Functional Planning Report

Grove Drive and Boundary Road Functional Plan

Harvest Ridge Drive to Highway 16A

Final Report

September 2018

Prepared for:

Al-Terra

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September 12, 2018

File: 2264-03

City of Spruce Grove
315 Jespersen Avenue
Spruce Grove, AB T7Z 1V7

Attention: **Mr. Trevor Crawford, C.E.T.**
Project Leader, Capital Projects

Re: **Grove Drive and Boundary Road Functional Plan**
Functional Planning Report

Please find enclosed two (2) hard copies, and one (1) digital copy of our Functional Planning Report for the above captioned project.

If there are any questions or concerns, please contact the undersigned.

Regards,
Al-Terra Engineering Ltd.

Derek Porter, E.I.T.

/ds

Enclosures

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CORPORATE AUTHORIZATION

This report titled **Grove Drive and Boundary Road Functional Plan** was prepared by Al-Terra Engineering Ltd., under authorization and exclusive use of the City of Spruce Grove.

The designs and recommendations put forward reflect Al-Terra's best judgment with the information available. Any use of this information in a manner not intended or with the knowledge that situations have changed shall not be the responsibility of Al-Terra Engineering Ltd.

Prepared by: Derek Porter

Reviewed by: Corry Broks

PERMIT TO PRACTICE
AL-TERRA ENGINEERING LTD.
Signature
Date Sept 12, 2018
PERMIT NUMBER: P 2104
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

Corporate Permit

PROFESSIONAL ENGINEER ALBERTA
C. G. BROKS
2018

Corry Broks, P.Eng.
President

EXECUTIVE SUMMARY

The recommended Functional Plan developed for Grove Drive between Harvest Ridge Drive and Highway 16A, provides an effective design to meet long term traffic demands while providing a safe, efficient, and cost effective arterial roadway for the City of Spruce Grove.

Five roundabout intersections have been specified through the functional plan utilizing, a staged implementation strategy to construct the eastern carriageway from McLeod Avenue north to Harvest Ridge Drive. The proposed two lane cross section through this area meets traffic demands in the long term and could limit the requirement to upgrade to the ultimate configuration in the future. From McLeod Avenue south to the interface of Highway 16A, full buildout consisting of the ultimate four lane cross-section and modification to the Highway 16A intersection, is recommended in the first stage of construction.

Traffic analysis completed from previous City of Spruce Grove projects in conjunction with further modelling using projected traffic volumes for Grove Drive indicated that roundabout intersections would provide equivalent or better levels of service as signalized intersections in peak hours and superior performance in off peak hours. Roundabouts also provide a variety of advantages as compared to traffic signals or stop control intersections. Roundabouts improve traffic flow, pedestrian safety, and have positive environmental factors while reducing high speed and right angle collisions. Although a larger overall intersection footprint, roundabouts provide cost efficiencies in operational costs, no requirement for signalization and lower maintenance costs.

The Functional Plan identified and resolved many design issues regarding shallow and deep utility alignments, depths and servicing of adjacent lands. Coordination was completed with land owners and developers along Grove Drive to ensure servicing needs were met. Due to the ambiguity of timing for the development of the Cook Lands, a longer storm truck main outletting to Copperhaven has be identified to limit the need for interim throwaway costs.

Due to the location and future twinning of Kinder Morgan pipelines, the McLeod Avenue and Grove Drive intersection will have to be relocated 100m north of its originally planned location. An ASP amendment will be required for the Cook Lands to execute the relocation.

Meetings were conducted regarding land requirements from Stony Plain as well as adjacent land owners east of Atim Creek. A Memorandum of Understanding is to be executed between the City of Spruce Grove and the Town of Stony Plain regarding the annexation of the existing road right-of-way. Further discussions are ongoing regarding development and servicing of the lands bounded by Atim Creek.

A cost estimate was prepared for the development of the first stage from the Grove Drive 2017 project limits to Highway 16A for approximately $11,000,000 inclusive of additional costs such as landscaping, auxiliary lanes and signal modifications as well as engineering, testing and contingency. Providing future traffic volumes require the additional two lanes and multi-lane roundabouts it is estimated to cost an additional $2,500,000 to complete the widening.

We believe this document will provide a detailed guideline for the subsequent design and construction of Grove Drive.

1.0 Introduction

In 2017, the City of Spruce Grove commissioned Al-Terra Engineering to complete a functional planning study of the Grove Drive corridor from Harvest Ridge Drive to Highway 16A. This document will function as the primary design aid and reference document for the future development of preliminary and detailed design plans as well as the ultimate construction of the corridor carriageway components.

1.1 Background Information

The study area, as indicated in *Figure 1 – Key Map,* is inclusive of the Cook Lands (West Central Lands), Fuhr Lands (Copperhaven subdivision), Boundary Road, Grove Drive, and lands east of Atim Creek. Approximately 240 hectares (ha) of serviceable land has been considered in the development of this report. The area within the functional planning study is governed by the West Central Area Structure Plan (ASP) completed by ISL Engineering, Fuhr Neighbourhood Traffic Impact Assessment (TIA) by Bunt & Associates and the preliminary and detailed design for the Copperhaven subdivision completed by Select Engineering.

The first stage construction of Grove Drive within the functional planning study area was completed in 2017 as part of the Grove Drive Extension project, inclusive of the intersections at Harvest Ridge Drive and the roundabout tying into the bus transfer station at the new K-9 school, Copperhaven School. A phased approach was utilized whereby the first section constructed consisted of the southern two lanes of the ultimate four lane cross section. *Exhibit X.06-X.09 – First Stage* in *Appendix J* shows the limit of 2017 construction.

The guiding TIA's estimate future traffic volumes based on the proposed development usage of adjacent lands. The study area along Grove Drive consists of commercial, low, medium and high density residential, and institutional land such as churches, recreation centers or schools. Using previous studies combined with Synchro and Sidra modelling software's, a detailed analysis of each intersection, using projected traffic volumes for the design horizon year of 2040, was completed to provide recommendations for the staged implementation of Grove Drive.

Figure1 – Key Map illustrates the location of the project within the City of Spruce Grove and the study area.

1.2 Studied Literature

A review was conducted of the existing engineering reports and design information available for the surrounding lands and the adjacent four quarter sections; SE-6-53-27-W4, SW-5-53-27-W4, NE-6-53-27-W4 and NW-5-53-27-W4. The historical resource overview and environmental screenings have been assumed to be addressed as part of the adjacent Area Structure Plan (ASP). The information in the documents studied are considered to be complete and inclusive of all considerations needed to arrive upon their conclusions.

1.2.1 The City of Spruce Grove – Transportation Master Plan (TMP), Urban Systems, May 2012

This document evaluated the existing transportation infrastructure and examined growth to prepare a long-term plan for development within Spruce Grove. Excerpts from this report, attached in *Appendix A,* estimate traffic volumes for this section of Grove Drive/Boundary Road to be approximately 21,000 vehicles per day (vpd) in 2040. The TMP suggests the development of this passageway in the second Five-Year Capital Plan which occurs from 2018 to 2022.

1.2.2 The City of Spruce Grove - Sanitary Sewer Master Plan, Associated Engineering, September 2013

This document identifies the requirement for the Boundary Road Trunk Sewer to be installed to service the western portion of the City bounded by Grove Drive, Highway 628 and Jennifer Heil Way. The location of this trunk main passes under Highway 16A and is centered on the property line one quarter section east of existing Boundary Road. Schematics from this document are attached in *Appendix B*.

1.2.3 The City of Spruce Grove – Stormwater Master Plan Update, Associated Engineering, October 2015

The Stormwater Master Plan shows that the majority of the area within the functional plan boundary is part of the larger Atim Creek basin. The basin is inclusive of a total of 790 ha of which 276 ha is considered offsite as it is within the Stony Plain jurisdictional limits.

Figure 7-1: Future Drainage Concept in *Appendix C* shows the development of stormwater management facilities (SWMF) within both the West Central ASP, SU19 and SU20, and the Copperhaven subdivision, SU18, which is currently under construction.

1.2.4 The City of Spruce Grove – Water Master Plan Update, Select Engineering, May 2015

The 2015 plan update reviewed the existing infrastructure in place in the City of Spruce Grove and recommended specific upgrades to each of the two-zone water distribution systems. The area related to the Grove Drive Functional Plan is on the boundary of the City's Pressure Zone 1 and Pressure Zone 2 with the southern portion located in Zone 1 and the northern portion in Zone 2. The drawing in *Appendix D* outlines the proposed ultimate water system for the City of Spruce Grove.

1.2.5 West Central Area Structure Plan Amendment – Traffic Impact Assessment (TIA), ISL Engineering, August 2017

A Traffic Impact Assessment was completed by ISL Engineering as part of the ASP amendment to update the utility and access requirements for the Cook Lands. The assessment included analysis of four intersections impacting the Grove Drive Functional Plan study area and is included for reference in *Appendix E.*

Al-Terra completed the analysis of two additional intersections within the West Central ASP boundary located on Boundary Road (Hwy 16A and McLeod Avenue) with the use of ISL Engineering's traffic volume predictions, the results of which are further discussed in Section 3.0 of the study.

This study outlines several additional considerations which impact to the Grove Drive Functional Plan including:

- As intersections develop on Highway 16A it is recommended to follow safe system practices. This includes speed reductions to 60km/h with corresponding red light cameras.
- Safe system approach should be utilized to have left turn phasing whereby the movement is protected across Highway 16A at all times.
- McLeod Avenue has been identified as a potential future bus transit route providing connectivity from Jennifer Heil Way to Grove Drive.
- The trail system was analyzed to provide service for cyclists and pedestrians through the study area. Attached in *Appendix E* is a figure created by ISL Engineering showing potential trails locations.

1.2.6 West Central Area Structure Plan – Wastewater Servicing, ISL Engineering, August 2017

This document confirmed that the existing and proposed infrastructure within the original ASP and the Sanitary Sewer Master Plan is sufficient to service the West Central Area. Adjustments to invert depths and cost were updated via this study. Calculations for contributing areas and serving concepts have been updated and included in *Appendix F*. No sanitary connections have been shown for the Boundary Road corridor within the West Central Area limits.

1.2.7 West Central Area Structure Plan – Stormwater Servicing, ISL Engineering, August 2017

This document reviews the original West Central ASP to provide a stormwater concept that will aid in the development of these lands. *Appendix G* contains relevant information from this document including the locations and sizes of existing and proposed storm servicing for the West Central lands. In addition, the storm chart attached shows a total of 9.69 hectares of drainage area, attributed to onsite multi-family, commercial and collector pavement, captured in storm manhole A6 located at the Boundary Road and McLeod Avenue intersection. The above drainage area in not inclusive of potential annexation of the full Grove Drive right-of-way (ROW).

1.2.8 West Central Area Structure Plan – Hydraulic Network Analysis, ISL Engineering, August 2017

The West Central ASP area will be serviced by the City of Spruce Grove's Zone 1 pumphouse and reservoir. This report confirmed the viability of the Water Master Plan for the West Central ASP area. The use of internal looping within the Cook Lands and onsite fire management limits the requirement for a watermain alignment through the Grove Drive ROW. Excerpts from this document are located in *Appendix H* overviewing the locations, sizing and staging of existing and proposed watermains.

1.2.9 Copperhaven and Adjacent Lands Preliminary & Detailed Design – Select Engineering, May 2017

Further information was gathered from Select Engineering regarding the Copperhaven subdivision (NW-5-53-27-W4) and the adjacent parcels (NE-6-53-27-W4) located on the west side of Grove Drive owned by Melcor Developments. Select Engineering is currently undertaking the detailed design and has completed their first stage of construction. Sufficient preliminary engineering information for future stages was available to confirm the servicing and grading requirements within the Fuhr area with reasonable accuracy.

Design plans for the Copperhaven School Site located in the north-west corner of the NW-5-53-27-W4 quarter section, have been reviewed. All accesses, utilities, and services have been approved and have been provided via Grove Drive and the Copperhaven subdivision. The school is slated to be open for September 2019.

1.3 Objectives

The objective of this study was the development of a functional plan for the Grove Drive corridor to act as a guiding document for the subsequent staged design and construction. This report outlines a staged implementation strategy based on traffic flow projections to meet short term and long term demands. The following items will be discussed in further detail:

- Identification of all utility requirements along and/or crossing the corridor (including franchise utilities).
- Traffic assessment and design considerations
- Access management for adjacent landowners.
- Identification of all right-of-way requirements for the project.
- Preparation of 1:1000 conceptual plans with staged implementation strategy.
- Identification of construction cost efficiencies.

2.0 Study Area

2.1 Grove Drive

Grove Drive functions as one of Spruce Grove's primary east-west arterial roadways. The majority of Grove Drive has been built to its ultimate configuration consisting of a 4 lane divided arterial cross section with a raised median. It is located approximately 1.4 km south of Highway 16 and 1.8 km north of Highway 16A. The TMP projects 2040 horizon year traffic volumes of 17,000 vpd on this section of Grove Drive.

The existing gradeline for the rural cross section of Grove Drive slopes downward from south to north averaging approximately 1% grade tying into the 2017 construction at station 1+480, then undulating at 0.6% slope to Harvest Ridge Drive. Existing overland flow routes have been accommodated via ditches on the north side between Harvest Ridge and the bus transfer station. The 1:100 year storm will be conveyed via these ditches, ultimately draining to the Atim Creek.

2.2 Boundary Road

Boundary Road (Range Road 275), is currently a 2 lane rural roadway that is paved to the Holy Trinity Catholic Church and unpaved to its limits to the north. It extends from Highway 16A north to its intersection with Atim Creek, primarily serving as a church and rural resident access. Based on the 2012 Transportation Master Plan, Boundary Road will ultimately connect to Grove Drive forming the westernmost leg of Spruce Grove's arterial network.

2.3 Vicinity Road Network

Grove Drive as an arterial roadway provides connections to the greater regional roadway network, which include:

- **Highway 16A –** A multilane highway, classified as a provincial route with Average Annual Daily Traffic (AADT) of 28,600 vpd in the area of Grove Drive. To the west, Highway 16A provides access to west commercial district of the City of Spruce Grove as well as access to Town of Stony Plain. To the east Highway 16A provides major link to the Edmonton City Centre and is used by commuter traffic between Town of Stony Plain, City of Spruce Grove and the City of Edmonton.
- **Highway 16 –** A major interprovincial highway, part of National Highway System, with AADT 35,700 vpd and 43,300 vpd east and west of Century Road, respectively. The Functional Road Classification designates Highway 16 as expressway, which eventually would be a freeway with fully controlled access. In vicinity of the City of Spruce Grove, the highway is already a freeway which provides high speed and convenient connection to the northern parts of the City of Edmonton.
- **Century Road –** A four lane north-south arterial, located 1.6 km west of Pioneer Road and provides direct access to Highway 16, via an interchange. Century Road has a direct access to Highway 16A, via a signalized intersection. Grove Drive traffic has access to Highway 16 and Highway 16A on Century Road
- **Jennifer Heil Way –** A north-south arterial roadway within the City of Spruce Grove directly connected to both Highway 16 and Highway 16A. Jennifer Heil Way is a 4 lane divided arterial roadway estimated to have 20,000 vpd between Highway 16A and Grove Drive in 2040.
- **Pioneer Road –** Is currently undergoing construction upgrading from a rural 2 lane unpaved roadway to hybrid 2 lane 4 lane arterial, utilizing roundabout intersections. The Grove Drive and Pioneer Road roundabout was constructed in 2017 and serves as access to Tonewood, Fenwyck, Greenbury and Highway 16A via Pioneer Road.

2.4 Jurisdictional Limits and Annexation

Currently, the eastern property line of Boundary Road is the jurisdictional divide between the Town of Stony Plain and the City of Spruce Grove. The parcels located along future Grove Drive including the existing Boundary Road right-of-way, are bounded to the west by Atim Creek. During recent coordination meetings, the Town of Stony Plain has suggested the lands to the east of Atim Creek geographically should be within the City of Spruce Grove jurisdiction. Atim Creek limits access from Stony Plain to these lands which renders them difficult to develop from access management, construction and monetary perspectives. The Town of Stony Plain administration supports the annexation and parties agreed a Memorandum of Understanding is required in the future to begin the process of Spruce Grove acquiring the rights to these lands. It is recommended that the City of Spruce Grove acquire the complete right-of-way to its northern limits. This will provide opportunities for temporary access during construction and ultimately provide saleable land to adjacent developments.

2.5 Access Management

The Functional Plan examines access and roadway networks along the western edge of Spruce Grove via the Grove Drive arterial. The Fuhr Neighborhood Area Structure Plan and the West Central Area Structure Plan identified five intersections north of Highway 16A including the two roundabouts previously constructed at Harvest Ridge Drive and the bus transfer station:

- Grove Drive and McLeod Avenue – approximately 400m north of Highway 16A
- Grove Drive and Collector A – approximately 950m north of Highway 16A
- Grove Drive and Collector B – approximately 1250m north of Highway 16A
- Grove Drive and Bus Transfer Station – approximately 1550m north of Highway 16A
- Grove Drive and Harvest Ridge Drive – approximately 1850m north of Highway 16A

An additional right-in only access has been requested at the south edge of the Holy Trinity Catholic Church to aid in accessibility to the parcel during off peak high volume church traffic. The existing access will be removed and the primary access will be accommodated via the roundabout and ultimately down Collector A to the first all-directional intersection.

3.0 Functional Plan Development

3.1 Traffic Assessment

With the exception of the commercial developments adjacent to Highway 16A, the lands along the Grove Drive corridor will be comprised primarily of residential development with institutional areas intermixed throughout. As such alternate transportation modes, primarily pedestrians and cyclists, are expected to comprise a significant component of the corridor user volume. To accommodate these users, path connectivity is required at each intersection. In addition, the TMP identifies Grove Drive as an arterial transit route with multiple connections to collector transit routes via the Copperhaven subdivision and McLeod Avenue. When considering the long term volumes and alternative traffic modes, the viability of roundabout intersections for Grove Drive was reviewed.

3.1.1 Previous Analysis for Geometric Design Considerations

Previous studies completed by Al-Terra Engineering for the City of Spruce Grove, specifically for the Pioneer Road corridor, analyzed the viability of an arterial corridor utilizing roundabout intersections and compared the resultant corridor configuration to a conventional corridor incorporating signalized intersections on the basis of traffic capacity and overall corridor access and functionality. The design parameters considered in the comparison were as follows:

- Option 1 – Conventional four-lane divided arterial roadway standard with raised median, signal control and required turning lanes at intersections with a design speed of 70 km/h (posted 60 km/h).
- Option 2 – Divided four-lane roadway with a painted median and roundabout control at intersections. Basic roadway design speed 70 km/h (posted 60 km/h), with 40 km/h speed at roundabouts.

Using the TIA estimated traffic, operations of Pioneer Road during AM and PM peak were determined using Synchro Studio 9 and Sidra 6.1 software suites. Level of Service (LOS) at intersections were determined using 2010 Highway Capacity Manual (HCM) methods. The software determines the LOS, which is defined by the HCM as average vehicle delay at an intersection. In addition, volume to capacity ratio (v/c) and the length of the queues were determined, which provided information used during intersection and turning lanes design.

Results indicated that both configurations would accommodate design horizon traffic volumes. Movements at each intersection studied indicated delays less than 30 seconds per vehicle, providing a minimum LOS D. Similarly, v/c ratio is less than 0.9 value for all intersections and any single turning movement, which indicated that an arterial corridor incorporating roundabout intersections would function comparably to a conventional configuration.

In addition to a projected reduction in the original implementation costs, the corridor incorporating roundabouts provided the unique benefit of being fully stagable with the real possibility that horizon traffic volumes would not require implementation of the third and fourth travel lanes or the additional circulatory lanes at each roundabout.

Due to the similar traffic volumes during the AM and PM Peak on Grove Drive corridor, Option 2 will meet all applicable requirements while maintaining safer driving conditions. Given these previous studies, a divided 4 lane cross section utilizing roundabout intersections will be specified and evaluated for the remainder of the Grove Drive Functional Plan.

3.1.2 Design Considerations

Generally, roundabout intersections function more efficiently than a signalized intersection under off peak traffic volume conditions because traffic can proceed freely through the intersection when no other traffic is present and no stopping for signals is required. One of the main advantage of the roundabouts is slower operating speed, which provides traffic calming and results in safer operations of the road network. Due to lower speeds the road network is safer for all users, which include drivers, cyclists, and pedestrians.

Some other benefits of roundabouts as compared to traffic signals or stop control are as follows:

- Improves traffic flow and safety.
- Traffic moves through intersection at reduced speeds.
- Continuous traffic flow.
- There are fewer conflicts points between vehicles and pedestrians.
- Reduces or eliminates head-on high speed and right angle collisions.
- Improves the character and aesthetics of the roadway.

Cost efficiencies and environmental factors of Roundabouts versus Traffic Signals:

- Potential for reduction in road right-of-way width due to narrower median and fewer approach lanes. Upon decreased right-of-way width the owner retains more saleable assets or decreased costs of acquisition.
- Lower operational and maintenance costs.
- Continues to function normally if damaged or during a power failure.
- Signalization will not be required in long term.
- Although a large overall intersection footprint, cost of construction is similar when considering signalization and maintenance costs.
- Due to reduced number of stops and vehicle idling, gas consumption and gas emissions are reduced.

3.1.3 Roundabout Design Principles and Objectives.

The proposed roundabouts are designed with the following attributes to achieve the objectives of optimum and safe operations:

- Vehicle approaching the roundabout has speed reduced with the fastest path condition satisfied - entrance speed into the roundabout is less than 20km/h higher than circulating speed, which is achieved with the appropriate geometry (radii) and entrance path deflection.
- The design allows vehicle to maintain natural path without encroachment into the adjacent travel lane.
- The Design Vehicle WB-21 off-tracking is accommodated with use of the central island truck apron.
- Emergency Vehicles, Busses, Single Unit Trucks are accommodated within the paved roadway.
- Stopping sight distances are provided for all approaches, circulating roadway and the pedestrian crossing locations.

- The approaches are constructed with splitter islands, which provide pedestrian refuge at crossing locations.

The traffic approaching the roundabout must yield to vehicles already on the roundabout, which would be identified with the traffic signs and pavement markings. In addition, in case of two lane approaches, allowable movements for the travel lanes would be shown in advance of the roundabout, in form of signs and pavement markings. Guiding signs will also be installed to provide drivers with the information on directions of travel.

3.1.4 Capacity analysis

In order to confirm the viability of roundabout intersections at these locations it is important to assess specific criteria to ensure compliance to the design conditions for Grove Drive. The objective of traffic operations at these intersections is to provide equivalent or better results given the long term traffic projections for the following criteria:

- LOS D – delays of less than 30 seconds/vehicle at unsignalized intersections
- Volume to capacity ratio less than 0.9

Long-term projected 2040 volumes were analyzed using Synchro and Sidra programs. The reports are inclusive of all turning movements for each leg of each of the roundabouts. These volumes were gathered from the Spruce Grove TMP, Fuhr ASP TIA and the West Central ASP TIA. The full analysis is included in *Appendix L*.

The following tables compare the AM and PM peak hour capacities and summarizes the Sidra results for the multi-lane roundabout controlled intersections along Grove Drive in the long term horizon (2040):

Table 1 - Grove Drive Functional Planning: Sidra Intersection 7.0 Analysis

Intersection/Criteria		AM Peak 2040				PM Peak 2040			
		South	East	North	West	South	East	North	West
Harvest Ridge Drive	Demand Volume (veh/hr)	239	1203	400	988	186	1233	250	1218
	Volume to Capacity Ratio (v/c)	0.471	0.494	0.757	0.830	0.423	0.566	0.450	0.610
	Average Delay (s)	15.6	8.3	28.8	19.7	16.2	10.4	13.9	12.1
	95% Queue Distance (m)	17.2	24.6	45.9	104.3	13.7	35.6	16.5	49.0
	Level of Service (LOS)	C	A	D	C	C	B	B	B

Table 1 - Grove Drive Functional Planning: Sidra Intersection 7.0 Analysis (CONT'D)

Intersection/Criteria		AM Peak 2040				PM Peak 2040			
		South	*East*	*North*	*West*	*South*	*East*	*North*	*West*
Bus Transfer Station	*Demand Volume (veh/hr)*	970	55	1219	52	1226	3	972	91
	Volume to Capacity Ratio (v/c)	0.365	0.143	0.465	0.108	0.473	0.011	0.371	0.100
	Average Delay (s)	6.1	11.6	7.4	9.0	7.6	13.0	6.2	7.0
	95% Queue Distance (m)	15.7	3.5	23.2	2.7	23.7	0.2	16.0	2.6
	Level of Service (LOS)	A	B	A	A	A	B	A	A
Collector B	*Demand Volume (veh/hr)*	1026	261	1274	47	1359	115	1041	23
	Volume to Capacity Ratio (v/c)	0.554	0.465	0.674	0.117	0.663	0.264	0.522	0.046
	Average Delay (s)	11.4	14.2	14.7	10.7	13.5	12.5	10.1	7.8
	95% Queue Distance (m)	25.6	14.8	53.8	2.2	42.2	5.7	24.5	0.9
	Level of Service (LOS)	B	B	B	B	B	B	B	A

Table 1 - Grove Drive Functional Planning: Sidra Intersection 7.0 Analysis (CONT'D)

Intersection/Criteria		AM Peak 2040				PM Peak 2040			
		South	*East*	*North*	*West*	*South*	*East*	*North*	*West*
Collector A	*Demand Volume (veh/hr)*	1040	161	1280	3	1500	113	1047	3
	Volume to Capacity Ratio (v/c)	0.385	0.277	0.529	0.008	0.562	0.266	0.418	0.006
	Average Delay (s)	6.2	10.0	8.9	9.1	8.9	12.8	7.0	7.2
	95% Queue Distance (m)	17.6	7.9	27.5	0.2	34.4	7.1	19.0	0.2
	Level of Service (LOS)	A	A	A	A	A	B	A	A
McLeod Avenue	*Demand Volume (veh/hr)*	1065	213	1399	3	1040	161	1280	3
	Volume to Capacity Ratio (v/c)	0.409	0.263	0.606	0.009	0.387	0.227	0.544	0.008
	Average Delay (s)	6.7	9.3	10.8	10.3	6.3	8.9	9.4	9.1
	95% Queue Distance (m)	18.8	7.3	33.2	0.2	17.6	6.2	27.5	0.2
	Level of Service (LOS)	A	A	B	B	A	A	A	A

In summary the analysis indicates that the corridor will function at or above the target LOS D and well above the target v/c ratio of 0.9 at 2040 horizon volumes.

Further analysis of the signalized intersection at Highway 16A and Grove Drive was reviewed with Synchro to gauge the intersection's capacity and performance in the long term horizon. Additional movements have been accommodated according to the lane configuration on *Exhibit X.01 in Appendix I*. The following table summarizes the AM Peak results:

Table 2 - Grove Drive Functional Planning: Synchro Analysis												
Intersection/ Criteria		AM Peak 2040										
		EBL	*EBT*	*EBR*	*WBL*	*WBT*	*WBR*	*NBL*	*NBT*	*NBR*	*SBL*	*SBT*	*SBR*
Highway 16A	*Demand Volume (veh/hr)*	400	2431	100	200	1800	284	150	290	500	416	415	553
	Volume to Capacity Ratio (v/c)	0.79	0.79	0.12	0.71	0.68	0.35	0.76	0.74	0.33	0.82	0.79	0.37
	Average Delay (s)	68.4	32.3	4.4	76.4	34.9	4.4	83.5	71.5	0.6	70.6	68.9	0.7
	Level of Service (LOS)	E	C	A	E	C	A	F	E	A	E	E	A

Similar results were found for the PM Peak whereby specific movements have higher than desired delays. Detailed Synchro charts have been attached in *Appendix L* for both scenarios. Given the total projected volumes and the limitations on right-of-way space for overpasses the level of service falls below the criteria noted above. This is only the case for lower volume, turning movements whereas the primary through movements have a higher level of service. The overall intersection has a factored delay of approximately 48 seconds producing a combined LOS D rating. LOS D is the typical accepted standard for intersection operations in a community like Spruce Grove. Specific movements may experience waits of two cycles or more although the overall intersections functions as expected under peak hour conditions.

Additional intersection analysis was completed by ISL Engineering to examine intersection requirements between Jennifer Heil Way and Grove Drive on Highway 16A. Two intersections west of Jennifer Heil Way were specified as per Figure 3 in *Appendix E*. Providing additional entrances are required to the commercial lands in the SW-5-53-27-4, a longer auxiliary lane will be required for the Highway 16A and Grove Drive intersection. This lane should be a minimum of 100 m east of the intersection and may lengthen dependent on additional entry points.

4.0 Utilities and Site Servicing

Al-Terra was tasked with defining the limits for site servicing and providing reasonable recommendations for both shallow and deep utilities through the corridor. Staging of development in the areas adjacent to the road right-of-way is undetermined at this time. Ownership of property, as previously discussed, for both public and private sections along the corridor have been assumed to be within Spruce Grove jurisdictional limits regarding servicing discussions below.

4.1 Storm

4.1.1 Cook Lands Stormwater Servicing

Due to the ambiguity of the timing for development in the southern portion of the functional plan, within the West Central ASP, it is important to consider the conveyance of the major and minor storm in the event there are delays in development in comparison to the arterial construction. Excerpts from the West Central ASP for Stormwater Servicing (*Appendix G*) include approximately 0.7 ha of drainage area from the existing ROW, allocated to the McLeod Avenue storm sewer and ultimately to the Cook Lands SWMF.

Upon upgrading Grove Drive to the proposed 4 lane arterial configuration, the SWMF located in the Cook Lands (West Central ASP) would have to accommodate approximately 3.5 ha of storm drainage from Highway 16A north to McLeod Avenue. At this time the West Central ASP has not accommodated for this area, nor sized their SWMF accordingly. This, in conjunction with the timing aspect led to considerations for a longer trunk tied into Collector A and ultimately the Copperhaven SWMF. Otherwise, without this measure, any delay in the development progress of the Cook lands would require significant temporary measures to accommodate stormwater runoff which would include extensive grading, overland ditching and implementation of temporary stormwater retention and storage areas.

Coordination with Select Engineering on behalf of Melcor was undertaken regarding the capacity of the Copperhaven SWMF. Parties agreed that through minor design adjustments and pipe upsizing through the subdivision, this additional area could be accommodated within the Copperhaven SWMF. In addition, an invert elevation of 691.36 at Manhole 990 has been evaluated and will work with the current design. *Exhibit X.02 in Appendix I* shows the preliminary sizing at design through this location. *Appendix M* contains a preliminary storm design chart for Station 0+000 to Station 0+970 detailing the storm system required to provide conveyance of the 1:5 year storm from Highway 16A to Collector A.

Upon annexation of Boundary Road and development of the 14 ha parcel to the west of future Grove Drive and south of McLeod Avenue, stormwater servicing of these lands requires a further review. Currently, Copperhaven SWMF cannot accommodate this area and the West Central ASP for the Cook Lands has not included provisions in their design for further development west. Alternative methods such as applications to Environment Canada for a storm scepter discharging into Atim Creek, onsite storage facilities, or underground storage can be examined upon development. Further communications with the developers from the Cook Lands are required to determine if routing flows to their SWMF is a viable option.

4.1.2 Collector B Stormwater Servicing

Additional pick-up locations have been specified approximately half way between Collector A and Collector B starting the next storm system along Grove Drive heading north. Upon picking up an additional 1.2 ha of drainage from the parcel to the west this system then leaves the Grove Drive right-of-way and continues

down Collector B ultimately terminating in the Copperhaven SWMF. *Appendix M* shows the 1:5 year preliminary storm design chart for this section from Station 1+125 to Station 1+250.

4.1.3 Existing Grove Drive to Harvest Ridge Drive Stormwater Servicing

The remainder of the storm required to be installed connects to the 600 diameter plug shown on *Exhibit X.03* in *Appendix I*. This leg provides servicing to both undeveloped western parcels, one of which is owned by Melcor. The other parcel is owned privately and requires further discussions regarding future development. Due to accommodating additional drainage from the hard surfaced areas on the K-9 school site in the major event and the limitations for overland flow routes, this section of storm main was sized to capture the 1:25 year parameters. In addition, the hydraulic gradeline was analyzed to ensure adequate conveyance and reduced risk of flooding was achieved with these specifications. The mainline turns south at station 1+850 and continues towards the Copperhaven SWMF. The majority of this system has been installed as part of the Grove Drive Extension 2017 project.

4.1.4 Major Storm Drainage and Overland Flow

In order to maintain 1:5 year storm pipe sizing through the unconstructed portion of Grove Drive it is important to design overland flow routes to transmit the water in the event catchbasin capture capacity and pipe capacity is surpassed. To aid in capture, F51 frame and covers have been specified for sags and major system low points to ensure maximum capture rates. In some cases double catchbasins are proposed to decrease ponding draw down time.

Storm Manhole 6 located at station 1+795 utilizes both of these techniques as well as is the entrance to the major overland flow route for the northern portion of Grove Drive. Upon ponding and topping the curb to the north the water will enter a drainage ditch that drains through the Alberta Capital Region Wastewater Commission (ACRWC) right-of-way and enters Atim Creek.

Additional overland flow routes should be considered through the corridor to alleviate stress at the northern portion of the functional planning area. An opportunity exists at the Grove Drive and Collector A intersection to utilize the geometry of the roundabout to provide an overland flow route northwest down existing Boundary Road right-of-way or through an easement to the Atim Creek. The location discussed is shown on *Exhibit X.02 in Appendix I.* Proper approvals, treatment and erosion control measures should be reviewed at the time of preliminary and detailed design.

4.2 Water

Existing and proposed waterlines are shown on *Exhibits X.02 and X.03* providing fire protection within the Grove Drive right-of-way and looping for the Copperhaven subdivision. In addition, service stubs are shown for the northern and western lots via this watermain. For the purpose of this study, 300 mm diameter PVC waterline has been specified. Ultimately, sizing of this line should be reviewed at the time of design.

The City of Spruce Grove Water Master Plan Update and West Central ASP shows all servicing for the SW-5-53-27-4 quarter section to be confined within their onsite collectors and have not identified any requirements for an alignment within the Grove Drive right-of-way. Should this change in the future, the 54m corridor ROW can accommodate an alignment for water infrastructure outside of the hard surface road carriageway area with minimal disruption. At this time no further watermain has been shown for the remainder of the functional plan.

Depending on timing, the 14 ha parcel will remain land locked on the west side of Grove Drive and will require water servicing potentially tied into Cook Lands system utilizing trenchless technologies if the roadway has already been constructed.

4.3 Sanitary

An existing easement for the ACRWC is located along the northern most property line within the functional plan limits. This easement contains a 750 mm diameter deep sanitary sewer line draining east along Grove Drive. Previous connections from the Copperhaven subdivision were constructed as part of the Grove Drive 2017 Extension project.

A 200 mm diameter sanitary main has been specified as part of Melcor's request to provide servicing to their future multifamily lots on the west side of Grove Drive. This follows the alignment of Collector B and ties into their onsite sanitary system. The alignment and plan-profile views for this sanitary line are shown in *Exhibits X.02 and X.03* in *Appendix I*.

As per the Sanitary Sewer Master Plan and the West Central ASP there is a requirement for a sanitary trunk main servicing the 2 quarter sections and lands south of Highway 16A. This trunk is to cross under Highway 16A into the Cook Lands outside of the road right-of-way. No further sanitary has been shown as part of this functional plan.

Similar to the water recommendations for the 14 ha parcel on the west side of Grove Drive at the south limits, upon development of this land it will be important to discuss potential sanitary servicing with the developers from the Cook Lands.

4.4 Shallow Utilities

Coordination meetings were completed with representatives from the each of the franchise utilities listed below as part of the functional planning process. Review of existing infrastructure, relocations and discussions regarding future alignments and requirements are discussed below. Additionally, existing and proposed utilities have been shown on the plan-profile drawings in *Appendix I*.

4.4.1 Power and Streetlighting - Fortis

Existing overhead power lines are located in the east ditch of Boundary Road running from Highway 16A north to service the Holy Trinity Catholic Church and some residences located further north. Upon upgrading to the arterial cross-section, underground 3 phase power will be installed on the east side, 1 m off the face of curb along the front edge of the 2.5 m trail. Streetlights will parallel this alignment and be offset 1.75 m off the face of curb as shown on the cross-sections. This will provide a consistent alignment matching what was installed as part of the Grove Drive Extension 2017 project. Upon commencement of preliminary design, Fortis to be contacted regarding removal, relocation, and installation of their new infrastructure.

4.4.2 Atco Gas

Atco Gas has existing infrastructure running along the north and west edge of the NW-5-53-27-W4 quarter section. The existing line currently runs south and services the Holy Trinity Catholic Church. This line is slated to be abandoned and replaced with a new service running 1.25m off the south/east property line as shown on the plans in *Appendix I*. The new line is planned for construction spring 2018 and will provide service to the new K-9 school. At the limits of the Grove Drive 2017 construction the line crosses to the west and ties into the original line feeding the Holy Trinity Catholic Church.

The proposed offset of 1.25m from the west property line continuing to the south allows for Atco to intercept their existing feeder line to the Church and reduces the installation adjacent to, or in berms. The west boulevard is free of other shallow and deep utilities and provides Atco the ability to adjust their alignment if required.

