68 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.65  74.53   0.00 -12.41  -1.44   0.00   0.00   0.00  60.68
----------------------------------------------------------------------------

Segment Leq : 60.68 dBA

Total Leq All Segments: 60.68 dBA

♀
Results segment # 1: Mayfield Rd (night)
----------------------------------------

Source height = 1.91 m

ROAD (0.00 + 54.98 + 0.00) = 54.98 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.56  67.99   0.00 -11.73  -1.28   0.00   0.00   0.00  54.98
----------------------------------------------------------------------------
```

Segment Leq : 54.98 dBA

Total Leq All Segments: 54.98 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 60.68
(NIGHT): 54.98

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 18:05:39
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fnbr14.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Mayfield Rd (day/night)
-----------------------------------------------
Car traffic volume  : 16781/1865  veh/TimePeriod  *
Medium truck volume :  1181/131   veh/TimePeriod  *
Heavy truck volume  :  2755/306   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  23019
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :  10.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: Mayfield Rd (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  75.00 / 75.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Results segment # 1: Mayfield Rd (day)
--------------------------------------

Source height = 1.91 m

ROAD (0.00 + 63.72 + 0.00) = 63.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.65  76.67   0.00 -11.52  -1.44   0.00   0.00   0.00  63.72
-----------------------------------------------------------------------------

Segment Leq : 63.72 dBA

Total Leq All Segments: 63.72 dBA

♀
Results segment # 1: Mayfield Rd (night)
----------------------------------------

Source height = 1.91 m

ROAD (0.00 + 57.97 + 0.00) = 57.97 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.56  70.14   0.00 -10.89  -1.28   0.00   0.00   0.00  57.97
-----------------------------------------------------------------------------
```

Segment Leq : 57.97 dBA

Total Leq All Segments: 57.97 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 63.72
(NIGHT): 57.97

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 13:50:44
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr1.te           Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :   0.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  44.50 / 44.50  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :   0.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  35.50 / 35.50  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 3: Airport Road (day/night)
------------------------------------------------
Car traffic volume  : 24993/2777  veh/TimePeriod  *
Medium truck volume :   833/93    veh/TimePeriod  *
Heavy truck volume  :  1944/216   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  30855
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :  10.00
    Medium Truck % of Total Volume     :   3.00
    Heavy Truck  % of Total Volume     :   7.00
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 3: Airport Road (day/night)
----------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 211.00 / 211.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Results segment # 1: MF Rd WB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        1.50 !        1.63 !         1.63

ROAD (0.00 + 61.04 + 0.00) = 61.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -7.21  -1.23   0.00   0.00  -5.24  61.04
----------------------------------------------------------------------------
```

Segment Leq : 61.04 dBA

♀
Results segment # 2: MF Rd EB (day)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.66	1.66

ROAD (0.00 + 62.56 + 0.00) = 62.56 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	74.72	0.00	-5.72	-1.23	0.00	0.00	-5.22	62.56

Segment Leq : 62.56 dBA

♀
Results segment # 3: Airport Road (day)

Source height = 1.63 m

ROAD (0.00 + 53.01 + 0.00) = 53.01 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	73.47	0.00	-19.02	-1.45	0.00	0.00	0.00	53.01

Segment Leq : 53.01 dBA

Total Leq All Segments: 65.15 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	61.04	61.04
2.50	2.50	60.33	60.33
3.00	3.00	59.29	59.29
3.50	3.50	58.22	58.22
4.00	4.00	57.23	57.23
4.50	4.50	56.37	56.37
5.00	5.00	55.62	55.62
5.50	5.50	54.96	54.96
6.00	6.00	54.39	54.39
6.50	6.50	53.88	53.88
7.00	7.00	53.42	53.42
7.50	7.50	53.13	53.13
8.00	8.00	52.87	52.87
8.50	8.50	52.70	52.70
9.00	9.00	52.58	52.58

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	62.56	62.56
2.50	2.50	61.75	61.75
3.00	3.00	60.59	60.59
3.50	3.50	59.42	59.42
4.00	4.00	58.35	58.35
4.50	4.50	57.42	57.42
5.00	5.00	56.62	56.62
5.50	5.50	55.91	55.91
6.00	6.00	55.29	55.29
6.50	6.50	54.73	54.73
7.00	7.00	54.23	54.23
7.50	7.50	53.97	53.97
8.00	8.00	53.71	53.71
8.50	8.50	53.53	53.53
9.00	9.00	53.40	53.40

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.63	1.63

ROAD (0.00 + 54.51 + 0.00) = 54.51 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-7.21	-1.23	0.00	0.00	-5.23	54.51

Segment Leq : 54.51 dBA

♀
Results segment # 2: MF Rd EB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.66	1.66

ROAD (0.00 + 56.03 + 0.00) = 56.03 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-5.72	-1.23	0.00	0.00	-5.22	56.03

Segment Leq : 56.03 dBA

♀
Results segment # 3: Airport Road (night)

Source height = 1.63 m

ROAD (0.00 + 46.48 + 0.00) = 46.48 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	66.94	0.00	-19.02	-1.45	0.00	0.00	0.00	46.48

Segment Leq : 46.48 dBA

Total Leq All Segments: 58.62 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 65.15
(NIGHT): 58.62
♀
♀

```
STAMSON 5.0        NORMAL REPORT        Date: 31-03-2013 13:51:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr2.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  44.00 / 44.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :   9.00 / 9.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  35.00 / 35.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :   9.00 / 9.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Results segment # 1: MF Rd WB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.58 !         1.58

ROAD (0.00 + 60.97 + 0.00) = 60.97 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -7.14  -1.23   0.00   0.00  -5.39  60.97
-----------------------------------------------------------------------------

Segment Leq : 60.97 dBA

♀
Results segment # 2: MF Rd EB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.61 !         1.61

ROAD (0.00 + 62.50 + 0.00) = 62.50 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -5.62  -1.23   0.00   0.00  -5.37  62.50
-----------------------------------------------------------------------------

Segment Leq : 62.50 dBA

Total Leq All Segments: 64.81 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)
---------------------------------------------
```

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	60.97	60.97
2.50	2.50	59.95	59.95
3.00	3.00	58.68	58.68
3.50	3.50	57.47	57.47
4.00	4.00	56.41	56.41
4.50	4.50	55.51	55.51
5.00	5.00	54.73	54.73
5.50	5.50	54.06	54.06
6.00	6.00	53.48	53.48
6.50	6.50	52.96	52.96
7.00	7.00	52.68	52.68
7.50	7.50	52.43	52.43
8.00	8.00	52.26	52.26
8.50	8.50	52.15	52.15
9.00	9.00	52.09	52.09

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	62.50	62.50
2.50	2.50	61.41	61.41
3.00	3.00	60.06	60.06
3.50	3.50	58.77	58.77
4.00	4.00	57.66	57.66
4.50	4.50	56.71	56.71
5.00	5.00	55.89	55.89
5.50	5.50	55.17	55.17
6.00	6.00	54.55	54.55
6.50	6.50	53.99	53.99
7.00	7.00	53.72	53.72
7.50	7.50	53.46	53.46
8.00	8.00	53.27	53.27
8.50	8.50	53.13	53.13
9.00	9.00	53.05	53.05

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.58	1.58

ROAD (0.00 + 54.43 + 0.00) = 54.43 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-7.14	-1.23	0.00	0.00	-5.39	54.43

Segment Leq : 54.43 dBA

♀

Results segment # 2: MF Rd EB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.61	1.61

ROAD (0.00 + 55.97 + 0.00) = 55.97 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-5.62	-1.23	0.00	0.00	-5.37	55.97

Segment Leq : 55.97 dBA

Total Leq All Segments: 58.28 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 64.81
(NIGHT): 58.28

♀
♀

```
STAMSON 5.0        NORMAL REPORT        Date: 31-03-2013 13:52:29
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr3.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :   0.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  56.50 / 56.50  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  22.00 / 22.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :   0.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  47.50 / 47.50  m
Receiver height            :   1.50 / 1.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 90.00 deg
Barrier height             :   2.00 m
Barrier receiver distance  :  22.00 / 22.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

♀
Results segment # 1: MF Rd WB (day)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.66	1.66

ROAD (0.00 + 59.55 + 0.00) = 59.55 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	74.72	0.00	-8.80	-1.23	0.00	0.00	-5.14	59.55

Segment Leq : 59.55 dBA

♀
Results segment # 2: MF Rd EB (day)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.69	1.69

ROAD (0.00 + 60.71 + 0.00) = 60.71 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	74.72	0.00	-7.65	-1.23	0.00	0.00	-5.14	60.71

Segment Leq : 60.71 dBA

Total Leq All Segments: 63.18 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	59.55	59.55
2.50	2.50	59.12	59.12
3.00	3.00	58.37	58.37
3.50	3.50	57.52	57.52
4.00	4.00	56.69	56.69
4.50	4.50	55.93	55.93
5.00	5.00	55.26	55.26
5.50	5.50	54.67	54.67
6.00	6.00	54.16	54.16
6.50	6.50	53.70	53.70
7.00	7.00	53.30	53.30
7.50	7.50	52.93	52.93
8.00	8.00	52.61	52.61
8.50	8.50	52.32	52.32
9.00	9.00	52.27	52.27

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	60.71	60.71
2.50	2.50	60.21	60.21
3.00	3.00	59.36	59.36
3.50	3.50	58.41	58.41
4.00	4.00	57.50	57.50
4.50	4.50	56.68	56.68
5.00	5.00	55.96	55.96
5.50	5.50	55.32	55.32
6.00	6.00	54.76	54.76
6.50	6.50	54.27	54.27
7.00	7.00	53.82	53.82
7.50	7.50	53.43	53.43
8.00	8.00	53.07	53.07
8.50	8.50	52.93	52.93
9.00	9.00	52.77	52.77

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.66	1.66

ROAD (0.00 + 53.02 + 0.00) = 53.02 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-8.80	-1.23	0.00	0.00	-5.14	53.02

Segment Leq : 53.02 dBA

♀

Results segment # 2: MF Rd EB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.69	1.69

ROAD (0.00 + 54.18 + 0.00) = 54.18 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-7.65	-1.23	0.00	0.00	-5.14	54.18

Segment Leq : 54.18 dBA

Total Leq All Segments: 56.65 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 63.18
(NIGHT): 56.65

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 13:53:18
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr4.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  44.50 / 44.50  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  35.50 / 35.50  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Results segment # 1: MF Rd WB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        1.50 !        1.59 !         1.59

ROAD (0.00 + 60.93 + 0.00) = 60.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -7.21  -1.23   0.00   0.00  -5.35  60.93
----------------------------------------------------------------------------

Segment Leq : 60.93 dBA

♀
Results segment # 2: MF Rd EB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        1.50 !        1.62 !         1.62

ROAD (0.00 + 62.44 + 0.00) = 62.44 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -5.72  -1.23   0.00   0.00  -5.33  62.44
----------------------------------------------------------------------------

Segment Leq : 62.44 dBA

Total Leq All Segments: 64.76 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)
---------------------------------------------
```

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	60.93	60.93
2.50	2.50	60.00	60.00
3.00	3.00	58.79	58.79
3.50	3.50	57.61	57.61
4.00	4.00	56.58	56.58
4.50	4.50	55.69	55.69
5.00	5.00	54.92	54.92
5.50	5.50	54.26	54.26
6.00	6.00	53.67	53.67
6.50	6.50	53.16	53.16
7.00	7.00	52.83	52.83
7.50	7.50	52.56	52.56
8.00	8.00	52.37	52.37
8.50	8.50	52.24	52.24
9.00	9.00	52.17	52.17

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	62.44	62.44
2.50	2.50	61.44	61.44
3.00	3.00	60.14	60.14
3.50	3.50	58.89	58.89
4.00	4.00	57.80	57.80
4.50	4.50	56.85	56.85
5.00	5.00	56.04	56.04
5.50	5.50	55.33	55.33
6.00	6.00	54.70	54.70
6.50	6.50	54.15	54.15
7.00	7.00	53.83	53.83
7.50	7.50	53.54	53.54
8.00	8.00	53.34	53.34
8.50	8.50	53.19	53.19
9.00	9.00	53.10	53.10

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.59	1.59

ROAD (0.00 + 54.40 + 0.00) = 54.40 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-7.21	-1.23	0.00	0.00	-5.35	54.40

Segment Leq : 54.40 dBA

♀

Results segment # 2: MF Rd EB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.62	1.62

ROAD (0.00 + 55.91 + 0.00) = 55.91 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-5.72	-1.23	0.00	0.00	-5.33	55.91

Segment Leq : 55.91 dBA

Total Leq All Segments: 58.23 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 64.76
(NIGHT): 58.23

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 13:54:02
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr5.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  45.50 / 45.50  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  36.50 / 36.50  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Results segment # 1: MF Rd WB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.59 !         1.59

ROAD (0.00 + 60.78 + 0.00) = 60.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -7.36  -1.23   0.00   0.00  -5.35  60.78
----------------------------------------------------------------------------

Segment Leq : 60.78 dBA

♀
Results segment # 2: MF Rd EB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.61 !         1.61

ROAD (0.00 + 62.26 + 0.00) = 62.26 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -5.90  -1.23   0.00   0.00  -5.33  62.26
----------------------------------------------------------------------------

Segment Leq : 62.26 dBA

Total Leq All Segments: 64.59 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)
---------------------------------------------
```

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	60.78	60.78
2.50	2.50	59.86	59.86
3.00	3.00	58.66	58.66
3.50	3.50	57.49	57.49
4.00	4.00	56.46	56.46
4.50	4.50	55.57	55.57
5.00	5.00	54.81	54.81
5.50	5.50	54.15	54.15
6.00	6.00	53.57	53.57
6.50	6.50	53.06	53.06
7.00	7.00	52.73	52.73
7.50	7.50	52.46	52.46
8.00	8.00	52.27	52.27
8.50	8.50	52.15	52.15
9.00	9.00	52.08	52.08

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	62.26	62.26
2.50	2.50	61.27	61.27
3.00	3.00	59.98	59.98
3.50	3.50	58.74	58.74
4.00	4.00	57.65	57.65
4.50	4.50	56.71	56.71
5.00	5.00	55.90	55.90
5.50	5.50	55.20	55.20
6.00	6.00	54.58	54.58
6.50	6.50	54.03	54.03
7.00	7.00	53.71	53.71
7.50	7.50	53.42	53.42
8.00	8.00	53.22	53.22
8.50	8.50	53.08	53.08
9.00	9.00	52.99	52.99

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.59	1.59

ROAD (0.00 + 54.25 + 0.00) = 54.25 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-7.36	-1.23	0.00	0.00	-5.35	54.25

Segment Leq : 54.25 dBA

♀

Results segment # 2: MF Rd EB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.61	1.61

ROAD (0.00 + 55.73 + 0.00) = 55.73 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-5.90	-1.23	0.00	0.00	-5.33	55.73

Segment Leq : 55.73 dBA

Total Leq All Segments: 58.06 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 64.59
(NIGHT): 58.06

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 13:54:38
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr6.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :   0.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  44.50 / 44.50  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :   0.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  35.50 / 35.50  m
Receiver height            :   1.50 / 1.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 90.00 deg
Barrier height             :   2.00 m
Barrier receiver distance  :  10.00 / 10.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

♀
Results segment # 1: MF Rd WB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.59 !         1.59

ROAD (0.00 + 60.93 + 0.00) = 60.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -7.21  -1.23   0.00   0.00  -5.35  60.93
----------------------------------------------------------------------------

Segment Leq : 60.93 dBA

♀
Results segment # 2: MF Rd EB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.62 !         1.62

ROAD (0.00 + 62.44 + 0.00) = 62.44 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -5.72  -1.23   0.00   0.00  -5.33  62.44
----------------------------------------------------------------------------

Segment Leq : 62.44 dBA

Total Leq All Segments: 64.76 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)
---------------------------------------------
```

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	60.93	60.93
2.50	2.50	60.00	60.00
3.00	3.00	58.79	58.79
3.50	3.50	57.61	57.61
4.00	4.00	56.58	56.58
4.50	4.50	55.69	55.69
5.00	5.00	54.92	54.92
5.50	5.50	54.26	54.26
6.00	6.00	53.67	53.67
6.50	6.50	53.16	53.16
7.00	7.00	52.83	52.83
7.50	7.50	52.56	52.56
8.00	8.00	52.37	52.37
8.50	8.50	52.24	52.24
9.00	9.00	52.17	52.17

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	62.44	62.44
2.50	2.50	61.44	61.44
3.00	3.00	60.14	60.14
3.50	3.50	58.89	58.89
4.00	4.00	57.80	57.80
4.50	4.50	56.85	56.85
5.00	5.00	56.04	56.04
5.50	5.50	55.33	55.33
6.00	6.00	54.70	54.70
6.50	6.50	54.15	54.15
7.00	7.00	53.83	53.83
7.50	7.50	53.54	53.54
8.00	8.00	53.34	53.34
8.50	8.50	53.19	53.19
9.00	9.00	53.10	53.10

♀

Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.59	1.59

ROAD (0.00 + 54.40 + 0.00) = 54.40 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-7.21	-1.23	0.00	0.00	-5.35	54.40

Segment Leq : 54.40 dBA

♀

```
Results segment # 2: MF Rd EB (night)
-------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.62 !         1.62

ROAD (0.00 + 55.91 + 0.00) = 55.91 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  68.19   0.00  -5.72  -1.23   0.00   0.00  -5.33  55.91
----------------------------------------------------------------------------

Segment Leq : 55.91 dBA

Total Leq All Segments: 58.23 dBA

♀


TOTAL Leq FROM ALL SOURCES (DAY): 64.76
                         (NIGHT): 58.23
♀
♀
```

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 13:55:19
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr7.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  46.00 / 46.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.00 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  37.00 / 37.00  m
Receiver height            :   1.50 / 1.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 90.00 deg
Barrier height             :   2.00 m
Barrier receiver distance  :  10.00 / 10.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

♀
Results segment # 1: MF Rd WB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.59 !         1.59

ROAD (0.00 + 60.71 + 0.00) = 60.71 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -7.43  -1.23   0.00   0.00  -5.35  60.71
----------------------------------------------------------------------------

Segment Leq : 60.71 dBA

♀
Results segment # 2: MF Rd EB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.61 !         1.61

ROAD (0.00 + 62.17 + 0.00) = 62.17 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.53  74.72   0.00  -5.99  -1.23   0.00   0.00  -5.34  62.17
----------------------------------------------------------------------------

Segment Leq : 62.17 dBA

Total Leq All Segments: 64.51 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)
---------------------------------------------
```

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	60.71	60.71
2.50	2.50	59.79	59.79
3.00	3.00	58.59	58.59
3.50	3.50	57.42	57.42
4.00	4.00	56.39	56.39
4.50	4.50	55.51	55.51
5.00	5.00	54.75	54.75
5.50	5.50	54.09	54.09
6.00	6.00	53.52	53.52
6.50	6.50	53.01	53.01
7.00	7.00	52.68	52.68
7.50	7.50	52.41	52.41
8.00	8.00	52.22	52.22
8.50	8.50	52.10	52.10
9.00	9.00	52.03	52.03

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	62.17	62.17
2.50	2.50	61.18	61.18
3.00	3.00	59.90	59.90
3.50	3.50	58.66	58.66
4.00	4.00	57.58	57.58
4.50	4.50	56.64	56.64
5.00	5.00	55.84	55.84
5.50	5.50	55.14	55.14
6.00	6.00	54.52	54.52
6.50	6.50	53.97	53.97
7.00	7.00	53.65	53.65
7.50	7.50	53.37	53.37
8.00	8.00	53.16	53.16
8.50	8.50	53.02	53.02
9.00	9.00	52.93	52.93

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.59	1.59

ROAD (0.00 + 54.18 + 0.00) = 54.18 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.53	68.19	0.00	-7.43	-1.23	0.00	0.00	-5.35	54.18

Segment Leq : 54.18 dBA

♀

```
Results segment # 2: MF Rd EB (night)
-------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.61 !         1.61

ROAD (0.00 + 55.64 + 0.00) = 55.64 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90     90   0.53  68.19   0.00  -5.99  -1.23   0.00   0.00  -5.34  55.64
--------------------------------------------------------------------------------

Segment Leq : 55.64 dBA

Total Leq All Segments: 57.98 dBA

♀



TOTAL Leq FROM ALL SOURCES (DAY): 64.51
                         (NIGHT): 57.98
♀
♀
```

```
STAMSON 5.0        NORMAL REPORT        Date: 31-03-2013 16:35:50
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr8.te            Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :   0.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  86.50 / 86.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  69.50 / 69.50  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :   0.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  77.50 / 77.50  m
Receiver height            :   1.50 / 4.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 90.00 deg
Barrier height             :   0.00 m
Barrier receiver distance  :  69.50 / 69.50  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

♀
Results segment # 1: MF Rd WB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.83 !         1.83

ROAD (0.00 + 62.89 + 0.00) = 62.89 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.65  76.87   0.00 -12.54  -1.44   0.00   0.00  -0.75  62.14*
   -90     90   0.65  76.87   0.00 -12.54  -1.44   0.00   0.00   0.00  62.89
----------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 62.89 dBA

♀
Results segment # 2: MF Rd EB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        1.50 !        1.87 !         1.87

ROAD (0.00 + 63.68 + 0.00) = 63.68 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.65  76.87   0.00 -11.75  -1.44   0.00   0.00  -0.36  63.32*
   -90     90   0.65  76.87   0.00 -11.75  -1.44   0.00   0.00   0.00  63.68
----------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 63.68 dBA
```

Total Leq All Segments: 66.31 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	58.98	58.98
2.50	2.50	58.78	58.78
3.00	3.00	58.18	58.18
3.50	3.50	57.41	57.41
4.00	4.00	56.63	56.63
4.50	4.50	55.90	55.90
5.00	5.00	55.27	55.27
5.50	5.50	54.71	54.71
6.00	6.00	54.23	54.23
6.50	6.50	53.82	53.82
7.00	7.00	53.46	53.46
7.50	7.50	53.15	53.15
8.00	8.00	52.88	52.88
8.50	8.50	52.64	52.64
9.00	9.00	52.58	52.58

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	59.70	59.70
2.50	2.50	59.17	59.17
3.00	3.00	58.06	58.06
3.50	3.50	56.87	56.87
4.00	4.00	55.80	55.80
4.50	4.50	54.89	54.89
5.00	5.00	54.13	54.13
5.50	5.50	53.49	53.49
6.00	6.00	52.94	52.94
6.50	6.50	52.47	52.47
7.00	7.00	52.07	52.07
7.50	7.50	51.94	51.94
8.00	8.00	51.81	51.81
8.50	8.50	51.75	51.75
9.00	9.00	51.74	51.74

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	2.42	2.42

ROAD (0.00 + 57.20 + 0.00) = 57.20 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.56	70.33	0.00	-11.85	-1.28	0.00	0.00	-0.40	56.80*
-90	90	0.56	70.33	0.00	-11.85	-1.28	0.00	0.00	0.00	57.20

* Bright Zone !

Segment Leq : 57.20 dBA

♀
Results segment # 2: MF Rd EB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	2.18	2.18

ROAD (0.00 + 57.94 + 0.00) = 57.94 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.56	70.33	0.00	-11.11	-1.28	0.00	0.00	-0.26	57.69*
-90	90	0.56	70.33	0.00	-11.11	-1.28	0.00	0.00	0.00	57.94

* Bright Zone !

Segment Leq : 57.94 dBA

Total Leq All Segments: 60.60 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 66.31
(NIGHT): 60.60

♀
♀

```
STAMSON 5.0        NORMAL REPORT        Date: 31-03-2013 16:35:04
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr9.te           Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  97.50 / 97.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  89.50 / 89.50  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 106.50 / 106.50 m
Receiver height            :   1.50 / 4.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 90.00 deg
Barrier height             :   0.00 m
Barrier receiver distance  :  89.50 / 89.50  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

♀
Results segment # 1: MF Rd WB (day)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.88	1.88

ROAD (0.00 + 62.04 + 0.00) = 62.04 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.65	76.87	0.00	-13.39	-1.44	0.00	0.00	-0.36	61.67*
-90	90	0.65	76.87	0.00	-13.39	-1.44	0.00	0.00	0.00	62.04

* Bright Zone !

Segment Leq : 62.04 dBA

♀
Results segment # 2: MF Rd EB (day)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.84	1.84

ROAD (0.00 + 61.40 + 0.00) = 61.40 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.65	76.87	0.00	-14.03	-1.44	0.00	0.00	-0.77	60.63*
-90	90	0.65	76.87	0.00	-14.03	-1.44	0.00	0.00	0.00	61.40

* Bright Zone !

Segment Leq : 61.40 dBA

Total Leq All Segments: 64.74 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	58.19	58.19
2.50	2.50	57.71	57.71
3.00	3.00	56.66	56.66
3.50	3.50	55.51	55.51
4.00	4.00	54.48	54.48
4.50	4.50	53.61	53.61
5.00	5.00	52.88	52.88
5.50	5.50	52.27	52.27
6.00	6.00	51.75	51.75
6.50	6.50	51.32	51.32
7.00	7.00	50.95	50.95
7.50	7.50	50.83	50.83
8.00	8.00	50.72	50.72
8.50	8.50	50.68	50.68
9.00	9.00	50.70	50.70

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	57.61	57.61
2.50	2.50	57.47	57.47
3.00	3.00	56.93	56.93
3.50	3.50	56.22	56.22
4.00	4.00	55.49	55.49
4.50	4.50	54.81	54.81
5.00	5.00	54.20	54.20
5.50	5.50	53.68	53.68
6.00	6.00	53.23	53.23
6.50	6.50	52.85	52.85
7.00	7.00	52.52	52.52
7.50	7.50	52.24	52.24
8.00	8.00	52.00	52.00
8.50	8.50	51.80	51.80
9.00	9.00	51.74	51.74

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	2.12	2.12

ROAD (0.00 + 56.39 + 0.00) = 56.39 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq

-90	90	0.56	70.33	0.00	-12.66	-1.28	0.00	0.00	-0.28	56.11*
-90	90	0.56	70.33	0.00	-12.66	-1.28	0.00	0.00	0.00	56.39

* Bright Zone !

Segment Leq : 56.39 dBA

♀
Results segment # 2: MF Rd EB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	2.32	2.32

ROAD (0.00 + 55.79 + 0.00) = 55.79 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.56	70.33	0.00	-13.26	-1.28	0.00	0.00	-0.46	55.33*
-90	90	0.56	70.33	0.00	-13.26	-1.28	0.00	0.00	0.00	55.79

* Bright Zone !

Segment Leq : 55.79 dBA

Total Leq All Segments: 59.11 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 64.74
(NIGHT): 59.11

♀
♀

```
STAMSON 5.0        NORMAL REPORT        Date: 31-03-2013 22:13:04
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr11a.te          Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  54.50 / 54.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  37.50 / 37.50  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  45.50 / 45.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  37.50 / 37.50  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Results segment # 1: MF Rd WB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        1.50 !        1.78 !         1.78

ROAD (0.00 + 66.20 + 0.00) = 66.20 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.65  76.87   0.00  -9.23  -1.44   0.00   0.00  -0.66  65.53*
   -90     90   0.65  76.87   0.00  -9.23  -1.44   0.00   0.00   0.00  66.20
-----------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 66.20 dBA

♀
Results segment # 2: MF Rd EB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        1.50 !        1.84 !         1.84

ROAD (0.00 + 67.49 + 0.00) = 67.49 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.65  76.87   0.00  -7.94  -1.44   0.00   0.00  -0.34  67.15*
   -90     90   0.65  76.87   0.00  -7.94  -1.44   0.00   0.00   0.00  67.49
-----------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 67.49 dBA
```

Total Leq All Segments: 69.90 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	62.01	62.01
2.50	2.50	61.62	61.62
3.00	3.00	60.82	60.82
3.50	3.50	59.89	59.89
4.00	4.00	58.98	58.98
4.50	4.50	58.16	58.16
5.00	5.00	57.44	57.44
5.50	5.50	56.81	56.81
6.00	6.00	56.25	56.25
6.50	6.50	55.77	55.77
7.00	7.00	55.33	55.33
7.50	7.50	54.95	54.95
8.00	8.00	54.61	54.61
8.50	8.50	54.47	54.47
9.00	9.00	54.32	54.32

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	63.21	63.21
2.50	2.50	62.49	62.49
3.00	3.00	61.22	61.22
3.50	3.50	59.90	59.90
4.00	4.00	58.74	58.74
4.50	4.50	57.75	57.75
5.00	5.00	56.91	56.91
5.50	5.50	56.19	56.19
6.00	6.00	55.56	55.56
6.50	6.50	55.01	55.01
7.00	7.00	54.70	54.70
7.50	7.50	54.43	54.43
8.00	8.00	54.25	54.25
8.50	8.50	54.14	54.14
9.00	9.00	54.07	54.07

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	2.72	2.72

ROAD (0.00 + 60.33 + 0.00) = 60.33 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq

