TRANSPORTATION PLANNERS AND ENGINEERS

Wainwright Industrial and Highway Commercial Lands
Traffic Impact Assessment

FINAL DRAFT Report

Prepared for

Select Engineering Consultants Ltd.

Date

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Prepared by

Bunt & Associates

Project No.

3298.15

CORPORATE AUTHORIZATION

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1. INTRODUCTION

1.1 Background

The Town of Wainwright continues to experience steady levels of growth in its commercial and industrial sectors. To accommodate market demands, the Town is considering permitting the development of about three quarter sections—NW, NE and SE ¼ Sections 5-45-6-4—located adjacent the north Town limit, west of the Highway 41 corridor as illustrated in **Exhibit 1-1**. The subject lands are proposed to accommodate commercial and industrial land uses. The Town of Wainwright has identified the need to complete a Traffic Impact Assessment (TIA) to better understand, assess and mitigate any identified traffic and transportation issues associated with the development of the subject lands. Bunt & Associates was retained by Select Engineering Consultants Ltd., the Town of Wainwright's civil engineering consultant, to complete the TIA.

1.2 Study Need and Purpose

Understanding the demands placed on an area's transportation infrastructure represents an important dimension in assessing overall impacts of development. The purpose of the TIA is to identify roadway and intersection geometry requirements and improvements that may be needed to accommodate the additional traffic anticipated to be generated by the development of the commercial and industrial lands. The study is anticipated to identify an appropriate and balanced traffic management plan for the area.

1.3 Study Methodology

The methodology for completing the study included a desktop review of existing data, field investigations and analysis of projected traffic data. Alberta Transportation's *Highway Geometric Design Guide (1995)* and *Traffic Impact Assessment Guideline* were referenced in the completion of the TIA. In this regard, the methodology used to prepare the TIA included:

- Gathering relevant information related to existing area characteristics including land use;
- Collecting and reviewing traffic related information, such as roadway and intersection turning movement volumes and existing roadway cross-section elements;
- Estimating cumulative traffic characteristics associated with the development of the subject lands;
- Reviewing *Alberta Transportation's Highway Geometric Design Guide* to identify the appropriate intersection geometry at study area intersections; and,
- Developing a recommended plan that accounts for known constraints and provides acceptable levels of traffic accommodation.

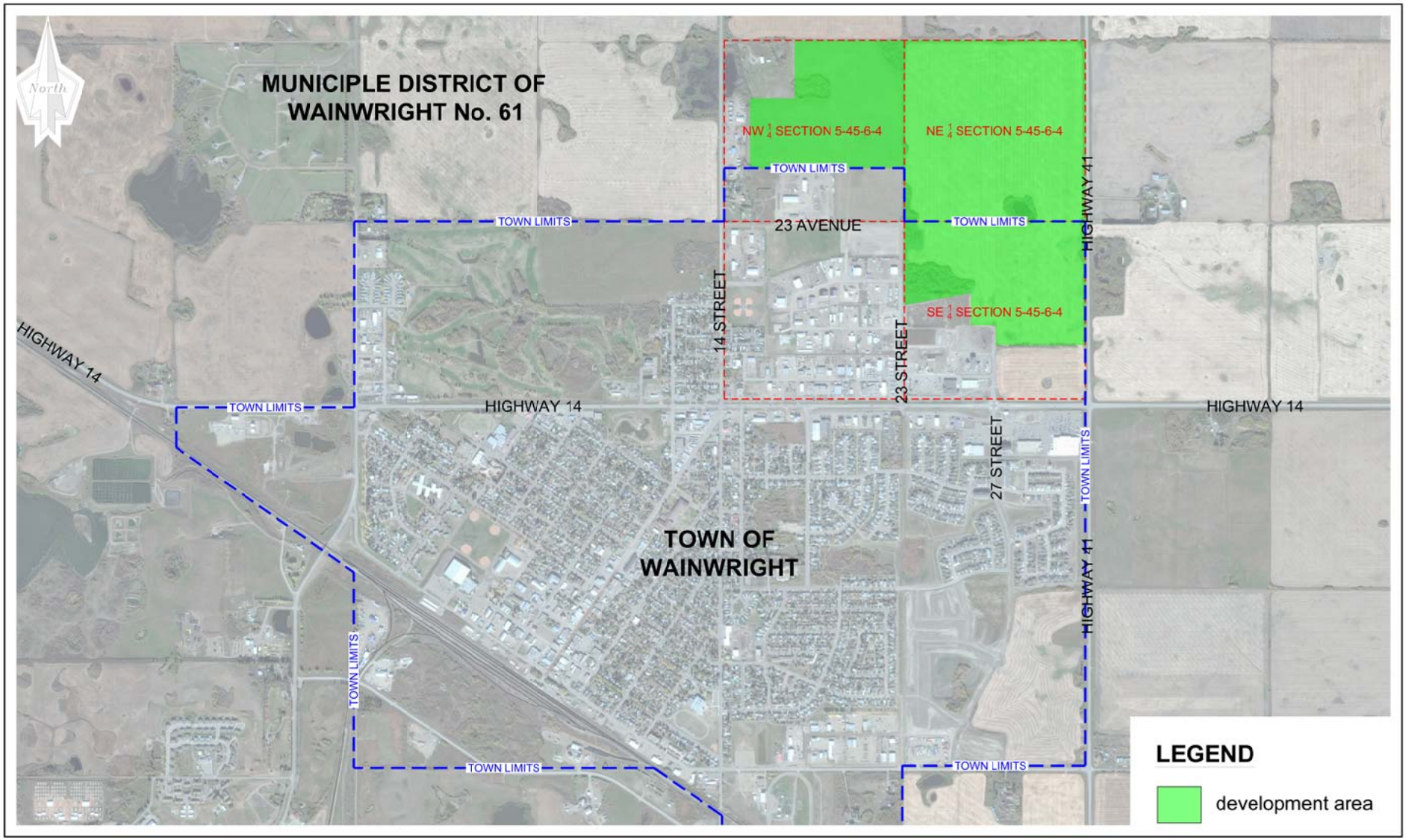


Exhibit 1-1

Area Context

bunt &associates

To supplement the aforementioned information, Bunt & Associates completed a comprehensive site investigation, paying particular attention to those segments of the roadway network that could be most impacted by site-generated traffic.

1.4 Study Goals

The primary goal of the study was to prepare a balanced traffic plan to assist with the orderly development of the subject lands. This was accomplished through the analysis of projected traffic demands associated with the development of the commercial and industrial lands. In general, the projected traffic impacts resulting from the development of the subject lands are documented. The report's completion will assist Alberta Transportation and the Town of Wainwright in making critical land use planning decisions regarding the transportation aspects of the area.

2. AREA CONDITIONS

2.1 Area Context

The Town of Wainwright is located about 180 km southeast of Edmonton and is serviced by two highways: Highway 14, which connects Edmonton and North Battleford, runs east-west through the Town; and Highway 41, which connects Bonnyville and Medicine Hat, runs north-south along the east boundary of the Town.

Most residential and commercial development in the Town of Wainwright has occurred south of Highway 14. Development north of Highway 14 within the Town of Wainwright generally consists of industrial and highway commercial developments with the exception of a small residential neighbourhood (located north of Highway 14 and west of 14 Street) and a few parks and recreation sites (including the Wainwright Golf Course, Tory Heights Ball Diamonds and Community Soccer Park).

2.2 Adjacent Land Uses

Developments in the Town of Wainwright north of Highway 14 between 14 Street and Highway 41 generally consist of industrial and highway commercial land uses. Lands adjacent the study area predominantly include industrial developments such as Carson Welding and Maintenance and the Coop Cardlock Facility. Highway commercial developments along the Highway 14 corridor generally include hotels and restaurants.

2.3 Area of Significant Traffic Influence

The scope of the study included the area within which traffic associated with the development of the subject lands was identified to have its most significant impact on the adjacent highway network. Based on conversations with Alberta Transportation representatives, the area of significant traffic influence was identified as the Highway 41 corridor.

2.4 Existing Roadway Network

The existing highway network in the vicinity of the study area includes the following:

Highway 41 (also called 31 Street or Buffalo Trail) is a paved two-lane undivided highway, as pictured in **Photo 2-1**, that runs north-south along the east Town of Wainwright limit. The highway is constructed to a rural cross-section standard and includes a road width of 10.8 metres (two 3.7-metre lanes plus 1.7-metre shoulders on both sides). The posted speed limit on Highway 41 is 100 km/h. Highway 41 is under the jurisdiction of Alberta Transportation.

Photo 2-1: Highway 41 north of Highway 14, Looking North

Highway 14 (named 14 Avenue within the Town of Wainwright limits) is a two-lane highway that runs east-west through the Town of Wainwright. Highway 14 is constructed to a rural cross-section standard, as illustrated in **Photo 2-2**, and is relatively straight and flat within the Town of Wainwright. Highway 14 includes signalized intersections at 14 Street and 27 Street and other traffic control devices such as pedestrian flashers. In the vicinity of the study area, the posted speed limit on Highway 14 is 60 km/h and transitions to 100 km/h east of Highway 41. Within the Town of Wainwright, Highway 14 provides a balance between mobility and accessibility to adjacent developments. Street lighting is provided along the road. Highway 14 is under the jurisdiction of Alberta Transportation.

Photo 2-2: Highway 14 West of 23 Street, Looking East

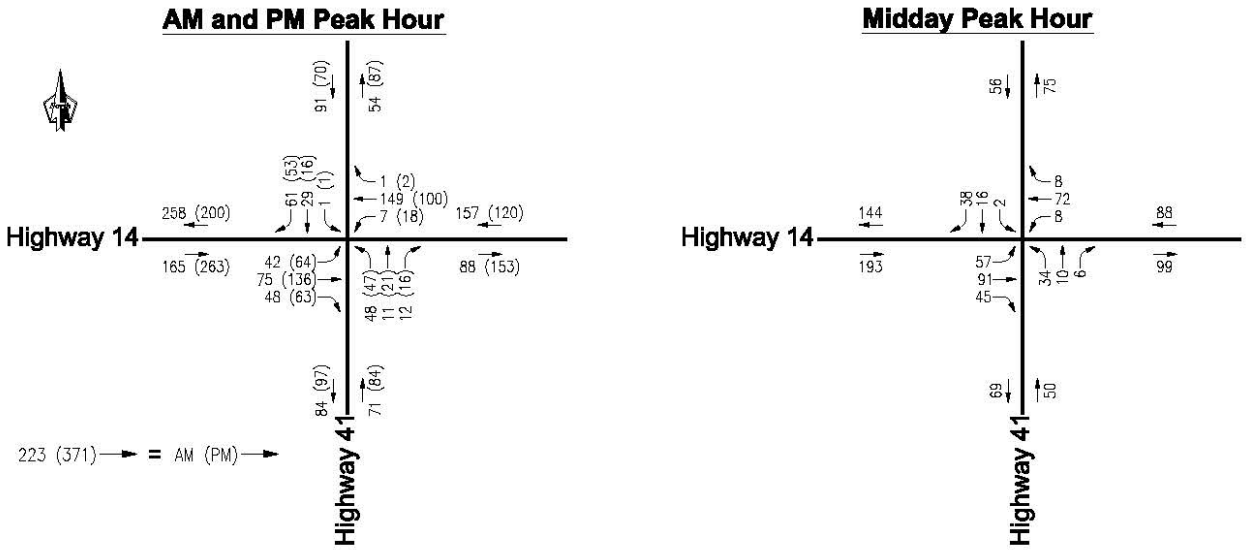
Highway 14/Highway 41 intersection is a four-legged intersection that is stop-controlled on the north and south approaches. The east and west approaches each include a shared left/through lane and a shared through/right lane. The north and south approaches are each developed with right-turn bays. Based on a review of the *Alberta Transportation's Highway Geometric Design Guide*, the Highway 14/Highway 41 intersection is most comparable to a Type IV intersection. The intersection is illuminated.

Photo 2-3: Highway 14/Highway 41 Intersection

2.4.1 Traffic Volumes

Bunt & Associates completed intersection turning movement surveys at the Highway 14/Highway 41 intersection on Thursday, October 23, 2014. Traffic volumes at the intersection were measured during the AM (7:00-9:00 AM), midday (11:30 AM – 1:30 PM) and PM (4:00-6:00 PM) peak periods. The AM, midday and PM peak hour intersection turning movement volumes are illustrated in **Figure 2-1**.

Figure 2-1: AM, Midday and PM Peak Hour Traffic Volumes



In addition to the intersection turning movement surveys completed by Bunt & Associates, Alberta Transportation posts intersection turning movement volume estimates on their website for most intersections on the Highway 14 corridor within the Town of Wainwright including the Highway 14/Highway 41 intersection. While the Bunt & Associates' surveys were used as the basis for background traffic volumes in the area, it should be noted that the Alberta Transportation intersection volume estimates were reviewed and considered.

3. DEVELOPMENT CHARACTERISTICS

3.1 Area Location

The subject lands are generally located north of Highway 14 and west of Highway 41 in the Town of Wainwright. The development area includes NE ¼ Section 5-45-6-4 and portions of the SE and NW ¼ Sections 5-45-6-4. The NE and NW ¼ Sections are privately owned; the Town of Wainwright controls the SE ¼ Section. It is of note that SE ¼ Section 5-45-6-4 is located within the Town of Wainwright boundaries; NE ¼ Section 5-45-6-4 and the north half of NW ¼ Section 5-45-6-4 are located within the Municipal District of Wainwright No. 61. It is understood that the Town of Wainwright is giving consideration to annexing the subject lands currently located within the Municipal District of Wainwright No. 61.

Portions of the SE and NW ¼ Sections 5-45-6-4 are currently developed. The south portion of NW ¼ Section 5-45-6-4 (fronting 23 Avenue) currently accommodates industrial developments and the east portion (fronting 14 Street) currently accommodates farmsteads. The south portion of SE ¼ Section 5-45-6-4 is currently being developed to accommodate highway commercial land uses and light industrial land uses. At the time of the traffic counts, commercial development east of 27 Street was under construction.

Commercial development west of 27 Street is currently constructed and operational. A portion of the future light industrial area located immediately north of the commercial developments west of 27 Street is also developed and operational.