4.4.3 Telus

Telus has existing underground infrastructure located in the east ditch of existing Boundary Road from Highway 16A north to service the Holy Trinity Catholic Church. This line requires relocation prior to the construction of the south leg of Grove Drive. Upon commencement of preliminary design, coordination with Telus for relocates will be undertaken.

Consistent with the Grove Drive Extension 2017, the remainder of the Telus infrastructure is proposed to be installed in a common alignment with Fortis and Shaw facilities. This alignment will be on the east side of the carriageway approximately 1 m off the face of curb and will remain consistent for the full length of Grove Drive.

4.4.4 Shaw

Shaw has existing lines in common trench with Fortis and Telus through the existing component of Grove Drive. This arrangement is planned to continue along the remainder of the Grove Drive corridor.

4.4.5 Pipelines

There is a crude oil pipeline located in an easement on the south side of the Grove Drive shown on *Exhibit X.01* in *Appendix I*. The easement, plan 3625 HW and 4380 HW, crosses diagonally across the road right-of-way and contains a 610 mm steel Trans Mountain/Kinder Morgan Canada oil pipeline. *Appendix N* shows the plan profile view for the pipeline crossing Boundary Road. Further investigations are required to determine the exact depth of the pipeline in relation to the existing ground and ultimately the design profile.

At this location the proposed profile is higher in elevation than the existing ground at the crossing. Should further investigation indicate that minimum cover depths cannot be achieved, the proposed roadway gradeline can be adjusted to accommodate an increase in depth by altering the grade from 1.00% to a minimum of 0.6%. Alternative protection may be required at the time of construction.

According to the regional Kinder Morgan inspector, the depth has been estimated to be 1.97m below existing surface yielding an elevation of 698.15 to the top of pipe in the center of the existing roadway. This would provide excess of 2 meters of cover from obvert of pipeline to proposed center gradeline. The storm mainline has been lowered to provide 0.75 meters from obvert of storm to invert of pipeline. Adjustments can be made for Storm Manhole 2000 and downstream pipes to accommodate an increase in cover if required.

Due the location of this easement in correlation with the application for an additional 22 meter ROW for the Trans Mountain/ Kinder Morgan pipeline twinning to the north, as shown in *Appendix N*, the location for the McLeod Avenue and Grove Drive intersection will require relocation to 100 meters north from its originally planned location. Guidelines and restrictions from Kinder Morgan throughout the ROW will dictate construction processes and methods. **An ASP amendment to the Cook Lands ASP will be required due to the intersection location change.**

A second easement is registered to Northwestern Pipelines along the north side of the Kinder Morgan Pipeline easement. The easement, plan number 922 3214, is operated by Atco Pipelines and contains no

facilities. Atco is in the process of discharging this instrument from file but will require a crossing agreement pending construction takes place prior to discharge.

5.0 Final Functional Plan

5.1 Proposed Grove Drive Long Term Plan

The recommended long term plan for the Grove Drive corridor is illustrated on *Exhibits X.01 through X.03 in Appendix I*. The plans detail the ultimate configuration of Grove Drive in plan and profile view at 1:1000 scale. Alignments for both shallow and deep utilities are shown in plan view with approximated pipe sizes and depth for deep utilities shown in profile view. Traffic markings have been included to show how the multi-lane roundabouts will function.

5.1.1 Cross- Sections

The Grove Drive corridor is proposed to be a consistent 54 m width right-of-way. Grove Drive is comprised of varying cross-sections through the corridor depending on the adjacent land use at each particular station. In areas adjacent to low density developments the cross-section includes a berm to aid in noise attenuation. In areas adjacent to commercial, medium and high density residential and the institutional areas, the cross-section does not include berm construction and rather utilizes a boulevard sloping approximately 2% from property line to top of curb.

Spruce Grove provides alternative mode connectivity along all their arterials within the city. A 2.5m wide trail for the south/east side and a 1.5m wide separate concrete walk for the north/west has been specified for the remainder of Grove Drive construction from Harvest Ridge to Highway 16A. City standard setback distances have been used for separation from the driving surface to the pedestrian and cyclist facilities. The separate walk and asphalt trail are 3.25 m and 2.25 m from face of curb to front of walk, respectively.

5.1.2 Study Intersections

Grove Drive and Highway 16A is currently undergoing upgrades and requires further long term improvements to the signalized intersection consisting of the following:

- Highway 16A eastbound and westbound consists of 6 lanes (2 dedicated left turn lanes, 3 through lanes and 1 right turn from auxiliary lane)
- Southbound Grove Drive to eastbound Highway 16A analysis shows a requirement for a double left
- Northbound Grove Drive consists of one through lane, one dedicated left and an auxiliary right turn onto Highway 16A.
- Signal modifications will be required upon completing the construction of Grove Drive.

Grove Drive and McLeod Avenue is proposed to be constructed as a multilane roundabout with the following attributes:

- An inscribed roundabout diameter of 50m.
- Northbound and southbound double entry and double exits are provided on Grove Drive.
- Eastbound on McLeod Avenue accessing the West Central neighborhood is a proposed 4 lane arterial with double entry and double to and from the roundabout.
- The western leg of the roundabout is shown as a single entry and exit to an approximately 14 ha parcel bounded by Atim Creek.

Grove Drive and Collector A provides access to the Copperhaven subdivision and the Holy Trinity Catholic Church with the following features:

- An inscribed roundabout diameter of 50m.
- Northbound and southbound double entry and double exits are provided on Grove Drive.
- The eastbound leg has a single entry and exit to and from the southern limits of the Copperhaven subdivision and provides the new main access point to the Holy Trinity Catholic Church at the first intersection down from the roundabout.
- The western leg of the roundabout is shown as a single entry and exit to a parcel bounded by Atim Creek.

Grove Drive and Collector B provides access to the Copperhaven subdivision and consists of:

- An inscribed roundabout diameter of 50m.
- Northbound and southbound double entry and double exits are provided on Grove Drive.
- The eastbound leg has a single entry and exit to and from the middle of Copperhaven and provides access to the southern entrance of the new K-9 school.
- The western leg of the roundabout is shown as a single entry and exit to another parcel bounded by Atim Creek. This land is currently owned by Melcor and is planned to be medium to high density residential.

Grove Drive and Bus Transfer Station was previously constructed in 2017 as part of the Grove Drive extension program and has the following characteristics:

- An inscribed roundabout diameter of 48m.
- Westbound and eastbound double entry and double exits are provided on Grove Drive.
- The northern single entry and exist provides access to a multifamily lot owner by Melcor and bounded by Atim Creek and the ACRWC.
- The southern single entry and exit provides access to the Bus Transfer Station for the K-9 Spruce Grove School.

Grove Drive and Harvest Ridge Drive was previously constructed in 2017 as part of the Grove Drive extension program and has the following characteristics:

- An inscribed roundabout diameter of 48m.
- Westbound and eastbound double entry and double exits are provided on Grove Drive.
- The northern leg consists of single lanes that lead to the Harvest Ridge subdivision and the St. Peter Catholic High School.
- The southern single entry and exit provides access the first stage of the Copperhaven Subdivision that was previously constructed in 2016/2017.

The ultimate configuration of each intersection detailed above provides a high level of service through Grove Drive while maintaining safe and efficient operations.

5.2 Construction Staging

Due to the timing of roadway construction in comparison to development through the corridor, a first stage plan was developed. The purpose of this plan was to provide an interim cross-section that aligns with the

final design while limiting throw away costs and meeting traffic demands prior to full build out. *Appendix J* contains *Exhibit X.04-X.06* detailing the proposed first stage plans.

Further analysis evaluated the interim cross-section in correlation to the traffic volume projections for 2040. The data supports the potential for the interim 2 lane cross-section to provide an adequate level of service at full buildout, possibly eliminating the need to upgrade Grove Drive to a 4 lane cross-section in the future. Factors such as driver education, gap acceptance and comfortability in roundabouts will improve with time and contribute to decreases in approach/entrance delays and idle times. Additional traffic counts and impact assessment are recommended as development proceeds.

5.2.1 Staged Implementation

The first stage consists of building the eastern carriageway with two 4.2 m wide lanes and a 1 m painted median. The roadway will cross fall at approximately 2% to the east. Upon upgrading, the first stage lane edge will become the crown and the remainder of the lanes will be built with opposite slopes to the west. Due to the configuration of the short term lanes it is recommended that the 2.5 m trail be constructed on the east side of Grove Drive and the 1.5 m walk be deferred until the future. Streetlighting is proposed to be installed along the east side of the carriageway adjacent to the pedestrian facilities.

Should future traffic volumes indicate a requirement to upgrade the corridor, design measures have been taken to limit duplicate construction and reduce throwaway costs. The roundabout outlines have been designed to be similar in the short term and long term conditions. Reconstruction of the center island will upgrade the roundabout from single to multilane. Landscaping designs for roundabouts should reflect this and maintain the larger plantings within the ultimate interior curb. Additionally, grading optimizations can be utilized whereby the total volumes can be balanced for future lane construction with interim ditches for drainage.

It is proposed to construct four lane cross-section between Highway 16A and McLeod Avenue in the first stage. The tie in to Highway 16A would include minor modification to the existing intersection and additional signal upgrades to accommodate the southbound to eastbound double left. A transition from 4 lanes to the above noted 2 lane cross-section will occur north of McLeod Avenue. The 2 lane cross-section will continue until the tie in location of the Grove Drive Extension 2017 construction.

5.2.2 Temporary Residential Access

In addition to the Holy Trinity Catholic Church, there are three additional residences located on the existing Boundary Road.

The first is located across from the Church and acts as a homestead for farmland to the west of Boundary Road within the Town of Stony Plain limits. Upon expansion of Grove Drive, acquisition of right-of-way through this property is required. Within the land obtained by the City there are some larger trees that will need to be removed for construction of the ultimate configuration. Access for this resident can be provided via the west leg of Collector A.

The second resident is located south and west of the previous stage's limit of construction between two parcels of Melcor land. The piece of land is currently serving as a rental property. At this time the owner has no intention to sell the parcel. When building the next leg of Grove Drive to the south, access to this property will be limited. Depending on the rate of development, there is potential to coordinate with Melcor to provide access off the west leg of the Collector B roundabout will provide access to this property. Providing Melcor

is developing the land south of this residence, a temporary right-in right-out may be considered north of the Grove Drive and Collector B roundabout.

The final property is located at the extreme north end of existing Boundary Road and provides access to a trailer in the next quarter section. Further discussions are needed with the Town of Stony Plain, though there is believed to be access via Range Road 280. Confirmation is required at the time of design.

5.3 Right-of-Way Requirements

Drawings in *Appendix K* have been prepared to outline the right-of-way required to construct Grove Drive from Harvest Ridge to Highway 16A. The requirements have been broken into three separate areas – existing Boundary Road right-of-way, City of Spruce Grove lands and Stony Plain lands. The cumulative area for each is 3.03 ha, 2.91 ha and 1.76 ha respectively. A breakdown per quarter section is provided on the right-of-way plans X.07 and X.08.

6.0 Opinion of Probable Cost

6.1 Detailed Cost Estimate

A detailed breakdown was prepared in *Appendix O* to estimate the probable cost for construction of the first stage for Grove Drive from the Copperhaven School Bus transfer station to Highway 16A. Further to the unit rate quantity breakdown provided, additional costs have been accounted for 800 lineal meters of auxiliary lane on Highway 16A, power and streetlighting, landscaping of the 3 remaining center roundabout islands, signal modifications and additional costs for pipeline measures. With the additional costs listed above and including engineering, testing and contingency, the opinion of probable cost for Grove Drive approximately $11,000,000.

6.2 Long Term 4-Lane Widening

Providing the future traffic volumes require the widening of Grove Drive from 2 lanes with single-lane roundabouts to 4 lanes with multi-lane roundabouts, it has been estimated that it will take an additional $2,500,000 worth of hard surface costs to complete the widening. This is inclusive of upgrading the 4 roundabout aprons, slab-ons, and profiles north of McLeod Avenue and construction of the remaining 8 meter width of roadway from McLeod Avenue to Harvest Ridge Drive.

7.0 Conclusions and Recommendations

- Previous studies in Spruce Gove along with the 2040 long term horizon analysis support the implementation of roundabout intersections on Grove Drive from Harvest Ridge to Highway 16A.
- Additional modifications are required to the intersection at Grove Drive and Highway 16A to accommodate a southbound to eastbound double left. A westbound auxiliary lane on Highway 16A of varying length is recommended dependent on commercial entry points.
- Potential future development parcels exists on the west side of Grove Drive, adjacent to McLeod Avenue. Upon development, servicing of this land will require coordination with the Cook Lands.
- Annexation of existing Boundary Road right-of-way from the Town Stony Plain is required. Additional acquisitions from land owners to the east and to the west are needed to support the full 54 m right-of-way.
- Deep utility requirements have been assessed for the Grove Drive corridor.
- Shallow utility coordination is ongoing. Preliminary alignments, existing infrastructure, required relocations and proposed utilities have be identified and addressed.
- Pipeline crossing agreements will be required for the Kinder Morgan Pipeline. Further investigations via hydro-vac agreements are required to identify the pipeline depth to assess if design modifications or alternative measures are required.
- A staged implementation strategy has been indicated whereby a 2 lane cross-section can be utilized prior to full buildout. Further analysis is required as development progresses to assess the demand for widening to 4 lanes.
- Access to residences along Grove Drive to be off roundabout intersections where applicable. Temporary measures may be required at the time of design.
- Northbound right-in only to be located at the south limits of the Holy Trinity Catholic Church property.
- ASP amendment is required for Cook Lands for the Grove Drive and McLeod Avenue intersection relocation.

Appendix A

Excerpts from Transportation Master Plan

Transportation Master Plan Update, 2012– *Urban Systems*

Al-Terra

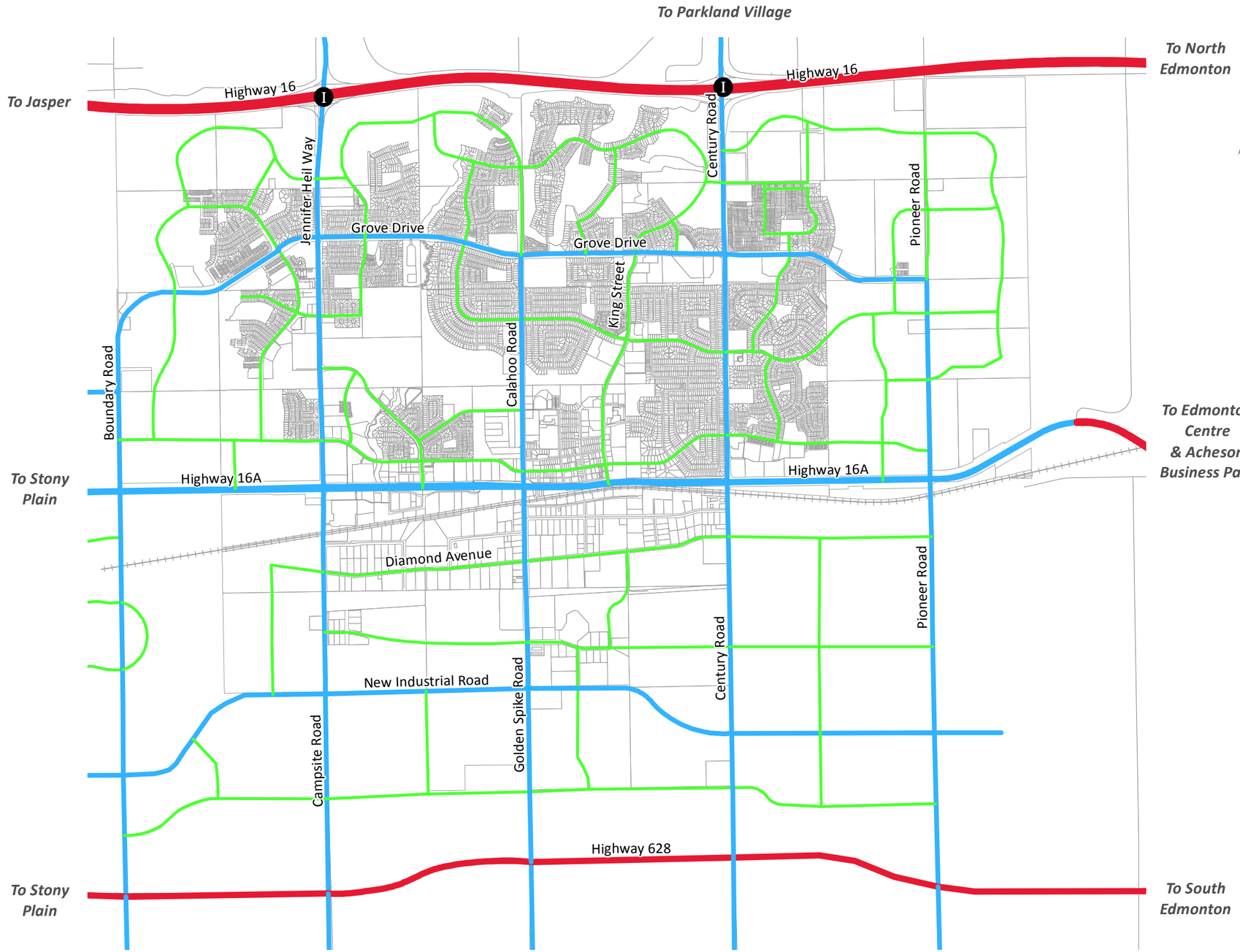
The City of
SPRUCE GROVE

2012 Transportation Master Plan

May 2012

URBANSYSTEMS®

Figure 5.1: 2040 Road Network Plan



Path: U:\Projects_EDM\3074\00001\01\R-Reports-Studies-Documents\Final\Figures\Figure MXDs\Fig5.1 2040 Road Network Plan.mxd

5.1.4 HOV Lanes

Carpools are currently used by about 18% of Spruce Grove commuters. The Vision Plan has set a target to increase this mode of travel to 21% of commuters, or nearly 50,000 person trips per day. Incentives for people to use carpools, or high occupancy vehicles (HOV), generally include lower travel costs and preferential parking privileges.

One of the most compelling incentives for carpool use is travel-time savings. Many major urban areas have employed high occupancy vehicle lanes (HOV lanes) to provide significant travel-time savings for commuters who carpool. HOV lanes are usually restricted to carpools, buses, motorcycles, and emergency vehicles. HOV Lanes are most commonly used on freeway or expressway facilities such as Highway 1 and Highway 99 in Vancouver, but may also be used on major arterial roads such as Harvey Avenue (Highway 97) in Kelowna and Centre Street in Calgary.

HOV lanes would provide significant incentives for commuters from Spruce Grove to Edmonton on Highway 16 or Highway 16A. It is estimated that more than 45,000 person trips per day will use carpools or buses on the corridor between Spruce Grove and Edmonton. It is recommended that a review of the benefits of designing any further widening of Highway 16 or Highway 16A over the next 30 years for HOV lanes should be undertaken by Alberta Transportation with its Capital Region partners.

5.1.5 Future Traffic Volumes

Average weekday traffic volumes have been projected using a VISUM travel demand forecasting model for the 30-year horizon of 2040. The model uses the future population and employment estimates illustrated in Figures 4.2 and 4.3, the future Vision travel behaviour illustrated in Figure 4.7, and the basic road network illustrated in ***Figure 5.1*** as inputs to develop traffic forecasts. Average weekday traffic volumes for the forecast year 2040 are shown in ***Figure 5.2.***

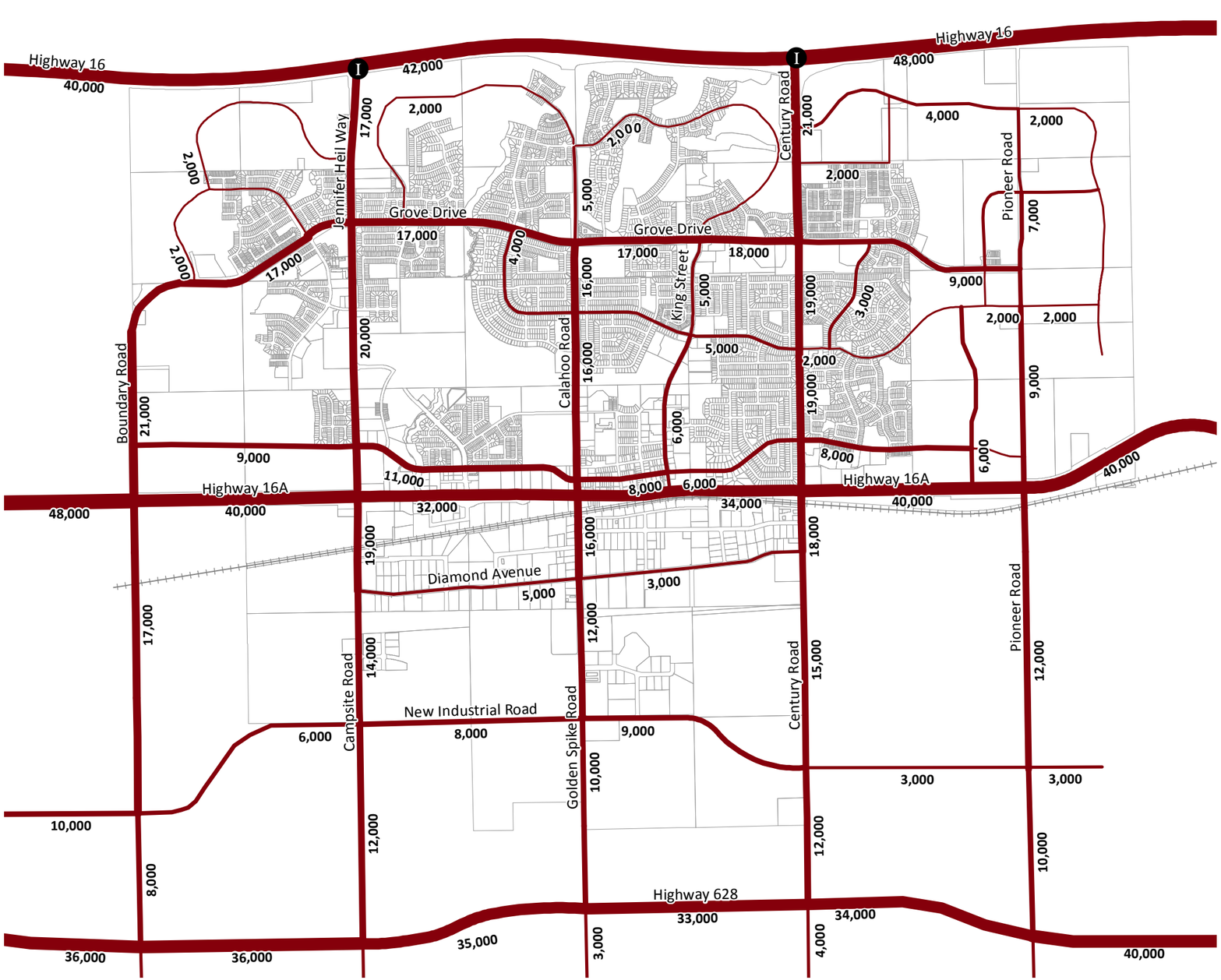
Much of the traffic on the **Freeway/Expressway** facilities does not originate in Spruce Grove. Daily traffic volumes on **Highway 16** are predicted to range between 40,000 and 48,000 vehicles per day, while the general capacity is estimated at 50,000 to 60,000 average daily trips (ADT) as a four-lane freeway and 90,000 to 100,000 ADT as a six-lane freeway. The projected volumes are within the generalized capacity. Daily traffic volumes on **Highway 16A** are predicted to range between 32,000 and 40,000 vehicles per day, while the general capacity is estimated at 45,000 to 50,000 ADT as a six-lane major arterial and 45,000 to 50,000 ADT as a four-lane expressway east of Pioneer Road. The projected volumes are within the generalized capacity. Daily traffic volumes on **Highway 628** are predicted to range between 33,000 and 40,000 vehicles per day while the general capacity is estimated at 45,000 to 50,000 ADT as a four-lane expressway east of Stony Plain. The projected volumes are within the future generalized capacity.

General capacity for a **four-lane divided arterial road** is estimated at 25,000 to 30,000 ADT while the general capacity of a two-lane arterial road with left

turn lanes (three-lane arterial) is estimated at about 12,000 to 15,000 ADT. Traffic volumes on **Boundary Road** are projected at about 21,000 vehicles per day north of Highway 16A. A four-lane divided arterial road will be required to accommodate the projected traffic within the plan period. South of Highway 16A, Boundary Road is in the jurisdiction of Stony Plain. Traffic volumes on **Jennifer Heil Way** are projected to range from 17,000 to 20,000 vehicles per day and the existing four-lane divided arterial road will accommodate the projected traffic. Traffic volumes on **Campsite Road** are projected to range from 12,000 to 19,000 vehicles per day. A three-lane arterial road will likely accommodate the projected traffic on Campsite Road by 2040, but it is recommended that a right-of-way for an ultimate four-lane divided road should be protected. Traffic volumes on **Calahoo Road** are projected to range from 11,000 to 16,000 vehicles per day and the existing four-lane divided arterial road south of Grove Drive will accommodate the projected traffic. Traffic volumes on **Golden Spike Road** are projected to range from 10,000 to 16,000 vehicles per day. A three-lane arterial road will likely accommodate the projected traffic on Golden Spike Road by 2040, but it is recommended that a right-of-way for an ultimate four-lane divided road should be protected. Traffic volumes on **Century Road** are projected to range from 19,000 to 21,000 vehicles per day north of Highway 16A while South of Highway 16A, traffic volumes are projected to range from 12,000 to 18,000 vehicles per day. The existing four-lane divided arterial road north of Highway 16A will accommodate the projected traffic. South of Highway 16A, Century Road will need to be widened to at least three lanes but the right-of-way should be protected for an ultimate four-lane divided road. Traffic volumes on **Pioneer Road** are projected to range from 7,000 to 12,000 vehicles per day. A three-lane arterial road will likely accommodate the projected traffic by 2040, but it is recommended that a right-of-way for an ultimate four-lane divided road should be protected.

Traffic volumes on **Grove Drive** are projected to range from 9,000 to 18,000 vehicles per day. The existing four-lane divided arterial road should be extended from Boundary Road to Pioneer Road to accommodate the projected traffic. Traffic volumes on the **New Industrial Road** are projected to range from 3,000 to 9,000 vehicles per day. A three-lane arterial road will likely accommodate the projected traffic by 2040, but it is recommended that a right-of-way for an ultimate four-lane divided road should be protected. Traffic volumes on **McLeod Avenue**, a collector street, are projected to range from 6,000 to 11,000 vehicles per day. A three-lane collector road would likely accommodate the projected traffic to 2040, but it is recommended that a special study of the corridor be undertaken with any revitalization of the downtown core.

Figure 5.2: 2040 Daily Traffic Volumes



Path: U:\Projects_EDM\3074\0001\01\R-Reports-Studies-Documents\Final\Figures\Figure MXDs\Fig5.2 2040 Traffic Volumes.mxd

6.2.3 Second Five-Year Capital Plan

The second Five-Year Capital Plan operates from 2018 to 2022. This plan proposes that Highway 628 would continue west to Campsite Road, Boundary Road would be connected to Grove Drive, a regional Park and Ride would be developed at the east end of Stony Plain, and a transit centre would be developed on MacLeod Avenue near Columbus Park. The project list is shown on ***Table 6.5*** and the projects are illustrated on ***Figure 6.3***.

The City budget for the second Five-Year Capital Plan is estimated at about $40 million or about $8 million per annum, as shown on ***Table 6.6.*** The regional and expressway component of the budget would add about $16 million ($3.2 million per annum). The most significant elements of this five-year budget are the continued investment in trails, but also in new arterial and collector roads and transit facilities.

Table 6.5: Second Five Year Capital Plan 2018 to 2022

#	PROJECT NAME	LIMITS	VEHICULAR	TRANSIT	ACTIVE
E6/7	Highway 628	Century to Campsite	Expressway	Optional	Arterial
A1	Boundary Road	Grove to Highway 16A	Arterial	Arterial	Arterial
A16	Grove Drive	Boundary to Spruce Ridge	Arterial	Arterial	Arterial
A19	Grove Drive	Century to Greystone	Arterial	Arterial	Arterial
A22/23	Highway 16A	J.Heil to King	Arterial	Optional	Arterial
C1	Heron Link	Harvest Ridge to Harvest R.	Collector	Collector	Collector
C16	Millgrove Drive	Grove to Calahoo	Collector	Collector	Collector
C21/31	Diamond Avenue	Campsite to Century	Collector	Collector	Collector
C29	Woodhaven Drive	Calahoo to King	Collector	Collector	Collector
C30	MacLeod Avenue	Calahoo to King	Collector	Arterial	Local
C32	Schram Street	Diamond to Unknown	Collector	None	Collector
C36	Un-named	Century to Pioneer	Collector	Arterial	Collector
C37	Un-named	Century to North	Collector	None	Collector
C40	Grove Meadow Dr	Century to Unknown	Collector	Collector	Collector
C43	MacLeod	Century to Lansdowne	Collector	Arterial	Collector
C49	Pioneer	Grove to North	Collector	Arterial	Arterial
T2	Stony Plain Regional Park & Ride		Local	Arterial	Collector
T3	Columbus Park Transit Centre		Collector	Arterial	Arterial
Trails	11 Off-street Trails	various	None	None	Collector

Appendix B

Excerpts from Sanitary Sewer Master Plan, 2012

Sanitary Sewer Master Plan Update, 2012– *Associated Engineering*

Al-Terra

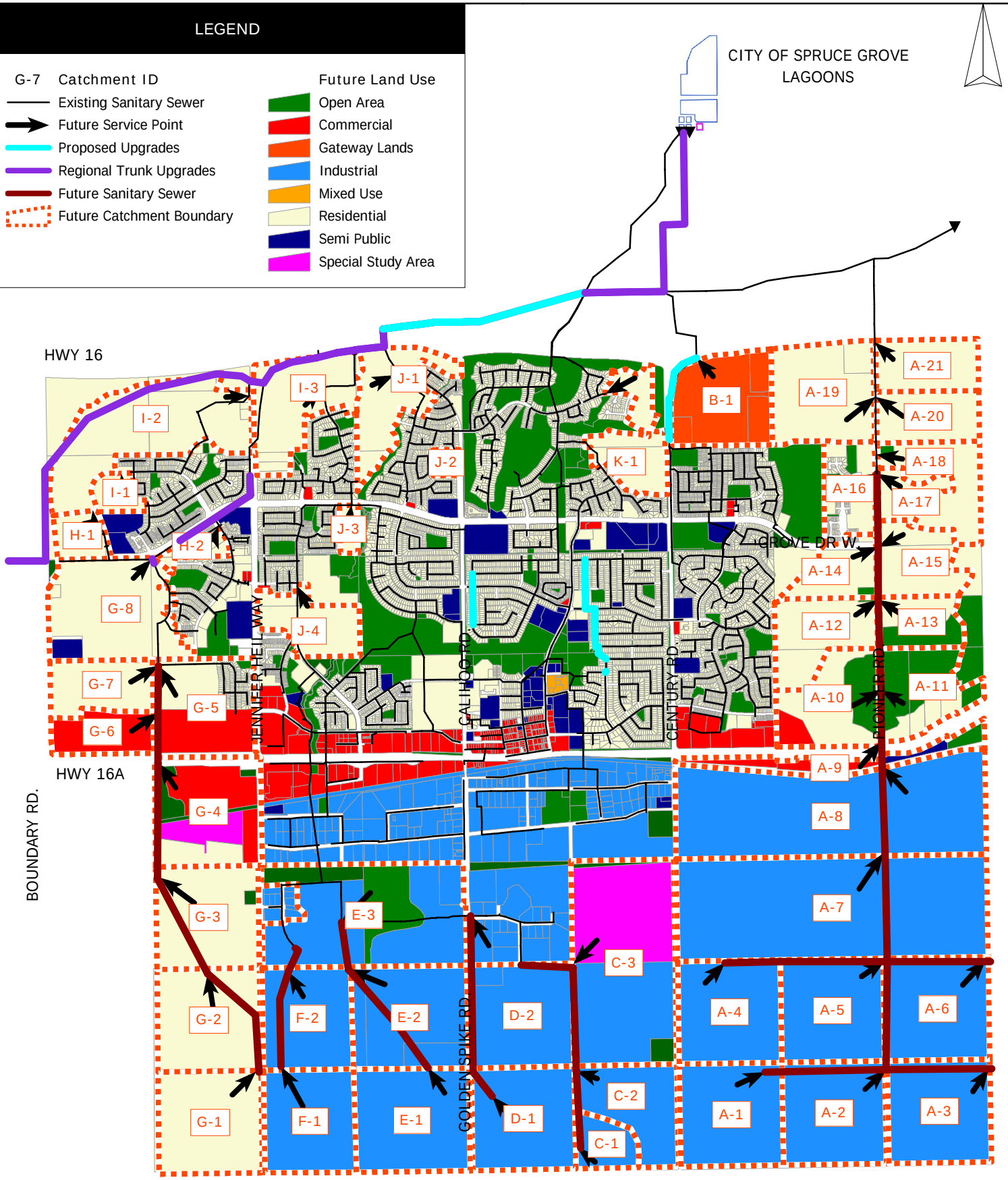
The City of Spruce Grove

REPORT

SANITARY SEWER MASTER PLAN (2012)

September 2013

Associated Engineering



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No.	REVISION	DATE

Associated Engineering

The City of SPRUCE GROVE

CITY OF SPRUCE GROVE
SANITARY SEWER MASTERPLAN

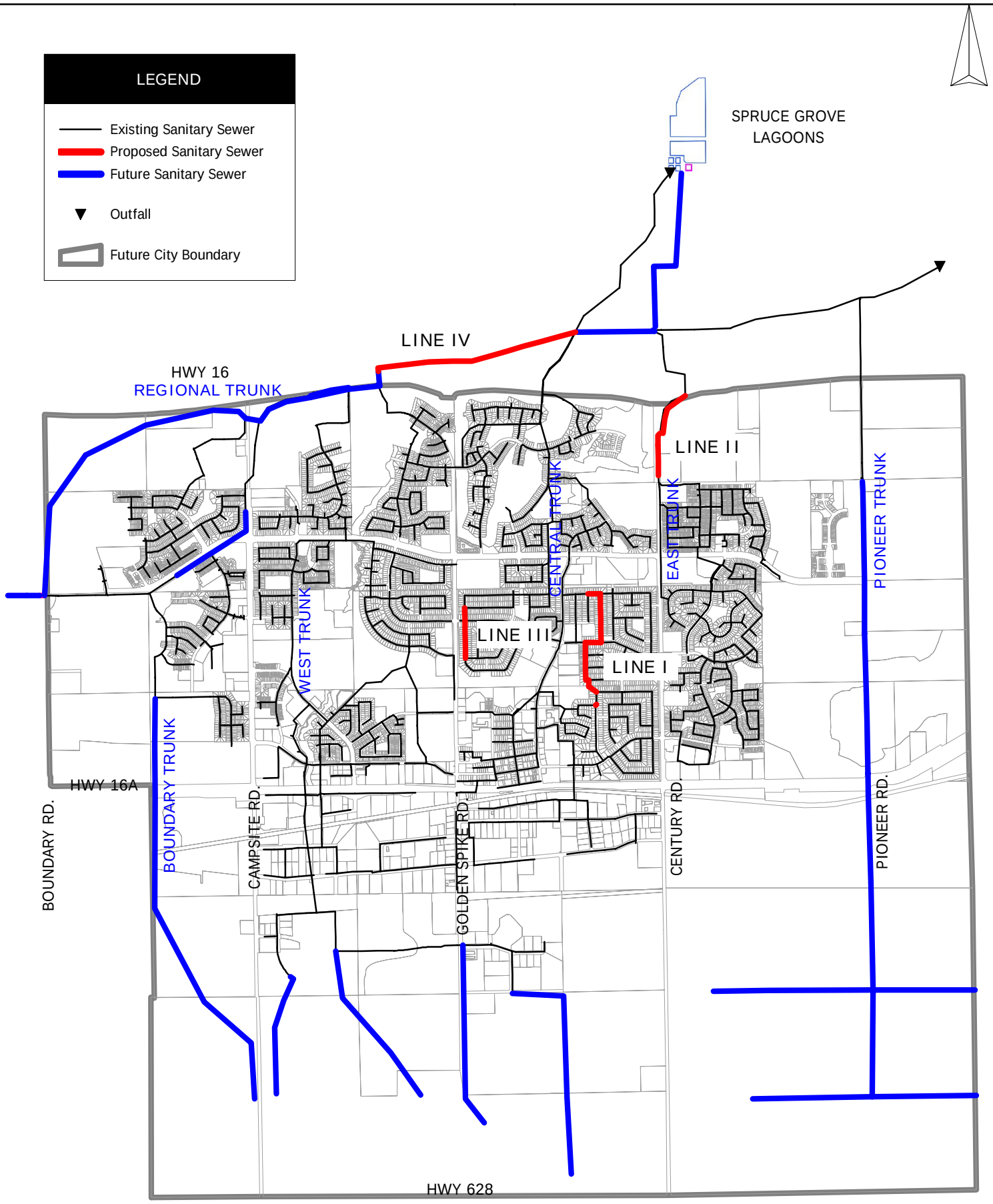
FIGURE 6-2

FUTURE SERVICE CONCEPT MAP

PROJECT No.: 2012-3513

DATE: 9/11/2013

SCALE: 1:40,000



REVISION	(Name) (Date)		Associated Engineering	The City of SPRUCE GROVE	CITY OF SPRUCE GROVE SANITARY SEWER MASTERPLAN FIGURE 6-3 FUTURE CONDITION CONCEPTUAL SANITARY SEWER SYSTEM	PROJECT No: 2012-3513 DATE: 9/18/2013 SCALE: 1:40,000 PROJECTION: 10TM115

Table 6-3
Future Sanitary Sewer for West Trunk

Pipe Segment	Length m	Proposed Pipe Diameter, mm	Unit Cost	Preliminary Cost
C10	605	300	$ 960	$ 581,000
C11	815	300	$ 960	$ 782,000
C12	407	450	$ 1,130	$ 460,000
C13	242	375	$ 1,090	$ 264,000
C14	1226	375	$ 1,090	$ 1,336,000
C15	413	300	$ 960	$ 396,000
C16	581	375	$ 1,090	$ 633,000
C17	376	375	$ 1,090	$ 410,000
C35A	755	300	$ 960	$ 725,000
C37A	218	300	$ 960	$ 209,000
Total				**$ 5,796,840**

Note: 2013 Dollars.