```
   -90     90   0.56  70.33   0.00  -8.73  -1.28   0.00   0.00  -0.27  60.06*
   -90     90   0.56  70.33   0.00  -8.73  -1.28   0.00   0.00   0.00  60.33
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 60.33 dBA

♀
Results segment # 2: MF Rd EB (night)
--------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
-------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        4.50 !        2.37 !         2.37

ROAD (0.00 + 61.55 + 0.00) = 61.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.56  70.33   0.00  -7.51  -1.28   0.00   0.00  -0.20  61.35*
   -90     90   0.56  70.33   0.00  -7.51  -1.28   0.00   0.00   0.00  61.55
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 61.55 dBA

Total Leq All Segments: 63.99 dBA

♀


TOTAL Leq FROM ALL SOURCES (DAY): 69.90
                         (NIGHT): 63.99
♀
♀
```

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 22:14:18
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr11b.te          Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  89.50 / 89.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  81.50 / 81.50  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  98.50 / 98.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  81.50 / 81.50  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

♀
Results segment # 1: MF Rd WB (day)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.87	1.87

ROAD (0.00 + 62.65 + 0.00) = 62.65 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.65	76.87	0.00	-12.78	-1.44	0.00	0.00	-0.36	62.29*
-90	90	0.65	76.87	0.00	-12.78	-1.44	0.00	0.00	0.00	62.65

* Bright Zone !

Segment Leq : 62.65 dBA

♀
Results segment # 2: MF Rd EB (day)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.84	1.84

ROAD (0.00 + 61.96 + 0.00) = 61.96 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.65	76.87	0.00	-13.47	-1.44	0.00	0.00	-0.76	61.20*
-90	90	0.65	76.87	0.00	-13.47	-1.44	0.00	0.00	0.00	61.96

* Bright Zone !

Segment Leq : 61.96 dBA

Total Leq All Segments: 65.33 dBA

♀

Barrier table for segment # 1: MF Rd WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	58.75	58.75
2.50	2.50	58.26	58.26
3.00	3.00	57.18	57.18
3.50	3.50	56.02	56.02
4.00	4.00	54.97	54.97
4.50	4.50	54.09	54.09
5.00	5.00	53.35	53.35
5.50	5.50	52.72	52.72
6.00	6.00	52.20	52.20
6.50	6.50	51.75	51.75
7.00	7.00	51.37	51.37
7.50	7.50	51.25	51.25
8.00	8.00	51.13	51.13
8.50	8.50	51.08	51.08
9.00	9.00	51.09	51.09

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	58.12	58.12
2.50	2.50	57.96	57.96
3.00	3.00	57.40	57.40
3.50	3.50	56.67	56.67
4.00	4.00	55.92	55.92
4.50	4.50	55.22	55.22
5.00	5.00	54.61	54.61
5.50	5.50	54.07	54.07
6.00	6.00	53.61	53.61
6.50	6.50	53.22	53.22
7.00	7.00	52.88	52.88
7.50	7.50	52.59	52.59
8.00	8.00	52.34	52.34
8.50	8.50	52.12	52.12
9.00	9.00	52.06	52.06

♀

Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	2.14	2.14

ROAD (0.00 + 56.97 + 0.00) = 56.97 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq

```
   -90     90   0.56  70.33   0.00 -12.08  -1.28   0.00   0.00  -0.27  56.70*
   -90     90   0.56  70.33   0.00 -12.08  -1.28   0.00   0.00   0.00  56.97
-----------------------------------------------------------------------------
```

 * Bright Zone !

Segment Leq : 56.97 dBA

♀
Results segment # 2: MF Rd EB (night)

Source height = 1.91 m

Barrier height for grazing incidence

```
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        4.50 !        2.36 !         2.36
```

```
ROAD (0.00 + 56.32 + 0.00) = 56.32 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.56  70.33   0.00 -12.73  -1.28   0.00   0.00  -0.44  55.88*
   -90     90   0.56  70.33   0.00 -12.73  -1.28   0.00   0.00   0.00  56.32
-----------------------------------------------------------------------------
```

 * Bright Zone !

Segment Leq : 56.32 dBA

Total Leq All Segments: 59.67 dBA

♀

```
TOTAL Leq FROM ALL SOURCES (DAY): 65.33
                         (NIGHT): 59.67
```

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 16:33:05
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr12.te           Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  53.50 / 53.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  36.50 / 36.50  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  44.50 / 44.50  m
Receiver height            :   1.50 / 4.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 90.00 deg
Barrier height             :   0.00 m
Barrier receiver distance  :  36.50 / 36.50  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

♀
Results segment # 1: MF Rd WB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        1.50 !        1.78 !         1.78

ROAD (0.00 + 64.18 + 0.00) = 64.18 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -90     90   0.65  74.72   0.00  -9.10  -1.44   0.00   0.00  -0.66  63.52*
   -90     90   0.65  74.72   0.00  -9.10  -1.44   0.00   0.00   0.00  64.18
--------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 64.18 dBA

♀
Results segment # 2: MF Rd EB (day)
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        1.50 !        1.84 !         1.84

ROAD (0.00 + 65.50 + 0.00) = 65.50 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -90     90   0.65  74.72   0.00  -7.78  -1.44   0.00   0.00  -0.34  65.17*
   -90     90   0.65  74.72   0.00  -7.78  -1.44   0.00   0.00   0.00  65.50
--------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 65.50 dBA
```

Total Leq All Segments: 67.90 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	59.99	59.99
2.50	2.50	59.59	59.59
3.00	3.00	58.78	58.78
3.50	3.50	57.84	57.84
4.00	4.00	56.92	56.92
4.50	4.50	56.10	56.10
5.00	5.00	55.37	55.37
5.50	5.50	54.74	54.74
6.00	6.00	54.18	54.18
6.50	6.50	53.69	53.69
7.00	7.00	53.26	53.26
7.50	7.50	52.87	52.87
8.00	8.00	52.52	52.52
8.50	8.50	52.39	52.39
9.00	9.00	52.24	52.24

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	61.21	61.21
2.50	2.50	60.48	60.48
3.00	3.00	59.20	59.20
3.50	3.50	57.88	57.88
4.00	4.00	56.71	56.71
4.50	4.50	55.72	55.72
5.00	5.00	54.87	54.87
5.50	5.50	54.15	54.15
6.00	6.00	53.52	53.52
6.50	6.50	52.97	52.97
7.00	7.00	52.66	52.66
7.50	7.50	52.39	52.39
8.00	8.00	52.20	52.20
8.50	8.50	52.09	52.09
9.00	9.00	52.02	52.02

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	2.73	2.73

ROAD (0.00 + 58.31 + 0.00) = 58.31 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq

-90	90	0.56	68.19	0.00	-8.60	-1.28	0.00	0.00	-0.26	58.04*
-90	90	0.56	68.19	0.00	-8.60	-1.28	0.00	0.00	0.00	58.31

* Bright Zone !

Segment Leq : 58.31 dBA

♀
Results segment # 2: MF Rd EB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	2.38	2.38

ROAD (0.00 + 59.55 + 0.00) = 59.55 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.56	68.19	0.00	-7.36	-1.28	0.00	0.00	-0.20	59.36*
-90	90	0.56	68.19	0.00	-7.36	-1.28	0.00	0.00	0.00	59.55

* Bright Zone !

Segment Leq : 59.55 dBA

Total Leq All Segments: 61.98 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 67.90
(NIGHT): 61.98

♀
♀

```
STAMSON 5.0        NORMAL REPORT       Date: 31-03-2013 16:31:05
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr13.te           Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  89.50 / 89.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  72.50 / 72.50  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   5.70
    Heavy Truck  % of Total Volume     :  13.30
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  80.50 / 80.50  m
Receiver height            :   1.50 / 4.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 90.00 deg
Barrier height             :   0.00 m
Barrier receiver distance  :  72.50 / 72.50  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

♀
Results segment # 1: MF Rd WB (day)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.83	1.83

ROAD (0.00 + 60.50 + 0.00) = 60.50 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.65	74.72	0.00	-12.78	-1.44	0.00	0.00	-0.75	59.75*
-90	90	0.65	74.72	0.00	-12.78	-1.44	0.00	0.00	0.00	60.50

* Bright Zone !

Segment Leq : 60.50 dBA

♀
Results segment # 2: MF Rd EB (day)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	1.50	1.87	1.87

ROAD (0.00 + 61.26 + 0.00) = 61.26 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.65	74.72	0.00	-12.02	-1.44	0.00	0.00	-0.36	60.90*
-90	90	0.65	74.72	0.00	-12.02	-1.44	0.00	0.00	0.00	61.26

* Bright Zone !

Segment Leq : 61.26 dBA

Total Leq All Segments: 63.91 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	56.61	56.61
2.50	2.50	56.42	56.42
3.00	3.00	55.83	55.83
3.50	3.50	55.07	55.07
4.00	4.00	54.30	54.30
4.50	4.50	53.58	53.58
5.00	5.00	52.95	52.95
5.50	5.50	52.40	52.40
6.00	6.00	51.93	51.93
6.50	6.50	51.52	51.52
7.00	7.00	51.16	51.16
7.50	7.50	50.86	50.86
8.00	8.00	50.59	50.59
8.50	8.50	50.36	50.36
9.00	9.00	50.30	50.30

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	57.31	57.31
2.50	2.50	56.78	56.78
3.00	3.00	55.68	55.68
3.50	3.50	54.50	54.50
4.00	4.00	53.43	53.43
4.50	4.50	52.53	52.53
5.00	5.00	51.78	51.78
5.50	5.50	51.14	51.14
6.00	6.00	50.60	50.60
6.50	6.50	50.14	50.14
7.00	7.00	49.74	49.74
7.50	7.50	49.62	49.62
8.00	8.00	49.49	49.49
8.50	8.50	49.43	49.43
9.00	9.00	49.42	49.42

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	2.40	2.40

ROAD (0.00 + 54.82 + 0.00) = 54.82 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq

```
   -90     90   0.56  68.19   0.00 -12.08  -1.28   0.00   0.00  -0.41  54.41*
   -90     90   0.56  68.19   0.00 -12.08  -1.28   0.00   0.00   0.00  54.82
-----------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 54.82 dBA

♀
Results segment # 2: MF Rd EB (night)
-------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        4.50 !        2.17 !         2.17

ROAD (0.00 + 55.54 + 0.00) = 55.54 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.56  68.19   0.00 -11.37  -1.28   0.00   0.00  -0.26  55.28*
   -90     90   0.56  68.19   0.00 -11.37  -1.28   0.00   0.00   0.00  55.54
-----------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 55.54 dBA

Total Leq All Segments: 58.21 dBA

♀



TOTAL Leq FROM ALL SOURCES (DAY): 63.91
                         (NIGHT): 58.21
♀
♀
```

```
STAMSON 5.0        NORMAL REPORT        Date: 31-03-2013 16:32:12
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: fbr14.te           Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MF Rd WB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :   0.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: MF Rd WB (day/night)
------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  70.50 / 70.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  62.50 / 62.50  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Road data, segment # 2: MF Rd EB (day/night)
--------------------------------------------
Car traffic volume  : 17532/1948  veh/TimePeriod  *
Medium truck volume :  1234/137   veh/TimePeriod  *
Heavy truck volume  :  2879/320   veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  24050
    Percentage of Annual Growth       :   0.00
    Number of Years of Growth         :   0.00
    Medium Truck % of Total Volume    :   5.70
    Heavy Truck  % of Total Volume    :  13.30
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 2: MF Rd EB (day/night)
------------------------------------------
```

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  79.50 / 79.50  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  62.50 / 62.50  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

♀
Results segment # 1: MF Rd WB (day)

```
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        1.50 !        1.86 !         1.86

ROAD (0.00 + 64.36 + 0.00) = 64.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.65  76.87   0.00 -11.07  -1.44   0.00   0.00  -0.35  64.00*
   -90     90   0.65  76.87   0.00 -11.07  -1.44   0.00   0.00   0.00  64.36
----------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 64.36 dBA
```

♀
Results segment # 2: MF Rd EB (day)

```
-----------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.91 !        1.50 !        1.82 !         1.82

ROAD (0.00 + 63.50 + 0.00) = 63.50 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.65  76.87   0.00 -11.93  -1.44   0.00   0.00  -0.74  62.76*
   -90     90   0.65  76.87   0.00 -11.93  -1.44   0.00   0.00   0.00  63.50
----------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 63.50 dBA
```

Total Leq All Segments: 66.96 dBA

♀
Barrier table for segment # 1: MF Rd WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	60.33	60.33
2.50	2.50	59.77	59.77
3.00	3.00	58.63	58.63
3.50	3.50	57.42	57.42
4.00	4.00	56.33	56.33
4.50	4.50	55.41	55.41
5.00	5.00	54.64	54.64
5.50	5.50	53.98	53.98
6.00	6.00	53.42	53.42
6.50	6.50	52.94	52.94
7.00	7.00	52.52	52.52
7.50	7.50	52.40	52.40
8.00	8.00	52.25	52.25
8.50	8.50	52.18	52.18
9.00	9.00	52.16	52.16

Barrier table for segment # 2: MF Rd EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
2.00	2.00	59.53	59.53
2.50	2.50	59.31	59.31
3.00	3.00	58.67	58.67
3.50	3.50	57.88	57.88
4.00	4.00	57.08	57.08
4.50	4.50	56.34	56.34
5.00	5.00	55.69	55.69
5.50	5.50	55.12	55.12
6.00	6.00	54.63	54.63
6.50	6.50	54.20	54.20
7.00	7.00	53.83	53.83
7.50	7.50	53.50	53.50
8.00	8.00	53.22	53.22
8.50	8.50	52.97	52.97
9.00	9.00	52.92	52.92

♀
Results segment # 1: MF Rd WB (night)

Source height = 1.91 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.91	4.50	2.20	2.20

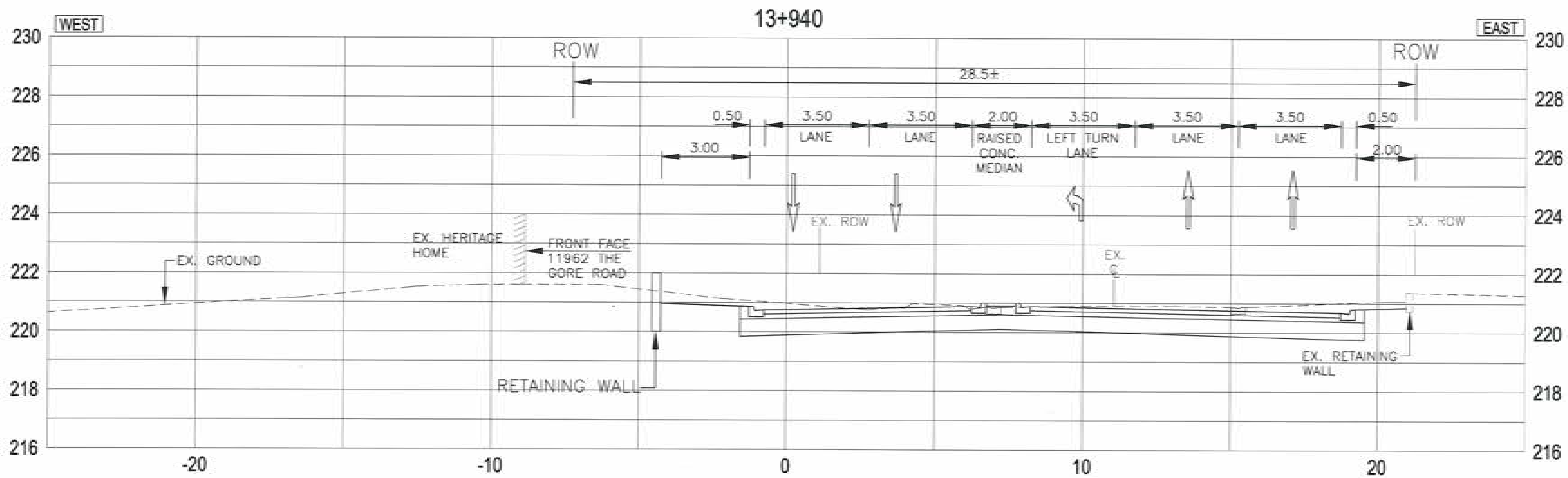
ROAD (0.00 + 58.58 + 0.00) = 58.58 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq

```
   -90     90   0.56  70.33   0.00 -10.47  -1.28   0.00   0.00  -0.25  58.34*
   -90     90   0.56  70.33   0.00 -10.47  -1.28   0.00   0.00   0.00  58.58
--------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 58.58 dBA

♀
Results segment # 2: MF Rd EB (night)
-------------------------------------

Source height = 1.91 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.91 !        4.50 !        2.46 !         2.46

ROAD (0.00 + 57.77 + 0.00) = 57.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90     90   0.56  70.33   0.00 -11.28  -1.28   0.00   0.00  -0.38  57.39*
   -90     90   0.56  70.33   0.00 -11.28  -1.28   0.00   0.00   0.00  57.77
--------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 57.77 dBA