3.2 Land Use Schedule

The subject lands are proposed to be developed to accommodate a mix of heavy industrial, light industrial, and commercial land uses. Heavy industrial land use refers to businesses that specialize in manufacturing or other industrial processes; light industrial land uses generally refers to (but is not limited to) businesses that specialize in warehousing, printing, material testing, etc.; commercial land uses generally include (but are not limited to) hotels, restaurants, gas bars, retailers of various types and sizes, car dealerships, etc. In addition to the land uses identified above, the NE ¼ Section 5-45-6-4 is proposed to include an RV park. **Table 3**-1 summarizes the proposed land use schedule for each quarter section considered. **Exhibit 3-1** on the following page illustrates the land use concept for the area.

It is noted that within the SE ¼ Section 5-45-6-4, 6.7 hectares of commercial development and 5.6 hectares of light industrial development has already been approved; however, construction had not been completed at the time of this study. For the purposes of the traffic assessment, theses development areas have been included in the land use schedule and subsequent analysis.

	SE ¼ SECTION	NE ¼ SECTION	NW ¼ SECTION	TOTAL
HEAVY INDUSTRIAL		38.5 ha	31.8 ha	70.3 ha
LIGHT INDUSTRIAL	19.1 ha	3.9 ha		23.0 ha
COMMERCIAL	20.1 ha	7.0 ha		27.1 ha
RV PARK		6.5 ha		6.5 ha
APPROVED COMMERCIAL	6.7 ha			6.7 ha
APPROVED LIGHT INDUSTRIAL	5.6 ha			5.6 ha

Exhibit 3-1

Land Use Concept Plan

Table 3-1: Land Use Schedule Summary

Land Use	Area			TOTAL
	SE ¼ Section	NE ¼ Section	NW ¼ Section	
Heavy Industrial	-	38.5 ha (95.1 acres)	31.8 ha (78.5 acres)	**70.3 ha (173.6 acres)**
Light Industrial	24.7 ha (61.0 acres)*	3.9 ha (9.7 acres)	-	**28.6 ha (70.7 acres)**
Commercial	26.8 ha (66.3 acres)*	7.0 ha (17.2 acres)	-	**33.8 ha (83.5 acres)**
RV Park	-	6.5 ha (15.9 acres)	-	**6.5 ha (15.9 acres)**
TOTAL	**51.5 ha (127.3 acres)**	**55.9 ha (137.9 acres)**	**31.8 ha (78.5 acres)**	**139.2 ha (343.7 acres)**

* includes the approved but undeveloped areas located in SE ¼ Section 4-45-6-4

As summarized in Table 3-1, the development initiative is anticipated to encompass an area in the order of about 139.2 hectares (343.7 acres). The majority of the lands are proposed to be developed as heavy industrial land uses (70.3 hectares). The remainder of the lands are proposed as commercial land uses (33.8 hectares), light industrial land uses (28.6 hectares) and an RV Park (6.5 hectares). Note that the areas identified for each land use represent net developable area; further deductions to account for public right-of-way and/or storm water management facilities are not required.

3.3 Future Area Roadway Network

3.3.1 Area Access

Access to the development area from the adjacent highway/arterial road network is anticipated to be provided via the following intersections:

- Highway 14 – existing all-direction intersections at 23 Street and 27 Street;
- Highway 41 – future all direction intersection at 23 Avenue and proposed right-in/right-out intersection at 18 Avenue; and,
- 14 Street - existing all-direction intersection at 23 Avenue and future all-direction intersection at 30 Avenue.

As identified above, the development of the subject lands is anticipated to result in the development of three intersections (23 Avenue/Highway 41, 18 Avenue/Highway 41 and 30 Avenue/14 Street). The existing intersections on Highway 14 (Highway 14/23 Street and Highway 14/27 Street) are anticipated to provide sufficient access to the area from Highway 14; therefore, no additional intersections on Highway 14 are planned.

3.3.2 Future Access Intersections

For the purposes of this assignment, the assessment focuses on identifying the intersection geometry associated with the future intersections along Highway 41 at 18 Avenue and 23 Avenue.

18 Avenue/Highway 41

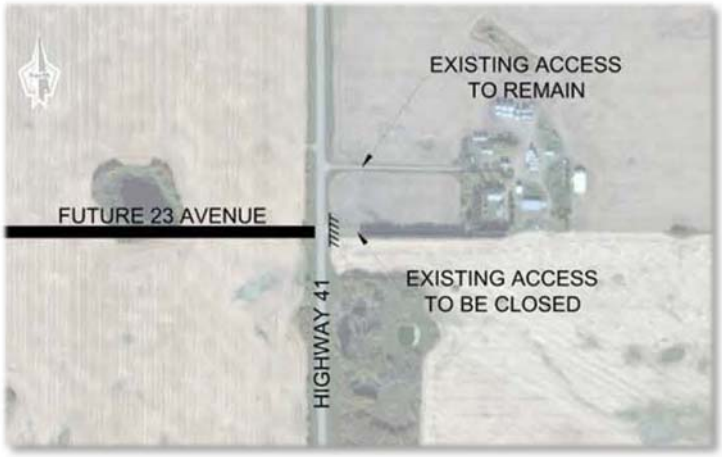
The 18 Avenue/Highway 41 intersection is proposed to be developed about 400 metres north of the existing Highway 14/Highway 41 intersection and is proposed to operate as a right-in/right-out intersection. In addition to providing a more direct access to the commercial development proposed in the SE ¼ Section, 18 Avenue is likely to be constructed before the extension of 23 Avenue to Highway 41, providing a connection to Highway 41 as the area begins to develop.

23 Avenue/Highway 41

The future 23 Avenue/Highway 41 intersection is proposed to be developed as a three-legged intersection accommodating all turning movements. The future 23 Avenue/Highway 41 intersection is located about 400 metres north of the proposed 18 Avenue/Highway 41 intersection and about 800 metres north of the existing Highway 14/Highway 41 intersection.

As illustrated in **Figure 3-1**, a private access to a farmstead currently exists on the east side of Highway 41. This access aligns with the future 23 Avenue and would potentially form the east leg of the intersection; however, Alberta Transportation and the Town of Wainwright have indicated that the private access will be eliminated with the construction of the intersection. Another private access to the farmstead exists about 100 metres north of 23 Avenue. It is anticipated that this access will serve as the only access to the farmstead once the 23 Avenue/Highway 41 intersection is constructed.

Figure 3-1: Future 23 Avenue/Highway 41 Intersection Location



3.3.3 Area Collector and Local Roadways

Direct access to future developments located within the development area is anticipated to be provided via the following roadways:

- **23 Avenue**, which currently runs east-west from 14 Street to 23 Street, will extend east to Highway 41 (bisecting Section 4-45-6-4 east-west) and serve as a collector road through the subject lands;
- **23 Street**, which currently runs north-south from Highway 14 to 23 Avenue, will extend to 30 Avenue (bisecting Section 4-45-6-4 north-south) and serve as a collector road through the subject lands;
- **27 Street** north of Highway 14 was recently constructed and will ultimately extend north to 23 Avenue, bisecting SE ¼ Section 4-45-6-4 north-south, serving as a collector road;
- **30 Street** is anticipated to run parallel to Highway 41, offset about 200 metres to the west, from 15 Avenue to 30 Avenue (and, ultimately, beyond) serving as a service road to commercial development on the west side of Highway 41;
- **30 Avenue** is anticipated to be developed as a local road that runs east-west from 14 Street to the future 30 Street;
- **15 Avenue** is anticipated to be developed as a local road that runs east-west from 27 Street to 30 Street.

3.4 Development Horizon

Alberta Transportation requires that any infrastructure improvements constructed on the highway network be able to accommodate future traffic volumes for the expected life of the infrastructure, which is approximately 20 years. Therefore, 2035 represents the long-term horizon for this analysis. The three quarter sections are anticipated to be fully developed within a five-year period; therefore, 2020 represents the development horizon (also referred to as the short-term horizon).

3.5 Development Staging

Development of the subject lands is likely to occur in a staged manner with the first stage of development occurring in SE ¼ Section 5-45-6-4, the second stage of development occurring in NE ¼ Section 5-45-6-4 and the third stage of development occurring in the north portion of the NW ¼ Section 5-45-6-4. Notwithstanding the above, it is acknowledged that demand and other market conditions will ultimately factor significantly into the order in which development of the subject lands will proceed. For the purposes of assessing the potential traffic impacts associated with the development, a staged approach to development was not considered.

4. BACKGROUND TRAFFIC CHARACTERISTICS

4.1 Background Traffic Basis

The existing traffic volumes measured at the Highway 14/Highway 41 intersection during the intersection turning movement survey completed by Bunt & Associates in October 2014 were used as the basis for establishing background traffic volumes for each of the assessment horizons.

4.2 Traffic Volume Growth

Based on a review of the Traffic Volume History (1962-2013) posted on Alberta Transportation's website, traffic volumes along the Highway 41 corridor north of Highway 14 are anticipated to grow at a rate of 3.7% per annum (linear growth) under the short-term horizon and 1.7% per annum under the long-term horizon. Traffic volumes along the Highway 14 corridor west of Highway 41 are anticipated to grow at a rate of 2.8% per annum under the short-term horizon and 1.7% per annum under the long-term horizon. Given that the long term annual growth rate is below the Provincial average of 2.0% per annum, a growth rate of 2.0% per annum has been assumed for both highways under the long-term development horizon. **Appendix A** includes the charts summarizing the Average Annual Daily Traffic (AADT) volumes used to identify the annual growth rate on each highway.

4.3 Approved Development

It is noted that at the time of the intersection turning movement survey, the previously approved lots in the SE ¼ Section had yet to be constructed; therefore, traffic associated with these developments was not captured in the survey. As such, traffic projected to be generated by these development areas has been included in the site-generated traffic.

4.4 Daily Traffic Projections

Based on a review of the daily intersection turning movement estimate prepared by Alberta Transportation, daily background traffic volumes are estimated to be 5.5 times the sum of the AM and PM peak hour volumes for each intersection turning movement.

4.5 Background Traffic Volumes

The background traffic volume projections for the AM and PM peak hours and a typical day under the short- and long-term assessment horizons are illustrated in **Exhibit 4-1**.

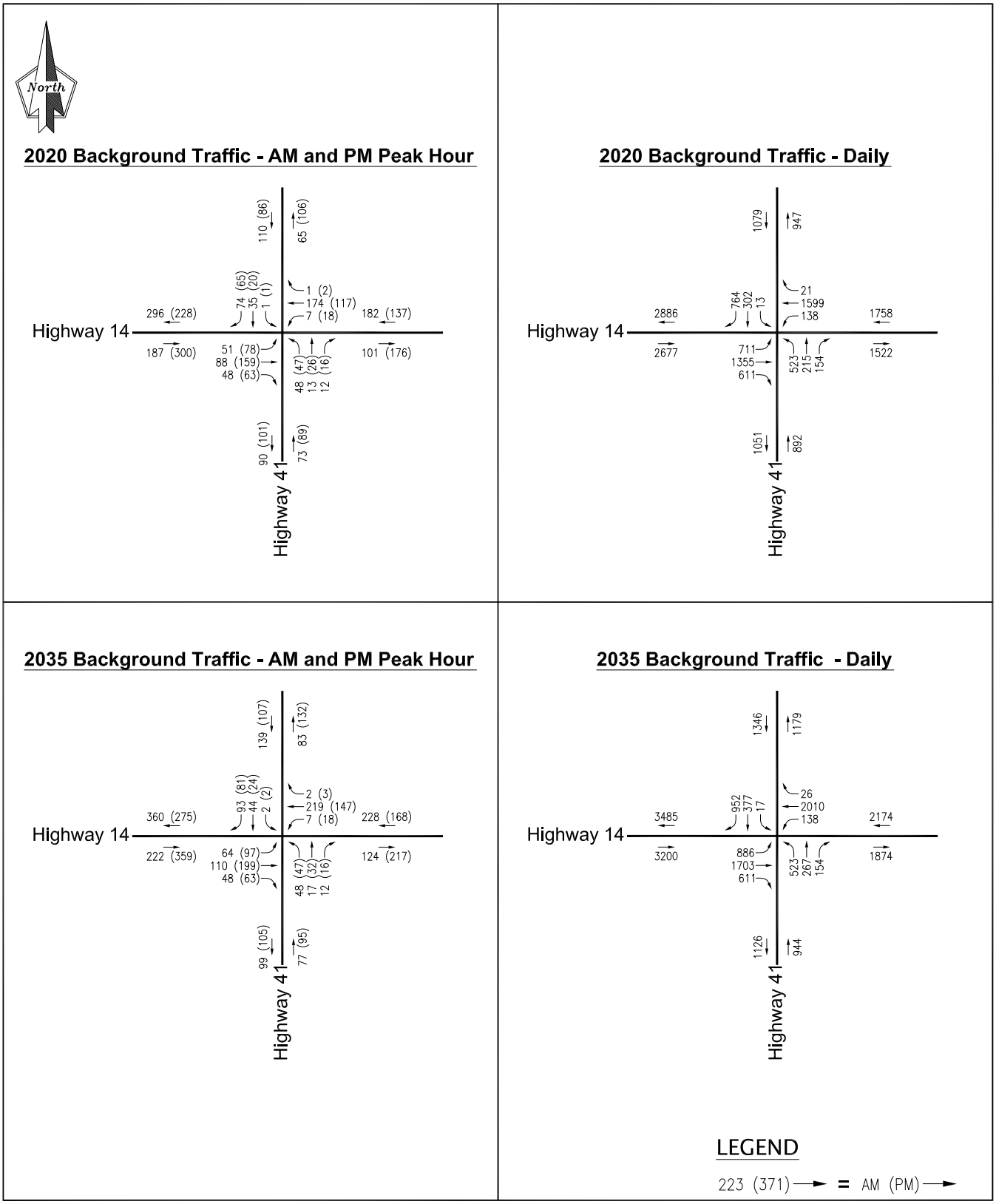


Exhibit 4-1

2020 and 2035 Background Traffic AM and PM Peak Hours and Daily

5. SITE TRAFFIC CHARACTERISTICS

5.1 Trip Generation Rates

Trip generation rates for each land use were established based on a review of *ITE (Institute of Transportation Engineers) Trip Generation Handbook, 9th Edition* and *Trip & Parking Generation Rates for Land Use in Rural Alberta – Final Report (December 2005)* prepared by Bunt & Associates in addition to Bunt & Associates' experience on similar projects in rural Alberta. It is of note that most of the trip generation rates are given in units of "per acre"; therefore, the areas associated with each land use have been converted from hectares to acres.