6.2.3 Boundary Trunk

The western portion of the City bounded by Grove Drive West, Highway 628, Jennifer Heil Way and Boundary Road, is proposed to be developed as a mix of residential and commercial land uses. The Boundary Trunk is proposed to be extended south to service seven quarter sections of future development, as shown in
Figure 6-2.

This concept assumes that the PSTS, which is presently overloaded, will be re-routed to by-pass the City on the west side, leaving the existing trunk along Grove Drive to service the local area. The existing trunk does not have enough capacity for the entire service area and will need to be twinned or replaced with a 750 mm pipe before the final three quarter sections (G1, G2, and G3) are developed.

Flows should be monitored in the downstream portion of this trunk as the basin develops, to confirm the capacity of this trunk to service the remainder of this basin and to confirm the schedule for upgrading the downstream portion.

A summary of future pipe sizes and preliminary cost for Boundary Trunk is provided in **Table 6-4**.

Table 6-4
Future Sanitary Sewer for Boundary Trunk

Pipe Segment	Length, m	Proposed Pipe Diameter, mm	Unit Cost	Preliminary Cost
C19	449	375	$ 1,090	$ 489,000
C20	497	375	$ 1,090	$ 542,000
C21	844	450	$ 1,130	$ 954,000
C22	903	525	$ 1,130	$1,020,000
C23	397	525	$ 1,130	$ 449,000
C44	689	525	$ 1,130	$ 779,000
P-MH-1255	150	750	$ 2,820	$ 423,000
P-MH-1254	150	750	$ 2,820	$ 423,000
P-MH-1253	150	750	$ 2,820	$ 423,000
P-MH-1252	150	750	$ 2,820	$ 423,000
P-MH-1251	51	750	$ 2,820	$ 144,000
P-MH-1250	152	750	$ 2,820	$ 429,000
Total				**$6,498,000**

Note: 2013 Dollars.

Appendix C

Excerpts from Stormwater Master Plan Update

Stormwater Master Plan Update, 2015– *Associated Engineering*

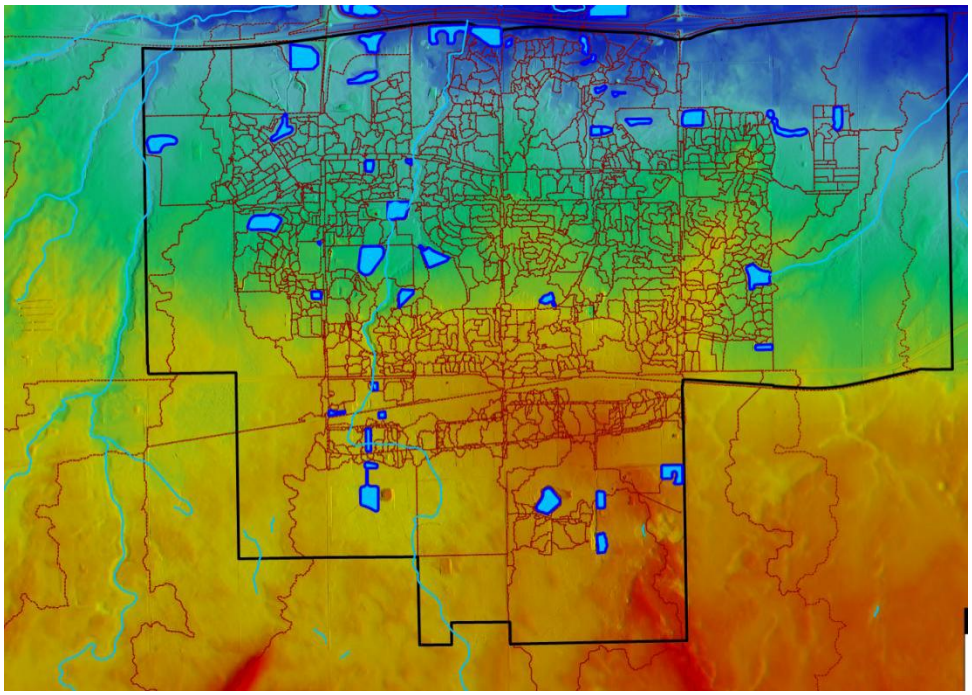
Al-Terra

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

REPORT

City of Spruce Grove

Stormwater Master Plan Update

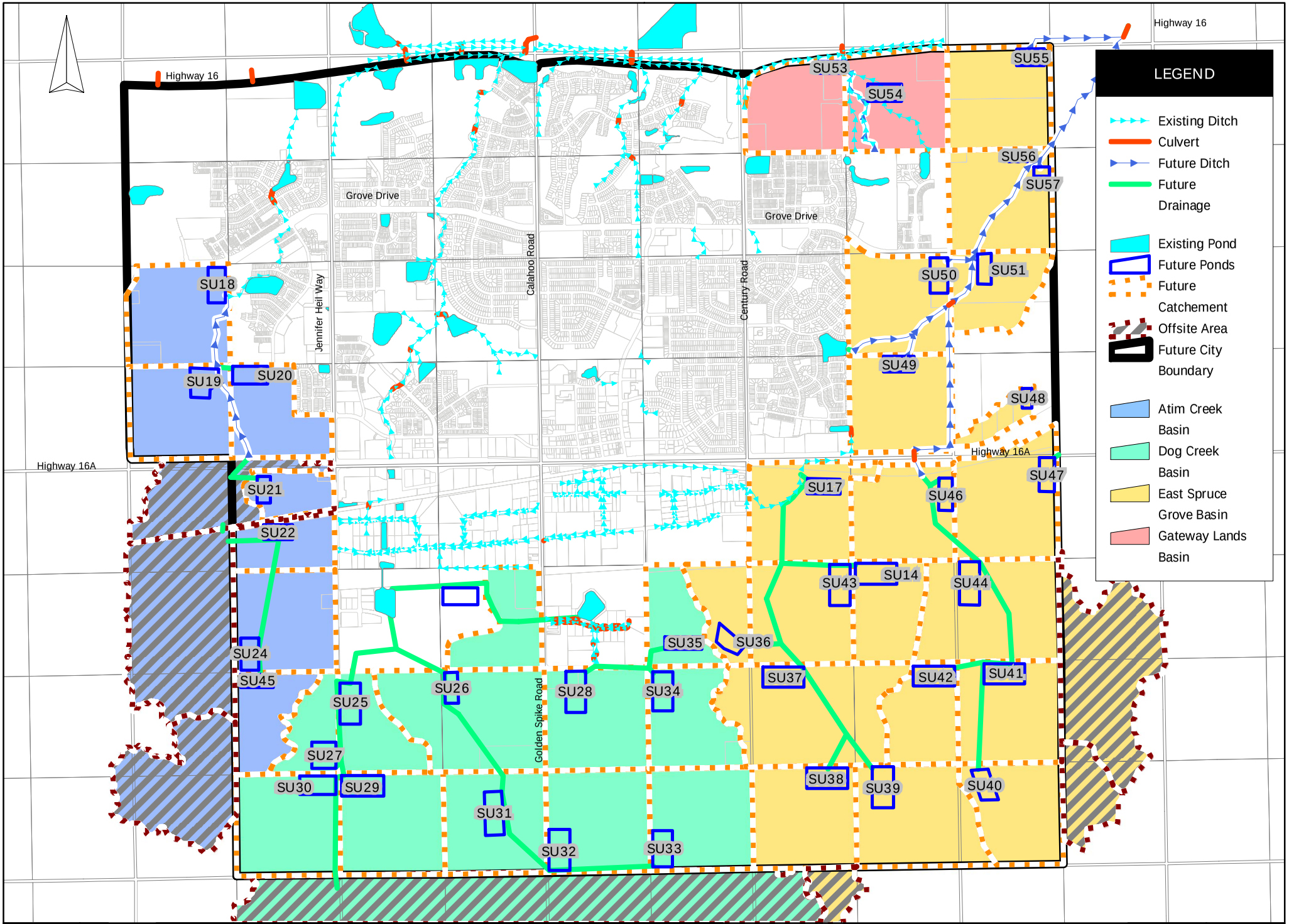


October 2015

CANADA'S BEST MANAGED COMPANIES Platinum member

Table 7-1
Summary of Future Stormwater Management Facilities

BASIN	SWMF ID	Land Use	Drainage Area (ha)	Offsite Area (ha)	Total Area (ha)	Release Rate (L/s/ha)	Peak Outflow Rate (L/s)	Storage Volume (m3)	Pond Area at Freeboard EL. (ha)	Normal Water Level (m)	High Water Level (m)	Freeboard EL. (m)
EAST SPRUCE GROVE BASIN	SU38	Industrial	65.7	16.1	81.8	2.5	203	61990	5.2	711.5	713.0	714.0
	SU39	Industrial	75.5		75.5	2.5	189	71050	5.9	712.5	714.0	715.0
	SU40	Industrial	55.7	27.3	83.0	2.5	207	52780	4.5	713.5	715.0	716.0
	SU37	Industrial (99%), Parks (1%)	102.2		102.2	2.5	256	95070	7.6	709.5	711.0	712.0
	SU42	Industrial	42.7		42.7	2.5	107	40770	3.6	711.5	713.0	714.0
	SU41	Industrial	65.6		65.6	2.5	164	61930	5.2	710.5	712.0	713.0
	SU43	Industrial	65.4		65.4	2.5	164	61740	5.2	705.5	707.0	708.0
	SU17	Commercial (10%), Industrial (91%)	66.3		66.3	2.5	166	63240	5.3	700.0	701.5	702.5
	SU57	Residential	28.6		28.6	2.5	72	30440	2.8	671.0	672.5	673.5
	SU49	Residential (90%), Commercial (10%)	62.3		62.3	2.5	156	45420	3.9	687.5	689.0	690.0
	SU48	Residential	12.8		12.8	2.5	32	8990	1.0	691.5	693.0	694.0
	SU50	Residential (96%), Parks (4%)	64.5		64.5	2.5	161	43950	3.8	683.5	685.0	686.0
	SU51	Residential	42.8		42.8	2.5	107	29860	2.7	680.5	682.0	683.0
	SU46	Commercial (8%), Industrial (92%)	59.5		59.5	2.5	149	56580	4.8	699.5	701.0	702.0
	SU47	Commercial (5%), Industrial (90%), Parks (5%)	72.4		72.4	2.5	182	66290	5.5	697.5	699.0	700.0
	SU14	Industrial	43.6		43.6	2.5	109	41610	3.6	706.5	708.0	709.0
	SU56	Residential (97%), Parks (3%)	37.3		37.3	2.5	93	26390	2.5	671.5	673.0	674.0
	SU44	Industrial	87.5	96.4	183.9	2.5	459	82110	6.7	706.5	708.0	709.0
	SU55	Residential	65.6		65.6	2.5	164	45700	3.9	664.5	666.0	667.0
	SU36	Industrial (94%), Parks (6%)	30.4		30.4	2.5	76	27560	2.5	708.5	710.0	711.0
GATEWAY LANDS BASIN	SU53	Residential (50%), Commercial (50%)	54.6		54.6	2.5	137	48220	4.1	668.5	670.0	671.0
	SU54	Residential	63.3		63.3	2.5	158	44100	3.8	669.5	671.0	672.0
DOG CREEK BASIN	SU34	Industrial (94%), Parks (6%)	52.0		52.0	1.8	94	47370	4.1	708.5	710.0	711.0
	SU33	Industrial	65.4		65.4	2.5	118	61720	5.2	711.5	713.0	714.0
	SU35	Industrial (96%), Parks (5%)	35.3		35.3	2.5	63	32820	3.0	708.5	710.0	711.0
	SU32	Industrial	65.7		65.7	1.8	118	64020	5.3	705.5	707.0	708.0
	SU28	Industrial	65.8		65.8	1.8	118	64100	5.3	707.5	709.0	710.0
	SU31	Industrial	65.1		65.1	1.8	117	63490	5.3	704.5	706.0	707.0
	SU26	Industrial	92.4		92.4	1.8	166	90010	7.2	701.0	702.5	703.5
	SU29	Industrial	66.4		66.4	1.8	120	64730	5.4	703.5	705.0	706.0
	SU25	Industrial	38.9		38.9	2.5	70	36830	3.3	702.5	704.0	705.0
	SU30	Residential	65.7	5.5	71.2	2.5	128	45880	4.0	704.5	706.0	707.0
	SU27	Residential	28.6		28.6	2.5	51	20040	1.9	703.5	705.0	706.0
ATIM CREEK (WEST) BA	SU45	Residential	37.0	75.8	112.9	2.5	282	26810	2.5	700.0	701.5	702.5
	SU24	Residential (98%), Parks (2%)	64.6		64.6	2.5	161	44570	3.9	700.0	701.5	702.5
	SU21	Commercial (96%), Industrial (1%), Parks (3%)	22.3		22.3	2.5	56	23140	2.2	699.0	700.5	701.5
	SU20	Residential (42%), Commercial (58%)	46.5		46.5	2.5	116	41790	3.7	692.5	694.0	695.0
	SU19	Residential (56%), Commercial (44%)	59.0		59.0	2.5	147	51500	4.4	692.5	694.0	695.0
	SU18	Residential (94%), Commercial (6%)	63.2		63.2	2.5	158	45440	3.9	686.5	688.0	689.0
	SU22	Residential (41%), Commercial (58%), Industrial (1%)	31.6		31.6	2.5	79	28540	2.6	700.5	702.0	703.0



No.	REVISION	DATE	(Name) (Date)	Associated Engineering	The City of SPRUCE GROVE	CITY OF SPRUCE GROVE STORMWATER MASTER PLAN FIGURE 7-1 : FUTURE DRAINAGE CONCEPT	PROJECT No.: 20143039 DATE: 10/6/2015 SCALE: 1 : 25,000 PROJECTION: 10TM 115

7.2 ATIM CREEK (WEST SPRUCE GROVE) BASIN

The West Spruce Grove Basin lies along the western edge of the City. Future development in this basin is primarily residential.

Seven additional SWMFs are planned for the future development. Four are located to the south of Highway 16A and will drain westward to an existing wetland located in Stony Plain This wetland drains to the North of Highway 16A to an existing ditch which bypasses the Spruce Ridge SWMF, flows through the Harvest Ridge neighbourhood, and discharges to the Harvest Ridge offsite SWMF and then to Atim Creek through a 900 mm culvert across Highway 16.

The Harvest Ridge offsite SWMF was not designed for a partial quarter section to the west. Existing topography suggests that this area could be drained to the offsite SWMF with minor changes to the facility.

This basin includes an offsite area of 195 ha that lies within the Town of Stony Plain. The offsite area will discharge through the City and their development will have to be coordinated with the City. Releases from the existing wetland will need to be included in the design flows through the City. The drainage course through Spruce grove may need to be lowered to facilitate development of these offsite areas.

7.3 DOG CREEK BASIN

The Dog Creek Basin within Spruce Grove currently contains approximately 415 ha of undeveloped land The City boundary is anticipated to be extended to Highway 628 in future which will add 6.5 quarter-sections or 423 ha to the basin area within Spruce Grove. Land use will mostly be industrial except for 100 ha in the southwest corner which is proposed to be Residential.

The basin will have three tributary drainage systems from the south, south east, and the east. Dog Creek upstream catchment will drain to the tributaries from the south and south east. The three tributaries are proposed to tie into the East Campsite Road Industrial SWMF which discharges to the Madison Industrial SWMF and ultimately to Dog Creek through Spruce Grove.

Dog Creek flows through the City and has flooded in the past. The main concern in this basin is the offsite flow from the south of Spruce Grove which could overload the culverts at the CNR and Highway 16A and flood low-lying areas of the Madison Industrial. However, as mentioned previously in the report, there is considerable uncertainty as to the magnitude of the flows that are generated in this offsite area and discharge through Spruce Grove.

The catchment area of Dog Creek was discussed previously in this report and shown in **Figure 4-8**. According to the LiDAR data available for this study the catchment area upstream of the CNR is 40 km^2, which includes about 18 km^2 to the west of Campsite Road. However the area to the west of Campsite Road drains to a large wetland that has no outlet. Further, there are numerous sloughs and depressions in the catchment area that store runoff and attenuate peak flows. These include a large low-lying area to the south of the Industrial area, within the City, that is perennially wet and attenuates the peak flow in the creek.

Appendix D

Excerpts from Water Master Plan Update

Water Master Plan Update, 2015 – *Select Engineering*

Al-Terra

CITY OF SPRUCE GROVE

WATER MASTER PLAN UPDATE

May 2015

Prepared for: City of Spruce Grove
Presented by: Select Engineering Consultants Ltd.
Date: June 4, 2015

RPT-02-13034-3.2-SpruceGroveWDSA-150507

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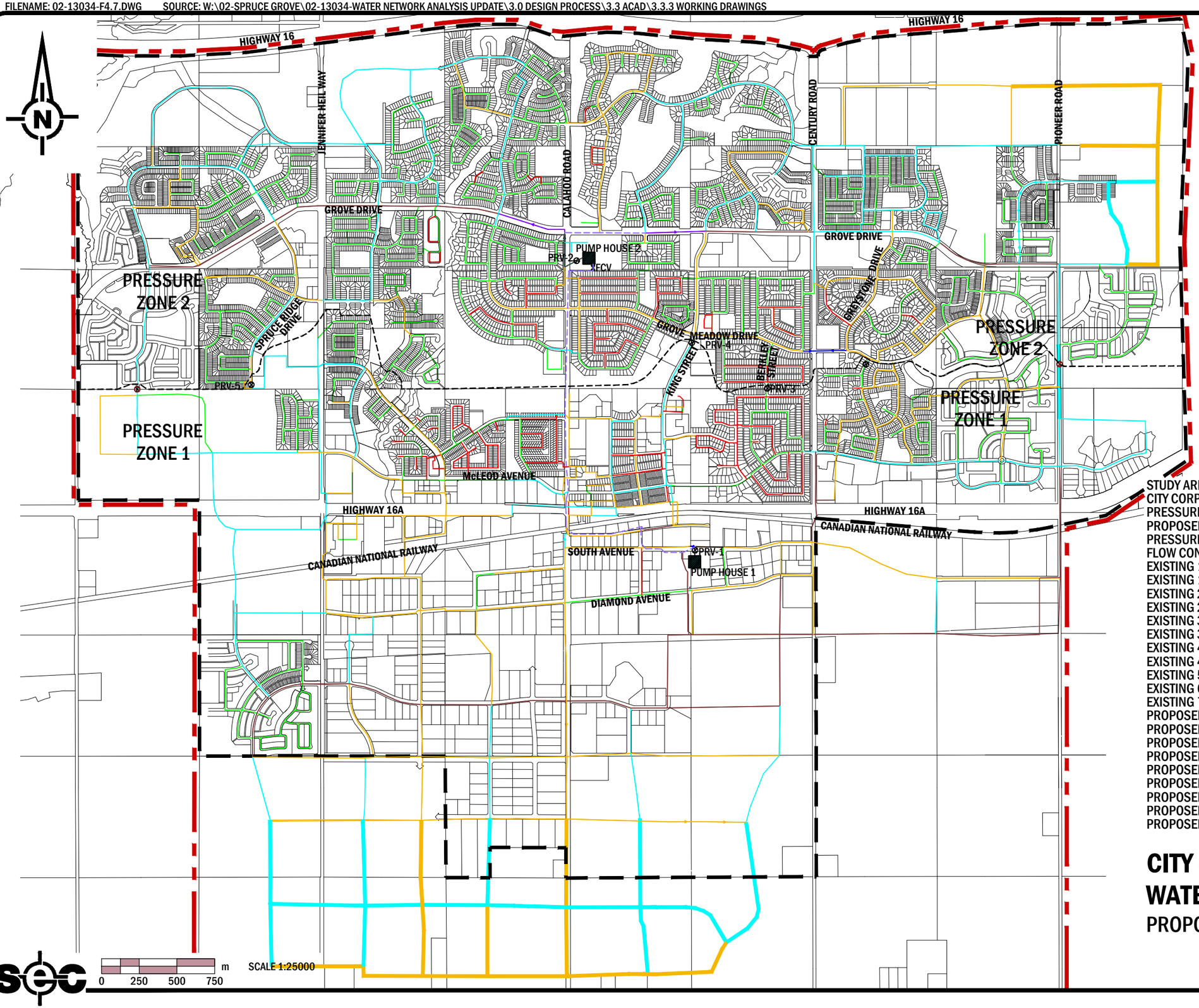


LEGEND

- STUDY AREA BOUNDARY
- CITY CORPORATE LIMITS
- PRESSURE ZONE BOUNDARY
- PROPOSED PRESSURE REDUCE VALVE, PRV
- PRESSURE REDUCE VALVE, PRV
- FLOW CONTROL VALVE, FCV
- EXISTING 100mm WATERMAIN
- EXISTING 150mm WATERMAIN
- EXISTING 200mm WATERMAIN
- EXISTING 250mm WATERMAIN
- EXISTING 300mm WATERMAIN
- EXISTING 350mm WATERMAIN
- EXISTING 400mm WATERMAIN
- EXISTING 450mm WATERMAIN
- EXISTING 500mm WATERMAIN
- EXISTING 600mm WATERMAIN
- EXISTING 750mm WATERMAIN
- PROPOSED 200mm WATERMAIN
- PROPOSED 250mm WATERMAIN
- PROPOSED 300mm WATERMAIN
- PROPOSED 350mm WATERMAIN
- PROPOSED 400mm WATERMAIN
- PROPOSED 450mm WATERMAIN
- PROPOSED 500mm WATERMAIN
- PROPOSED 600mm WATERMAIN
- PROPOSED 750mm WATERMAIN

CITY OF SPRUCE GROVE
WATER MASTER PLAN UPDATE
PROPOSED ULTIMATE WATER SYSTEM

0 250 500 750 m

SCALE 1:25000

FIGURE 4.7

SAVED BY: KDANIELS PLOT DATE: May 28, 2015

Appendix E

Excerpts from West Central Area Structure Plan

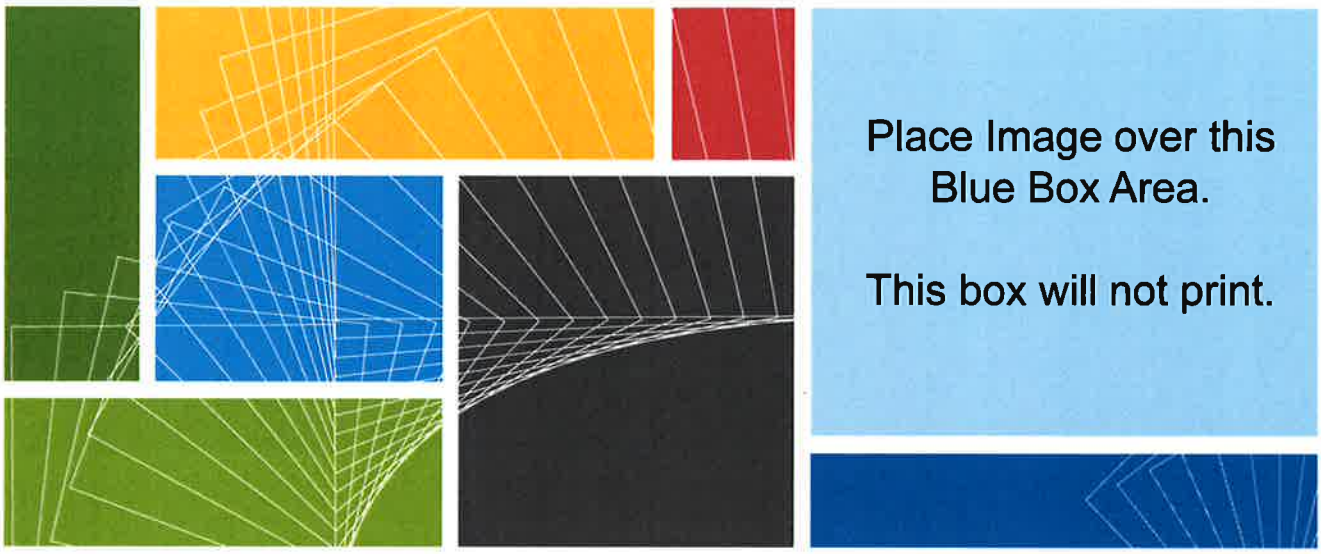
Traffic Impact Assessment, 2017 – *ISL Engineering*

Al-Terra

ISL Engineering and Land Services

Inspiring sustainable thinking

30 ANNIVERSARY 1987–2017



City of Spruce Grove

Draft Report

West Central Area Structure Plan Amendment
Traffic Impact Assessment

August 2017

1. The trail system will provide good service for cyclists and pedestrians making trips between the residential areas to the north and the commercial areas to the south. Given the short distances between these uses both walking and cycling trips are viable and need to be encouraged. There are five north/south trails that provide this service:
   a. Along Boundary Road
   b. Along the north/south collector in the east area of the ASP
   c. Along Spruce Ridge Road
   d. Along the school/park site on the west side of Legacy Park
   e. Along Jennifer Heil Way
2. Trips along the above north/south trails will be re-distributed along the McLeod Avenue trail, giving cyclists and pedestrians a safer route to "zig-zag" between the residential and commercial uses.
3. There are two north/south trails through the commercial area that are "potential" trails. These are potential should the City desire them and they can be accommodated on the commercial sites. They will connect through to the Hwy 16A trail, allowing users along Hwy 16A easier access to the commercial area and to the residential areas further north.
4. The five north/south trails will cross McLeod Avenue, which is expected to be a busy collector road. In addition, McLeod Avenue's tangent alignment will encourage higher speeds. Therefore the crossings should be designed to manage speeds such that, in the event of a collision, severe injury or fatality is highly unlikely. The following section provides a framework to guide the design.

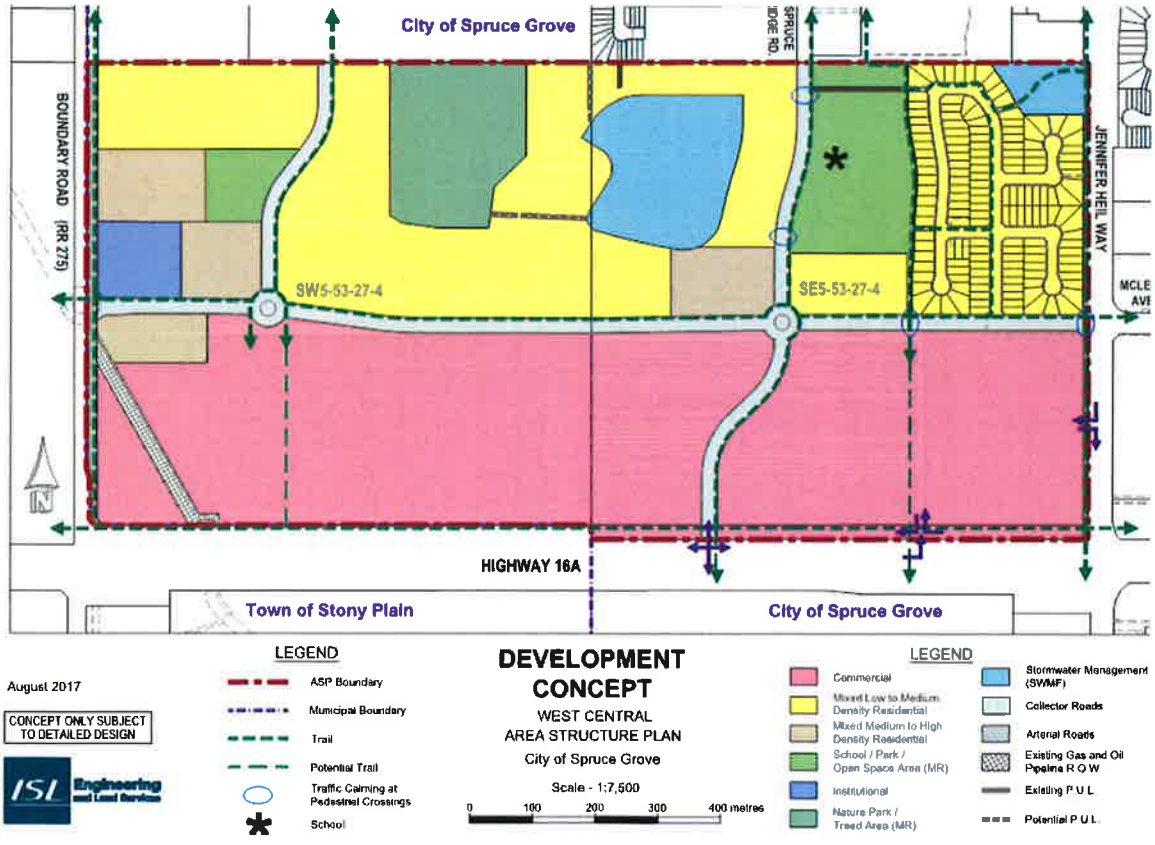


Figure 5.3: Development Concept

7.0 Conclusions and Recommendations

7.1 Conclusions

1. Trip reductions can be applied due to the area having a significant amount of residential and commercial development. 20% of all trips generated are expected to be from inside the ASP boundary.
2. For existing traffic all delays and v/c ratios fall within the typical thresholds. There are no existing deficiencies at the two intersections on Jennifer Heil Way.
3. The lane configurations shown in Appendix D will accommodate the traffic generated from the ASP as well as the background traffic at the 2040 horizon.
4. The City's TMP identifies future bus routes in the ASP, but the City is also conducting a regional transit study and the routes are subject to change.
5. A Safe System approach will greatly reduce risks of fatal and serious injury crashes.

7.2 Recommendations

1. The intersections should be built out to the lane configurations shown in Appendix D.
2. As a strategy to allow maximum flexibility to the City, ISL recommends that the West Central ASP identify all collector roads as being potential bus routes. Bus stops can be installed at subdivision or even later, as necessary and as determined by the City.
3. A safe system approach should be followed on pedestrian crossings to achieve a target speed of 30 km/h:
   a. Across McLeod Avenue west of Legacy Park, use a raised cross walk.
   b. Across McLeod Avenue on the west side of Jennifer Heil Way, use appropriate curb radii and if necessary, a raised crosswalk.
   c. Along Spruce Ridge Road in front of the school site, use raised crosswalks lined up with intersections on the west side, or with the school site if determined.
4. A safe system approach should be followed for right angle collisions:
   a. Use protected-only left turn phasing for all left turn movements across Highway 16A
   b. Reduce the posted speed to 60 km/h as new intersections are created on Highway 16A, and introduce Red Light cameras at these intersections.
5. A safe system approach should be followed for left turns on Highway 16 A. Protected-only phasing should be used for left turns to ensure that the potential of a left-turning vehicle colliding with an opposing through vehicle at a high-speed is completely eliminated.
6. A TIA should be completed for each subdivision phase for this ASP to determine the impacts specific to the subdivision boundary. The results should be consistent with the overall ASP TIA, and should be consistent with the Grove Drive Functional Study.

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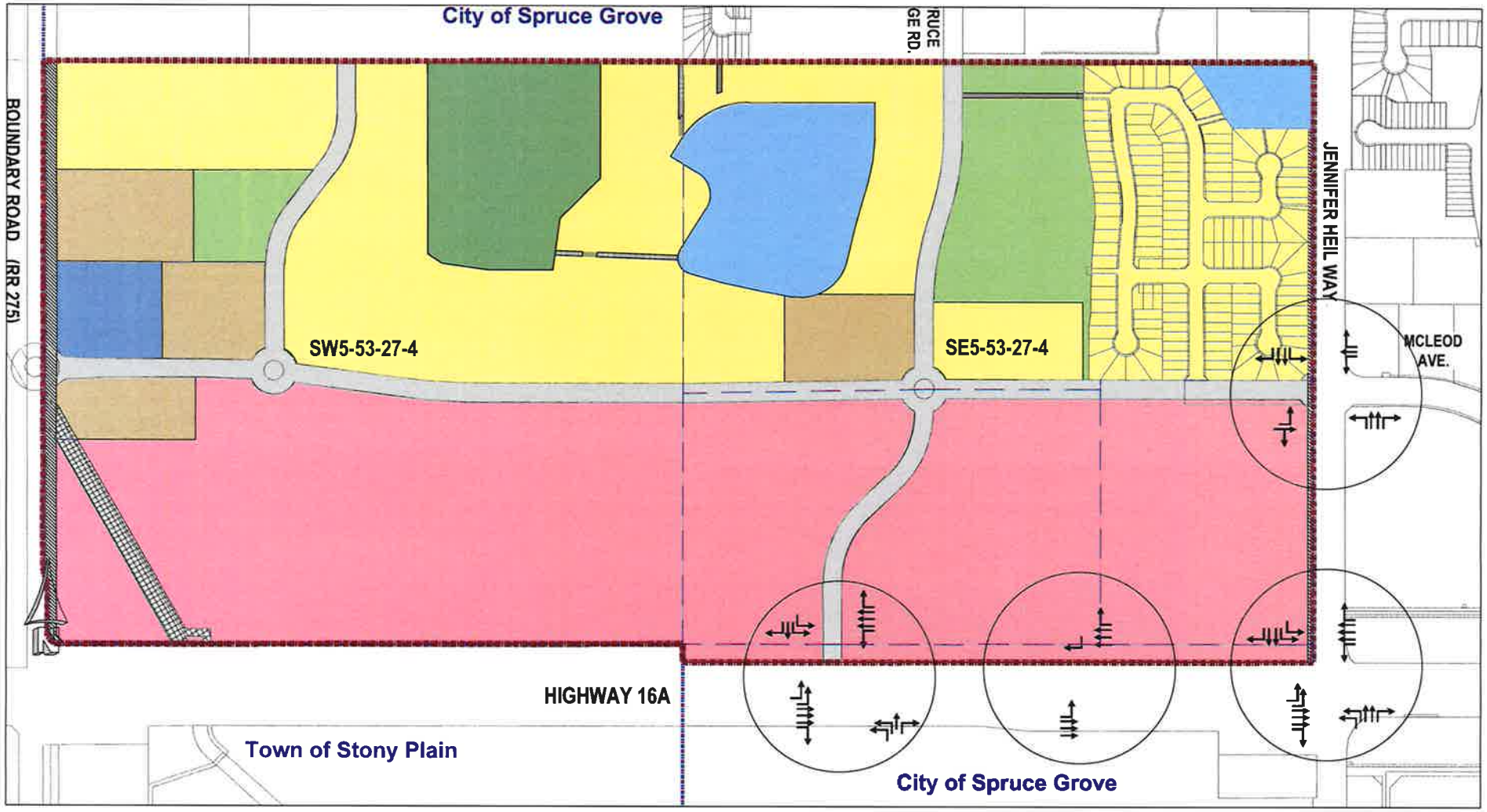

LEGEND

ASP Boundary

August 2017

CONCEPT ONLY SUBJECT TO DETAILED DESIGN

ISL Engineering and Land Services

FUTURE LANE CONFIGURATION

WEST CENTRAL
AREA STRUCTURE PLAN
City of Spruce Grove

Scale - 1:7,500

0 100 200 300 400 metres

LEGEND

- Commercial
- Mixed Low to Medium Density Residential
- Mixed Medium to High Density Residential
- School / Park / Open Space Area (MR)
- Institutional
- Nature Park / Treed Area (MR)
- Stormwater Management (SWMF)
- Collector Roads
- Arterial Roads
- Existing Gas and Oil Pipeline R.O.W.
- Existing P.U.L.
- Potential P.U.L.

