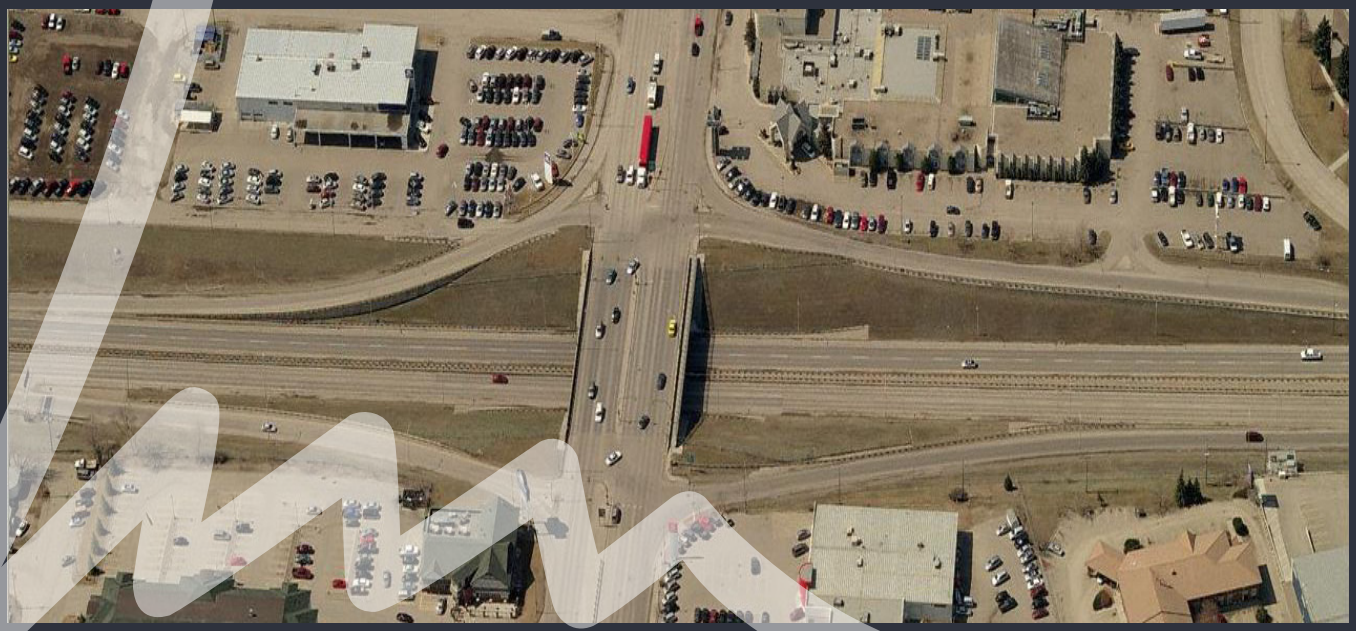


Idylwyld Drive - Circle Drive Functional Design Study

FINAL REPORT - February, 2011

Prepared for:
The City of Saskatoon
Transportation Branch
Infrastructure Services Department

Prepared By:
Hatch Mott MacDonald
#201 - 121 Research Drive
Saskatoon, SK S7N 1K2

City Project No.
6332.18

HMM Project No.
279129

Document No.
279129-G-RPT-001-REV. 0

Hatch Mott MacDonald

201-121 Research Drive
Saskatoon, SK, S7N 1K2
T 306.657.7500, F.306.657.7501
www.hatchmott.com

February 17, 2011

Mr. Lanre Akindipe, EIT
Traffic Systems Engineer - Transportation Branch
The City of Saskatoon, Infrastructure Services Department
222 - 3rd Avenue North
Saskatoon, SK S7K 0J5

Dear Mr. Akindipe:

Regarding: Idylwyld Drive – Circle Drive Functional Design Study

We are pleased to submit the final report for the above-noted project.

The report confirms that there is no quick fix for the problems at the interchange and Circle Drive North corridor. It identifies some short and medium term operational and intersection geometric improvements that will improve traffic operations and safety for a short period of time but concludes that additional network improvement beyond the immediate study area will be required to accommodate future growth in traffic.

We sincerely appreciate the opportunity to complete this study on behalf of the City. If you have any questions or require additional information, please do not hesitate to contact the undersigned at 403.920.4147.

Sincerely,

Hatch Mott MacDonald Ltd.

Steve Stowkowy, MBA, P. Eng.
Project Principal
Steve.stowkowy@hatchmott.com

PROFESSIONAL ENGINEER
S.M. STOWKOWY
MEMBER 21998
11 02 17
YR. MN. DAY
SASKATCHEWAN

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
Hatch Mott MacDonald Ltd.
Number 1294
Permission to Consult held by:

Discipline	Sk. Reg. No.	Signature
Transp.	21998	

Distribution List

# of Copies	Association / Company Name	PDF	Hard Copy
5	City of Saskatoon, Attn: Mr. Lanre Akindipe (Olanrewaju.akindipe@saskatoon.ca)	1	5
1	Steve Stowkowy (HMM), John Hemingway (HMM), Robert Shamess (HMM), Ed Miller (HMM)	1	

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
0		Feb 17, 2011	279129-G-RPT-001-REV.0 Final report

Executive Summary

This study was commissioned by the City of Saskatoon to address current traffic operational problems being experienced at the Idylwyld Drive and Circle Drive interchange and along the Circle Drive North corridor between Avenue C and Millar Avenue.

In addition, the study considered traffic conditions under two future horizon years: one horizon representing late 2012 when the new South River Crossing and southwest section of Circle Drive are to be completed and open to traffic; and the other representing approximately 2029, when it is anticipated that the City will reach a population level of 300,000.

The problems being addressed in this study are complex and long standing. A previous operational review and redesign study concluded: "*In reviewing Circle Drive within the study area, today and in the future, it became abundantly clear that there is no quick or inexpensive 'fix' for the roadway*"[1]. The study herein has concluded similarly. It found that there are a number of problems being experienced at the Circle Drive interchange with Idylwyld Drive. The current simple diamond interchange configuration does not provide sufficient spacing between the ramp terminals to accommodate traffic volumes, and the movements of a high number of trucks using this interchange and corridor. The design of the southbound off-ramp from Idylwyld Drive does not provide sufficient separate queuing space for left and right turning movements to Circle Drive. Local access is provided to the ramp that can interfere with ramp operation and there are closely spaced intersections adjacent to the ramp terminals on Circle Drive that affect the operation of the ramp terminals by not providing sufficient queuing space.

[1] Bunt and Assoc. Engineering (Alberta) Ltd., "*Circle Drive: Millar Avenue to Idylwyld Drive Operational Review and Redesign Study: Final Report*", Calgary, March 2005, p. 1.

When the new South River Crossing and southwest section of Circle Drive are completed in 2012, it is expected that approximately 300 – 400 vehicles per hour (veh/h) will be attracted to this section and away from the Circle Drive North corridor. While some relief will be afforded to the corridor, this change in patterns will add more traffic to the southbound to westbound movement from Idylwyld Drive to Circle Drive and possibly to the eastbound to northbound movement from Circle Drive to Idylwyld Drive at the interchange. These movements are projected to continue to be operating at capacity for the foreseeable future.

While the traffic along the remainder of the Circle Drive corridor to the east is reduced, some of the operational problems currently being experienced will remain but become less acute. These problems arise from physical, spatial and land use conditions which will remain essentially unchanged either by the completion of the new South River Crossing or by improvements to the Idylwyld Drive interchange. They will persist and become more acute as traffic grows again beyond the 2012 planning horizon.

This study has concluded that the capacity and operational problems at the interchange can be addressed in the short term with the implementation of a number of localized improvements to the ramps, ramp terminals and traffic signal operation. Current operational problems cannot be completely addressed as the close spacing of the ramp terminals and adjacent intersections will continue to constrain and inhibit the operational effectiveness of these improvements.

Problems in the corridor will be improved somewhat in the short term with the completion of Circle Drive across the South Saskatchewan River, and with a further diversion of traffic to other routes accessing Idylwyld Drive. This study suggests, subject to further investigation of feasibility, increased use by trucks and other traffic of the Warman Road – 51st Street routing between Circle Drive North and Idylwyld Drive as a viable short term strategy to reducing the traffic at the Circle Drive – Idylwyld Drive interchange and Circle Drive North corridor. In addition, improvements to Dalmeny Road to improve access to Highway 16 west of the City have been identified by the trucking community as necessary

to encourage greater use of the Circle Drive West corridor around the City and to reduce truck traffic on Circle Drive North.

Over the medium to long term, it is concluded that additional capacity will be required through provision of a northern perimeter road that can accommodate a larger share of the longer-distance truck and other traffic that is currently using the Circle Drive North and East route around Saskatoon. Additionally, depending on the amount of traffic that is diverted from Circle Drive North by the completion of the South River Crossing and a future North Perimeter Road, a reconfiguration of the Circle Drive – Idylwyld Drive interchange may be required. Based on an evaluation of alternative configurations at this location, a Single Point Urban Interchange configuration is recommended if further capacity enhancement is required in the future (See **Figure G-3** in **Appendix G**).

Traffic operations in the Circle Drive corridor are anticipated to remain problematic for the foreseeable future due to the closely spaced intersections and driveways, the mixing of long distance through traffic and local traffic generated by the area development and the presence of heavy, large vehicles using the corridor. The operation of the interchange and corridor are integral to one another: the effectiveness of improvements to one relies to a large extent upon the effectiveness of improvements to the other. Addressing just the interchange problems will not address the corridor problems, and vice versa. They must be addressed together.

This study recommends managing congestion in the Circle Drive North corridor through a variety of means: encouraging more of the truck and other longer distance traffic to use alternate routes to Circle Drive; improving lane configuration and intersection geometry and directional signage so truck movements can be accommodated more easily; selectively adding through lane capacity (at Millar Avenue eastbound and westbound); and improving the coordination and progression of traffic signals where possible. To accomplish this will require a frequent monitoring and updating of traffic information and a periodic assessment of the timing for additional longer-term improvements, including

either a reconfiguration of the Idylwyld Drive – Circle Drive interchange or a North Perimeter Road and River Crossing.

Specific recommendations made in this study are:

1. That the City implement short term operational improvements to the Idylwyld Drive – Circle Drive interchange that include:

    - Widening the N-EW (southbound exit) ramp to separate the left and right turning traffic adequately and converting the southbound shared through and left turn lane to a dedicated left turn lane.
    - In conjunction with 1 above, eliminate the local access to the N-EW and the EW-S ramps.

2. That the City implement short term operational improvements to the Circle Drive Corridor between Avenue C and Millar Avenue that include the following:

    - Provision of added eastbound and westbound through lanes at the Millar Avenue intersection.
    - Reconfiguration of the southbound movements at the Circle Drive intersection with First Avenue to include a separate left and shared through and right turn lane.
    - Reconfiguration of the southbound movements at the Circle Drive and Avenue C intersection to include separate free-flow right turn lane.

3. That the City investigate the potential to improve the Warman Road and 51st Street corridors in the short term as a means to relieve the traffic operational problems being experienced at the Idylwyld Drive – Circle Drive interchange and Circle Drive North corridor between Avenue C and Millar Avenue.

4. That the City monitor the effects upon traffic patterns arising from the implementation of the South River Crossing and the south western section of Circle Drive, in conjunction with the introduction of the alternate routing strategy noted in Recommendation 3 and the short-term interchange and corridor improvements noted in Recommendations 1 and 2, and assess the combined effect on the operation of the Circle Drive interchange and corridor.

5. That in conjunction with the monitoring of traffic patterns after the opening of the southwest section of Circle Drive, the City undertake further investigations into the design of a Single Point Urban interchange at the Idylwyld Drive – Circle Drive interchange, refine preliminary cost estimates associated with the construction of these works and relocation of existing utilities and, if appropriate, to incorporate these works into the City's Capital Plan.

6. That the City, in conjunction with the Province, update the long range transportation planning studies of the need for a north perimeter road. Further, that the City investigate the effect that such a facility will have upon traffic demand in the Circle Drive corridor and at the Idylwyld Drive interchange with Circle Drive. Based on these investigations, the need for a reconfiguration of the interchange and further improvements to the corridor and possibly other alternative corridors can be reassessed in conjunction with the findings of Recommendation 5.

Acknowledgements

The City of Saskatoon managed and directed this study with a Project Team that consisted of the following members:

City of Saskatoon

Lanre Akindipe, Project Manager
Angela Gardiner, Transportation Branch Manager
David LeBoutillier, Transportation Planning
Don Cook, Transportation Planning
Lisa Thibodeau, Community Development
Goran Lazic, Traffic Operations

Saskatchewan Ministry of Highways and Infrastructure

Geoff Meinert, Senior Project Manager

Prime Consultant, Hatch Mott MacDonald

Steve Stowkowy, Project Director
Ed Miller, Project Manager
John Hemingway, Design Manager
Robert Shamess, Senior Design Engineer
Altaf Hussain, Senior Traffic Engineer

Subconsultant, Leslie Bell Marketing and Communications

Leslie Bell, Public Consultation

In addition to project review meetings with the above participants, meetings were held with representatives of the Saskatchewan Trucking Association and the North Saskatoon Business Association to present preliminary findings, obtain comments on the alternatives studied and identify any other feasible alternatives for consideration. These consultations are discussed further in Section 7 of this report. The minutes of these meetings are included in **Appendix B.**

This study builds upon the planning work undertaken by the City and Consultants retained to complete specific planning and design studies that included the Circle Drive corridor and interchange at Idylwyld Drive. The contributions from the background studies related to this specific assignment are acknowledged and have been considered further in this study. Pertinent findings and recommendations from related studies are summarized in **Appendix C**.

Table of Contents

List of Figures

List of Tables

Appendices

Appendix A ~ Terms of Reference

Appendix B ~ Stakeholder Consultations

Appendix C ~ Literature Review

Appendix D ~ Base Traffic Volumes

Appendix E ~ Development of Truck Trip Table

Appendix F ~ VISUM Model Outputs

Appendix G ~ Improvement Alternatives

1. Introduction

1.1 Background

Circle Drive and its connection to Idylwyld Drive in north Saskatoon provides a gateway for traffic moving to/from the City and areas to the north and west of the City. Since its inception in 1967, the Circle Drive corridor in Saskatoon has provided a dual function of a ring road accommodating movements of through traffic around the City as well as an arterial route providing local access to adjacent properties. While this route was envisaged as a continuous ring road around both the east and west sides of the City, it has been implemented in sections. Today, Circle Drive provides for continuous movement around the east half of the City, with links to Highways 16 and 11 in the southeast and Highways 16, 11 and 12 in the north. The section on the west side of Idylwyld Drive is not yet complete but does provide links to Highways 14 and 7. Much of the Circle Drive corridor operates as a free flow, access controlled facility with connections to other controlled access facilities such as Idylwyld Drive. However, the section between Warman Road and Avenue C operates as a six-lane arterial road with direct fronting access to adjacent properties.

As the City has grown over the years, so has the traffic demand on Circle Drive. The interchange between Circle Drive and Idylwyld Drive, one of the key gateways to the City from the north now accommodates approximately 50,000 vehicles per day, with approximately 10 percent of this traffic consisting of heavy trucks. The Idylwyld Drive – Circle Drive interchange currently represents one of the heaviest travelled interchanges in the City. As traffic demand has grown so has the conflict between through traffic movement and local access, particularly in the section between Warman Road and Avenue C (Circle Drive North).

The City of Saskatoon has implemented a number of improvements to Circle Drive and to its interchange with Idylwyld Drive in conjunction with this growth in travel demand.

Idylwyld/Circle Drive interchange and Circle Drive corridor improvements history is provided in **Table 1**.

Table 1: Circle Drive and Idylwyld Drive Improvement History

Year	Improvement Description
1967	Circle Drive bridge over Idylwyld Drive was constructed with four traffic lanes and additional left turn bays
1980	Warman Road and CNR rail bridges were constructed over Circle Drive
1983	Circle Drive bridge across the South Saskatchewan River was constructed with four traffic lanes
2001	Circle Drive bridge over Idylwyld Drive was widened to six traffic lanes
2006	Circle Drive bridge across the South Saskatchewan River was widened to include an additional eastbound traffic lane (three eastbound lanes)
2007	Circle Drive bridge across the river was widened to include an additional westbound traffic lanes (three westbound lanes)
2007	Approaches to the Warman Road bridge over Circle Drive were improved

Source: City of Saskatoon Transportation Planning

In conjunction with making these improvements to Circle Drive, the City has completed planning studies that have identified additional long range transportation improvements required to accommodate traffic generated by continued development in the City and growth in regional and provincial traffic. These improvements include the scheduled completion of the South River Crossing of the South Saskatchewan River and the southwest section of the Circle Drive corridor in 2012; and a new perimeter road to be built in the northeast part of the City at a date yet to be determined.