5.1.1 Heavy Industrial Land Use

ITE Land Use Code 120 – General Heavy Industrial Area from *ITE Trip Generation Manual, 9th Edition* is assumed to reflect the land use characteristics proposed for the heavy industrial area. A trip generation rate of 1.98 trips/acre was assumed during the AM peak hour and a rate of 2.16 trips/acre was assumed during the PM peak hour. A daily rate of 6.75 trips/acre was assumed for a typical weekday.

5.1.2 Light Industrial Land Use

As part of a previous study completed Ii 2010, Bunt & Associates measured the trip generating characteristics associated with an industrial subdivision located in Parkland Industrial Estates (Acheson, Parkland County). The industrial area generated trips at a rate of 2.10 trips/acre during the AM peak hour and 1.96 trips/acre during the PM peak hour. In the study (and subsequent studies), Bunt & Associates has typically applied a trip generation rate of 3.50 trips/acre during the AM and PM peak hours to account for potentially higher peak generation land uses. For the purposes of this study, a trip generation rate of 3.50 trips/acre during the AM and PM peak hours and 24.00 trips/acre during a typical weekday are assumed for the light industrial land use.

5.1.3 Commercial Land Use

The trip generation characteristics associated with a specific development are influenced by numerous factors including (but not limited to):

- Type of development proposed (developments within each land use category, especially the commercial land use category, can vary significantly);
- Location within a region and city or town relative to other land uses;
- Whether development is urban or rural;
- Size of the area the development services (in terms of area and/or population); and,
- Site accessibility by other modes of transportation besides private auto.

Given the influence these factors may have on trip generation characteristics, especially for those associated with commercial developments, the trip generation rates published in the *ITE Trip Generation Manual* should be used with discretion and local trip generation rates should be used whenever possible.

In terms of developments in rural municipalities, it is generally acknowledged that the trip generation rates published in *ITE Trip Generation Manual* may either over- or underestimate trip generating characteristics and may not be representative of local conditions. To further evaluate and identify discrepancies between trip generation rates published by ITE and conditions associated with smaller, rural municipalities, Bunt & Associates was retained by the Center for Transportation Engineering and Planning (C-TEP) to undertake a study that summarized and analyzed parking and trip generation rates associated with numerous land uses in several rural municipalities located in Alberta. The report entitled *Trip & Parking Generation Rates for Land Use in Rural Alberta – Final Report* was finalized in December 2005.

The study identified several commercial land uses to be reviewed in terms of parking and trip generating characteristics including Highway Commercial. The report acknowledges that Highway Commercial is not a specific land use category; however, for the purposes of the study, Highway Commercial represents a mixed-use site clustered with a variety of land uses including restaurants, gas bars, truck stops and hotels. The study also comments that these development areas are often situated adjacent to highways. It is of note that the Highway Commercial land use is not identified in the *ITE Trip Generation Manual*.

The Bunt study identifies a trip generation rate of 2.56 trips/1,000 SF Gross Floor Area (GFA) and 4.21 trips/1,000 SF GFA during the AM and PM peak hours respectively. Based on an assumed floor-area ratio (FAR) of 0.15, the commercial land use is anticipated to generate trips at a rate of 16.72 trips/acre and 27.49 trips/acre during the AM and PM peak hours respectively. The daily trip generation rate is estimated to be six times the sum of the AM and PM peak hour rates. A daily trip generation rate of 265.26 trips/acre ((16.72 trips/acre + 27.49 trips/acre) x 6) has been assumed.

5.1.4 RV Park Land use

The primary purpose of the RV park is to serve as a workforce accommodation camp. Generally, the RV park is anticipated to accommodate longer duration stays and experience lower turnover than that associated with a typical campsite. Given these characteristics, the RV park is likely more comparable to a mobile home park in terms of density and function and is also assumed to exhibit similar trip generating characteristics as a mobile home park.

The trip generation rates assumed for the RV Park land use are based on those published in *ITE Trip Generation Manual, 9th Edition* under land use code 240—Mobile Home Park. Trip generation rates of 3.20 trips/acre and 4.45 trips/acre are assumed for the AM and PM peak hours respectively. A daily trip generation rate of 39.61 trips/acre is assumed.

5.1.5 Summary

Table 5-1 summarizes the AM and PM peak hour and daily trip generation rates used in the assessment.

Table 5-1: Trip Generation Rate Summary

Land Use	Source	AM Peak Hour	PM Peak Hour	Daily
Heavy Industrial	ITE 120	1.98 trips/acre	2.16 trips/acre	6.75 trips/acre
Light Industrial	BUNT Study	3.50 trips/acre	3.50 trips/acre	24.00 trips/acre
Commercial	BUNT Study	16.72 trips/acre	27.49 trips/acre	265.25 trips/acre
RV Park	ITE 240	3.20 trips/acre	4.45 trips/acre	39.61 trips/acre

Table 5-2 summarizes the AM and PM peak hour trip generating characteristics by land use for each ¼ section of development. **Table 5-3** summarizes the daily trip generating characteristics associated with the proposed development.

Table 5-2: Trip Generation by Land Use for Each ¼ Section – AM and PM Peak Hour

Land Use	Area (acres)	AM Peak Hour				PM Peak Hour			
		Rate	In	Out	Total	Rate	In	Out	Total
SE ¼ Section									
Light Industrial	61.0	3.50	152	62	214	3.50	51	162	213
Commercial	66.3	16.72	687	421	1,108	27.49	875	948	1,823
Sub-Total	*127.3*		*839*	*483*	*1,322*		*926*	*1,110*	*2,036*
NE ¼ Section									
Heavy Industrial	95.1	1.98	156	32	188	2.16	43	162	205
Light Industrial	9.7	3.50	24	10	34	3.50	8	26	34
Commercial	17.2	16.72	178	109	287	27.49	227	246	473
RV Park	15.9	3.20	9	42	51	4.45	45	26	71
Sub-Total	*137.9*		*367*	*193*	*560*		*323*	*460*	*783*
NW ¼ Section									
Heavy Industrial	78.5	1.98	129	26	155	2.16	36	134	170
Sub-Total	*78.5*		*129*	*26*	*155*		*36*	*134*	*170*
TOTAL	**343.7**		**1,335**	**702**	**2,037**		**1,285**	**1,704**	**2,989**

Table 5-3: Trip Generation by Land Use for Each ¼ Section – Daily

Land Use	Area (acres)	Daily			
		Rate	In	Out	Total
SE ¼ Section					
Light Industrial	61.0	24.00	732	732	1,464
Commercial	66.3	265.25	8,793	8,793	17,586
Sub-Total	*127.3*		*9,525*	*9,525*	*19,050*
NE ¼ Section					
Heavy Industrial	95.1	6.75	321	321	642
Light Industrial	9.7	24.00	116	116	232
Commercial	17.2	265.25	2,281	2,281	4,562
RV Park	15.9	39.61	315	315	630
Sub-Total	*137.9*		*3,033*	*3,033*	*6,066*
NW ¼ Section					
Heavy Industrial	78.5	6.75	265	265	530
Sub-Total	*78.5*		*265*	*265*	*530*
TOTAL	**343.7**		**12,823**	**12,823**	**25,646**

As summarized in Tables 5-2 and 5-3, the development of the subject lands (plus the approved but not developed commercial and light industrial areas) is anticipated to generate 2,037 two-way trips during the AM peak hour, 2,989 two-way trips during the PM peak hour and 25,646 two-way trips during a typical weekday.

5.2 Traffic Distribution and Assignment

Trip distribution for the Heavy and Light Industrial and RV Park land uses is based on the distribution of existing traffic on the highway network. The distribution of commercial trips is based on the existing distribution of traffic adjusted to reflect that a greater portion of the trips associated with the commercial land use will likely be completed by residents of the Town of Wainwright. The assumed distribution is summarized in **Exhibit 5-1**.

Site generated traffic was assigned to the highway network via the area roadway network by the shortest route in terms of distance and time.

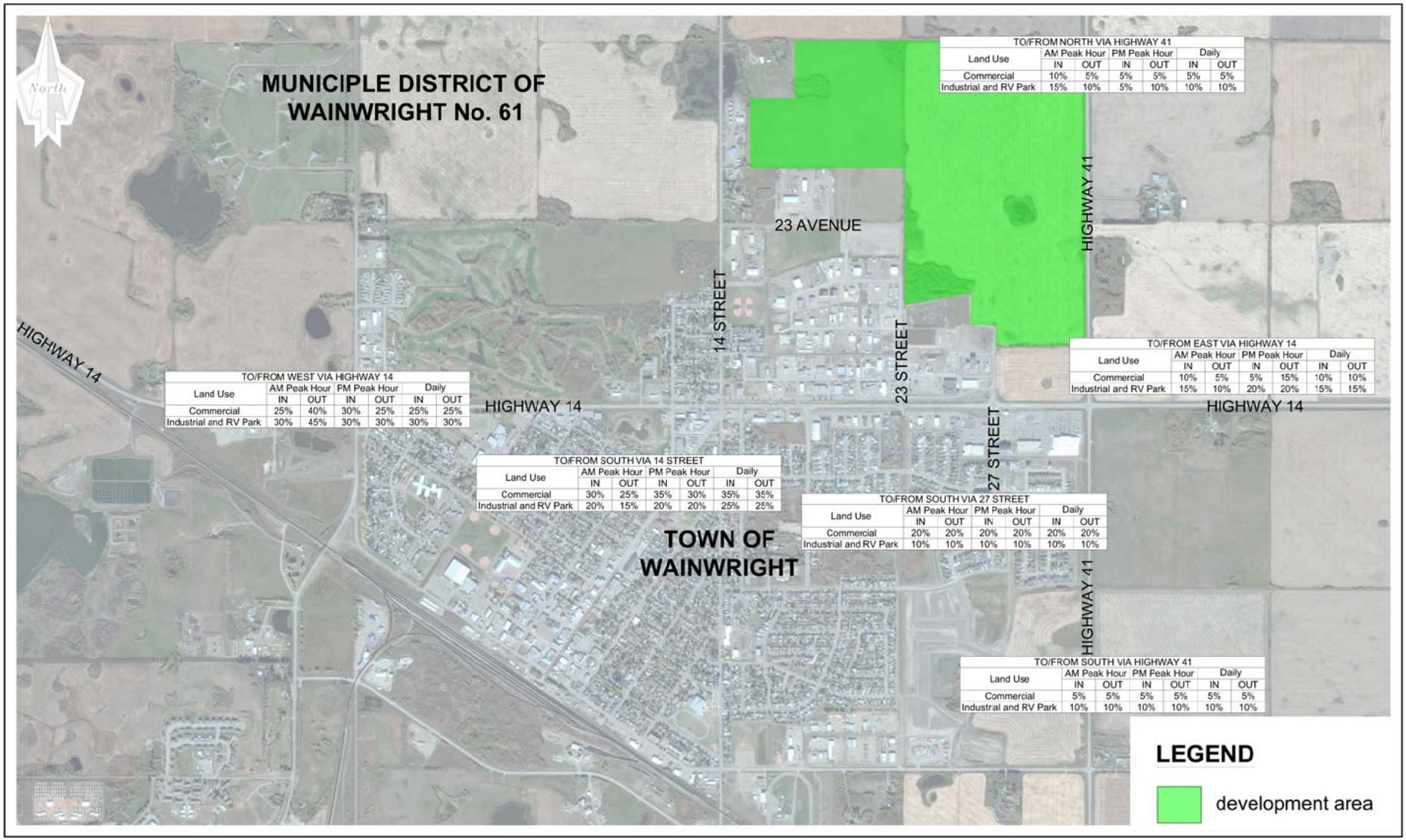


Exhibit 5-1

Site Generated Traffic Distribution

5.3 Pass-by and Primary Trips

ITE Trip Generation Handbook (June 2004) describes pass-by trips as intermediate stops on the way from an origin to a primary trip destination without a route diversion. Several factors contribute to the magnitude of pass-by trips generated by a particular development. These factors may include the frequency and location of site accesses, traffic volumes along the adjacent roadways and the function of adjacent roadways. Pass-by trips are typically only associated with commercial land uses.

For commercial sites, the rate of pass-by traffic is typically calculated as an aggregate rate of published pass-by rates for each specific commercial development. However, given the high level of planning associated with the area concept plan in that specific commercial developments are not yet identified, the pass-by rates assumed are based on the magnitude of traffic on the adjacent street. For the purposes of this assessment, 20% and 15% of the commercial trips during the AM and PM peak hours, respectively, are assumed to represent pass-by trips. During a typical weekday, 10% of the commercial trips are assumed to represent pass-by trips.

Table 5-4 summarizes the magnitude of pass-by trips assumed for the commercial land use by quarter section while **Table 5-5** summarizes the primary trips anticipated to be generated by the development area. Note that each vehicle entering the site as a pass-by trip is assumed to also leave the site within the peak hour; therefore, the amount of in and out trips are equal. For calculation purposes, the magnitude of pass-by trips is determined by multiplying the pass-by rate with the in or out trips, whichever is the fewest. Primary trips represent new trips added to the roadway network as a result of the development (total trips minus pass-by trips).

As summarized in Table 5-4, 212 pass-by trips (168 pass-by trips + 44 pass-by trips) are projected during the AM peak hour, 330 pass-by trips (262 pass-by trips + 68 pass-by trips) are projected during the PM peak hour, and 2,214 pass-by trips (1,758 pass-by trips + 456 pass-by trips) are projected during a typical day. Pass-by trips were distributed based on the existing distribution of traffic on the highway network.