FIGURE 3

Appendix F

Excerpts from West Central Area Structure Plan

Wastewater Servicing, 2017 – *ISL Engineering*

Al-Terra

ISL Engineering and Land Services

Inspiring sustainable thinking

30 ANNIVERSARY 1987–2017

City of Spruce Grove

Draft Report

West Central ASP
Wastewater Servicing

August 2017

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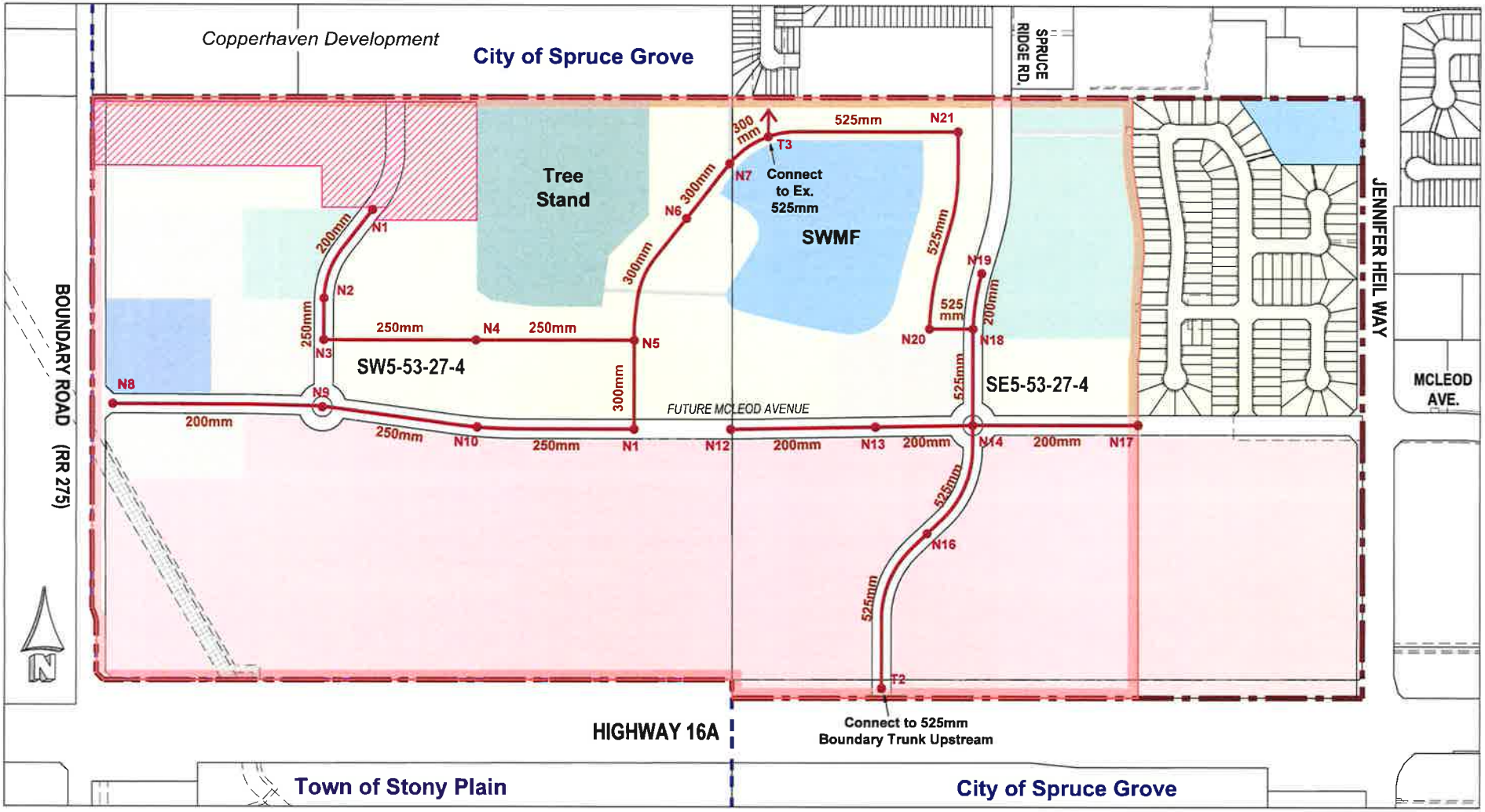


OVERALL WASTEWATER SERVICING CONCEPT

WEST CENTRAL
AREA STRUCTURE PLAN

City of Spruce Grove

Scale - 1:7,500

0 100 200 300 400 metres

LEGEND

- Proposed Wastewater Pipes
- Servicing Boundary
- Low Lying Area Potentially Serviced Through Copperhaven Development
- ASP Boundary
- Municipal Boundary

CONCEPT ONLY SUBJECT TO DETAILED DESIGN

ISL Engineering and Land Services

August 2017

FIGURE 4.1

Sanitary Flow Calculations

Project No.: 14970
Project Name: West Central ASP - Wastewater Servicing Report
Client: Wind Dancer Properties
Completed by: Sophia Lu
Checked by: Angela Steward
Date: 04-Aug-17

ISL Engineering and Land Services

		Residential Peak DWF								Residential Peak DWF (Medium to High Density)								Non-Residential Flows										I/I					Other Flows			Design Flows	
																		Highway Commercial Area				Institutional				Non-Res Peak DWF											
U/S MH	D/S MH	Existing Area (ha)	Future Area (ha)	Cummulative Existing Area (ha)	Cummulative Future Area (ha)	Cummlative Design Pop (persons)	Cummul-ative Average Flow (L/s)	Peaking Factor	Cummula-tive Peak Flow (L/s)	Existing Area (ha)	Future Area (ha)	Cummulative Existing Area (ha)	Cummulative Future Area (ha)	Cummlative Design Pop (persons)	Cummul-ative Average Flow (L/s)	Peaking Factor	Cummula-tive Peak Flow (L/s)	Existing Area (ha)	Future Area (ha)	Cummula-tive Total Hwy Commercial Area (ha)	Cummula-tive Average Flow (L/s)	Existing Area (ha)	Future Area (ha)	Cummula-tive Total Institutional Area (ha)	Cummula-tive Average Flow (L/s)	Total Average Non-Res Flow (L/s)	Peaking Factor	Cummula-tive Peak Flow (L/s)	Total Area (ha)	I/I Allowance (L/s)	Sag Manhole (YES/NO)	Sag Manhole I/I (L/s)	Cummula-tive Total I/I Allowance (L/s)	Description	Flow Allowance (L/s)	Cummula-tive Flow Allowance (L/s)	Cummulative Total Peak Flow (L/s)	**Qdesign (1.2*peak flow) (L/s)**
N1	N2		9.07	0.00	9.07	762	2.6	**3.5**	9.3		1.98	0.00	1.98	293	1.0	**3.5**	3.6			0	0.0			0.00	0.0	0.0	**3.5**	0.0	11.05	3.1		0.0	3.1			0	16	**19**
N2	N3			0.00	9.07	762	2.6	**3.5**	9.3		1.57	0.00	3.55	525	1.8	**3.5**	6.4			0	0.0		1.62	1.62	0.3	0.3	**3.5**	1.1	3.19	0.9		0.0	4.0			0	21	**25**
N3	N4		1.49	0.00	10.56	887	3.1	**3.5**	10.8			0.00	3.55	525	1.8	**3.5**	6.4			0	0.0			1.62	0.3	0.3	**3.5**	1.1	1.49	0.4		0.0	4.4			0	23	**27**
N4	N5		2.88	0.00	13.44	1129	3.9	**3.5**	13.7			0.00	3.55	525	1.8	**3.5**	6.4			0	0.0			1.62	0.3	0.3	**3.5**	1.1	2.88	0.8		0.0	5.2			0	26	**32**
N8	N9			0.00	0.00	0	0.0	**3.5**	0.0		1.37	0.00	1.37	203	0.7	**3.5**	2.5		7.73	8	1.5			0.00	0.0	1.5	**3.5**	5.4	9.10	2.5		0.0	2.5			0	10	**13**
N9	N10			0.00	0.00	0	0.0	**3.5**	0.0			0.00	1.37	203	0.7	**3.5**	2.5		6.18	14	2.8			0.00	0.0	2.8	**3.5**	9.7	6.18	1.7		0.0	4.3			0	16	**20**
N10	N11			0.00	0.00	0	0.0	**3.5**	0.0			0.00	1.37	203	0.7	**3.5**	2.5		6.09	20	4.0			0.00	0.0	4.0	**3.5**	14.0	6.09	1.7		0.0	6.0			0	22	**27**
N11	N5		3.33	0.00	3.33	280	1.0	**3.5**	3.4			0.00	1.37	203	0.7	**3.5**	2.5			20	4.0			0.00	0.0	4.0	**3.5**	14.0	3.33	0.9		0.0	6.9			0	27	**32**
				0.00	16.77	1409						0.00	4.92	728						20.00				1.62									12.13					
N5	N6			0.00	16.77	1409	4.9	**3.5**	17.1			0.00	4.92	728	2.5	**3.5**	8.8			20	4.0			1.62	0.3	4.3	**3.5**	15.1	0.00	0.0		0.0	12.1			0	53	**64**
N6	N7		3.34	0.00	20.11	1689	5.9	**3.5**	20.5			0.00	4.92	728	2.5	**3.5**	8.8			20	4.0			1.62	0.3	4.3	**3.5**	15.1	3.34	0.9		0.0	13.1			0	58	**69**
N7	T3			0.00	20.11	1689	5.9	**3.5**	20.5			0.00	4.92	728	2.5	**3.5**	8.8			20	4.0			1.62	0.3	4.3	**3.5**	15.1	0.00	0.0		0.0	13.1			0	58	**69**
T2	N15																																					
N15	N16			0.00	0.00	0	0.0	**3.5**	0.0			0.00	0.00	0	0.0	**3.5**	0.0		10.65	11	2.1			0.00	0.0	2.1	**3.5**	7.5	10.65	3.0		0.0	3.0		217	217	227	**273**
N16	N14			0.00	0.00	0	0.0	**3.5**	0.0			0.00	0.00	0	0.0	**3.5**	0.0			11	2.1			0.00	0.0	2.1	**3.5**	7.5	0.00	0.0		0.0	3.0			217	227	**273**
								3.5																														
N12	N13			0.00	0.00	0	0.0	**3.5**	0.0			0.00	0.00	0	0.0	**3.5**	0.0		5.93	6	1.2			0.00	0.0	1.2	**3.5**	4.2	5.93	1.7		0.0	1.7			0	6	**7**
N13	N14			0.00	0.00	0	0.0	**3.5**	0.0		1.76	0.00	1.76	260	0.9	**3.5**	3.2			6	1.2			0.00	0.0	1.2	**3.5**	4.2	1.76	0.5		0.0	2.2			0	9	**11**
N17	N14		1.83	0.00	1.83	154	0.5	**3.5**	1.9			0.00	0.00	0	0.0	**3.5**	0.0			0	0.0			0.00	0.0	0.0	**3.5**	0.0	1.83	0.5		0.0	0.5			0	2	**3**
				0.00	1.83	154						0.00	1.76	260						16.58				0.00									5.65					
N14	N18			0.00	1.83	154	0.5	**3.5**	1.9			0.00	1.76	260	0.9	**3.5**	3.2		3.74	20	4.1			0.00	0.0	4.1	**3.5**	14.2	3.74	1.0		0.0	6.7		217	217	243	**292**
N19	N18			0.00	0.00	0	0.0	**3.5**	0.0			0.00	0.00	0	0.0	**3.5**	0.0			0	0.0		2.87	2.87	0.6	0.6	**3.5**	2.0	2.87	0.8		0.0	0.8			0	3	**3**
				0.00	1.83	154						0.00	1.76	260						20.32				2.87									7.50					
N18	N20			0.00	1.83	154	0.5	**3.5**	1.9			0.00	1.76	260	0.9	**3.5**	3.2			20	4.1			2.87	0.6	4.6	**3.5**	16.2	0.00	0.0		0.0	7.5		217	217	246	**295**
N20	N21		2.17	0.00	4.00	336	1.2	**3.5**	4.1			0.00	1.76	260	0.9	**3.5**	3.2			20	4.1			2.87	0.6	4.6	**3.5**	16.2	2.17	0.6		0.0	8.1			217	249	**298**
N21	T3		1.58	0.00	5.58	469	1.6	**3.5**	5.7			0.00	1.76	260	0.9	**3.5**	3.2			20	4.1			2.87	0.6	4.6	**3.5**	16.2	1.58	0.4		0.0	8.5			217	251	**301**
				0.00	5.58	469	1.6	**3.5**	5.7			0.00	1.76	260	0.9	**3.5**	3.2			20	4.1			2.87	0.6	4.6	**3.5**	16.2	0.00	0.0		0.0	8.5			217	251	**301**
				0.00	5.58	469	1.6	**3.5**	5.7			0.00	1.76	260	0.9	**3.5**	3.2			20	4.1			2.87	0.6	4.6	**3.5**	16.2	0.00	0.0		0.0	8.5			217	251	**301**

Legacy Park Existing System Capacity Check:

		Residential Peak DWF								Residential Peak DWF (Medium to High Density)								Non-Residential Flows										I/I					Other Flows			Design Flows	
																		Highway Commercial Area				Institutional				Non-Res Peak DWF											
U/S MH	D/S MH	Existing Area (ha)	Future Area (ha)	Cummulative Existing Area (ha)	Cummulative Future Area (ha)	Cummlative Design Pop (persons)	Cummul-ative Average Flow (L/s)	Peaking Factor	Cummula-tive Peak Flow (L/s)	Existing Area (ha)	Future Area (ha)	Cummulative Existing Area (ha)	Cummulative Future Area (ha)	Cummlative Design Pop (persons)	Cummul-ative Average Flow (L/s)	Peaking Factor	Cummula-tive Peak Flow (L/s)	Existing Area (ha)	Future Area (ha)	Cummula-tive Total Hwy Commercial Area (ha)	Cummula-tive Average Flow (L/s)	Existing Area (ha)	Future Area (ha)	Cummula-tive Total Institutional Area (ha)	Cummula-tive Average Flow (L/s)	Total Average Non-Res Flow (L/s)	Peaking Factor	Cummula-tive Peak Flow (L/s)	Total Area (ha)	I/I Allowance (L/s)	Sag Manhole (YES/NO)	Sag Manhole I/I (L/s)	Cummula-tive Total I/I Allowance (L/s)	Description	Flow Allowance (L/s)	Cummula-tive Flow Allowance (L/s)	Cummulative Total Peak Flow (L/s)	**Qdesign (1.2*peak flow) (L/s)**
Comm. Stub (1)	2			0.00	0.00	0	0.0	**3.5**	0.0			0.00	0.00	0	0.0	**3.5**	0.0			0	0.0			0.00	0.0	0.0	**3.5**	0.0	0.00	0.0		0.0	0.0			0	0	**0**
2	3		4.00	0.00	4.00	154	0.5	**3.5**	1.9			0.00	0.00	0	0.0	**3.5**	0.0		8.7	9	1.7			0.00	0.0	1.7	**3.5**	6.1	12.70	3.6		0.0	3.8			0	12	**14**
3	4		3.00	0.00	7.00	294	1.0	**3.5**	3.6			0.00	0.00	0	0.0	**3.5**	0.0			9	1.7			0.00	0.0	1.7	**3.5**	6.1	3.00	0.8		0.0	4.4			0	14	**17**
4	5			0.00	7.00	294	1.0	**3.5**	3.6			0.00	0.00	0	0.0	**3.5**	0.0			9	1.7			0.00	0.0	1.7	**3.5**	6.1	0.00	0.0		0.0	4.4			0	14	**17**
5	6		3.00	0.00	10.00	423	1.5	**3.5**	5.1			0.00	0.00	0	0.0	**3.5**	0.0			9	1.7			0.00	0.0	1.7	**3.5**	6.1	3.00	0.8		0.0	5.2			0	16	**20**
6	7			0.00	10.00	423	1.5	**3.5**	5.1			0.00	0.00	0	0.0	**3.5**	0.0			9	1.7			0.00	0.0	1.7	**3.5**	6.1	0.00	0.0		0.0	5.2			0	16	**20**
7	8			0.00	10.00	423	1.5	**3.5**	5.1			0.00	0.00	0	0.0	**3.5**	0.0			9	1.7			0.00	0.0	1.7	**3.5**	6.1	0.00	0.0		0.0	5.2			0	16	**20**
8	9			0.00	10.00	423	1.5	**3.5**	5.1			0.00	0.00	0	0.0	**3.5**	0.0			9	1.7			0.00	0.0	1.7	**3.5**	6.1	0.00	0.0		0.0	5.2			0	16	**20**
9	10			0.00	10.00	423	1.5	**3.5**	5.1			0.00	0.00	0	0.0	**3.5**	0.0			9	1.7			0.00	0.0	1.7	**3.5**	6.1	0.00	0.0		0.0	5.2			0	16	**20**
10	11			0.00	10.00	423	1.5	**3.5**	5.1			0.00	0.00	0	0.0	**3.5**	0.0			9	1.7			0.00	0.0	1.7	**3.5**	6.1	0.00	0.0		0.0	5.2			0	16	**20**
11	12			0.00	10.00	423	1.5	**3.5**	5.1			0.00	0.00	0	0.0	**3.5**	0.0			9	1.7			0.00	0.0	1.7	**3.5**	6.1	0.00	0.0		0.0	5.2			0	16	**20**

Design Criteria

Typical Future Residential Density, low to medium (people/ha) = 84
Typical Future Residential Density, medium to high (people/ha) = 148
Residential Gen Rate (L/p/d)= 300

Highway Commercial Gen Rate (L/ha/d)= 17280
Institutional Gen Rate (L/ha/d)= 17280

Residential PF= Harmon's Formula, Max 3.5
Non-Residential Peaking Factor = 3.5

General Inflow/Infiltration Allowance (L/s/ha)= 0.28
Sag Manhole Inflow Allowance (L/s)= 0

Appendix G

Excerpts from West Central Area Structure Plan

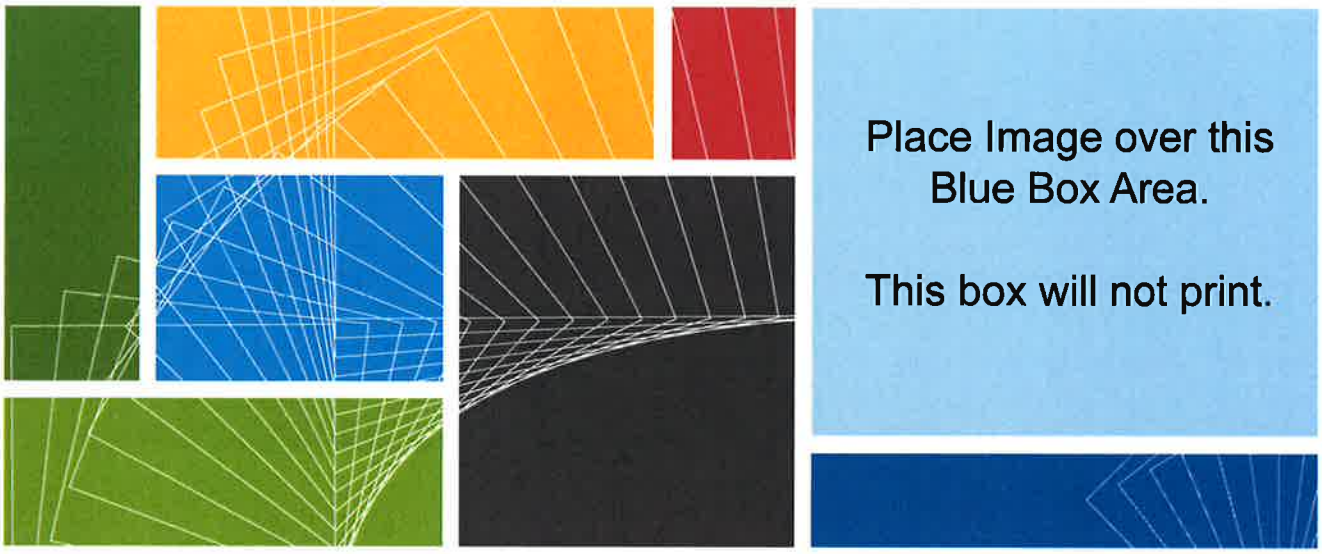
Stormwater Servicing, 2017 – *ISL Engineering*

Al-Terra

ISL Engineering and Land Services

Inspiring sustainable thinking

30 ANNIVERSARY 1987–2017



City of Spruce Grove

Draft Report

West Central ASP
Stormwater Servicing

August 2017

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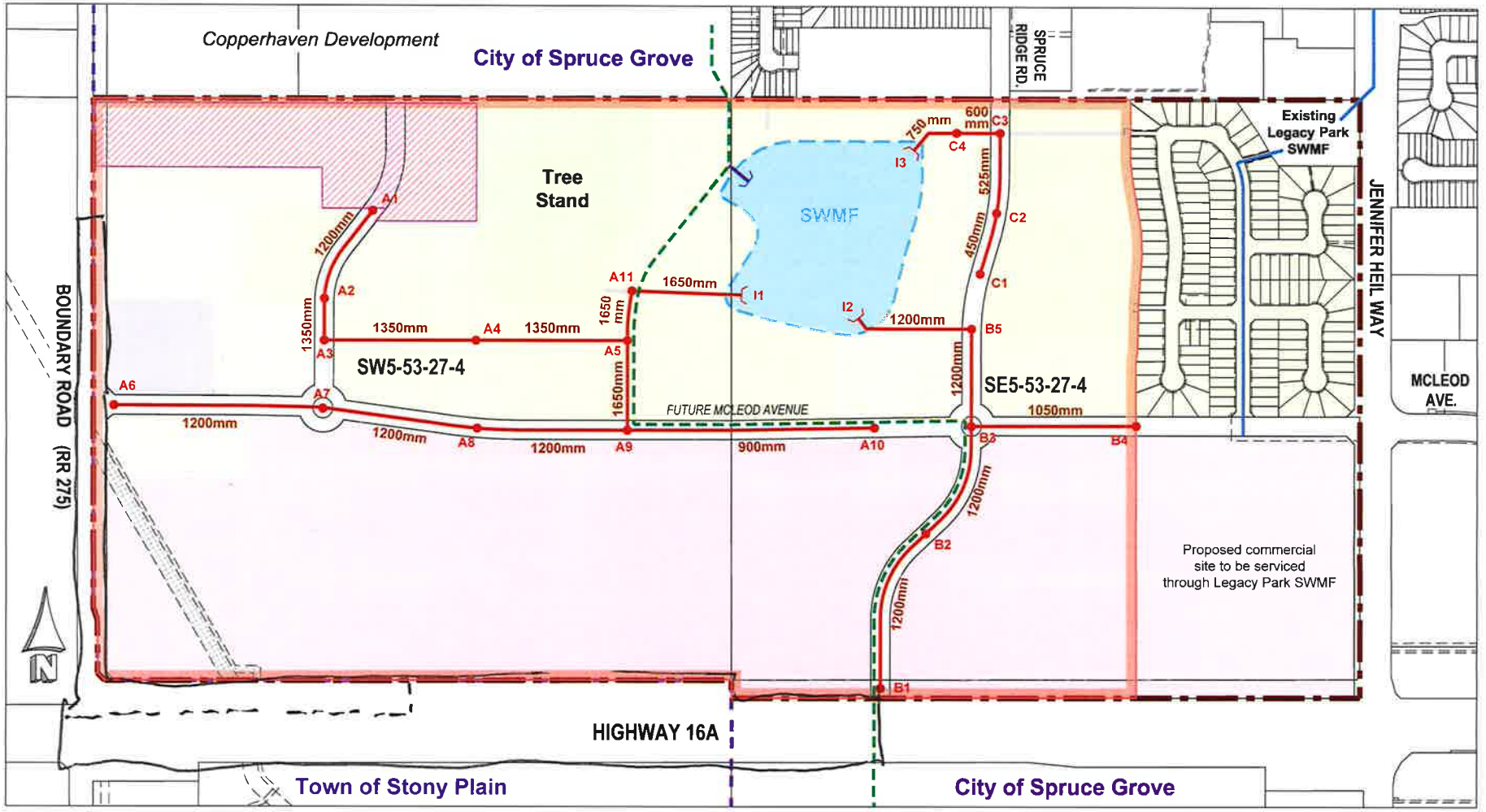

OVERALL STORMWATER MANAGEMENT CONCEPT

WEST CENTRAL
AREA STRUCTURE PLAN

City of Spruce Grove

Scale - 1:7,500

0 100 200 300 400 metres

LEGEND

- Proposed SWMF
- SWMF Catchment Boundary
- Low Lying Area Potentially Serviced Through Copperhaven Development

LEGEND

- Proposed Atim Creek Storm Trunk (1050mm)
- Proposed Storm Sewer
- Existing Storm Sewer
- SWMF Outlet (1050mm)
- ASP Boundary
- Municipal Boundary

CONCEPT ONLY SUBJECT TO DETAILED DESIGN

ISL Engineering and Land Services

August 2017

FIGURE 5.1

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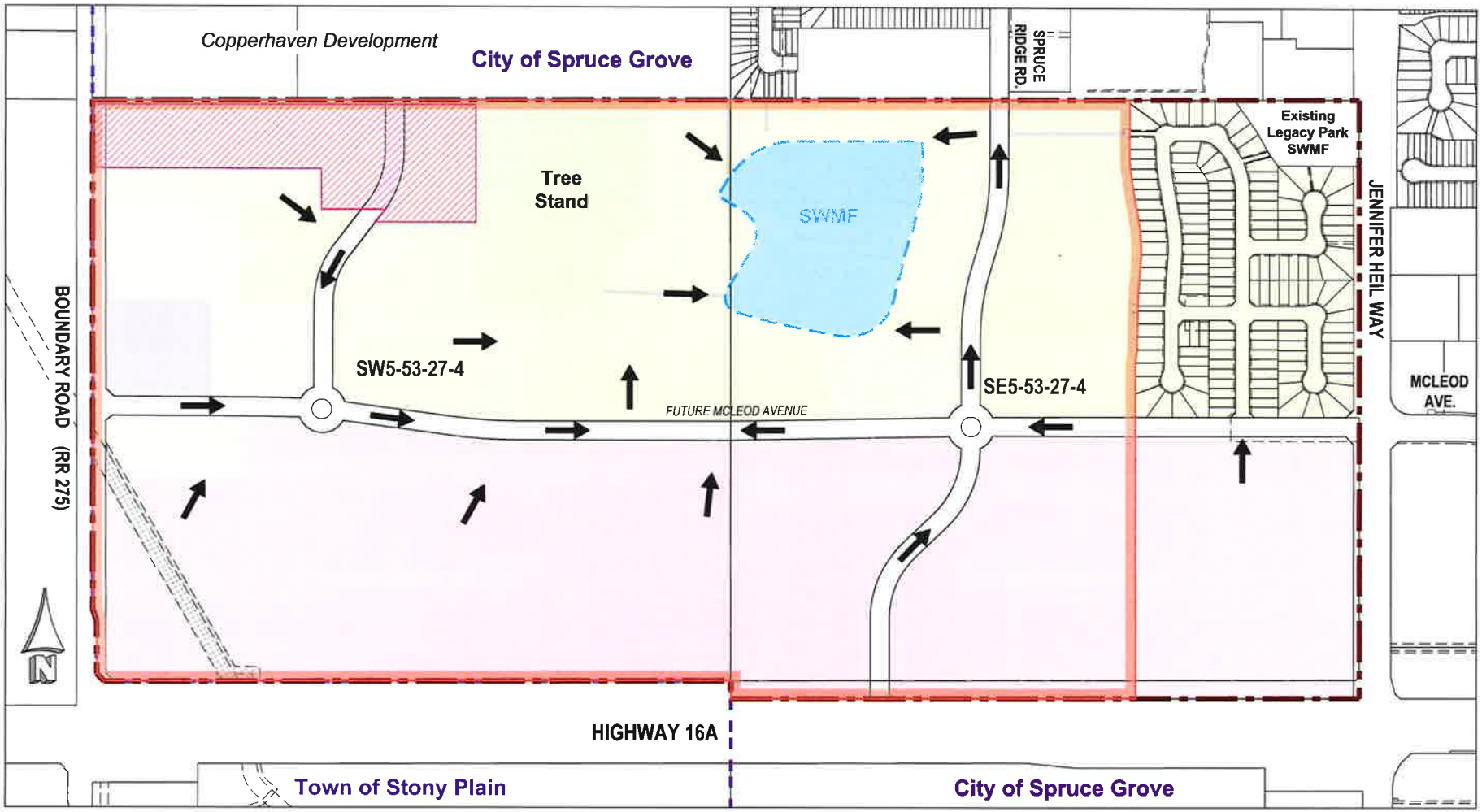


OVERLAND DRAINAGE CONCEPT

WEST CENTRAL
AREA STRUCTURE PLAN

City of Spruce Grove

Scale - 1:7,500

0 100 200 300 400 metres

LEGEND

- ASP Boundary
- Municipal Boundary

LEGEND

- Proposed Overland Drainage Route
- Proposed SWMF
- SWMF Catchment Boundary
- Low Lying Area Potentially Serviced Through Copperhaven Development

CONCEPT ONLY SUBJECT TO DETAILED DESIGN

ISL Engineering and Land Services

August 2017

FIGURE 5.2

Storm Sewer Design - Rational Method - Design Sheet

Project No.: 14970
Project Name: West Central ASP - Stormwater Management Report
Client: Wind Dancer Properties
Completed by: Sophia Lu
Checked by: Angela Steward
Date: 04-Aug-17

ISL Engineering and Land Services

Manning's n = 0.013

DESIGN FLOW CALCULATIONS																	PIPE SIZING								SEWER LAYOUT						
			AREA (ha)										A X MOD. 'C'												Ground Elevation		Invert Elevation			Depth of Cover to Obvert	
U/S MH	D/S MH	DESIGN STORM	Grass/Parks	Single Family	Duplex	Multi-family	Commercial	Pavement	Total	COMBINED 'C'	MULTIPLY C	MODIFIED 'C'	Increm. (m^2)	Accum. (m^2)	Tc (min)	INTENSITY (mm/hr)	Q_{DESIGN} (m^3/s)	PIPE DIA. (mm)	A (m^2)	Hydraulic Radius, R (m)	PIPE SLOPE (%)	$Q_{CAPACITY}$ (m^3/s)	Q_{DESIGN} / $Q_{CAPACITY}$	VELOCITY (m/s)	LENGTH (m)	U/S MH	D/S MH	U/S End	D/S End	Invert Drop Across D/S MH	U/S MH	D/S MH
																										(m)	(m)	(m)	(m)	(m)	(m)	(m)
A1	A2	5 year	1.29	9.07		1.98		0.32	12.66	0.53	1.00	0.53	6.7085	6.7085	10	67.80	1.263	1200	1.131	0.30	0.12	1.351	0.94	1.2	134.5	698	699.5	694.500	694.339		2.300	3.961
A2	A3	5 year				1.57	1.62	0.26	3.45	0.79	1.00	0.79	2.7255	9.4340	11.88	61.36	1.608	1350	1.431	0.34	0.1	1.688	0.95	1.2	54.6	699.5	700.389	694.339	694.284		3.811	4.755
A3	A4	5 year							0	0.00	1.00	0.00	0.0000	9.4340	12.65	59.15	1.550	1350	1.431	0.34	0.1	1.688	0.92	1.2	193.0	700.389	699.307	694.284	694.091		4.755	3.866
A4	A5	5 year		2.44					2.44	0.55	1.00	0.55	1.3420	10.7760	15.38	52.72	1.578	1350	1.431	0.34	0.1	1.688	0.94	1.2	198.7	699.307	698	694.091	693.892	0.3	3.866	2.758
A6	A7	5 year				1.37	7.73	0.59	9.69	0.87	1.00	0.87	8.4080	8.4080	10	67.80	1.584	1200	1.131	0.30	0.18	1.654	0.96	1.5	263.0	699.301	700.58	695.801	695.328		2.300	4.052
A7	A8	5 year						0.67	0.67	0.95	1.00	0.95	0.6365	9.0445	13.00	58.22	1.463	1200	1.131	0.30	0.18	1.654	0.88	1.5	195.6	700.58	700.914	695.328	694.976		4.052	4.738
A8	A9	5 year					6.18	0.48	6.66	0.90	1.00	0.90	6.0180	15.0625	15.23	53.04	2.219	1200	1.131	0.30	0.34	2.273	0.98	2.0	199.0	700.914	699.125	694.976	694.299	0.45	4.738	3.626
A10	A9	5 year					5.93		5.93	0.90	1.00	0.90	5.3370	5.3370	10	67.80	1.005	900	0.636	0.23	0.4	1.145	0.88	1.8	295.0	699.646	699.646	696.146	694.966	0.75	2.600	3.780
														20.3995																		
A9	A5	5 year					6.09	0.95	7.04	0.91	1.00	0.91	6.3835	26.7830	16.88	49.88	3.711	1650	2.138	0.41	0.18	3.867	0.96	1.8	112.3	699.125	698	693.849	693.647	0	3.626	2.703
														37.5590																		
A5	A11	5 year		5.26					5.26	0.55	1.00	0.55	2.8930	40.4520	18.19	47.69	5.358	1650	2.138	0.41	0.4	5.764	0.93	2.7	65.0	698	697.466	693.592	693.332		2.758	2.484
A11	Inlet 1	5 year		3.34					3.34	0.55	1.00	0.55	1.8370	42.2890	18.59	47.06	5.528	1650	2.138	0.41	0.4	5.764	0.96	2.7	110.3	697.466	696.918	693.332	692.891		2.484	2.377
B1	B2	5 year					10.65	0.38	11.03	0.90	1.00	0.90	9.9460	9.9460	10	67.80	1.873	1200	1.131	0.30	0.3	2.135	0.88	1.9	156.8	699.832	699.822	696.332	695.861		2.300	2.761
B2	B3	5 year						0.41	0.41	0.95	1.00	0.95	0.3895	10.3355	11.38	62.87	1.805	1200	1.131	0.30	0.3	2.135	0.85	1.9	202.8	699.822	700.258	695.861	695.253	0	2.761	3.805
B4	B3	5 year		1.83			3.74		5.57	0.79	1.00	0.79	4.3725	4.3725	10	67.80	0.823	1050	0.866	0.26	0.1	0.864	0.95	1.0	204.4	699.07	700.258	695.570	695.366	0.15	2.450	3.842
														14.71																		
B3	B5	5 year						0.74	0.74	0.95	1.00	0.95	0.7030	15.4110	13.42	57.15	2.446	1200	1.131	0.30	0.4	2.466	0.99	2.2	119.6	700.258	700.612	695.216	694.737		3.842	4.675
B5	Inlet 2	5 year				1.76		0.20	1.96	0.68	1.00	0.68	1.3340	16.7450	14.33	54.97	2.557	1200	1.131	0.30	0.5	2.757	0.93	2.4	132.2	700.612	699.28	694.737	694.076		4.675	4.004
C1	C2	5 year		2.87					2.87	0.55	1.00	0.55	1.5785	1.5785	10	67.80	0.297	450	0.159	0.11	1.5	0.349	0.85	2.2	98.7	700.316	698.241	696.816	695.335	0.6	3.050	2.456
C2	C3	5 year	2.2					0.38	2.58	0.23	1.00	0.23	0.5810	2.1595	10.75	64.98	0.390	525	0.216	0.13	1	0.430	0.91	2.0	105.8	698.241	696.859	694.735	693.678	0.075	2.981	2.656
C3	C4	5 year						0.36	0.36	0.95	1.00	0.95	0.3420	2.5015	11.64	62.08	0.431	600	0.283	0.15	0.5	0.434	0.99	1.5	52.2	696.859	695.944	693.603	693.341	0.15	2.656	2.003
C4	Inlet 3	5 year		3.75					3.75	0.55	1.00	0.55	2.0625	4.5640	12.20	60.40	0.766	750	0.442	0.19	0.5	0.787	0.97	1.8	53.1	695.944	695.618	693.191	692.926		2.003	1.942

Table 1: Run-off Coefficient (City of Spruce Grove)

Land Use	Run-off Coefficient
Grass/Park	0.10
Single Family	0.55
Duplex	0.60
Multi-family	0.65
Industrial	0.60
Neighborhood Commercial	0.70
Large Commercial	0.90
Pavement/Roof	0.95

Runoff "C" Multiplier 1.00 (1:5 year event)

Rainfall Intensity Equation Coefficients

a =	335.26
b =	-0.654
c =	1.542

Appendix H

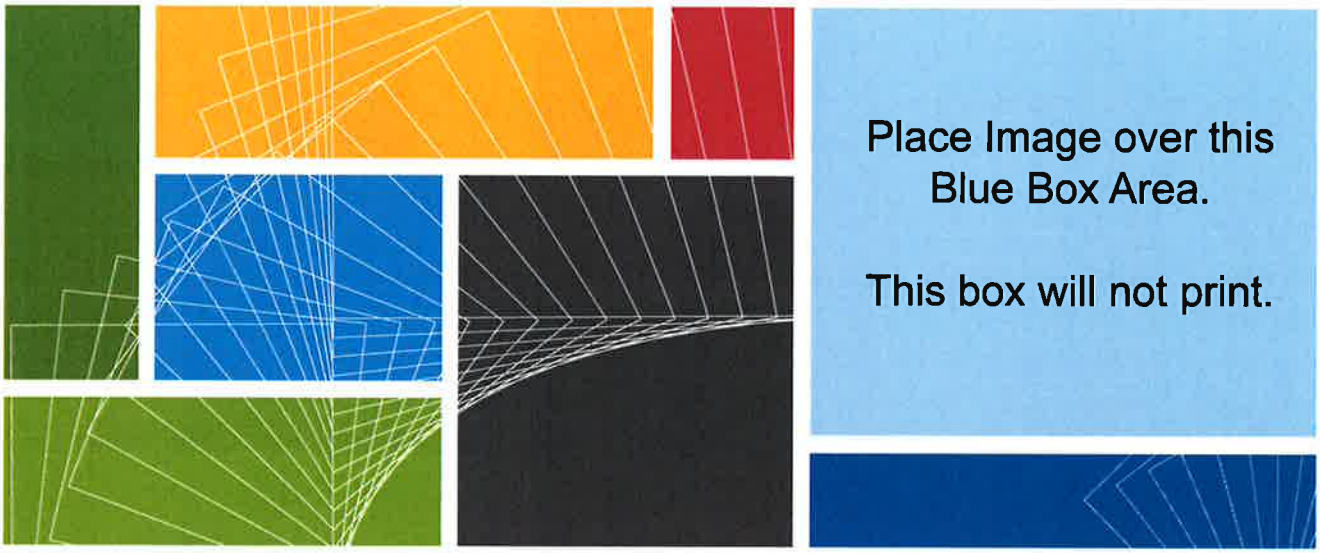
Excerpts from West Central Area Structure Plan