The Circle Drive interchange with Idylwyld Drive currently experiences a number of operational problems that show no sign of abating in the near future. What's more, the effect that completion of the South River Crossing and the southwest section of the Circle Drive corridor will have on the traffic patterns and movements at the Idylwyld Drive interchange is unclear. The City is concerned that the current design of the interchange

may in fact limit the ability to accommodate not only current but future traffic patterns and movement. Motorists using the arterial section of Circle Drive North also experience delays and movement conflicts with traffic using adjacent driveways. Accordingly, the City initiated this study of the role and function of the interchange and the Circle Drive North corridor to clarify and address these issues.

1.2 Purpose

In August, 2010, the City of Saskatoon retained Hatch Mott MacDonald (HMM) to review the current design of the Idylwyld Drive interchange in an effort to identify opportunities to improve the operation and function of the interchange and the Circle Drive North corridor between Avenue C and Millar Avenue. A copy of the Terms of Reference for this study is contained in **Appendix A**.

As noted in the Terms of Reference, the scope of this study: *"…is to develop a detailed functional design for intersection improvements and recommendations for signage and for signal changes at the intersection. All improvements must remain within the existing right-of-way; no recommendations for major property acquisition will be considered*".[2] The study is to focus on the interchange between Idylwyld Drive and Circle Drive but is also to consider improvements to the corridor on the east and west sides of the interchange, between Avenue C to the west and Millar Avenue to the east.

1.3 Objectives

The objectives of this study are:

1. To assess the current use of the corridor between Avenue C and Millar Avenue and the interchange of Idylwyld Drive and Circle Drive.

[2] City of Saskatoon, "*Request for Proposals: Detailed Design Study – Improvements to the Intersection of Idylwyld Drive & Circle Drive: Terms of Reference*", Transportation Branch, Infrastructure Services, City of Saskatoon, June, 2010, p.1.

2. To identify improvements to the existing diamond interchange that may include consideration of the following alternatives:
   - Diverging Diamond Interchange (DDI);
   - Single Point Urban Interchange (SPUI);
   - Dual-lane interchange ramps;
   - Signal timing and coordination plans; and
   - Designation of additional eastbound and northbound truck routes.

The focus of these improvements is to be the accommodation of expected changes in truck turning movements as well as an overall improvement in the function of the interchange.

1.4 Study Area

The area of this study includes the Idylwyld Drive – Circle Drive interchange, including the area of the on and off-ramps to / from Idylwyld Drive; and the section of Circle Drive North from the Avenue C intersection in the west to the Millar Avenue intersection in the east. The study area along Circle Drive extends to the limits of the intersection approaches on the north and south side of Circle Drive. The intersection limits are generally taken to be the extent of the introduced turning lanes (left or right) and / or the limits of the corner radii where turning lanes are not provided. The Study Area is shown in **Figure 1**.

Figure 1: Study Area

1.5 Approach

The approach taken in this study has been based on firstly identifying and developing an understanding of the traffic and access issues in the corridor, the future traffic conditions arising from the significant network changes being implemented in the City; establishing the ability of the current interchange and corridor design to accommodate these conditions; identifying opportunities to improve these conditions both in the short and long term; evaluating alternative improvements to accommodating the future traffic requirements; and selecting and preparing a functional design for the preferred method of addressing both the short and long term requirements.

The horizon years used in the analysis are consistent with the planned improvements and achievement of future population levels. Specifically, a 2012 base year was selected for analysis as this will be consistent with the opening of the South River Crossing and the southwest section of Circle Drive. A future horizon year of 2029 was selected on the basis that this year is consistent with the City having a population of 300,000 persons. Traffic projections were available for this population horizon and these have been incorporated into this analysis.

1.6 Relevant Studies

A number of studies have been completed that have included the Circle Drive North corridor and its connection to Idywyld Drive. These studies were made available by the City and were reviewed to identify salient points that may have a bearing in this study. **Appendix C** contains a summary of relevant reports reviewed during this study. The following three studies provided the most direct information and data.

1. *River Crossing Study for the City of Saskatoon* (1999). The most important finding in this study was that the results of the network analysis indicated that at the 250,000 population level, both the north and South River Crossings achieved the best overall system performance. The roadway system assessment concluded that improving the existing Circle Drive Bridge by itself created network problems between Warman Drive

and Airport Drive. The implication here is that as traffic growth continues, more congestion is expected in the study area that can be relieved by implementation of both a north and South River Crossing. This is essentially describing the situation now being faced by the City, the conditions representing pre-implementation of either added river crossing.

2. *Saskatoon Long Range Transportation Planning Study* (2001). This study notes that a west perimeter route is the lowest priority and may not be required once the east portion of the perimeter route is operating between Hwy. 11S and Hwy. 16 W. This will be the key truck routing in the future. The study also provides a comprehensive origin – destination survey of movements through a series of external gateways. It was found that the percentage of through traffic, including through traffic with stop and through non-stop traffic, on average was 10 percent of total trips. Roadways with the highest through traffic included Hwy. 16 E and W and Hwy. 11 S. Through traffic percentages in these routes were generally less than 20 percent.

3. *Circle Drive: Millar Avenue to Idylwyld Drive Operational Review and Redesign Study* (2005). This study was commissioned to identify steps necessary to resolve congestion evident along Circle Drive North. The study concludes: "There is no quick or inexpensive fix" to the problems experienced in the Circle Drive North corridor. Fixing the congestion here would require either an expressway standard roadway or a one-way couplet urban arterial system through the corridor. The study recommends that in the short term the following improvements be made:

- Widen Circle Drive in selective areas to an 8-lane cross section;
- Reconstruct side street approaches to accommodate truck turns better;
- Revise and optimize directional signage and messaging;
- Improve sight lines at intersections;
- Adjust the traffic signal phasing and timing using a 100 seconds background cycle length.

The following medium term improvements were recommended:

- Amalgamate the Home Depot / Venture Crescent West intersections and relocate the Home Depot traffic signal;
- Re-align the Faithful Avenue – Quebec Avenue intersection to provide continuous north – south movement;
- Develop a new connection to Warman Road from 46th Street and provide a fly-over of 46th Street across Idylwyld Drive to provide a continuous connection parallel to Circle Drive from Warman Road to Avenue C.

In the long term, the study recommends the following:

- Acquisition of the rail right-of-way south of Circle Drive and development of an arterial road in this corridor;
- Re-organizing Circle Drive and this new parallel route as a one-way couplet, or developing a new freeway in the rail corridor.

The solution in the longer term is identified as a new roadway providing a parallel through traffic carrying function to Circle Drive. Limited operational and capacity improvements to Circle Drive are recommended for the short and medium term but these improvements will not in themselves resolve the capacity issues in the Circle Drive North corridor. Additional capacity will be needed, and this report suggests a parallel 46th Street route as the best option to provide this capacity.

2. Study Area Conditions

2.1 Site Reconnaissance

A site visit was conducted on September 1, 2010 with representatives of the City of Saskatoon, Saskatchewan Department of Highways and Infrastructure and the consultant.. The following points were noted during the reconnaissance:

1. The Circle Drive corridor is characterized by several closely spaced signalized and unsignalized intersections, with a general spacing of approximately 150 – 190 metres (less than 200m).

2. The background traffic signal cycle length is approximately 110 seconds. While the corridor has three basic lanes in each direction, the current signal phasing includes protected and permissive left turns across three opposing traffic lanes.

3. The adjacent land uses include highway commercial and fast food establishments with numerous driveways to Circle Drive. The Travel Lodge has a direct access to/from its parking area to the exit ramp from the southbound Idylwyld Drive.

4. The City has recently required that all trucks use the outer (right) traffic lane. The effect of this is to create a barrier for traffic wishing to access the local driveways along the corridor. Many conflicts were witnessed between vehicles turning through the queues of trucks and other vehicles in the right lanes to access these driveways.

5. There are very few pedestrian facilities along the corridor. Sidewalks exist along the north side only and terminate just east of Northridge Drive. Pedestrian tracks are present and some movements across Circle Drive were noted during the visit in early afternoon.

6. Queues of vehicles on the southbound exit ramp from Idylwyld Drive were common and consisted primarily of left turning traffic. Right turn movements were trapped within the left turning traffic as the ramp was only a single lane ramp and a queue jump lane for the right turning vehicles is not provided.

7. The critical movements are the southbound left, the eastbound left and westbound right at the interchange. The City noted that these patterns may change somewhat when 'local truck traffic only' restrictions are imposed next year for traffic using Idylwyld Drive south of Circle Drive.

8. Opportunities to shift some of the traffic from the Circle Drive corridor were discussed. These included use of the local streets for the eastbound left which can divert to Idylwyld Drive south of Circle Drive. Ontario Avenue was found to be the logical routing as a crossing of the existing railway lines exists today with automatic protection. Shifting the westbound rights to a parallel road with connection to the freeway (46th Street proposal in the previous operational review) will be difficult due to the location of the 51st. Street interchange ramps to the north.

9. The City noted that the existing structure was widened recently by adding an extra through lane in each direction. While provision was included for pedestrian and cycling traffic on the north side of the structure the affect of this is limited due to the lack of pedestrian/cyclist facilities elsewhere in the corridor.

2.2 Land Use and Development

The Study Area falls within the North Saskatoon Business Area. The land use within the area bounded by 51st Street to the north, 33rd Street to the south, Warman Road to the east and Airport Drive to the west is predominantly industrial, with highway commercial uses adjacent to Circle Drive North. The area is generally built out, with an established local road and driveway system adjacent to Circle Drive. A key feature in the study area between Avenue C and Millar Avenue is the fronting access provided to several of the

adjacent properties from Circle Drive. Restriction to access is imposed by a raised center median along the roadway in some areas. The existing buildings and parking areas are located in close proximity to the roadway. A relatively small building setback is provided.

Traffic on Circle Drive and intersecting streets is characterized by the number of trucks using these roadways and in many instances, the sizes of trucks being categorized as inter-provincial haulers with either longer trailers or multi-unit trailers.

2.3 Roadways

Circle Drive within the Study Area consists of a 6-lane urban arterial road, with auxiliary turning lanes at intersections. The full cross section can include up to eight lanes in some locations.

The roadway has an urban cross section, with concrete curb and gutter. There is a raised concrete/grass median for almost the full length of the roadway between Avenue C and Millar Avenue. The width of the median varies from as narrow as 1.5 metres to approximately 6 metres. Full illumination is provided within the study area.

Provision of a curb face, 1.5-metre (approximate) sidewalk has been made at the structure over Idylwyld Drive, along the north side only, and along the north side of the roadway between Idylwyld Drive and Avenue C and between Idylwyld Drive and Northridge Drive.

In most sections there is little space available between the back of walk (where it exists) and property line. Little setback is provided between the road and buildings and parking facilities in some areas.

Overhead directional signs are present for both eastbound and westbound traffic approaching the Idylwyld Drive interchange. Red Light Cameras have also been installed at the Circle Drive and Avenue C intersection.

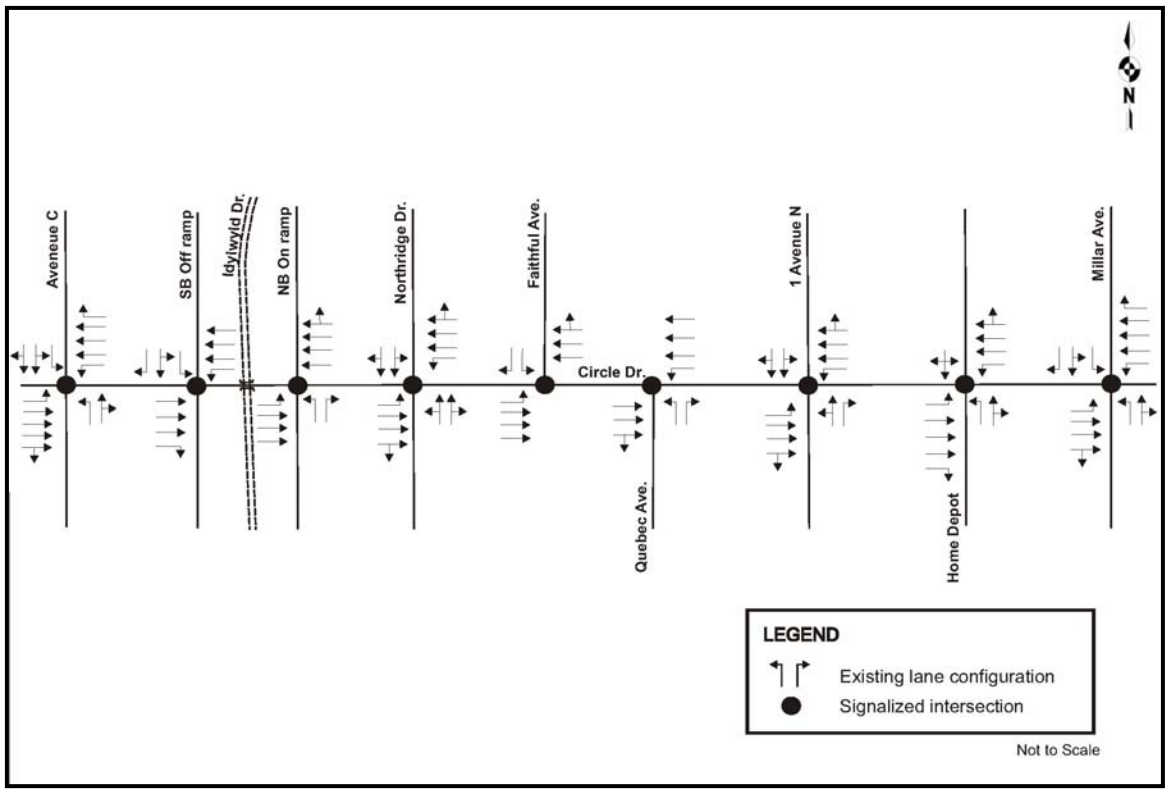
Within the Study Area there are nine intersections with public roads, most of which are signalized. In the central area of the corridor the intersections of Faithful Avenue and Quebec Avenue are offset from one another by approximately 100 metres, with traffic signals located at both intersections. In addition, within the study area there are numerous driveways to adjacent businesses, with poorly defined drop curbs delimiting the entrances. Some of these driveways are signalized (Venture Crescent and Home Depot entrance). The result is a set of closely spaced signalized intersections, with intersection spacing in some areas being as little as 81 metres.

The posted speed limit in this section is 50 km/h. Trucks are restricted to using the right (outer) traffic lanes.

The intersecting roadways are generally industrial collector roads consisting of two traffic lanes and on-street parking. The throat widths are widened to accommodate separate left and right turn lanes in some locations.

Figure 2 illustrates the existing lane configuration and traffic control in the study area.

Figure 2: Existing Lane Configuration and Traffic Control



2.4 Utilities

Previous studies have included extensive data collection and analysis of the utilities in the corridor. The results of these inventories have been used as a basis to develop the base information and plans in this study. The findings as presented in these studies are summarized below.[3]

SaskPower

- 3 phase overhead 25 kV line, between Warman Road and Faithful Avenue with the poles located on the north property line. The line runs underground from Faithful Avenue to west of Avenue C, across the Idylwyld bridge. At Warman Road the line

[3] Bunt and Assoc. Engineering (Alberta) Ltd., "*Circle Drive: Millar Avenue to Idylwyld Drive Operational Review and Redesign Study: Final Report*", Calgary, March 2005, pp. 12-15.

turns south crossing Circle Drive, and 100 metres south of Circle Drive it goes underground at the route turns east under the CN Railway and Warman Road.

- 3 phase overhead 25 kV line running on the west side of Miller Avenue which connects to line running along Circle Drive.

City of Saskatoon Electrical Services

- Overhead 15 kV line on south side of Circle Drive between Millar Avenue and Northridge Drive. Just to the west of North ridge this line goes underground and crosses to the north side of Circle Drive. From this point the line runs underground to the west across the Idylwyld Bridge.
- Underground services to lighting throughout corridor and overhead signs at Millar and Idylwyld intersections.
- Underground crossing on all four legs of the Home Depot intersection
- Underground crossings at Venture Crescent, Millar Avenue and in the median of Circle Drive.
- Underground crossing of Circle Drive 100 m east of Millar Avenue intersection.

SaskTel

- Overhead line on south side between Venture Crescent (east) and 1st Avenue which turns south on 1st with underground services to buildings.
- Overhead line on south side between 1st Avenue and Quebec Avenue which turns south on Quebec with underground connections to buildings.
- On north side of Circle Drive between Venture Crescent and Faithful Avenue, overhead line in lanes behind buildings with underground connections to buildings.
- Underground crossing of Circle Drive just west of Northridge Drive.
- Ducting in south side of bridge but no service through.
- Overhead line on east side of Millar Avenue crosses Circle Drive 50 m east of intersection.