Total Leq All Segments: 61.20 dBA

♀


TOTAL Leq FROM ALL SOURCES (DAY): 66.96
                         (NIGHT): 61.20
♀
♀
```

APPENDIX Q

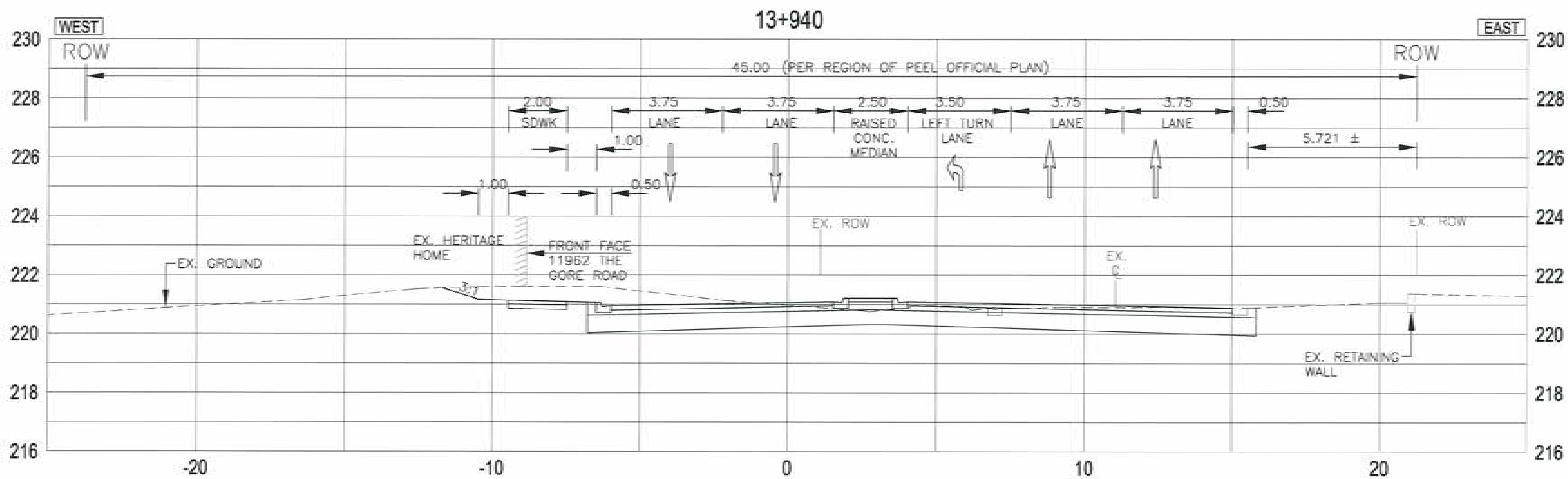
GORE ROAD CROSS SECTIONS
11962 THE GORE ROAD



TYPICAL CROSS SECTION FOR
"2006 THE GORE ROAD CLASS EA
R.J. BURNSIDE"

Client: Region of Peel — Working for you	Stantec	Scale: 1.5m 0 1.5 3.0 4.5m	NOTE: DIMENSIONS SHOWN ARE E/P TO E/P OR LINE MARKING TO LINE MARKING AS APPLICABLE	MAYFIELD ROAD AIRPORT ROAD TO COLERAINE DRIVE CLASS EA STUDY TYPICAL CROSS SECTION AT 11962 THE GORE ROAD

Drawn By	Checked By	Drawing No.
W.R.W.	J.C.B.	GS1
Date: 2012-10-19	Project No. 160210480	



TYPICAL CROSS SECTION FOR
4 LANES WITH TURN LANE
SHIFTED TO WEST
MATCHING EXISTING EAST CURB
(AVOIDS POSSIBLE GRAVES)

Client

Region of Peel
Working for you

Stantec

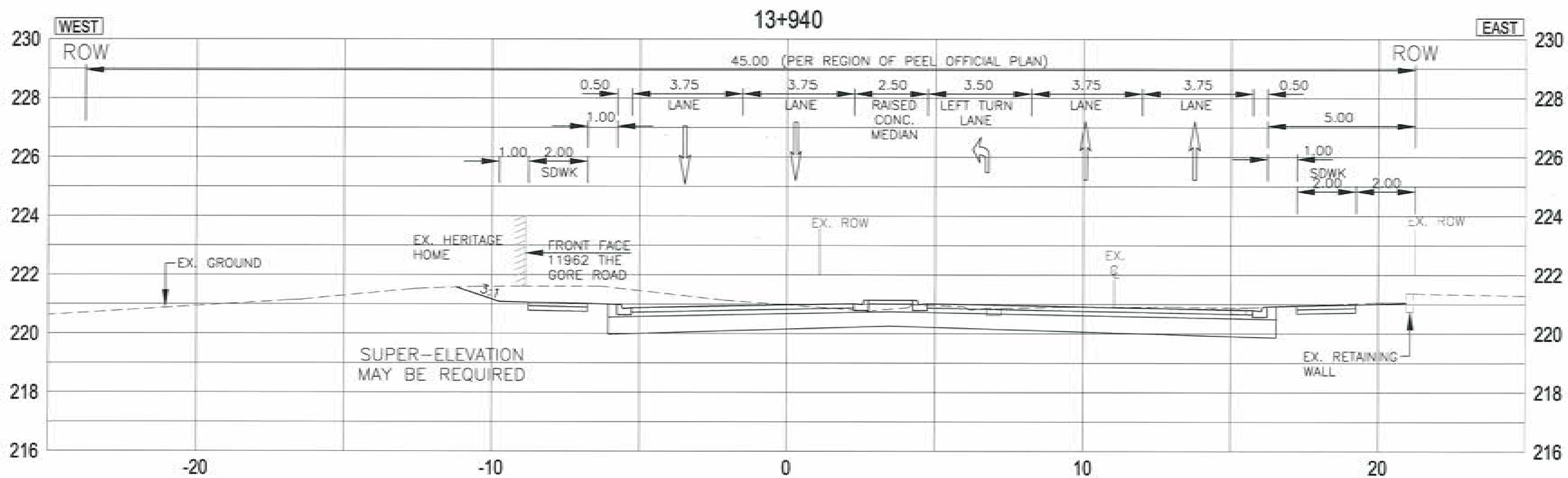
Scale

1.5m 0 1.5 3.0 4.5m

NOTE: DIMENSIONS SHOWN ARE E/P TO E/P OR LINE MARKING TO LINE MARKING
AS APPLICABLE

MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY
TYPCIAL CROSS SECTION AT
11962 THE GORE ROAD

Drawn By	Checked By	Drawing No.
W.R.W.	J.C.B.	GS2
Date 2012-10-19	Project No. 160210480	



TYPICAL CROSS SECTION FOR
4 LANES WITH TURN LANE
MATCHING EXISTING EAST ROW
(ASSUMES NO GRAVES)

Client
Region of Peel
Working for you

Stantec

Scale
1.5m 0 1.5 3.0 4.5m

NOTE: DIMENSIONS SHOWN ARE E/P TO E/P OR LINE MARKING TO LINE MARKING
AS APPLICABLE

MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY
TYPCIAL CROSS SECTION AT
11962 THE GORE ROAD

Drawn By	Checked By	Drawing No.
W.R.W.	J.C.B.	
Date 2012-10-19	Project No. 160210480	GS3

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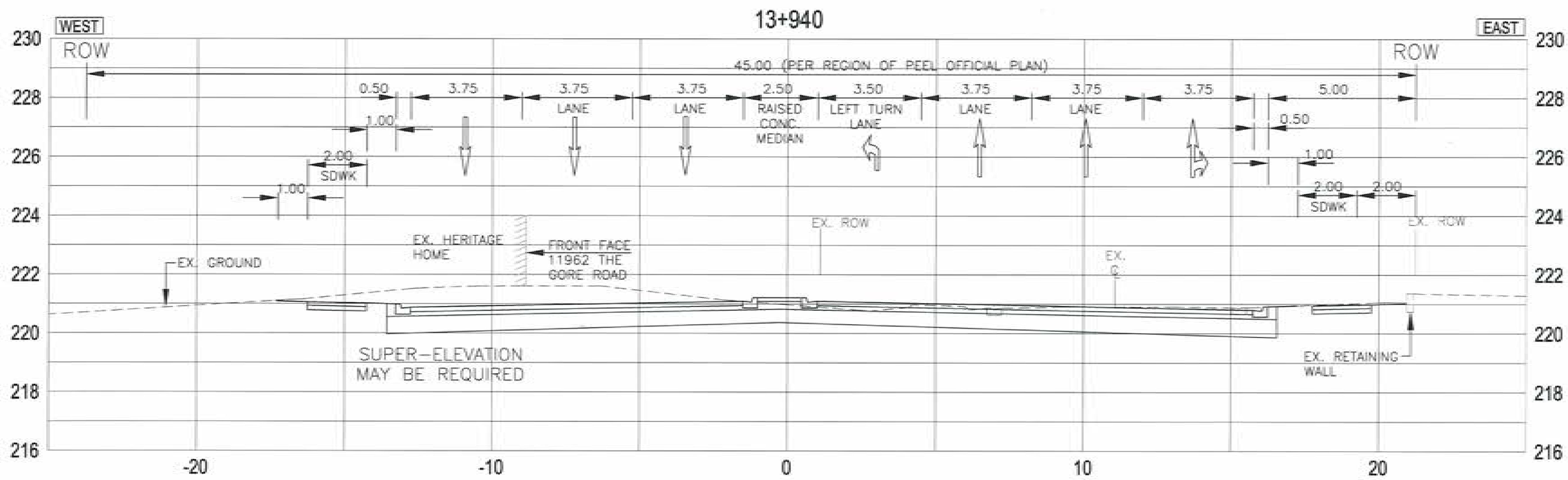
2012/10/19 9:18 AM by white, bill (kitchener)



TYPICAL CROSS SECTION FOR
6 LANE ULTIMATE ROADWAY
STARTING WITH EAST ROW LINE

Client

Region of Peel
Working for you

Stantec

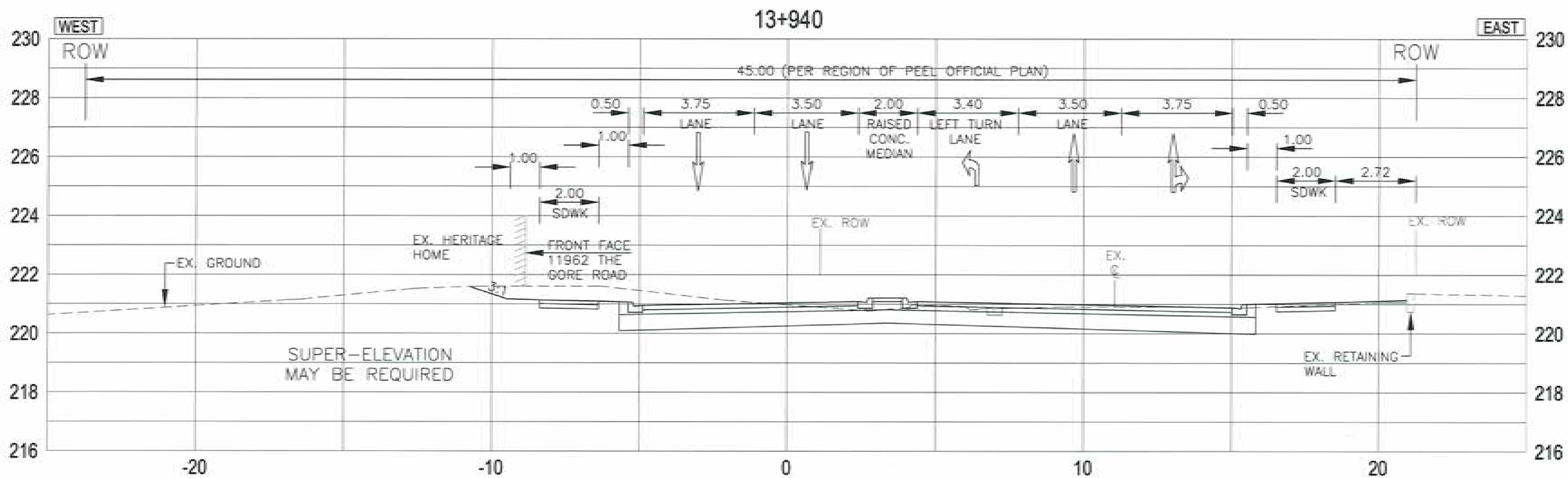
Scale

1.5m 0 1.5 3.0 4.5m

NOTE: DIMENSIONS SHOWN ARE E/P TO E/P OR LINE MARKING TO LINE MARKING
AS APPLICABLE

MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY
TYPCIAL CROSS SECTION AT
11962 THE GORE ROAD

Drawn By	Checked By	Drawing No.
W.R.W.	J.C.B.	
Date	Project No.	GS4
2012-10-19	160210480	



TYPICAL CROSS SECTION FOR 4 LANE INTERIM
CONDITION MATCHING EXISTING EAST CURB WITH
MODIFIED LANE WIDTHS (STA. 13+940)
(SAME AS MAYFIELD ROAD)

Client

Region of Peel
Working for you

Stantec

Scale

1.5m 0 1.5 3.0 4.5m

NOTE: DIMENSIONS SHOWN ARE E/P TO E/P OR LINE MARKING TO LINE MARKING AS APPLICABLE

MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY
TYPCIAL CROSS SECTION AT
11962 THE GORE ROAD

Drawn By	Checked By	Drawing No.
W.R.W.	J.C.B.	GS5
Date 2012-10-19	Project No. 160210480	

V:\01602\Active\160210480\design\drawings\class_ea\report\ear_dwgs\typ_13940_gore 2012/10/19 9:18 AM by:white, bill (kitchener)

APPENDIX R

MEANDER BELT ANALYSIS

Stantec Consulting Ltd.
49 Frederick Street
Kitchener, ON N2H 6M7

March 25, 2013
File: 1602-10480/10

Attention: Mr. Ben Krul
The Toronto and Region Conservation Authority
Development Services Section
Watershed Management Division
5 Shoreham Drive
Downsview ON M3N 1S4

Dear Mr. Krul:

Reference: Mayfield Road Improvements Airport Road to Coleraine Drive Addendum Meander Belt and 100-Year Erosion Assessment Humber River Watershed Crossings 5 and 14 Town of Caledon \ City of Brampton, Region of Peel

This addendum has been prepared in order to document the meander belt width and 100-year erosion rate for two additional watercourses that cross Mayfield Road, and that were not included in the original *Mayfield Road Improvements Airport Road to Coleraine Drive Meander Belt and 100-Year Erosion Assessment Humber River Watershed, Town of Caledon \ City of Brampton Region of Peel Report*, Stantec Consulting Ltd., February 2012. Background information regarding surficial geology and drainage characteristics within the project limits may be found in this reporting. The two additional watercourses are unnamed and, as such, are referenced in this document by their crossing identification numbers. Location details for the two additional water crossings are as follows:

Crossing ID	Mayfield Road Chainage	Drainage Area (Ha.)	Reach ID	Easting	Northing
5	11+800	377	M-05	601082	4850830
14	15+955	666	M-14	603477	4854065

Geomorphic Assessment

A geomorphic assessment of the watercourses was undertaken to identify active fluvial processes (e.g., erosion or deposition) and to document any change that has occurred that may affect these processes (e.g., change in land use, drainage). These changes were reviewed within a historical context, using aerial photographs as well as through a detailed examination of existing conditions as determined through field assessment.

Historical Assessment

Reference: Mayfield Road Improvements Airport Road to Coleraine Drive Addendum Meander Belt and 100-Year Erosion Assessment Humber River Watershed Crossings 5 and 14 Town of Caledon \ City of Brampton, Region of Peel

A sequence of aerial photographs (1954, 1978, and 2011 and topographic mapping (1:50 000 (1909) and OBM 1:10,000), and geologic (Quaternary) mapping were reviewed to gain insight into channel form, surrounding influences (e.g., land use/cover), and to identify any changes that have occurred during the period of record. An overlay of the channel configuration, where it was clearly identifiable on the air photos, was created in AutoCAD to enable any changes in planform (spatial position) of the watercourse to be discerned.

Land Use/Cover

Throughout the period of record, the surrounding lands have been utilized mainly for agriculture (e.g., pasture or ploughed fields), although residential development has been expanding as well in recent years. Lands upstream of Mayfield Road remain largely agricultural. The two additional watercourses traverse valley features typically vegetated with woodland, meadow or scrub.

Channel Changes

Aerial photographs were used to identify changes to channel planform (the path of the watercourse) such as those that result from artificial straightening or from long-term, gradual bank erosion. The watercourse at Crossing 5 was naturally sinuous and the quantification of the meander belt width was relatively straightforward. However, the watercourse at Crossing 14 has undergone substantial planform modification since 1909, with reach M-14U, located upstream of Mayfield Road, being realigned and straightened (sinuosity close to 1.0). The downstream section (Reach M-14D) remains naturally sinuous (sinuosity 1.6) and was used as a surrogate reach for the upstream straightened section.

Reach	Length (m)	Creek Slope[1] (%)	Sinuosity[2]	Adjacent Land Cover (upstream / downstream)
M-05	400	0.30	1.30	Scrubland-Residential / Scrubland-Ploughed Agricultural Field
M-14U	155	0.55	1.00	Scrubland-Residential / Agricultural Field-Residential
M-14D	226	0.55	1.58	Scrubland-Ploughed Agricultural Field

[1] *Creek slope measured from 2.5 m contour data*
[2] *Sinuosity is the ratio of creek length to valley length and is a measure of the "bendiness" of a watercourse. A sinuosity of 1.00 indicates a straight watercourse with no bends.*

Bank erosion rates were measured in the above reaches using 1978 and 2011 air photos, thus encompassing a 33-year interval. This timeframe is close to the 20- to 30-year interval recommended by TRCA (2004) for fluvial systems where no change to the hydrologic regime is anticipated. Where the channel was not visible on the 1978 imagery, the 1954 imagery was used to supplement the erosion rate measurements.

The channels, where visible on air photos, have not shifted substantially over the period of record and erosion rates are close to the limit imposed by measurement error. Average lateral (cross-valley) channel migration rates along in Reach M-05 and Reach M-14D is 0.06 and 0.08 m/yr., respectively, which are considered typical of small southern Ontario streams. These rates were used to determine 100-year erosion rates used in support of the final meander belt calculations.

Reference: Mayfield Road Improvements Airport Road to Coleraine Drive Addendum Meander Belt and 100-Year Erosion Assessment Humber River Watershed Crossings 5 and 14 Town of Caledon \ City of Brampton, Region of Peel

Existing Conditions

Geomorphic conditions and characteristics along the watercourse, within the subject property, were assessed in October 2011 through general level field reconnaissance. Flow conditions appeared to be close to baseflow on the date of the site visit. In addition to observations of site conditions and channel processes, field measurements such as channel dimensions were obtained. A photographic inventory of the existing site conditions has been attached in Appendix B.

Crossing 5 (Reach M-05)

- Channel conveyed through concrete box culvert under Mayfield Road
- Channel very well treed for about 70 m upstream of culvert, then vegetation transitions to scrub
- Channel bankfull width was 5 m
- Channel morphology dominated by pool-riffle structures
- Deep (~1 m) pool through culvert
- Frequent fine-textured sediment deposition in bars (vegetated and non-vegetated)
- Large vegetated bar immediately downstream of road crossing
- Some flow apparent (<10 L/s)
- Variable substrate (silt/clay and sand; pools and sand/gravel; riffles)
- Minor basal scour observed along outside of bends
- Channel well connected to floodplain
- Channel was sinuous

Crossing 14 (Reach M-14U; upstream of Mayfield Road)

- Channel conveyed through concrete box culvert under Mayfield Road
- Channel enters culvert at relatively sharp angle
- Channel straightened upstream of Mayfield Road culvert

- Partially confined valley setting (channel in contact with east valley wall)
- Channel bankfull width was 7 m
- No excessive erosion or deposition observed, minor pool scour at upstream end of culvert
- Some flow apparent (<10 L/s)
- Channel well connected to floodplain

Crossing 14 (Reach M-14D, downstream of Mayfield Road

- Relatively deep pool continues through culvert to downstream end
- Large bar deposit (sand/gravel) 5-15 m downstream of culvert (well vegetated with grasses and herbaceous vegetation)
- Sinuous channel
- Minor basal scour along outside bends (not excessive)
- Good channel-floodplain connection
- Banks well-protected by vegetation

Summary

The crossings examined above have drainage areas of 377 and 666 ha, for Crossing 5 and 14, respectively. These were larger watercourses, have defined bed and banks and, except for reach M-14U, exhibited a sinuous planform. Both watercourses were well vegetated and did not exhibit excessive erosion or deposition. The large bar deposit downstream of the culvert at Crossing 14 does not appear to be active as evidenced by well-established vegetation and no recent deposition.

Both watercourses appear to be generally stable, as determined by the assessment of historic and existing channel conditions. The bank erosion rate measured between 1954/1978 and 2011 were 0.06 and 0.08 m/yr, for Reach M-05 and Reach M-14U/L, respectively, and are close to the theoretical limit of detection, as imposed by the imagery resolution. Field investigations confirmed that the channels were stable, as indicated by the abundant bank vegetation, minimal erosion, and generally good floodplain connection (low bank height permits floodwaters to spill readily onto the floodplain, thus minimizing the energy available for bank erosion). As such, the bank erosion rates as determined by air photo interpretation were considered to be a reasonable estimate.

Reference: Mayfield Road Improvements Airport Road to Coleraine Drive Addendum Meander Belt and 100-Year Erosion Assessment Humber River Watershed Crossings 5 and 14 Town of Caledon \ City of Brampton, Region of Peel

Meander Belt Analysis

The meander belt is a term used to quantify the lateral extent of a river's occupation of its floodplain (TRCA, 2004). Meander belts are inherently variable and their extent is dependent on a number of controlling factors. These include, among other things, hydrology, stormwater flows, bank erosion rates, and the degree of channel confinement by the valley walls.

The technique applied in this assessment follows the procedures outlined in the TRCA Meander Belt Delineation Procedure (2004). The specific methodology applied to the study area was the method that assumes that no change in hydrology is anticipated. This scenario is considered appropriate as the proposed works include only the widening of Mayfield Road and extension or replacement of the existing culvert structures.

The basis for the meander belt delineation is outlined in Section 5.5.1 of TRCA (2004).

Surrogate Reaches

Reach M-05 and Reach M-14D had sections of channel that were naturally sinuous, thus simplifying the belt width delineation procedure. The meander configuration in Reach M-14D (downstream of Mayfield Road), was used as a surrogate to quantify the meander belt dimensions for the entire watercourse at this location, including the straightened upstream section in reach M-14U.

Meander Axis

The meander axis is a term used to describe the general down-valley orientation of the meander pattern. The meander axis defined the trend of the valley, and thus the trend or orientation of the meander belt within that valley. The delineation of the meander axis along the watercourse crossings of Mayfield Road was fairly straightforward owing to the generally simple meander patterns of the channels. No meander belt shift was observed for any of the crossings using the 1954 and 1978 aerial photography overlays.

Preliminary Belt Width

In order to define the meander belt width, an accurate map of the channel planform is required. The high resolution aerial photography (flown 2011) provided a suitable means with which to accurately map channel planform. The location of the channel on the imagery was confirmed during the site reconnaissance.

Final Belt Width

The final belt width was determined by incorporating additional setbacks that are appropriate to the physical setting of the watercourse, anticipated changes to the meander belt axis and hydrological regime, and to account for methodological variations in the belt width delineation (e.g., use of in situ meander pattern, surrogate reach(es) or empirical equations).

The computations were undertaken in consideration of the following:

- No alteration to peak flow discharge (i.e., Q2) was anticipated, due to established stormwater management (SWM) guidelines
- No change in flow duration or volume is anticipated
- During the air photo analysis, it was the channel centerline that was mapped (not the banks). Therefore, the channel bankfull width (as measured during the site visit) was added to the meander belt width calculations
- The 100-year erosion amount was added to each side of the meander belt
- There was no observed shift in meander axis throughout the air photo record

The computational procedures follow the method outlined in TRCA (2004), Section 5.5.1.

Crossing 5

The watercourse at Crossing 5 exhibited a well-defined meander pattern. Upstream, the channel is well-defined and is treed with conifers; however, the channel lies within private property and it was not possible to investigate the alignment in detail. Downstream, the channel is surrounded by heavily vegetated scrubland. Current aerial imagery showed some evidence of chute features within a portion of the downstream scrubland, the presence of which was confirmed by site reconnaissance. The lateral extent of the preliminary belt width was delineated to include all chute features.

1. A preliminary belt width of 41.0 m was measured.
2. The channel bankfull width of 5.0 m was added to the preliminary belt width to yield an existing belt width of 46.0 m.
3. Since the existing belt width is less than 50 m, the 100-year erosion rate of 6.0 m was added to each side of the meander belt for a total 58.0 m.
4. No shift in meander axis was observed; therefore, the final belt width is 58.0 m.
5. The final belt width is presented in Appendix A - Figure 1.0.

Crossing 14

The watercourse at Crossing 14 exhibited a well-defined meander pattern downstream of Mayfield Road while upstream, it appears the channel has been straightened. The upstream channel is well-defined through a narrow section of scrubland that abuts an inactive agricultural field and a recently cleared residential lot; however, due to the straightening of the channel, it could not be used for meander belt width calculations. Historical aerial imagery shows that the culvert crossing of Mayfield Road was previously located 65 m southwest of the current culvert crossing location and evidence of the former (abandoned) channel downstream of Mayfield Road is clearly visible on the 2011 imagery. This abandoned channel was incorporated into the belt width as per TRCA (2004) guidelines. Aerial imagery from 1978 was available for this reach, however it was not used as the location of the stream could not be clearly defined.

1. A preliminary belt width of 74.4 m was measured in the surrogate reach downstream of Mayfield Road.
2. The channel bankfull width of 7.0 m was added to the preliminary belt width to yield an existing belt width of 81.4 m.
3. Since the existing belt width is greater than 50 m, it was multiplied by a factor of safety of 1.1 (TRCA, 2004) for a final belt width of 89.5 m.
4. No shift in meander axis was observed therefore the final belt width is 89.5 m.
5. The final belt width is presented in Appendix A - Figure 2.0.

Summary

Meander Belt Assessments were completed for two crossings (Crossing 5 and 14), in addition to the eight crossings presented in the *Mayfield Road Improvements Airport Road to Coleraine Drive Meander Belt and 100-Year Erosion Assessment Humber River Watershed, Town of Caledon \ City of Brampton Region of Peel Report*, Stantec Consulting Ltd., February 2012 and the three crossings presented in the June 2012 addendum to this report.