Hydraulic Network Analysis, 2017 – *ISL Engineering*

ISL Engineering and Land Services

Inspiring sustainable thinking

30 ANNIVERSARY 1987–2017



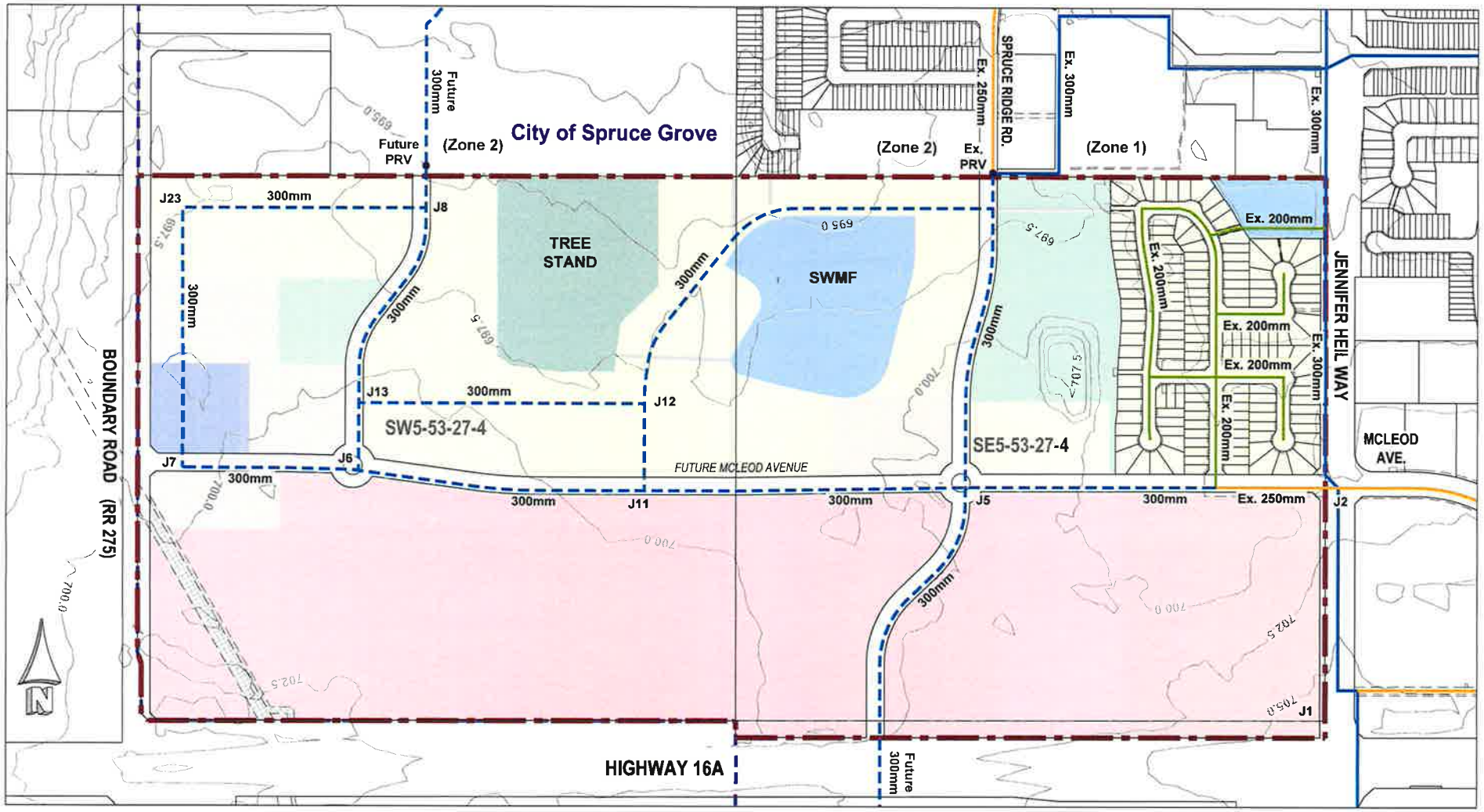
City of Spruce Grove

Draft Report

West Central ASP
Hydraulic Network Analysis

August 2017

j:\14900\14970_west_central_asp_and_lub_amendments\02_cadd\20_drafting\203_dwg\figure_4-1_proposed_water_distribution_system.dwg



LEGEND

- ASP Boundary
- Municipal Boundary

PROPOSED WATER DISTRIBUTION SYSTEM

WEST CENTRAL
AREA STRUCTURE PLAN
City of Spruce Grove

Scale - 1:8,000

0 100 200 300 400 metres

LEGEND

- Existing 200mm Watermain
- Existing 250mm Watermain
- Existing 300mm Watermain
- Proposed 300mm Watermain
- Pressure Reduce Valve (PRV)

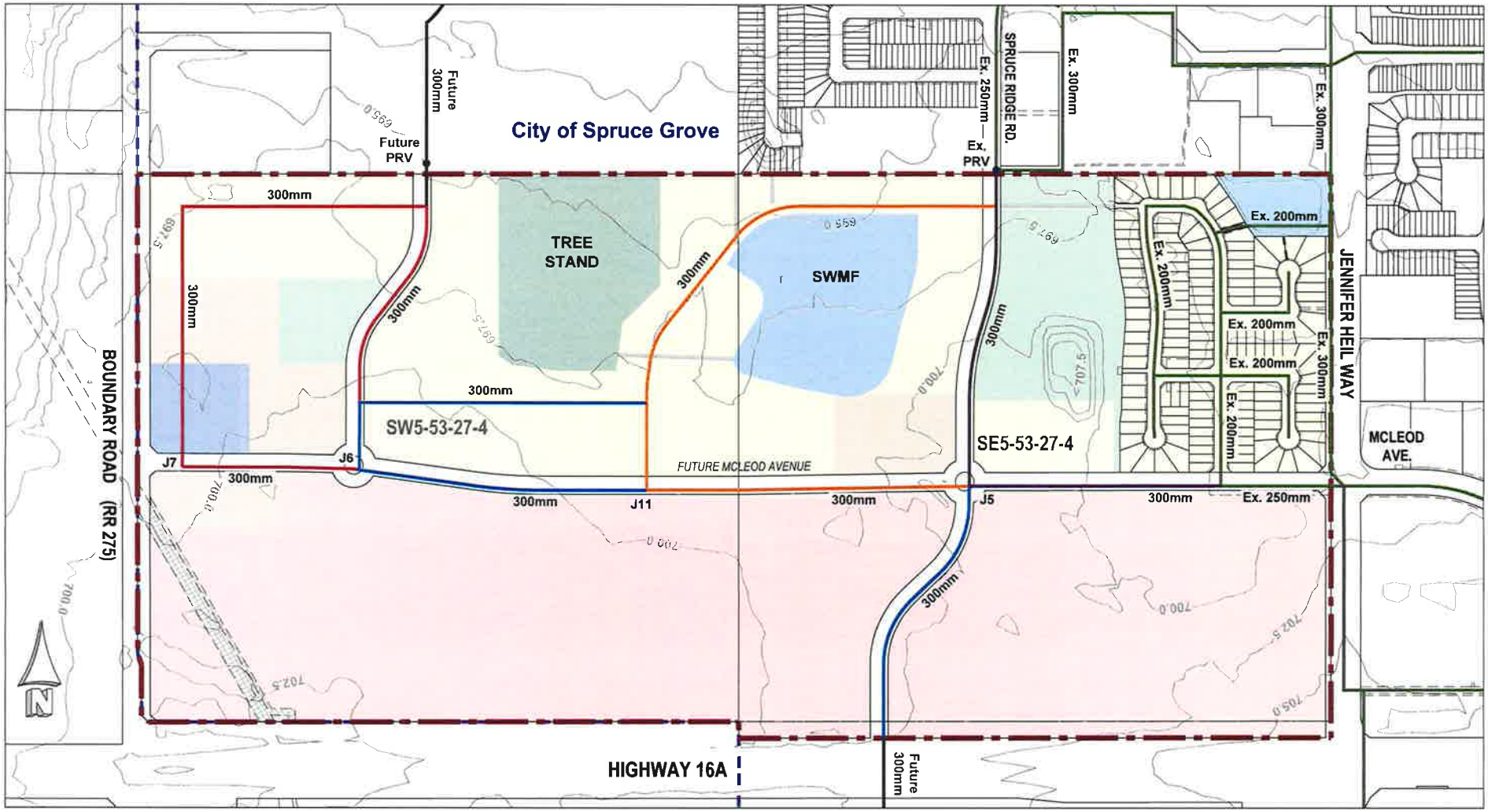
CONCEPT ONLY SUBJECT TO DETAILED DESIGN

ISL Engineering and Land Services

August 2017

FIGURE 4.1

j:\14900\14970_west_central_asp_and_lub_amendments\02_cadd\20_drafting\203_dwg\figure_4-2_proposed_staging_water_distribution_system.dwg



PROPOSED STAGING OF WATER DISTRIBUTION SYSTEM

WEST CENTRAL
AREA STRUCTURE PLAN

City of Spruce Grove

Scale - 1:8,000

0 100 200 300 400 metres

LEGEND

ASP Boundary

Municipal Boundary

LEGEND

Existing

Stage 1

Stage 2

Stage 3

Stage 4

CONCEPT ONLY SUBJECT TO DETAILED DESIGN

ISL Engineering and Land Services

August 2017

FIGURE 4.2

Appendix I

Grove Drive – Proposed Final Stage Plan

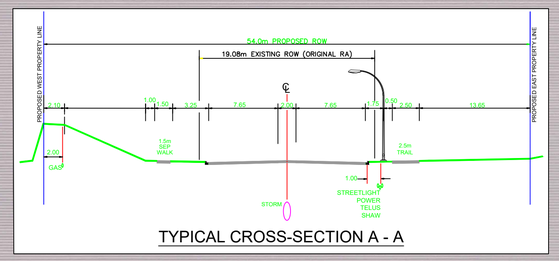
Function Plan – Profile (1:1000)

Exhibit X.01 – X.03

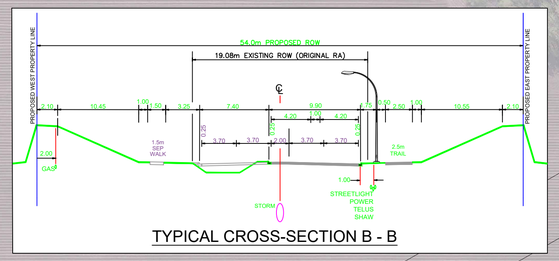
Al-Terra Engineering Ltd.

SE 6-53-27-W4

POTENTIAL 14ha
FUTURE CoSG
DEVELOPMENT



TYPICAL CROSS-SECTION A - A



TYPICAL CROSS-SECTION B - B

TOWN OF STONY PLAIN

HIGHWAY 16A

EXISTING ℄

FACE OF CURB

PROPOSE UG GAS ALIGNMENT

PROPOSED ℄

GROVE DRIVE

60m BAY

50m TAPER

54.0m

EXISTING ℄

EXISTING UNDERGROUND TELUS

EXISTING OVERHEAD POWER

PROPOSED UNDERGROUND POWER, SHAW & TELUS ALIGNMENT

CROSSING AGREEMENT APPLICATION REQUIRED

ORIGINAL ROAD R.O.W. ASSIGNED FOR MCLEOD AVENUE ASP AMENDMENT REQUIRED

REVISED INTERSECTION LOCATION DUE TO PIPELINE CROSSING

24.0m

16.8

24.0

9.5m

Rad. 9.0m

FUTURE FACE OF CURB

2.0m PAINTED MEDIAN

2.5m TRAIL

MATCHLINE 2264-W2

EXISTING EDGE OF ASPHALT

PROPOSED EDGE OF ASPHALT

*AUXILIARY LANE TO BE MINIMUM 100m EAST OF INTERSECTION DEPENDANT ON REQUIRED ACCESS TO THE ADJACENT COMMERCIAL DEVELOPMENTS

FUTURE COMMERCIAL

KINDER MORGAN CANADA PIPELINE R.O.W.
610mm CRUDE OIL

NOVA/TRANSCANADA PIPELINE R.O.W. - NO EXCAVATION

PROPOSED KINDER MORGAN CANADA PIPELINE R.O.W.

FUTURE ℄

MEDIUM TO HIGH DENSITY RESIDENTIAL

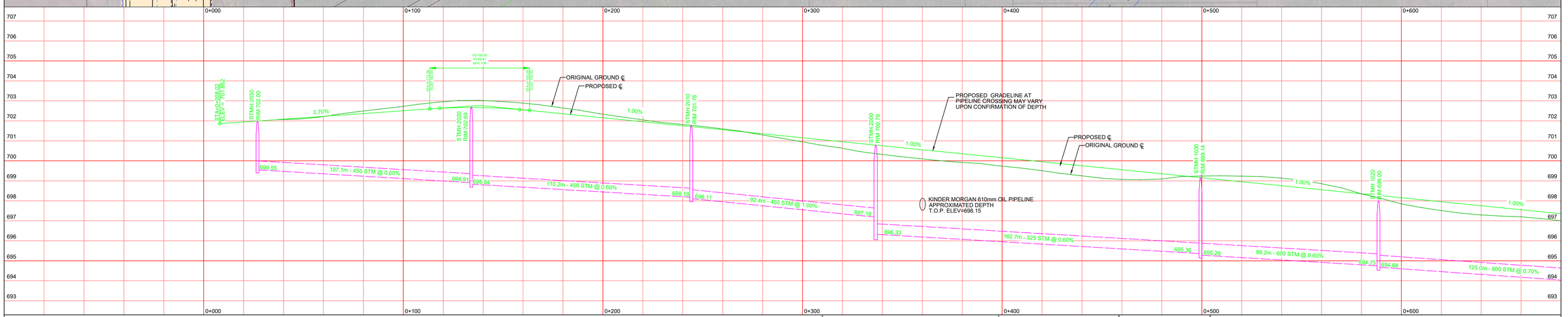
INSTITUTIONAL

MCLEOD AVENUE

FUTURE COOK LANDS WATER

CITY OF SPRUCE GROVE
SW 5-53-27-W4

FUNCTIONAL PLAN:
SUBJECT TO DETAIL DESIGN



PROPERTY LINE - PROPOSED
PROPERTY LINE - FUTURE
PROPERTY LINE - EXISTING
FACE OF CURB
LANE LINE
WALK / TRAIL

STORM - PROPOSED
STORM - EXISTING
STORM - FUTURE
SANITARY- PROPOSED
SANITARY - EXISTING
SANITARY - FUTURE
WATER - PROPOSED
WATER - EXISTING
WATER - FUTURE

EXISTING
PROPOSED
FUTURE

0 10m 20m 40m
SCALE

The City of SPRUCE GROVE

FUNCTIONAL PLANNING STUDY

PROJECT: GROVE DRIVE
FROM HIGHWAY 16A TO HARVEST RIDGE DRIVE
PROPOSED FINAL STAGE PLAN - PROFILE

DRAWN BY	D. PORTER	PROJECT NO.	2264
CHECKED	C. BROKS		
DATE	FEBRUARY 2018	PLAN NO.	EXHIBIT X.01

SE 6-53-27-W4

NE 6-53-27-W4

SW 5-53-27-W4

NW 5-53-27-W4

POTENTIAL 14ha FUTURE CoSG DEVELOPMENT

GROVE DRIVE

PROPOSED ℄

EXISTING ℄

EXISTING BOUNDARY ROAD

FACE OF CURB

1.5m SEPARATE WALK

2.0m PAINTED MEDIAN

2.5m TRAIL

EXISTING UNDERROAD CROSSING

EXISTING ACCESS (TO BE CLOSED)

REMOVE EXISTING ACCESS

PROPOSED RIGHT-IN ONLY ACCESS

PROPOSED UNDERGROUND POWER, SHAW & TELUS ALIGNMENT

PROPOSE UG GAS ALIGNMENT

PROPOSED PRIMARY CHURCH ACCESS

HOLY TRINITY CATHOLIC CHURCH

FUTURE CHURCH SERVICING

FUTURE COOK LANDS WATER

COLLECTOR A

COLLECTOR B

11.0m

9.5m

8.9m

12.0m

Dia. 26m

ABANDON EXISTING GAS LINE NEW ALIGNMENT ALONG WEST PL

INTERCEPT EXISTING GAS

COPPERHAVEN: LOW TO MEDIUM DENSITY RESIDENTIAL

MEDIUM TO HIGH DENSITY RESIDENTIAL

LOW TO MEDIUM DENSITY RESIDENTIAL

MEDIUM TO HIGH DENSITY RESIDENTIAL

SPRUCE GROVE - NEW K-9 SCHOOL

MATCHLINE 2264-X01 STA 0+560

MATCHLINE 2264-X02 STA 1+340

MATCHLINE 2264-X03 STA 1+340

TYPICAL CROSS-SECTION C - C

54.0m PROPOSED ROW

PROPOSED WEST PROPERTY LINE

PROPOSED EAST PROPERTY LINE

2.10 10.45 1.00 1.50 3.25 7.65 3.70 3.70 2.00 3.70 3.70 7.65 0.75 0.50 2.50 1.00 10.55 2.10

1.5m SEP. WALK

2.5m TRAIL

2.00 GAS

STORM

1.00 STREETLIGHT POWER TELUS SHAW

TYPICAL CROSS-SECTION D - D

13.55 1.00 1.50 3.25 7.65 3.70 3.70 2.00 3.70 3.70 7.65 0.75 0.50 2.50 1.00 10.55 2.10

1.5m WALK

2.5m TRAIL

2.00 GAS

1.00 STREETLIGHT POWER TELUS SHAW

WATER

12.00

FUNCTIONAL PLAN: SUBJECT TO DETAIL DESIGN

0+700 0+800 0+900 1+000 1+100 1+200 1+300

700 699 698 697 696 695 694 693 692 691 690 689 688 687 686

MATCHLINE 2264-X01 STA 0+560

STMH 1010 RIM 698.72

STMH 1000 RIM 695.47

STA 0+892.38 ELEV = 695.233

STMH 1500 RIM 693.00

STMH 460 RIM 692.57

STMH 470 RIM 691.75

SANMH 200 RIM=691.55

MATCHLINE 2264-X03 STA 1+340

ORIGINAL GROUND ℄

PROPOSED ℄

1.00% 1.00% 1.00% 1.00% 0.75% 1.40% 0.75%

125.0m - 600 STM @ 0.70%

120.0m - 600 STM @ 0.80%

135.3m - 675 STM @ 1.00%

128.8m - 375 STM @ 0.50%

693.80 693.73 692.77 692.71 691.36 689.54 688.87 686.138

300 WM 300 WM 300 WM 300 WM

200 SAN

VC=50.00 K=78.92 M=0.041

VC=50.00 K=78.92 M=0.041

PROPERTY LINE - PROPOSED
PROPERTY LINE - FUTURE
PROPERTY LINE - EXISTING
FACE OF CURB
LANE LINE
WALK / TRAIL

STORM - PROPOSED
STORM - EXISTING
STORM - FUTURE
SANITARY- PROPOSED
SANITARY - EXISTING
SANITARY - FUTURE
WATER - PROPOSED
WATER - EXISTING
WATER - FUTURE

EXISTING
PROPOSED
FUTURE

0 10m 20m 40m
SCALE

The City of SPRUCE GROVE

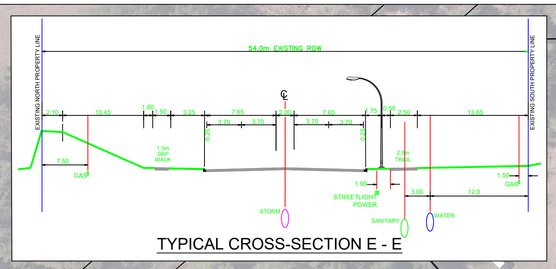
FUNCTIONAL PLANNING STUDY

PROJECT:

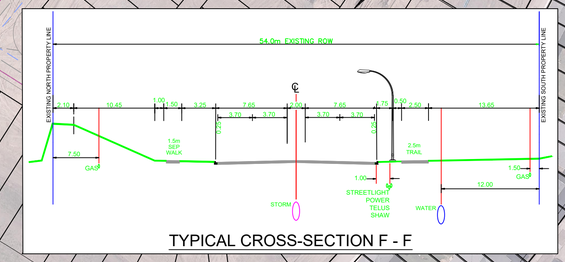
GROVE DRIVE
FROM HIGHWAY 16A TO HARVEST RIDGE DRIVE
PROPOSED FINAL STAGE PLAN - PROFILE

DRAWN BY	D. PORTER	PROJECT NO.	2264
CHECKED	C. BROKS		
DATE	FEBRUARY 2018	PLAN NO.	EXHIBIT X.02

NE 6-53-27-W4



TYPICAL CROSS-SECTION E - E



TYPICAL CROSS-SECTION F - F

EXISTING ROAD

ALBERTA CAPITAL REGION WASTEWATER COMMISSION

HARVEST RIDGE FUTURE DEVELOPMENT

GROVE DRIVE SUBDIVISION 2017 BUILD OUT

FULL X-SECTION BUILD OUT

GROVE DRIVE

EXISTING ℄

EXISTING GAS

EXISTING OVERHEAD POWER, TELUS & SHAW ALIGNMENT

2017 CONSTRUCTION LIMITS

MATCHLINE 2264-X03 STA 1+340

Dia. 48m

2.0m PAINTED MEDIAN

2.5m TRAIL

MEDIUM TO HIGH DENSITY RESIDENTIAL

FACE OF CURB

1.5m SEPARATE WALK

PROPOSE UG GAS ALIGNMENT

PROPOSED UNDERGROUND POWER, SHAW & TELUS ALIGNMENT

Dia. 80m

COLLECTOR B

COPPERHAVEN: LOW TO MEDIUM DENSITY RESIDENTIAL

SPRUCE GROVE - NEW K-9 SCHOOL

HARVEST RIDGE DRIVE

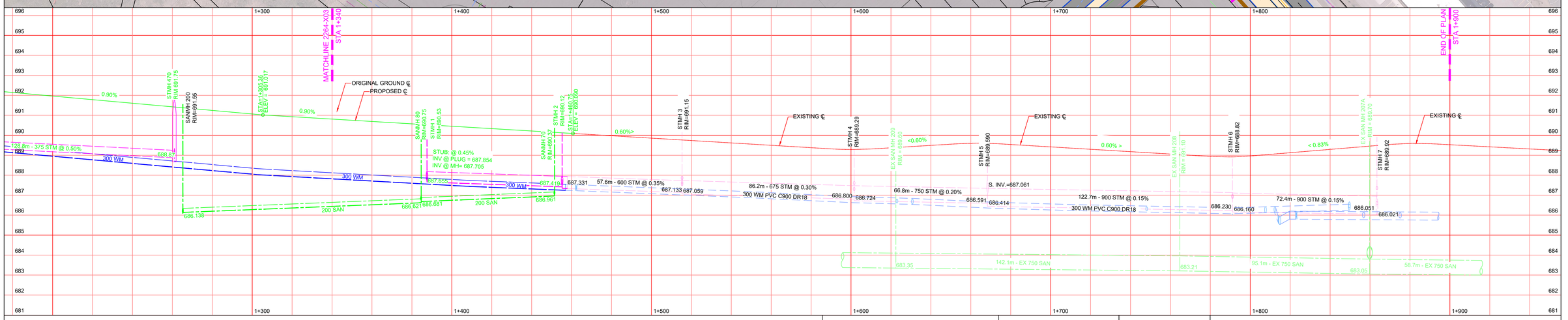
ST. PETER CATHOLIC HIGH SCHOOL

Dia. 48m

END OF PLAN STA 1+900

FUNCTIONAL PLAN: SUBJECT TO DETAIL DESIGN

NW 5-53-27-W4



PROPERTY LINE - PROPOSED
PROPERTY LINE - FUTURE
PROPERTY LINE - EXISTING
FACE OF CURB
LANE LINE
WALK / TRAIL

STORM - PROPOSED
STORM - EXISTING
STORM - FUTURE
SANITARY- PROPOSED
SANITARY - EXISTING
SANITARY - FUTURE
WATER - PROPOSED
WATER - EXISTING
WATER - FUTURE

EXISTING
PROPOSED
FUTURE

0 10m 20m 40m
SCALE

The City of SPRUCE GROVE

FUNCTIONAL PLANNING STUDY

PROJECT: GROVE DRIVE
FROM HIGHWAY 16A TO HARVEST RIDGE DRIVE
PROPOSED FINAL STAGE PLAN - PROFILE

DRAWN BY	D. PORTER	PROJECT NO.	2264
CHECKED	C. BROKS		
DATE	FEBRUARY 2018	PLAN NO.	EXHIBIT X.03

Appendix J

Grove Drive – Proposed First Stage Plan

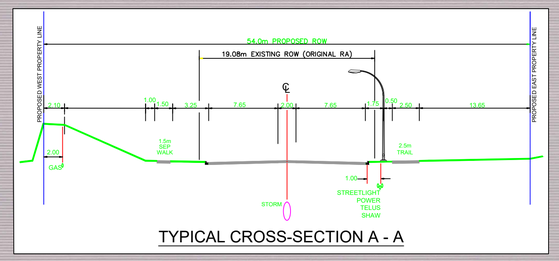
Function Plan – Profile (1:1000)

Exhibit X.04 – X.06

Al-Terra Engineering Ltd.

SE 6-53-27-W4

POTENTIAL 14ha
FUTURE CoSG
DEVELOPMENT



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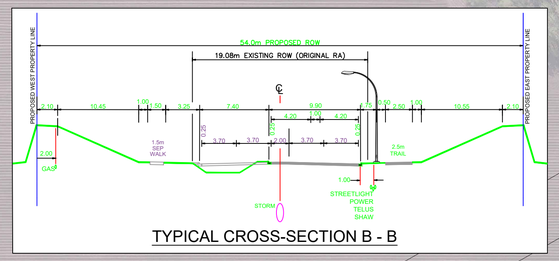


TYPICAL CROSS-SECTION B - B

TOWN OF STONY PLAIN

HIGHWAY 16A

EXISTING ℄

FACE OF CURB

PROPOSE UG GAS ALIGNMENT

PROPOSED ℄

GROVE DRIVE

60m BAY

50m TAPER

54.0m

EXISTING ℄

EXISTING UNDERGROUND TELUS

EXISTING OVERHEAD POWER

PROPOSED UNDERGROUND POWER, SHAW & TELUS ALIGNMENT

CROSSING AGREEMENT APPLICATION REQUIRED

24.0m

9.5m

PROPOSED ℄

Rad. 8.0m

FUTURE FACE OF CURB

FACE OF CURB

TRANSITION TO FIRST STAGE X-SECTION

60m TAPER

54.0m

2.0m PAINTED MEDIAN

2.5m TRAIL

MATCH LINE 2264-X02 STA 0+600

EXISTING EDGE OF ASPHALT

PROPOSED EDGE OF ASPHALT

*AUXILIARY LANE TO BE MINIMUM 100m EAST OF INTERSECTION DEPENDANT ON REQUIRED ACCESS TO THE ADJACENT COMMERCIAL DEVELOPMENTS

FUTURE COMMERCIAL

KINDER MORGAN CANADA PIPELINE R.O.W. 610mm CRUDE OIL

NOVA/TMEASTERN PIPELINE R.O.W. - NO LONGER IN USE

PROPOSED KINDER MORGAN CANADA PIPELINE R.O.W.

FUTURE ℄

MEDIUM TO HIGH DENSITY RESIDENTIAL

INSTITUTIONAL

ORIGINAL ROAD R.O.W. ASSIGNED FOR MCLEOD AVENUE ASP AMENDMENT REQUIRED

REVISED INTERSECTION LOCATION DUE TO PIPELINE CROSSING

16.8

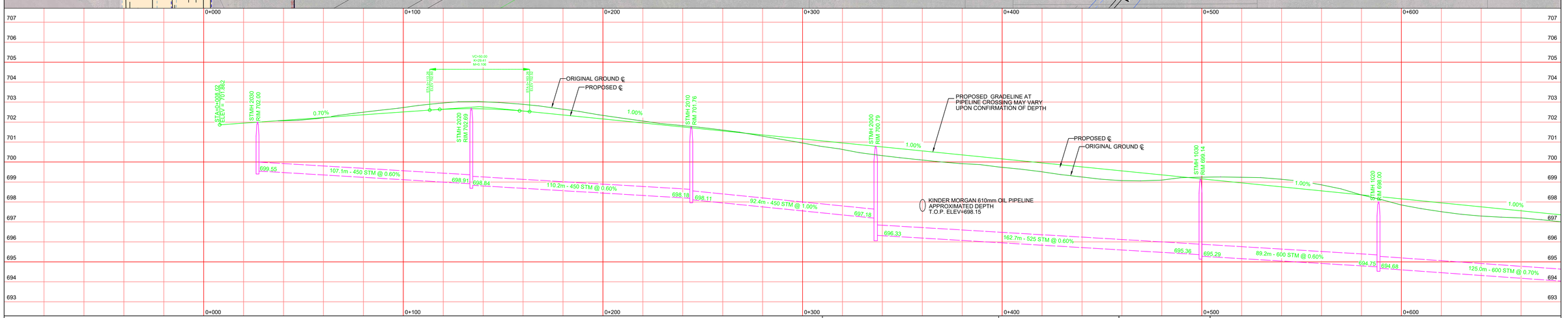
24.0

MCLEOD AVENUE

FUTURE COOK LANDS WATER

CITY OF SPRUCE GROVE
SW 5-53-27-W4

FUNCTIONAL PLAN:
SUBJECT TO DETAIL DESIGN



PROPERTY LINE - PROPOSED
PROPERTY LINE - FUTURE
PROPERTY LINE - EXISTING
FACE OF CURB
LANE LINE
WALK / TRAIL

STORM - PROPOSED
STORM - EXISTING
STORM - FUTURE
SANITARY- PROPOSED
SANITARY - EXISTING
SANITARY - FUTURE
WATER - PROPOSED
WATER - EXISTING
WATER - FUTURE

EXISTING
PROPOSED
FUTURE

0 10m 20m 40m
SCALE

FUNCTIONAL PLANNING STUDY

PROJECT: GROVE DRIVE
FROM HIGHWAY 16A TO HARVEST RIDGE DRIVE
PROPOSED FIRST STAGE PLAN - PROFILE

DRAWN BY	D. PORTER	PROJECT NO.	2264
CHECKED	C. BROKS		
DATE	FEBRUARY 2018	PLAN NO.	EXHIBIT X.04

SE 6-53-27-W4

NE 6-53-27-W4

SW 5-53-27-W4

NW 5-53-27-W4

POTENTIAL 14ha FUTURE CoSG DEVELOPMENT

PROPOSED ℄

EXISTING ℄

TRANSITION TO FIRST STAGE X-SECTION

MATCHLINE 2264-X01 STA 0+560

FUTURE FACE OF CURB

FACE OF CURB

GROVE DRIVE

PROPOSE UG GAS ALIGNMENT

11.0m

EXISTING BOUNDARY ROAD

EXISTING WATER LINE

EXISTING GAS LINE

EXISTING POWER POLE

1.0m PAINTED MEDIAN

2.5m TRAIL

PROPOSED RIGHT-IN ONLY ACCESS

PROPOSED UNDERGROUND POWER, SHAW & TELUS ALIGNMENT

REMOVE EXISTING ACCESS

PROPOSED PRIMARY CHURCH ACCESS

9.5m

ABANDON EXISTING GAS LINE NEW ALIGNMENT ALONG WEST PL

HOLY TRINITY CATHOLIC CHURCH

FUTURE CHURCH SERVICING

COLLECTOR A

COPPERHAVEN: LOW TO MEDIUM DENSITY RESIDENTIAL

MEDIUM TO HIGH DENSITY RESIDENTIAL

LOW TO MEDIUM DENSITY RESIDENTIAL

FUTURE COOK LANDS WATER

FUTURE ℄

Dia. 50m

Dia. 25m

8.9m

INTERCEPT EXISTING GAS

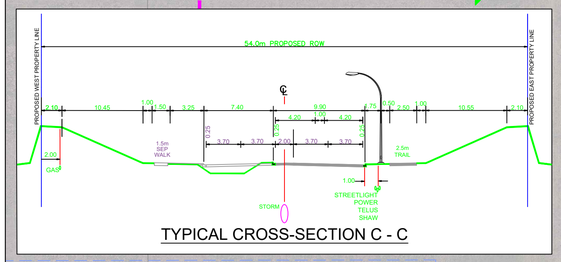
12.0m

COLLECTOR B

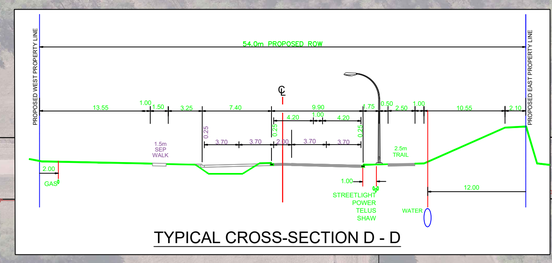
MATCHLINE 2264-X03 STA 1+340

EXISTING ℄

SPRUCE GROVE - NEW K-9 SCHOOL

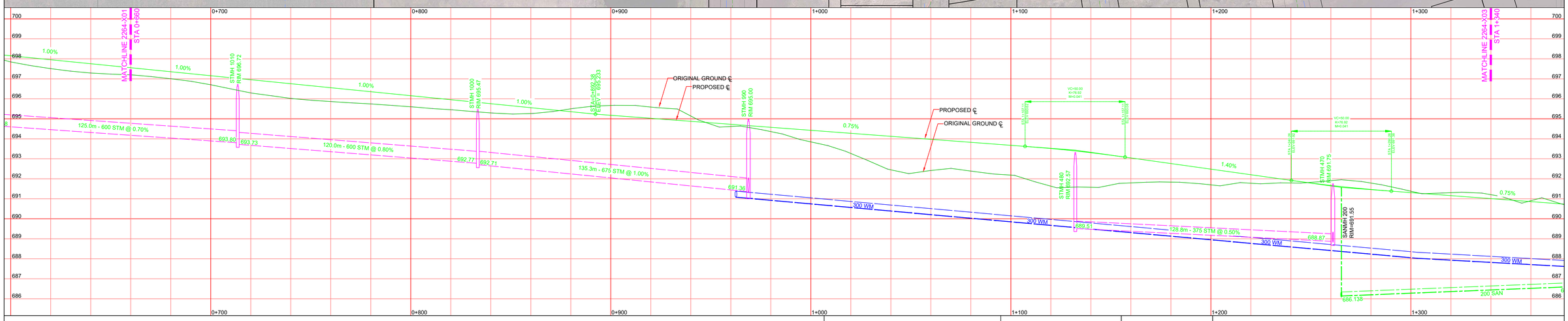


TYPICAL CROSS-SECTION C - C



TYPICAL CROSS-SECTION D - D

FUNCTIONAL PLAN: SUBJECT TO DETAIL DESIGN



PROPERTY LINE - PROPOSED
PROPERTY LINE - FUTURE
PROPERTY LINE - EXISTING
FACE OF CURB
LANE LINE
WALK / TRAIL

STORM - PROPOSED
STORM - EXISTING
STORM - FUTURE
SANITARY- PROPOSED
SANITARY - EXISTING
SANITARY - FUTURE
WATER - PROPOSED
WATER - EXISTING
WATER - FUTURE

EXISTING
PROPOSED
FUTURE

0 10m 20m 40m
SCALE

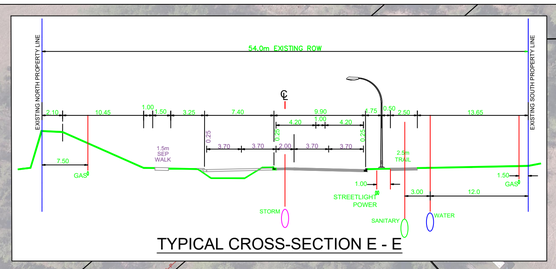
FUNCTIONAL PLANNING STUDY

PROJECT:

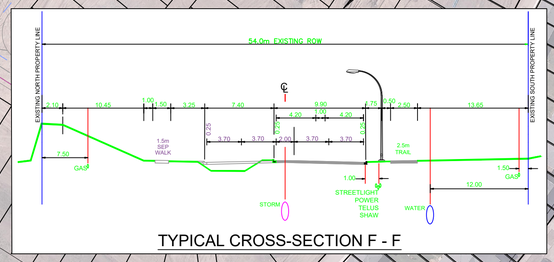
GROVE DRIVE
FROM HIGHWAY 16A TO HARVEST RIDGE DRIVE
PROPOSED FIRST STAGE PLAN - PROFILE

DRAWN BY	D. PORTER	PROJECT NO.	2264
CHECKED	C. BROKS		
DATE	FEBRUARY 2018	PLAN NO.	EXHIBIT X.05

NE 6-53-27-W4



TYPICAL CROSS-SECTION E - E



TYPICAL CROSS-SECTION F - F

EXISTING BOUNDARY ROAD

MEDIUM TO HIGH DENSITY RESIDENTIAL

FUTURE FACE OF CURB
FACE OF CURB

MAJOR CONSTRUCTION LIMITS STA 1+340

1.0m PAINTED MEDIAN

2.5m TRAIL

PROPOSE UG GAS ALIGNMENT

PROPOSED UNDERGROUND POWER, SHAW & TELUS ALIGNMENT

Dia. 40m

COLLECTOR B

COPPERHAVEN: LOW TO MEDIUM DENSITY RESIDENTIAL

NW 5-53-27-W4

EXISTING GAS

ALBERTA CAPITAL REGION WASTEWATER COMMISSION

2014 CONSTRUCTION LIMITS STA 1+340

Dia. 46m

FUTURE FACE OF CURB
FACE OF CURB

GROVE DRIVE

EXISTING ℄

EXISTING GAS

EXISTING OVERHEAD POWER, TELUS & SHAW ALIGNMENT

HARVEST RIDGE FUTURE DEVELOPMENT

HARVEST RIDGE DRIVE

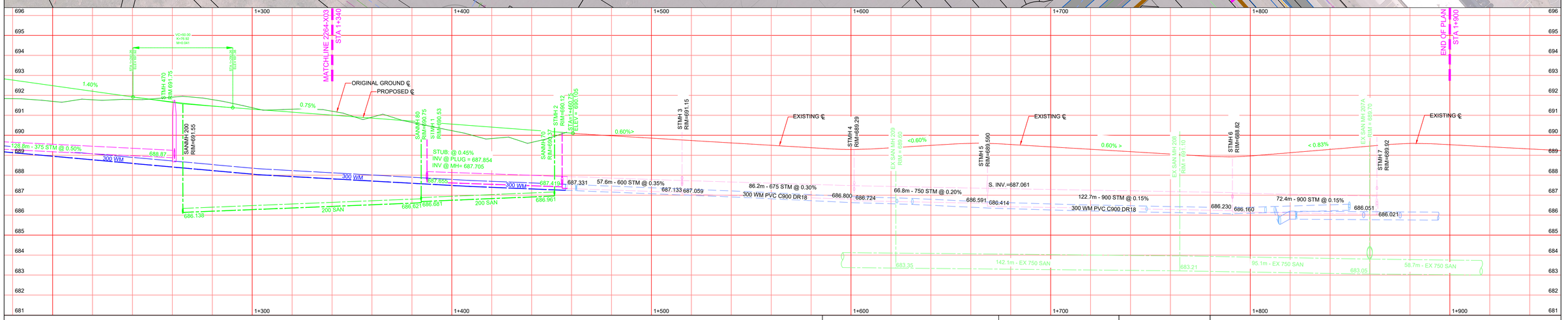
ST. PETER CATHOLIC HIGH SCHOOL

SPRUCE GROVE - NEW K-9 SCHOOL

Dia. 48m

END OF PLAN STA 1+900

FUNCTIONAL PLAN:
SUBJECT TO DETAIL DESIGN



PROPERTY LINE - PROPOSED
PROPERTY LINE - FUTURE
PROPERTY LINE - EXISTING
FACE OF CURB
LANE LINE
WALK / TRAIL

STORM - PROPOSED
STORM - EXISTING
STORM - FUTURE
SANITARY- PROPOSED
SANITARY - EXISTING
SANITARY - FUTURE
WATER - PROPOSED
WATER - EXISTING
WATER - FUTURE

EXISTING
PROPOSED
FUTURE

0 10m 20m 40m
SCALE

The City of SPRUCE GROVE

FUNCTIONAL PLANNING STUDY

PROJECT:
GROVE DRIVE
FROM HIGHWAY 16A TO HARVEST RIDGE DRIVE
PROPOSED FIRST STAGE PLAN - PROFILE

DRAWN BY	D. PORTER	PROJECT NO.	2264
CHECKED	C. BROKS		
DATE	FEBRUARY 2018	PLAN NO.	EXHIBIT X.06

Appendix K

Grove Drive – Right of Way Requirements

Function Plan (1:1000)

Exhibit X.07 & X.08

Al-Terra Engineering Ltd.