Water Mains

- Main in median from Avenue C to Idylwyld Drive which then crosses under Idylwyld south of the bridge goes up the off ramp and crosses to the north side of Circle Drive to Warman Road and then north on Warman. A line "T's off this main at 1st Avenue and goes north.
- North-south main on Alberta Avenue-Northridge Drive corridor with a "T" intersection for a line that runs along the median of Circle Drive to Faithful Avenue. From Faithful, this line crosses to the south curb line at the Home Depot intersection. There are additional "T's" intersections off this line that go north on Faithful, south on Quebec, south on 1st, south on Venture(W).
- Main runs north up Ontario, crosses the eastbound lanes of Circle, runs along the median to Faithful Avenue and crosses the westbound lanes of Circle to go north on Faithful.
- Crossing of Circle Drive for a north-south line on 1st Ave.
- Line down east side of Millar crosses Circle to connect with the main on the south side of Circle.
- Main on the east side of Warman Road runs under Circle Drive to east of the Warman Road bridge.

SaskEnergy

- Two lines, one medium pressure 114 mm diameter and the other intermediate pressure 273 mm diameter, run on the north side of Circle Drive. The 114 mm line runs from Avenue C to Northridge Drive. The 273 mm pipe reduces to 219 mm at 1st Avenue and continues to Millar Avenue, where it turns north.
- Medium pressure line crossing Circle Drive at Tony Roma's with a connection from the 114 mm line.
- Intermediate pressure line crossing Circle Drive at Alberta Avenue.
- Medium pressure line running north on Northridge Drive from the 114 mm line.
- Medium pressure line crosses the westbound lanes of Circle Drive, east of Northridge Drive and then runs along median of Circle Drive to 1st Avenue.

- North-south medium pressure line crossing Circle Drive at 1st Avenue.
- Medium pressure line crossing Circle Drive 150 m east of 1st Avenue.
- Medium pressure line crossing Circle Drive 80 west of Venture W.
- Medium pressure line crossing Circle Drive 125 m west of Venture.

Storm Water

- System along Circle Drive median between Avenue C and Idylwyld Drive
- East of bridge, system along Circle Drive median to Venture (W), which crosses Circle Drive eastbound lanes and terminates on Venture Crescent (W)
- Catch basins for storm water system are located at all the corners of the intersections with leads crossing Circle Drive to the median.
- Between 1st and Venture W, catch basins in the north and south curb lines at a spacing of 120 m with leads crossing Circle Drive.
- Connections to the Circle Drive system on the north side of the corridor from Faithful and 1st Avenues.
- System for drainage of Millar commences at median of Circle on west side of intersection and crosses westbound traffic lanes.

Sanitary

- Main up Alberta Avenue crossing eastbound lanes of Circle Drive, runs under the median to 1st Avenue, crosses the eastbound lanes again and continues south on 1st Avenue.
- Main on Quebec Avenue commences at Circle Drive intersection and runs south.
- Main commences on Faithful, 100 metres north of Circle Drive intersection and runs north.
- Main runs under median from 1st Avenue to west of the Home Depot Intersection, then crosses to south curb line at Venture Crescent (west), continues to the Toyota dealership near the CN Railway and turns south to the railway.
- Crossing 50 metres east of Millar Avenue intersection.

2.5 Geotechnical

The pavement structure along Circle Drive within the Study Area shows signs of distress. Wheel rutting is pronounced in some sections. The traffic growth and growth in truck traffic in particular appears to be accelerating the deterioration of the pavement. Previous studies have indicated that the pavement has reached the end of its useful life and that replacement of the pavement structure is required, irrespective of other geometric changes.

2.6 Structural

The Circle Drive bridge structure over Idylwyld Drive was originally constructed as a four-lane structure in 1967. This structure was subsequently widened to a six-lane cross section in 2001, including a sidewalk on the north side only. A structure condition assessment was not conducted as part of this study. It has been assumed that the service life of the structure is adequate and that major rehabilitation of the existing bridge will not be required for the planning horizons under consideration in this study.

2.7 Traffic Characteristics and Volumes

2.7.1 General Traffic

Figures D-1 and **D-2** in **Appendix D** summarize the observed 2009 morning and afternoon traffic volumes respectively at key intersections in the study area. The higher traffic volumes occur during the afternoon peak hour. Generally, in the afternoon peak hour the link volumes on Circle Drive immediately east of the Idylwyld Drive are approximately 2314 veh/h eastbound and 2274 veh/h westbound. At the eastern end of the study area, the link volumes are approximately 3944 veh/h eastbound and 2420 veh/h westbound.

Relatively high turning movements were observed at a number of intersections, particularly Avenue C, the Idylwyld Drive interchange ramp intersections, Faithful Avenue and Millar Avenue.

2.7.2 Truck Traffic

As indicated in the figures, currently there is a high movement of truck traffic between Idylwyld Drive and Circle Drive. Truck volumes on Circle Drive in the afternoon peak hour are approximately 100 trucks per hour in each direction, compared with total vehicular traffic volumes of approximately 2314 veh/h, yielding a commercial vehicle percentage of total traffic of approximately 4 percent. As noted above, a large part of the truck traffic is highway traffic making longer distance trips, and many of these trucks are larger sized vehicles.

The *Saskatoon Long Range Transportation Planning Study* (Trialpha, 2001) had summarized an extensive origin – destination survey undertaken in 1999 that included roadside surveys at fourteen stations around the City. Trucks represented approximately 8 – 9 percent of the surveyed traffic and of these, approximately 27 percent were multi-trailer units. The trip types were characterized as non-through, through with stop and through non-stop trips. Of the total trips, on average, less than 10 percent of trips were classed as through trips (including both through non-stop and through with stop). Most of the traffic observed in this survey was making local trips, i.e. trips with an origin or destination in the City of Saskatoon.

2.8 Regulations and Policies

Significant policies affecting traffic movement through the corridor is the requirement for trucks to use the right (outer) lane on Circle Drive. The City has indicated that it is proposing to restrict truck traffic on Idylwyld Drive, south of Circle Drive to local deliveries only. This restriction is to go into place by 2012, when the new South River Crossing and southwestern section of Circle Drive are completed.

2.9 Current Issues and Problems

The review of the existing configuration and operation of the roadways within the study area has identified a number of issues and problems related to the interchange and to the Circle Drive corridor. The following discusses the issues identified specific to each.

2.9.1 Interchange

The most significant issue for the operation and design of the existing simple diamond interchange is the constraint imposed by the property limits and intersection spacing. The centre-to-centre spacing of the ramps limits the ability to process and queue eastbound and westbound traffic turning left at either the east or west ramp terminals respectively. This constraint limits the capacity of the interchange ramps and affects other ramp operations, including the southbound to eastbound movement and the northbound to westbound movement. The proximity of Avenue C to the west of the interchange and Alberta Avenue to the east also constrains for operation of the interchange as queue spill back from these intersections to the ramp terminals inhibits the operation of the ramp terminals. This is clearly demonstrated by the queuing that is chronic on the southbound ramp to Circle Drive, where queues can often extend back to the freeway itself.

Some of the ramps to/from Idylwyld Drive are accessible to adjacent properties and as such present a safety issue related to vehicles slowing and entering the ramp unexpectedly. This situation arises on the southbound exit ramp from Idylwyld Drive, which has an entrance and exit to the Travelodge Parking lot; and to the southbound entrance ramp to Idylwyld Drive which has a connection to the service road between Circle Drive and the freeway.

2.9.2 Corridor

The fundamental issue faced by the corridor is the role and function of Circle Drive in providing through traffic movement on the one hand and for access to the adjacent properties and intersections on the other. Clearly, many problems arise from a conflict between accommodating these two functions in conjunction with the high volumes of traffic using this corridor. The conflicts between turning traffic and through movements at intersections and driveways, the relatively high truck volumes using the corridor (both through and local truck traffic) and the speed and spatial restrictions these movements pose to other traffic, the restriction of trucks to the right (outer) lane of traffic which compounds the difficulties for movements into or out of intersections and driveways,

closely spaced intersections and high traffic volumes which create queue spillback at some locations, affecting overall corridor operation are some of the key issues being experienced in this section of Circle Drive.

The geometry of several intersections is inadequate to accommodate the movements of larger vehicles. The Faithful Avenue, 1ST Avenue and Millar Avenue approaches to Circle Drive are two of the heavier travelled roadways where improvement to corner turning radii would assist these movements.

These corridor and interchange issues are not new. Many of them have been identified in previous investigations but have now become more acute due to the relatively rapid increase in traffic volumes and composition of truck traffic. Traffic pattern changes anticipated with implementation of the South River Crossing and completion of the southwest section of Circle Drive are expected to aggravate the current operational and capacity problems further. This potential is discussed in subsequent sections of this report.

3. Planning and Design Criteria

3.1 Study Horizons

A base year for analysis of 2012 was selected for this study in order to represent traffic conditions on opening day of the South River Crossing and the southwest section of Circle Drive. Future conditions have been based on an assessment of traffic when the City reaches a population of 300,000 people. This horizon is consistent with the modelling forecasts that have been prepared by the City and were provided as input to this study. For the purposes of this analysis, it has been assumed that the City will reach this population by the year 2029.

3.2 Network Assumptions

For the base year, 2012, the network includes the new South River Crossing and south western section of Circle Drive. Otherwise no further change to the existing network has been incorporated into the transportation network. For the future year (2029), no further network improvements have been assumed. It was noted that the City's current plan is to include a new North River Crossing and perimeter road by the time the City reaches a population of 400,000 although the timing for this provision has not been determined.

3.3 Analysis Timeframes

While base traffic count data for the year 2009 provided by the City included both morning (a.m.) and afternoon (p.m.) peak hours, the p.m. peak hour exhibited higher traffic volumes and has been used as a basis for capacity and operations analysis. This approach is consistent with that used in previous operational reviews of the Circle Drive corridor and is consistent with the peak hour used in the City's transportation model.

3.4 Analysis Tools

A number of tools have been used to prepare, analyze and visualize the traffic data produced in this study. The following outlines these tools. Subsequent sections outline the planning criteria employed during the analysis.

3.4.1 Travel Demand Forecasting

The City provided a VISUM travel demand model for use in identification of future travel demand in the Study Area. This model was employed, after limited adjustment to reflect the network and demographic assumptions associated with the base (2012) and future (2029) horizon years to prepare auto traffic forecasts for link and intersection turning movements. Truck movements were based on observed traffic classification counts at the Idylwyld Drive interchange. Within the corridor, truck percentages of 2 percent have been assumed for all intersection turning movements.

3.4.2 Operations Analysis

Capacity and level of service analyses at intersections and ramp terminals have been based on procedures contained in the Highway Capacity Manual (HCM), as implemented by the Synchro/SimTraffic analysis software, Version 7. A Synchro network extending from Avenue C in the west to Millar Avenue in the east was constructed and used for this analysis.

3.4.3 Micro simulation

Additional micro simulation of traffic conditions for the existing and proposed intersection and interchange alternatives employed the VISSIM software and micro simulation package. Models for both the corridor and interchange within the Study Area were constructed for this purpose. The City assisted in this regard by providing a micro simulation network for the Idylwyld Drive corridor that was used to determine appropriate parameters and settings for the VISSIM modelling.

3.5 Planning Criteria

3.5.1 Capacity and Level of Service

The capacity and level of service analyses undertaken in this study have been based on the criteria and procedures of the Highway Capacity Manual (HCM), as implemented by the Synchro/SimTraffic software. Level of Service (LOS) for signalized and unsignalized intersections and arterial corridors is a quality measure describing operational conditions within the traffic stream, generally in terms of such service measures as speed, travel time, freedom to manoeuvre, traffic interruptions and comfort and convenience. Six levels of service based on the intersection control delay (seconds per vehicle) are defined for each type of intersection operation, with the letters A through F inclusive designating each level. LOS A represents the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions and the driver's perception of those conditions. Safety is not included in the measures that establish service levels but is considered separately. Although LOS E defines the capacity of a facility, maintaining operations at LOS D and above is desirable for planning purposes. Once an operational level of D can no longer be attained, improvements should be implemented.

Capacity of a facility or intersection is defined as the maximum hourly rate at which persons and vehicles reasonably can be expected to traverse a point or uniform section of a roadway within a given time period under prevailing roadway, traffic and control conditions. Vehicle capacity is the maximum number of vehicles that can pass a given point during a specified period of time under prevailing roadway, traffic and control conditions. This assumes that there is no influence from downstream traffic operation, such as the backing up of traffic into the analysis point.

Capacity utilization is commonly measured by the traffic volume-to-capacity ratio (v/c) and is presented as a decimal value less than 1.0 (volume equal to capacity) for observed conditions. Analysis values of the v/c ratio above 1.0 indicate over capacity conditions.

3.5.1.1 Intersection and Corridor

Urban arterial street level of service is based on average through vehicle travel speed for the segment or the entire street under consideration. Travel speed is the basic service measure for urban streets. The average travel speed is computed from the travel times on the urban street and the control delay of through movements at signalized intersections. The control delay is the portion of the total delay for a vehicle approaching and entering a signalized intersection that is attributable to the traffic signal operation. Control delay includes the delays of initial deceleration, move-up time in the queue, stops and re-acceleration. The LOS for urban streets is influenced by the number of signals per kilometre and by the intersection control delay. Inappropriate signal timing, poor progression and increasing traffic flow can degrade LOS substantially. Streets with medium to high signal densities (i.e. more than one per 800 metres) are more susceptible to these factors, and poor LOS might be observed even before significant problems occur. On the other hand, longer urban street segments comprising heavily loaded intersections can provide reasonably good LOS, although an individual signalized intersection might be operating at a lower level. The term through vehicle refers to all vehicles passing directly through a street segment and not turning.

Signalized intersection level of service is evaluated on the basis of the control delay per vehicle (in seconds per vehicle). Control delay is the portion of the delay attributed to the traffic signal operation. At unsignalized intersections, LOS is computed and evaluated for measured control delay and is defined for each minor movement at the intersection. LOS is not defined for the intersection as a whole. The LOS criteria for unsignalized intersections are somewhat different from the criteria used for signalized intersections primarily because different transportation facilities create different driver perceptions. The expectation is that a signalized intersection is designed to carry higher traffic volumes and experience greater traffic delay than an unsignalized intersection.

Capacity for a signalized intersection is evaluated in terms of the ratio of demand flow rate to capacity (v/c ratio).

3.6 Roadway Criteria

Roadway design criteria have been selected on the basis of the Urban Arterial Divided (UAD) functional classification published by the Transportation Association of Canada (TAC), with a design speed of 60 km/h. The following summarize the key design criteria used for Circle Drive.

Class: UAD			
Design Speed:	60 km/h	Posted Speed:	50 km/h
Lane Widths:	3.75m	Boulevard Widths:	1.5m – 3m
Sidewalk Width:	1.5m	Design Vehicle:	WB-20.5

The key criteria for this project include the design vehicle for determination of turning radii and intersection geometry. Also, ideally, a sidewalk would normally be provided on both sides of the road and would be separated from the travelled lanes by a 1.5 – 3.0 metre boulevard width. Through Lane widths should be 3.75 metres in width due to the predominance of large trucks using Circle Drive. Turning lane widths would be 3.5 metres for right turns and 3.25 metres for left turn lanes. The raised concrete median would have a minimum width of 1.5 metres (between edges of the travelled lanes).

4. Traffic Forecasts

4.1 Methodology

The City made available an auto-only VISUM transportation model for the p.m. peak hour that had been calibrated to the 2006 base year and for which forecasts had been prepared for population horizons of 300,000 and 400,000 persons. At the commencement of the study, it was agreed that a 2012 base year for analysis should be selected so that traffic conditions representing the opening of the new South River Crossing and southwest section of Circle Drive would be used for baseline comparison. Accordingly, the City provided a scaling methodology to scale back the forecasts from the 300,000 population level to one at approximately 230,000 persons, consistent with the 2012 horizon year. This scaling methodology was applied to the 300,000 population forecast to obtain the 2012 trip table. This table was subsequently assigned to the 2012 network that included the new South River Crossing, but excluded a new perimeter road in the north eastern part of the City. This provided one forecast for the base year condition that resulted in traffic volumes on Circle Drive that were less than the observed 2009 counted volumes and in fact were less than the level associated with the shift of traffic to the new river crossing route. It was concluded from this analysis that a more reliable approach would be to use the 2009 volumes for the 2012 base year traffic assuming zero growth between 2009 and 2012, and adjusted for the effect of the opening of the new South River Crossing. This effect was obtained from the VISUM model using the 2012 forecast assigned to a network with and without the South River Crossing. The changes in traffic volumes were then applied to the observed 2009 traffic count data to obtain a second forecast for the 2012 base year. This approach was the one adopted in this study. Truck traffic was added to the through movements on the basis of the observed truck movements at the interchange. For operational analyses purposes, turning movements at the Study Area intersections have included an assumed 2 percent trucks.