Table 5-4: Pass-by Trips by Commercial Land Use for Each ¼ Section

Land Use	AM Peak Hour			PM Peak Hour			Daily		
	In	Out	Total	In	Out	Total	In	Out	Total
SE ¼ Section									
Total Trips	687	421	1,108	875	948	1,823	8,793	8,793	17,586
Pass-by	84	84	168	131	131	262	879	879	1,758
Primary	*603*	*337*	*940*	*744*	*817*	*1,561*	*7,914*	*7,914*	*15,828*
NE ¼ Section									
Total Trips	178	109	287	227	246	473	2,281	2,281	4,562
Pass-by	22	22	44	34	34	68	228	228	456
Primary	*156*	*87*	*243*	*193*	*212*	*405*	*2,053*	*2,053*	*4,106*

Table 5-5: Primary Trips by Land Use for Each ¼ Section

Land Use	AM Peak Hour			PM Peak Hour			Daily		
	In	Out	Total	In	Out	Total	In	Out	Total
SE ¼ Section									
Light Industrial	152	62	214	51	162	213	732	732	1,464
Commercial	603	337	940	744	817	1,561	7,914	7,914	15,828
Sub-Total	*755*	*399*	*1,154*	*795*	*979*	*1,774*	*8,646*	*8,646*	*17,292*
NE ¼ Section									
Heavy Industrial	156	32	188	43	162	205	321	321	642
Light Industrial	24	10	34	8	26	34	116	116	232
Commercial	156	87	243	193	212	405	2,053	2,053	4,106
RV Park	9	42	51	45	26	71	315	315	630
Sub-Total	*345*	*171*	*516*	*289*	*426*	*715*	*2,805*	*2,805*	*5,610*
NW ¼ Section									
Heavy Industrial	129	26	155	36	134	170	265	265	530
Sub-Total	*129*	*26*	*155*	*36*	*134*	*170*	*265*	*265*	*530*
TOTAL	**1,229**	**596**	**1,825**	**1,120**	**1,539**	**2,659**	**11,716**	**11,716**	**23,432**

As summarized in Table 5-5, full buildout of the development area (plus the approved development areas) is anticipated to generate 1,825 two-way trips that are new to the road network during the AM peak hour, 2,659 two-way trips that are new to the road network during the PM peak hour, and 23,432 two-way trips that are new to the road network during a typical day.

5.3.1 Total Traffic

The increases in AM and PM peak hour and daily traffic volumes along Highway 41 as a result of the full buildout of the development area are illustrated in **Exhibit 5-1**. The trips generated by the development of the subject lands were superimposed on the 2020 and 2035 background traffic volumes to represent the short- and long-term total traffic along Highway 41. **Exhibits 5-2** and **5-3** illustrate the AM and PM peak hour and daily total traffic volumes along the Highway 41 corridor under the 2020 and 2035 horizon respectively.

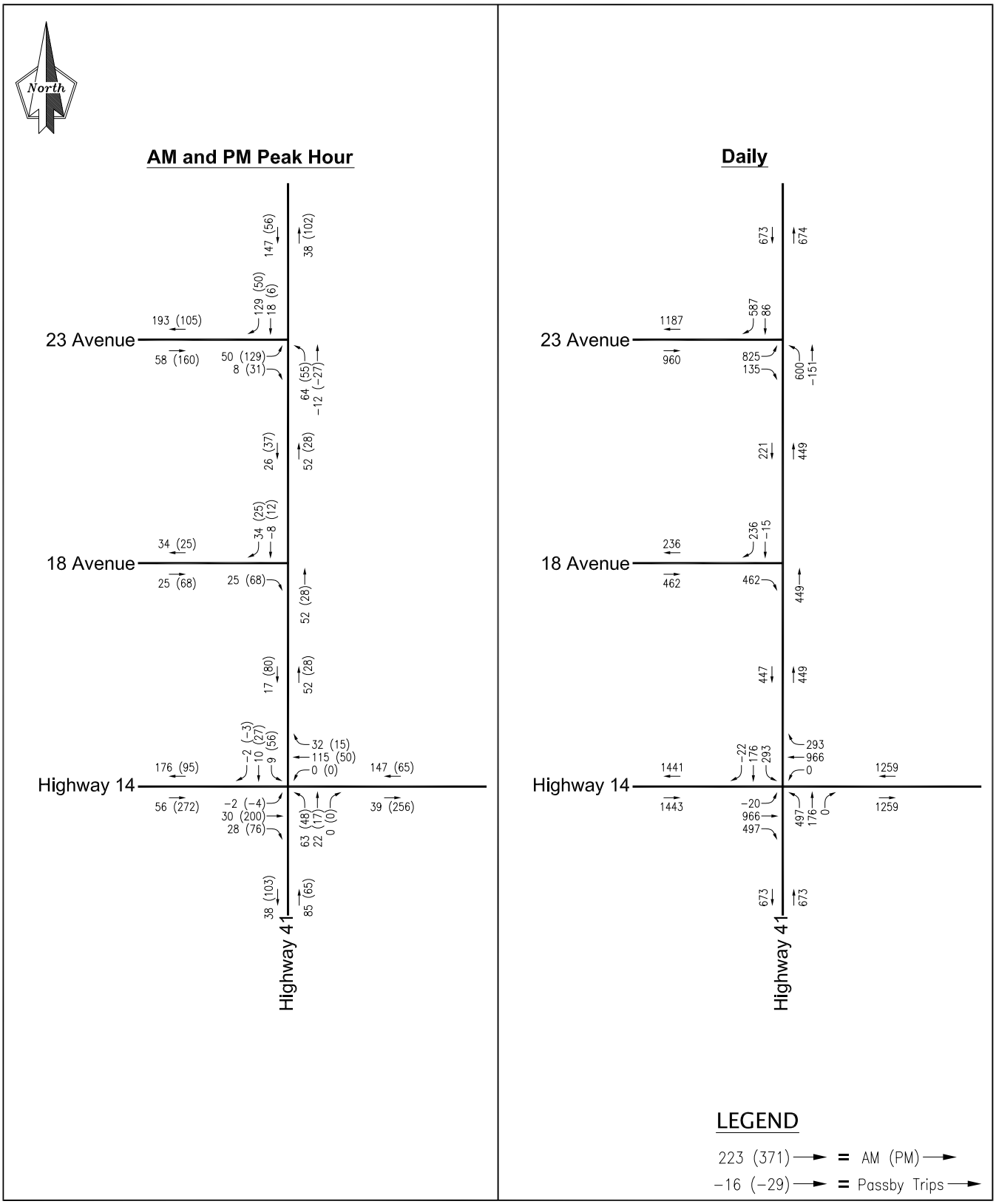


Exhibit 5-2

Site Generated Traffic
AM and PM Peak Hours and Daily

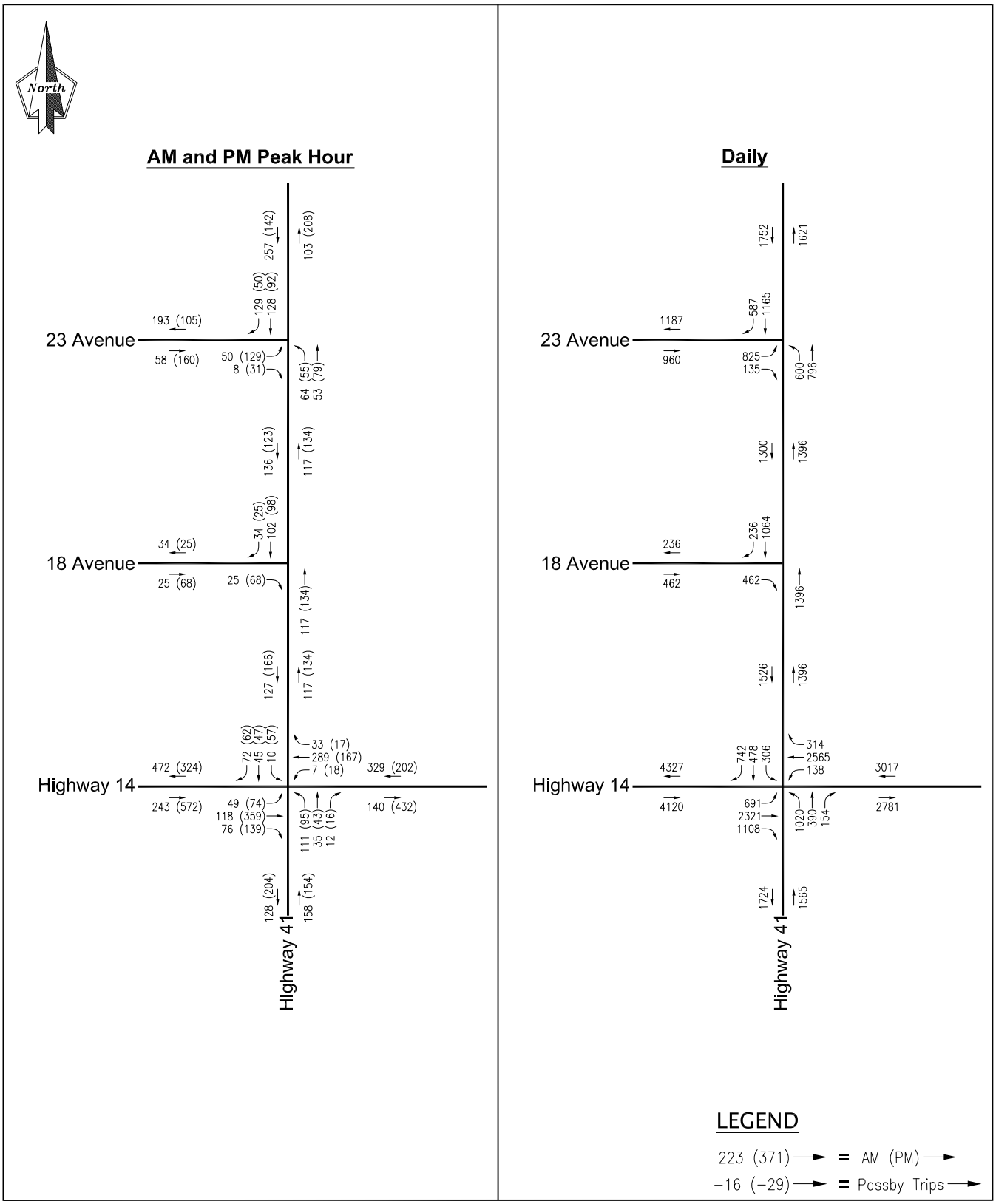


Exhibit 5-3

2020 Total Traffic
AM and PM Peak Hours and Daily

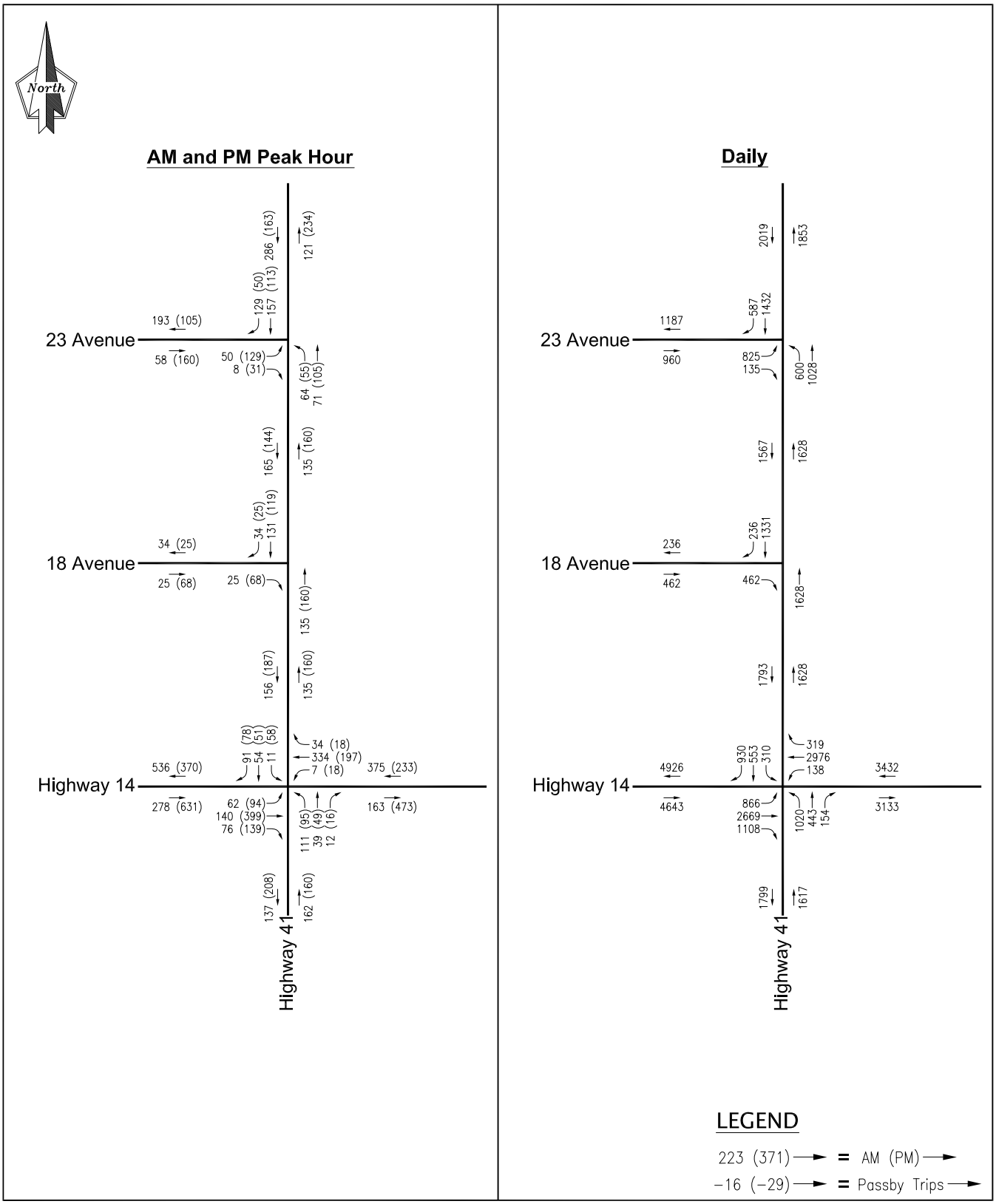


Exhibit 5-4

2035 Total Traffic
AM and PM Peak Hours and Daily

6. TRAFFIC ANALYSIS

6.1 Evaluation Methodology

The transportation assessment considers the following five components:

Alberta Transportation Highway Geometric Design Guide Review
Based on the procedures outlined in *Alberta Transportation's Highway Geometric Design Guide*, assessments of left and right-turn bay requirements were completed for each of the following study area intersections: Highway 14/Highway 41; 23 Avenue/Highway 41; and the proposed right-in/right-out.