SE 6-53-27-W4

POTENTIAL 14ha
FUTURE CoSG
DEVELOPMENT

EXISTING ℄

PROPOSED ℄

24.0m

TOTAL AREA REQUIRED FROM
SE-6-53-27-W4 WITHIN TOWN
OF STONY PLAIN
1.373 ha (3.393 acres)

EXISTING ℄

PROPOSED ℄

GROVE DRIVE

17.0m
25.0m
12.0m
54.0m

EXISTING ℄

PROPOSED ℄

EXISTING ℄

PROPOSED ℄

GROVE DRIVE

16.9m
20.1m
17.0m
54.0m

EXISTING ℄

PROPOSED ℄

TOTAL AREA REQUIRED
FROM SW-5-53-27-W4 WITHIN
CITY OF SPRUCE GROVE
1.239 ha (3.061 acres)

TOTAL AREA REQUIRED
FROM EXISTING ROAD
RIGHT OF WAY
1.499 ha (3.705 acres)

EXISTING ℄

FUTURE
COMMERCIAL

KINDER MORGAN CANADA PIPELINE R.O.W.
610mm CRUDE OIL
NORTHWESTERN PIPELINE R.O.W. – NO FACILITIES
PROPOSED KINDER MORGAN CANADA
PIPELINE R.O.W.

FUTURE
COMMERCIAL

FUTURE ℄

MEDIUM TO HIGH
DENSITY
RESIDENTIAL

INSTITUTIONAL

MCLEOD AVENUE

24.0m

FUTURE ℄

MEDIUM TO HIGH
DENSITY
RESIDENTIAL

FUTURE ℄

LOW TO MEDIUM
DENSITY
RESIDENTIAL

EXISTING ℄

CITY OF SPRUCE GROVE
SW 5-53-27-W4

FUNCTIONAL PLAN:
SUBJECT TO DETAIL DESIGN

PROPERTY LINE - PROPOSED
PROPERTY LINE - FUTURE
PROPERTY LINE - EXISTING
FACE OF CURB

CITY OF SPRUCE GROVE
EXISTING ROAD RIGHT OF WAY
TOWN OF STONY PLAIN

EXISTING
PROPOSED
FUTURE

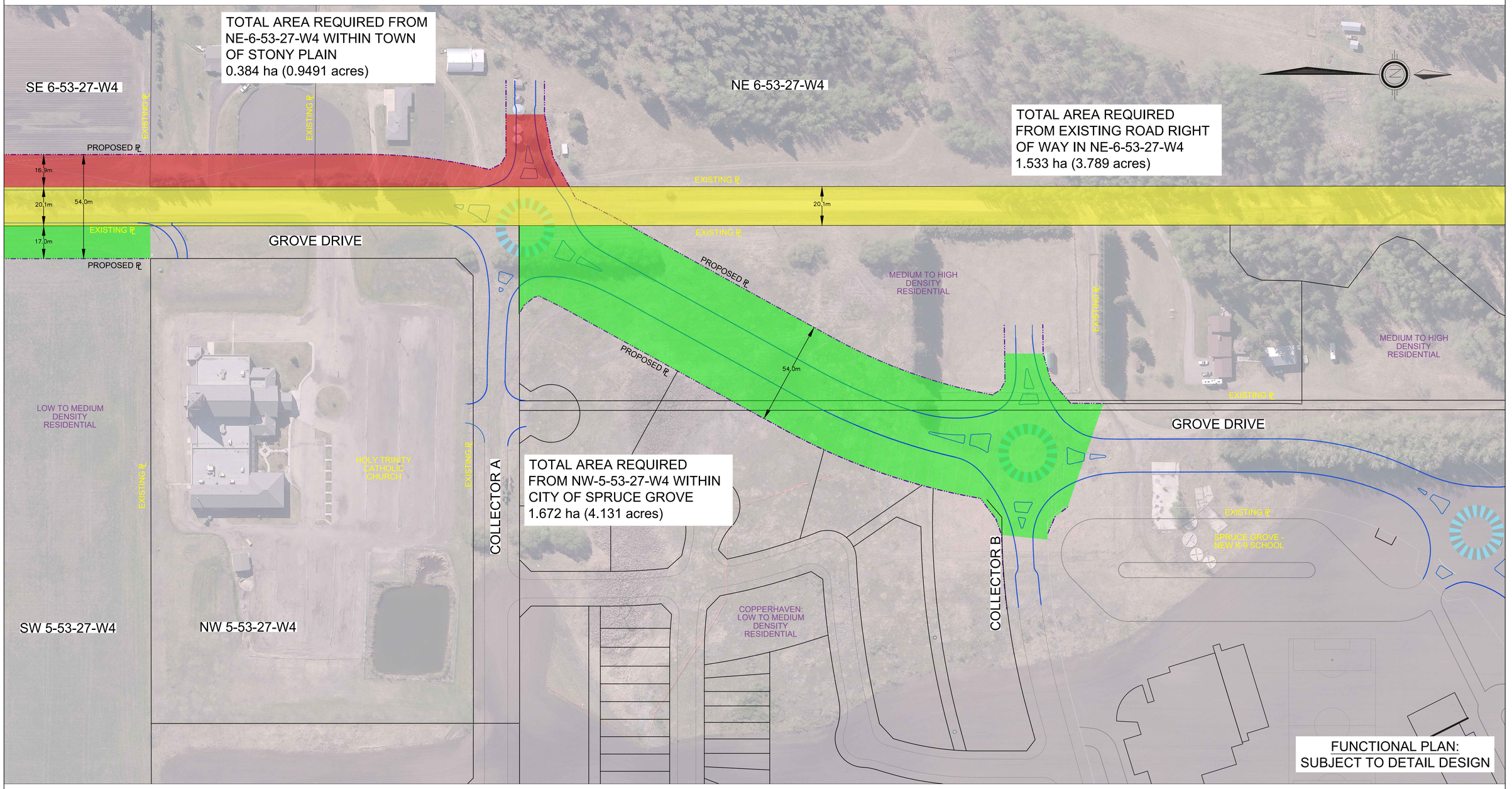
0 10m 20m 40m
SCALE

The City of SPRUCE GROVE

FUNCTIONAL PLANNING STUDY

PROJECT:
GROVE DRIVE
FROM HIGHWAY 16A TO HARVEST RIDGE DRIVE
RIGHT OF WAY REQUIREMENT PLAN

DRAWN BY	D. PORTER	PROJECT NO.	2264
CHECKED	C. BROKS		
DATE	FEBRUARY 2018	PLAN NO.	EXHIBIT X.07



PROPERTY LINE - PROPOSED
PROPERTY LINE - FUTURE
PROPERTY LINE - EXISTING
FACE OF CURB

CITY OF SPRUCE GROVE
EXISTING ROAD RIGHT OF WAY
TOWN OF STONY PLAIN

EXISTING
PROPOSED
FUTURE

0 10m 20m 40m
SCALE

FUNCTIONAL PLANNING STUDY

PROJECT:
GROVE DRIVE
FROM HIGHWAY 16A TO HARVEST RIDGE DRIVE
RIGHT OF WAY REQUIREMENT PLAN

DRAWN BY	D. PORTER	PROJECT NO.	2264
CHECKED	C. BROKS		
DATE	FEBRUARY 2018	PLAN NO.	EXHIBIT X.08

Appendix L

Grove Drive – Additional Technical Analysis

Synchro and Sidra Reports

Al-Terra

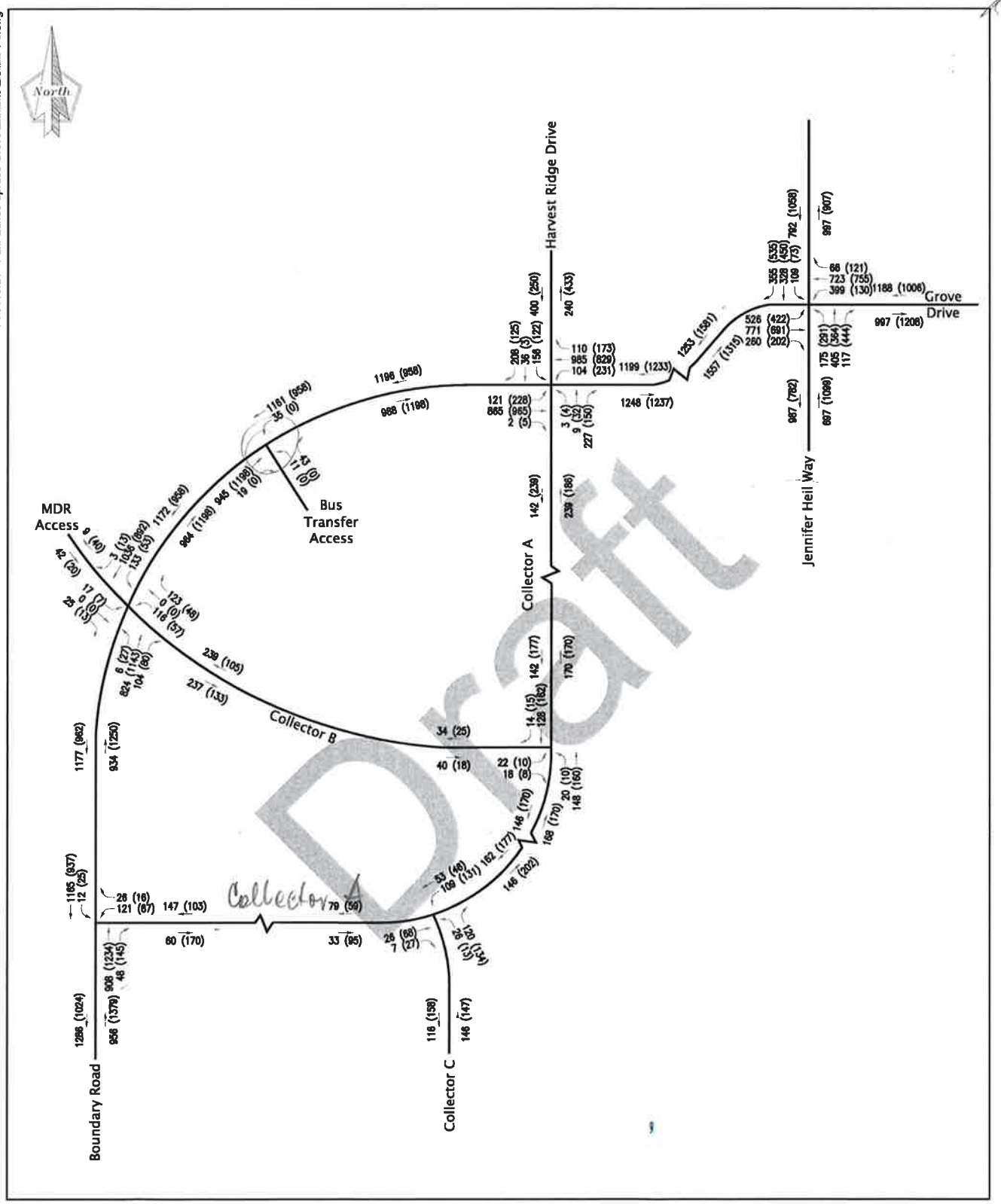


Exhibit 4-8

N.T.S.

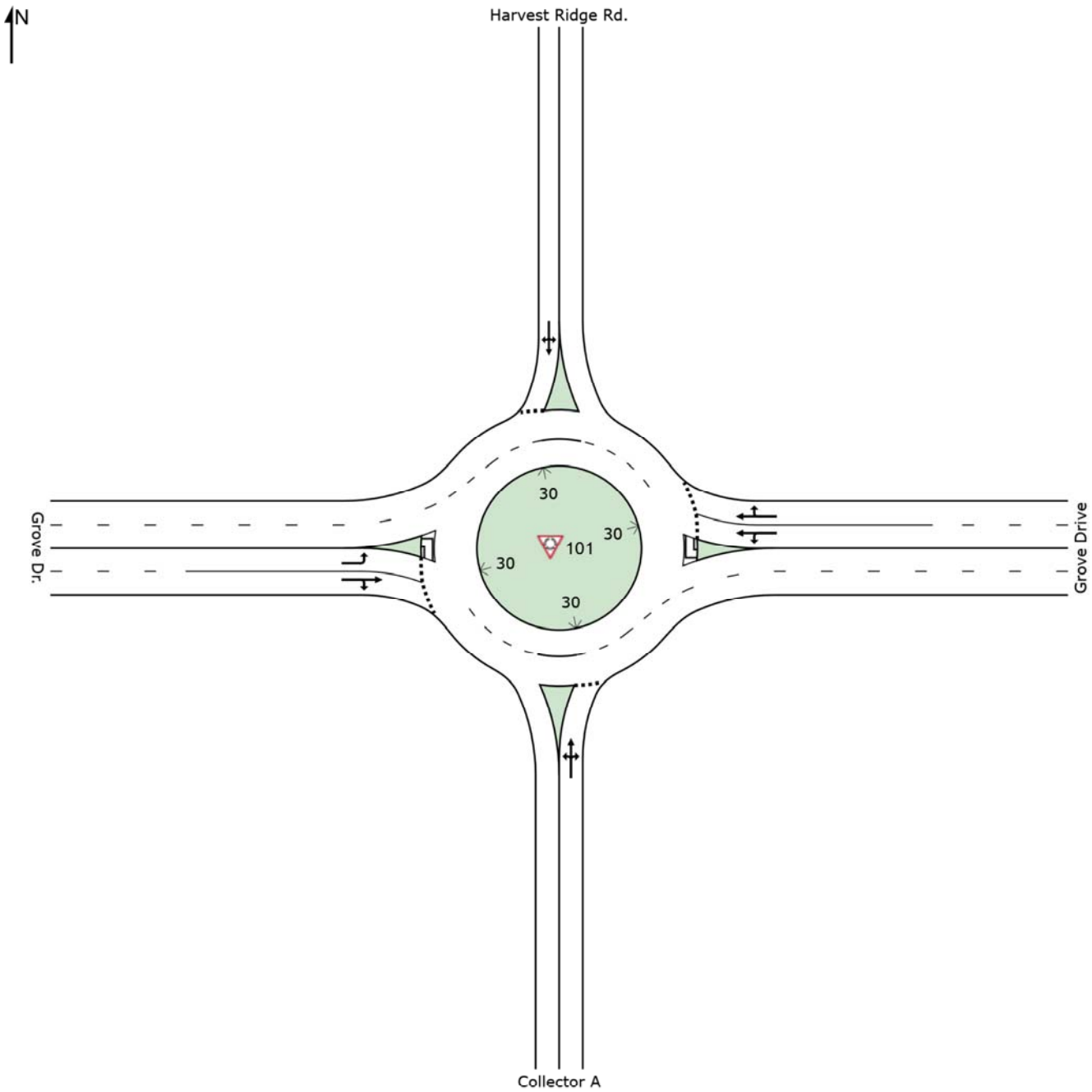
2040 Total Traffic Volumes
AM (PM) Peak Hours

Fuhr NSP TIA
bunt & associates | Project No. 3113.21

SITE LAYOUT

Site: 101 [Harvest Ridge Intersection - AM Peak year 2040]

New Site
Roundabout



MOVEMENT SUMMARY

Site: 101 [Harvest Ridge Intersection - AM Peak year 2040]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Collector A											
3	L2	3	3.0	0.471	15.6	LOS C	2.2	17.2	0.76	0.87	49.2
8	T1	9	3.0	0.471	15.6	LOS C	2.2	17.2	0.76	0.87	49.1
18	R2	227	3.0	0.471	15.6	LOS C	2.2	17.2	0.76	0.87	47.8
Approach		239	3.0	0.471	15.6	LOS C	2.2	17.2	0.76	0.87	47.9
East: Grove Drive											
1	L2	104	3.0	0.494	8.3	LOS A	3.2	24.6	0.41	0.25	53.9
6	T1	989	3.0	0.494	8.3	LOS A	3.2	24.6	0.41	0.25	54.2
16	R2	110	3.0	0.494	8.3	LOS A	3.2	24.6	0.41	0.25	52.9
Approach		1203	3.0	0.494	8.3	LOS A	3.2	24.6	0.41	0.25	54.0
North: Harvest Ridge Rd.											
7	L2	156	3.0	0.757	28.8	LOS D	5.9	45.9	0.86	1.18	41.1
4	T1	36	3.0	0.757	28.8	LOS D	5.9	45.9	0.86	1.18	41.0
14	R2	208	3.0	0.757	28.8	LOS D	5.9	45.9	0.86	1.18	40.2
Approach		400	3.0	0.757	28.8	LOS D	5.9	45.9	0.86	1.18	40.6
West: Grove Dr.											
5	L2	121	3.0	0.116	4.5	LOS A	0.5	3.6	0.40	0.29	53.4
2	T1	865	3.0	0.830	21.8	LOS C	21.1	164.3	0.94	1.31	45.6
12	R2	2	3.0	0.830	21.8	LOS C	21.1	164.3	0.94	1.31	44.5
Approach		988	3.0	0.830	19.7	LOS C	21.1	164.3	0.87	1.18	46.5
All Vehicles		2830	3.0	0.830	15.8	LOS C	21.1	164.3	0.66	0.76	48.5

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Harvest Ridge Intersection - PM Peak year 2040]

New Site
Roundabout

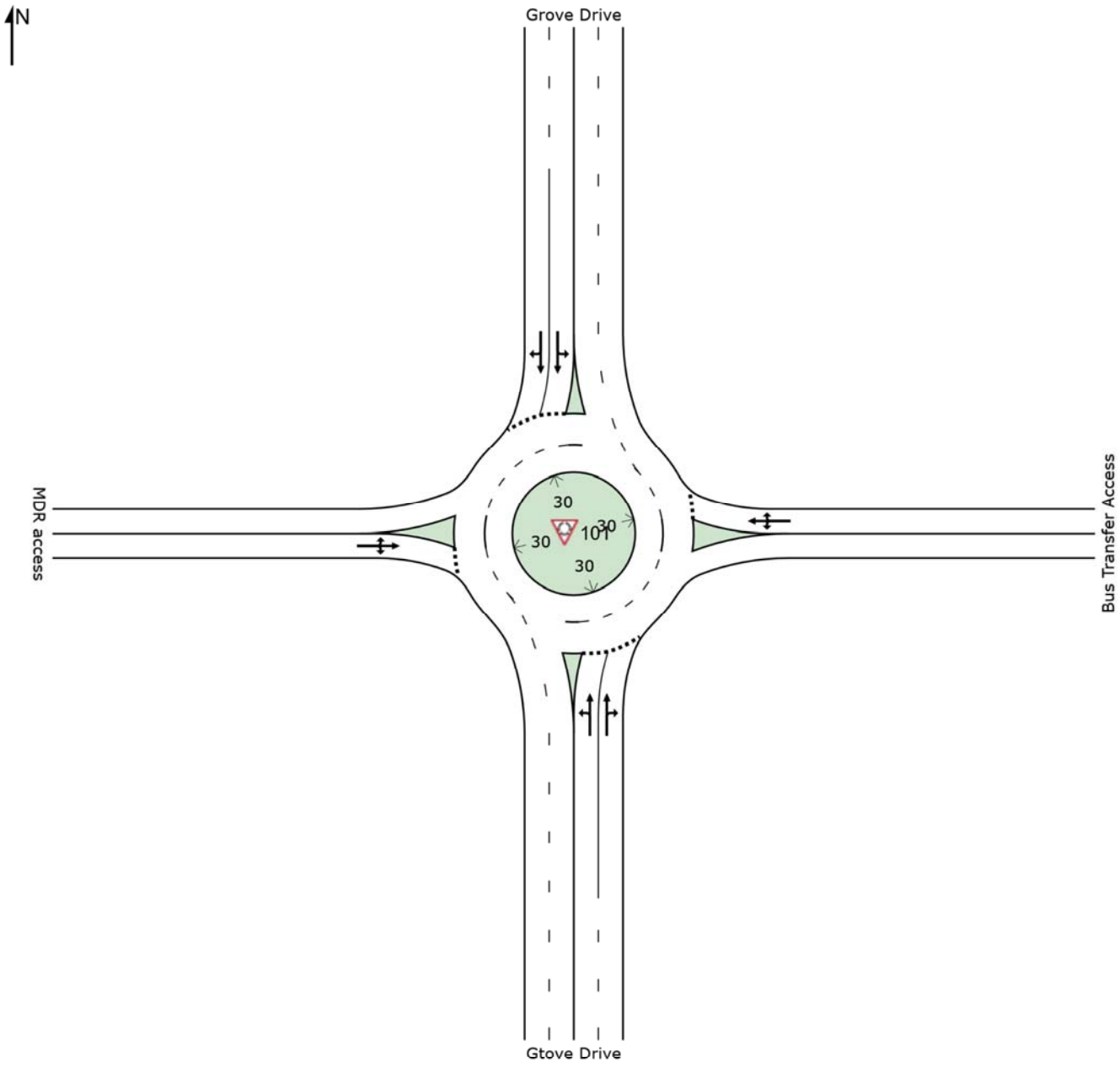
Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Collector A											
3	L2	4	1.0	0.423	16.2	LOS C	1.8	13.7	0.79	0.88	48.9
8	T1	32	1.0	0.423	16.2	LOS C	1.8	13.7	0.79	0.88	48.8
18	R2	150	1.0	0.423	16.2	LOS C	1.8	13.7	0.79	0.88	47.5
Approach		186	1.0	0.423	16.2	LOS C	1.8	13.7	0.79	0.88	47.8
East: Grove Drive											
1	L2	231	1.0	0.566	10.3	LOS B	4.6	35.6	0.60	0.53	51.7
6	T1	829	3.0	0.566	10.4	LOS B	4.6	35.6	0.60	0.53	52.2
16	R2	173	1.0	0.566	10.3	LOS B	4.6	35.5	0.60	0.53	51.4
Approach		1233	2.3	0.566	10.4	LOS B	4.6	35.6	0.60	0.53	52.0
North: Harvest Ridge Rd.											
7	L2	122	1.0	0.450	13.9	LOS B	2.2	16.5	0.73	0.83	48.9
4	T1	3	1.0	0.450	13.9	LOS B	2.2	16.5	0.73	0.83	48.8
14	R2	125	1.0	0.450	13.9	LOS B	2.2	16.5	0.73	0.83	47.5
Approach		250	1.0	0.450	13.9	LOS B	2.2	16.5	0.73	0.83	48.2
West: Grove Dr.											
5	L2	228	1.0	0.610	12.1	LOS B	6.3	49.0	0.69	0.78	50.5
2	T1	985	3.0	0.610	12.2	LOS B	6.3	49.0	0.69	0.78	51.1
12	R2	5	1.0	0.610	12.1	LOS B	6.3	48.9	0.69	0.78	50.2
Approach		1218	2.6	0.610	12.1	LOS B	6.3	49.0	0.69	0.78	51.0
All Vehicles		2887	2.3	0.610	11.8	LOS B	6.3	49.0	0.66	0.68	50.9

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101 [Bus Transfer AM Peak - Year 2040 Traffic]

New Site
Roundabout



MOVEMENT SUMMARY

Site: 101 [Bus Transfer AM Peak - Year 2040 Traffic]

New Site
Roundabout

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Gtove Drive											
3	L2	6	3.0	0.365	6.2	LOS A	2.0	15.7	0.09	0.02	56.3
8	T1	945	3.0	0.365	6.1	LOS A	2.0	15.7	0.09	0.02	56.3
18	R2	19	3.0	0.365	6.0	LOS A	2.0	15.3	0.09	0.02	54.7
Approach		970	3.0	0.365	6.1	LOS A	2.0	15.7	0.09	0.02	56.3
East: Bus Transfer Access											
1	L2	11	100.0	0.143	14.0	LOS B	0.3	3.5	0.60	0.60	48.8
6	T1	1	3.0	0.143	8.3	LOS A	0.3	3.5	0.60	0.60	50.7
16	R2	43	50.0	0.143	11.1	LOS B	0.3	3.5	0.60	0.60	47.9
Approach		55	59.1	0.143	11.6	LOS B	0.3	3.5	0.60	0.60	48.2
North: Grove Drive											
7	L2	3	3.0	0.465	7.6	LOS A	3.0	23.2	0.17	0.06	55.2
4	T1	1181	3.0	0.465	7.4	LOS A	3.0	23.2	0.17	0.06	55.2
14	R2	35	3.0	0.465	7.3	LOS A	2.9	22.6	0.16	0.05	53.6
Approach		1219	3.0	0.465	7.4	LOS A	3.0	23.2	0.17	0.06	55.2
West: MDR access											
5	L2	9	3.0	0.108	9.0	LOS A	0.3	2.7	0.68	0.68	53.4
2	T1	1	3.0	0.108	9.0	LOS A	0.3	2.7	0.68	0.68	53.3
12	R2	42	3.0	0.108	9.0	LOS A	0.3	2.7	0.68	0.68	51.8
Approach		52	3.0	0.108	9.0	LOS A	0.3	2.7	0.68	0.68	52.1
All Vehicles		2296	4.3	0.465	7.0	LOS A	3.0	23.2	0.16	0.07	55.4

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Bus Transfer PM Peak - Year 2040 Traffic]

New Site
Roundabout

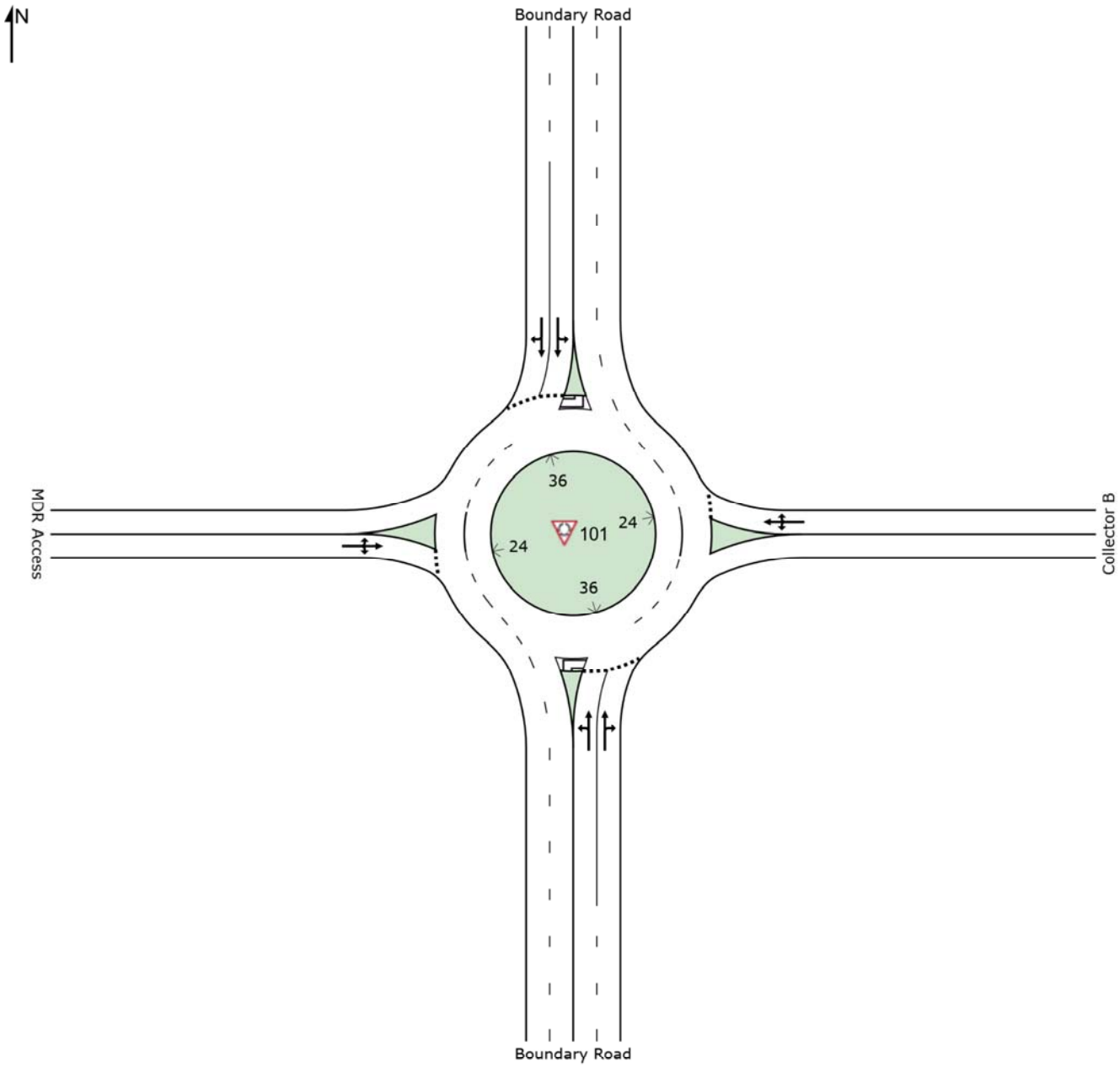
Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Gtove Drive											
3	L2	27	0.0	0.473	7.7	LOS A	3.0	23.7	0.21	0.08	55.1
8	T1	1198	3.0	0.473	7.6	LOS A	3.0	23.7	0.21	0.08	55.0
18	R2	1	0.0	0.473	7.4	LOS A	3.0	23.0	0.20	0.08	53.6
Approach		1226	2.9	0.473	7.6	LOS A	3.0	23.7	0.21	0.08	55.0
East: Bus Transfer Access											
1	L2	1	100.0	0.011	15.5	LOS C	0.0	0.2	0.67	0.61	48.0
6	T1	1	0.0	0.011	7.9	LOS A	0.0	0.2	0.67	0.61	49.9
16	R2	1	100.0	0.011	15.5	LOS C	0.0	0.2	0.67	0.61	47.2
Approach		3	66.7	0.011	13.0	LOS B	0.0	0.2	0.67	0.61	48.3
North: Grove Drive											
7	L2	1	0.0	0.371	6.3	LOS A	2.0	16.0	0.15	0.05	56.4
4	T1	958	3.0	0.371	6.2	LOS A	2.0	16.0	0.15	0.05	56.2
14	R2	13	0.0	0.371	6.0	LOS A	2.0	15.5	0.14	0.05	54.7
Approach		972	3.0	0.371	6.2	LOS A	2.0	16.0	0.15	0.05	56.2
West: MDR access											
5	L2	40	0.0	0.100	7.0	LOS A	0.3	2.6	0.60	0.60	53.1
2	T1	1	0.0	0.100	7.0	LOS A	0.3	2.6	0.60	0.60	52.9
12	R2	20	0.0	0.100	7.0	LOS A	0.3	2.6	0.60	0.60	51.4
Approach		61	0.0	0.100	7.0	LOS A	0.3	2.6	0.60	0.60	52.5
All Vehicles		2262	2.9	0.473	7.0	LOS A	3.0	23.7	0.19	0.08	55.4

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101 [Collector B and Boundary Road AM Peak]

New Site
Roundabout



MOVEMENT SUMMARY

Site: 101 [Collector B and Boundary Road AM Peak]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Boundary Road											
3	L2	17	3.0	0.554	11.4	LOS B	3.3	25.6	0.49	0.36	52.2
8	T1	896	3.0	0.554	11.4	LOS B	3.3	25.6	0.49	0.36	52.1
18	R2	113	3.0	0.554	11.4	LOS B	3.3	25.6	0.49	0.36	50.8
Approach		1026	3.0	0.554	11.4	LOS B	3.3	25.6	0.49	0.36	51.9
East: Collector B											
1	L2	126	3.0	0.465	14.2	LOS B	1.9	14.8	0.64	0.75	48.3
6	T1	1	3.0	0.465	14.2	LOS B	1.9	14.8	0.64	0.75	48.3
16	R2	134	3.0	0.465	14.2	LOS B	1.9	14.8	0.64	0.75	47.0
Approach		261	3.0	0.465	14.2	LOS B	1.9	14.8	0.64	0.75	47.6
North: Boundary Road											
7	L2	145	3.0	0.674	14.7	LOS B	6.9	53.8	0.57	0.47	49.3
4	T1	1126	3.0	0.674	14.7	LOS B	6.9	53.8	0.57	0.47	49.5
14	R2	3	3.0	0.674	14.7	LOS B	6.9	53.8	0.57	0.47	48.7
Approach		1274	3.0	0.674	14.7	LOS B	6.9	53.8	0.57	0.47	49.5
West: MDR Access											
5	L2	18	3.0	0.117	10.7	LOS B	0.3	2.2	0.66	0.66	50.8
2	T1	1	3.0	0.117	10.7	LOS B	0.3	2.2	0.66	0.66	50.9
12	R2	27	3.0	0.117	10.7	LOS B	0.3	2.2	0.66	0.66	49.4
Approach		47	3.0	0.117	10.7	LOS B	0.3	2.2	0.66	0.66	50.0
All Vehicles		2608	3.0	0.674	13.3	LOS B	6.9	53.8	0.55	0.46	50.2

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Collector B and Boundary Road PM Peak]