Standard TRCA (2004) meander belt delineation protocols were applied. The 100-year erosion rate was calculated using recent and historic aerial photography and the reliability of the results confirmed by creek inspections. The results of the meander belt analysis are presented below.

Reference: Mayfield Road Improvements Airport Road to Coleraine Drive Addendum Meander Belt and 100-Year Erosion Assessment Humber River Watershed Crossings 5 and 14 Town of Caledon \ City of Brampton, Region of Peel

100-Year Erosion Rate and Meander Belt Width Summary

Crossing ID	100-year Erosion Rate (m)	Final Meander Belt Width (m)
5	6	58.0
14	8	89.5

We trust these recommendations meet with your approval. Please do not hesitate to contact the undersigned should you have any questions.

Regards,

STANTEC CONSULTING LTD.

Heather Amirault, P.Eng.
Water Resources Engineer
Tel: (519) 585-7453
Fax: (519) 579-8664
heather.amirault@stantec.com

Trevor Chandler, M.Sc
Fluvial Systems Specialist
Tel: (519) 836-6050
Fax: (519) 836-2493
trevor.chandler@stantec.com

Attachment: Appendix A: Figures
Appendix B: Photos

c. Mr. Hitesh Topiwala / Mr. Steve Ganesh / Mr. Gino Dela Cruz, Region of Peel
Mr. John Bayley, Stantec Consulting Ltd.

dm w:\active\160210480\design\report\meanderbeltassessment\meander belt assessment addendum\let_b21-13_dm_meanderbelt_crossing_5&14_hea.docx

REFERENCES

Stantec Consulting, 2012. Mayfield Road Improvements Airport Road to Coleraine Drive Meander Belt and 100-year Erosion Assessment Humber River watershed, Town of Caledon \ City of Brampton Region of Peel. Prepared for the Toronto and Region Conservation Authority.

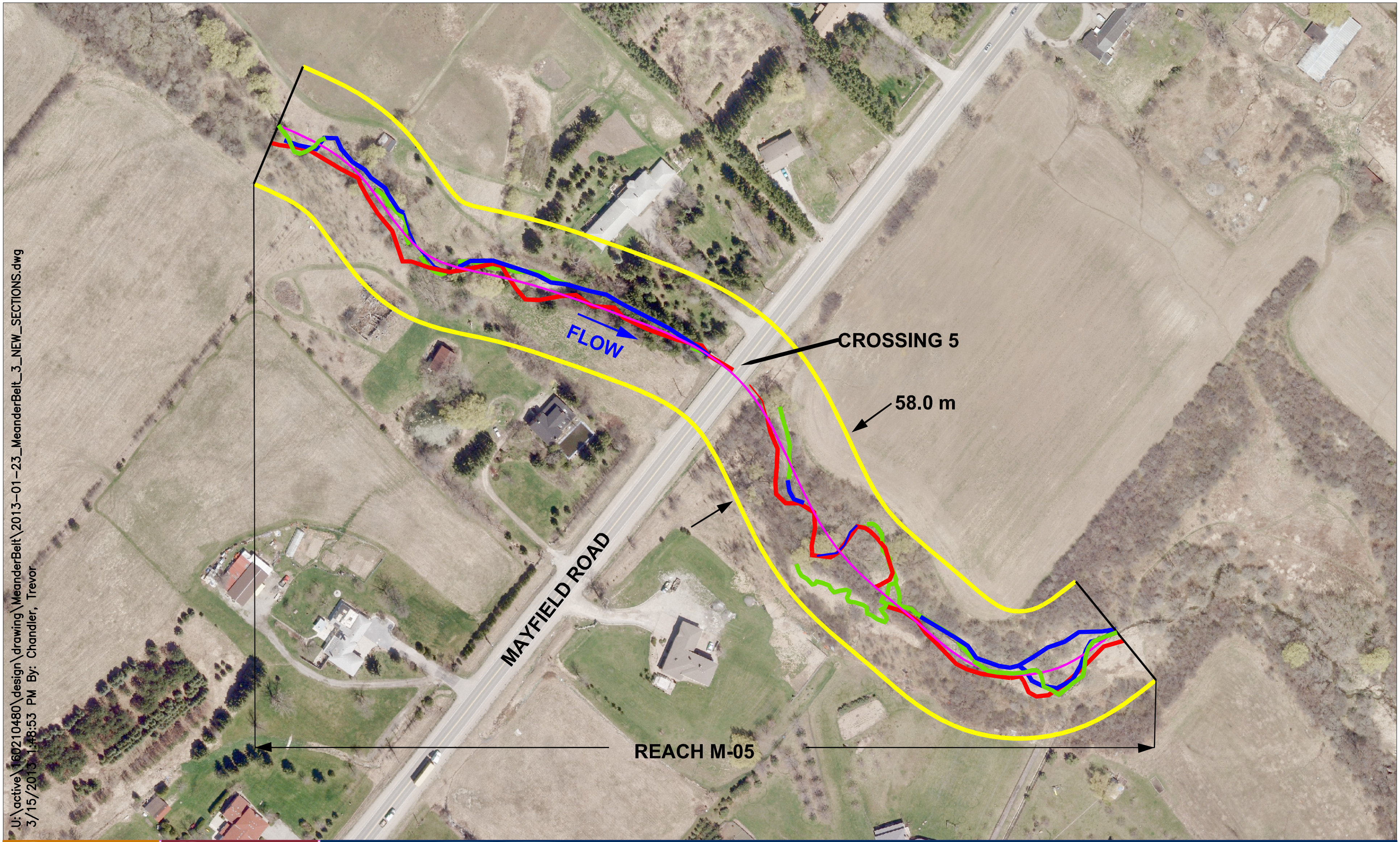
Stantec Consulting, June 2012. Addendum: Mayfield Road Improvements Airport Road to Coleraine Drive Meander Belt and 100-year Erosion Assessment Humber River watershed, Town of Caledon \ City of Brampton Region of Peel. Prepared for the Toronto and Region Conservation Authority.

Toronto and Region Conservation Authority (TRCA). 2004. *Belt Width Delineation Procedures*.

White, O.L., and Karrow, P.F., 1973, Quaternary Geology of Bolton, Ontario geological Survey, Map 2275.

APPENDIX A

Figures



Stantec

Scale

0 25 75 125m

1:2500

N

Legend

- Watercourse 2011
- Watercourse 1978
- Watercourse 1954
- Reach Break
- Meander Axis
- Final Belt Width

Notes

1. Background imagery 2011

Client/Project

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

160210480

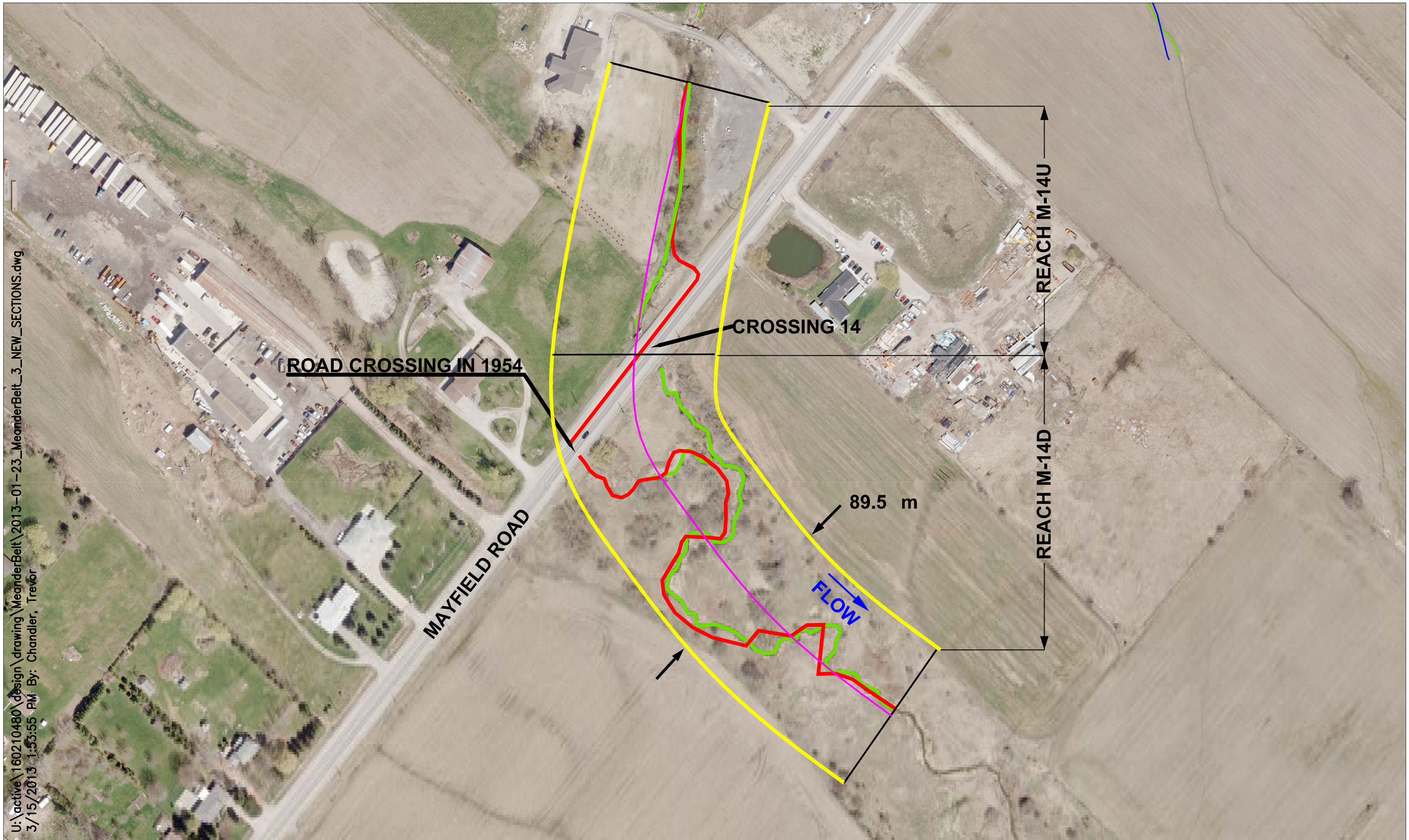
February 2013

Figure No.

1.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 5



Scale

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1:3000

N

Stantec

Legend

Watercourse 2011	Meander Axis
Watercourse 1978	Final Belt Width
Watercourse 1954	
Reach Break	

Notes

1. Background imagery 2011

Client/Project

February 2013

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

160210480

Figure No.

2.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 14

APPENDIX B

Photos

Photo 1: Crossing 5 upstream – looking upstream from Mayfield Road

Photo 2: Crossing 5 upstream – looking upstream from Mayfield Road

Photo 3: Crossing 5 downstream – looking upstream toward Mayfield Road

Photo 4: Crossing 5 downstream – looking downstream

Photo 5: Crossing 5 downstream – looking downstream

Photo 6: Crossing 5 downstream – downstream end of culvert

Photo 7: Crossing 5 downstream – looking downstream from Mayfield Road

Photo 8: Crossing 14 upstream – upstream end of culvert

Photo 9: Crossing 14 upstream – looking upstream

Photo 10: Crossing 14 upstream – looking upstream from Mayfield Road

Photo 11: Crossing 14 upstream – looking upstream from Mayfield Road

Photo 12: Crossing 14 downstream – looking downstream from Mayfield Road


Photo 13: Crossing 14 downstream – looking upstream


Photo 14: Crossing 14 downstream – looking downstream


Photo 15: Crossing 14 downstream – downstream bank


Photo 16: Crossing 14 downstream - looking downstream

Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410

June 15, 2012
File: 1602-10480/10

The Toronto and Region Conservation Authority
Development Services Section
Watershed Management Division
5 Shoreham Drive
Downsview ON M3N 1S4

Attention: Mr. Ben Krul, Senior Planner

Dear Mr. Krul:

Reference: Mayfield Road Improvements Airport Road to Coleraine Drive Meander Belt and 100-Year Erosion Assessment Humber River Watershed Town of Caledon \ City of Brampton Region of Peel

INTRODUCTION

Stantec Consulting Ltd. (Stantec) has been retained to undertake an Environmental Assessment (EA) for proposed Mayfield Road improvements between Airport Road and Coleraine Drive. As part of this assessment, a Meander Belt Assessment was undertaken for eight (8) watercourses within the study area (Mayfield Road Improvements Airport Road to Coleraine Drive Meander Belt and 100-Year Erosion Assessment, Stantec, 2012). Subsequent to this assessment, three (3) additional watercourses that were not originally assessed were included in this investigation.

The three watercourses include:

- Salt Creek (Crossing 3)
- Unnamed tributary to the West Humber River (Crossing 6)
- West Humber River (Crossing 11)

This memo presents the Meander Belt Assessments for these three (3) watercourses and as such is considered supplemental to, and should be read in conjunction with, the original Stantec (2012) Meander Belt Assessment reporting.

Reference: Mayfield Road Improvements Airport Road to Coleraine Drive Meander Belt and 100-Year Erosion Assessment Humber River Watershed Town of Caledon \ City of Brampton Region of Peel

BACKGROUND INFORMATION

Reaches

To facilitate the Meander Belt Assessment, reaches were delineated along each of the watercourses investigated (Table 1). The reaches contain relatively large channels that are naturally sinuous and, as a result, belt width was measured directly for each watercourse. No surrogate reaches were required, thereby, simplifying the assessment procedure.

Table 1: Location of Mayfield Road Watercourse Crossings and Project Reaches

Crossing ID	Mayfield Road Chainage	Reach ID	Easting	Northing
3	11+015	M-03	600417	4850203
6	12+300	M-06	601211	4851206
11	14+400	M-11	602535	4852848

Geology

The three (3) watercourses are dominated by glacial sediments and, to a lesser extent, Pleistocene bedrock. Salt Creek is dominated by Ordovician shale of the Dundas-Meaford Formation, particularly in the vicinity of Mayfield Road (White and Karrow, 1973).

The West Humber River and its assessed tributary have cut into glacial sediments (Wildfield Till), which consists of silty-clay loam and lesser amounts of coarser material. Owing to this geology and the relatively large size of the watercourses, surface deposits are dominated by extensive deposits of modern alluvium (silt, sand, and gravel).

GEOMORPHIC ASSESSMENT

As in the original Assessment (Stantec 2012), geomorphic assessment of the watercourses were undertaken to identify active fluvial processes (e.g., erosion or deposition) and to document any change that has occurred that may affect these processes (e.g., change in land use, drainage). These changes were reviewed within a historical context, using archival aerial photographs as well as thorough a detailed examination of existing conditions as determined through field assessment.

HISTORIC ASSESSMENT

The watercourses were examined using aerial photographs flown in 1954, 1978, 1994 and 2011. Land use upstream of Mayfield Road was predominantly agriculture throughout the period of record and remains so to this day. Riparian land cover has changed gradually since 1954, at which time there were few trees along the creeks or adjacent valleys. Since then, valleys have become increasingly forested, in particular along the Humber River. The three (3) channels were sinuous on all imagery with no apparent disturbance to planform (Table 2).

Table 2: Summary of Reach Characteristics Estimated from Topographic Mapping and Aerial Photographs

Reach	Length (m)	Creek Slope[1] (%)	Sinuosity[2]	Adjacent Land Cover (upstream and downstream of Mayfield Road)
M-03	1994	0.67	1.18	Scrubland (valley) / agriculture (uplands)
M-06	1578	0.65	1.29	Scrubland, cattails and hayfield (valley) / agriculture and houses (uplands)
M-11	894	0.21	1.38	Wooded (valley) / manicured lawns (uplands)

[1] *Creek slope measured from 10 m contour data*
[2] *Sinuosity is the ratio of creek length to valley length and is a measure of the "bendiness" of a watercourse. A sinuosity of 1.00 indicates a straight watercourse with no bends.*

Bank erosion rates were measured in appropriate reaches using 1978 and 2011 air photos, thus encompassing a 33-year interval. Imagery from 1994 was used to assess bank erosion rates along the West Humber tributary owing to the good visibility of this watercourse in the 1994 imagery, thus providing a 17 year interval. These timeframes are close to the 20 to 30 year interval recommended by The Toronto and Region Conservation Authority (TRCA) (2004) for assessing erosion rates in systems where no change to the hydrologic regime is anticipated.

The channels, where visible on air photos, have not shifted substantially over the period of record and erosion rates are close to the limit imposed by measurement error. Average lateral (cross-valley) channel migration rates for Crossings 3, 6, and 11 are a respective 0.10, 0.07, and 0.08 m/yr., which are typical of small southern Ontario streams. These rates were used to determine 100-year erosion rates used in support of the final meander belt calculations.

EXISTING CONDITIONS

Geomorphic conditions and characteristics along each watercourse within the subject property were assessed in October 2011 through general level field reconnaissance. Flow conditions appeared to be close to baseflow on the date of the site visit. In addition to observations of site conditions and channel processes, field measurements such as channel bankfull width were obtained, where possible. A photographic inventory of the existing site conditions has been compiled in Appendix A.

Reference: Mayfield Road Improvements Airport Road to Coleraine Drive Meander Belt and 100-Year Erosion Assessment Humber River Watershed Town of Caledon \ City of Brampton Region of Peel

Crossing 3 (Reach M-03) Salt Creek

- Channel passes through open bottom concrete bridge at Mayfield Road
- Unconfined channel at Mayfield Road but within reach channel is partially confined. Channel approaches or contacts valley wall on west (right downstream facing) side of valley
- Channel vegetation dominated by densely rooted grass
- Channel bankfull width approximately 8 m wide
- Channel difficult to discern in many areas due to grassy cover
- No excessive erosion or deposition observed near Mayfield Road
- Some flow apparent (< 50 L/s)
- Channel well connected to floodplain
- Channel was sinuous

Crossing 6 (Reach M-06) West Humber Tributary

- Channel conveyed through opened-bottomed concrete bridge at Mayfield Road
- Channel is set within well-defined valley with 3-4 m high valley walls
- Channel is unconfined near Mayfield Road
- No excessive erosion or deposition observed near Mayfield Road
- Watercourse is well-connected to floodplain with no valley wall contacts
- Good channel definition with bankfull width of 5 m
- Channel morphology vegetation (cattails) dominated, no well-developed pool-riffles
- No excessive erosion or deposition observed near Mayfield Road
- Channel is generally straight within 150 m of Mayfield Road but sinuous elsewhere

Crossing 11 (Reach M-11) West Humber River

- Channel conveyed through open-bottomed bridge at Mayfield Road
- Channel is unconfined upstream and downstream of Mayfield Road
- Good channel definition with bankfull width of 7.5 m
- Channel slightly incised; bank height approximately 1.5 m, bankfull < 1.5 m

- Modest bank erosion observed upstream and downstream of Mayfield Road
- Bank material is dense clay-silt and somewhat resistant to bank erosion
- Channel is in a wooded area with grasses and herbs on banks in more open areas
- Watercourse is well-connected to floodplain with no valley wall contacts
- Channel morphology dominated by pool and riffles

MEANDER BELT ANALYSIS

The final meander belt width was determined by incorporating additional setbacks that are appropriate to the physical setting of the watercourse, anticipated changes to the meander belt axis and hydrological regime, and to account for methodological variations in the belt width delineation (e.g., use of in situ meander pattern, surrogate reach(es) or empirical equations).

The channels investigated were unconfined or partially confined and naturally sinuous, thus simplifying the meander belt calculations. The computations were undertaken in consideration of the following:

- No alteration to peak flow discharge (i.e., Q2) was anticipated, due to established stormwater management (SWM) guidelines
- No change in flow duration or volume is anticipated
- During the air photo analysis, it was the channel centerline that was mapped (not top of bank). Therefore, the channel bankfull width (as measured during the site visit) was added to the meander belt width calculations
- The 100-year erosion amount was added to each side of the meander belt
- There was no observed shift in meander axis throughout the air photo record

The computational procedures follow the method outlined in TRCA (2004), Section 5.5.1.

Crossing 3 (Salt Creek)

Salt Creek exhibits an irregular but well-defined meander pattern. Aerial photographs further indicate that the meander planform is dynamic, with the dominant processes being bank erosion and avulsion, as evidenced by extensive chute development on 2011 imagery. All observed chutes were considered to be part of the active channel and therefore included within the preliminary meander belt.

1. Preliminary belt width of 48 m was measured.
2. Channel bankfull width of 8 m was added to the preliminary belt width to yield an existing belt width of 56 m.
3. Since the existing belt width is greater than 50 m, it was multiplied by a factor of safety of 1.1 (TRCA, 2004) for a total of 61.6 m.
4. No shift in meander axis was observed therefore the final belt width is 61.6 m.
5. The final belt width is presented in Figure 1.

Crossing 6 (West Humber Tributary)

The tributary exhibits a well-defined meander pattern. The watercourse is relatively straight within 150 m of Mayfield Road but sinuous upstream and downstream of this location. The channel is well defined and is clearly visible on 2011 aerial photography. The imagery indicated two prominent oxbow features located on the east side of the floodplain approximately 120 m downstream of Mayfield Road. No channel was evident on 1954 or 1978 imagery but the features were considered to lie within the preliminary belt width.

1. Preliminary belt width of 42 m was measured.
2. Channel bankfull width of 5.0 m was added to the Preliminary belt width to yield an existing belt width of 47 m.
3. Since the existing belt width is less than 50 m, the 100 year erosion rate of 7.3 m was added to each side of the meander belt for a total of 61.6 m.
4. No shift in meander axis was observed therefore the final belt width is 61.6 m.
5. The final belt width is presented in Figure 2.

Reference: Mayfield Road Improvements Airport Road to Coleraine Drive Meander Belt and 100-Year Erosion Assessment Humber River Watershed Town of Caledon \ City of Brampton Region of Peel

Crossing 11 (West Humber River)

The West Humber River is a large watercourse and exhibits a naturally meandering planform in the vicinity of Mayfield Road. The dominant mode of planform change is bank erosion with no chute development evident, as was observed along Salt Creek. Prominent meanders near Mayfield Road are propagating in the downstream direction with some cross-valley migration evident as well.

1. Preliminary belt width of 48 m was measured.
2. Channel bankfull width of 7.5 m was added to the preliminary belt width to yield an existing belt width of 55.5 m.
3. Since the existing belt width is greater than 50 m, it was multiplied by a factor of safety of 1.1 (TRCA, 2004) for a total of 61.1 m.
4. No shift in meander axis was observed therefore the final belt width is 61.1 m.
5. The final belt width is presented in Figure 3

SUMMARY

Meander Belt Assessments were conducted for three additional crossings in the vicinity of Mayfield Road, in the Region of Peel. Standard TRCA meander belt delineation procedures were applied. The 100-year erosion rate was measured using recent and archival aerial photography and, where appropriate, the result incorporated into the final belt width calculation. The results of the belt width analysis are presented in Table 3.

Table 3: 100-Year Erosion Rate and Meander Belt Width Summary

Crossing ID	Watercourse	100-year Erosion Rate (m)	Final Meander Belt Width (m)
3	Salt Creek	10	61.6
6	West Humber Tributary	7	61.7
11	West Humber River	8	61.1

**Reference: Mayfield Road Improvements Airport Road to Coleraine Drive Meander Belt and 100-Year Erosion Assessment Humber River Watershed
Town of Caledon \ City of Brampton
Region of Peel**

REFERENCES

Stantec Consulting, 2012. Mayfield Road improvements Airport Road to Coleraine Drive Meander Belt and 100-year Erosion Assessment Humber River watershed, Town of Caledon \ City of Brampton Region of Peel. Prepared for the Toronto and Region Conservation Authority.

Toronto and Region Conservation Authority (TRCA). 2004. *Belt Width Delineation Procedures*.

White, O.L., and Karrow, P.F., 1973, Quaternary Geology of Bolton, Ontario geological Survey, Map 2275.

All of which is respectfully submitted;

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Attachment: Appendices A and B

c. Ms. Heather Amirault / Mr. John Bayley, Stantec Consulting Ltd.

APPENDIX A

Photographic inventory

Photo 1: Crossing 3 upstream - looking upstream from Mayfield Road

Photo 2: Crossing 3 downstream– looking downstream from Mayfield Road