Capacity Analysis
To evaluate the traffic operating conditions during the peak periods of traffic activity, capacity assessments were completed based on the methods outlined in the *Highway Capacity Manual 2010*, using Synchro 8.0 analysis software.

Traffic Signal Warrant Analysis
Signal warrant analyses were conducted for each of the study area intersections using the methodology outlined in the *Transportation Association of Canada's (TAC) Canadian Traffic Signal Warrant Matrix Procedure, 2005* and using the spreadsheets associated with the *Traffic Signal Warrant Handbook, 2007*. The analysis identifies whether traffic signals are anticipated to be required at each of the intersections in the future.

Lighting Analysis
A lighting assessment was completed at each of the study area intersections based on the *TAC Guide for the Design of Roadway Lighting, 2006*.

Access Spacing Requirements
To review the spacing requirements for intersections along the Highway 41 corridor north of Highway 14, *Alberta Transportation's Highway Geometric Design Guide Urban Supplement (DRAFT – Nov. 2003)* was reviewed.

6.2 Geometry Warrants

Alberta Transportation's left- and right-turn warrants from the *Highway Geometric Design Guide* were reviewed to identify if any geometric intersection improvements are required. The warrants were reviewed for each of the study area intersections located along the Highway 41 corridor. Detailed calculations are summarized in **Appendix B**.

6.2.1 Highway 14 and Highway 41

A preliminary assessment based on Figure D-7.4 in the *Highway Geometric Design Guide* was completed for the Highway 14/Highway 41 intersection. The average annual daily traffic volumes on Highway 14, in the vicinity of Highway 41, are estimated to grow from about 4,875 vehicles per day (vpd) in 2014 to

about 8,450 vpd in 2020 assuming full buildout of the subject lands, while volumes on Highway 41, in the vicinity of Highway 14, are estimated to grow from about 1,660 vpd in 2014 to about 2,920 vpd. Based on these volumes, Figure D-7.4 indicates that the intersection should currently and ultimately be designed as Type II, III, IV, or V. Further analysis was conducted to determine the intersection treatment required, including warrant analysis for left and right-turn lanes along Highway 14.

Based on site observations, the east and west approaches of the Highway 14/Highway 41 intersection are currently constructed as two-lane approaches that include a shared left/through lane and a shared through/right lane. The north and south approaches each include a shared left/through lane and a right-turn bay. The intersection is stop-controlled along the north and south approaches. Based on a review of the *Highway Geometric Design Guide*, the intersection is generally dissimilar to the intersection standards identified; however, based on lane configuration, it would be most comparable to a Type IV intersection standard. **Table 6-1** summarizes the review of the left-turn warrants for the Highway 14/Highway 41 intersection for all horizons considered.

Table 6-1: Warrant Analysis for Left-Turn Lanes – Highway 14 and Highway 41

Horizon	East Approach		West Approach	
	Intersection Type Required	Left-Turn Bay Required? (Additional Storage Length)	Intersection Type Required	Left-Turn Bay Required? (Additional Storage Length)
Existing (2014)	III	Yes (0 m)	III	Yes (0 m)
2020 Background	III	Yes (0 m)	III	Yes (0 m)
2020 Total	IV	Yes (0 m)	IV	Yes (0 m)
2035 Background	III	Yes (0 m)	IV	Yes (0 m)
2035 Total	IV	Yes (0 m)	IV	Yes (10 m)

As summarized in Table 6-1, a left-turn lane is warranted along the east and west approaches of the Highway 14/Highway 41 intersection under existing, background and total traffic conditions for each horizon considered. To accommodate total traffic conditions, the east and west approaches of the intersection should be developed to a Type IV standard. In addition, the left-turn lane associated with the west intersection approach should include 10 metres of additional storage space. Both intersection approaches along Highway 41 currently include two lanes: a shared left-through lane and a shared through-right lane. It is anticipated that the existing infrastructure could accommodate a Type IV intersection; however, the approaches would have to be restriped to define the left turn bays.

Table 6-2 summarizes the review of the right-turn warrants for the Highway 14/Highway 41 intersection.

Table 6-2: Warrant Analysis for Right-Turn Lanes – Highway 14 and Highway 41

Horizon	East Approach	West Approach
	Right-Turn Bay Required	
Existing (2014)	No	Yes
2020 Background	No	Yes
2020 Total	No	Yes
2035 Background	No	Yes
2035 Total	No	Yes

As summarized in Table 6-2, a right-turn bay is warranted on the west intersection approach for each scenario considered. The viability of constructing a right-turn bay on the west approach will be discussed further in a subsequent section.

6.2.2 23 Avenue and Highway 41

A preliminary assessment based on Figure D-7.4 in the *Highway Geometric Design Guide* was completed for the future 23 Avenue/Highway 41 intersection. The average annual daily traffic volumes on Highway 41, in the vicinity of the future 23 Avenue, are projected to be in the order of about 3,870 (vpd) in 2035 assuming full buildout of the subject lands while volumes on 23 Avenue, in the vicinity of Highway 41, are projected to be in the order of about 2,150 vpd. Based on these volumes, Figure D-7.4 indicates that the future intersection should be designed as Type II, III, IV, or V. Further analysis was conducted to determine the intersection treatment required, including warrant analysis for left and right-turn lanes along Highway 41.

As mentioned previously, the future 23 Avenue/Highway 41 intersection is proposed to be developed as a T-intersection; therefore, the left-turn warrant is only considers the south approach and the right-turn warrant only considers the north approach. **Table 6-3** summarizes the review of the left-turn warrants for the 23 Avenue/Highway 41 intersection for all horizons considered.

Table 6-3: Warrant Analysis for Left-Turn Lanes – 23 Avenue and Highway 41

Horizon	South Approach	
	Intersection Type Required	Left-Turn Bay Required? (Additional Storage Length)
2020 Total	III	Yes (0 m)
2035 Total	III	Yes (0 m)

As summarized in Table 6-3, a left-turn lane is warranted along the south approach of the future 23 Avenue/Highway 41 intersection under total traffic conditions for each horizon considered. The south intersection approach should be developed to a Type III standard; no additional storage length is anticipated to be required.

Table 6-4 summarizes the review of the right-turn warrants for the future 23 Avenue/Highway 41 intersection. As summarized in Table 6-4, a right-turn bay is warranted along the north approach of the future 23 Avenue/Highway 41 intersection assuming the full buildout of the subject lands.

Table 6-4: Warrant Analysis for Right-Turn Lanes – 23 Avenue and Highway 41

Horizon	North Approach
	Right-Turn Bay Required
2020 Total	Yes
2035 Total	Yes

6.2.3 18 Avenue and Highway 41

Given that the proposed 18 Avenue/Highway 41 intersection is a right-in/right-out, the left-turn warrant was not considered for either approach and the right-turn warrant was only considered for the north approach. **Table 6-5** summarizes the review of the right-turn warrants for the future 23 Avenue/Highway 41 intersection.

Table 6-5: Warrant Analysis for Right-Turn Lanes – 18 Avenue and Highway 41

Horizon	North Approach
	Right-Turn Bay Required
2020 Total	No
2035 Total	No

As summarized in Table 6-5, a right-turn bay is not warranted along the north approach of the proposed 18 Avenue/Highway 41 intersection. Notwithstanding the above, the intersection will need to be designed to mitigate unwanted left-turns. This could include either a small section of raised concrete median on Highway 41, and/or a large channelizing island (depressed or raised) on 18 Avenue and steep entrance/exit angles accomplished through deceleration/acceleration tapers.

6.3 Signal Warrants

Signal warrant analyses were conducted for the study area intersections using *TAC's Canadian Traffic Signal Warrant Matrix Procedure 2005* and spreadsheets from the *Traffic Signal Warrant Handbook 2007*. **Appendix C** contains a summary of the warrant calculation sheets for reference.

The TAC warrant matrix procedure uses 6 hours of traffic volume data (three two-hour periods during the AM, midday and PM) to determine the requirements for signalization. For future traffic scenarios, the ratios of the existing AM and PM peak hour data to the full two hour counts were used to adjust the projected AM and PM peak hour volumes to two hour volumes. The midday two-hour traffic volumes were estimated based on the ratio of the sum of the existing AM and PM peak hour volumes to the existing midday two-hour volumes. For intersections where midday turning movement counts were not available, the midday two-hour traffic volumes were based on the sum of the AM and PM peak hour volumes. For the proposed accesses along Highway 41, the AM and PM two-hour volumes were estimated by doubling the peak hour volumes. It is noted that the estimated AM, PM and midday two-hour traffic volumes are considered conservative.

The results of the signal warrant analysis for study area intersections are summarized in **Table 6-6**. When an analysis score is higher than 100, traffic signalization is warranted at the intersection.

Table 6-6: Summary of Signal Warrant Analysis

Intersection	2014	2020		2035	
	Existing	Background	Total	Background	Total
Hwy 14/Hwy 41	21	26	99	36	122
23 Ave/Hwy 41	-	-	28	-	32

As summarized in Table 6-6, signalization is warranted at the Highway 14/Highway 41 intersection under total traffic conditions for the 2035 horizon.

6.4 Intersection Capacity Analysis

The intersection operations are typically rated by two measures: volume-to-capacity (v/c) ratio and Level of Service (LOS). The v/c ratio describes the extent to which the traffic volumes can be accommodated by the physical capacity of the road configuration and traffic control. A value (measured during the peak hour) less than 0.90 indicates that generally there is sufficient capacity and the projected traffic volumes can be accommodated at the intersection. A value between 0.90 and 1.0 suggests unstable operations may occur and volumes are nearing capacity conditions. A calculated value over 1.0 indicates that traffic volumes are theoretically exceeding capacity.

The second measure of performance, LOS, is based on the estimated average delay per vehicle among all traffic passing through the intersection. A low average delay merits a LOS A rating. Average delays greater

than 80 seconds per vehicle at a signalized intersection generally produce a LOS F rating, while at unsignalized intersections a LOS F is reached when vehicles experience an average delay greater than 50 seconds. **Table 6-7** summarizes the levels of service and their respective delay ranges.

Table 6-7: Level of Service Delay Ranges

LOS	Control Delay per Vehicle (seconds)	
	Signalized Intersection	Stop-Control Intersection
A	≤10	≤10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

The anticipated 95th percentile queue length has also been included in the following assessment summaries. Capacity assessments were completed for each of the study intersections for each traffic scenario and horizon considered. **Appendix D** contains the Synchro reports for each intersection included in the analysis.

6.4.1 Highway 14/Highway 41 Intersection

The Highway 14/Highway 41 intersection is stop-controlled along the north and south approaches and includes the following geometry:

- **West Approach** – one shared through/left lane, one shared through/right lane;
- **East Approach** – one shared through/left lane, one shared through/right lane;
- **South Approach** – one shared left/through, one right-turn bay; and,
- **North Approach** – one shared left/through, one right-turn bay.

The peak hour factors calculated based on the existing traffic volumes at the intersections range from 0.25 to 0.91. Peak hour factors are typically in the range of 0.80 to 0.95. Peak hour factors less than 0.80 are generally associated with low-volume intersection movements in which the arrival of one or two vehicles may significantly skew the movement's peaking characteristics. Given the magnitude of traffic anticipated to be generated by the development of the subject lands, each movement would likely exhibit peaking characteristics similar to a typical intersection. For the purposes of this assessment, a peak hour factor of 0.92 has been assumed for each movement at the intersection. **Tables 6-8** and **6-9** summarize the existing and projected intersection operations at the Highway 14/Highway 41 intersection during the AM and PM peak hours, respectively, for all scenarios considered.

Table 6-8: Highway 14/Highway 41 Intersection – AM Peak Hour

	Eastbound			Westbound			Northbound			Southbound		
Movement	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**
Geometry	**LT/TR**			**LT/TR**			**LT/R**			**LT/R**		
2014 Existing Traffic Conditions (north-south stop-controlled)												
Volume (vph)	42	75	48	7	149	1	48	11	12	1	29	61
v/c	0.04			0.06			0.19		0.19	0.10		0.10
LOS	A			A			B		B	B		B
95th Queue (m)	1			0			6		6	3		3
2020 Background Traffic Conditions (north-south stop-controlled)												
Volume (vph)	51	88	48	7	174	1	48	13	12	1	35	74
v/c	0.07			0.06			0.23		0.23	0.12		0.12
LOS	A			A			C		C	B		B
95th Queue (m)	1			0			7		7	3		3
2020 Total Traffic Conditions (north-south stop-controlled)												
Volume (vph)	49	118	76	7	289	33	111	35	12	10	45	72
v/c	0.09			0.12			0.56		0.56	0.22		0.22
LOS	A			A			D		D	B		B
95th Queue (m)	1			0			26		26	7		7
2035 Background Traffic Conditions (north-south stop-controlled)												
Volume (vph)	64	110	48	7	219	2	48	17	12	2	44	93
v/c	0.07			0.08			0.32		0.32	0.19		0.19
LOS	A			A			C		C	B		B
95th Queue (m)	2			0			11		11	6		6
2035 Total Traffic Conditions (north-south stop-controlled)												
Volume (vph)	62	140	76	7	334	34	111	39	12	11	54	91
v/c	0.10			0.13			0.74		0.74	0.31		0.31
LOS	A			A			F		F	C		C
95th Queue (m)	2			0			42		42	11		11

Table 6-9: Highway 14/Highway 41 Intersection – PM Peak Hour

	Eastbound			Westbound			Northbound			Southbound		
Movement	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**
Geometry	**LT/TR**			**LT/TR**			**LT/R**			**LT/R**		
2014 Existing Traffic Conditions (north-south stop-controlled)												
Volume (vph)	64	136	64	18	100	2	43	18	15	1	16	53
v/c	0.09			0.04			0.27		0.27	0.09		0.09
LOS	A			A			C		C	B		B
95th Queue (m)	2			1			9		9	2		2
2020 Background Traffic Conditions (north-south stop-controlled)												
Volume (vph)	78	159	64	18	117	2	47	26	16	1	20	65
v/c	0.10			0.04			0.37		0.37	0.13		0.13
LOS	A			A			C		C	B		B
95th Queue (m)	2			1			13		13	4		4
2020 Total Traffic Conditions (north-south stop-controlled)												
Volume (vph)	74	359	139	18	167	17	95	43	16	57	47	62
v/c	0.21			0.07			0.82		0.82	0.51		0.51
LOS	A			A			F		F	D		D
95th Queue (m)	2			1			49		49	22		22
2035 Background Traffic Conditions (north-south stop-controlled)												
Volume (vph)	97	199	64	18	147	3	47	32	16	2	24	81
v/c	0.12			0.05			0.51		0.51	0.21		0.21
LOS	A			A			D		D	B		B
95th Queue (m)	3			1			22		22	6		6
2035 Total Traffic Conditions (north-south stop-controlled)												
Volume (vph)	94	399	139	18	197	18	95	49	16	58	51	78
v/c	0.23			0.08			1.12		1.12	0.69		0.69
LOS	A			A			F		F	E		E
95th Queue (m)	2			1			77		77	39		39

During the AM peak hour, all intersection movements at the Highway 14/Highway 41 intersection are projected to operate at LOS C or better except for northbound movements which are projected to operate at LOS D under total traffic conditions in 2020 and LOS F in 2035. During the PM peak hour, northbound traffic volumes are projected to exceed the capacity of the intersection resulting in a v/c ratio that is greater than 1 and the northbound movements are projected to operate at LOS F. The southbound traffic movements are projected to operate at LOS E under the 2035 horizon. All intersection movements along Highway 14 are anticipated to operate at LOS A with low v/c ratios.