New Site
Roundabout

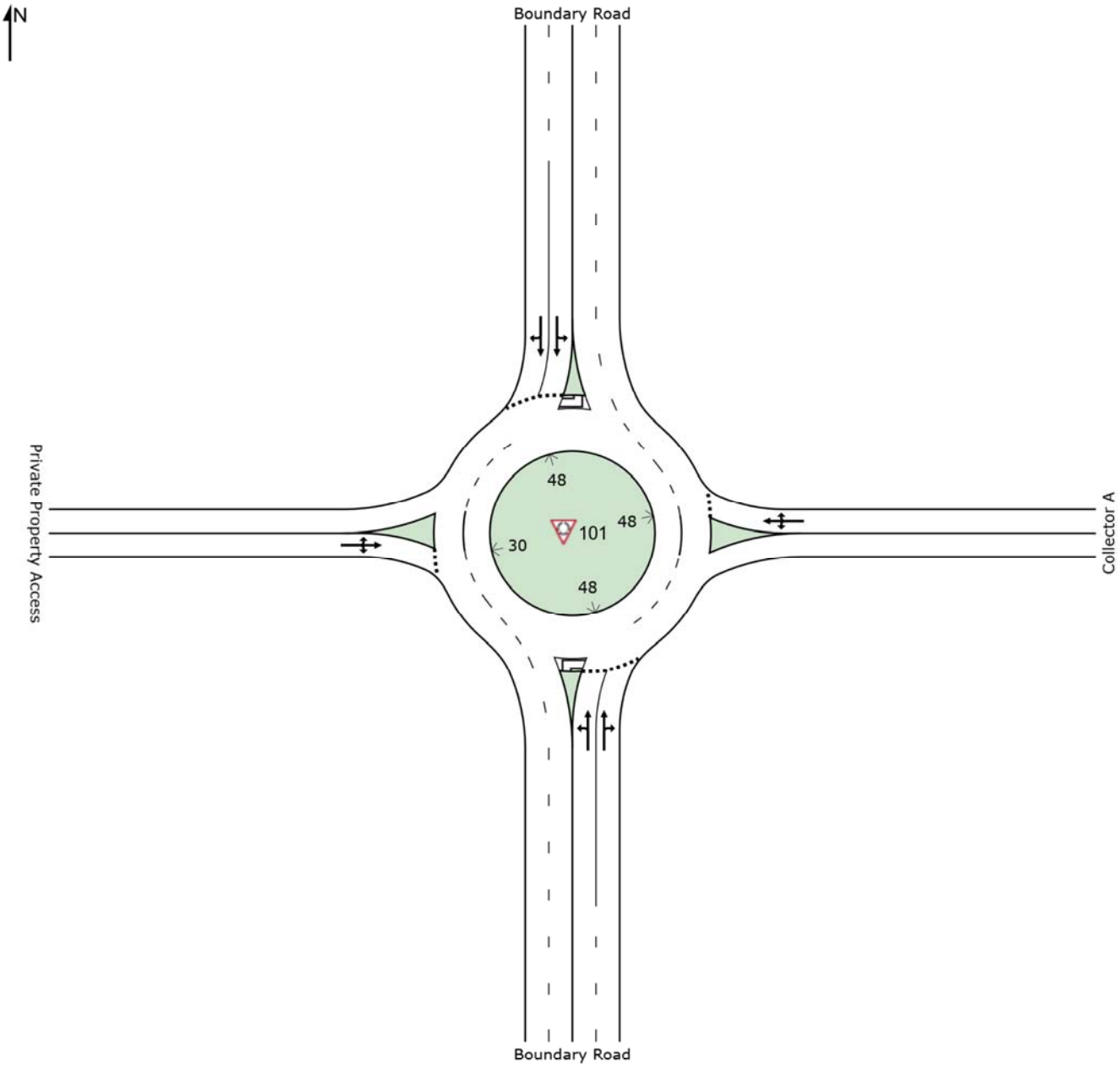
Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Boundary Road											
3	L2	29	3.0	0.663	13.5	LOS B	5.4	42.2	0.40	0.21	50.7
8	T1	1242	3.0	0.663	13.5	LOS B	5.4	42.2	0.40	0.21	50.6
18	R2	87	3.0	0.663	13.5	LOS B	5.4	42.2	0.40	0.21	49.4
Approach		1359	3.0	0.663	13.5	LOS B	5.4	42.2	0.40	0.21	50.5
East: Collector B											
1	L2	62	3.0	0.264	12.5	LOS B	0.7	5.7	0.67	0.70	49.2
6	T1	1	3.0	0.264	12.5	LOS B	0.7	5.7	0.67	0.70	49.2
16	R2	52	3.0	0.264	12.5	LOS B	0.7	5.7	0.67	0.70	47.8
Approach		115	3.0	0.264	12.5	LOS B	0.7	5.7	0.67	0.70	48.6
North: Boundary Road											
7	L2	58	3.0	0.522	10.1	LOS B	3.1	24.5	0.36	0.21	52.9
4	T1	970	3.0	0.522	10.1	LOS B	3.1	24.5	0.36	0.21	52.9
14	R2	14	3.0	0.522	10.1	LOS B	3.1	24.5	0.36	0.21	51.7
Approach		1041	3.0	0.522	10.1	LOS B	3.1	24.5	0.36	0.21	52.8
West: MDR Access											
5	L2	8	3.0	0.046	7.8	LOS A	0.1	0.9	0.56	0.56	53.2
2	T1	1	3.0	0.046	7.8	LOS A	0.1	0.9	0.56	0.56	53.3
12	R2	14	3.0	0.046	7.8	LOS A	0.1	0.9	0.56	0.56	51.6
Approach		23	3.0	0.046	7.8	LOS A	0.1	0.9	0.56	0.56	52.2
All Vehicles		2538	3.0	0.663	12.0	LOS B	5.4	42.2	0.40	0.24	51.4

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101 [Boundary Road and Collector A - AM peak]

New Site
Roundabout



MOVEMENT SUMMARY

Site: 101 [Boundary Road and Collector A - AM peak]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Boundary Road											
3	L2	1	3.0	0.385	6.2	LOS A	2.3	17.6	0.11	0.03	41.7
8	T1	987	3.0	0.385	6.2	LOS A	2.3	17.6	0.11	0.03	58.6
18	R2	52	3.0	0.385	6.2	LOS A	2.3	17.6	0.11	0.03	56.2
Approach		1040	3.0	0.385	6.2	LOS A	2.3	17.6	0.11	0.03	58.5
East: Collector A											
1	L2	132	3.0	0.277	10.0	LOS A	1.0	7.9	0.66	0.67	51.4
6	T1	1	3.0	0.277	10.0	LOS A	1.0	7.9	0.66	0.67	37.9
16	R2	28	3.0	0.277	10.0	LOS A	1.0	7.9	0.66	0.67	49.6
Approach		161	3.0	0.277	10.0	LOS A	1.0	7.9	0.66	0.67	51.0
North: Boundary Road											
7	L2	13	3.0	0.529	8.9	LOS A	3.5	27.5	0.43	0.27	55.9
4	T1	1266	3.0	0.529	8.9	LOS A	3.5	27.5	0.43	0.27	55.2
14	R2	1	3.0	0.529	8.9	LOS A	3.5	27.5	0.43	0.27	41.0
Approach		1280	3.0	0.529	8.9	LOS A	3.5	27.5	0.43	0.27	55.2
West: Private Property Access											
5	L2	1	3.0	0.008	9.1	LOS A	0.0	0.2	0.71	0.65	49.3
2	T1	1	3.0	0.008	9.1	LOS A	0.0	0.2	0.71	0.65	48.3
12	R2	1	3.0	0.008	9.1	LOS A	0.0	0.2	0.71	0.65	45.6
Approach		3	3.0	0.008	9.1	LOS A	0.0	0.2	0.71	0.65	47.7
All Vehicles		2485	3.0	0.529	7.9	LOS A	3.5	27.5	0.31	0.19	56.2

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary Road and Collector A - PM peak]

New Site
Roundabout

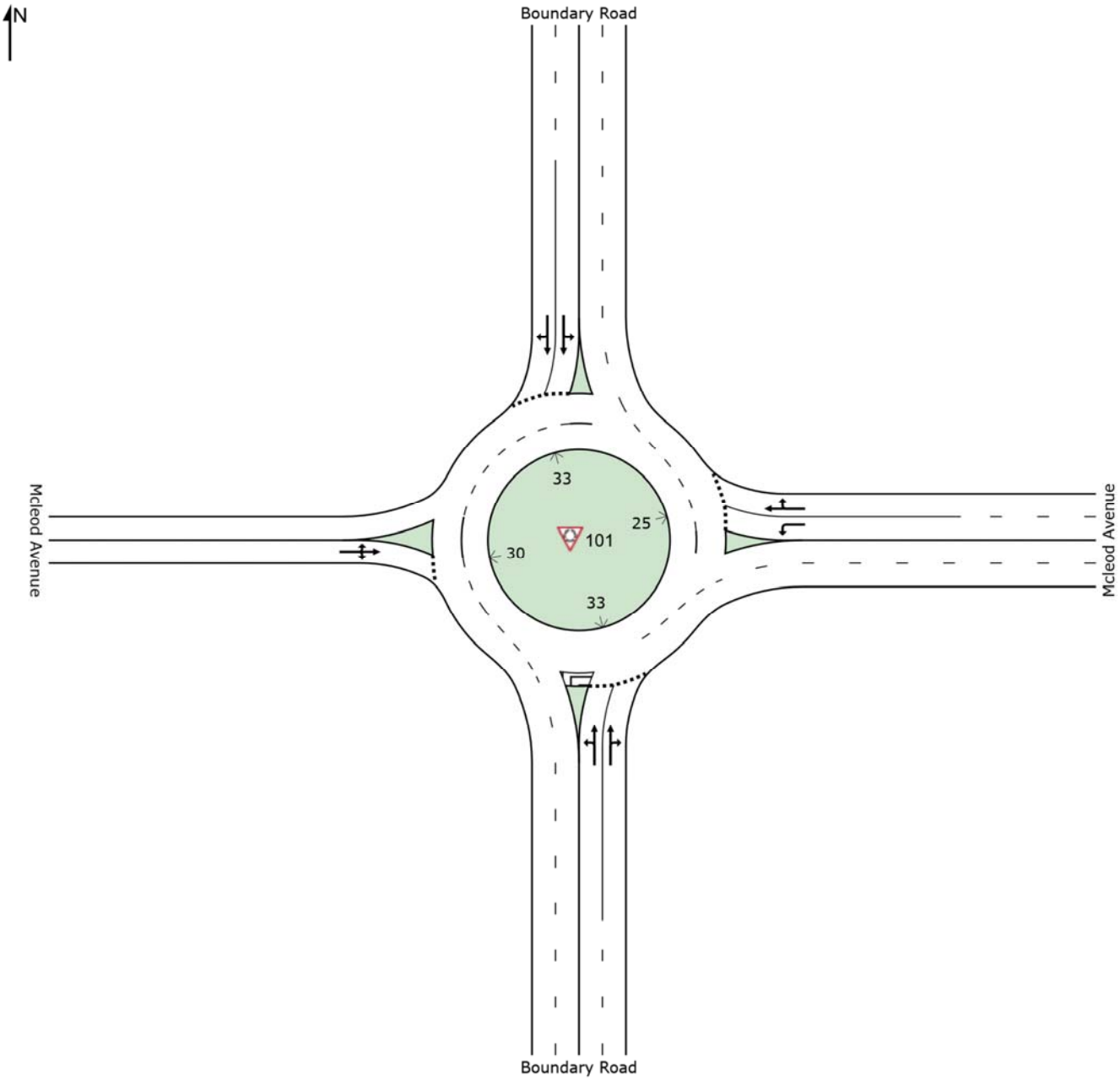
Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Boundary Road											
3	L2	1	3.0	0.562	8.9	LOS A	4.4	34.4	0.21	0.07	39.8
8	T1	1341	3.0	0.562	8.9	LOS A	4.4	34.4	0.21	0.07	56.3
18	R2	158	3.0	0.562	8.9	LOS A	4.4	34.4	0.21	0.07	54.0
Approach		1500	3.0	0.562	8.9	LOS A	4.4	34.4	0.21	0.07	56.0
East: Collector A											
1	L2	95	3.0	0.266	12.8	LOS B	0.9	7.1	0.75	0.77	49.5
6	T1	1	3.0	0.266	12.8	LOS B	0.9	7.1	0.75	0.77	36.3
16	R2	17	3.0	0.266	12.8	LOS B	0.9	7.1	0.75	0.77	47.8
Approach		113	3.0	0.266	12.8	LOS B	0.9	7.1	0.75	0.77	49.1
North: Boundary Road											
7	L2	27	3.0	0.418	7.0	LOS A	2.4	19.0	0.31	0.17	57.3
4	T1	1018	3.0	0.418	7.0	LOS A	2.4	19.0	0.31	0.17	56.6
14	R2	1	3.0	0.418	7.0	LOS A	2.4	19.0	0.31	0.17	42.4
Approach		1047	3.0	0.418	7.0	LOS A	2.4	19.0	0.31	0.17	56.7
West: Private Property Access											
5	L2	1	3.0	0.006	7.2	LOS A	0.0	0.2	0.63	0.53	51.3
2	T1	1	3.0	0.006	7.2	LOS A	0.0	0.2	0.63	0.53	50.3
12	R2	1	3.0	0.006	7.2	LOS A	0.0	0.2	0.63	0.53	47.4
Approach		3	3.0	0.006	7.2	LOS A	0.0	0.2	0.63	0.53	49.6
All Vehicles		2663	3.0	0.562	8.3	LOS A	4.4	34.4	0.27	0.14	55.9

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101 [McLeod Ave and Boundary Road AM Peak]

New Site
Roundabout



MOVEMENT SUMMARY

Site: 101 [McLeod Ave and Boundary Road AM Peak]

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Boundary Road											
3	L2	1	3.0	0.409	6.7	LOS A	2.4	18.8	0.21	0.09	50.7
8	T1	980	3.0	0.409	6.7	LOS A	2.4	18.8	0.21	0.09	52.8
18	R2	84	3.0	0.409	6.7	LOS A	2.4	18.8	0.21	0.09	48.0
Approach		1065	3.0	0.409	6.7	LOS A	2.4	18.8	0.21	0.09	52.3
East: Mcleod Avenue											
1	L2	153	3.0	0.263	9.7	LOS A	0.9	7.3	0.65	0.65	44.8
6	T1	1	3.0	0.116	8.5	LOS A	0.4	3.0	0.63	0.63	44.2
16	R2	59	3.0	0.116	8.5	LOS A	0.4	3.0	0.63	0.63	46.4
Approach		213	3.0	0.263	9.3	LOS A	0.9	7.3	0.65	0.65	45.2
North: Boundary Road											
7	L2	47	3.0	0.606	11.1	LOS B	4.3	33.2	0.52	0.35	47.4
4	T1	1351	3.0	0.606	10.8	LOS B	4.3	33.2	0.50	0.34	50.1
14	R2	1	3.0	0.606	10.6	LOS B	4.2	32.7	0.49	0.33	45.7
Approach		1399	3.0	0.606	10.8	LOS B	4.3	33.2	0.50	0.34	50.0
West: Mcleod Avenue											
5	L2	1	3.0	0.009	10.3	LOS B	0.0	0.2	0.74	0.70	47.7
2	T1	1	3.0	0.009	10.3	LOS B	0.0	0.2	0.74	0.70	47.8
12	R2	1	3.0	0.009	10.3	LOS B	0.0	0.2	0.74	0.70	46.1
Approach		3	3.0	0.009	10.3	LOS B	0.0	0.2	0.74	0.70	47.2
All Vehicles		2680	3.0	0.606	9.1	LOS A	4.3	33.2	0.40	0.26	50.5

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [McLeod Ave and Boundary Road PM Peak]

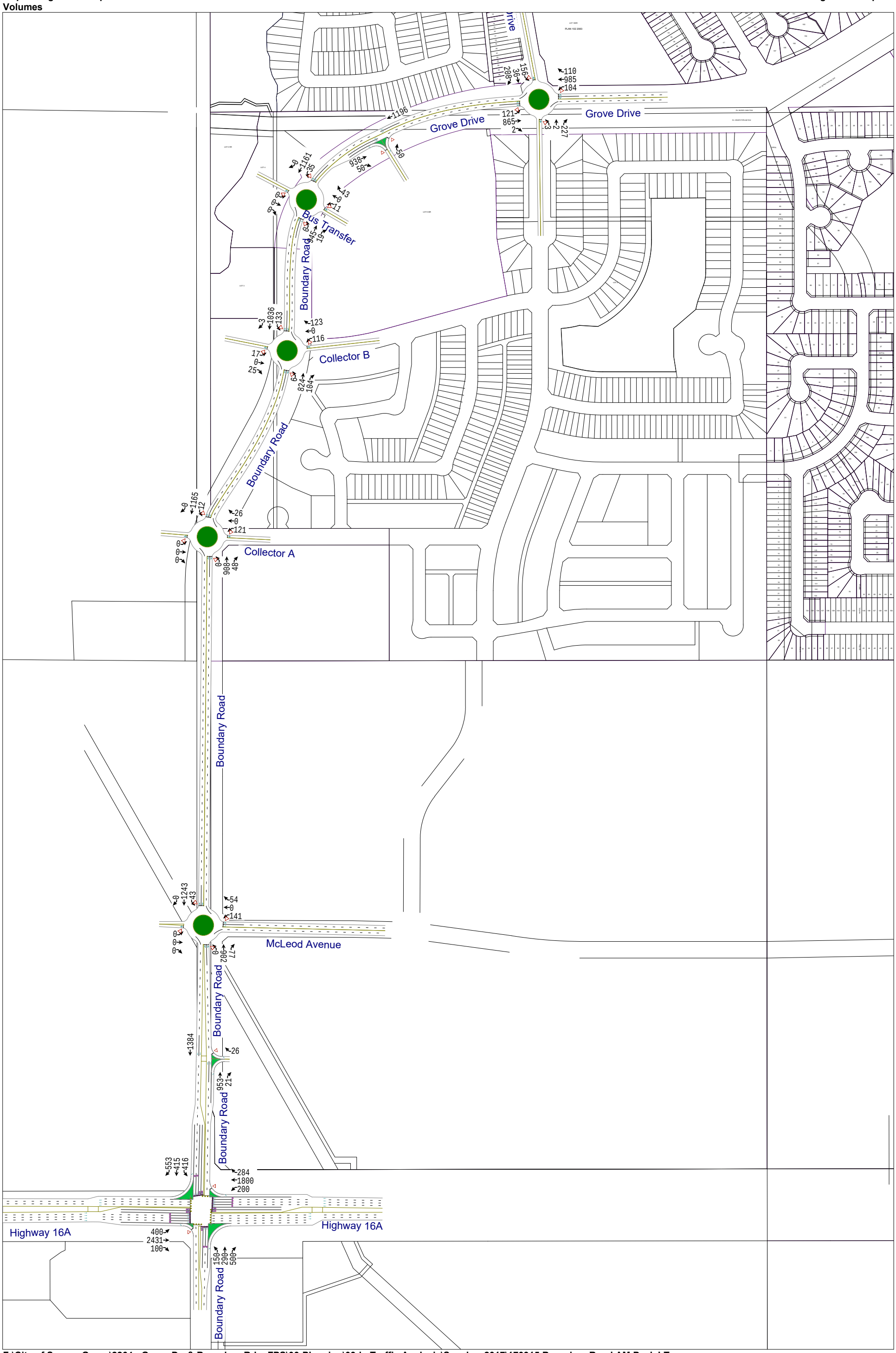
New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Boundary Road											
3	L2	1	3.0	0.387	6.3	LOS A	2.3	17.6	0.11	0.03	51.1
8	T1	987	3.0	0.387	6.3	LOS A	2.3	17.6	0.11	0.03	53.1
18	R2	52	3.0	0.387	6.3	LOS A	2.3	17.6	0.11	0.03	48.2
Approach		1040	3.0	0.387	6.3	LOS A	2.3	17.6	0.11	0.03	52.8
East: Mcleod Avenue											
1	L2	132	3.0	0.227	9.2	LOS A	0.8	6.2	0.64	0.64	45.0
6	T1	1	3.0	0.057	7.7	LOS A	0.2	1.5	0.62	0.62	44.9
16	R2	28	3.0	0.057	7.7	LOS A	0.2	1.5	0.62	0.62	47.0
Approach		161	3.0	0.227	8.9	LOS A	0.8	6.2	0.64	0.64	45.3
North: Boundary Road											
7	L2	13	3.0	0.544	9.6	LOS A	3.5	27.5	0.44	0.28	48.4
4	T1	1266	3.0	0.544	9.4	LOS A	3.5	27.5	0.43	0.27	51.2
14	R2	1	3.0	0.544	9.2	LOS A	3.5	27.1	0.42	0.26	46.8
Approach		1280	3.0	0.544	9.4	LOS A	3.5	27.5	0.43	0.27	51.1
West: Mcleod Avenue											
5	L2	1	3.0	0.008	9.1	LOS A	0.0	0.2	0.71	0.65	48.8
2	T1	1	3.0	0.008	9.1	LOS A	0.0	0.2	0.71	0.65	48.8
12	R2	1	3.0	0.008	9.1	LOS A	0.0	0.2	0.71	0.65	47.1
Approach		3	3.0	0.008	9.1	LOS A	0.0	0.2	0.71	0.65	48.2
All Vehicles		2485	3.0	0.544	8.0	LOS A	3.5	27.5	0.31	0.19	51.4

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Map - Long Term AM peak Volumes

Long Term AM peak



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02-18-2016

Intersection	
Intersection Delay, s/veh	12.7
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	2	2	1	1
Conflicting Circle Lanes	1	1	2	2
Adj Approach Flow, veh/h	988	1199	232	400
Demand Flow Rate, veh/h	1037	1259	243	420
Vehicles Circulating, veh/h	311	132	1199	1146
Vehicles Exiting, veh/h	1255	1310	149	244
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	9.3	8.5	16.2	32.0
Approach LOS	A	A	C	D

Lane	Left	Right	Left	Right	Left	Left
Designated Moves	LT	TR	LT	TR	LTR	LTR
Assumed Moves	LT	TR	LT	TR	LTR	LTR
RT Channelized						
Lane Util	0.470	0.530	0.470	0.530	1.000	1.000
Follow-Up Headway, s	2.535	2.535	2.535	2.535	2.535	2.535
Critical Headway, s	4.544	4.544	4.544	4.544	4.328	4.328
Entry Flow, veh/h	487	550	592	667	243	420
Cap Entry Lane, veh/h	1070	1070	1259	1259	512	536
Entry HV Adj Factor	0.953	0.952	0.952	0.953	0.954	0.953
Flow Entry, veh/h	464	524	563	635	232	400
Cap Entry, veh/h	1020	1019	1199	1200	489	511
V/C Ratio	0.455	0.514	0.470	0.530	0.474	0.784
Control Delay, s/veh	8.7	9.8	8.0	9.0	16.2	32.0
LOS	A	A	A	A	C	D
95th %tile Queue, veh	2	3	3	3	3	7

Intersection	
Intersection Delay, s/veh	9.7
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	2	2
Conflicting Circle Lanes	2	2	1	1
Adj Approach Flow, veh/h	0	54	964	1196
Demand Flow Rate, veh/h	0	57	1012	1256
Vehicles Circulating, veh/h	1268	992	37	12
Vehicles Exiting, veh/h	0	57	1231	1037
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	7.3	13.0	7.1
Approach LOS	-	A	B	A

Lane	Left	Left	Left	Right	Left	Right
Designated Moves	LTR	LTR	LT	R	LT	TR
Assumed Moves	LTR	LTR	LT	R	LT	TR
RT Channelized						
Lane Util	1.000	1.000	0.980	0.020	0.470	0.530
Follow-Up Headway, s	2.535	2.535	2.535	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.544	4.544	4.544	4.544
Entry Flow, veh/h	0	57	992	20	590	666
Cap Entry Lane, veh/h	483	611	1373	1373	1405	1405
Entry HV Adj Factor	1.000	0.947	0.952	0.950	0.953	0.952
Flow Entry, veh/h	0	54	945	19	562	634
Cap Entry, veh/h	483	579	1308	1304	1338	1337
V/C Ratio	0.000	0.093	0.722	0.015	0.420	0.474
Control Delay, s/veh	7.4	7.3	13.2	2.9	6.7	7.5
LOS	A	A	B	A	A	A
95th %tile Queue, veh	0	0	7	0	2	3

Intersection	
Intersection Delay, s/veh	8.1
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	2	2
Conflicting Circle Lanes	2	2	1	1
Adj Approach Flow, veh/h	42	239	934	1172
Demand Flow Rate, veh/h	44	251	980	1231
Vehicles Circulating, veh/h	1350	889	158	128
Vehicles Exiting, veh/h	9	249	1236	1012
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	9.8	10.9	7.1	8.3
Approach LOS	A	B	A	A

Lane	Left	Left	Left	Right	Left	Right
Designated Moves	LTR	LTR	LT	TR	LT	TR
Assumed Moves	LTR	LTR	LT	TR	LT	TR
RT Channelized						
Lane Util	1.000	1.000	0.470	0.530	0.470	0.530
Follow-Up Headway, s	2.535	2.535	2.535	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.544	4.544	4.544	4.544
Entry Flow, veh/h	44	251	461	519	579	652
Cap Entry Lane, veh/h	451	667	1230	1230	1264	1264
Entry HV Adj Factor	0.955	0.952	0.952	0.954	0.952	0.953
Flow Entry, veh/h	42	239	439	495	551	621
Cap Entry, veh/h	430	635	1171	1173	1203	1204
V/C Ratio	0.098	0.376	0.375	0.422	0.458	0.516
Control Delay, s/veh	9.8	10.9	6.8	7.4	7.8	8.7
LOS	A	B	A	A	A	A
95th %tile Queue, veh	0	2	2	2	2	3

Intersection	
Intersection Delay, s/veh	7.4
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	2	2
Conflicting Circle Lanes	2	2	1	1
Adj Approach Flow, veh/h	0	147	956	1177
Demand Flow Rate, veh/h	0	154	1003	1236
Vehicles Circulating, veh/h	1363	953	13	127
Vehicles Exiting, veh/h	0	63	1350	980
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	9.1	6.0	8.3
Approach LOS	-	A	A	A

Lane	Left	Left	Left	Right	Left	Right
Designated Moves	LTR	LTR	LT	TR	LT	TR
Assumed Moves	LTR	LTR	LT	TR	LT	TR
RT Channelized						
Lane Util	1.000	1.000	0.470	0.530	0.470	0.530
Follow-Up Headway, s	2.535	2.535	2.535	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.544	4.544	4.544	4.544
Entry Flow, veh/h	0	154	471	532	581	655
Cap Entry Lane, veh/h	446	632	1403	1403	1265	1265
Entry HV Adj Factor	1.000	0.955	0.954	0.952	0.952	0.952
Flow Entry, veh/h	0	147	449	506	553	624
Cap Entry, veh/h	446	603	1338	1336	1204	1205
V/C Ratio	0.000	0.244	0.336	0.379	0.459	0.518
Control Delay, s/veh	8.1	9.1	5.7	6.2	7.8	8.7
LOS	A	A	A	A	A	A
95th %tile Queue, veh	0	1	1	2	2	3

Intersection	
Intersection Delay, s/veh	8.3
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	2	2	2
Conflicting Circle Lanes	2	2	1	2
Adj Approach Flow, veh/h	0	195	979	1286
Demand Flow Rate, veh/h	0	205	1028	1350
Vehicles Circulating, veh/h	1498	947	45	148
Vehicles Exiting, veh/h	0	126	1453	1004
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	9.4	6.3	9.7
Approach LOS	-	A	A	A

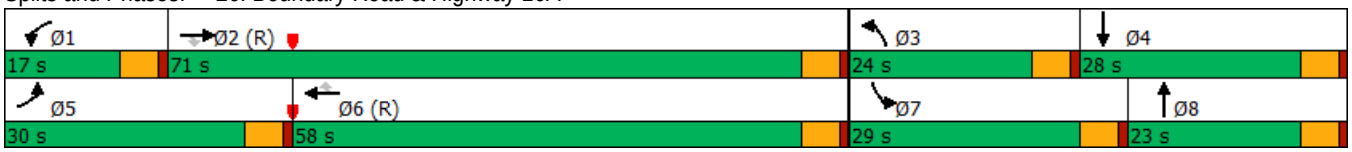
Lane	Left	Left	Right	Left	Right	Left	Right
Designated Moves	LTR	L	TR	LT	TR	LT	TR
Assumed Moves	LTR	L	TR	LT	TR	LT	TR
RT Channelized							
Lane Util	1.000	0.722	0.278	0.470	0.530	0.470	0.530
Follow-Up Headway, s	2.535	2.667	2.535	2.535	2.535	2.667	2.535
Critical Headway, s	4.328	4.645	4.328	4.544	4.544	4.645	4.328
Entry Flow, veh/h	0	148	57	483	545	634	716
Cap Entry Lane, veh/h	397	565	635	1363	1363	1178	1252
Entry HV Adj Factor	1.000	0.953	0.947	0.953	0.952	0.953	0.952
Flow Entry, veh/h	0	141	54	460	519	604	682
Cap Entry, veh/h	397	538	601	1298	1298	1123	1192
V/C Ratio	0.000	0.262	0.090	0.354	0.400	0.538	0.572
Control Delay, s/veh	9.1	10.4	7.0	6.1	6.6	9.6	9.8
LOS	A	B	A	A	A	A	A
95th %tile Queue, veh	0	1	0	2	2	3	4

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	400	2431	100	200	1800	284	150	290	500	416	415	553
Future Volume (vph)	400	2431	100	200	1800	284	150	290	500	416	415	553
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	100.0		100.0	100.0		200.0	60.0		60.0	100.0		100.0
Storage Lanes	2		1	2		1	1		1	2		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Satd. Flow (prot)	3283	6128	1514	3283	6128	1514	1692	3385	1514	3283	3385	1514
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3283	6128	1514	3283	6128	1514	1692	3385	1514	3283	3385	1514
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			97			284			305			422
Link Speed (k/h)		70			70			70			70	
Link Distance (m)		156.0			168.3			143.9			219.7	
Travel Time (s)		8.0			8.7			7.4			11.3	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Shared Lane Traffic (%)												
Lane Group Flow (vph)	400	2431	100	200	1800	284	150	290	500	416	415	553
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		9.0			9.0			7.4			9.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.0			4.0			4.0			4.0	
Two way Left Turn Lane												
Headway Factor	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6			Free			Free
Detector Phase	5	2	2	1	6	6	3	8		7	4	
Switch Phase												
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0		7.0	7.0	
Minimum Split (s)	12.0	23.0	23.0	12.0	23.0	23.0	12.0	23.0		12.0	23.0	
Total Split (s)	30.0	71.0	71.0	17.0	58.0	58.0	24.0	23.0		29.0	28.0	
Total Split (%)	21.4%	50.7%	50.7%	12.1%	41.4%	41.4%	17.1%	16.4%		20.7%	20.0%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Recall Mode	None	C-Max	C-Max	None	C-Max	C-Max	None	None		None	None	
Act Effct Green (s)	21.7	69.9	69.9	12.1	60.3	60.3	16.4	16.3	140.0	21.7	21.6	140.0
Actuated g/C Ratio	0.16	0.50	0.50	0.09	0.43	0.43	0.12	0.12	1.00	0.16	0.15	1.00
v/c Ratio	0.79	0.79	0.12	0.71	0.68	0.35	0.76	0.74	0.33	0.82	0.79	0.37
Control Delay	68.4	32.3	4.4	76.4	34.9	4.4	83.5	71.5	0.6	70.6	68.9	0.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	68.4	32.3	4.4	76.4	34.9	4.4	83.5	71.5	0.6	70.6	68.9	0.7
LOS	E	C	A	E	C	A	F	E	A	E	E	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		36.2			34.7			35.7			42.2	
Approach LOS		D			C			D			D	
Queue Length 50th (m)	55.4	167.9	0.4	27.8	119.1	0.0	40.5	41.1	0.0	57.6	58.6	0.0
Queue Length 95th (m)	71.6	183.4	10.2	#43.0	141.0	18.1	63.7	56.6	0.0	75.1	77.0	0.0
Internal Link Dist (m)		132.0			144.3			119.9			195.7	
Turn Bay Length (m)	100.0		100.0	100.0		200.0	60.0		60.0	100.0		100.0
Base Capacity (vph)	586	3061	805	291	2640	813	229	435	1514	562	556	1514
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.79	0.12	0.69	0.68	0.35	0.66	0.67	0.33	0.74	0.75	0.37

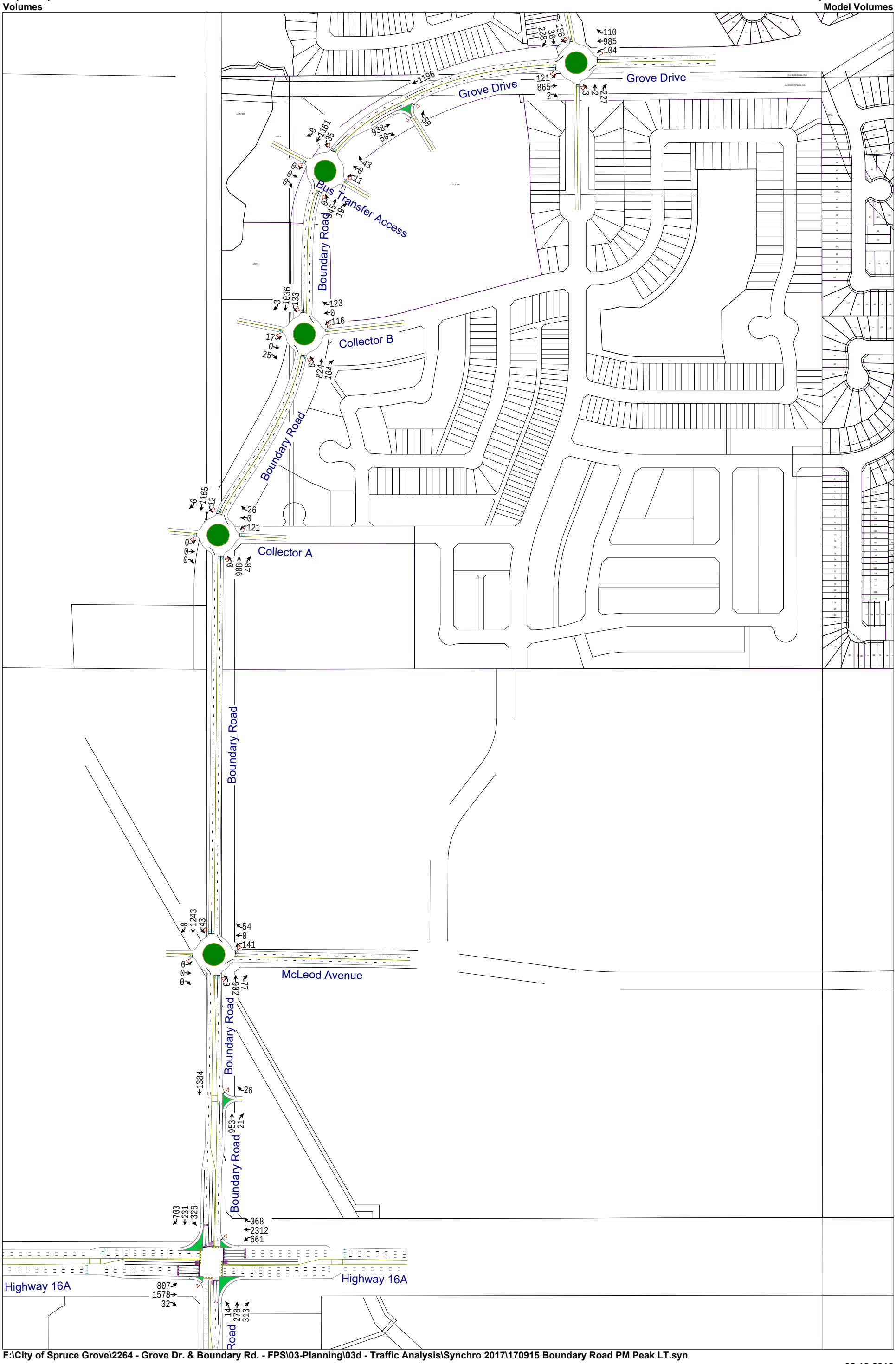
Intersection Summary			
Area Type:	Other		
Cycle Length: 140			
Actuated Cycle Length: 140			
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.82			
Intersection Signal Delay: 36.8		Intersection LOS: D	
Intersection Capacity Utilization 79.1%		ICU Level of Service D	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 26: Boundary Road & Highway 16A



Map - PM peak - Year 2040
Volumes

PM peak - Year 2040
Model Volumes



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02-18-2016

Intersection	
Intersection Delay, s/veh	12.7
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	2	2	1	1
Conflicting Circle Lanes	1	1	2	2
Adj Approach Flow, veh/h	988	1199	232	400
Demand Flow Rate, veh/h	1037	1259	243	420
Vehicles Circulating, veh/h	311	132	1199	1146
Vehicles Exiting, veh/h	1255	1310	149	244
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	9.3	8.5	16.2	32.0
Approach LOS	A	A	C	D

Lane	Left	Right	Left	Right	Left	Left
Designated Moves	LT	TR	LT	TR	LTR	LTR
Assumed Moves	LT	TR	LT	TR	LTR	LTR
RT Channelized						
Lane Util	0.470	0.530	0.470	0.530	1.000	1.000
Follow-Up Headway, s	2.535	2.535	2.535	2.535	2.535	2.535
Critical Headway, s	4.544	4.544	4.544	4.544	4.328	4.328
Entry Flow, veh/h	487	550	592	667	243	420
Cap Entry Lane, veh/h	1070	1070	1259	1259	512	536
Entry HV Adj Factor	0.953	0.952	0.952	0.953	0.954	0.953
Flow Entry, veh/h	464	524	563	635	232	400
Cap Entry, veh/h	1020	1019	1199	1200	489	511
V/C Ratio	0.455	0.514	0.470	0.530	0.474	0.784
Control Delay, s/veh	8.7	9.8	8.0	9.0	16.2	32.0
LOS	A	A	A	A	C	D
95th %tile Queue, veh	2	3	3	3	3	7