Photo 3: Crossing 6 upstream – looking upstream from Mayfield Road

Photo 4: Crossing 6 downstream – looking upstream

Photo 5: Crossing 11 upstream – looking downstream at culvert

Photo 6: Crossing 11 downstream – looking downstream from Mayfield Rd

Stantec

APPENDIX
A

PREPARED FOR:
Region of Peel

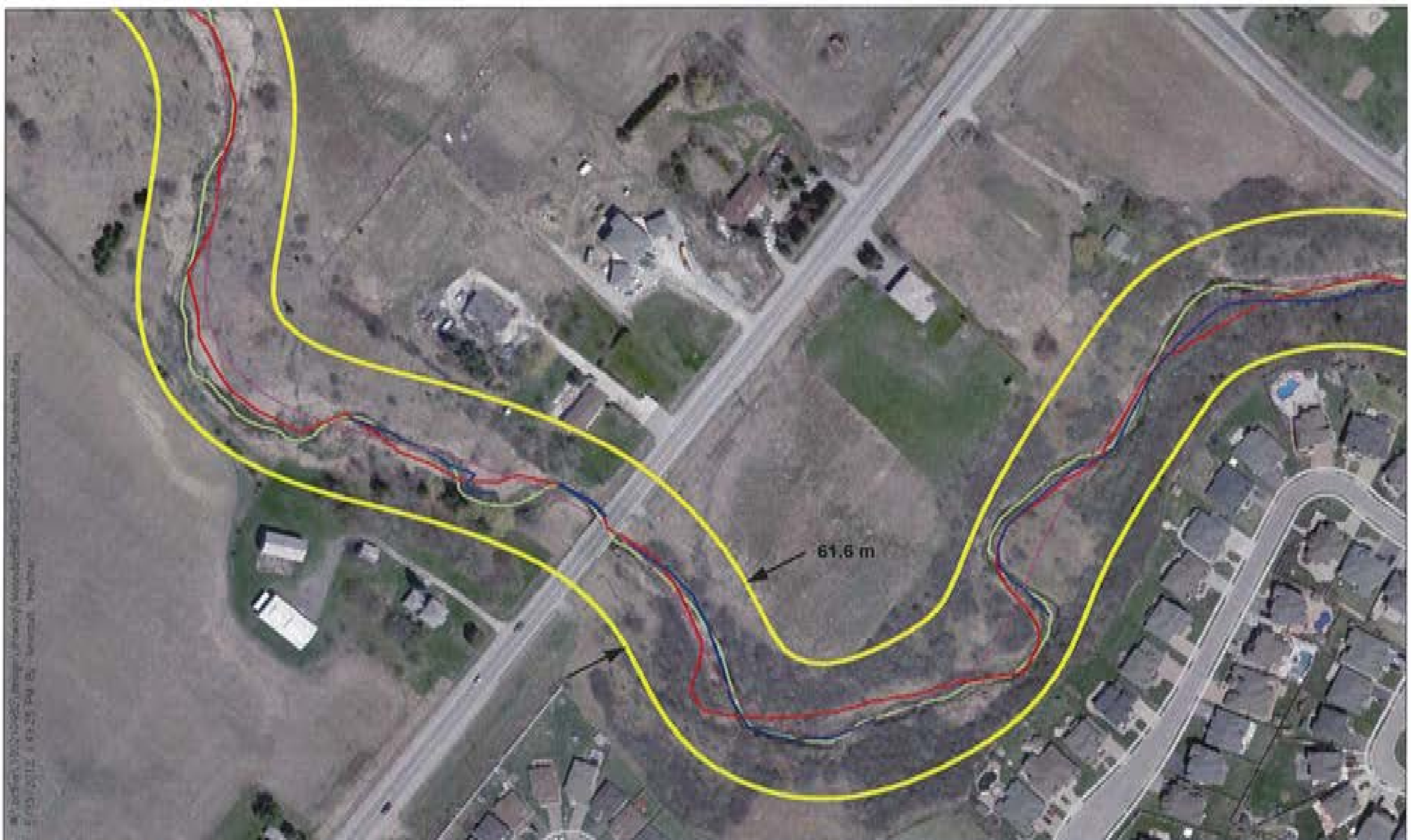
TITLE
Photographic Inventory

SITE
Mayfield Road Crossings

kas w:\active\160210480\design\report\meanderbeltassessment\addendum\appa_photos_addendum.docx

APPENDIX B

Figures



Scale

0 25 75 125

1:2500

N

Stantec

Legend

- Watercourse 2011
- Watercourse 1978
- Watercourse 1954
- Reach Break
- Meander Axis
- Final Belt Width

Notes

1. Background imagery 2011

May 2012

Client/Project

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

160210480

Figure No.

1.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 3 (Salt Creek)

June 2012

Scale

0 20 60 100m

1:2000

N

Stantec

Legend

Watercourse 2011

Watercourse 1994

Watercourse 1978

Watercourse 1954

Oxbow Feature

Meander Axis

Final Belt Width

Notes

1. Background imagery 2011

Client/Project

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

160210480

Figure No.

2.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 6

Scale

1:2000 0 20 60 100m

N

Legend

- Watercourse 2011
- Watercourse 1978
- Watercourse 1954
- Meander Axis
- Final Belt Width

Notes

1. Background imagery 2011

Stantec

June 2012

Client/Project

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

160210480

Figure No.

3.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 11 (West Humber River)

Mayfield Road Improvements
Airport Road to Coleraine Drive
Meander Belt and 100-Year Erosion Assessment
Humber River Watershed
Town of Caledon /
City of Brampton, Region of Peel

Prepared for:

The Toronto and Region
Conservation Authority
Development Services Section
Watershed Management Division
5 Shoreham Drive
Downsview ON M3N 1S4

Prepared by:

Stantec Consulting Ltd.
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Kitchener ON N2H 6M7

File No. 1602-10480
Date: February 2012

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Glossary of Terms

Aggradation	The process by which sediment or other material accumulates and builds up. In river landforms, aggradation often occurs because of the channel's inability to transport its sediment load.
Alluvial	Relating to rivers.
Alluvial Channel	A watercourse that flows through its own sediment wherein active processes of erosion and deposition occur.
Avulsion	The sudden change in the course (planform) of a river, most often caused by a large flood.
Bankfull Flow	Flow that fills the channel to top of bank. The term is strictly applicable only to equilibrium channels and corresponds to the critical channel-forming flow that has a recurrence interval of approximately 1.5 years.
Bank Widening	An increase of channel width, typically caused by bank erosion.
Bedform	A depositional or erosional feature found on the channel bed (e.g. riffle or pool).
Bed Material	Sediment found on the channel bed that chiefly comprises channel depositional features (e.g. medial bars) and typically consists of sand, gravel, cobble or boulders.
Channel	An alluvial drainage feature with well-defined bed and banks.
Chute	A channel feature created when a channel avulses and abandons or is in the process of abandoning the existing active channel. Chutes indicate the location of the meander belt.
D_{50}	The median grain size of a particular sediment sample (i.e., 50% of the sediment is smaller than the diameter indicated).
Degradation	In fluvial systems, refers to the process of erosion or wearing down of the channel bed. Also called "downcutting".
Entrenchment	The degree to which a watercourse is able to access its floodplain. Highly entrenched channels are essentially cut off from their floodplain.
Longitudinal Profile	The graphical representation of a streambed as viewed in the longitudinal direction.

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Morphology	The structure or physical form of a feature or landform that may also provide insight to the processes responsible for its creation.
Planform	The course of a river as viewed from above.
Planimetric Form Adjustment	A shift in the course of a channel which may be gradual or sudden (e.g. caused by meander cutoffs or avulsions).
Pool	A topographic low in a river channel caused by scour that typically occurs during bankfull flow stage. Once formed, pools are relatively stable and frequently form in bends of regularly meandering channels. (See riffle)
Reach	A length of channel that exhibits uniform physical properties.
Riffle	A topographical high along a channel caused by deposition. Riffles tend to form at inflection points between channel bends. (See pool)
Roughness	A degree of resistance to flow imposed by substrate, vegetation or other obstructions.
Semi-alluvial clay	A watercourse that flows through a combination of its own sediment and underlying clay (till) whose origin is not associated with fluvial processes operative within the modern channel.
Sinuosity	The degree of "crookedness" in the planform of a watercourse. Sinuosity is expressed numerically as the ratio of stream length to valley length.
Step-pool	A channel with closely-spaced pools, typically forming in steep gradients.
Stream Power	The measure of energy available to a watercourse to perform work through erosion of the channel boundary and the transport of sediment.
Subpavement	The parent material (e.g. clay till or unconsolidated sediments) that is underneath the surface alluvium.
Swale	A poorly defined drainage feature that often flows ephemerally, that lacks a well-defined bed or banks.
Unconsolidated	A term used to describe sediment that is loose and not bound by inter-granular cohesion.
Till (Glacial)	Sediment deposited directly by glaciers (i.e., ice-contact). The fluvial erosion of till creates, and largely determines the natural of, alluvial sediments.

1.0 Introduction

Stantec Consulting Ltd. (Stantec) has been retained to undertake an Environmental Assessment (EA) for proposed Mayfield Road improvements between Airport Road and Coleraine Drive. As part of this EA, the Toronto Region Conservation Authority (TRCA) has requested that Meander Belt Assessments be conducted for several of the watercourse crossings of Mayfield Road. The required analysis for the selected watercourse crossings is summarized in correspondence received from the TRCA on September 29, 2011 (attachment, Appendix A). These assessments are being conducted in anticipation of a proposed road widening at the various watercourse crossings to determine the physical impacts to the watercourses and to recommend appropriate planning setbacks. The assessment results will inform structure design which will allow the development of accurate cost estimates for the Region of Peel's Capital Budget process and will facilitate the TRCA's review of the preferred alternative. The study area is presented in (Figure 1, Appendix B). Of the 16 crossings, 8 (Crossing 2, 7, 8, 10, 12, 13, 15, and 16) have been identified by TRCA as requiring meander belt width and 100-year erosion rate analysis.

1.1 SCOPE OF WORK

The scope of this Meander Belt Assessment has involved various components that together lead to the ultimate goal of providing an appropriate meander belt width for the selected watercourse crossings situated within the study area. These components were as follows:

i. Review background information.

ii. Review topographic and geologic mapping, aerial photographs to determine degree of channel confinement within its valley and define reaches.

iii. Measure bank erosion/recession rates by aerial photograph interpretation.

iv. Conduct a general-level field reconnaissance of the watercourse to adjust (if necessary) reach break locations, and to identify active processes and controls on channel form.

v. Determine 100-year erosion rates.

vi. Determine meander belt widths.

2.0 Background Information

2.1 REACHES

Reaches are lengths of channel that exhibit essentially the same physical characteristics (e.g., channel form, geology, vegetation, sinuosity, physical dimensions), and are affected by similar anthropogenic influences (e.g., crossing structures or urbanization), resulting in relatively consistent channel form, functions and processes occurring within it (e.g., water flow, sediment transport); as well as anthropogenic influences. This partitioning guides desktop and field analyses in that it considers the influence of localized channel patterns and processes.

Reaches were delineated at each of the identified road crossings and extended a minimum of 50 m upstream and downstream of Mayfield Road. Where possible, existing planform geometry of the channel in these reaches was used to delineate belt width. In situations where the watercourse at the road crossing was straightened, one or more surrogate reaches exhibiting a naturally sinuous planform were delineated, if present, immediately upstream and/or downstream of the straightened section. Where this was not possible, belt width dimensions were obtained from a surrogate reach located in a nearby watershed that exhibited similar geology, landuse and drainage area to the study reach, as per methods described in TRCA (2004).

All but 1 of the 8 identified tributaries are unnamed and, as such, are referenced in this document by their crossing identification numbers. The Gore Road Tributary is located at Crossing 12.

Table 1: Location of Mayfield Road Watercourse Crossings and Project Reaches

Crossing ID	Mayfield Road Chainage	Reach ID	Easting	Northing
2	10+689	M-02	600211	4849939
7	12+500	M-07	601341	4851359
8	13+763	M-08	602122	4852344
10	14+177	M-10	602380	4852674
12	15+156	M-12	602984	4853440
13	15+249	M-13	603043	4853513
15	16+327	M-15	603709	4854361
16	16+700	M-16	603939	4854656

2.2 GEOLOGY

The tributaries traverse level to gently undulating terrain associated with the clay soils of the Peel Plain (Chapman and Putnam, 1984). As such, the surface deposits tend to be relatively uniform (silt/clay) within the study area that are indicative of Wildfield Till (White and Karrow, 1973). Deposits of modern alluvium are present along the Gore Road Tributary (Crossing 12).

No exposed bedrock has been reported in the identified watercourses although outcrops of limestone are documented along Salt Creek and an adjacent tributary (White and Karrow, 1973).

2.3 DRAINAGE CHARACTERISTICS

The watercourses in this area generally drain from north to south toward Lake Ontario. Watercourse catchment areas were delineated based on the 1:10,000 topographic Ontario Base Mapping (OBM) (5 m contour interval). The 8 identified watercourses are small first or second order channels except the Gore Road Tributary, which is third order, as defined by the drainage network depicted at a topographic mapping scale of 1:50,000. Table 2 presents the crossings identified as being of particular interest to TRCA; the highlighted crossings have been selected for analysis (meander belt and 100-year erosion rate).

Table 2: Crossings and Drainage Areas

Crossing ID	*Road Station*	Drainage Area (ha)	Identified by TRCA for Meander Belt Assessment
1	10+425	10.1	No
2	10+689	42.8	Yes
3	11+015	N/A	No
4	11+603	5.7	No
5	11+800	377.0	No
6	12+300	402.1	No
7	12+500	89.6	Yes
8	13+763	20.3	Yes
9	13+970	35.1	No
10	14+177	60.0	Yes
11	14+400	N/A	No
12	15+156	560.0	Yes
13	15+249	17.9	Yes
14	15+955	666.0	No
15	16+327	5.4	Yes
16	16+700	2.3	Yes

**Note: Crossings 3, 11 and 12 represent Salt Creek, the Humber River, and the Gore Road Tributary respectively.*

3.0 Geomorphic Assessment

3.1 BACKGROUND

A geomorphic assessment of the watercourse was undertaken to identify active fluvial processes (e.g., erosion or deposition) and to document any change that has occurred that may affect these processes (e.g., change in land use, drainage). These changes were reviewed within a historical context, using aerial photographs as well as through a detailed examination of existing conditions as determined through field assessment.

3.2 HISTORIC ASSESSMENT

A sequence of aerial photographs (1954, 1978, and 2011 and topographic OBM 1:10,000), and geologic (Quaternary) mapping were reviewed to gain insight into channel form, surrounding influences (e.g., land use/cover), and to identify any changes that have occurred during the period of record. An overlay of the channel configuration, where it was clearly identifiable on the air photos, was created in AutoCAD to enable any changes in the spatial position of the watercourse to be discerned.

3.2.1 Land Use/Cover

Throughout the period of record, the surrounding lands have been utilized mainly for agricultural uses (e.g., pasture or ploughed fields), although residential development has been expanding as well in recent years, particularly near Airport Road (Crossing 2). Lands upstream of Mayfield Road remain largely agricultural. Most of the watercourses traverse valley features typically vegetated with scrub. The smaller drainage features at Crossings 8, 15, and 16 traverse agricultural fields and are likely routinely disturbed by ploughing.

3.2.2 Channel Changes

Aerial photographs were used to identify changes to channel planform (the path of the watercourse) such as those that result from artificial straightening or from long-term, gradual bank erosion. Many of the identified watercourses have likely been straightened or have had the natural planform disturbed to some degree, as reflected in the low sinuosity (Table 3).

Table 3: Summary of Reach Characteristics Estimated from Topographic Mapping and Aerial Photographs

Reach	Length (m)	Creek Slope[1] (%)	Sinuosity[2]	Adjacent Land Cover (upstream / downstream)
M-02	200	1.18	1.01	Scrubland / Residential Subdivisions
M-07	177	1.22	1.06	Scrubland / Scrubland
M-08	262	1.96	1.14	Ploughed Agricultural Field / Scrubland
M-10	138	1.50	1.05	Scrubland / Scrubland-Wetland
M-12	409	0.48	1.29	Scrubland / Scrubland
M-13	161	0.72	1.04	Scrubland / Roadside Ditch
M-15	100	1.21	1.01	Scrubland / Ploughed Agricultural Field
M-16	100	0.76	1.00	Scrubland / Ploughed Agricultural Field

[1] *Creek slope measured from 2.5 m contour data*
[2] *Sinuosity is the ratio of creek length to valley length and is a measure of the "bendiness" of a watercourse. A sinuosity of 1.00 indicates a straight watercourse with no bends.*

Bank erosion rates were measured in appropriate reaches using 1978 and 2011 air photos, thus encompassing a 33-year interval. This timeframe is close to the 20- to 30-year interval recommended by TRCA (2004) for fluvial systems where no change to the hydrologic regime is anticipated.

The channels, where visible on air photos, have not shifted substantially over the period of record and erosion rates are close to the limit imposed by measurement error. Average lateral (cross-valley) channel migration rates along the various reaches is approximately 0.05 m/yr., which is considered typical of small southern Ontario streams. The rate was somewhat higher along the Gore Road Tributary (0.08 m/yr.). These rates were used to determine 100-year erosion rates used in support of the final meander belt calculations.

3.3 EXISTING CONDITIONS

Geomorphic conditions and characteristics along the watercourse, within the subject property, were assessed in October 2011 through general level field reconnaissance. Flow conditions appeared to be close to baseflow on the date of the site visit. In addition to observations of site conditions and channel processes, field measurements such as channel dimensions were obtained. A photographic inventory of the existing site conditions has been compiled in Appendix C.

Crossing 2 (Reach M-02)

- Downstream of culvert inaccessible due to road construction
- Channel passes through corrugated steel pipe (CSP) culvert at Mayfield Road
- Unconfined valley setting

- Channel very well treed for about 10 m upstream of culvert, then vegetation transitions to scrub with deep and dense root penetration
- Channel bankfull width was 3 m wide in treed area narrowing to less than 1 m in scrub
- Poor to modest channel definition
- Channel morphology vegetation dominated, no pool-riffle structures
- No excessive erosion or deposition observed
- Some flow apparent (< 1 L/s)
- Channel well connected to floodplain
- Channel was straight

Crossing 7 (Reach M-07)

- Channel conveyed through CSP culvert at Mayfield Road
- Channel is set within well-defined valley feature with 2-3 m high valley walls
- Channel is partially confined upstream of Mayfield Road and fully confined downstream
- No excessive erosion or deposition observed
- Watercourse is well-connected to floodplain with no valley wall contacts
- Poor to modest channel definition
- Channel morphology vegetation dominated, no pool-riffle structures
- No excessive erosion or deposition observed
- Upstream end of culvert is perched
- Channel is generally straight

Crossing 8 (Reach M-08)

- Channel conveyed through CSP culvert at Mayfield Road
- Channel is unconfined upstream and downstream of Mayfield Road
- Upstream of Mayfield road water flows through a swale in an agricultural field and then into a more defined channel with a width of approximately 1.5 m and a depth of approximately 0.4 m
- Downstream channel is heavily vegetated with tall grass species (fragmites)
- A small amount of basal scour erosion was noted upstream of Mayfield Road
- The swale upstream of Mayfield Road appears to be routinely ploughed through by farm equipment

- Watercourse is well-connected to floodplain with no valley wall contacts
- Poor to modest channel definition
- Channel morphology vegetation dominated, no pool-riffle structures

Crossing 10 (Reach M-10)

- Channel conveyed through CSP / PVC culvert at Mayfield Road
- Channel is partially confined and poorly defined downstream of Mayfield Road
- Channel is set within well-defined valley feature with 2-3 m high valley walls