Figures D-3, D-4, **D-5**, and **D-6** provided in **Appendix D** summarize the forecasting methodology used in this study, the 2012 VISUM model traffic volumes (with and

without South River Crossing), the anticipated diverted traffic with South River Crossing, and 2012 estimated traffic volumes for the p.m. peak hour, respectively.

The future horizon year traffic forecast (2029) was developed in two ways as well. Initially, the VISUM model results for the 300,000 population level were used to obtain a low estimate for the 2029 horizon year. Subsequent work included assessment of the differences between the VIUSM model forecasts produced for the 2012 base year and 2029 and these differences were applied to the 2012 estimated traffic volumes (Figure D-6) to obtain a high estimate for the 2029 horizon year traffic. Trucks were added to the auto-only forecast by using the observed 2009 volumes and expanding them with a growth factor of approximately 2 percent per year (from 2012 to 2029). The projected 2029 traffic volumes (high estimate) and 2029 traffic volumes (low estimate) are summarized in **Figures D-7** and **D-8**, respectively, provided in **Appendix D**.

4.2 Assumptions

Assumptions employed in the traffic forecasting include the following:

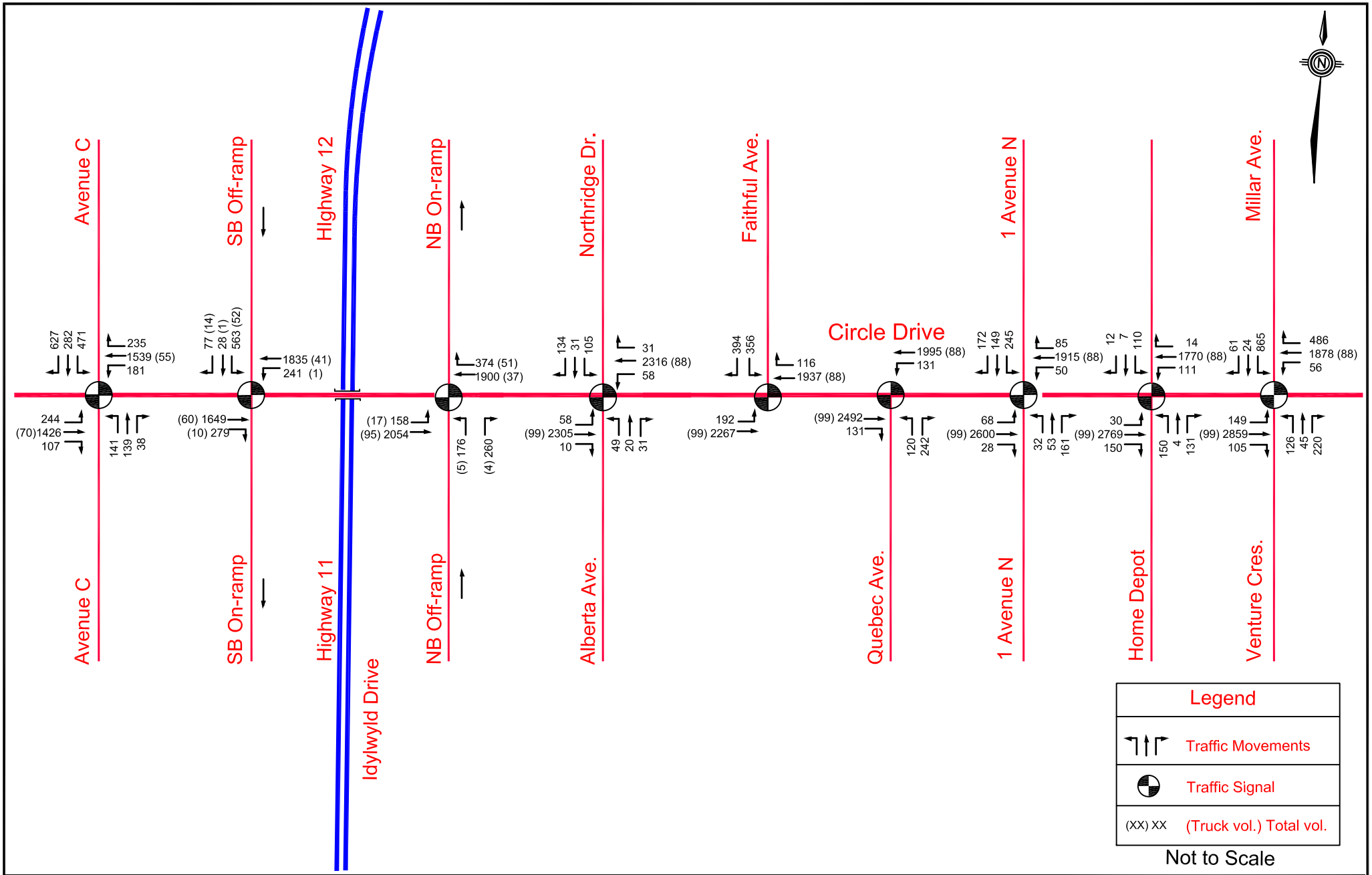
1. Base year traffic conditions will be represented by the 2009 observed volumes, adjusted for the effects of the new South River Crossing.
2. Truck volumes will be as per the observed 2009 volumes and will grow at a rate of 2 percent per annum between 2012 and 2029. This rate of growth is based on the growth in population between these horizon years.
3. The 2012 and 2029 networks include the South River Crossing, but not the north perimeter road and added North River Crossing.

4.3 Short Term

The short term (2012) traffic volume forecast for the p. m. peak hour is shown on **Figure 3**. Both total and truck volumes are shown in this figure. The traffic patterns reflect the implementation of the South River Crossing. Derivation of these volumes from the 2009 observed counts is described in **Appendix D**. The methodologies used for the adjustment

of existing truck volumes and development of truck trip table, are summarized in **Appendix E**.

Generally, the effect of the South River Crossing is to reduce the traffic volumes on Circle Drive North by approximately 300 vehicles per hour in both directions (150 veh/h each direction) after the opening in 2012. The movements from Idylwyld Drive to and from the west increase almost by the same magnitude, with increased volumes on the southbound to westbound right turn at the west terminal and increased eastbound to northbound right turn at the east terminal.



Hatch Mott MacDonald

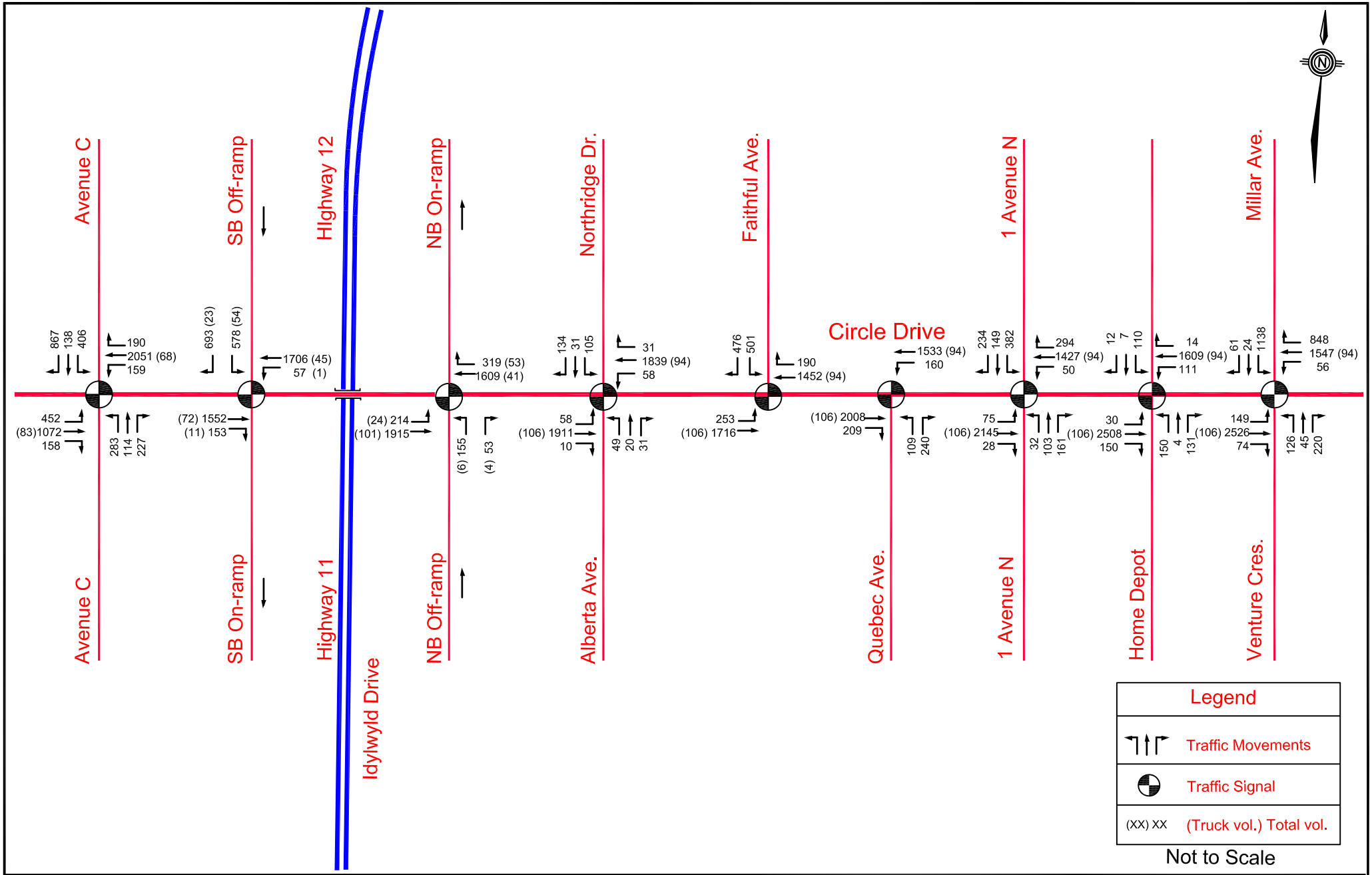
Figure 3 ~ 2009 Traffic Volumes, PM Peak Hour

4.4 Long Term

The long term (2029) traffic volume forecast for the p.m. peak hour shown in **Figure 4** represents the forecast taken directly from the VISUM model and for the purposes of this analysis represent a low estimate of the corridor and intersection traffic. The alternative high estimate developed for 2029 using the methodology described in the previous section is summarized in **Figure 5**. Analysis of improvement requirements at the interchange and corridor has been based on the higher forecast.

In the longer term, the high estimate forecast indicates a traffic diversion to other routes of approximately 300 – 400 veh/h by 2029. Other north – south routes such as Faithful Avenue, Warman Road and Avenue C are projected to be being used more as motorists appear to be avoiding some of the capacity bottlenecks in the Circle Drive corridor east of Idylwyld Drive.

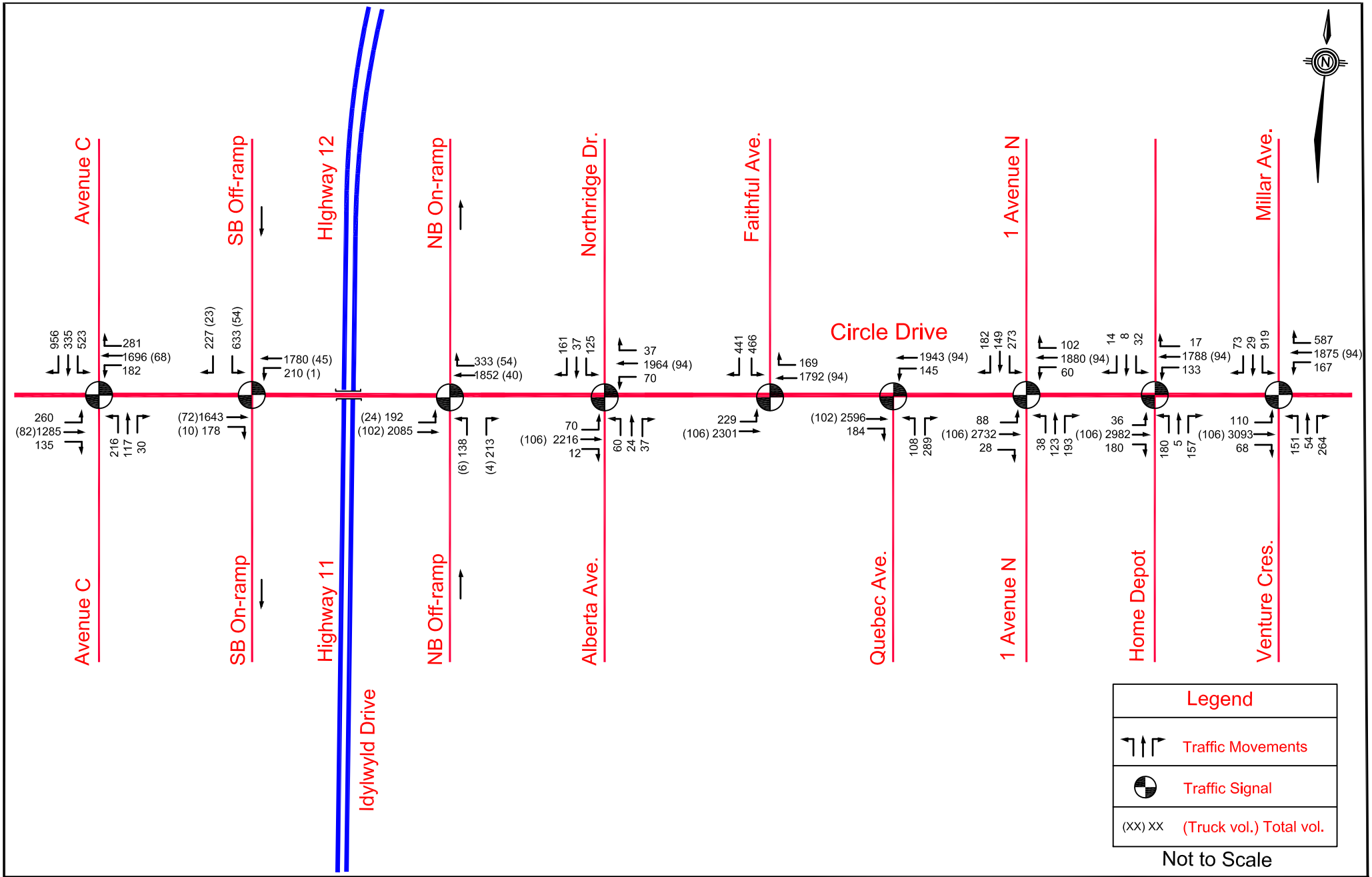
The City of Saskatoon Transportation VISUM model output sheets are provided in **Appendix F**.



Hatch Mott MacDonald

Figure 4 ~ 2029 Projected Volumes, PM Peak Hour (Low Estimate)

Source: City of Saskatoon Transportation Model Outputs



Hatch Mott MacDonald

Figure 5 ~ 2029 Projected Volumes, PM Peak Hour (High Estimate)

5. Current Configuration Needs Assessment

5.1 Structural (Bridge, Pavement and Utility)

5.1.1 Short Term

Previous studies have identified the need to replace the existing pavement section on Circle Drive. Due to the faster than anticipated traffic growth, and particularly the growth in heavier vehicles, the existing pavement has or will soon be reaching the point at which it has to be replaced just to maintain the current capacity and status quo. Previous studies have identified a cost of approximately $4,000,000 (2005 dollars) to do this.[4]

5.1.2 Long Term

Longer term improvements required to accommodate the increased traffic may require the widening of the existing interchange structure, as a result it may be necessary to undertake a more detailed structural analysis to determine the ability of the structure to accommodate additional widening, including a review of clearances under the structure. Similarly if Circle Drive is widened to provide additional lane capacity relocation of above ground and some underground utilities will be required (overhead utility lines, storm sewer inlets). It is anticipated, however, that given that the area is fully developed the majority of the underground utilities (sanitary and water) have been adequately sized for the adjacent land uses and should only require replacement as a result of normal maintenance operations.

5.2 Traffic

The needs assessment was based on an analysis of the interchange ramp terminal and corridor intersection operation as well as an assessment of the overall arterial corridor operation. These two approaches were used as assessment and evaluation criteria differed for each (see Section 3). They are summarized separately below.

[4] Bunt and Assoc. Engineering (Alberta) Ltd., "*Circle Drive: Millar Avenue to Idylwyld Drive Operational Review and Redesign Study: Final Report*", Calgary, March 2005, p. 2.

5.2.1 Short Term

5.2.1.1 Interchange

The operation of the ramp terminal intersections under the base year (2012) traffic volumes (Do Nothing Option) are summarized in **Table 1**. The southbound ramp terminal (west terminal) will be operating at LOS C in 2012, with a volume-to-capacity ratio (v/c) of 0.92 on an overall intersection basis. The southbound left turn movement is the critical one and will be operating at LOS E with a v/c ratio of 0.96. Capacity for this movement is taken as LOS E, indicating that this movement is presently operating at its effective capacity. The effect of the West Ramp terminal operating at capacity is a queuing of traffic on the southbound off-ramp from Idylwyld Drive. Analysis indicates that these queues often extend to the freeway mainline and can affect the operations on the freeway itself.