Intersection	
Intersection Delay, s/veh	9.7
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	2	2
Conflicting Circle Lanes	2	2	1	1
Adj Approach Flow, veh/h	0	54	964	1196
Demand Flow Rate, veh/h	0	57	1012	1256
Vehicles Circulating, veh/h	1268	992	37	12
Vehicles Exiting, veh/h	0	57	1231	1037
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	7.3	13.0	7.1
Approach LOS	-	A	B	A

Lane	Left	Left	Left	Right	Left	Right
Designated Moves	LTR	LTR	LT	R	LT	TR
Assumed Moves	LTR	LTR	LT	R	LT	TR
RT Channelized						
Lane Util	1.000	1.000	0.980	0.020	0.470	0.530
Follow-Up Headway, s	2.535	2.535	2.535	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.544	4.544	4.544	4.544
Entry Flow, veh/h	0	57	992	20	590	666
Cap Entry Lane, veh/h	483	611	1373	1373	1405	1405
Entry HV Adj Factor	1.000	0.947	0.952	0.950	0.953	0.952
Flow Entry, veh/h	0	54	945	19	562	634
Cap Entry, veh/h	483	579	1308	1304	1338	1337
V/C Ratio	0.000	0.093	0.722	0.015	0.420	0.474
Control Delay, s/veh	7.4	7.3	13.2	2.9	6.7	7.5
LOS	A	A	B	A	A	A
95th %tile Queue, veh	0	0	7	0	2	3

Intersection	
Intersection Delay, s/veh	8.1
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	2	2
Conflicting Circle Lanes	2	2	1	1
Adj Approach Flow, veh/h	42	239	934	1172
Demand Flow Rate, veh/h	44	251	980	1231
Vehicles Circulating, veh/h	1350	889	158	128
Vehicles Exiting, veh/h	9	249	1236	1012
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	9.8	10.9	7.1	8.3
Approach LOS	A	B	A	A

Lane	Left	Left	Left	Right	Left	Right
Designated Moves	LTR	LTR	LT	TR	LT	TR
Assumed Moves	LTR	LTR	LT	TR	LT	TR
RT Channelized						
Lane Util	1.000	1.000	0.470	0.530	0.470	0.530
Follow-Up Headway, s	2.535	2.535	2.535	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.544	4.544	4.544	4.544
Entry Flow, veh/h	44	251	461	519	579	652
Cap Entry Lane, veh/h	451	667	1230	1230	1264	1264
Entry HV Adj Factor	0.955	0.952	0.952	0.954	0.952	0.953
Flow Entry, veh/h	42	239	439	495	551	621
Cap Entry, veh/h	430	635	1171	1173	1203	1204
V/C Ratio	0.098	0.376	0.375	0.422	0.458	0.516
Control Delay, s/veh	9.8	10.9	6.8	7.4	7.8	8.7
LOS	A	B	A	A	A	A
95th %tile Queue, veh	0	2	2	2	2	3

Intersection	
Intersection Delay, s/veh	7.4
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	2	2
Conflicting Circle Lanes	2	2	1	1
Adj Approach Flow, veh/h	0	147	956	1177
Demand Flow Rate, veh/h	0	154	1003	1236
Vehicles Circulating, veh/h	1363	953	13	127
Vehicles Exiting, veh/h	0	63	1350	980
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	9.1	6.0	8.3
Approach LOS	-	A	A	A

Lane	Left	Left	Left	Right	Left	Right
Designated Moves	LTR	LTR	LT	TR	LT	TR
Assumed Moves	LTR	LTR	LT	TR	LT	TR
RT Channelized						
Lane Util	1.000	1.000	0.470	0.530	0.470	0.530
Follow-Up Headway, s	2.535	2.535	2.535	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.544	4.544	4.544	4.544
Entry Flow, veh/h	0	154	471	532	581	655
Cap Entry Lane, veh/h	446	632	1403	1403	1265	1265
Entry HV Adj Factor	1.000	0.955	0.954	0.952	0.952	0.952
Flow Entry, veh/h	0	147	449	506	553	624
Cap Entry, veh/h	446	603	1338	1336	1204	1205
V/C Ratio	0.000	0.244	0.336	0.379	0.459	0.518
Control Delay, s/veh	8.1	9.1	5.7	6.2	7.8	8.7
LOS	A	A	A	A	A	A
95th %tile Queue, veh	0	1	1	2	2	3

Intersection	
Intersection Delay, s/veh	8.3
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	2	2	2
Conflicting Circle Lanes	2	2	1	2
Adj Approach Flow, veh/h	0	195	979	1286
Demand Flow Rate, veh/h	0	205	1028	1350
Vehicles Circulating, veh/h	1498	947	45	148
Vehicles Exiting, veh/h	0	126	1453	1004
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	9.4	6.3	9.7
Approach LOS	-	A	A	A

Lane	Left	Left	Right	Left	Right	Left	Right
Designated Moves	LTR	L	TR	LT	TR	LT	TR
Assumed Moves	LTR	L	TR	LT	TR	LT	TR
RT Channelized							
Lane Util	1.000	0.722	0.278	0.470	0.530	0.470	0.530
Follow-Up Headway, s	2.535	2.667	2.535	2.535	2.535	2.667	2.535
Critical Headway, s	4.328	4.645	4.328	4.544	4.544	4.645	4.328
Entry Flow, veh/h	0	148	57	483	545	634	716
Cap Entry Lane, veh/h	397	565	635	1363	1363	1178	1252
Entry HV Adj Factor	1.000	0.953	0.947	0.953	0.952	0.953	0.952
Flow Entry, veh/h	0	141	54	460	519	604	682
Cap Entry, veh/h	397	538	601	1298	1298	1123	1192
V/C Ratio	0.000	0.262	0.090	0.354	0.400	0.538	0.572
Control Delay, s/veh	9.1	10.4	7.0	6.1	6.6	9.6	9.8
LOS	A	B	A	A	A	A	A
95th %tile Queue, veh	0	1	0	2	2	3	4

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	807	1578	32	661	2312	368	14	278	313	326	231	700
Future Volume (vph)	807	1578	32	661	2312	368	14	278	313	326	231	700
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Storage Length (m)	100.0		100.0	100.0		200.0	60.0		60.0	100.0		100.0
Storage Lanes	2		1	2		1	1		1	2		1
Taper Length (m)	30.0			30.0			30.0			30.0		
Satd. Flow (prot)	3283	6128	1514	3283	6128	1514	1692	3385	1514	3283	3385	1514
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3283	6128	1514	3283	6128	1514	1692	3385	1514	3283	3385	1514
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			132			183			313			583
Link Speed (k/h)		70			70			70			70	
Link Distance (m)		156.0			168.3			143.9			219.7	
Travel Time (s)		8.0			8.7			7.4			11.3	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Shared Lane Traffic (%)												
Lane Group Flow (vph)	807	1578	32	661	2312	368	14	278	313	326	231	700
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6			Free			Free
Detector Phase	5	2	2	1	6	6	3	8		7	4	
Switch Phase												
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0		7.0	7.0	
Minimum Split (s)	12.0	23.0	23.0	12.0	23.0	23.0	12.0	23.0		12.0	23.0	
Total Split (s)	40.0	55.0	55.0	43.0	58.0	58.0	12.0	23.0		19.0	30.0	
Total Split (%)	28.6%	39.3%	39.3%	30.7%	41.4%	41.4%	8.6%	16.4%		13.6%	21.4%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Recall Mode	None	C-Max	C-Max	None	C-Max	C-Max	None	None		None	None	
Act Effct Green (s)	36.3	57.1	57.1	32.9	53.7	53.7	7.0	16.0	140.0	14.0	30.2	140.0
Actuated g/C Ratio	0.26	0.41	0.41	0.24	0.38	0.38	0.05	0.11	1.00	0.10	0.22	1.00
v/c Ratio	0.95	0.63	0.05	0.86	0.98	0.53	0.17	0.72	0.21	0.99	0.32	0.46
Control Delay	71.6	35.3	0.1	62.9	57.7	19.2	68.4	70.7	0.3	110.4	48.5	1.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	71.6	35.3	0.1	62.9	57.7	19.2	68.4	70.7	0.3	110.4	48.5	1.0
LOS	E	D	A	E	E	B	E	E	A	F	D	A
Approach Delay		47.0			54.5			34.2			38.1	
Approach LOS		D			D			C			D	
Queue Length 50th (m)	113.7	101.8	0.0	90.6	184.6	38.8	3.8	39.4	0.0	47.2	27.1	0.0
Queue Length 95th (m)	#156.8	123.0	0.0	108.3	#214.0	69.4	11.3	54.3	0.0	#78.4	43.1	0.0
Internal Link Dist (m)		132.0			144.3			119.9			195.7	
Turn Bay Length (m)	100.0		100.0	100.0		200.0	60.0		60.0	100.0		100.0
Base Capacity (vph)	850	2500	695	891	2351	693	84	435	1514	328	730	1514
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.95	0.63	0.05	0.74	0.98	0.53	0.17	0.64	0.21	0.99	0.32	0.46

Intersection Summary			
Area Type:	Other		
Cycle Length: 140			
Actuated Cycle Length: 140			
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green			
Natural Cycle: 130			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.99			
Intersection Signal Delay: 47.8		Intersection LOS: D	
Intersection Capacity Utilization 92.2%		ICU Level of Service F	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 26: Boundary Road & Highway 16A

Appendix M

Grove Drive Storm Design Charts

Grove Drive – Preliminary Storm Design Chart: 0+000-0+970

Grove Drive – Preliminary Storm Design Chart: 1+125-1+250

Grove Drive – Detailed Storm Design Chart: 1+400-1+900

Al-Terra

CIty of Spruce Grove

STORM SEWER DESIGN SHEET

PROJECT: Grove Drive Functional Plan
JOB NO.: 2264
DATE: February 22, 2018

DESIGN FLOW PARAMETERS
$T_{c=}$ 10.00
Cr= 0.95
Cb= 0.25

5 YEAR RETURN PERIOD IDF PARAMETERS:
a = 335.26
b = -0.654
c = 1.542

PIPE ROUGHNESS:
n= 0.013

COMPUTED BY: Derek Porter

Location	From MH	To MH	DESIGN FLOW CALCULATIONS									SEWER DESIGN & ANALYSIS						
			Area, A			C	C*A	Cumulative Area	Cumulative C*A	T_c	I	Required Design Capacity, Q_c	Nominal Pipe Diameter	Pipe Slope	Pipe Length	Full Flow Capacity, Q_f	Percent of Full Flow Q_c/Q_f	Full Flow Velocity, V_f	Time in Pipe
			Blvd (ha)	Road (ha)	Total (ha)			(ha)		(min)	(mm/hr)	(m^3/s)	(mm)	(%)	(m)	(m^3/s)	(%)	(m/s)	(min)
GROVE DRIVE WEST																			
1+125	STMH 480	STMH 470	0.183	0.550	0.734	0.78	0.57	0.73	0.57	10.00	67.71	0.107	375	0.50%	128.8	0.129	83%	1.134	1.89
1+250	Plug	STMH 470	From Select		1.210	0.65	0.79	1.21	0.79	10.00	67.71	0.148	450	0.50%	70.9	0.210	70%	1.281	0.92
1+250	STMH 470	STMH 460	0.228	0.684	0.912	0.78	0.71	2.86	2.06	11.89	61.31	0.351	600	0.50%	80.6	0.453	78%	1.552	0.87

CIty of Spruce Grove

STORM SEWER DESIGN SHEET

5307 - 47 Street NW, Edmonton, Alberta, T6B 3T4
Tel: 780-440-4411 Fax: 780-440-2585

PROJECT: Grove Drive West 2017
JOB NO.: 2265
DATE: February 22, 2017

DESIGN FLOW PARAMETERS
$T_{c=}$ 10.00
Cr= 0.95
Cb= 0.25

5 YEAR RETURN PERIOD IDF PARAMETERS:
a = 335.26
b = -0.654
c = 1.542

PIPE ROUGHNESS:
n= 0.013

COMPUTED BY: Derek Porter
CHECKED BY: Brad Crossland

Location	From MH	To MH	DESIGN FLOW CALCULATIONS										SEWER DESIGN & ANALYSIS							Hydraulic Gradeline Analysis					
			Area, A			C	C*A	Cumulative Area	Cumulative C*A	T_c	I	Required Design Capacity, Q_c	Nominal Pipe Diameter	Pipe Slope	Pipe Length	Full Flow Capacity, Q_f	Percent of Full Flow Q_c/Q_f	Full Flow Velocity, V_f	Time in Pipe	Friction Slope	U/S Head Loss in MH	U/S HGL	D/S HGL	U/S Depth below Grade	U/S Depth of Surcharge
			Blvd (ha)	Road (ha)	Total (ha)			(ha)		(min)	(mm/hr)	(m^3/s)	(mm)	(%)	(m)	(m^3/s)	(%)	(m/s)	(min)	(%)	(m)	(m)	(m)	(m)	(m)
GROVE DRIVE WEST 2017																									
Lot 3 Block 1	Plug	FUT STMH 1	From Select		0.850	0.65	0.55	0.85	0.55	10.00	67.71	0.104	525	0.45%	33.0	0.301	35%	1.347	0.41						
0+605	FUT STMH 1	FUT STMH 2	0.361	0.238	0.599	0.53	0.32	1.45	0.87	10.41	66.19	0.160	525	0.35%	67.6	0.265	60%	1.188	0.95	0.14	0.005	687.995	687.902	2.705	-0.530
Lot 4 Block 1	Plug	FUT STMH 2	From Select		0.880	0.65	0.57	0.88	0.57	10.00	67.71	0.108	525	0.55%	33.0	0.333	32%	1.489	0.37						
0+675	FUT STMH 2	STMH3	0.257	0.122	0.379	0.48	0.18	2.71	1.62	11.36	62.96	0.284	600	0.35%	69.3	0.379	75%	1.298	0.89	0.21	0.006	687.896	687.749	2.384	-0.342
Onsite School Overflow	Parking Lot	STMH 3			1.320	0.65	0.86	1.32	0.86	10.00	67.71	0.161	1:100 Year overflow drainage from SW bus loop												
0+700	STMH 3	STMH 4	0.173	0.253	0.426	0.67	0.28	4.45	2.76	12.25	60.28	0.463	675	0.30%	135.6	0.480	96%	1.300	1.74	0.30	0.006	687.743	687.332	2.057	-0.203
0+780	STMH 4	STMH 5	0.451	0.280	0.731	0.52	0.38	5.18	3.14	13.98	55.77	0.487	750	0.20%	65.2	0.519	94%	1.139	0.95	0.19	0.004	687.328	687.204	1.962	-0.161
Onsite School Drainage	Parking Lot	STMH 5	From The Workun Garrick Partnership - IFT New K-9 School Drawing									0.197													
0+885	STMH 5	STMH 6	0.000	0.000	0.000	0.89	0.00	5.18	3.14	14.94	53.64	0.665	900	0.15%	121.2	0.731	91%	1.114	1.81	0.13	0.003	687.201	687.038	2.389	-0.108
1+005	STMH 6	STMH 7	0.675	0.325	1.000	0.48	0.48	6.18	3.62	16.75	50.10	0.700	900	0.15%	70.9	0.731	96%	1.114	1.06	0.15	0.003	687.035	686.929	1.785	-0.042
1+080	STMH 7	STMH 8	0.127	0.237	0.363	0.71	0.26	6.55	3.88	17.81	48.29	0.716	900	0.15%	78.3	0.731	98%	1.114	1.17	0.16	0.003	686.926	686.804	2.674	0.005
	STMH 8	STMH 9	0.000	0.000	0.000	0.60	0.00	6.18	3.62	17.81	48.29	0.682	1200	0.28%	13.3	2.152	32%	1.844	0.12						

CIty of Spruce Grove

STORM SEWER DESIGN SHEET

PROJECT: Grove Drive Functional Plan
JOB NO.: 2264
DATE: February 22, 2018

DESIGN FLOW PARAMETERS
$T_{c=}$ 10.00
Cr= 0.95
Cb= 0.25

5 YEAR RETURN PERIOD IDF PARAMETERS:
a = 335.26
b = -0.654
c = 1.542

PIPE ROUGHNESS:
n= 0.013

COMPUTED BY: Derek Porter

Location	From MH	To MH	DESIGN FLOW CALCULATIONS										SEWER DESIGN & ANALYSIS						
			Area, A			C	C*A	Cumulative Area	Cumulative C*A	T_c	I	Required Design Capacity, Q_c	Nominal Pipe Diameter	Pipe Slope	Pipe Length	Full Flow Capacity, Q_f	Percent of Full Flow Q_c/Q_f	Full Flow Velocity, V_f	Time in Pipe
			Blvd (ha)	Road (ha)	Total (ha)			(ha)		(min)	(mm/hr)	(m^3/s)	(mm)	(%)	(m)	(m^3/s)	(%)	(m/s)	(min)
GROVE DRIVE WEST																			
0+030	STMH 2030	STMH 2020	0.375	1.126	1.501	0.78	1.16	1.50	1.16	10.00	67.71	0.219	450	0.60%	107.1	0.230	95%	1.403	1.27
0+135	STMH 2020	STMH 2010	0.000	0.000	0.000	0.78	0.00	1.50	1.16	11.27	63.23	0.204	450	0.60%	110.2	0.230	89%	1.403	1.31
0+250	STMH 2010	STMH 2000	0.161	0.483	0.644	0.78	0.50	2.15	1.66	12.58	59.34	0.274	450	1.00%	92.4	0.297	92%	1.812	0.85
0+390	STMH 2000	STMH 1030	0.117	0.350	0.467	0.78	0.36	2.61	2.03	13.43	57.11	0.321	525	0.60%	162.7	0.348	92%	1.555	1.74
0+500	STMH 1030	STMH 1020	0.223	0.670	0.893	0.78	0.69	3.51	2.72	15.17	53.14	0.401	600	0.60%	89.2	0.496	81%	1.700	0.87
0+580	STMH 1020	STMH1010	0.113	0.339	0.452	0.78	0.35	3.96	3.07	16.05	51.40	0.438	600	0.70%	125.0	0.536	82%	1.836	1.13
0+715	STMH 1010	STMH 1000	0.169	0.506	0.675	0.78	0.52	4.63	3.59	17.18	49.34	0.492	600	0.80%	120.0	0.573	86%	1.963	1.02
0+830	STMH 1000	STMH 990	0.163	0.489	0.652	0.78	0.51	5.28	4.10	18.20	47.66	0.542	675	1.00%	135.3	0.877	62%	2.374	0.95
0+970	STMH 990	STMH 970	0.237	0.711	0.948	0.78	0.73	6.23	4.83	19.15	46.22	0.620	750	0.50%	117.7	0.821	76%	1.801	1.09

Appendix N

Trans Mountain Plan Profile Pipeline Drawing

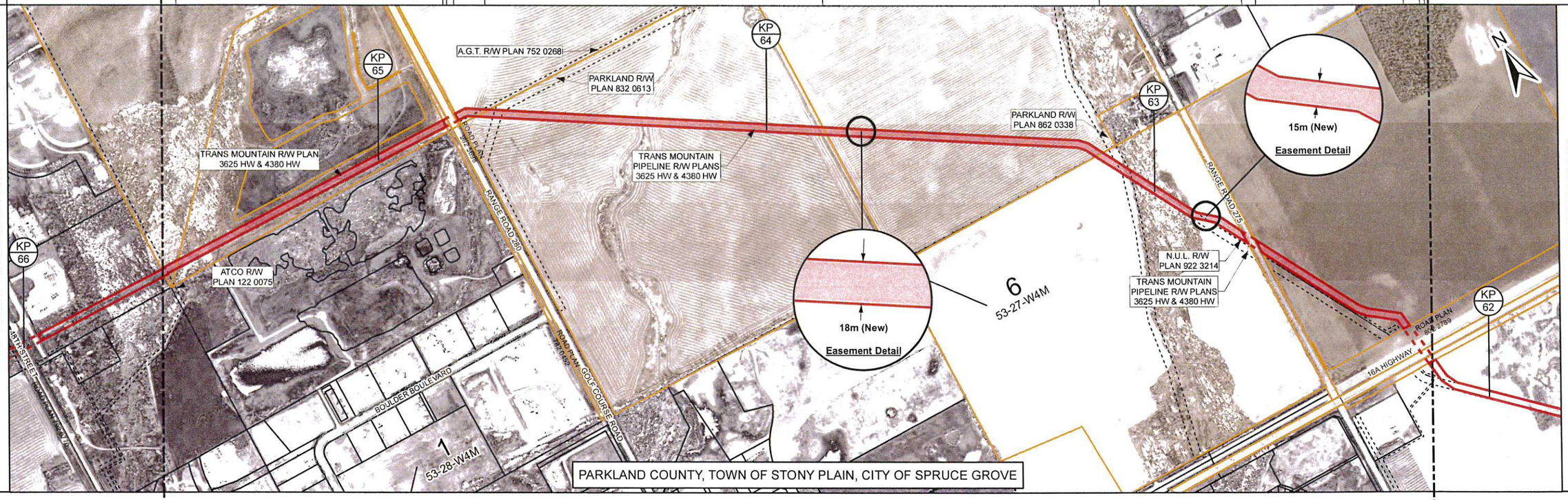
KP 62+168 to KP 65+610

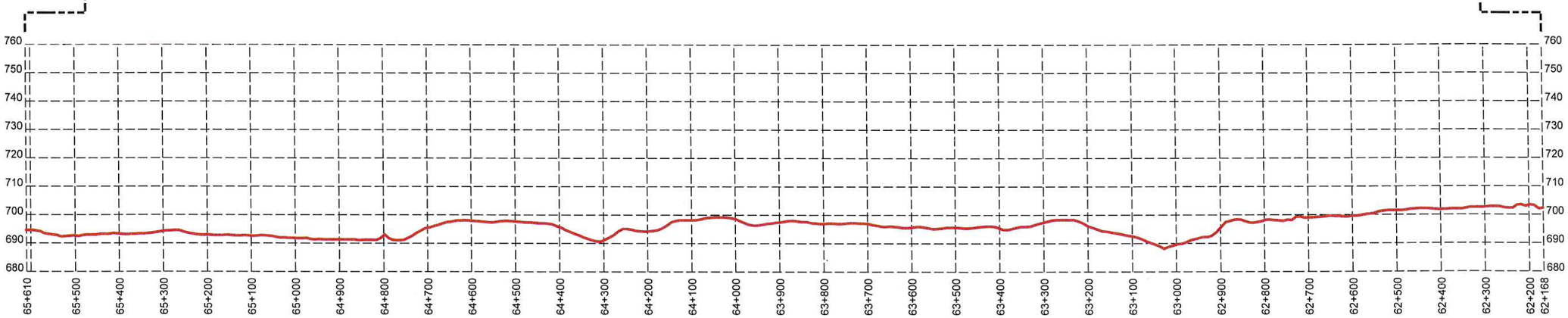
Al-Terra

TRACT NUMBER: 227 | 226 | 225 | 224 | 223 | 222 | 221

FOR CONTINUATION SEE: M002-PM03006-006

FOR CONTINUATION SEE: M002-PM03006-004





PROFILE

SCALE: HORIZONTAL 1:10,000. VERTICAL 1:1,000.
DATA SOURCE: LIDAR PROVIDED BY AIRBORNE IMAGING, 2007.

LEGEND

- KP ? — TMEP KILOMETRE POST (1KM)
- PROPOSED TMEP EASEMENT
- PROPOSED TMEP LAND RIGHTS ACQUIRED THROUGH UTILITY CROSSING OR OTHER NON-EASEMENT AGREEMENT
- OTHER EXISTING EASEMENTS
- LAND PARCEL / TRACT
- QUARTER SECTION (ALBERTA TOWNSHIP SYSTEM)

SCALE: 1:10,000
COORDINATE SYSTEM: NAD 1983 UTM ZONE 12N

SIZE: 11 x 17

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS SHOWN OTHERWISE.
2. PARCEL BOUNDARIES ARE AS OF 2017/02/14.
3. TRACT BOUNDARIES SHOWN IN THE BAND ACROSS THE TOP OF THE MAP ARE PROJECTIONS UPWARDS OF THE LOCATIONS WHERE THE PIPELINE CROSSES THE PARCEL BOUNDARIES.
4. UNIT CONVERSIONS:
   1 HECTARE (ha) = 2.471 ACRES (Ac.).
   1 METRE (m) = 3.281 FEET (ft).
   1 KILOMETRE (km) = 0.621 MILES (mi).

0 100 200 300 400 500 METRES

REV	DESCRIPTION	DATE	DRN	CKD	APP
0	ISSUED FOR INFORMATION	2017/02/24	LPT	KBW	DMM

TRANS MOUNTAIN

TRANS MOUNTAIN EXPANSION PROJECT

PLAN AND PROFILE OF TMEP EASEMENT

KP 62+168 TO KP 65+610

TWP.53-RGE.28-W4M & TWP.52-RGE.27-W4M

DRAWING NUMBER	SHT. NO.	REV.
M002-PM03006	005	0

Appendix O

Cost Estimates

Opinion of Probable Cost

5307 - 47 Street NW, Edmonton, Alberta T6B 3T4 Phone: (780) 440-4411

Owner: City of Spruce Grove
Project: Grove Drive Functional Plan
Location: West end of Grove Drive at Harvest Ridge Drive to Hwy 16A

Job # 2264
Date: September 12, 2018

Item	Cost
Preliminary First Stage Cost Estimate - *Copperhaven School Bus Transfer to Highway 16A (2 lane cross-section with single lane roundabouts north of McLeod)*	$ 6,970,496.75
Sub Total	***$ 6,970,496.75***
Additional Costs	
Power and Streetlighting (Fortis - Estimated)	$ 750,000.00
Signal Modification	$ 100,000.00
Landscaping of Interior Roundabout Islands - 3 Roundabouts	$ 225,000.00
Highway 16A Auxiliary Lane ~800m Length (Provisional)	$ 300,000.00
Pipeline Additional Measures (Provisional)	$ 50,000.00
Sub Total	***$ 1,425,000.00***
Total	**$ 8,395,496.75**
Contingency at 15%	$ 1,259,324.51
Engineering and Testing at 15%	$ 1,259,324.51
TOTAL ANTICIPATED PROJECT COST	***$ 10,914,145.78***

Notes:

Costs do not include GST

Power and Streetlight estimate is not inclusive of Fortis Cost Share Program.

Prepared by: Derek Porter

Preliminary First Stage Construction Cost Estimate

5307 - 47 Street NW, Edmonton, Alberta T6B 3T4 Phone: (780) 440-4411

Owner: City of Spruce Grove
Project: Grove Drive Functional Plan
Location: West end of Grove Drive at Harvest Ridge Drive to Hwy 16A

Job # 2264
Date: September 12, 2018

	Schedules	Amount of Tender	
Schedule A	Site Preparation	$	85,450.00
Schedule B	Earthworks	$	2,224,000.00
Schedule C	Underground Utilities	$	1,152,278.00
Schedule D	Road Works	$	3,450,018.75
Schedule E	Lane Markings and Signage	$	58,750.00
Sub Total		***$***	***6,970,496.75***
GST		$	348,524.84
Total		**$**	**7,319,021.59**

Notes:

~ Prices extrapolated from Grove Drive Extension 2017 and Spruce Grove related projects plus 10% inflation.

~Costs shown above do not include landscape design and services over and above topsoil for center of the roundabouts.

Date: _____

Schedule A

Site Preparation

Tender Form

Owner: City of Spruce Grove
Project: Grove Drive Functional Plan
Location: West end of Grove Drive at Harvest Ridge Drive to Hwy 16A

Job # 2264
Date: September 12, 2018

Item	Description	Unit	Quantity	Unit Price	Price
A.1	Pavement Removal (variable depth) (Sec 02071, 01012)	m^2cm	125000.0	$0.33	$41,250.00
A.2	Removal and disposal of existing curb, or curb & gutter (Sec 02071)	lm	50.0	$20.00	$1,000.00
A.3	Removal and disposal of existing concrete sidewalk and curb ramps (Sec 02071)	m^2			
A.4	Surface milling nominal 50mm depth (Sec 02113, 01013)	m^2	1000.0	$27.50	$27,500.00
A.5	Supply and install mini barriers	ea	20.0	$385.00	$7,700.00
A.6	Tree Clearing	ha	0.8	$10,000.00	$8,000.00
Total					***$85,450.00***

Note:

Date: _____

Schedule B

Earthworks

Tender Form

Owner: City of Spruce Grove
Project: Grove Drive Functional Plan
Location: West end of Grove Drive at Harvest Ridge Drive to Hwy 16A

Job # 2264
Date: September 12, 2018

Item	Description	Unit	Quantity	Unit Price	Price
B.1	Waste excavation - Remove off-site (Sec 02231, 01014)	m^3	70,000.0	$15.00	$1,050,000.00
B.2	Common excavation - Place and compact to 98% SPD (Sec 02231, 01015)	m^3	10,000.0	$7.00	$70,000.00
B.3	Import borrow material - Contractor supplied - Place and compact to 98% SPD - PROVISIONAL (Sec 02231, 01017)	m^3	50,000.0	$15.00	$750,000.00
B.4	Contractor supply and placement of topsoil to 150mm depth (Sec 02480)	m^2	49,300.0	$5.00	$246,500.00
B.5	Contractor supply and placement of topsoil to 400mm depth (Sec 02480)	m^2	1,940.0	$15.00	$29,100.00
B.6	Seeding - Boulevard Mix (Sec 02480)	m^2	49,300.0	$1.50	$73,950.00
B.7	Supply and install catch basin sediment barriers (01018)	ea	30.0	$105.00	$3,150.00
B.8	Supply and install ditch line sediment barriers (01019)	ea	20.0	$65.00	$1,300.00
Total	***Schedule B***				***$2,224,000.00***

Note:

Date: _____

Schedule C

Underground Utilities

Tender Form

Owner: City of Spruce Grove
Project: Grove Drive Functional Plan
Location: West end of Grove Drive at Harvest Ridge Drive to Hwy 16A

Job # 2264
Date: September 12, 2018

Item	Description	Unit	Quantity	Unit Price	Price
C.1	Supply and install 250mm Ø concrete catch basin lead, including trenching, backfill (to 97% SPD), Class "B" bedding & connection	lm	395.0	$275.00	$108,625.00
C.2	Supply and install 300mm Ø concrete catch basin lead, including trenching, backfill (to 97% SPD), Class "B" bedding & connection	lm			
C.3	Supply and install 900mm catch basin	ea	30.0	$3,300.00	$99,000.00
C.4	Supply and install storm main incl. trenching, backfill (to 97% SPD) & Class 'B' bedding (<3m depth)				
.1	375mm ø	lm	128.8	$185.00	$23,828.00
.2	450mm ø	lm	364.0	$225.00	$81,900.00
.3	525mm ø	lm	262.7	$275.00	$72,242.50
.4	600mm ø	lm	245.0	$300.00	$73,500.00
.5	675mm ø	lm	135.3	$350.00	$47,355.00
.6	750mm ø	ea	98.8	$375.00	$37,050.00
.7	450mm ø plug	ea	4.0	$250.00	$1,000.00
.8	750mm ø plug	ea	1.0	$275.00	$275.00
C.5	Supply and install manhole, catchbasin manhole and catchbasin frame & cover				
.1	F51	ea	14.0	$1,500.00	$21,000.00
.2	F36A	ea	16.0	$1,250.00	$20,000.00
.3	NF80	ea	13.0	$950.00	$12,350.00
C.6	Supply and install 1200mm catch basin manhole	vm			
C.7	Supply and install manhole				

Item	Description	Unit	Quantity	Unit Price	Price
.1	1500mm	vm	12.0	$3,300.00	$39,600.00
.2	1800mm	vm	30.0	$3,900.00	$117,000.00
C.8	Supply and install C900 PVC Water incl. trenching, backfill (to 97% SPD) , Class 'B' bedding, thrust blocking, plug and marker post				
.1	300mm ø	lm	450.0	$330.00	$148,500.00
C.9	Supply and installwater main appertanences				
.1	300X300mm ø tee	ea	6.0	$2,500.00	$15,000.00
.2	300mm ø 90° bend	ea	1.0	$1,900.00	$1,900.00
.3	300mm ø plug	ea	6.0	$1,000.00	$6,000.00
C.10	Connect to existing 300mm ø water main	ea	1.0	$1,700.00	$1,700.00
C.11	Supply and install Gate valve c/w Box, Stem, Extension, Cathodic Protection and Thrust Blocking				
.1	300mm ø	ea	3.0	$3,500.00	$10,500.00
C.12	Hydrant c/w 150mmØ lead, valve, tee box, stem, extentions, reaction blocking and cathodic protection.	ea	3.0	$8,500.00	$25,500.00
C.13	Added Washed Bedding	t	2500.0	$50.00	$125,000.00
C.14	Additional Payment for Extra Excavation of Unsuitable Material	lm	750.0	$100.00	$75,000.00
C.15	Supply and install sanitary main incl. trenching, backfill (to 97% SPD) & Class 'B' bedding (<4m depth)				
.1	200mm ø	lm	427.9	$225.00	$96,277.50
.2	200mm ø plug	ea	4.0	$200.00	$800.00
Total	***Schedule C***				***$1,152,278.00***

Note:

Date: _____

Owner: City of Spruce Grove
Project: Grove Drive Functional Plan
Location: West end of Grove Drive at Harvest Ridge Drive to Hwy 16A

Job # 2264
Date: September 12, 2018

Item	Description	Unit	Quantity	Unit Price	Price
D.1	Construct 500mm depth of 63mm granular sub-base working platform (Sec 02226, 02235, 01027)	m^2	29,925.0	$32.00	$957,600.00
D.2	Construct 200mm depth of 20mm crushed gravel base course (Sec 02226, 02235, 01027)	m^2	29,925.0	$13.85	$414,461.25
D.3	Construct 70mm depth of asphaltic concrete base course- ACB (Sec 02514, 02502 & 01028)	m^2	28,500.0	$17.00	$484,500.00
D.4	Construct 50mm depth of asphaltic concrete surface course - ACO (Sec 02514, 02502 & 01028)	m^2	28,500.0	$14.70	$418,950.00
D.5	Supply and install woven geotextile (Nilex 2002 or equivalent) (Sec 02897, 01029)	m^2	31,350.0	$3.85	$120,697.50
D.6	Supply and install wick drain (01030)	lm	3,500.0	$2.00	$7,000.00
D.7	Supply and install GlasGrid (01031)	lm	200.0	$18.00	$3,600.00
D.8	Construct 1.5m wide separate walk including 150mm depth of 20mm crushed gravel (Sec 02529)	m^2			
D.9	Construct 150mm depth concrete road base (01032)	m^2			
D.10	Construct 200mm depth plant mix soil cement (Sec 02530)	m^2			
D.11	Construct 2.5m wide asphalt trail including: -65mm depth ACR -200mm depth Des 2CL 20A -woven geotextile -97% prepared subgrade (Sec 02226, 02235, 02514, 02897, 01033)	m^2	4,570.0	$55.00	$251,350.00
D.12	Construct 150mm curb with 250mm gutter (Sec 02529)	lm	3,735.0	$82.50	$308,137.50
D.13	Construct 150mm curb with 250mm reverse gutter (Sec 02529)	lm	725.0	$87.50	$63,437.50

Item	Description	Unit	Quantity	Unit Price	Price
D.14	Construct low profile mountable reverse curb and gutter (Sec 02529)	lm	548.0	$120.00	$65,760.00
D.15	Construct pedestrian ramps - 1.5m pan width (Sec 02529)	ea			
D.16	Construct pedestrian ramps - 2.5m pan width (Sec 02529)	ea	10.0	$1,750.00	$17,500.00
D.17	Construct 180mm depth concrete truck apron (Sec 02529, 01034)	m^2	1,305.0	$155.00	$202,275.00
D.18	Construct 250mm slab on concrete island (Sec 02529)	m^2	770.0	$175.00	$134,750.00
Total	***Schedule D***				***$3,450,018.75***

Note:

Date: _____

Schedule E

Lane Markings and Signage

Tender Form

Owner: City of Spruce Grove
Project: Grove Drive Functional Plan
Location: West end of Grove Drive at Harvest Ridge Drive to Hwy 16A

Job # 2264
Date: September 12, 2018

Item	Description	Unit	Quantity	Unit Price	Price
E.1	Remove exisitng paint	lm	500.0	$3.50	$1,750.00
E.2	Line painting including pre-marking and maintenance (Sec 02577, 01035)				
.1	100mm wide solid yellow	lm	3,000.0	$2.25	$6,750.00
.2	100mm wide solid white	lm	1,000.0	$2.25	$2,250.00
.3	300mm wide broken white, 0.6m line by 0.6m skip	lm	1,000.0	$10.00	$10,000.00
.4	Zebra Crosswalk	lm	150.0	$10.00	$1,500.00
E.3	Salvage existing signage (01036)	ea	10.0	$225.00	$2,250.00
E.4	Install new signage (01036)	ea	90.0	$225.00	$20,250.00
E.5	Install new sign post (01036)	ea	70.0	$200.00	$14,000.00
Total	***Schedule E***				***$58,750.00***

Note:

Date: _____


Al-Terra