- Channel is confined upstream of Mayfield Road
- Upstream channel has good definition with a width of approximately 2.5 m and a depth of between 0.5 and 1.0 m
- Fill has been placed on the right bank upstream of Mayfield Road
- Standing water was observed upstream of the road crossing
- Iron staining was observed in the channel
- Multiple channels were observed throughout the wetland located downstream of the road crossing
- Channel morphology vegetation dominated, no pool-riffle structures

Crossing 12 (Reach M-12)

- Channel conveyed through concrete box culvert under Mayfield Road
- Unconfined Valley Setting
- Standing water present upstream and downstream of culvert
- Evidence of recent beaver activity observed upstream of culvert crossing
- Beaver dam located downstream of culvert
- Beaver baffle located downstream of culvert crossing
- Downstream bankfull width measured at 4.3 m, upstream channel width measured at 8-10 m wide (impacted by beaver activity)
- No excessive erosion or deposition observed
- Channel morphology vegetation dominated, no pool-riffle structures
- Channel well connected to floodplain

Crossing 13 (Reach M-13)

- Drainage feature (swale) is conveyed through CSP culvert under Mayfield Road
- Standing water present upstream and downstream of culvert
- No defined channel downstream of Mayfield Road, flow appears to be conveyed by roadside ditch
- Swale upstream of Mayfield road through heavily vegetated unconfined valley
- No excessive erosion or deposition observed

Crossing 15 (Reach M-15)

- Drainage feature conveyed through CSP culvert under Mayfield Road
- Upstream of Mayfield Road flows are conveyed in a well vegetated swale
- Upstream swale dimensions are approximately 1.0m wide and 0.2 m deep, as defined by vegetation
- Downstream flows are conveyed through a poorly defined swale through an agricultural field with no defined meander pattern
- The swale downstream of Mayfield Road appears to be routinely ploughed through by farm equipment
- No excessive erosion or deposition observed.

Crossing 16 (Reach M-16)

- Drainage feature conveyed through PVC culvert under Mayfield Road
- Upstream of Mayfield Road flow appear to be conveyed through vegetated roadside ditches
- Downstream of Mayfield Road flows are conveyed in a poorly defined swale through an agricultural field
- Some ponded water observed upstream and downstream of culvert
- The swale downstream of Mayfield Road appears to be routinely ploughed through by farm equipment
- No excessive erosion or deposition observed

3.4 SUMMARY

The crossings examined above have drainage areas from 2.3 to 560 ha. The larger watercourses typically have a more defined bed and bank and exhibit a somewhat sinuous planform. The smaller drainage areas are associated with poorly defined channels or swales, often exhibiting a relatively straight planform. Most of the watercourses were well vegetated and did not exhibit excessive erosion or deposition.

The watercourses appear to be generally stable, as determined by the assessment of historic and existing channel conditions. Bank erosion rates measured between 1978 and 2011 are close to the theoretical limit of detection (0.05-0.08 m/yr.), as imposed by the imagery resolution. Field investigations confirmed that the channels were stable, as indicated by the abundant bank vegetation, minimal erosion, and generally good floodplain connection (low bank height permits floodwaters to spill readily onto the floodplain, thus minimizing the energy available for bank erosion). As such, the bank erosion rates of 0.05-0.08 m/yr., as determined by air photo interpretation, were considered to be a reasonable estimate.

4.0 Meander Belt Analysis

The meander belt is a term used to quantify the lateral extent of a river's occupation of its floodplain (TRCA, 2004). Meander belts are inherently variable and their extent is dependent on a number of controlling factors. These include, among other things, hydrology, stormwater flows, bank erosion rates, and the degree of channel confinement by the valley walls.

The technique applied in this assessment follows the procedures outlined in the TRCA Meander Belt Delineation Procedure (2004). The specific methodology applied to the study area was the method that assumes that no change in hydrology is anticipated. This scenario is considered appropriate as the proposed works include only the widening of Mayfield Road and extension or replacement of the existing culvert structures.

The basis for the meander belt delineation is outlined in Section 5.5.1 of TRCA (2004).

4.1 SURROGATE REACHES

Ideally, the existing planform configuration is used to define belt width dimensions. However, this was not possible in this study since all watercourses being investigated had had their planforms straightened or altered to some degree. To quantify the belt width a surrogate reach approach was adopted, as per methods outlined in TRCA (2004). A surrogate reach is a naturally sinuous section of channel that may be located upstream and/or downstream along the same watercourse, or in another drainage basin that exhibits similar characteristics to the study reach, such as geology, vegetation cover, hydrology, and slope. Where possible, surrogate reaches in this study were selected in the same watercourse either upstream or downstream of the study reach. Where no suitable surrogate was available in the same watercourse, a surrogate reach from a nearby drainage basin was used.

In this study, a surrogate reach from a nearby drainage basin was required at Crossings 2, 7, and 8. A suitable surrogate reach (Reach A) was identified approximately 500 m southwest of the intersection of Mayfield Road and Airport Road. The watercourse at this location was naturally meandering with a sinuosity of 1.52 and an existing belt width of 23 m. The drainage area of Reach A was approximately 200 ha and somewhat larger than the drainage areas of the three study reaches requiring surrogates. As such, the belt width defined by Reach A is considered to be a conservative representation of the belt width of the watercourses at Crossings 2, 7, and 8.

4.2 MEANDER AXIS

The meander axis is a term used to describe the general down-valley orientation of the meander pattern. The meander axis defined the trend of the valley, and thus the trend or orientation of the meander belt within that valley. The delineation of the meander axis along the watercourse crossings of Mayfield Road was fairly straightforward owing to the generally simple meander patterns of the channels. No meander belt shift was observed for any of the crossings using the 1954 and 1978 aerial photography overlays.

4.3 PRELIMINARY BELT WIDTH

In order to define the meander belt width, an accurate map of the channel planform is required. The high resolution aerial photography (flown 2011) provided a suitable means with which to accurately map channel planform. The location of the channel on the imagery was confirmed during the site reconnaissance.

4.4 FINAL BELT WIDTH

The final belt width was determined by incorporating additional setbacks that are appropriate to the physical setting of the watercourse, anticipated changes to the meander belt axis and hydrological regime, and to account for methodological variations in the belt width delineation (e.g., use of in situ meander pattern, surrogate reach(es) or empirical equations).

The majority of the channels within the study area were unconfined, thus simplifying the meander belt calculations. The computations were undertaken in consideration of the following:

- No alteration to peak flow discharge (i.e., Q2) was anticipated, due to established stormwater management (SWM) guidelines
- No change in flow duration or volume is anticipated
- During the air photo analysis, it was the channel centerline that was mapped (not the banks). Therefore, the channel bankfull width (as measured during the site visit) was added to the meander belt width calculations
- The 100-year erosion amount was added to each side of the meander belt
- There was no observed shift in meander axis throughout the air photo record

The computational procedures follow the method outlined in TRCA (2004), Section 5.5.1.

4.4.1 Crossing 2

TRCA typically requires meander belt analyses for watercourses with contributing drainage areas of greater than 50 ha. With a contributing drainage area of 42.8 ha, the catchment of Reach M-2 is slightly smaller than the minimum TRCA drainage area of 50 ha.

The watercourse at Crossing 2 has been historically straightened and does not exhibit a well-defined meander pattern. A surrogate reach (Reach A) was used to estimate the preliminary belt width at M-2.

1. Preliminary belt width of 23 m was used based on surrogate Reach A (Figure 2).
2. Channel bankfull width of 2.8 m at Crossing #2 was added to the preliminary belt width to yield an existing belt width of 25.8 m.
3. Since the existing belt width is less than 50 m, the 100-year erosion rate of 5.0 m was added to each side of the meander belt for a total 35.8 m.
4. No shift in meander axis was observed therefore the final belt width is 35.8 m.
5. The final belt width is presented in Figure 3.

4.4.2 Crossing 7

The watercourse at Crossing 7 does not exhibit a well-defined meander pattern, but is present as a wide heavily vegetated channel. Downstream of Mayfield Road it is assumed that the watercourse is piped through an area of agricultural land as it is not visible on aerial photography. The channel lies within fenced private property south of Mayfield Road and it was not possible to investigate the channel alignment in detail in this area. As no defined meander pattern was observed through Reach M-7, a surrogate reach (Reach A) was used to estimate the preliminary belt width.

1. Preliminary belt width of 23 m was used based on surrogate Reach A (Figure 2).
2. Channel bankfull width of 3.5 m was added to the Preliminary belt width to yield an existing belt width of 26.5 m.
3. Since the existing belt width is less than 50 m, the 100 year erosion rate of 5.0 m was added to each side of the meander belt for a total 36.5 m.
4. No shift in meander axis was observed therefore the final belt width is 36.5 m.
5. The final belt width is presented in Figure 4.

4.4.3 Crossing 8

TRCA typically requires meander belt analyses for watercourses with contributing drainage areas of greater than 50 ha. With a contributing drainage area of 20.3 ha, the catchment of Reach M-8 is much smaller than the minimum TRCA drainage area of 50 ha. In spite of the small drainage area, a channel with identifiable bankfull width of 2.5 m was observed.

The watercourse upstream of Mayfield Road the watercourse traverses agricultural fields and does not exhibit a well-defined meander pattern. However, numerous chute features visible on the imagery provided a good indication of the degree to which the channel occupies its valley setting. The lateral extent of these drainage features was used to estimate the extent of the meander belt. A densely vegetated straightened watercourse with moderately good channel definition is present downstream of Mayfield Road.

1. Preliminary belt width of 20.4 m was measured, as defined by chute features.
2. Channel bankfull width of 2.5 m was added to the preliminary belt width to yield an existing belt width of 22.9 m.
3. Since the existing belt width is less than 50 m, the 100-year erosion rate of 5.0 m was added to each side of the meander belt for a total 32.9 m
4. No shift in meander axis was observed therefore the final belt width is 32.9 m.
5. The final belt width is presented in Figure 5

4.4.4 Crossing 10

TRCA typically requires meander belt analyses for watercourses with contributing drainage areas of greater than 50 ha. With a contributing drainage area of 60.0 ha, the catchment of Reach M-10 is slightly larger than the minimum TRCA drainage area of 50 ha.

The watercourse at Crossing 10 is well-defined but has been straightened and thus does not exhibit a well-defined meander pattern. A meander pattern is present immediately upstream in surrogate Reach M-10(S), which was used to determine the preliminary belt width at M-10.

1. Preliminary belt width of 22 m was measured in surrogate reach M-10 (S).
2. Channel bankfull width of 2.5 m was added to the preliminary belt width to yield an existing belt width of 24.5 m.
3. Since the existing belt width is less than 50 m, the 100 year erosion rate of 5.0 m was added to each side of the meander belt for a total 34.5 m
4. No shift in meander axis was observed therefore the final belt width is 34.5 m.
5. The final belt width is presented in Figure 6.

4.4.5 Crossing 12

The Gore Road Tributary has a two-phase meander pattern, with smaller secondary meanders nested inside larger primary meanders. The secondary meanders in the study reach M-12 near Mayfield Road have been removed but the primary meander pattern appears to be largely intact. The primary meander pattern was considered responsible for defining the belt width. Since the primary meander pattern was preserved, it was used to estimate the belt width of Reach M-12.

However, as confirmation, two surrogate reaches were delineated upstream and downstream of Reach M-12, where sinuosity was well preserved and primary and secondary meanders clearly evident. The meander belt widths of these surrogate reaches were calculated and the average of the two preliminary belt widths was used to determine the preliminary belt width at the crossing. As presented in Figure 7, this average value generates a meander belt that encompasses the extents of the primary meanders through Reach M12.

1. Preliminary belt width of 58 m was measured in the upstream surrogate reach.
2. A preliminary belt width of 84 m was measured in the downstream surrogate reach.
3. An average preliminary belt width of 71 m was calculated for Reach M-12 at Mayfield Road.
4. The channel bankfull width of 4.3 m was added to the average preliminary belt width to yield an existing belt width of 75.3 m.
5. Since the existing belt width is greater than 50 m, it was multiplied by a factor of safety of 1.1 (TRCA, 2004) for a total of 82.8 m.
6. No shift in meander axis was observed therefore the final belt width is 82.8 m.

4.4.6 Crossing 13

The watercourse at Crossing 13 has been identified as a swale. It appears to have been straightened upstream of Mayfield Road and is indistinct downstream of Mayfield Road. It does not exhibit a well-defined meander pattern or centreline. TRCA typically requires meander belt analyses for watercourses with contributing drainage areas of greater than 50 ha. With a contributing drainage area of 17.9 ha, the catchment of Reach M-13 is much smaller than the minimum TRCA drainage area of 50 ha. With such a small contributing drainage area at the Mayfield Road crossing and no alluvial channel or meander pattern, belt width was not determined for this reach. An aerial view of Crossing #13 is presented in Figure 8.

4.4.7 Crossing 15

The watercourse at Crossing 15 has been identified as a swale. It is straightened upstream of Mayfield Road and crosses through an agricultural field downstream of the road. It does not exhibit a well-defined meander pattern or centreline. TRCA typically requires meander belt analyses for watercourses with contributing drainage areas of greater than 50 ha. With a contributing drainage area of 5.4 ha, the catchment of Reach M-15 is much smaller than the minimum TRCA drainage area of 50 ha. With such a small contributing drainage area at the Mayfield Road crossing, an alluvial channel or meander pattern have not developed in Reach M-15. As such, no meaningful measure of belt width could be undertaken at this location. An aerial view of Crossing 15 is presented in Figure 9.

4.4.8 Crossing 16

The watercourse at Crossing 16 has been identified as a swale. Flows are conveyed by ditches upstream and alongside Mayfield Road and the drainage crosses through an agricultural field downstream of the road. It does not exhibit a well-defined meander pattern or centreline. TRCA typically requires meander belt analyses for watercourses with contributing drainage areas of greater than 50 ha. With a contributing drainage area of 2.3 ha, the catchment of Reach M-15 is much smaller than the minimum TRCA drainage area of 50 ha. With such a small contributing drainage area at the Mayfield Road crossing, Reach M-16 has not developed an alluvial channel or a meander pattern. Disturbance caused by agricultural practices (i.e., plough furrows through the swale) indicates that during most of the year the swale is dry or conveys flows that are small enough to have little to no impact on agricultural practices. An aerial view of Crossing #16 is presented in Figure 10.

5.0 Summary

Meander belt assessments were conducted for 8 crossings in the vicinity of Mayfield Road, in the Region of Peel. Of these, 3 crossings were determined to occupy drainage basins that are too small to support the development of alluvial channels or an active meandering stream pattern. As such, belt widths were calculated for a total of 5 watercourses.

Standard TRCA meander belt delineation protocols were applied, and surrogate reaches were used to define belt width where a naturally meandering watercourse did not exist at the crossing. The 100-year erosion rate was calculated using recent and historic aerial photography. The results of the analysis are presented below.

Table 4: 100-Year Erosion Rate and Meander Belt Width Summary

Crossing ID	100-year Erosion Rate (m)	Final Meander Belt Width (m)
2	5	35.8
7	5	36.5
8	5	32.9
10	5	34.5
12	8	82.8
13*	NA	NA
15*	NA	NA
16*	NA	NA

*Crossings 13, 15, and 16 have been identified as swales with no alluvial channel; no meander belt or erosion rate was calculated

All of which is respectfully submitted,

STANTEC CONSULTING LTD.

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6.0 References

Chapman and Putnam. 1984. *The Physiography of Southern Ontario.*