As summarized in Section 6.3, the Highway 14/Highway 41 intersection met the warrants for signalization for total traffic conditions under the 2035 horizons. However, given that the intersection is currently two-way stop-controlled, consideration was first given to increasing the level of intersection traffic-control to a four-way stop-control. **Table 6-10** summarizes the projected traffic operations associated with the Highway 14/Highway 41 intersection for total traffic conditions under the 2035 horizon assuming the intersection is four-way stop-controlled.

Table 6-10: Highway 14/Highway 41 Intersection – 2035 Total Traffic Conditions

	Eastbound			Westbound			Northbound			Southbound		
Movement	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**
Geometry	**LT/TR**			**LT/TR**			**LT/R**			**LT/R**		
AM Peak Hour (four-way stop-controlled)												
Volume (vph)	62	140	76	7	334	34	111	39	12	11	54	91
v/c	0.29			0.39			0.36		0.02	0.15		0.18
LOS	B			B			B		A	B		A
95th Queue (m)	25*			26*			29*		13*	24*		19*
PM Peak Hour (four-way stop-controlled)												
Volume (vph)	94	399	139	18	197	18	95	49	16	58	51	78
v/c	0.65			0.27			0.36		0.03	0.27		0.17
LOS	C			B			B		A	B		A
95th Queue (m)	31*			22*			23*		11*	24*		18*

* average 95th percentile queue length based on five SimTraffic simulation runs

It is of note that Synchro does not report the 95th percentile queue length for four-way stop-controlled intersections; therefore, the 95th percentile queue length was estimated based on traffic simulations completed using SimTraffic, a companion product to Synchro. The 95th percentile queue length reported in Table 6-10 is the average measured 95th percentile queue length based on five simulation runs under each scenario.

As summarized in Table 6-10, all movements at the Highway 14/Highway 41 intersection are projected to operate at LOS C or better during the AM and PM peak hours for total traffic conditions under the 2035 horizon assuming the intersection is four-way stop-controlled. It is of note that if the intersection is converted to all-way stop-control, the development of an eastbound right turn bay would no longer be considered appropriate as it would result in an approach with three lanes. Approaches that are stop-controlled typically should accommodate two lanes or fewer.

In addition to a favourable capacity assessment, the Highway 14/Highway 41 intersection is anticipated to be an appropriate intersection for all-way stop-control for the following reasons:

- Two of the intersection quadrants are anticipated to include development adjacent both highway corridors in the near future;
- Both roadways are of the same classification; and,
- Traffic volumes between both highways are somewhat comparable.

It is acknowledged that the traffic generated by the development of the subject lands, in addition to traffic growth along the highway corridors, may meet the warrants for intersection signalization, which would typically trigger consideration of a roundabout design. However, given that the capacity analysis indicates that the intersection is projected to operate at acceptable levels of service as a four-way stop-controlled intersection, which is anticipated to represent a viable solution, a roundabout design was not considered in the analysis.

6.4.2 23 Avenue/Highway 41 Intersection

Based on the results of the left and right-turn warrants completed for the future 23 Avenue/Highway 41 intersection (Section 6.2.2), the intersection is anticipated to include the following geometry:

- **West Approach** – one shared left/right lane;
- **South Approach** – one left-turn bay, one through lane; and,
- **North Approach** – one right-turn bay, one through lane.

Table 6-11 summarizes projected intersection operations at the future 23 Avenue/Highway 41 intersection during the AM and PM peak hours for the 2035 horizon.

As summarized in Table 6-11, all movements at the future 23 Avenue/Highway 41 intersection are anticipated to operate at LOS B or better during the AM and PM peak hour under the 2035 horizon assuming the full buildout of the subject lands.

Table 6-11: 23 Avenue/Highway 41 Intersection – 2035 Total Traffic Conditions

	Eastbound		Northbound		Southbound	
Movement	**L**	**R**	**L**	**T**	**T**	**R**
Geometry	**LR**		**L/T**		**R/T**	
AM Peak Hour (eastbound stop-controlled)						
Volume (vph)	50	8	64	71	157	129
v/c	0.11		0.06	0.05	0.13	0.08
LOS	B		A	A	A	A
95th Queue (m)	3		2	0	0	0
PM Peak Hour (eastbound stop-controlled)						
Volume (vph)	129	31	55	105	113	50
v/c	0.28		0.04	0.07	0.08	0.03
LOS	B		A	A	A	A
95th Queue (m)	9		1	0	0	0

6.4.3 18 Avenue/Highway 41 Intersection

Based on the left and right-turn warrants, the proposed 18 Avenue/Highway 41 intersection is anticipated to include the following geometry:

- **West Approach** – one right-turn lane;
- **South Approach** – one through lane; and,
- **North Approach** – one shared through/right-turn lane.

Table 6-12 summarizes projected intersection operations at the future 18 Avenue/Highway 41 intersection during the AM and PM peak hours for the 2035 horizon. As summarized in Table 6-12, all movements at the future 18 Avenue/Highway 41 intersection are anticipated to operate at LOS A during the AM and PM peak hour under the 2035 horizon assuming the full buildout of the subject lands.

Table 6-12: 18 Avenue/Highway 41 Intersection – 2035 Total Traffic Conditions

	Eastbound	Northbound	Southbound	
Movement	**R**	**T**	**T**	**R**
Geometry	**R**	**T**	**RT**	
AM Peak Hour (eastbound stop-controlled)				
Volume (vph)	25	135	131	34
v/c	0.03	0.09	0.13	
LOS	A	A	A	
95th Queue (m)	1	0	0	
PM Peak Hour (eastbound stop-controlled)				
Volume (vph)	68	160	119	25
v/c	0.09	0.11	0.10	
LOS	A	A	A	
95th Queue (m)	2	0	0	

6.5 Lighting Warrants

A lighting assessment was completed at each of the study area intersections based on the *TAC Guide for the Design of Roadway Lighting 2006*. Illumination is required if a warrant score is equal to or greater than 120 or if the intersection is/requires signalization. The Highway 14/Highway 41 intersection is currently fully illuminated; therefore, it is not included in the assessment. The assessment included a review of the illumination requirements for the area access intersections along Highway 41 under the 2020 and 2035 horizons. **Table 6-13** summarizes the results of the lighting assessment. Calculation spreadsheets for the street lighting assessment are included in **Appendix E**.

Table 6-13: Summary of Illumination Warrant Analysis

Intersection	2020	2035	Illumination Warranted?
23 Ave/Hwy 41	83	83	No
18 Ave/Hwy 41	88	98	No

As summarized in Table 6-13, illumination is not warranted at either of the area access intersections along Highway 41 under the full buildout scenarios based on the illumination warrants. Notwithstanding the above, if either intersection is constructed to include raised medians, illumination would be warranted.

6.6 Intersection Spacing

As mentioned previously, two additional access intersections along Highway 41 are proposed to be developed to service the subject lands: 18 Avenue/Highway 41 is proposed to be developed as a right-in/right-out intersection; and 23 Avenue/Highway 41 is proposed to be developed as an all-direction intersection. In terms of intersection spacing, the 18 Avenue/Highway 41 intersection is proposed to be located about 400 metres north of the Highway 14/Highway 41 intersection and the 23 Avenue/Highway 41 intersection is proposed to be located about 400 metres north of the future 18 Avenue (as illustrated in Exhibit 3-1).

Given the existing and planned commercial development along the Highway 41 corridor in the vicinity of Highway 14, the function of Highway 41 immediately north of Highway 14 is likely to transition from a rural highway to a semi-urban roadway over the long term horizon. Similar to how the function of Highway 14 within the Town of Wainwright transitioned to provide a better balance between mobility and accessibility to adjacent developments, Highway 41 is likely to experience a similar transition as development proceeds along the corridor. Therefore, to review the spacing requirements for intersections along the Highway 41 corridor north of Highway 14, *Alberta Transportation's Highway Geometric Design Guide Urban Supplement (DRAFT – Nov. 2003)* was reviewed.

Based on a review of Table U.A.1 Typical Characteristics of Urban Roadways for New Construction and assuming that Highway 41 is best classified as a major arterial roadway, a minimum intersection spacing of 400 metres is identified. A proposed intersection spacing of 400 metres between the future intersections along the Highway 41 corridor meets the spacing requirements identified.

As this area develops, consideration should be given to reducing the speed limit on Highway 41 between Highway 14 and north of the future 23 Avenue. Given that the Highway 14/Highway 41 intersection is stop-controlled along the Highway 41 approaches, transitioning to a lower posted speed on this portion of Highway 41 seems reasonable as vehicles are already either decelerating as they approach the Highway 14/Highway 41 intersection or have yet to fully accelerate to the posted speed heading northbound.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Study Synopsis

The Town of Wainwright continues to experience steady levels of growth in its commercial and industrial sectors. To accommodate market demands, the Town is considering permitting the development of about three quarter sections of land located adjacent the north Town limit, west of the Highway 41 corridor. The subject lands are proposed to accommodate commercial and industrial land uses. The Town of Wainwright has identified the need to complete a TIA to better understand, assess and mitigate any identified traffic and transportation issues associated with the development of the subject lands. Bunt & Associates was retained by Select Engineering Consultants Ltd., the Town of Wainwright's civil engineering consultant, to complete the TIA.

The subject lands are generally located north of Highway 14 and west of Highway 41 in the Town of Wainwright. The development area includes NE ¼ Section 5-45-6-4 and portions of the SE and NW ¼ Sections 5-45-6-4. SE ¼ Section 5-45-6-4 is located within the Town of Wainwright boundaries; NE ¼ Section 5-45-6-4 and the north half of NW ¼ Section 5-45-6-4 are located within the Municipal District of Wainwright No. 61.

The development initiative is anticipated to encompass an area in the order of about 139.2 hectares (343.7 acres). The majority of the lands are proposed to be developed as heavy industrial land uses (70.3 hectares). The remainder of the lands are proposed as commercial land uses (33.8 hectares), light industrial land uses (28.6 hectares) and an RV Park (6.5 hectares). The subject lands are anticipated to be fully developed within a five-year period (2020).

Full buildout of the development area (plus the approved commercial and light industrial development areas located north of Highway 14, adjacent 27 Street) is anticipated to generate 1,825 two-way trips that are new to the road network during the AM peak hour, 2,659 two-way trips that are new to the road network during the PM peak hour, and 23,432 two-way trips that are new to the road network during a typical day. The trips were assigned to Highway 14 and Highway 41; however, the study only considered the potential traffic impacts on intersections on the Highway 41 corridor.

7.1.1 Intersection Spacing

Two additional access intersections along Highway 41 are proposed to be developed to service the subject lands: 18 Avenue/Highway 41 is proposed to be developed as a right-in/right-out intersection; and 23 Avenue/Highway 41 is proposed to be developed as an all-direction intersection. In terms of intersection spacing, the 18 Avenue/Highway 41 intersection is proposed to be located about 400 metres north of the Highway 14/Highway 41 intersection and the 23 Avenue/Highway 41 intersection is proposed to be located about 400 metres north of the future 18 Avenue. A proposed intersection spacing of 400 metres between the future intersections along the Highway 41 corridor meets the spacing requirements identified in Alberta Transportation's *Highway Geometric Design Guide Urban Supplement (DRAFT – Nov. 2003)*.

7.1.2 Highway 14/Highway 41

The Highway 14/Highway 41 intersection currently includes a shared left/through lane and a shared through/right lane on each of the east and west approaches and is considered to be comparable to a Type IV intersection based on a review of Alberta Transportation's *Highway Geometric Design Guide*. The left and right-turn warrant analysis for the intersection identified that a left-turn lane is warranted along the east and west approaches of the intersection under existing, background and total traffic conditions for each horizon considered. In addition, the left-turn lane associated with the west approach of the intersection should include 10 metres of additional storage space. A right-turn bay is warranted on the west intersection approach for each scenario considered.

Under the existing intersection geometry and traffic control (two-way stop-controlled along the north and south approaches), all intersection movements at the Highway 14/Highway 41 intersection are projected to operate at LOS C or better except for northbound movements which are projected to operate at LOS D under total traffic conditions in 2020 and LOS F in 2035 during the AM peak hour. During the PM peak hour, northbound traffic volumes are projected to exceed the capacity of the intersection resulting in a v/c ratio that exceeds 1. Northbound traffic movements are projected to operate at LOS F under total traffic conditions while southbound traffic movements are projected to operate at LOS E under the long term horizon. All intersection movements along Highway 14 are anticipated to operate at LOS A with low v/c ratios.

Given the potential capacity and level of service issues identified in the capacity analysis and that the intersection met the warrants for signalization for total traffic conditions under the 2035 horizon, further analysis was required. The analysis first considered increasing the level of intersection traffic-control to a four-way stop-control from a two-way stop-control. Assuming the intersection is four-way stop-controlled, all movements at the Highway 14/Highway 41 intersection are projected to operate at LOS C or better during the AM and PM peak hours for total traffic conditions under the 2035 horizon. As an all-way stop-controlled intersection, the development of an eastbound right turn bay would no longer be considered appropriate.