The east terminal was found to be operating at LOS C with a v/c ratio of 0.70 on an overall basis. The critical movement will be the northbound right turn which will be operating at LOS E with a v/c ratio of 0.84

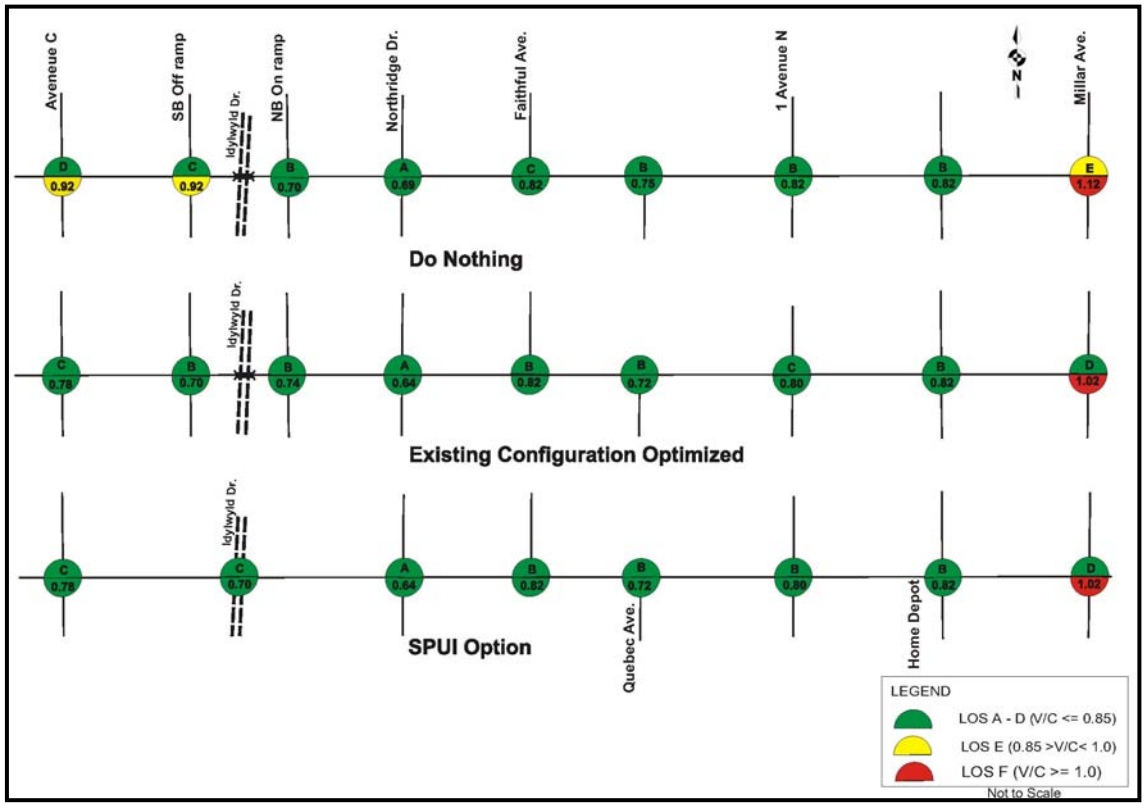
Table 2 : Idylwyld Drive Circle Drive Interchange Operations Summary – 2012

Scenario	Lane Configuration	Overall LOS [Delay] (V/C)	Critical Movement# (V/C ≥0.85)	LOS	Delay (sec)	V/C
2012 Traffic and Existing Lane Configuration (Do Nothing)	***SB Off-ramp/Circle Drive***	***C [25.6] (0.92)***				
	EBTTT		EBTTT	C	27.5	0.87
	EBR		WBL	E	58.0	0.90
	WBL		SBL-T	E	67.1	0.96
	WBTTT					
	SBL					
	SBL-T					
	SBR					
	NB Off-ramp/Circle Drive	***C [16.8] (0.70)***				
	EBL		NBR	E	65.7	0.84
	EBTTT					
	WB TTT-R					
	NBL					
	NBR					

5.2.1.1 Corridor

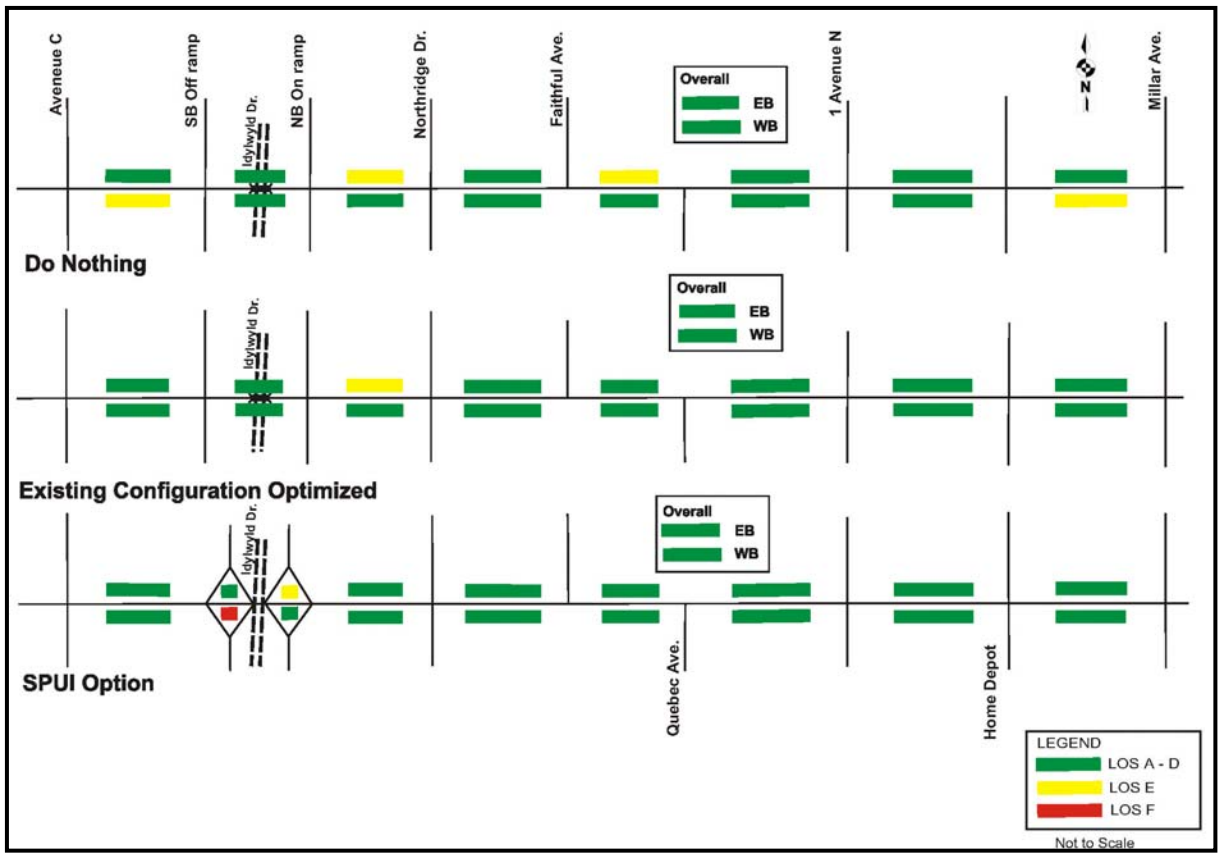
Operations for intersections in the Circle Drive corridor within the Study Area are summarized in **Figure 6**.

Figure 6: 2012 Corridor Intersection Operations Summary



The intersections at the gateway points to the Circle Drive corridor, Avenue C and Millar Avenue are estimated to be operating at LOS D and E (capacity), with v/c of 0.92 and 1.12 respectively. The intersections at the existing diamond interchange ramp terminals are estimated to be operating at LOS C and v/c of 0.92 to 0.70 as noted in **Table 2**. All other locations are projected to be showing signs of operating with a LOS of C or better and v/c ratio of 0.82 or below, on an overall basis. **Figure 7** summarizes the corridor link levels of service.

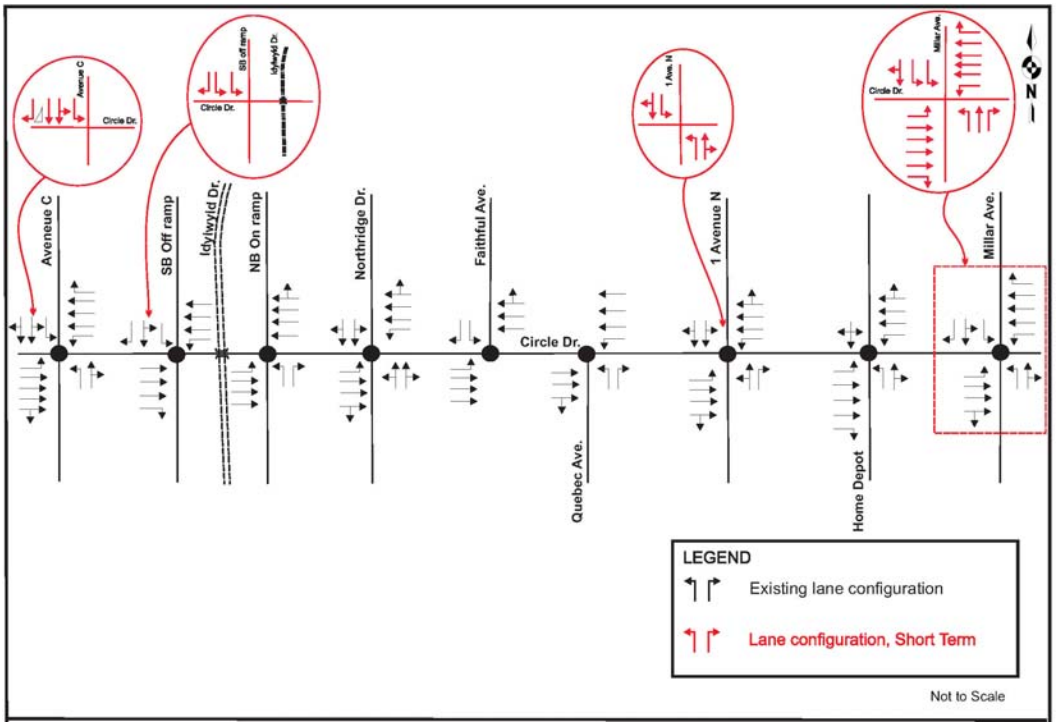
Figure 7: 2012 Corridor link Levels of Service Summary



There are a number of locations that indicate that the corridor speeds drop to levels corresponding with capacity or over-capacity conditions. These areas include the eastbound and westbound sections between Avenue C and the Idylwyld Drive West Ramp terminal, and the eastbound section between the Home Depot Entrance and Millar Avenue. In the westbound direction, the section between Northridge Drive and the Idylwyld Drive East Ramp terminal is estimated to be operating at an over-capacity level of service (LOS E).

Based on these results a number of improvements will be required to address the operational deficiencies. These improvements are summarized in **Figure 8**.

Figure 8: Short Intersections Improvements



In the short term, there are four areas where improvement is called for:

- at the Avenue C intersection, where southbound right turn and through lanes are separated and southbound free flow right turn lane is provided in conjunction with an additional merging lane along Circle Drive west of Avenue C;
- at the west ramp terminal at the Idylwyld Drive interchange, where the southbound shared left and through lanes are separated and the southbound left turn becomes a dedicated left turn (the shared through movement is eliminated);
- the 1st Avenue North intersection where the lane configuration for the north and south approaches are revised to include dedicated left turns fro safety reasons; and
- at the Millar Avenue intersection where the dual southbound left turn movements are dedicated left turns and the through and right turn movements are shared. Exclusive left turn and through movements are required at the south approach. This analysis also indicates a need for additional eastbound and westbound through lanes at the Millar Avenue intersection by 2012.

5.2.2 Long Term

5.2.2.1 Interchange

The operation of the ramp terminal intersections under the base year (2029) traffic volumes are summarized in **Table 3**.

Table 3: Idylwyld Drive Circle Drive Interchange Operations Summary - 2029

Scenario	Lane Configuration	Overall LOS [Delay] (V/C)	Critical Movement# (V/C ≥0.85)	LOS	Delay (sec)	V/C
2029 Traffic and Existing Lane Configuration (Do Nothing)	***SB Off-ramp/Circle Drive***	**C [25.6] (0.94)**				
	EBTTT		EBTTT	C	29.8	0.91
	EBR		WBL	E	59.4	0.93
	WBL		SBL	E	66.7	0.96
	WBTTT					
	SBL					
	SBL-T					
	SBR					
	NB Off-ramp/Circle Drive	**B [12.4] (0.68)**				
	EBL		NBR	E	69.3	0.80
	EBTTT					
	WB TTT-R					
	NBL					
	NBR					

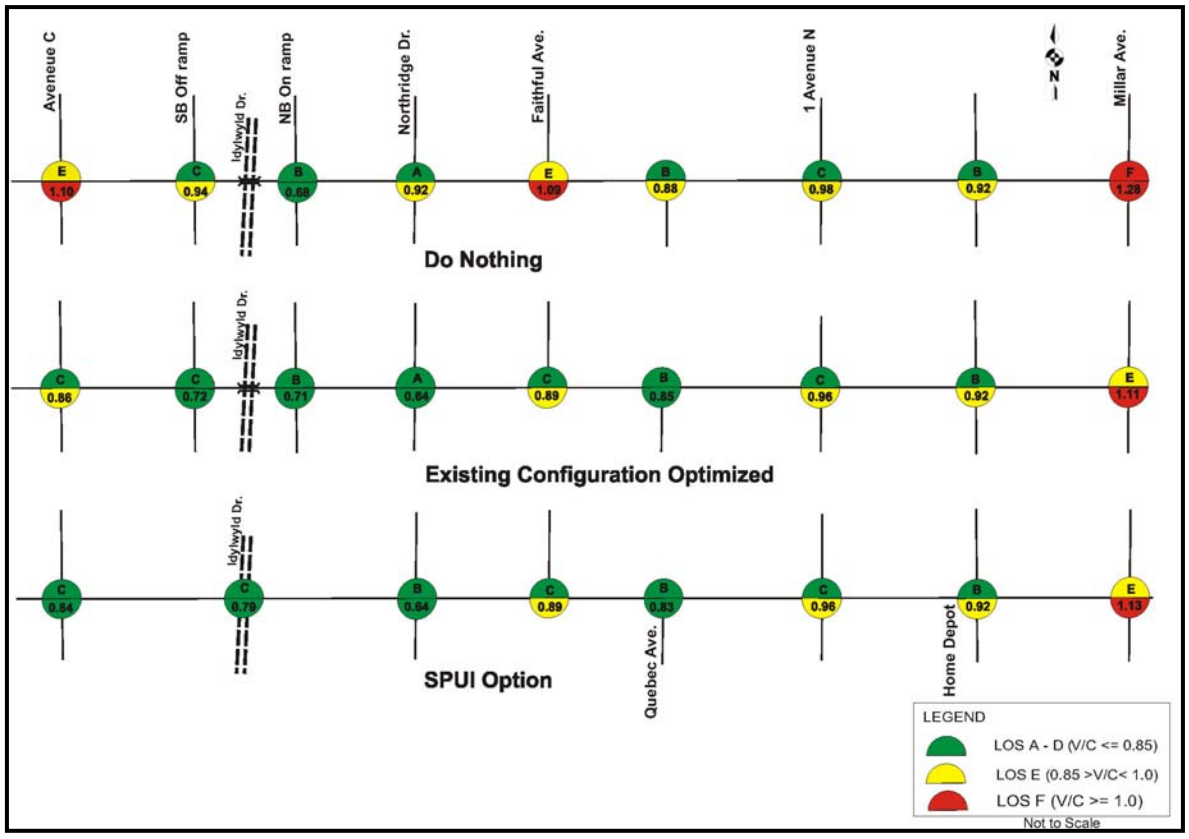
By the year 2029, under existing lane geometry and traffic control (do nothing option), the southbound ramp terminal (west terminal) is projected to be operating at LOS C, with a volume-to-capacity ratio (v/c) of 0.94 on an overall intersection basis. The southbound and westbound left turn movements are the critical ones and will be operating at LOS E and a v/c ratio of 0.96 and 0.93, respectively. Capacity for these movements is LOS E, indicating that these movements will continue to be operating at their effective capacities.

The east terminal was found to be operating at LOS B with a v/c ratio of 0.68 on an overall basis. Overall improvement has been noticed in the LOS and v/c in this time period reflecting the reduced traffic moving to/from the west via Circle Drive due to the influence of the completed south western link. The critical movement will be the northbound right turn which will be operating at LOS E and a v/c ratio of 0.80.