Toronto and Region Conservation Authority (TRCA). 2004. *Belt Width Delineation Procedures.*

APPENDIX A

TRCA Correspondence

September 29, 2011 CFN 39924

BY MAIL AND EMAIL (hitesh.topiwala@peelregion.ca)

Mr. Hitesh Topiwala
Region of Peel
9445 Airport Road, 3rd Floor
Brampton, ON
L6S 4J3

Dear Mr. Topiwala:

Re: Response to Meander Belt and 100 Year Erosion Limit Assessment Requirements
Mayfield Road Improvements (Airport Road to Coleraine Drive)
Municipal Class Environmental Assessment (EA) - Schedule C
Humber River Watershed; City of Brampton; Regional Municipality of Peel

Toronto and Region Conservation Authority (TRCA) staff has met to discuss the watercourse crossing and detailed design requirements for fourteen watercourses crossing along Mayfield Road between Airport Road and Coleraine Drive. It is our understanding that this project involves widening Mayfield Road from Airport Road to Coleraine Drive, and that the preferred alignment is concept 4, which involves widening equally about the centreline in most areas, and to the north or south in areas where property impacts are expected.

On September 2, 2011 Stantec requested TRCA staff defer the requirements for the meander belt and 100 year erosion limit analysis until the detailed design stage. This request was made since the cost of undertaking these studies was not incorporated into their original bid. In general, it is TRCA staff's recommendation that these analyses be completed early in the EA stage, as the results and these analyses will be used to inform the project details through the EA process. This information is critical when determining the preferred structure design and will develop accurate cost estimates for the Region's capital budget process. TRCA staff understands that by completing the appropriate studies during the EA stage, the permit review and approval process is structured and will be generally be expedited as a result.

By completing the meander belt analysis and 100 year erosion limit analyses for each crossing and submitting the draft studies and recommended design options to TRCA staff, the proponent and their consultants, these results will facilitate negotiation when discussing the appropriate structure sizes and designs for each crossing. TRCA staff takes a risk based approach to their review of the study results and recommendations and will use this information to form basis of either supporting or rejecting the preferred design.

With respect to this particular project, TRCA staff has had the opportunity to review the requirements for the fourteen regulated watercourse in our previous letter dated December 1, 2009. Of the fourteen watercourses, TRCA staff had previously requested that meander belt and 100 year erosion limit analysis be completed for eleven of the watercourse locations (2, 3,5,6,7,9,10,11,12,13 and 14.)

As a result of the internal meeting held on September 8, 2011, TRCA senior staff determined that a meander belt and 100 year erosion limit analysis would be required for crossings if they are recommended for replacement. Three watercourse crossings (3, 5, and 6) may not require the analysis as culvert extensions are proposed at these locations. However, a hydraulic analysis is required to show that the proposed extension will not increase flooding risks at these locations (3, 5, and 6). Furthermore, TRCA staff is currently calculating the drainage areas for watercourse crossings 8, 15, and 16. If the drainage area is less than 50 hectares at each crossing location then the meander belt and 100 year erosion limit analysis will not be required for these crossings as well. Since replacement structures are proposed at crossings 2,7,8,10,12 and 13 analyses should be completed for these crossing. TRCA staff will follow up on the crossing locations 8, 15 and 16, once the drainage areas have been calculated and will indicated whether analyses will be required for these crossings.

TRCA staff looks forward to reviewing your next submission which will include the meander belt and 100 year erosion limit analysis for the above watercourse crossing locations.

Should you have any questions or would like to setup a meeting, please contact me at extension 5769 or by email at bkrul@trca.on.ca.

Sincerely,

Ben Krul
Acting Planner II, Environmental Assessments
Planning and Development
BK/

Encl: Revised Watercourse Crossing Chart

BY EMAIL
cc: Stantec:John Bayley (john.bayley@stantec.ca)
TRCA: Carolyn Woodland, Director, Planning and Development
Beth Williston, Senior Manager, Environmental Assessment Planning
Sameer Dhalla, Senior Manager, Water Resources
Quentin Hanchard, Senior Manager, Development, Planning and Regulation
Dena Lewis, Manager, Planning Ecology
Gary Wilkins, Humber River Watershed Specialist

H:\39924 - 2011 09 15 Mayfield Airport to Coleraine follow up.doc

APPENDIX A

- **Please note: All addressed comments and TRCA comments and responses from the first submission have been removed from the table**

ITEM	TRCA COMMENT (December 1, 2010)	RESPONSE	TRCA COMMENT (September 29, 2011)
1.	Table 2 should be updated to include the additional regulated areas, as TRCA regulates all identified watercourse crossings. For example, at Station 2 a watercourse was identified both upstream and downstream of Mayfield Road which will result in both of these sections of watercourse being regulated. It should also be noted that the ELC work identifies wetlands within the study area which will need to also be considered when designing the road.	Table 2 has been updated to reflect the additional regulated areas.	Comment Addressed.
4.	Please provide the correspondence received from MNR to verify the fisheries timing windows at each crossing.	No written correspondence was received from MNR. Timing window information was provided verbally from MNR. Information related to fisheries timing windows has been added to the report in Section 6. Section 6 of the report has been completely updated and includes a quantification of impacts. In summary approx. 1.7 ha of wetland will be lost and a total length of 110 m of watercourse supporting Redside Dace habitat will be impacted (total for all 3 watercourses). The report suggests that specific mitigation measures be dealt with during final design consultation with the approval agencies. An approvals section has also been added.	Please be advised that TRCA staff is unable to confirm the fisheries timing windows identified in table 8 until MNR has provided feedback related to the Endangered Species Act and redside dace.
5.	Based on the preliminary drawings, it appears that channel realignments may be required to accommodate the culvert extensions/replacements. Please ensure that the Natural Environment Report, EA and plan drawings clearly identify the watercourses and locations where realignments are required to accommodate the location/angle of proposed culvert structure(s). A discussion should be provided related to impacts and mitigation and at the detailed design stage; natural features (including watercourses and wetlands) should be accurately identified on the drawings.	Discussions with respect to the channel realignments and the potential impact to impact fish habitat had been provided in Section 6.1.4 of the report and the proposed culvert extensions are identified in table 7. The locations of anticipated wetland impacts are now shown on the figures, as well.	Comment Addressed.
6.	Further comments may be provided once details regarding the headwall/retaining wall are provided.	The specific details of headwalls and retaining walls will be addressed further during the detailed design phase of the	To be addressed during detailed design.

ITEM		TRCA COMMENT (December 1, 2010)	RESPONSE	TRCA COMMENT (September 29, 2011)
			project. At present, the assumption is that concrete or stone headwalls and retaining walls are provided to assure a reasonable costing perspective and that alternative material and configurations will be investigated and reviewed with the approving agencies during detailed design and permitting phase of the project. The current intent is to identify and confirm the anticipated grading impacts and required property limits in order to initiate discussions related to property acquisition.	
8.	a)	Table 7 indicates that aquatic habitat will be restored to pre-construction (or better) condition. In the case of lost wetland area, it is unclear how this will be accomplished. Please provide a plan for compensating for impacts where restoration to pre-construction conditions is not feasible. Please also ensure that impacts are quantified (i.e., wetland area lost, number of trees required for removal, loss of restorable habitat).	a) The loss of wetland habitat has been quantified and assessed in Section 6.1.1 of the report. The areas of wetland loss are shown on the revised figures. A compensation plan for the loss of habitat and any habitat restoration or enhancement plans will be provided during the final design phase.	a) The response letter indicates that a compensation plan will be developed during the final design phase. Please identify this commitment in the EA document. Please also provide an inventory of trees required for removal within TRCA's regulated area.
	b)	Table 7 also indicates that habitat features such as pool riffle structures will be restored or enhanced. Table 4 identifies features, especially pools, which are immediately downstream of the existing culverts. The extension of the culverts will likely result in the loss of these pools. Please indicate which habitat features will be impacted/removed and indicate how these features will be restored/enhanced. The habitat value of these features should also be assessed to ensure that they are not providing a critical function to the aquatic communities in the area, especially as it relates to redside dace.	b) Table 7 suggests that during the final stage that habitat features such as pools and riffle structures be restored or enhanced. The location and detailed design of these restoration measures will be provided during detailed design and will be a requirement for an ESA permit approval for the development of the roadway within protected redside dace habitat.	b) It is TRCA's expectation that impacted aquatic habitat will be restored or compensated for. The details of the compensation can be determined during the final design stage. Please identify this commitment in the EA document. Please also note that any compensation plan may require modification based on MNR's interest through the ESA.
	c)	The submitted plans indicate that land is being acquired for stormwater management (SWM) facilities related to the road work. Please provide further analysis of the impacts related to the construction of the SWM facilities, such as the required removal of vegetation communities and the impacts related to any required outfalls. Please also provide further analysis related to the appropriateness of	c) An assessment of the proposed SWM facility locations has been provided in sections 6.1.5.	c) Section 6.1.5 indicates that no impacts are expected. While this section indicates that SWM ponds will not be located within any natural heritage features, they can have a negative impact on receiving watercourses. SWM ponds often discharge to watercourses which are unable to assimilate the increased flows causing excessive erosion. Thermal impacts from SWM ponds can have an adverse effect on receiving watercourses as well. Please indicate how impacts to the receiving watercourses will be mitigated.

ITEM	TRCA COMMENT (December 1, 2010)	RESPONSE	TRCA COMMENT (September 29, 2011)
	the proposed locations from an ecological perspective.		

**Comments based on submission of additional reports and information.

ITEM	TRCA COMMENT (December 1, 2010)	RESPONSE	TRCA COMMENT (September 29, 2011)
Fluvial Geomorphology			
10.	TRCA's summary sheet for structure sizing indicates a number of analyses that must be completed for selected watercourses within the study area. For example, a meander belt analysis and 100-year erosion limit analysis must be completed for watercourses 2, 3, 5, 6, 7, 9, 10, 11, 12, 13 and14. The table also indicates geomorphologic analyses may be required (to be determined) at watercourses 8, 15 and 16. Please complete the required analyses as these may provide input to the proposed culvert sizes. Please also ensure that the EA clearly identifies in the body of the report the proposed works at each crossing, including sizing and locations of culvert replacements, extensions and watercourse realignments.		Outstanding.
11.	Please indicate which culverts should be designed with a low flow channel for fisheries passage and provide information such as dimensions and stone sizing for these proposed channels.		Outstanding.
Preliminary Culvert and Stormwater Management Report			
12.	Watercourses with an upstream contributing drainage area greater than 50 ha are regulated by the TRCA. For these watercourses please demonstrate that the proposed culvert size and changes to the road profile will maintain or reduce the extent of the regulatory floodplain upstream of the crossing location (will not negatively impact flood levels).		Outstanding.
13.	The report states that preliminary modeling was completed for the 5 proposed SWM ponds to ensure that they are sufficient to provide the required quality and quantity controls, as per the Humber River Watershed Plan. Please provide the erosion control criteria applied for sizing the extended detention portion of the facility, and the predevelopment flows used to size the flood control portion of the facility (unit flow rates for basin F).		Outstanding.

ITEM	TRCA COMMENT (December 1, 2010)	RESPONSE	TRCA COMMENT (September 29, 2011)
	Please provide a table in the report showing the amount of storage used during each event modeled and the controlled flow at that storage level.		
14.	TRCA staff is supportive of the use of SWM ponds to meet stormwater objectives for the road. However, there is limited space available within the right-of-way. Consequently, it is possible that failure to acquire land adjacent to the right-of-way may limit the effectiveness of the proposed SWM strategy. Please comment on opportunities to achieve SWM objectives within the right-of-way should land acquisition not be possible.		Outstanding.
15.	Please note that the TRCA position regarding use of oil grit separator (OGS) units, regardless of manufacturer, is to recognize the unit as being capable of achieving up to a 50% total suspended solids (TSS) removal. As TRCA staff requires 80% TSS removal, additional measures must be considered. Please investigate opportunities to implement additional water quality measures downstream of each of the 7 proposed OGS units. Please update plan drawings to show the locations of additional water quality treatment measures.		Outstanding.
Hydrogeology			
16.	The hydrogeology report does not contain the borehole logs. Please provide a copy that has the borehole logs referred to in the report.		Outstanding.
General Comments			
17.	Please number the watercourse crossings on the preliminary plans.	The reference watercourse numbers provided by the TRCA have been included on the latest study plans along with photographs of the existing culvert ends.	Comment Addressed.
18.	Please ensure that details for all crossings are shown on the plans. For instance, details for the crossings along The Gore Road both north and south of Mayfield Road appear to be missing. If this work is going to be completed as part of The Gore Road widening, please clearly indicate this in the EA.	Where applicable, additional notions and general representations have been added to the plans for public presentation. The Gore Road culvert references have been added to the plans and general impacts noted. A notation will also be included in the Class EA documentation to advise about the related culvert impacts and the potential for inclusion of related improvements in The Gore Road of Mayfield Road widening projects.	Comment Addressed.
19.	Preliminary plans identify the future Major Mackenzie Drive	The requested revision to labeling and also the details and	Comment Addressed.

ITEM	TRCA COMMENT (December 1, 2010)	RESPONSE	TRCA COMMENT (September 29, 2011)
	extension. Please re-label this future road as "by others under a separate permitting and review process".	notations on the drawings have been made to reflect the preliminary nature of the extension and related future roadway location.	

APPENDIX B

List of Figures:

Stantec

Scale

1:10000

Legend

Watercourse 2011

Notes

1. Background imagery 2011

December 2011

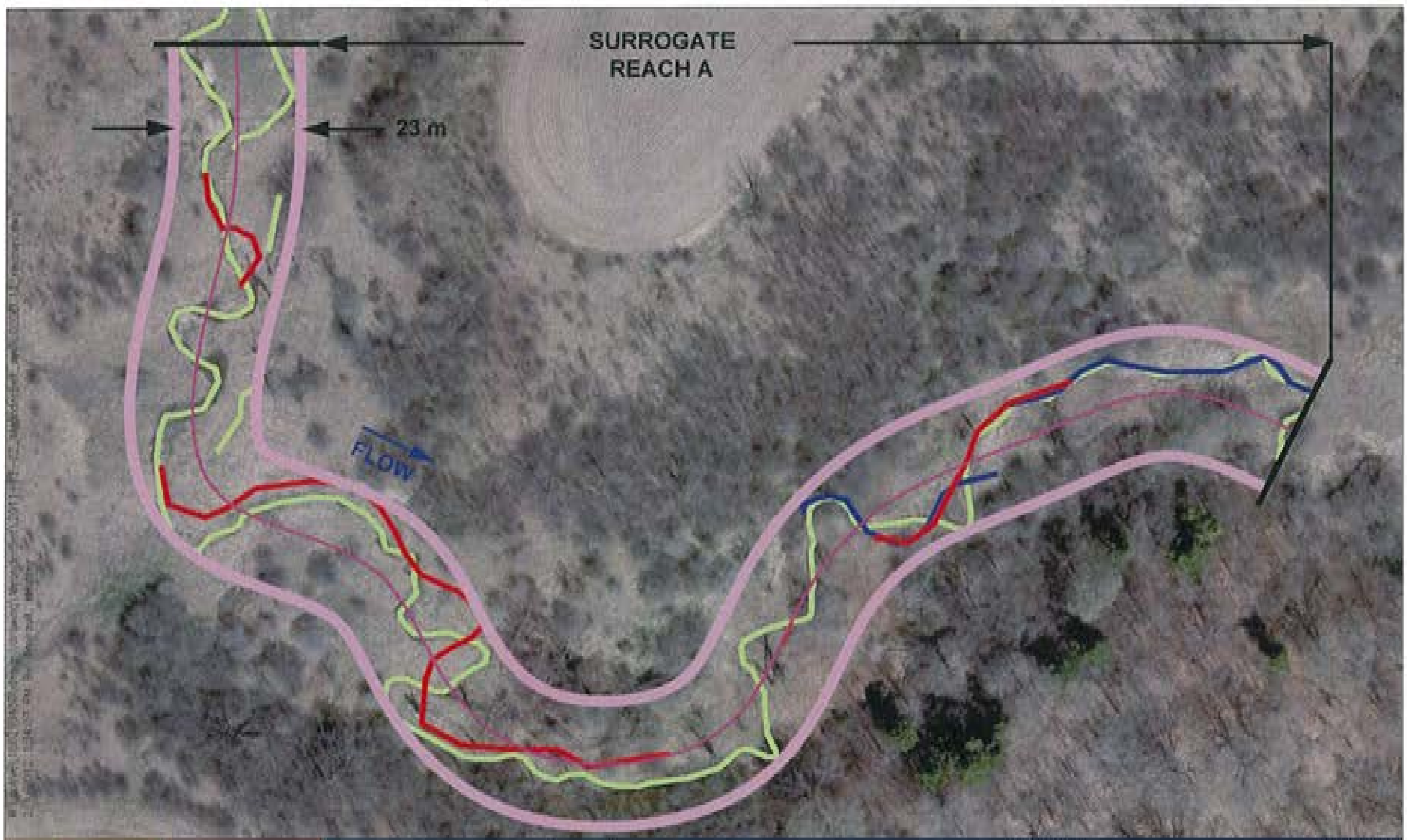
REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

Figure No.

1.0

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING LOCATIONS



Stantec

Scale

0 10 30 50m

1:1000

N

Legend

Watercourse 2011	Meander Scar 2011
Watercourse 1978	Meander Axis
Watercourse 1954	Existing Belt Width
Reach Break	

Notes

1. Background imagery 2011
2. Reach drainage area = 240 hectares

Client/Project

December 2011

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

160210480

Figure No.

2.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
SURROGATE REACH A

Legend

- Watercourse 2011
- Watercourse 1978
- Watercourse 1954
- Reach Break
- Meander Axis
- Final Belt Width

Scale
0 12.5 37.5 62.5m
1:1250

N

Notes
1. Background imagery 2011

Stantec

Client/Project
REGION OF PEEL
MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT
160210480

December 2011

Figure No.
3.0

Title
MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 2

Client/Project | December 2011

Scale

1:1250 0 12.5 37.5 62.5m

Legend

Watercourse 2011

Meander Axis

Final Belt Width

Reach Break

Notes

1. Background imagery 2011

Stantec

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

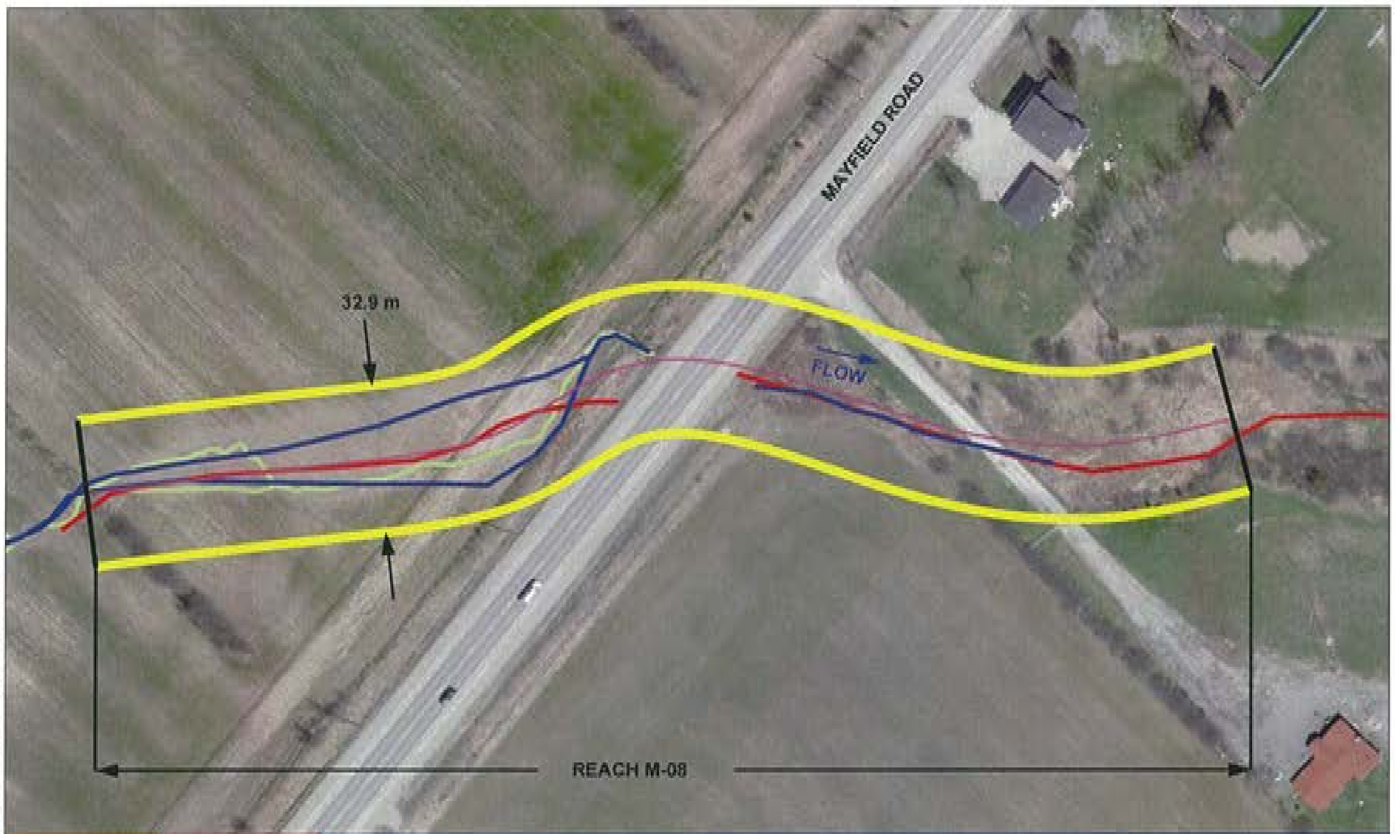
160210480

Figure No.

4.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 7



Stantec