It is acknowledged that the traffic generated by the development of the subject lands, in addition to traffic growth along the highway corridors, may meet the warrants for intersection signalization, which would typically trigger consideration of a roundabout design. However, given that the capacity analysis indicates that the intersection is projected to operate at acceptable levels of service as a four-way stop-controlled, which is anticipated to represent a more practical intersection design, a roundabout design was not considered in the analysis.

7.1.3 23 Avenue and Highway 41

The future 23 Avenue/Highway 41 intersection is proposed to be developed as a T-intersection as the farmstead access currently located on the east side of Highway 41, which would align with the future 23 Avenue, is anticipated to be eliminated. A left-turn lane is warranted along the south approach of the future 23 Avenue/Highway 41 intersection with the development of the subject lands. (The south

intersection approach should be developed to a Type III standard; no additional storage length is anticipated to be required.) A right-turn bay is warranted along the north approach of the future 23 Avenue/Highway 41 intersection assuming full buildout of the subject lands.

The capacity analysis identified that all movements at the future 23 Avenue/Highway 41 intersection are anticipated to operate at LOS B or better during the AM and PM peak hour under the long-term horizon based on the intersection geometry identified through the left and right-turn warrants. Intersection illumination is not warranted at the intersection under the full buildout scenarios.

7.1.4 18 Avenue and Highway 41

The proposed 18 Avenue/Highway 41 intersection is anticipated to be developed as a right-in/right-out intersection. Assuming single lane approaches in all directions, the capacity analysis identified that all movements at the intersection are anticipated to operate at LOS A during the AM and PM peak hour under full buildout of the subject lands. Given that Highway 41 is an undivided roadway, the right-in/right-out operations associated with the proposed 18 Avenue/Highway 41 intersection are anticipated to be imposed through the geometric design of the intersection which will likely include lane channelization. While illumination is not warranted at the intersection based on traffic volumes, partial intersection illumination may be required if lane channelization be accommodated by way of a raised concrete median.

7.2 Recommendations

The following is a summary of recommendations and conclusions:

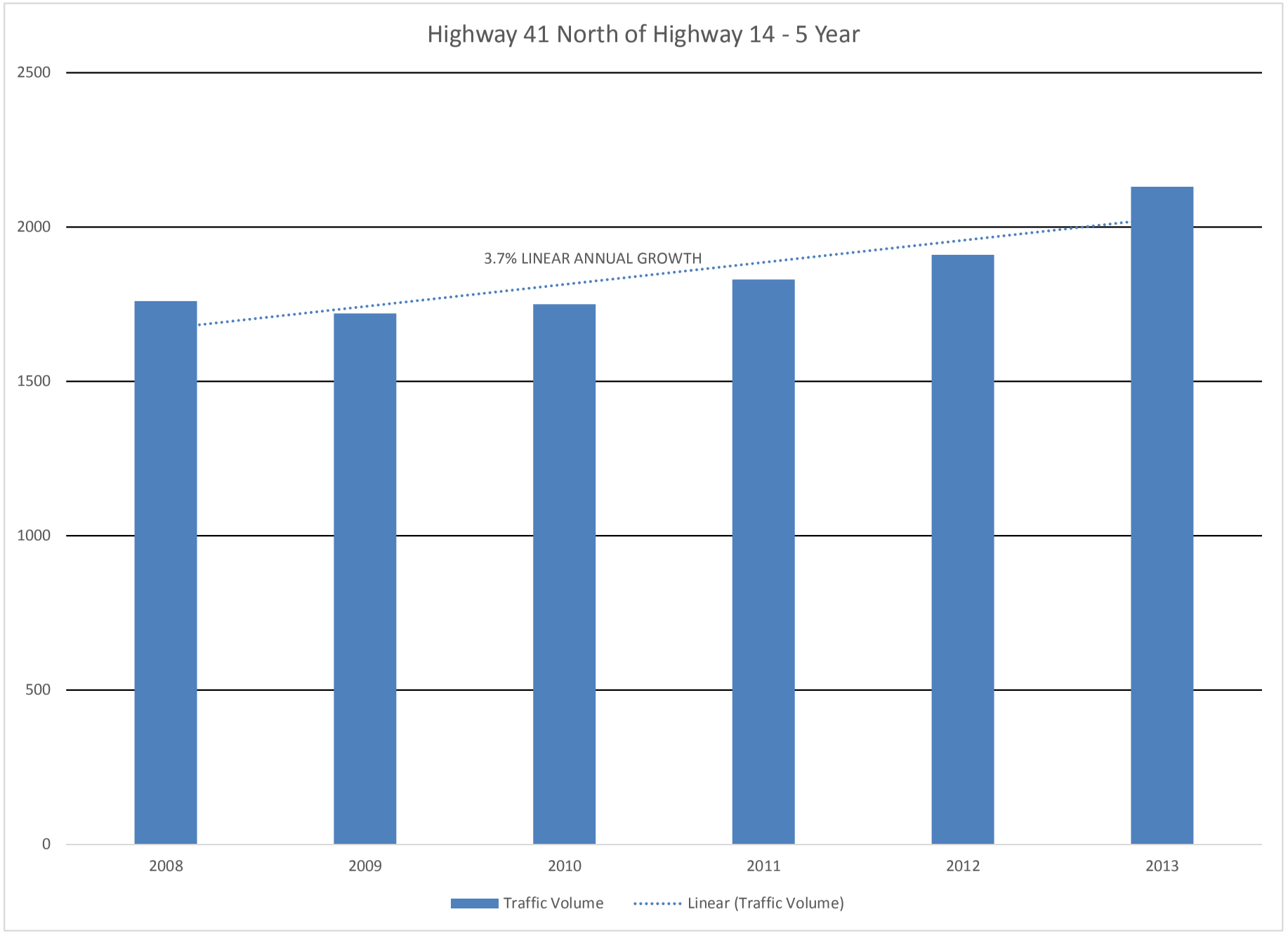
- Two new intersections are proposed to accommodate the subject development, a T-intersection at 23 Avenue/Highway 41 and a southbound right-in/right-out at 18 Avenue/Highway 41.
- In both the 2020 and 2035 horizon, a Type III T-intersection treatment plus a southbound right-turn bay is recommended at the intersection of 23 Avenue and Highway 41. This is based on the assumption that the farmstead access to the east will be closed. If the farmstead access remains in operation, additional analysis will be required to identify the appropriate intersection treatment.
- For the proposed right-in/right-out at 18 Avenue off of Highway 41, a designated right-turn bay is not warranted; however, the intersection will need to be designed to mitigate unwanted left-turns. This could include either a small section of raised concrete median on Highway 41, and/or a large channelizing island (depressed or raised) on 18 Avenue and steep entrance/exit angles accomplished through deceleration/acceleration tapers. While illumination warrants are not met at this intersection, if raised concrete medians or channelizing islands are installed, intersection illumination will be required.
- The existing intersection of Highway 14 and Highway 41 includes a shared through/left and a shared through/right on both the eastbound and westbound approaches along Highway 14, and a shared through/left and designated right-turn lane on both the northbound and southbound approaches on Highway 14. The intersection currently operates as a two-way stop controlled intersection with the stop condition occurring on Highway 41 (northbound/southbound). Based on

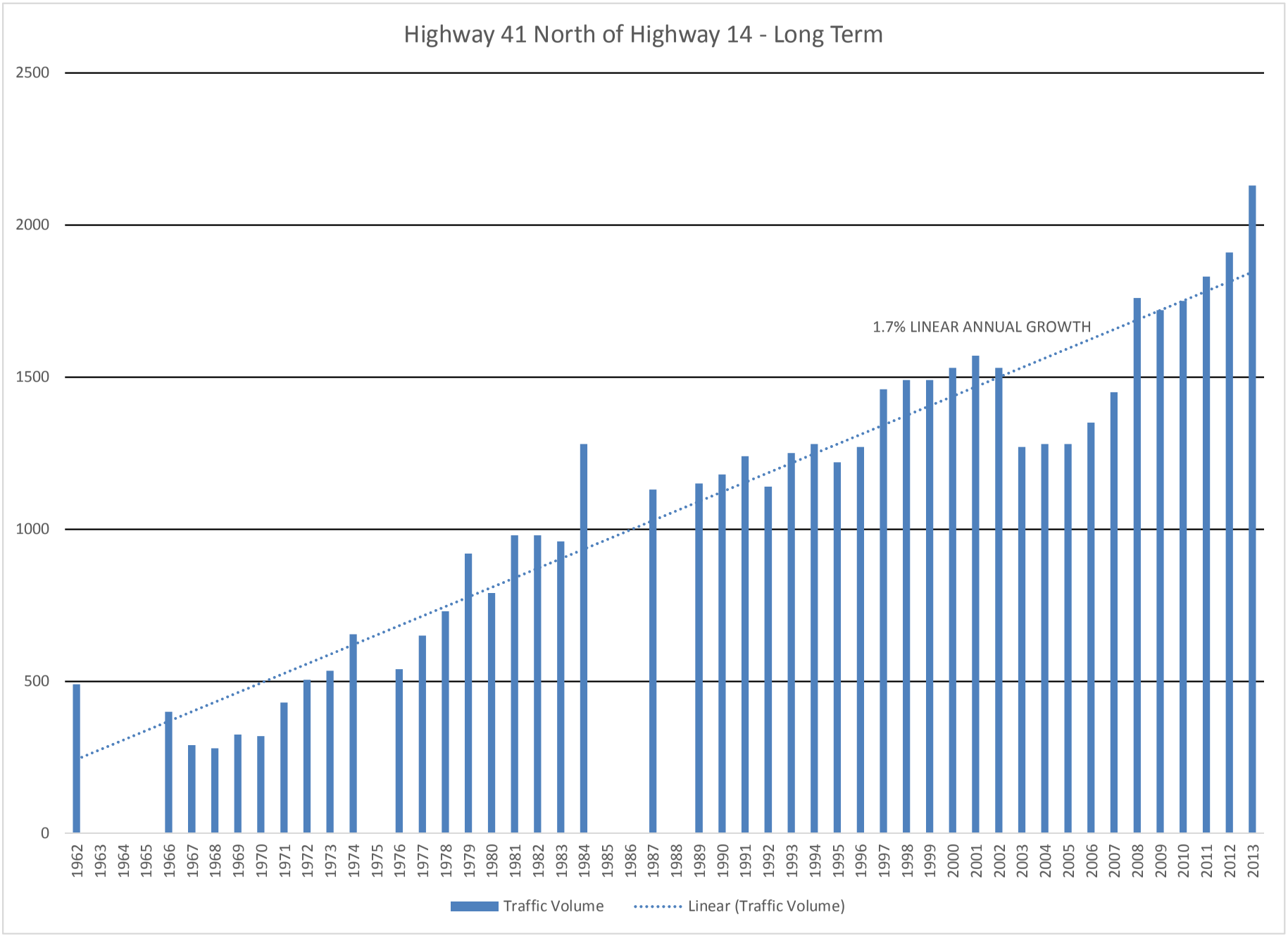
existing traffic volumes, an eastbound right-turn lane is warranted at the intersection of Highway 14 and Highway 41.

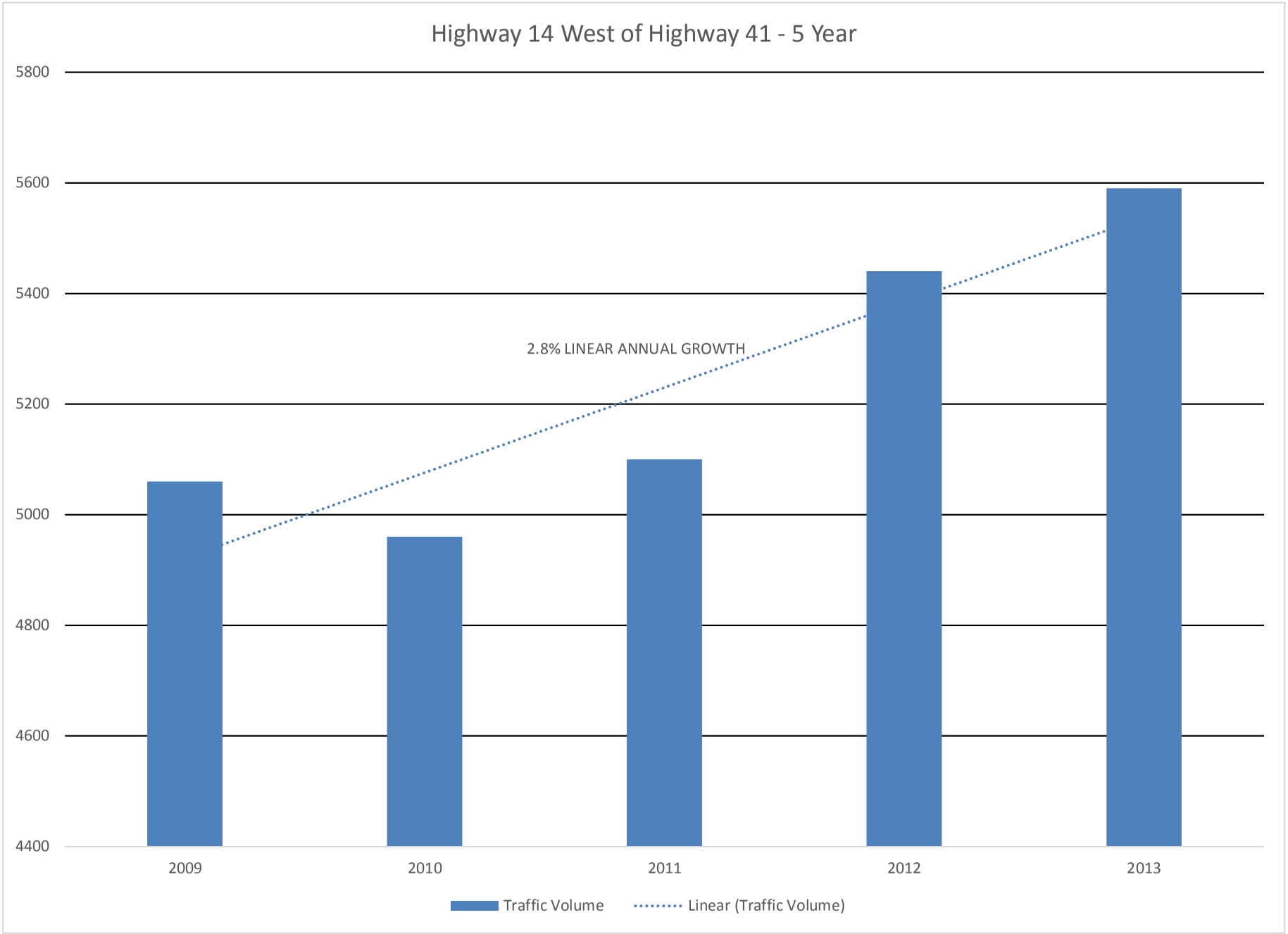
- Assuming that the intersection of Highway 14 and Highway 41 continues to operate with the stop condition on Highway 41, the northbound and southbound movements on Highway 41 are anticipated to operate at LOS E/F during the AM and PM peak of the 2035 build-out horizon.
- Based on traffic signal warrants at the Highway 14/Highway 41intersection, traffic signals are not warranted under the 2020 horizon but are warranted under the 2035 horizon. As an alternative to traffic signals, consideration was given to converting this intersection to all-way stop control. Analysis indicates that the intersection will operate well as a four-way stop with all traffic movements operating at LOS C or better. As an-all-way stop-controlled intersection, no additional intersection upgrades are required, including eliminating the need for an eastbound right-turn bay. As such, it is recommended that consideration be given to converting this intersection to an all-way stop-controlled intersection rather than constructing an eastbound right turn bay.
- While not critical under existing conditions, as this area develops it is recommended that consideration be given to reducing the speed limit on Highway 41, north of Highway 14, to improve safety at the intersections with 18 Avenue and 23 Avenue, and to reflect the semi-urban nature of surrounding lands.