5.2.2.2 Corridor

Operations for intersections in the Circle Drive corridor within the Study Area are summarized in **Figure 9**.

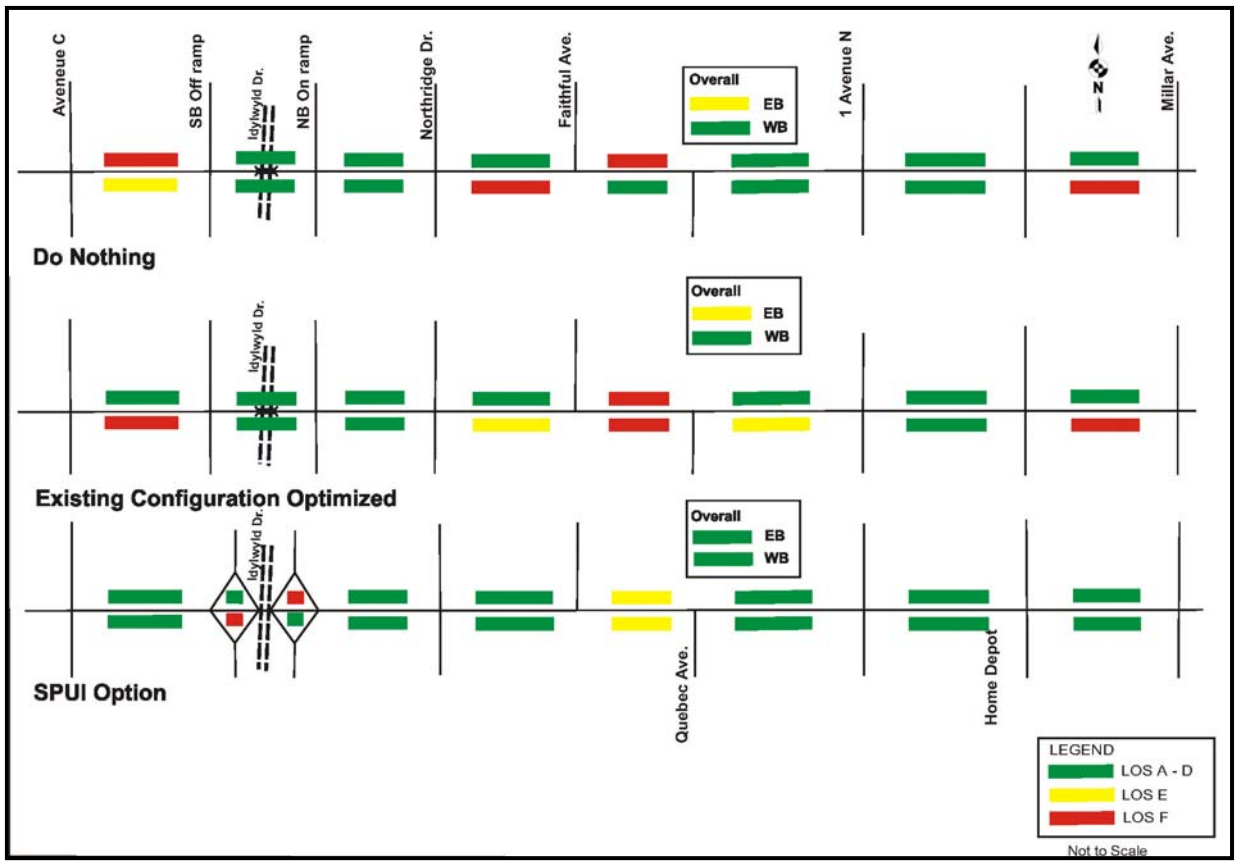
Figure 9: 2029 Corridor Intersection Operations Summary



The gateway intersections at either end of the study area are projected to be operating at LOS E and F (over-capacity) with v/c ratios in excess of 1.0. The Intersection at Faithful Avenue is projected to be operating at capacity (LOS E), with a v/c of 1.09. The ramp terminal intersections are projected to be operating at LOS C, with v/c ratios of 0.68 (east) to 0.94 (west) as indicated in **Table 3**.

Figure 10 summarizes the corridor link levels of service.

Figure 10: 2029 Corridor link Levels of Service Summary

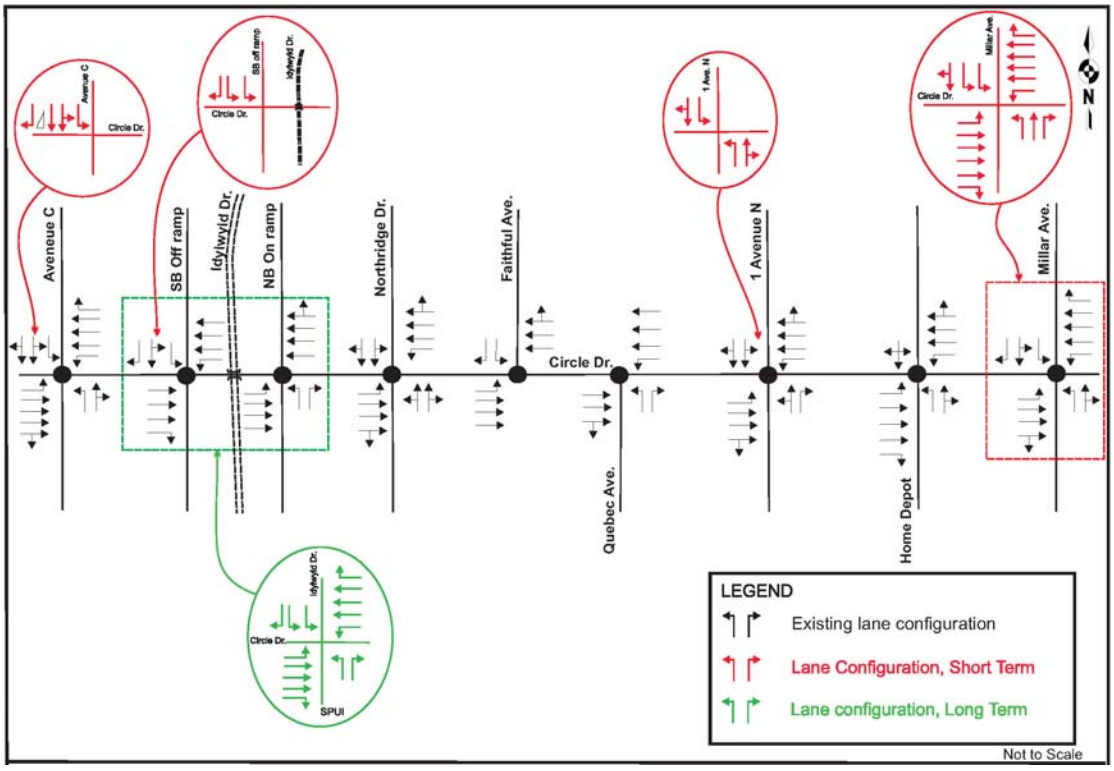


By 2029, a number of the corridor links will be operating at LOS E or worse. These links include the eastbound and westbound section between Avenue C and the Idylwyld Drive West Ramp terminal, the eastbound sections between Northridge Drive and Faithful Avenue, Quebec Home Depot Entrance and Millar Avenue, and the westbound section between Quebec and Faithful Avenues. The section of Circle Drive westbound between the East and West Ramp terminals is also projected to be operating at capacity.

This intersection operation analysis is indicating that the current diamond configuration of the Idylwyld Drive interchange will continue to exert capacity constraint to movements along the corridor. Critical movements at the ramp terminals that were found to be operating at capacity in 2012 will continue to do so as traffic builds into the future. The proximity of intersections on either side of the terminals affects the corridor operations as queue spillback continues to affect upstream and downstream intersections.

Accommodation of increased volumes in this corridor will require a change to the configuration of the interchange to provide more capacity at the ramp terminals. In the short term, with the completion of the Circle Drive perimeter route on the west side of the City, some diversion of traffic will take place. This shift in patterns will reduce the pressure currently being experienced in the Circle Drive corridor. However, as traffic continues to grow after 2012, this analysis indicates that conditions will deteriorate again to the point that either added capacity at the interchange and corridor is needed, or some other network improvement that will effectively reduce some of the traffic using Circle Drive will be required. This analysis indicates that in the absence of other network improvements, added capacity will be required at some of the intersections in the corridor, namely Avenue C and Millar Avenue which will required added through lane capacity westbound and eastbound respectively. These requirements are summarized in **Figure 11.** In the longer term, a single point urban interchange would provide added benefits to the Circle Drive corridor improvement in terms of traffic flows (saving time on links) due to elimination of one intersection and better signal coordination along the corridor.

Figure 11: Long Term Intersection Improvements



6. Improvement Alternatives

6.1 Identification of Improvement Alternatives

Following the finding of the traffic analysis that improvements to the existing interchange and the Circle Drive Corridor would be required to satisfy the objectives of this study, a number of alternative designs were developed for the interchange and the corridor.

6.1.1 Interchange

A total of four alternatives were developed for the interchange at Circle Drive and Idylwyld Drive as follows:

1. Do Nothing – Typically in this alternative no improvements are made to facilitate traffic movement or accommodate additional traffic volumes entering and exiting Circle Drive from Idylwyld. However, in the case of this study, improvements are proposed to be undertaken, which will facilitate some improvement to traffic movement or to facilitate the safe traffic movement at the interchange ramps (closure of local accesses and reconfiguration of lanes). These improvements are identified as Optimization of the existing system and are shown on **Figure G-1**, sheets 1 to 5 contained in **Appendix G**.

2. Diverging Diamond Interchange (DDI) – this alternative consists of the development of a Diverging Diamond Interchange in place of the existing Diamond interchange. While a relatively new concept in North America, this interchange configuration has had wider use in Europe, and recently has been put into operation at a number of locations in the United States. While similar in general configuration to the existing layout of the interchange, a diverging diamond differs in the way left and through movements navigate between Circle Drive and the Idylwyld on and off ramps. On Circle Drive, traffic crosses over to the left side of the roadway between the nodes of the interchange. Two-phase traffic signals are installed at the crossovers. Once on the left side of the arterial roadway, vehicles can turn left onto

the limited-access Idylwyld ramps without stopping and without conflicting with through traffic. The configuration is shown in **Figure G-2** contained in **Appendix G**. It should be noted that this alternative will require significant modifications to the existing structure including widening, removal of centre barrier and replacement with wider raised median which will accommodate pedestrian and cyclist movements. In addition property will be required on each of the approaches to accommodate alignment modifications sufficient to allow the cross-over manoeuvres to occur at a less oblique angle.

3. Single Point Urban Interchange (SPUI) - A single point urban interchange is similar in form to a diamond interchange, but has the advantage of allowing opposing left turns to proceed simultaneously by compressing the two intersections of a diamond into one single intersection over or under the free-flowing road. The name "Single Point" refers to the fact that all through traffic on the arterial street, as well as the traffic turning left onto or off the interchange, can be controlled from a single set of traffic signals. Due to the space efficiency of SPUIs relative to the volume of traffic they can handle, the interchange design is being used extensively in the reconstruction of existing freeways as well as constructing new freeways, particularly in dense urban environments. In the case of Circle Drive and Idylwyld, the interchange would be reconfigured as indicated in **Figure G-3** contained in **Appendix G**. In order to provide a SPUI at the Idylwyld Drive Interchange modifications will be required to the structure. These will consist of additional width constructed in a general parabolic shape to better accommodate the left turn movements onto and off of Circle Drive. It is anticipated that no additional property would be required to construct an SPUI at this location.

4. Flyover Interchange – A flyover interchange is characterized by the physical separation of traffic movements onto or off of the limited access roadway. This configuration is typically used for high speed movements from one highway to a second the critical movements of the interchange, usually left turn movements, are grade separated from the through movements to provide a free flow operation.

The configuration proposed for Circle Drive/Idywyld Drive is shown in **Figure G-4** contained in **Appendix G**. Modifications required to accommodate a flyover interchange at this location would have a significant impact on adjacent properties up to an including full property purchases of adjacent business. The grade separation of the problem left turn movements to make them free flowing is inhibited by closely spaced intersections on either side of the interchange. Due to the likely sudden speed drop at these locations, this configuration raises safety concerns.

6.1.2 Intersection

Previous studies have identified the need to undertake improvements to two specific intersections to improve traffic operations, namely the reconfiguring of the Faithful and Quebec intersections to eliminate the offset and the reconfiguring of the Venture and Home Depot intersections. In both cases extensive study was conducted in the previous studies which identified extensive property impacts to the reconfigurations. **Figure G-5** contained in **Appendix G** illustrates the alternatives identified in previous studies of the jog elimination at Faithful Avenue and Quebec Avenue. In addition, illustrations are provided for some of the intersection geometry along the corridor that is inadequate to accommodate truck movements.

6.1.3 Corridor

Previous studies have also identified a need for increased capacity in the Circle Drive North corridor and have examined the potential to widen the existing roadway to include 8 traffic lanes, plus turning lanes. **Figure G-6**, sheets 1 to 5 contained in **Appendix G** illustrates the effects of the eight lanes widening throughout the corridor. After extensive analysis of this alternative, it was concluded, as was concluded in previous studies, that the impacts associated with this widening would be extensive. Widening to include additional traffic lanes in select areas had also been suggested as a means of providing added capacity but with reduced impact to adjacent properties. These improvements have

been examined again in this study and evaluated in conjunction with the other corridor and interchange alternatives.

6.1.4 Other (alternative Routes)

Previous studies identified significant constraints to widening the Circle Drive corridor and have suggested improving parallel routes to provide continuous connections between Warman Road in the east and Avenue C in the west. These alternatives generally duplicate the through traffic carrying function of Circle Drive. Other alternatives such as improvement of the Warman Road and 51st Street corridors have been considered in this study, in addition to the 46th Street alternative already considered. **Figure G-7** contained in **Appendix G** illustrates the alternative routes considered in this study.

6.2 Evaluation Criteria

Generalized criteria were identified to evaluate the interchange and corridor alternatives. These criteria included traffic service, socio-economic, system design, land use and development and affordability. For each of these criteria, suitable indicators and measures were identified which could be used to quantitatively and qualitatively assess and evaluate the alternatives. **Table 4** summarizes the criteria, indicators and measures used in this process.

6.3 Analysis and Assessment

Table 5 summarizes the results of the analysis of the interchange and corridor alternatives using the evaluation framework described in the previous section. The left side of the table presents the interchange alternative analysis and assessment; the right side the corridor assessment. Effects during both the short and long term have been considered and presented. The following discusses the results under each factor for the interchange and corridor alternatives separately.