Scale

1:1250 0 12.5 37.5 62.5m

Legend

- Watercourse 2011
- Watercourse 1978
- Watercourse 1954
- Reach Break
- Meander Axis
- Final Belt Width

Notes

1. Background imagery 2011

December 2011

Client/Project

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

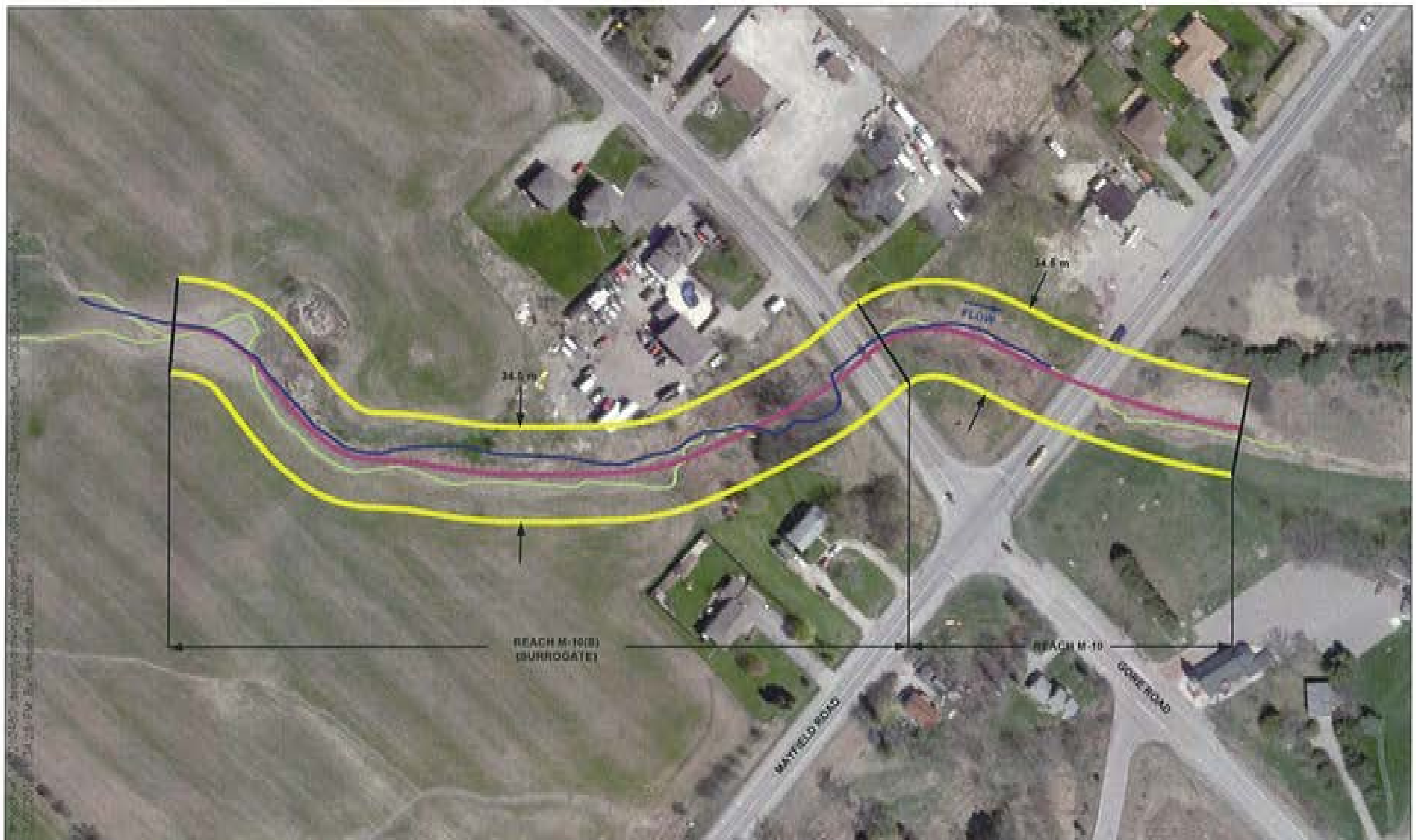
160210480

Figure No.

5.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 8



Scale

1:2000 0 20 60 100m

N

Stantec

Legend

Watercourse 2011	
Watercourse 1978	
Watercourse 1954	
Meander Axis	
Final Belt Width	

Notes

1. Background imagery 2011

Client/Project

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

160210480

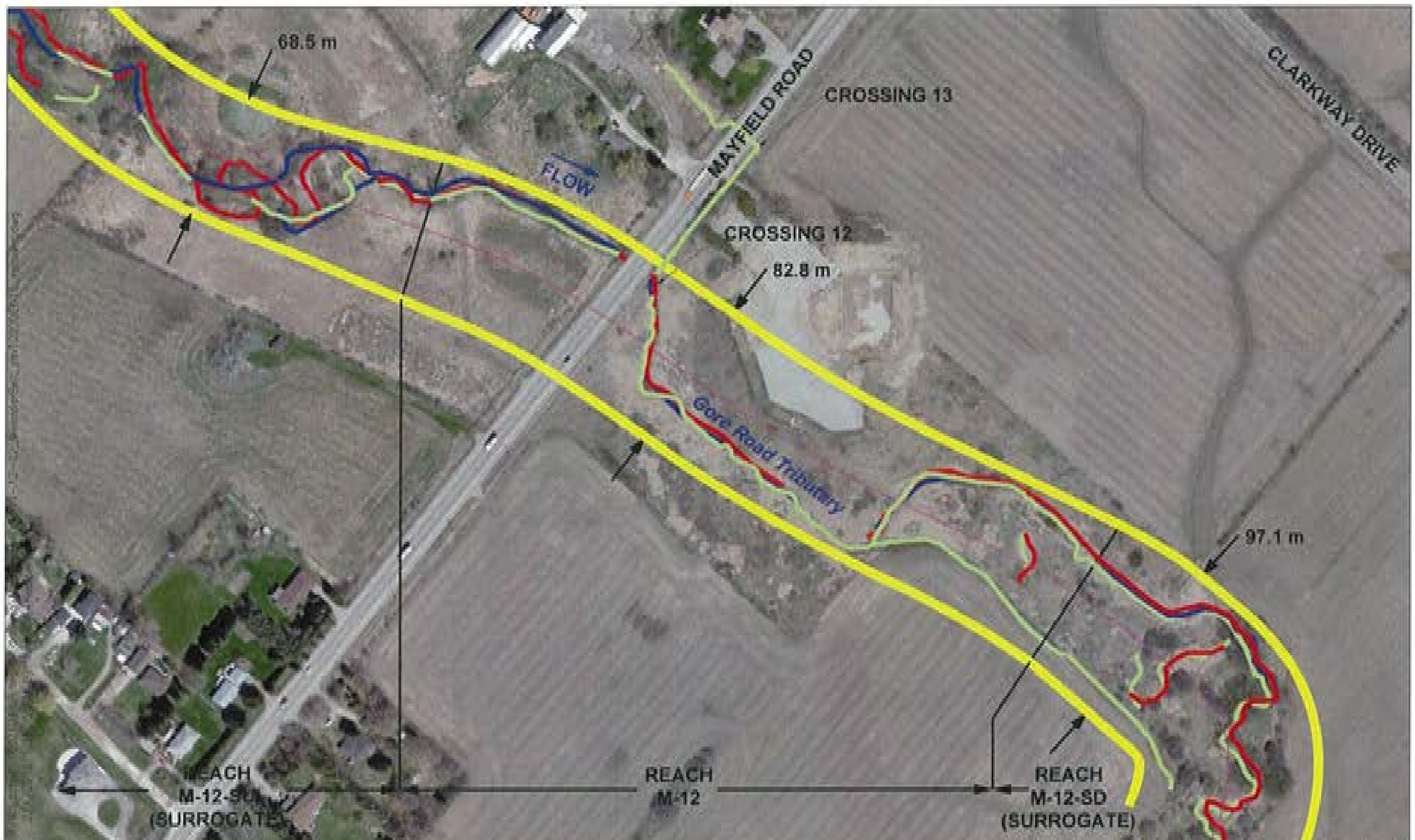
December 2011

Figure No.

6.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 10



December 2011

Stantec

Scale

1:3000

0 30 90 150m

N

Legend

Watercourse 2011	Chute/oxbow 2011
Watercourse 1978	Chute/oxbow 1978
Watercourse 1954	Chute/oxbow 1954
Meander Axis	Reach Break
Final Belt Width	

Notes

1. Background imagery 2011

Client/Project

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

160210480

Figure No.

7.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 12

Scale

0 15 45 75m

1:1500

N

Stantec

Legend

Watercourse 2011

Notes

1. Background imagery 2011

Client/Project

December2011

REGION OF PEEL

MAYFEILD ROAD ENVIRONMENTAL ASSESSMENT

160210480

Figure No.

8.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 13

Scale

1:1500 0 15 45 75m

Legend

Watercourse 2011

Notes

1. Background imagery 2011

Stantec

Client/Project

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

160210480

December 2011

Figure No.

9.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 15

Scale

1:1500 0 15 45 75m

Legend

Watercourse 2011

Notes

1. Background imagery 2011

Stantec

Client/Project

December 2011

REGION OF PEEL

MAYFIELD ROAD ENVIRONMENTAL ASSESSMENT

160210480

Figure No.

10.0

Title

MAYFIELD WATERCOURSES
FINAL MEANDER BELT WIDTH
CROSSING 16

APPENDIX C

Photographic Inventory

Photo 1: Crossing 2 upstream - looking downstream towards culvert

Photo 2: Crossing 7 upstream – looking upstream from Mayfield Road

Photo 3: Crossing 7 downstream – looking downstream from Mayfield Road

Photo 4: Crossing 8 upstream – looking upstream

Photo 5: Crossing 8 downstream – looking upstream at culvert

Photo 6: Crossing 10 upstream – looking upstream

Photo 7: Crossing 10 downstream – looking downstream

Photo 8: Crossing 12 upstream – looking upstream

Photo 9: Crossing 12 downstream – looking upstream at beaver dam and culvert

Photo 10: Crossing 12 downstream – looking downstream

Photo 11: Crossing 13 upstream – looking upstream

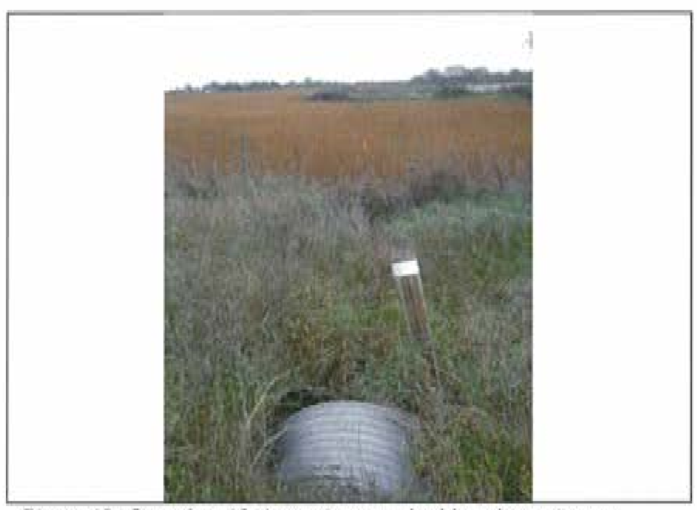


Photo 12: Crossing 13 downstream – looking downstream


Photo 13: Crossing 15 upstream – looking upstream


Photo 14: Crossing 15 downstream – looking downstream


Photo 15: Crossing 16 upstream – looking upstream


Photo 16: Crossing 16 downstream - looking downstream

APPENDIX S

CULVERT & BRIDGE COST ESTIMATES

Mayfield Road Class EA - Airport Road to Coleraine Drive

TRCA Culvert Crossing ID	Regulated Area	Culvert Location on Project Plans	Location Characteristic	Valley Top Width (Avg.)	Valley Floor Width	Ex. Bridge/Culvert Span (m)	Ex. Bridge/Culvert Height	Culvert Material/Type	Ex. Culvert Length	Prop. Extension Left Side	Prop. Extension Right Side	Ext. Length Total	New Length Total
1	No	Sta. 10+425				1.200		CSP					48.00
2	Yes	Sta. 10+689				2.500	1.800	CSPA					55.00
3	Yes	Sta. 11+015	Confined Valley	70	40	9.000	2.600	Concrete Rigid Frame	12.23	16.50	19.30	35.80	48.03
4	No	Sta. 11+603				1.200		CSP					60.00
5	Yes	Sta. 11+800				3.660	1.830	Concrete Rigid Frame					56.00
6	Yes	Sta. 12+300	Confined Valley	110	50	5.500	1.950	Concrete Rigid Frame	37.90	13.40	14.70	28.10	66.00
7	Yes	Sta. 12+500				1.800		CSP					69.00
8	No	Sta. 13+763				1.050		CSP					65.00
9	Yes	Sta. 13+970				0.915		PVC					61.00
10	Yes	Sta. 14+177				1.100		HDPE					48.00
11	Yes	Sta. 14+400	Confined Valley	138	96	9.000	4.000	Concrete Arch Culvert	19.87	15.40	24.40	39.80	59.67
12	Yes	Sta. 15+156				6.070	1.250	Concrete Box					51.00
13	No	Sta. 15+249				1.200		CSP					48.00
14	Yes	Sta. 15+955				4.630	1.590	Concrete Box					51.00
15	No	Sta 16+327				1.200		CSP					39.00
16	No	Sta. 16+700				0.450		CSP					41.00
Total Costs													

Mayfield Road Class EA - Airport Road to Co

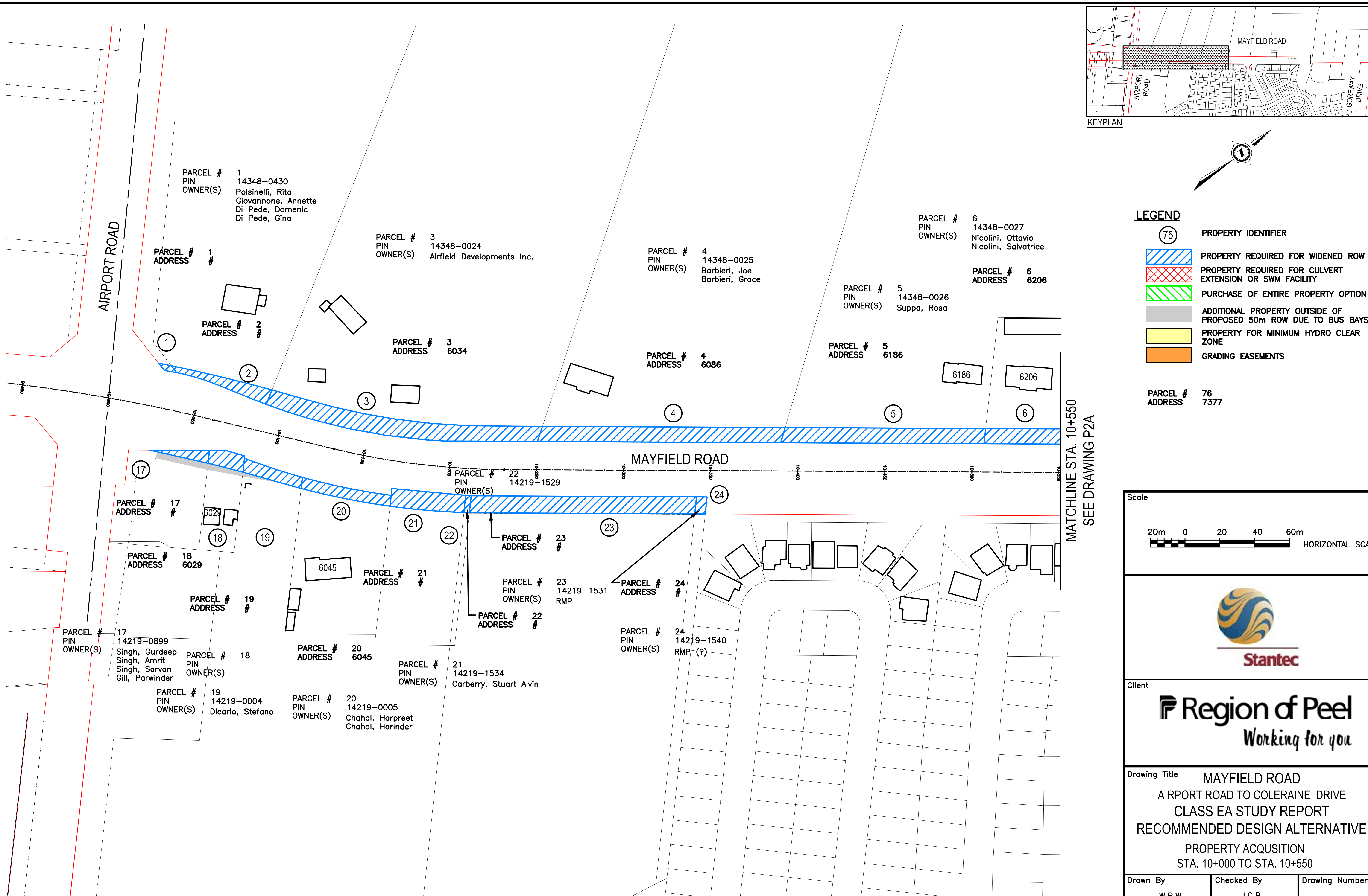
TRCA Culvert Crossing ID	Regulated Area	Culvert Location on Project Plans	New Span	Height	Alternative Width	1. Extension Cost (Alt. Length) ($3000/m, CPA - $4000/m)	2. Full Replacement Cost ($3500/m)	Increased Cost (2-1)	3. Modified Span Replacement (50% Wider Span) Cost ($3500/m)	Increased Cost (3-1)	4. Valley Span Replacement Cost ($2500/m)	Increased Cost (4-1)	5. Practical Span Replacement Cost ($3500/m)
1	No	Sta. 10+425	0.675										
2	Yes	Sta. 10+689	1.800										
3	Yes	Sta. 11+015	18.400	3.000	48.00	$965,817.00	$1,512,000.00	$546,183.00	$2,268,000.00	$1,302,183.00	$8,400,000.00	$7,434,183.00	$3,091,200.00
4	No	Sta. 11+603	1.200										
5	Yes	Sta. 11+800	7.200	1.830									
6	Yes	Sta. 12+300	6.000	2.100	48.00	$166,650.00	$924,000.00	$757,350.00	$1,386,000.00	$1,219,350.00	$13,200,000.00	$13,033,350.00	
7	Yes	Sta. 12+500	1.950										
8	No	Sta. 13+763	2 x 0.9										
9	Yes	Sta. 13+970	0.915										
10	Yes	Sta. 14+177	1.200										
11	Yes	Sta. 14+400	15.600	4.000	48.00	$1,012,680.00	$1,512,000.00	$499,320.00	$2,268,000.00	$1,255,320.00	$16,560,000.00	$15,547,320.00	$2,620,800.00
12	Yes	Sta. 15+156	6.000	1.800									
13	No	Sta. 15+249	1.200										
14	Yes	Sta. 15+955	5.480	1.520									
15	No	Sta 16+327	1.200										
16	No	Sta. 16+700	0.600										
Total Costs						**$2,145,147.00**	**$3,948,000.00**	**$1,802,853.00**	**$5,922,000.00**	**$3,776,853.00**	**$38,160,000.00**	**$36,014,853.00**	**$5,712,000.00**

Mayfield Road Class EA - Airport Road to Co

TRCA Culvert Crossing ID	Regulated Area	Culvert Location on Project Plans	Increased Cost (5-1)	Rigid Frame Unit Cost ($3500/m)	6. Box Culvert Replacement Cost/Rigid Frame ($ varies/m)	Circular Pipe Unit Cost ($/m)	6. Circular Pipe Replacement Cost ($ varies/m)	Comments
1	No	Sta. 10+425				$350.00	$16,800.00	Circular Pipe
2	Yes	Sta. 10+689				$720.00	$39,600.00	Circular Pipe
3	Yes	Sta. 11+015	$2,125,383.00					Redside Dace Habitat
4	No	Sta. 11+603				$480.00	$28,800.00	Circular Pipe
5	Yes	Sta. 11+800		$3,500.00	$1,411,200.00			Replacement Open Bottom Culvert
6	Yes	Sta. 12+300		$3,500.00	$1,386,000.00			Replacement Open Bottom Culvert
7	Yes	Sta. 12+500				$780.00	$53,820.00	Circular Pipe
8	No	Sta. 13+763				$732.00	$47,580.00	Twin Circular Pipes
9	Yes	Sta. 13+970				$366.00	$22,326.00	Circular Pipe
10	Yes	Sta. 14+177				$480.00	$23,040.00	Circular Pipe
11	Yes	Sta. 14+400	$1,608,120.00					Redside Dace Habitat
12	Yes	Sta. 15+156		$3,500.00	$1,071,000.00			Replacement Open Bottom Culvert
13	No	Sta. 15+249				$480.00	$23,040.00	Circular Pipe
14	Yes	Sta. 15+955		$3,500.00	$978,180.00			Replacement Open Bottom Culvert
15	No	Sta 16+327				$480.00	$18,720.00	Circular Pipe
16	No	Sta. 16+700				$240.00	$9,840.00	Circular Pipe
Total Costs			**$3,733,503.00**		**$4,846,380.00**		**$283,566.00**	

APPENDIX T

PROPERTY IMPACTS & ACQUISITION



LEGEND

Symbol	Meaning
75	PROPERTY IDENTIFIER
Blue hatch	PROPERTY REQUIRED FOR WIDENED ROW
Red cross-hatch	PROPERTY REQUIRED FOR CULVERT EXTENSION OR SWM FACILITY
Green hatch	PURCHASE OF ENTIRE PROPERTY OPTION
Grey	ADDITIONAL PROPERTY OUTSIDE OF PROPOSED 50m ROW DUE TO BUS BAYS
Yellow	PROPERTY FOR MINIMUM HYDRO CLEAR ZONE
Orange	GRADING EASEMENTS

PARCEL # 76
ADDRESS 7377

Scale
20m 0 20 40 60m HORIZONTAL SCALE

Stantec

Client
Region of Peel
Working for you

Drawing Title
MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY REPORT
RECOMMENDED DESIGN ALTERNATIVE
PROPERTY ACQUSITION
STA. 10+000 TO STA. 10+550

Drawn By	Checked By	Drawing Number
W.R.W.	J.C.B.	P17
Date	Project No.	
2013–04–04	160210480	

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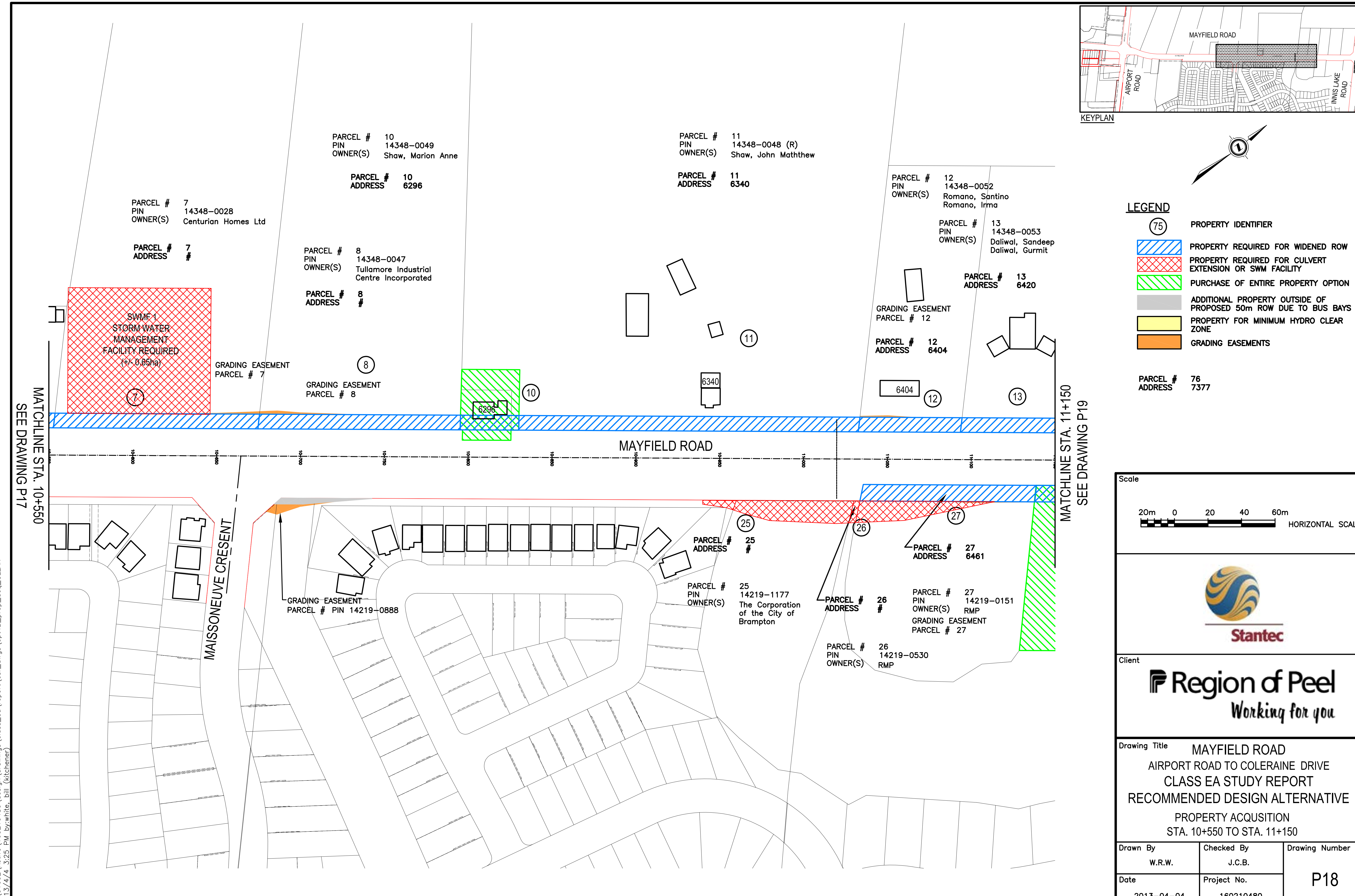

Scale

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Stantec

Client

Region of Peel
Working for you

Drawing Title

MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY REPORT
RECOMMENDED DESIGN ALTERNATIVE
PROPERTY ACQUSITION
STA. 10+550 TO STA. 11+150

Drawn By	Checked By	Drawing Number
W.R.W.	J.C.B.	P18
Date	Project No.	
2013–04–04	160210480	

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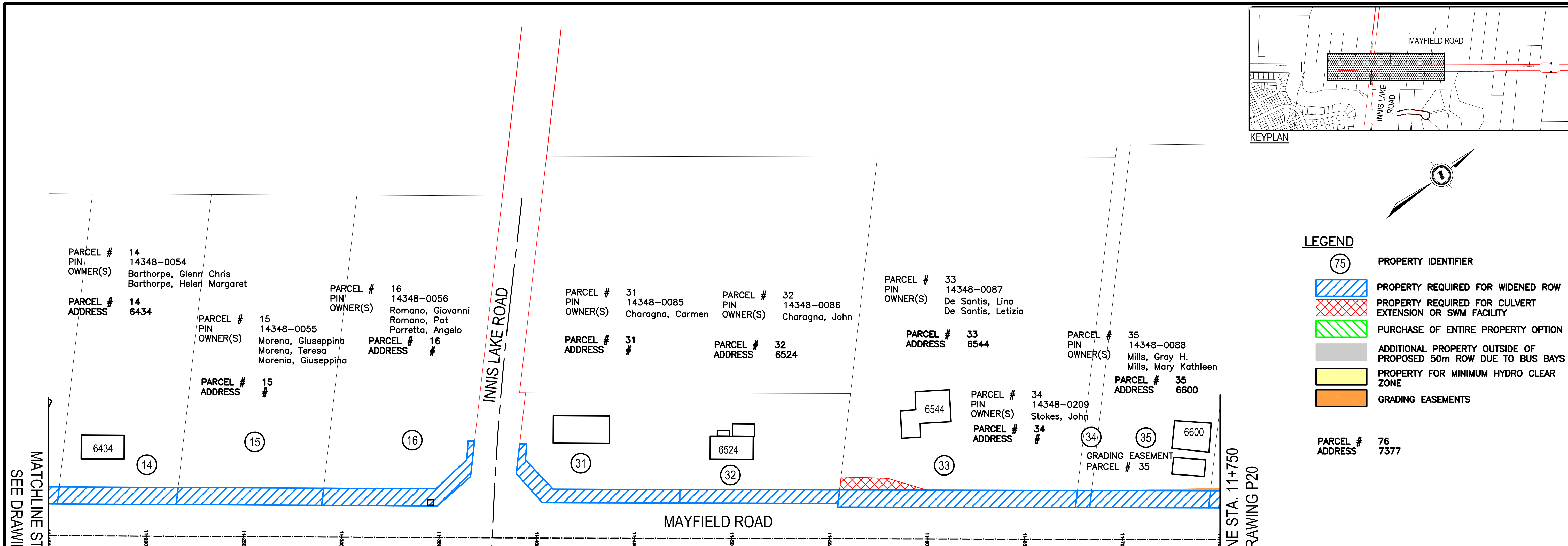

Scale

20m 0 20 40 60m HORIZONTAL SCALE

Stantec

Client

Region of Peel
Working for you

Drawing Title

MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY REPORT
RECOMMENDED DESIGN ALTERNATIVE
PROPERTY ACQUISITION
STA. 11+150 TO STA. 11+750

Drawn By	Checked By	Drawing Number
W.R.W.	J.C.B.	P19
Date	Project No.	
2013-04-04	160210480	

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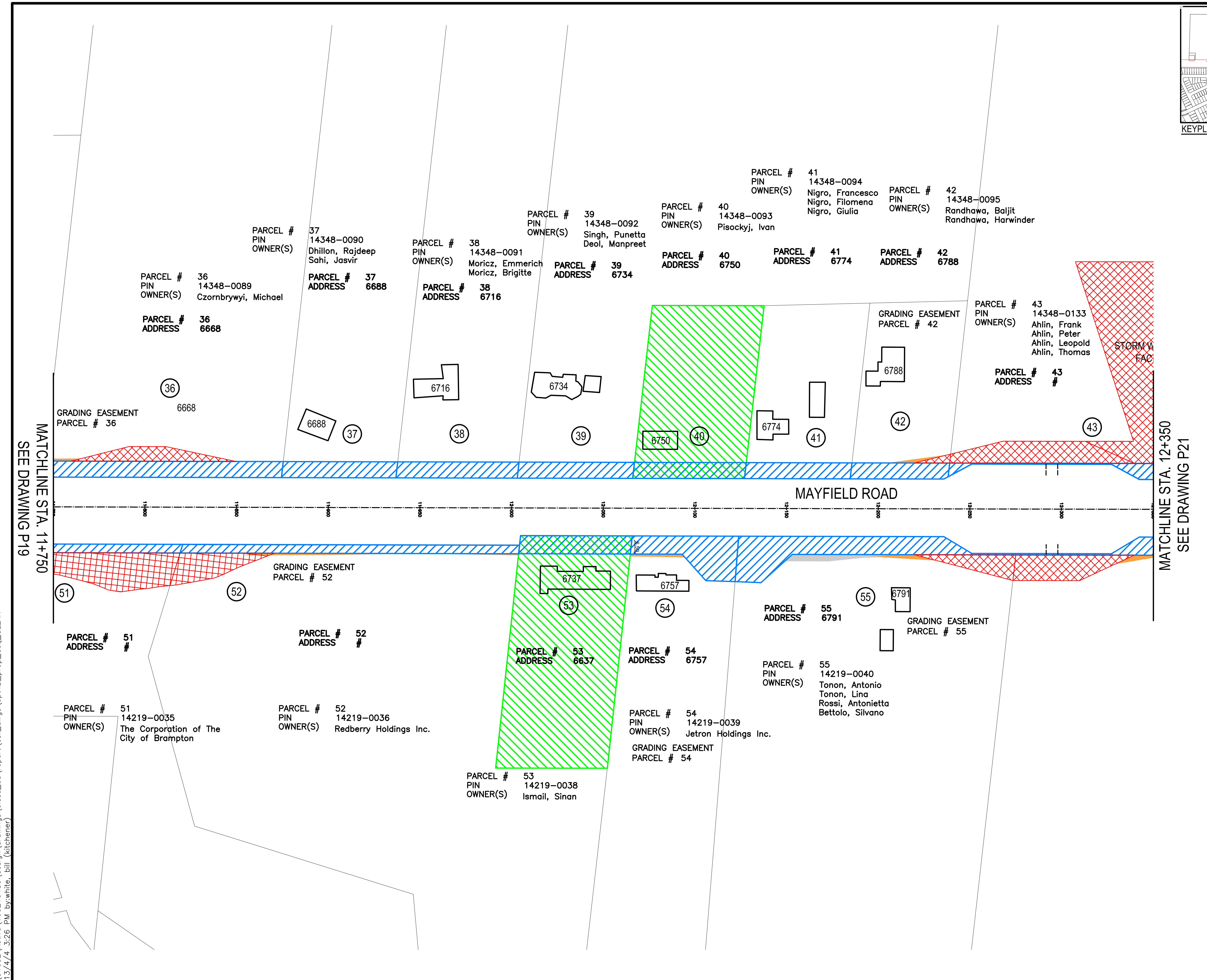

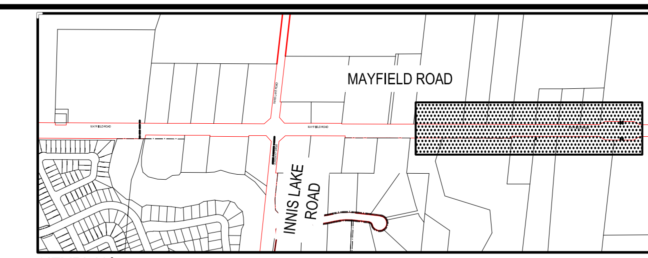

KEYPLAN

LEGEND

- 75 PROPERTY IDENTIFIER
- PROPERTY REQUIRED FOR WIDENED ROW
- PROPERTY REQUIRED FOR CULVERT EXTENSION OR SWM FACILITY
- PURCHASE OF ENTIRE PROPERTY OPTION
- ADDITIONAL PROPERTY OUTSIDE OF PROPOSED 50m ROW DUE TO BUS BAYS
- PROPERTY FOR MINIMUM HYDRO CLEAR ZONE
- GRADING EASEMENTS

PARCEL # 76
ADDRESS 7377

Scale

20m 0 20 40 60m HORIZONTAL SCALE

Stantec

Client

Region of Peel
Working for you

Drawing Title

MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY REPORT
RECOMMENDED DESIGN ALTERNATIVE
PROPERTY ACQUSITION
STA. 11+750 TO STA. 12+350

Drawn By	Checked By	Drawing Number
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Date	Project No.	
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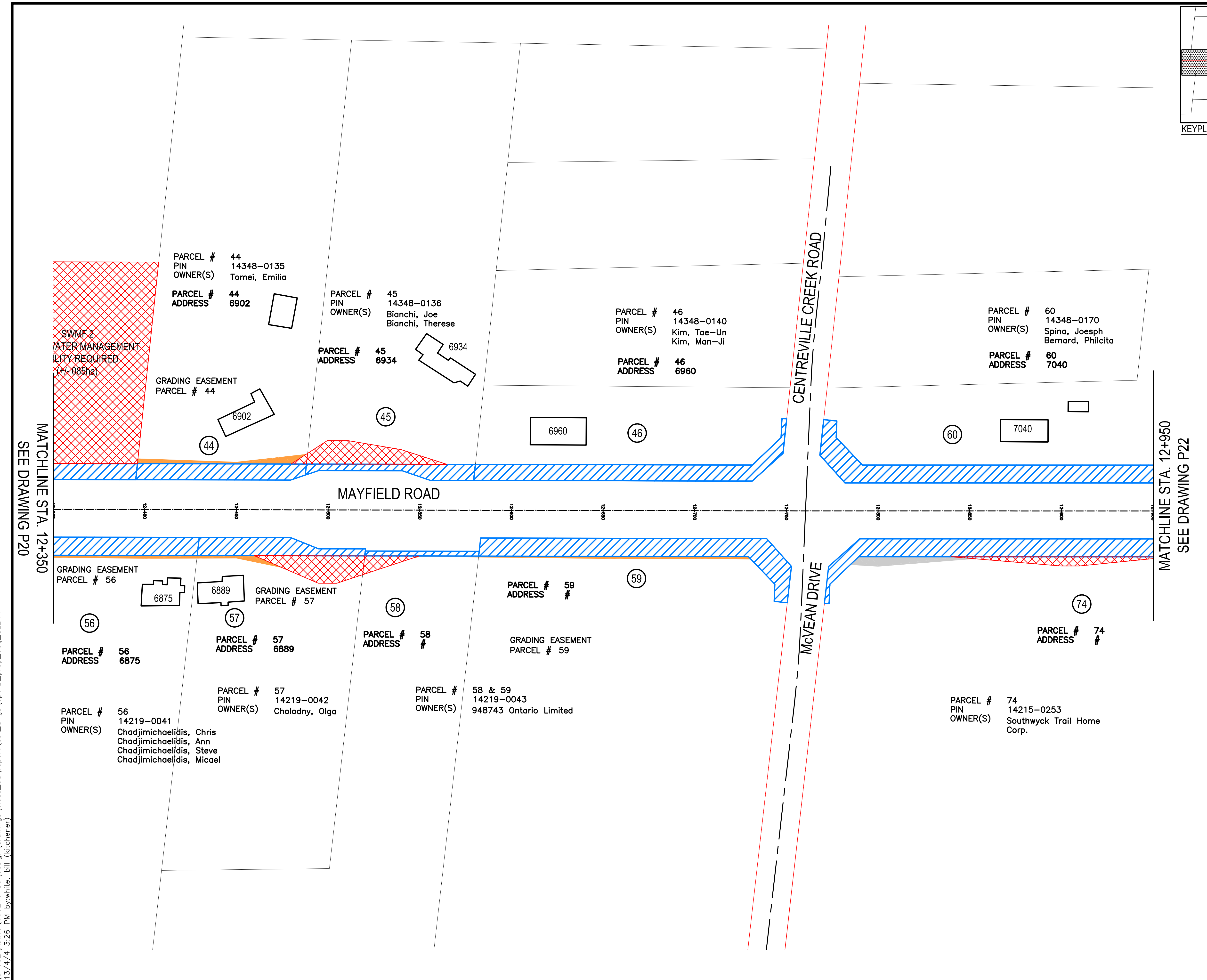

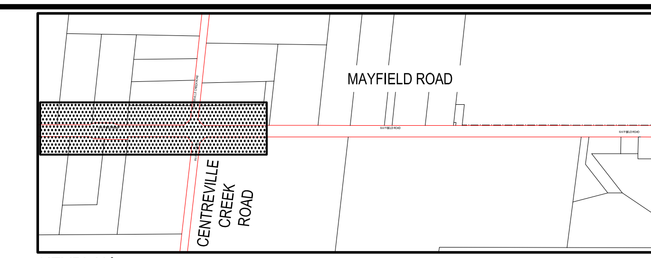

KEYPLAN

LEGEND

- (75) PROPERTY IDENTIFIER
- PROPERTY REQUIRED FOR WIDENED ROW
- PROPERTY REQUIRED FOR CULVERT EXTENSION OR SWM FACILITY
- PURCHASE OF ENTIRE PROPERTY OPTION
- ADDITIONAL PROPERTY OUTSIDE OF PROPOSED 50m ROW DUE TO BUS BAYS
- PROPERTY FOR MINIMUM HYDRO CLEAR ZONE
- GRADING EASEMENTS

PARCEL # 76
ADDRESS 7377

Scale
20m 0 20 40 60m
HORIZONTAL SCALE

Stantec

Client
Region of Peel
Working for you

Drawing Title
MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY REPORT
RECOMMENDED DESIGN ALTERNATIVE
PROPERTY ACQUSITION
STA. 12+350 TO STA. 12+950

Drawn By	Checked By	Drawing Number
W.R.W.	J.C.B.	P21
Date	Project No.	
2013-04-04	160210480	

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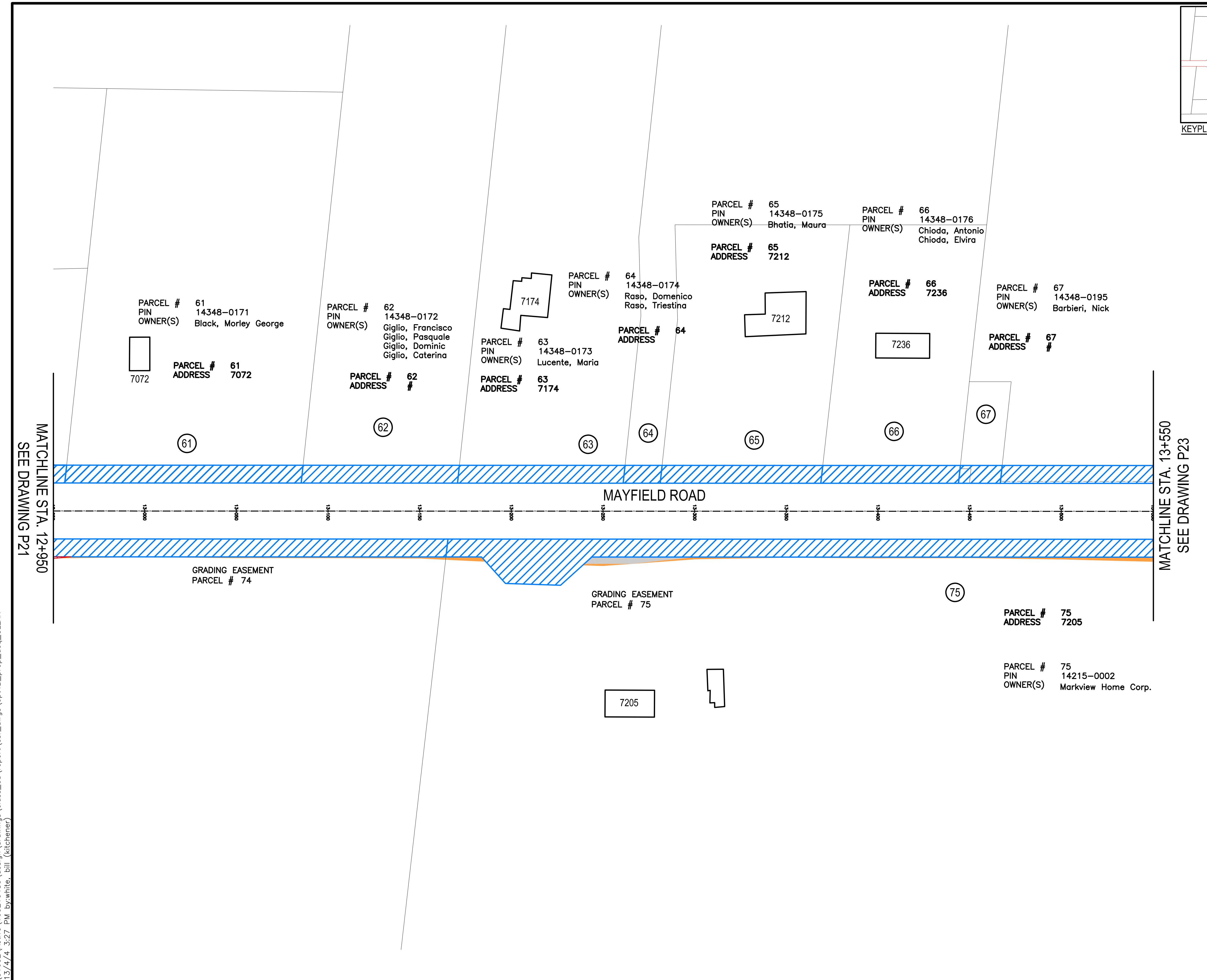

LEGEND

75	PROPERTY IDENTIFIER
	PROPERTY REQUIRED FOR WIDENED ROW
	PROPERTY REQUIRED FOR CULVERT EXTENSION OR SWM FACILITY
	PURCHASE OF ENTIRE PROPERTY OPTION
	ADDITIONAL PROPERTY OUTSIDE OF PROPOSED 50m ROW DUE TO BUS BAYS
	PROPERTY FOR MINIMUM HYDRO CLEAR ZONE
	GRADING EASEMENTS

PARCEL # 76
ADDRESS 7377

Scale
20m 0 20 40 60m HORIZONTAL SCALE

Stantec

Client
Region of Peel
Working for you

Drawing Title
MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY REPORT
RECOMMENDED DESIGN ALTERNATIVE
PROPERTY ACQUSITION
STA. 12+950 TO STA. 13+550

Drawn By	Checked By	Drawing Number
W.R.W.	J.C.B.	P22
Date: 2013–04–04	Project No.: 160210480	

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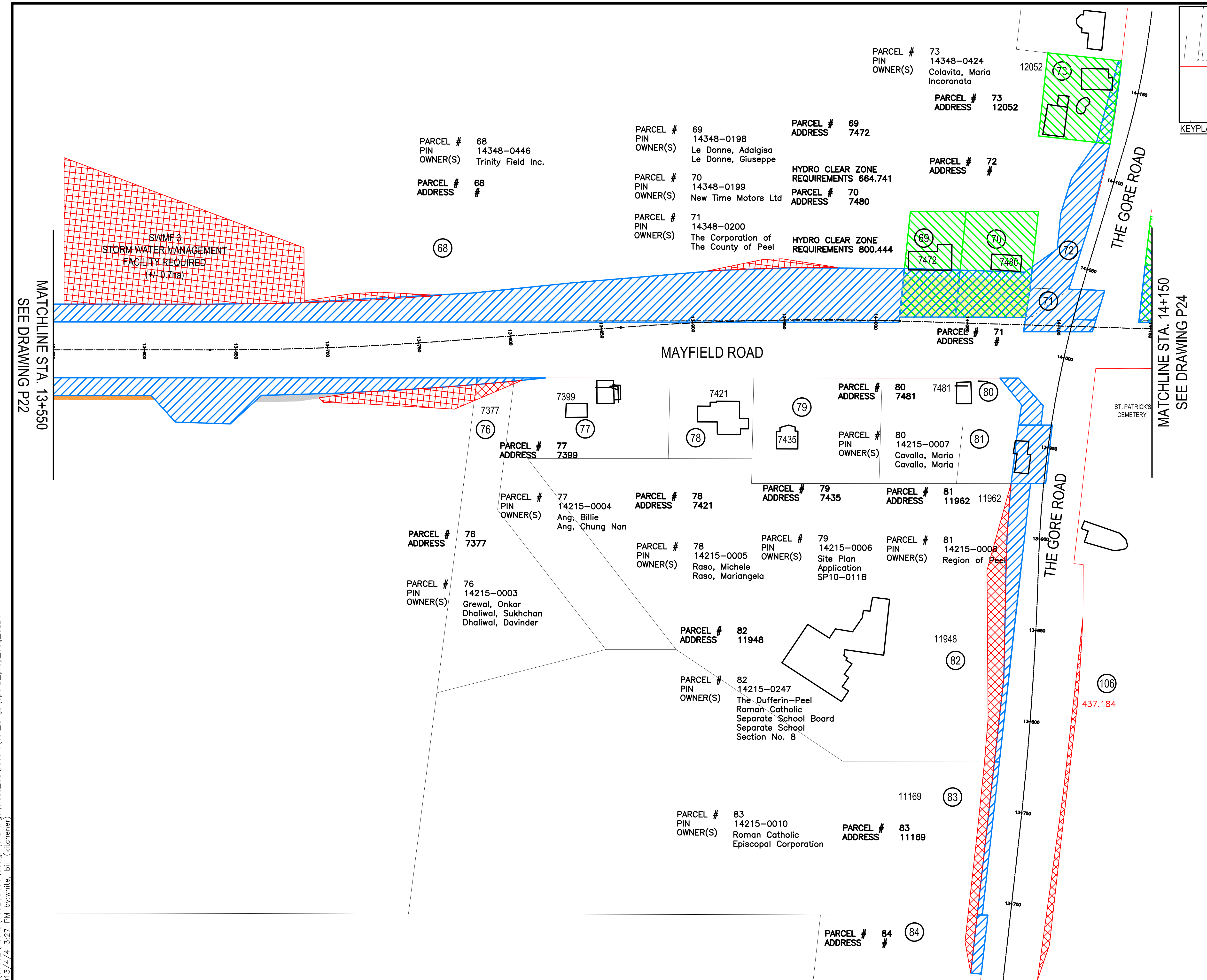

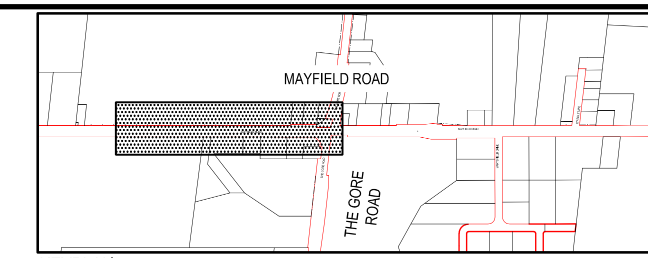

KEYPLAN

LEGEND

- 75 PROPERTY IDENTIFIER
- PROPERTY REQUIRED FOR WIDENED ROW
- PROPERTY REQUIRED FOR CULVERT EXTENSION OR SWM FACILITY
- PURCHASE OF ENTIRE PROPERTY OPTION
- ADDITIONAL PROPERTY OUTSIDE OF PROPOSED 50m ROW DUE TO BUS BAYS
- PROPERTY FOR MINIMUM HYDRO CLEAR ZONE
- GRADING EASEMENTS

PARCEL # 76
ADDRESS 7377

Scale
20m 0 20 40 60m HORIZONTAL SCALE

Stantec

Client
Region of Peel
Working for you

Drawing Title
MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY REPORT
RECOMMENDED DESIGN ALTERNATIVE
PROPERTY ACQUSITION
STA. 13+550 TO STA. 14+150

Drawn By	Checked By	Drawing Number
W.R.W.	J.C.B.	P23
Date 2013-04-04	Project No. 160210480	

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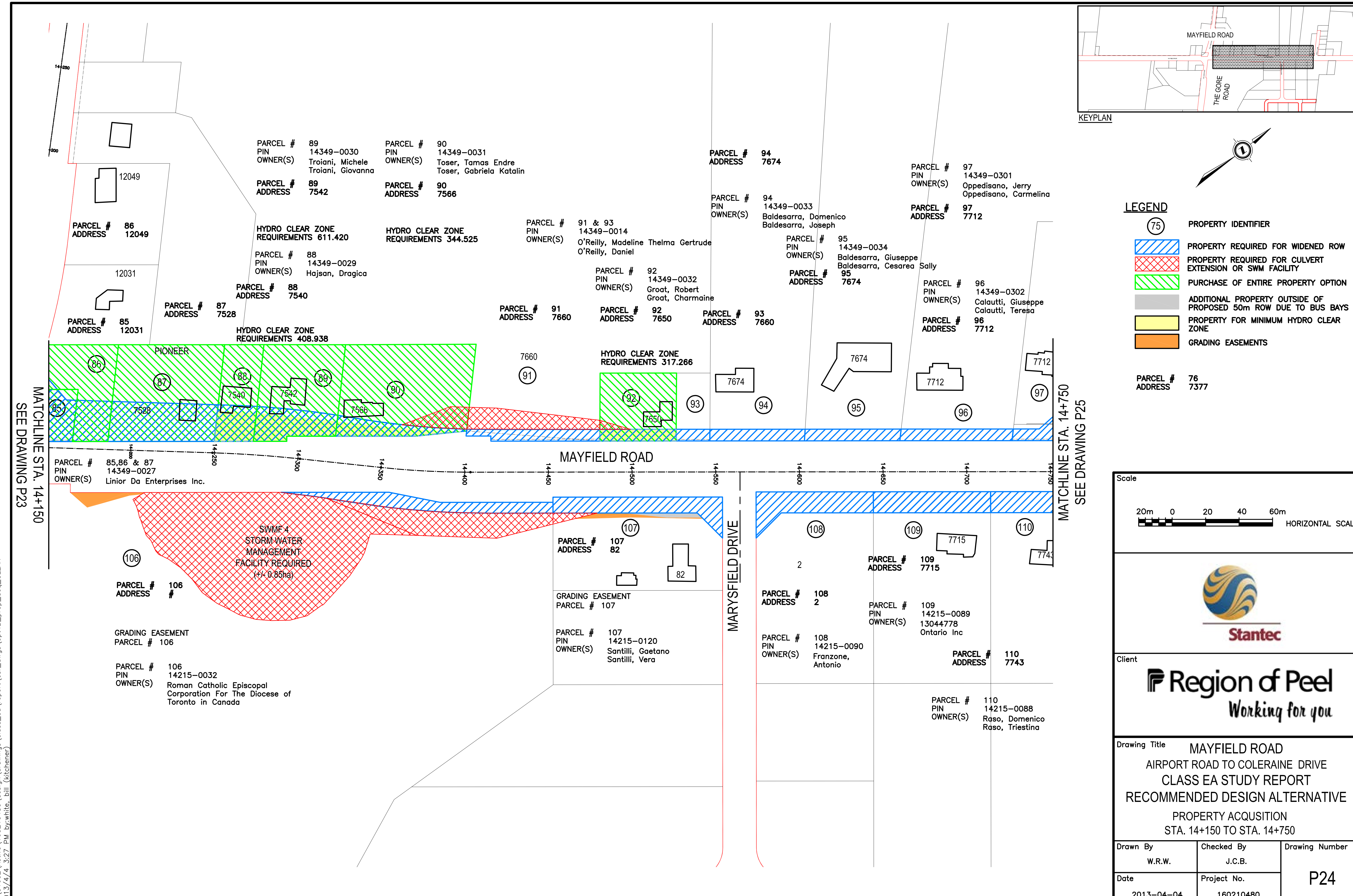

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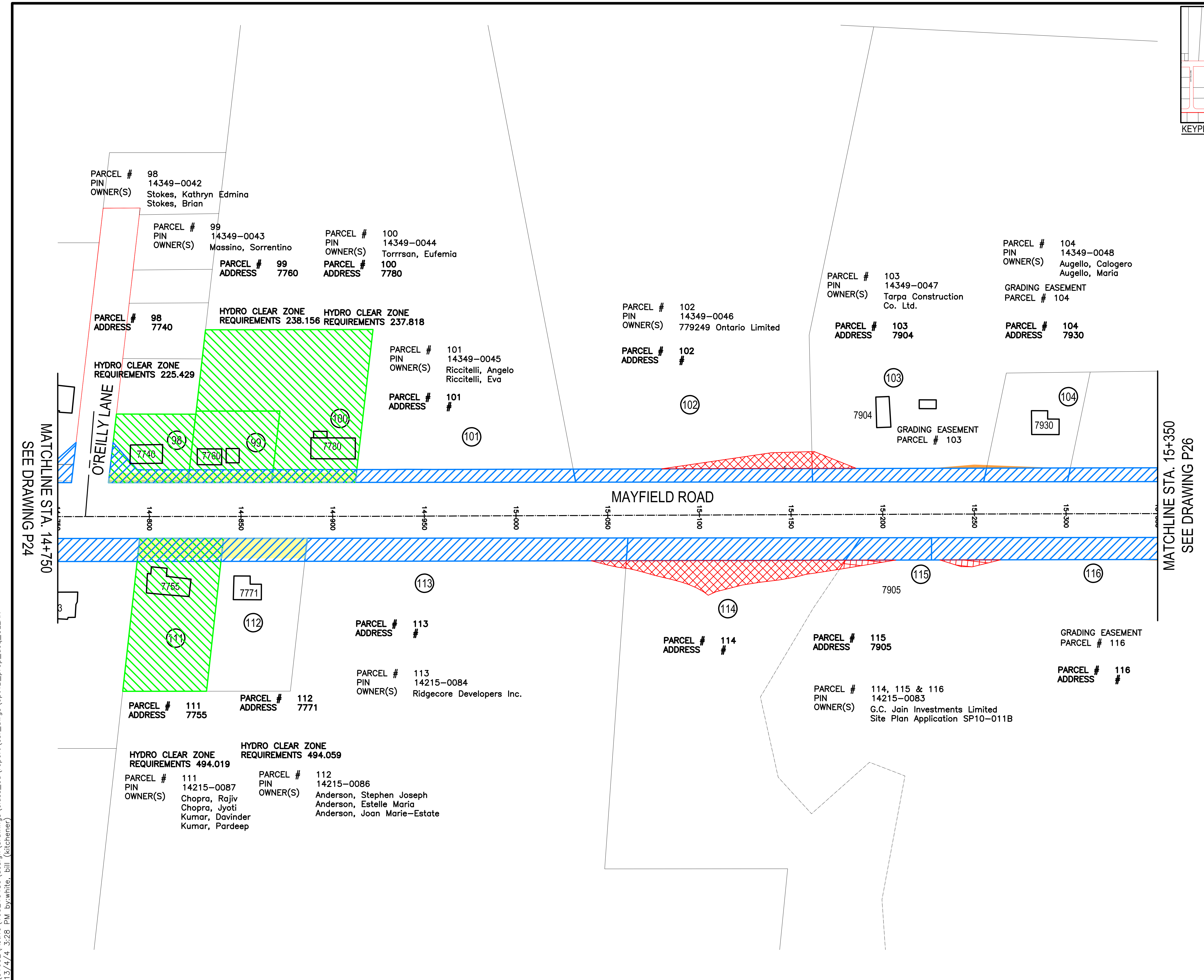
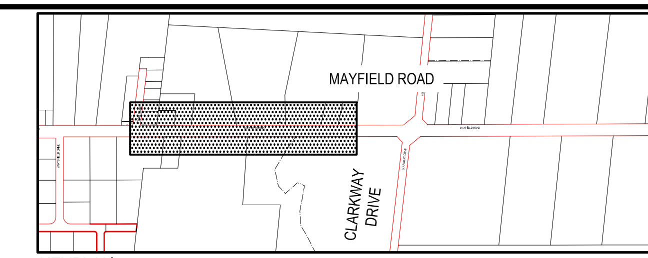
Stantec		
Client: Region of Peel — Working for you		
Drawing Title: MAYFIELD ROAD AIRPORT ROAD TO COLERAINE DRIVE CLASS EA STUDY REPORT RECOMMENDED DESIGN ALTERNATIVE PROPERTY ACQUSITION STA. 14+150 TO STA. 14+750		
Drawn By: W.R.W.	Checked By: J.C.B.	Drawing Number: P24
Date: 2013–04–04	Project No.: 160210480	





LEGEND

75	PROPERTY IDENTIFIER
	PROPERTY REQUIRED FOR WIDENED ROW
	PROPERTY REQUIRED FOR CULVERT EXTENSION OR SWM FACILITY
	PURCHASE OF ENTIRE PROPERTY OPTION
	ADDITIONAL PROPERTY OUTSIDE OF PROPOSED 50m ROW DUE TO BUS BAYS
	PROPERTY FOR MINIMUM HYDRO CLEAR ZONE
	GRADING EASEMENTS

PARCEL # 76
ADDRESS 7377

Scale

20m 0 20 40 60m
HORIZONTAL SCALE

Stantec

Client

Region of Peel
Working for you

Drawing Title
MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY REPORT
RECOMMENDED DESIGN ALTERNATIVE
PROPERTY ACQUISITION
STA. 14+750 TO STA. 15+350

Drawn By	Checked By	Drawing Number
W.R.W.	J.C.B.	P25
Date	Project No.	
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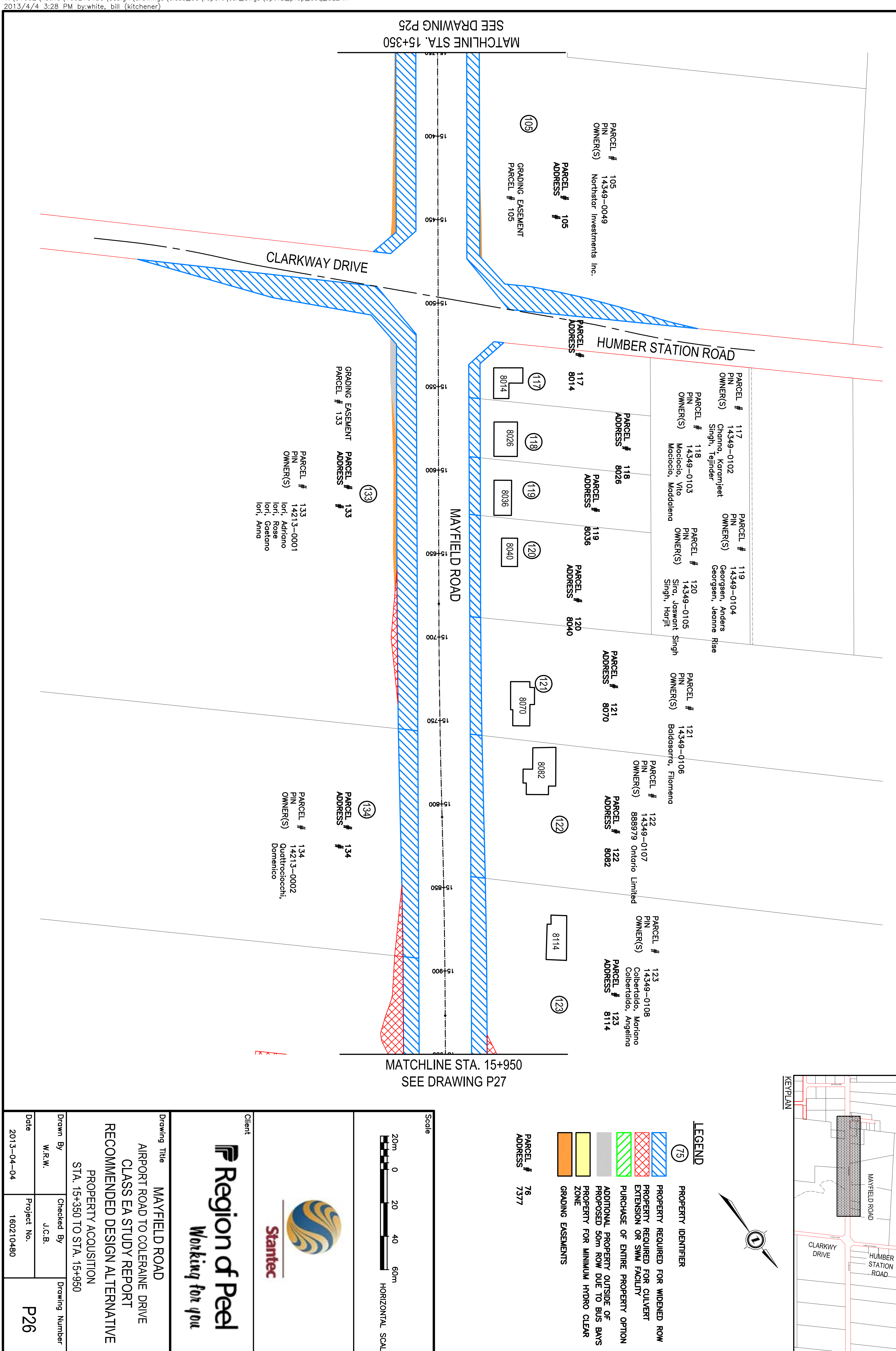

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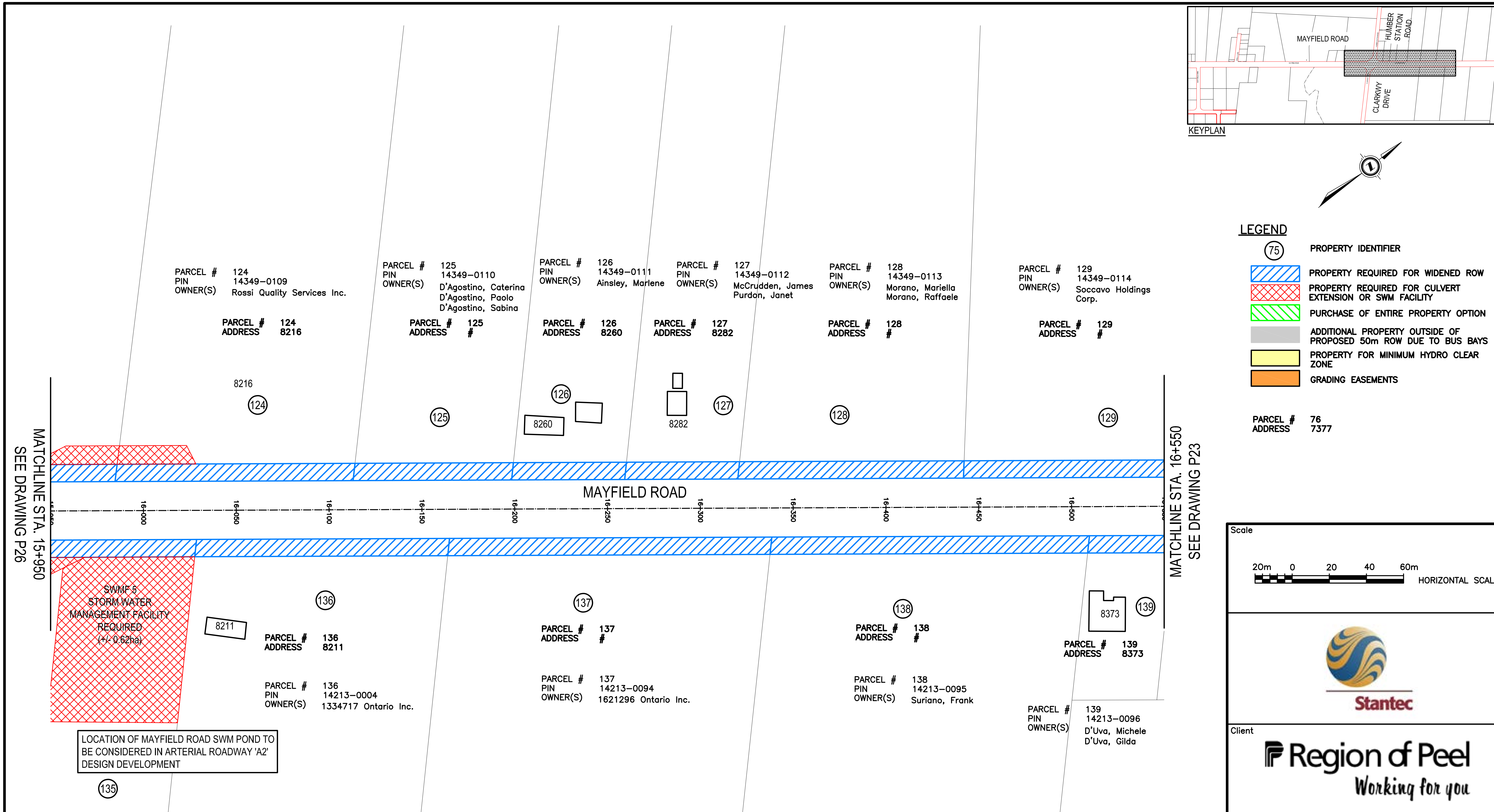
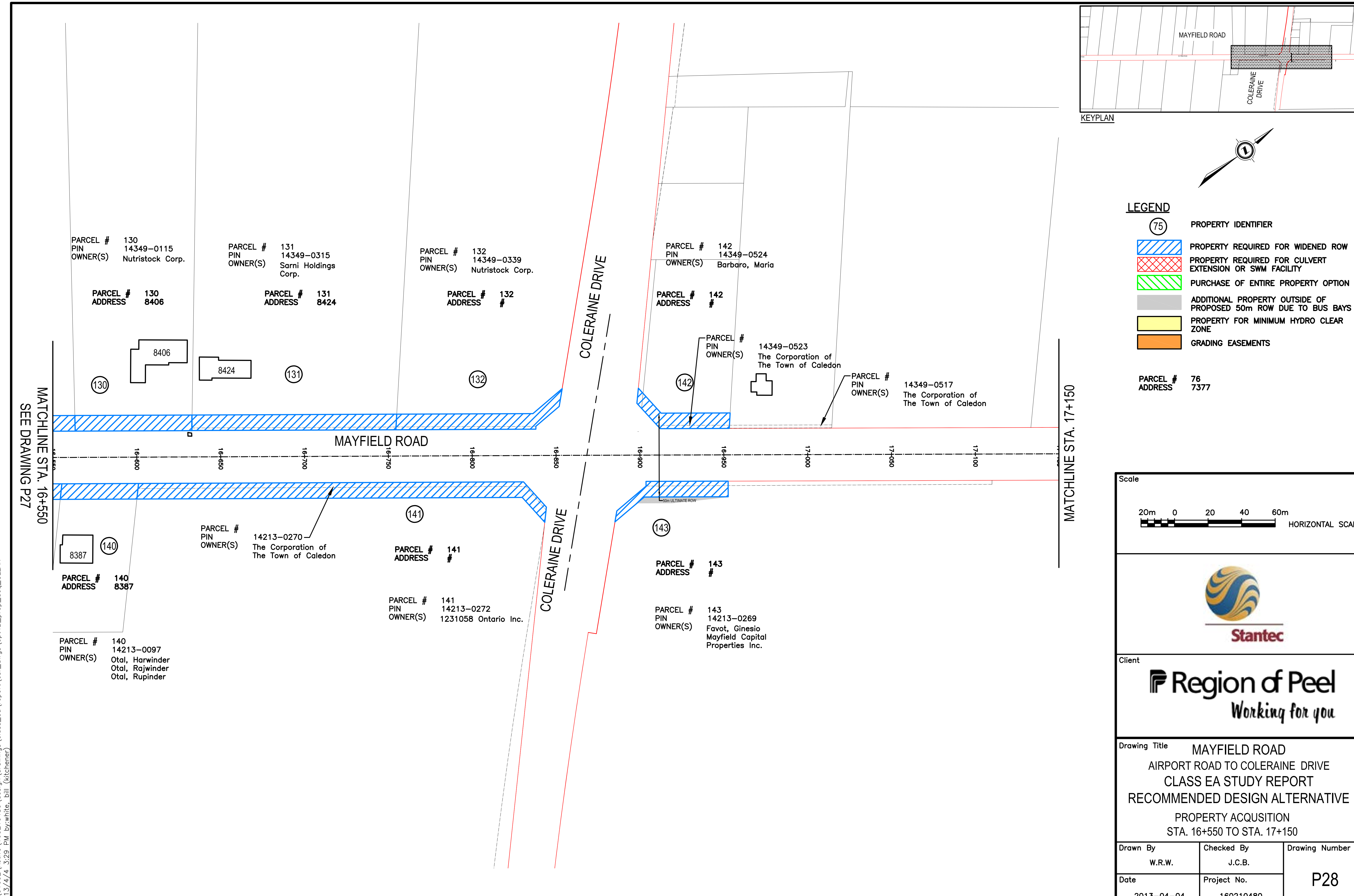


Client
Region of Peel
Working for you

Drawing Title
MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY REPORT
RECOMMENDED DESIGN ALTERNATIVE
PROPERTY ACQUISITION
STA. 15+950 TO STA. 16+550

Drawn By	Checked By	Drawing Number
W.R.W.	J.C.B.	P27
Date	Project No.	
2013–04–04	160210480	



Stantec

Client

Region of Peel
Working for you

Drawing Title

MAYFIELD ROAD
AIRPORT ROAD TO COLERAINE DRIVE
CLASS EA STUDY REPORT
RECOMMENDED DESIGN ALTERNATIVE
PROPERTY ACQUSITION
STA. 16+550 TO STA. 17+150

Drawn By	Checked By	Drawing Number
W.R.W.	J.C.B.	P28
Date	Project No.	
2013–04–04	160210480	

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2013/4/4 3:29 PM by:white, bill (kitchener)

APPENDIX U

OPINION OF PROBABLE COST

Region of Peel
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PRELIMINARY CONSTRUCTION ESTIMATE (REVISED)

ROAD MAYFIELD ROAD CONCEPT 4 (July 2010)
From: AIRPORT RD **To:** COLERAINE DR.
Length = 7.05 km 20% Contingency

Component/ Category	Item Description	Units	Unit Price	Quantity	Sub Total	Total
Design/Contract Administration	Design (@ 6% of Construction)				**$3,361,536**	
	Contract Administration @ 6% of construction				**$3,361,536**	
	Contingency (20 %)				**$1,344,614**	
	Sub Total			1	**$8,067,686**	**$8,067,686**
Property Acquisition	Strip property purchase	ha	$1,500,000	28.15	**$42,225,000**	
	Whole purchase (specify)	lump sum				
	Sub Total				**$42,225,000**	**$42,225,000**
Utility Relocation	General	km	$100,000	7.05	**$705,000**	
	Other (Hydro Poles)	ea	$5,000	190	**$950,000**	
	Contingency (20 %)				**$331,000**	
	Sub Total			1	**$1,986,000**	**$1,986,000**
Construction	Excavation/Earthworks	m3	$12	173,135	**$2,077,620**	
	Install storm sewer	m per diam	$500	7,500	**$3,750,000**	
	Granular 'A'	tonne	$20	95,210	**$1,904,200**	
	Granular 'B'	tonne	$17	332,925	**$5,659,725**	
	Asphalt Base	tonne	$80	61,105	**$4,888,416**	
	Asphalt Top	tonne	$100	30,553	**$3,055,260**	
	Remove curb and gutter	m	$25	1,000	**$25,000**	
	Install curb and gutter	m	$60	21,930	**$1,315,800**	
	Install subdrains	m	$20	15,000	**$300,000**	
	Install catch-basin leads	m	$250	1,400	**$350,000**	
	Erosion & Sediment Control	km	$35,000	7	**$246,750**	
	Install catch-basin	each	$2,500	300	**$750,000**	
	Adjust catch-basin	each		N/A	**$0**	
	Remove manhole	each		N/A	**$0**	
	Install manhole	each	$4,500	150	**$675,000**	
	Adjust manhole	each		N/A	**$0**	
	Asphalt removal	m2		N/A	**$0**	
	Asphalt planing	m2	$5	10,000	**$50,000**	
	Asphalt in place recycle	m2	$0	N/A	**$0**	
	Asphalt pulverizing	m2	$0	N/A	**$0**	
	SWM Ponds	each	$1,000,000	5	**$5,000,000**	
	Oil/Grit Separators	each	$70,000	7	**$490,000**	
	Line Painting & signs	km	$85,000	7	**$603,500**	
	Contingency (20 %)				**$6,228,254**	
	Sub Total				**$37,369,525**	**$37,369,525**
Intersections	Additional turning lane (specify extra lanes and Municipal split)			N/A		
	Contingency (specify %)			N/A		
	Sub Total					**$0**

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ROAD MAYFIELD ROAD CONCEPT 4 (July 2010)
From: AIRPORT RD **To:** COLERAINE DR.
Length = 7.05 km 20% Contingency

Component/ Category	Item Description	Units	Unit Price	Quantity	Sub Total	Total
Streetlights	Both sides	km	$430,000	7.05	**$3,031,500**	
	Centre median	km or each		N/A		
	Median	km		N/A		
	Contingency (specify 20%)				**$606,300**	
	Sub Total				**$3,637,800**	**$3,637,800**
Traffic Signals	Permanent 4 - way	each	$200,000	6	**$1,200,000**	
	Permanent 3 - way	each	$0	N/A	**$0**	
	Temporary	each	$50,000	6	**$300,000**	
					$0	
	Contingency (20%)		$225,000	1	**$300,000**	
	Sub Total				**$1,800,000**	**$1,800,000**
Culverts	Rehabilitation of existing					
	Widening of existing	L.S.	$2,124,048	1	**$2,124,048**	
	Removal & Repl. of existing	L.S.	$490,000	1	**$490,000**	
	New structure					
	Contingency (20 %)				**$392,107**	
	Sub Total				**$3,006,155**	**$3,006,155**
Bridges	Rehabilitation of existing			N/A		
	Widening of existing	L.S	1,200,000	1	**$1,200,000**	
	Removal of existing			N/A		
	New structure			N/A		
	Contingency (20%)				**$240,000**	
	Sub Total				**$1,440,000**	**$1,440,000**
Noise Walls	Installation			N/A		
	Removal of existing			N/A		
	Contingency (specify %)			N/A		
	Sub Total					**$0**
Landscaping/ Sidewalks	Sidewalk incl medians	sm	$60	9520	**$571,200**	
	Asphalt Path	sm	$35	57180	**$2,001,300**	
	Topsoiling & Sodding	sm	8	156200	**$1,249,600**	
	Trees and shrubs	km	$260,000	7.05	**$1,833,000**	
	Contingency (20 %)				**$1,131,020**	
	Sub Total				**$6,786,120**	**$6,786,120**

PROJECT TOTAL **$106,318,287**

CASH FLOW	Year I	Year II	Year III	Year IV	Total