Table 4: Evaluation Criteria

Factor	Indicator	Measure
Traffic Service	Ability to accommodate projected volumes	Corridor or Intersection Level of Service
		Capacity Improvement (Percent)
	Effects on Goods Movement	Potential to improve freight movement
Socio-economic	Traffic Safety	Potential to reduce conflicts at driveways and intersections
System Design	Quality of Design	Ability to achieve Acceptable Design Standards
	Implementation	Staging Flexibility
	Structural Impact	Affect on Structure and / or Utilities
Land Use and Development	Property Requirements	Amount of Additional Property Required (m^2)
Affordability	Implementation Cost	Construction Cost
		Property Cost

Preliminary cost estimates based upon anticipated construction costs for the optimized, grade separation of problem movements, single point urban interchange and added lane to both sides of Circle Drive (8 lane) alternative were prepared for assessment and evaluation purposes. Details sheets of these cost estimates are provided in **Appendix G.**

Table 5: Interchange and Corridor Alternative Analysis

Criteria			Interchange Alternative					Corridor Alternative				
Factor	**Indicator**	**Measure**	**Do-Nothing**	**Optimized Existing Configuration (incl. Dual Ramps)**	**Grade Separation of "Problem Movements"**	**Single Point Urban Interchange (SPUI)**	**Diverging Diamond Interchange (DDI)**	**Do-Nothing**	**Optimized Existing Configuration (signal coordination)**	**Add Through Lane Capacity (8 lanes and variations)**	**Elimination of Intersections (Faithful - Quebec and Venture Crescent)**	**Rerouting Alternatives (Warman Road and/or Faithful)**
Traffic Service	Ability to accommodate projected volumes	Corridor or Intersection Level of Service	Increased delays as a result of growth in traffic volume	Moderate reduction in delays	N/A - See Note 1	Moderate reduction in delays	N/A - See Note 1	Decrease in vehicle speed as result of growth of traffic volumes	Moderate increase in vehicle speeds	Moderate increase in vehicle speeds	No appreciable increase in vehicle speeds	Moderate increase in vehicle speeds
		Capacity Improvement (Percent)	None	Short term 25 percent Long term 25 percent	N/A - See Note 1	Short term 25 percent Long term 20 percent	N/A - See Note 1	None	Short term 10 percent Long term 20 percent	Short term 10 percent Long term 20 percent	Short term <10 percent Long term <10 percent	Short term 10 percent Long term 30 percent
	Effects on Goods Movement	Potential to improve freight movement	Increased delays as a result of growth in traffic volume will negatively impact goods movement	Minor reduction in delays will see a small improvement in goods movement	Minor reduction in delays will see a small improvement in goods movement	Minor reduction in delays will see a small improvement in goods movement	Minor reduction in delays will see a small improvement in goods movement	Increased delays as a result of growth in traffic volume will negatively impact goods movement	Minor improvement in vehicle delays will see a small improvement in goods movement	Minor improvement in vehicle delays will see a small improvement in goods movement	No appreciable improvement in vehicle speed nor in goods movement	Minor improvement in vehicle delays will see a small improvement in goods movement
Socio-economic	Traffic Safety	Potential to reduce conflicts at driveways and intersections	No reduction in conflicts	Improvement due to removal of current right in/right out access and roadway access on ramps		No reduction in driveway conflicts. Potential to improve intersection conflicts due to reduction in number of intersections	Improvement due to removal of current right in/right out access and roadway access on ramps. Potential for decrease in traffic safety due to introduction of unusual traffic movement	No reduction in conflicts	Rationalization of entrance locations will see a reduction in conflicts	No reduction in driveway conflicts without entrance rationalization. Some reduction in intersection conflicts	No reduction in drive conflicts. Potential to improve intersection conflicts due to reduction in number of intersections	Small reduction in driveway conflicts with thru traffic
System Design	Quality of Design	Ability to achieve Acceptable Design Standards	No Change	Yes	Yes	Yes	Yes	No Change	Yes	Yes	Yes	No Change
	Implementation	Staging Flexibility	No Impact	Some delays experienced during construction of additional lanes	Significant delays as a result of construction staging and operations to construct overpass structure	Significant delays due to modification to structure resulting in delays to both Circle Drive and Idylwyld during construction	Significant delays during construction. May require closure and rerouting of traffic to facilitate construction	No Impact	Some delays experienced during construction of improvements	Delays experienced during construction of additional lanes	Some delays experienced during construction of improvements	No Impacts. Can be implemented quickly depending upon route selected
	Structural Impact	Affect on Structure and / or Utilities	No Impact	No significant impact	Impact varies depending upon location of support columns for upper levels	Significant impact as a result of required widening of structure	Significant impact as a result of required widening of structure and surface modifications	No Impact	Some utility relocation may be required (pole relocations, CB relocation adjustment)	Significant utility relocation may be required (pole relocations, CB relocation adjustment)	Some utility relocation may be required (pole relocations, CB relocation adjustment)	No Impacts.
Land Use and Development	Property Requirements	Amount of Additional Property Required (m^2)	No Impact	No additional property required. Impact due to removal of accesses onto and off ramps	Significant property impacts	Can be designed to fit within existing rights of way. Property impacts as a result of closure of access	Property is required due to footprint of required improvements	No Impact	May require some property taking/easements to accommodate intersection improvements	Significant property purchase throughout corridor	Significant property purchase depending upon alternative selected.	Depending upon route selected some property may be required to accommodate turning movements
Affordability	Implementation Cost	Construction Cost (See note 5)	$0	$5 million	44 million	$15 million	N/A - See Note 6	$0	$5 million	$9 million	Alternative not costed due to extensive property impacts	Some costs anticipated to improve intersections and turning movements, advance signage
		Property Cost	$0	Minimal - may require some construction easements but possible to construct without purchase of property	Extensive - requires purchase of adjacent properties and businesses	Minimal - may require some construction easements but possible to construct without purchase of property	Extensive - requires purchase of adjacent properties to accommodate traffic movements	$0	Minimal - may require minor widening but possible to construct without purchase of property	Extensive - requires purchase of adjacent properties to accommodate additional lanes (approx. 6000m2)	Extensive - requires purchase of adjacent properties and businesses	Minimal - may require some construction easements but possible to construct without purchase of property

Notes:
1. An operational analysis was not undertaken on the basis of the results of a functional design review that indicated significant property impact is associated with this alternative.
2. Traffic operational analysis are based on PM peak hour traffic volumes
3. Short term - 2012 year, Long term - 2029
4. Interchange delay improvement based on results for the critical movement only (Southbound left turn)
5. Costs do not include property acquisition (if required)
6. Alternative not costed due to extensive property impacts

6.3.1 Interchange

6.3.1.1 Traffic Service

Ability to accommodate projected traffic volumes: Under the do-nothing interchange alternative, increased delays are expected as a result of the growth in traffic volumes. The optimized alternative is estimated to result in a moderate decrease in vehicle delay, as is the Single Point Urban Interchange (SPUI) alternative. Separate analyses of the grade separation of problem movements or the Diverging Diamond Interchange (DDI) alternatives were not completed as these alternatives could not be accommodated without extensive impact on existing property. It is anticipated that if the problem movements were separated, the ramp movements would become free flow, however, the operation of the downstream intersections would be aggravated as the vehicle arrival rates would be increased without a concomitant increase in capacity. The result would be more extensive queuing at these locations. In the case of the DDI, it is anticipated that the proximity of the adjacent intersections downstream from the interchange would inhibit the operation of the cross over intersections at the interchange leading to a general failure of this alternative to reduce the overall vehicle delay.

In terms of capacity improvement, the optimization and SPUI alternatives are expected to provide a short term improvement of approximately 25 percent. In the longer term, the SPUI is expected to provide an improvement of approximately 20 percent. Capacity improvement was not estimated for the grade separation of problem movements or the DDI alternative. The closely spaced intersections associated with this alternative inhibit its operational effectiveness and traffic carrying capacity.

Effects on goods movement: The do-nothing alternative will contribute to increased delays as a result of growth in traffic volumes. These delays will negatively affect the movement of goods through the corridor. All of the other alternatives are estimated to contribute to a minor reduction in delays for overall traffic and as a result for the movement of goods through the corridor.

6.3.1.2 Traffic Safety

The Optimization alternative is expected to result in some improvement in safety due to the removal of the current local access to the ramp. This change is also effective in each of the other interchange improvement alternatives. The SPUI alternative is expected to result in improved safety with the removal of one intersection. The DDI alternative on the other hand is expected to result in a less safe configuration, given motorists unfamiliarity with this configuration.

6.3.1.3 System Design

Quality of Design: This analysis has shown that it is possible to achieve an acceptable design for all of the interchange alternatives under study.

Implementation: Some traffic delays are anticipated to arise during the construction of the optimized configuration alternative, however, these delays will not be more significant than any other road widening project. However, significant delays are expected from any of the structural alternatives (grade separated problem movements, SPUI or DDI alternatives) due to problems with maintaining traffic movement through the interchange during construction.

Structural and/or Utility Impact: The optimized configuration alternative is not expected to cause significant impact to either the existing structure or utilities. All of these other alternatives are anticipated to affect utilities and/or the existing structure due to the related foundation work.

6.3.1.4 Land Use and Development

Property Requirements: For the optimized configuration alternative, minor widening at the intersections of Avenue C and Millar Avenue with Circle Drive is required (**Figure G1** in Appendix G). At the Millar Avenue intersection, property may be required at the southwest quadrant. No added property is anticipated to be required from the SPUI interchange alternative. The advantage of the SPUI is that it can be designed to fit within

the property available. Significant property will be required to implement the DDI or the grade separation of problem movement alternatives.

6.3.1.5 Affordability

Implementation Cost: Optimization improvements are projected to cost in the order of $5 million. The grade separation of problem movements is expected to cost in the order of $44 million. The SPUI alternative is expected to cost approximately $15 million. The cost for DDI alternative was not estimated due to significant impacts associated with this alternative.

6.3.2 Corridor

6.3.2.1 Traffic Service

Ability to accommodate projected traffic volumes: The do-nothing alternative is projected to result in a decrease in vehicle speed as a result of the growth in traffic volumes. The optimizing of the existing configuration, including improved signal co-ordination is projected to result in a moderate increase in vehicle speeds, as is the provision of an additional through traffic lane in the eastbound and westbound directions. This improvement in vehicle speeds implies an improved corridor level of service. The elimination of the jogged alignment at the Faithful and Quebec intersections is not expected to result in much of an improvement in vehicle speeds. The alternative that includes rerouting of some traffic away from the Circle Drive corridor is projected to be effective in providing a modest increase in vehicle speeds. All of the alternatives are expected to lead to a 10 – 20 percent improvement in capacity.

Table 6 presents the sensitivity analysis conducted for the corridor level of service for the various alternatives.

Table 6: Sensitivity Analysis, Circle Drive Corridor Level of Service

Alternative Options	Direction		Direction	
	EB		WB	
	Arterial Speed (km)	LOS*	Arterial Speed (km)	LOS*
Do Nothing Option	17.5 **(11.7)**	D **(E)**	20.1 **(16.3)**	D **(D)**
Consolidation of Faithful and Quebec Avenue Intersections Option	18.1 **(11.7)**	E **(F)**	23.6 **(18.0)**	D **(E)**
Adding One Thru Lane Option	20.0 **(14.5)**	D **(D)**	19.8 **(18.1)**	D **(D)**
Rerouting Thru 350 Trips from Both Directions Option	19.7 **(19.0)**	D **(D)**	20.9 **(19.2)**	C **(D)**
Existing Configuration, Optimized Option	19.7 **(18.3)**	D **(E)**	20.6 **(20.3)**	D **(D)**
Single Point Urban Interchange (SPUI) with Optimized Option	22.4 **(18.6)**	C **(D)**	21.9 **(21.4)**	C **(C)**

*Arterial Level of Service based on Highway Capacity Manual 2000 methodologies, 2012 (**2029**)

Effects on goods movement: Minor improvement in goods movement associated with improved travel speeds associated with the optimized configuration, added through lane and rerouting alternatives. The removal of the jogged intersections at Faithful and Quebec Avenues is not expected to have a significant effect on overall corridor travel speed.

6.3.2.2 Traffic Safety

The optimization of the existing configuration, including possible rationalization of entrance locations is expected to reduce vehicle conflicts slightly. The elimination of the jogged Faithful and Quebec intersections is also expected to result in improved safety due to the reduced number of intersections. The rerouting of some of the corridor traffic away from the corridor will also result in some improvement in safety due to a reduction in conflicts with driveway traffic. Adding a through traffic lane eastbound and westbound is not expected to result in improved safety in the corridor.

6.3.2.3 System Design

Quality of Design: This analysis has shown that it is possible to achieve an acceptable design for all of the corridor alternatives under study.

Implementation: Some traffic delays are expected from implementing the optimized configuration, addition of a westbound and eastbound through lane or the elimination of the jogged intersections at Faithful and Quebec Avenues. No impacts are associated with the rerouting of traffic alternative.

Structural Impact: Some utility relocation will be required with the optimized configuration and Faithful and Quebec jog elimination alternatives. Significant impacts are expected from the addition of a through lane in each direction in the corridor. No impacts are associated with the rerouting alternative.

6.3.2.4 Land Use and Development

Property Requirements: Some property may be required to implement intersection geometric improvements such as improvement to corner radii. Significant property will be required to implement either the added through lane in each direction or the jogged intersection elimination at Faithful and Quebec Avenues. Depending on the route selected for the rerouting of traffic, some property may be required to accommodate the turning movements and added traffic in these corridors.

6.3.2.5 Affordability

Implementation Cost: The cost of the optimized configuration alternative, excluding property costs, is estimated to be approximately $5 million. The cost to widen the roadway by one through lane in each direction is estimated to cost $9 million. The elimination of the jogged intersections at Faithful and Quebec Avenues is expected to cost in the order of $5 million, depending on the amount of property that is required by this alternative. The rerouting alternative is also expected to cost in the order of $5 million to construct added turning lanes and road widening to accommodate the increased

truck traffic in these corridors. This cost is preliminary and subject to further, more detailed investigation.

Based on this initial analysis, an assessment and evaluation of the alternatives was completed by rating the effects of each alternative according to a 'Good', 'Fair', 'Poor' scale and subsequently assigning a point value to each of the ratings in each factor category and summing to obtain an overall score and ranking of the alternatives. This approach provided a balancing of the benefits of each alternative against the costs associated with each to determine their relative cost effectiveness in addressing the identified problems. **Table 7** summarizes the results of this preliminary evaluation.

As indicated in the table, the optimized configuration interchange and the Single Point Interchange alternative were rated as the best. The rerouting of traffic from the corridor was rated as the best overall corridor alternative, followed closely by the optimized configuration.

Table 7: Interchange and Corridor Alternative Assessment

Criteria			Interchange Alternative					Corridor Alternative				
Factor	**Indicator**	**Measure**	**Do-Nothing**	**Optimized Existing Configuration (incl. Dual Ramps)**	**Grade Separation of "Problem Movements"**	**Single Point Urban Interchange (SPUI)**	**Diverging Diamond Interchange (DDI)**	**Do-Nothing**	**Optimized Existing Configuration (signal coordination)**	**Add Through Lane Capacity (8 lanes and variations)**	**Elimination of Intersections (Faithful - Quebec and Venture Crescent)**	**Rerouting Alternatives (Warman Road and/or Faithful)**
Traffic Service	Ability to accommodate projected volumes	Corridor or Intersection Level of Service	POOR	GOOD	GOOD	GOOD	FAIR	POOR	GOOD	GOOD	FAIR	GOOD
		Capacity Improvement (Percent)	POOR	FAIR	GOOD	GOOD	FAIR	POOR	GOOD	GOOD	FAIR	GOOD
	Effects on Goods Movement	Potential to improve freight movement	POOR	FAIR	FAIR	FAIR	FAIR	POOR	FAIR	FAIR	POOR	FAIR
Socio-economic	Traffic Safety	Potential to reduce conflicts at driveways and intersections	POOR	FAIR	GOOD	FAIR	FAIR	POOR	FAIR	FAIR	FAIR	FAIR
System Design	Quality of Design	Ability to achieve Acceptable Design Standards	POOR	GOOD	GOOD	GOOD	GOOD	POOR	GOOD	GOOD	GOOD	POOR
	Implementation	Staging Flexibility	GOOD	FAIR	POOR	POOR	POOR	GOOD	FAIR	FAIR	FAIR	GOOD
	Structural Impact	Affect on Structure and / or Utilities	GOOD	GOOD	FAIR	POOR	POOR	GOOD	FAIR	POOR	FAIR	GOOD
Land Use and Development	Property Requirements	Amount of Additional Property Required (m^2)	GOOD	FAIR	POOR	FAIR	POOR	GOOD	FAIR	POOR	POOR	FAIR
Affordability	Implementation Cost	Construction Cost	GOOD	FAIR	POOR	FAIR	POOR	GOOD	FAIR	POOR	FAIR	GOOD
		Property Cost	GOOD	FAIR	POOR	FAIR	POOR	GOOD	FAIR	POOR	POOR	FAIR
OVERALL			**10**	**13**	**10**	**11**	**6**	**10**	**13**	**9**	**8**	**14**

7. Stakeholder Consultation

Following the identification and preliminary assessment of interchange and corridor improvement alternatives, input was sought from stakeholders affected by these changes. During the study, the City of Saskatoon identified two key groups who should be contacted and requested to provide the planning team with their input on the issues and solutions developed to this point in the study. These groups included the Saskatoon Trucking Association (STA) and the North Saskatoon Business Association (NSBA). During November, 2010 separate meetings were conducted with these groups and members of the City and Consultant teams. The following summarizes these meetings. Copies of relevant meeting minutes and presentation materials can be found in **Appendix B.**

7.1 Saskatoon Trucking Association

The findings of the study were reviewed, and it was generally accepted that the Warman Road to 51st Street route would be a viable alternative for trucks to access Idylwyld Drive in lieu of the Circle Drive route, subject to a number of improvements being made to this route. It was noted that many trucks have an origin or destination in the north end of the City and there are fuelling stations on 51st Street. However, Warman Road and 51st Street require improvements including:

- Improved signage to direct trucks through Warman Road and 51st Street;
- Additional lanes to be provided on Warman Road, both northbound and southbound;
- Dual right turn lanes from Circle Drive westbound to Warman Road northbound;
- Additional left turn lane from Warman Road northbound to 51st Street westbound;
- Additional right turn lane from 51st Street eastbound to Warman Road southbound; and
- Additional left turn lane for Warman Road southbound to Circle Drive eastbound.

The geometry of several intersections along the Circle Drive corridor were also noted as the cause of operational problems for trucks. Two locations in particular that were noted included the southbound to westbound right turn at both the Millar Avenue and Faithful Avenue intersections.

Members expressed the view that the Circle Drive South River Crossing and completion of the perimeter road on the west side of the City will not have much of an effect on the truck travel patterns. Most truckers, it was felt, will continue to use the Circle Drive routing to/from the east due to its perceived shorter travel distance. It was suggested that improvements to Dalmeny Road to improve access to Highway 16, in conjunction with the new South River Crossing would convince more truckers to take this route.

Grade separating the problem movements or even providing a grade-separated decking over the existing Circle Drive corridor were not seen to be feasible solutions as the connections to/from other roads that are at a different elevation would require additional property and high cost to construct these connections. A preferred solution would be to provide alternate routes for trucks such as the Warman Road – 51st Street route or the 46th Street route identified in the previous Circle Drive Operations study (Bunt & Associates, 2005).

7.2 North Saskatoon Business Association

Some of the suggestions provided by this group included the following:

- Through trucks (without stop) should be removed from the Circle Drive corridor between Warman Road and Avenue C. Trucks with 53-foot trailers (dual trailers) have difficulty navigating existing turns due to their wide turning radius. In the future it is anticipated that truck volumes will increase as economic conditions improve. Truck sizes are also expected to increase.
- It was noted that Saskatoon was not a 'truck-friendly' City. Turning radii should be improved at several of the intersections, including Millar Avenue and Circle Drive and at the on-ramp from Circle Drive to Idylwyld Drive northbound.

- The completion of the new South River Crossing and the southwest section of Circle Drive will result in additional congestion at the Circle Drive – Idylwyld Drive interchange.
- Signage, in general, and that for trucks in particular, should be improved.
- Coordination and progression of traffic along the Circle Drive corridor needs improvement.
- Recent City initiatives such as the Red Light Cameras were thought to be successful in controlling the movements through the Avenue C intersection.
- A new fuelling station at Millar Avenue and 51st Street is not a good location as this just exacerbates truck congestion in an already congested area.
- Improvements to Dalmeny Road are seen as one way to reduce some of the traffic currently using Circle Drive. With improved access to Highway 16 on the west side of the City, more truck traffic may opt to use the new South River Crossing and Circle Drive West route. This would relieve the pressure on the Circle Drive – Idylwyld Drive interchange.
- Concrete median barriers could be used in lieu of a raised median to economize on space. Widening to incorporate more traffic lanes would then have less effect on adjacent property. However, adding more traffic lanes will not resolve the conflicts between through traffic movement and traffic entering or exiting from adjacent developments.

When the Consultant indicated that the congestion in the Circle Drive corridor is likely to remain for the foreseeable future and that improvement alternatives may only have a small effect, but at relatively high cost, the stakeholders indicated that a preferred strategy would be to advance the planning and implementation for a north perimeter road. This route would provide an alternative routing for trucks and other vehicles moving around the City.

8. Conclusions and Recommendations

This study was initiated by the City in response to continued operational problems being experienced at the Idylwyld Drive – Circle Drive interchange and along the section of Circle Drive North from Avenue C to Millar Avenue. Previous studies have confirmed the critical nature of this gateway interchange and corridor into and around the City of Saskatoon. The Circle Drive route around the eastern side of the City is the primary link between Highway 16 East and Highway 11 South with Highway 16 West and Highway 11 North and is currently carrying much of the truck traffic moving around and through the City. At the same time, Circle Drive provides access to the North Saskatoon commercial and industrial area. As provincial and inter-provincial through traffic volumes have grown and as commercial business traffic has increased with the economic vitality of the City and Province, the ability to maintain the dual role of Circle Drive as a route for through highway traffic and as a means of accessing adjacent and local area development has become increasingly difficult.

These effects are not new nor have they been unanticipated. Previous studies, some dating back many years have identified the limitations of the Circle Drive perimeter route in accommodating both through and local traffic demands. Additional network improvements have been identified to address these demands. Among these are the widening to the existing river crossings and Circle Drive corridor as well as providing an additional river crossing and perimeter road to the north of Circle Drive.

In response to these pressures, the City of Saskatoon is proceeding with completion of the Circle Drive perimeter route in the southwest section of the City and construction of a new southern crossing of the South Saskatchewan River as part of this project. These improvements are expected to reduce traffic movement on Circle Drive North and delay the need for additional major network improvement. However, they may exacerbate some of the movements at the current simple diamond interchange at Idylwyld Drive. This study was initiated to address this last point and to clarify, if possible, the ability of the existing interchange configuration in meeting the effects of these changes.

A number of operational problems were identified with the existing Idylwyld / Circle Drive interchange configuration:

1. The ramp terminals are closely spaced, with little room to store queued vehicles in the eastbound and westbound directions. The Avenue C and Alberta Avenue-Northridge Drive intersections are also closely spaced to the interchange ramp terminals where westbound and eastbound queues extend back to the terminals and interfere with their operation.
2. The southbound ramp from Idylwyld Drive to Circle Drive (N-EW ramp) currently experiences queuing on the ramp that extends from the ramp terminal to the freeway proper. There is inadequate separation between the southbound left and right turn movements to permit right turning vehicles to bypass the southbound left turn queue.
3. Local access is provided to the N-EW (southbound off) and the EW-S (southbound on) ramps that can potentially interfere with the smooth operation of the ramps.

The following operational problems were identified with the Circle Drive corridor:

1. The geometry of some intersections does not accommodate turning movements of larger vehicles. The northwest corners of the Faithful Avenue, 1st Avenue and Millar Avenue intersections in particular were noted as being inadequate.
2. There is a high proportion of trucks using the corridor. Trucks are restricted to using the right lanes, with conflicts with the turning movements into and out of driveways to adjacent businesses.
3. There is a lack of pedestrian facilities in the corridor.
4. There are a number of closely spaced signalized and unsignalized intersections along the corridor, with several driveways located between them. Queuing between the intersections often extends back to interfere with the operation of upstream intersections.

Traffic using the interchange and corridor has been growing rapidly for the past five years. Approximately 4 percent of this traffic, equivalent to approximately100 trucks/hour is classed as heavy (long) trucks.[5]

Previous studies have identified that the through traffic component (i.e. the component of traffic that does not have an origin or destination in the study area or its environs) is between 10 and 20 percent of the total traffic, depending on location. This finding was based on survey data collected during 1999. During this study, anecdotal evidence was presented from the local trucking community to suggest that this percentage of though traffic has increased in recent years. The significance of this issue is that the divertability of traffic from the Circle Drive corridor to other routes in and around the City increases as the amount of traffic that is classed as "through" traffic increases.

The completion of the south western section of the Circle Drive perimeter road is anticipated by the fall of 2012. This study has concluded, based on the City's transportation model, that the effect of the Circle Drive completion upon the traffic flows using the Circle Drive North corridor will be relatively minor. Approximately 300 – 400 vehicles per hour that are currently using the Circle Drive North corridor may divert to the western side of the City.

8.1 Conclusions – Short-Term Effects

With the shift in traffic to the Circle Drive West corridor, the existing simple diamond interchange configuration will continue to operate with difficulty, primarily due to the closely spaced intersections, not only at the ramp terminals but at the two intersections upstream and downstream from them.

However, there are a number of operational improvements that can be implemented to improve the interchange operation. These improvements include:

[5] Traffic counts collected in 2009 by the City indicated truck movements eastbound and westbound were in the order of approximately 100 trucks/hour in the afternoon (p.m.) peak hour.

1. Widening the N-EW (southbound exit) ramp to separate the left and right turning traffic adequately and also converting the southbound shared through and left turn lane to a dedicated left turn lane.
2. In conjunction with 1 above, eliminating the local access to the N-EW and the EW-S ramps.

Even with these improvements, selected movements at the interchange will continue to operate at capacity. Furthermore, if the shift in traffic occasioned by the completion of the Circle Drive corridor is greater than that predicted in this study, the operation of the southbound left turn from Idylwyld Drive and the westbound left turn from Circle Drive back to Idylwyld Drive will deteriorate further, possibly to unsatisfactory levels. This study has found that under these conditions two options are available:

1. Revise the configuration of the interchange to one that can accommodate these movements better; and/or
2. Divert some of the traffic currently using the Circle Drive corridor, and in particular truck traffic in the corridor, to alternate routes to avoid using this interchange.

In the short term, this study has concluded that diversion of traffic to alternate routes is the preferred strategy to reduce the operational stress at the existing simple diamond interchange. This alternative is easier to implement in the short run, less expensive and provides potential to improve operations along the remainder of the Circle Drive North corridor.

This study has concluded that the most logical alternative routing for trucks and other vehicles in the short term is use of the Warman Road and 51st Street routing to/from Idylwyld Drive from Circle Drive. However, a number of geometric and capacity issues may need to be addressed to achieve the intended use of this alternate route. As this route extends beyond the immediate area of this study, investigation of the feasibility of using

these alternatives for routing some of the Circle Drive traffic will need to be done as a subsequent study to this functional design study. This would include examining the potential to improve this corridor in the short term as a means to provide additional relief to the Circle Drive route. Should improvement of this route prove not to be feasible, consideration of other alternatives, as identified in previous studies should be considered further.[6]

Current operational problems being experienced along the remainder of the Circle Drive corridor are expected to remain irrespective of what happens at the interchange. These problems arise from a number of factors including closely spaced intersections and driveways, inadequate turning radii and corner geometry, and a predominance of truck traffic using the right (outer) traffic lanes to/from Idylwyld Drive. However, some localized improvements to alleviate these problems in the short term include:

1. Provision of added eastbound and westbound through lanes, exclusive double southbound left turn lanes, and exclusive northbound through and right turn lanes at the Millar Avenue intersection.
2. Reconfiguration of the north and south approaches to the Circle Drive intersection with 1st Avenue to include separate left turn lanes for safety.
3. Reconfiguration of the southbound movements at the Circle Drive and Avenue C intersection to include a separate, free-flow right turn lane at Avenue C.

Improving the corridor operations hinges on improved access management where access to adjacent properties is restricted to select points to reduce turning conflicts as much as possible. To accomplish this may require that some of the adjacent parking facilities and lots be interconnected to allow traffic to flow through them without having to access Circle Drive directly. This type of solution will depend on, and require the cooperation of adjacent property owners.

[6] These alternatives include the 46th Street extensions and fly-over of Idylwyld Drive, as described in the report by Bunt and Associates (2005).

The uncertainty of changes in traffic patterns arising from completion of the Circle Drive South Western section will disappear by 2012 with the opening of this facility. Consideration can then be given to the problems that remain at this time, after other short term corridor and interchange improvements have been implemented and a monitoring of the effects of these changes.

8.2 Conclusions – Long-Term Effects

The discussion of the short term effects above has emphasized that improvements to the interchange and corridor will not provide a long-term answer to continued traffic growth in north Saskatoon. The current diamond configuration of the interchange has limited traffic capacity and the short term improvements may extend this capacity by 10 – 15 percent, but at some point in the future, with continued growth in traffic, operations will fall below an acceptable level. At this point further improvement will be necessary.

This study examined traffic conditions to a 2029 horizon year, corresponding to a Saskatoon population level of 300,000 persons. At this time the traffic volumes will have grown to the point that the existing simple diamond configuration will be incapable of accommodating the projected traffic demand. Under these conditions two options could be considered:

1. Revising the configuration of the current interchange into a form that can provide the required capacity.
2. Providing additional network improvements to accommodate some of the additional traffic projected to be using this corridor.

The City and Province have clearly adopted the second strategy for accommodating future travel demand in and around the City. The long term needs were studied in the *Saskatoon Long Range Transportation Planning Study* (2001) and an additional North River Crossing and Perimeter Road was recommended as part of the City's

Transportation Plan. The question now is not whether a new crossing and perimeter road is needed, but when. The previous studies are somewhat dated and traffic patterns and growth have changed. This study has concluded therefore, that there is a need for the City and Province to revisit the long term planning study and its recommendations and update them in light of the current and project development in the City and projected growth in provincial travel.

Provision of a new northern perimeter road is a major undertaking that, depending on the implementation delivery model and funding availability, may take a number of years to achieve. In the meantime, improvement of the current simple diamond interchange configuration at Idylwyld Drive – Circle Drive will be needed by or soon after 2012 and may in fact be needed even with the provision of a new northern perimeter road. Of the several alternative configurations reviewed in this study, the reconfiguration of the current diamond interchange into a Single Point Urban Interchange (SPUI) can provide additional capacity to accommodate future traffic volumes and can be built within the available property. Other improvements including a diverging diamond interchange and grade separation of "problem" movements cannot be made to fit within the available property and are affected by the proximate intersections in the corridor. The recommended configuration of the interchange is shown in **Figure G-3** contained in **Appendix G**.

The cost for the SPUI is estimated to be approximately $10 – 20 million and these improvements can be constructed to provide for dual turning lanes for any turning movement.

This reconfiguration of the interchange can potentially add up to 15 percent additional capacity to the interchange and has been determined to work the best considering the location of other intersections and the limited availability of property.

The timing for the implementation of this improvement depends on a number of factors including the effect on travel patterns caused by the completion of the southwest section

of Circle Drive, the growth in traffic, particularly truck traffic, the availability and use of alternative truck and general purpose vehicle routes, including the Warman Road – 51st Street route, the development activity and growth over the next 5 – 10 years, and the implementation timing for the new North Perimeter Road. This study has concluded, everything else being equal, that the current interchange configuration improvements as suggested in this report will need further improvement after 2012, possibly as early as 2016.

In conjunction with the monitoring of traffic patterns and conditions after the opening of the southwest section of Circle Drive, should problems at the existing diamond interchange remain chronic, investigations can be undertaken by the City into the design of a Single Point Urban Interchange. Costs for this conversion along with cost for relocation of any existing utilities can be explored further and decisions made as to whether to incorporate these improvements into the long-term Capital improvement Plan.

As noted above in the discussion of short term effects, the operation of the Circle Drive North corridor will remain essentially the same as it is today. This conclusion is reached on the basis of future traffic conditions, the physical characteristics of the corridor and limited property available to implement changes over those already implemented to address short term problems.

This study has considered a number of improvements to the corridor including adding an additional through lane throughout the corridor, elimination of the jogged north – south through movement between Faithful and Quebec Avenues, improved traffic signal co-ordination and progression and reduction of traffic through diversion to alternative routes. This study has concluded that widening for an added through lane and elimination of the jogged north – south movement at Faithful and Quebec Avenue are not feasible due to the impact these improvements would have on adjacent properties. There are opportunities to add an additional through lane in the eastbound direction at Millar Avenue (short term improvement) to improve intersection capacity at this location. This improvement should be incorporated into the corridor plan in the short term. Improved

traffic co-ordination and progression and reduction in traffic volumes associated with a diversion of some traffic to route alternatives should also be done as part of the short term strategy and also recommended for continuation in the longer term.

The need to widen other sections such as in the westbound direction at Avenue C will depend on the changes to traffic patterns associated with the completion of the South River Crossing. This need should be reassessed after the opening of this new crossing in 2012 and included in the longer term plan, as appropriate.

8.3 Recommendations

In summary, the recommendations made as a result of this study are the following:

1. That the City implement short term operational improvements to the Idylwyld Drive – Circle Drive interchange that include:

    - Widening the N-EW (southbound exit) ramp to separate the left and right turning traffic adequately and converting the southbound shared through and left turn lane to a dedicated left turn lane.
    - In conjunction with 1 above, eliminate the local access to the N-EW and the EW-S ramps.

2. That the City implement short term operational improvements to the Circle Drive Corridor between Avenue C and Millar Avenue that include the following:

    - Provision of added eastbound and westbound through lanes at the Millar Avenue intersection.
    - Reconfiguration of the southbound movements to the Circle Drive intersection with 1st Avenue to include a separate left and shared through and right turn lane for safety reasons.

- Reconfiguration of the southbound movements of the Circle Drive and Avenue C intersection to include separate free-flow right turn lane.

3. That the City investigate the potential to improve the Warman Road and 51st Street corridors in the short term as a means to relieve the traffic operational problems being experienced at the Idylwyld Drive – Circle Drive interchange and Circle Drive North corridor between Avenue C and Millar Avenue.

4. That the City monitor the effects upon traffic patterns arising from the implementation of the South River Crossing and the southwest section of Circle Drive, in conjunction with the introduction of the alternate routing strategy noted in Recommendation 3 and the short-term interchange and corridor improvements noted in Recommendations 1 and 2, and assess the combined effect on the operation of the Circle Drive interchange and corridor.

5. That in conjunction with the monitoring of traffic patterns after the opening of the south west section of Circle Drive, the City undertake further investigations into the design of a Single Point Urban interchange at the Idylwyld Drive – Circle Drive interchange, refine preliminary cost estimates associated with the construction of these works and relocation of existing utilities and, if appropriate, to incorporate these works into the City's Capital Plan.

6. That the City, in conjunction with the Province, update the long range transportation planning studies of the need for a north perimeter road. Further, that the City investigate the effect that such a facility will have upon traffic demand in the Circle Drive corridor and at the Idylwyld Drive interchange with Circle Drive. Based on these investigations, the need for a reconfiguration of the interchange and further improvements to the corridor and possibly other alternative corridors can be reassessed in conjunction with the findings of Recommendation 5.