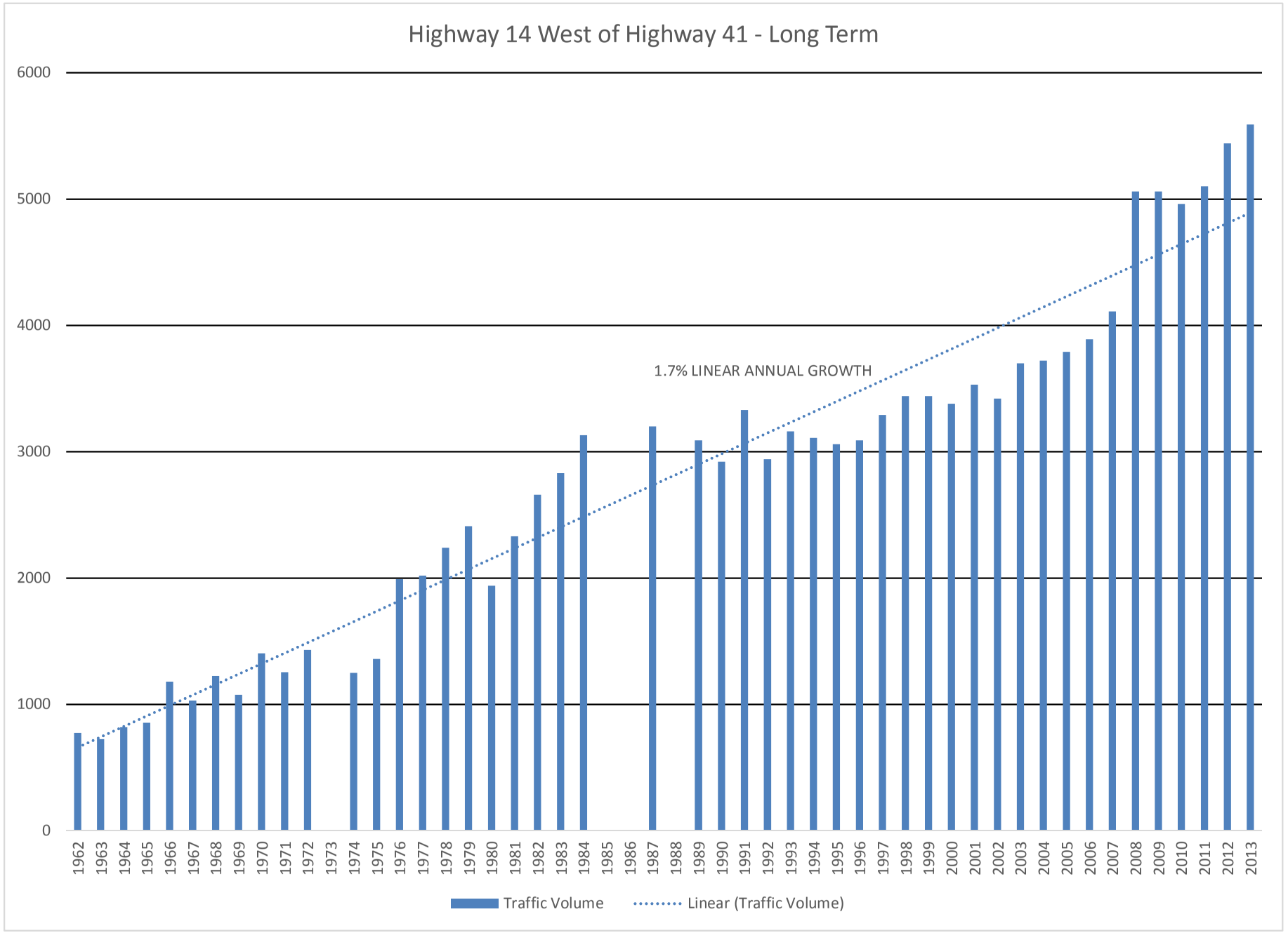
APPENDIX A

Highway Growth Calculations


Highway 41 North of Highway 14 - 5 Year
2500
2000
1500
1000
500
0
3.7% LINEAR ANNUAL GROWTH
2008
2009
2010
2011
2012
2013
Traffic Volume
Linear (Traffic Volume)


Highway 41 North of Highway 14 - Long Term
2500
2000
1500
1000
500
0
1.7% LINEAR ANNUAL GROWTH
1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Traffic Volume
Linear (Traffic Volume)


Highway 14 West of Highway 41 - 5 Year
5800
5600
5400
5200
5000
4800
4600
4400
2.8% LINEAR ANNUAL GROWTH
2009
2010
2011
2012
2013
Traffic Volume
Linear (Traffic Volume)


Highway 14 West of Highway 41 - Long Term
6000
5000
4000
3000
2000
1000
0
1.7% LINEAR ANNUAL GROWTH
1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Traffic Volume
Linear (Traffic Volume)

APPENDIX B

Alberta Transportation Geometry Warrants

AT Warrant Analysis for Left Turn Lanes

Highway 14 and Highway 41

EXISTING (2014) TRAFFIC ANALYSIS	AM Peak Hour									PM Peak Hour								
Location	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**
West Approach																		
Highway 14	42	19%	165	25%	157	D-7.6-3c (25%)	II	0 m	0 m	64	5%	263	24%	120	D-7.6-3c (25%)	III	0 m	0 m
East Approach																		
Highway 14	7	0%	157	4%	165	D-7.6-7a (5%)	II	0 m	0 m	18	39%	120	15%	263	D-7.6-7b (15%)	III	0 m	0 m

Background Traffic Conditions

2020 BACKGROUND TRAFFIC ANALYSIS	AM Peak Hour									PM Peak Hour								
Location	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**
West Approach																		
Highway 14	51	19%	187	27%	182	D-7.6-3c (25%)	II	0 m	0 m	78	5%	300	26%	137	D-7.6-3c (25%)	III	0 m	0 m
East Approach																		
Highway 14	7	0%	182	4%	187	D-7.6-7a (5%)	II	0 m	0 m	18	39%	137	13%	300	D-7.6-7b (15%)	III	0 m	0 m

2035 BACKGROUND TRAFFIC ANALYSIS	AM Peak Hour									PM Peak Hour								
Location	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**
West Approach																		
Highway 14	64	19%	222	29%	228	D-7.6-3c (30%)	III	0 m	0 m	97	5%	359	27%	168	D-7.6-3c (25%)	IV	0 m	0 m
East Approach																		
Highway 14	7	0%	228	3%	222	D-7.6-7a (5%)	III	0 m	0 m	18	39%	168	11%	359	D-7.6-7a (10%)	III	0 m	0 m

Full Build Out Traffic Conditions

2020 TOTAL TRAFFIC ANALYSIS	AM Peak Hour									PM Peak Hour								
Location	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**
West Approach																		
Highway 14	49	19%	243	20%	329	D-7.6-3b (20%)	III	0 m	0 m	74	5%	572	13%	202	D-7.6-3b (15%)	IV	0 m	0 m
East Approach																		
Highway 14	7	0%	329	2%	243	N/A	-	-	-	18	39%	202	9%	572	D-7.6-7a (10%)	IV	0 m	0 m

2035 TOTAL TRAFFIC ANALYSIS	AM Peak Hour									PM Peak Hour								
Location	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**
West Approach																		
Highway 14	62	19%	278	22%	375	D-7.6-3b (20%)	IV	0 m	0 m	94	5%	631	15%	233	D-7.6-3b (15%)	IV	10 m	0 m
East Approach																		
Highway 14	7	0%	375	2%	278	N/A	-	-	-	18	39%	233	8%	631	D-7.6-7a (10%)	IV	0 m	0 m

Notes:

1. Posted speed limit for eastbound traffic on Highway 14 approaching Highway 41 is 60 km/h (transitions to 100 km/h east of Highway 41); assumed a design speed of 70 km/h.
2. Posted speed limit for westbound traffic on Highway 14 approaching Highway 41 is 100 km/h (transitions to 60 km/h west of Highway 41); assumed a design speed of 110 km/h.
3. Percentage trucks in Advancing Left Turn Volume are based on the October 2014 Traffic Counts completed by Bunt & Associates.
4. In scenarios where proportion of left turns in advancing left turn volume is less than 3% or the opposing volume is less than 100 vph, a Type I intersection was assumed to be adequate.
5. In scenarios where proportion of left turns in advancing left turn volume is greater than 40%, 40% was assumed.

AT Warrant Analysis for Right Turn Lanes

Highway 14 and Highway 41

EXISTING (2014) TRAFFIC ANALYSIS	2014						
Location	**Main Road AADT**	**Main Road AADT > 1800 vph?**	**Estimated Intersecting Road AADT**	**Intersecting Road AADT > 900 vpd?**	**Estimated AADT Right Turn Volume**	**Daily Right Turn Volume > 360?**	**Right Turn Lane Warranted?**
West Approach							
Highway 14	4858	yes	1812	yes	616	yes	**YES**
East Approach							
Highway 14	2846	yes	1646	yes	17	no	**NO**

Background Traffic Conditions

2020 BACKGROUND TRAFFIC ANALYSIS	2020						
Location	**Main Road AADT**	**Main Road AADT > 1800 vph?**	**Estimated Intersecting Road AADT**	**Intersecting Road AADT > 900 vpd?**	**Estimated AADT Right Turn Volume**	**Daily Right Turn Volume > 360?**	**Right Turn Lane Warranted?**
West Approach							
Highway 14	5563	yes	1943	yes	611	yes	**YES**
East Approach							
Highway 14	3280	yes	2026	yes	21	no	**NO**

2035 BACKGROUND TRAFFIC ANALYSIS	2035						
Location	**Main Road AADT**	**Main Road AADT > 1800 vph?**	**Estimated Intersecting Road AADT**	**Intersecting Road AADT > 900 vpd?**	**Estimated AADT Right Turn Volume**	**Daily Right Turn Volume > 360?**	**Right Turn Lane Warranted?**
West Approach							
Highway 14	6685	yes	2070	yes	611	yes	**YES**
East Approach							
Highway 14	4048	yes	2525	yes	26	no	**NO**

Full Build Out Traffic Conditions

2020 TOTAL TRAFFIC ANALYSIS	2020						
Location	**Main Road AADT**	**Main Road AADT > 1800 vph?**	**Estimated Intersecting Road AADT**	**Intersecting Road AADT > 900 vpd?**	**Estimated AADT Right Turn Volume**	**Daily Right Turn Volume > 360?**	**Right Turn Lane Warranted?**
West Approach							
Highway 14	8447	yes	3289	yes	1108	yes	**YES**
East Approach							
Highway 614	5798	yes	2922	yes	314	no	**NO**

2035 TOTAL TRAFFIC ANALYSIS	2035						
Location	**Main Road AADT**	**Main Road AADT > 1800 vph?**	**Estimated Intersecting Road AADT**	**Intersecting Road AADT > 900 vpd?**	**Estimated AADT Right Turn Volume**	**Daily Right Turn Volume > 360?**	**Right Turn Lane Warranted?**
West Approach							
Highway 14	9569	yes	3416	yes	1108	yes	**YES**
East Approach							
Highway 14	6565	yes	3421	yes	319	no	**NO**

Notes:

1. "Main Road AADT" is assumed to be the approach from which the right turns are leaving
2. "Intersecting Road Volume" assumed to be volume on leg that right-turning traffic is turning into

AT Warrant Analysis for Left Turn Lanes

23 Avenue/Highway 41

Full Build Out Traffic Conditions																		
2020 TOTAL TRAFFIC ANALYSIS	**AM Peak Hour**									**PM Peak Hour**								
Location	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**
South Approach																		
Highway 41	64	10%	117	55%	257	D-7.6-7d (40%)	III	0 m	0 m	55	10%	134	41%	142	D-7.6-7d (40%)	III	0 m	0 m
2035 TOTAL TRAFFIC ANALYSIS	**AM Peak Hour**									**PM Peak Hour**								
Location	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**	**Advancing Left Turn Volume, vph**	**Percent Trucks in ALTV, %**	**Advancing Volume (Va), vph**	**Proportion of Left Turns in Advancing Left Turn Volume (L), %**	**Opposing Volume (V-o), vph**	**Chart Used**	**Design Type**	**Additional Storage Length (m)**	**Extra Storage for Trucks?**
South Approach																		
Highway 41	64	10%	135	47%	286	D-7.6-7d (40%)	III	0 m	0 m	55	10%	160	34%	163	D-7.6-7d (35%)	III	0 m	0 m

Notes:
1. Posted speed limit along Highway 41 is 100 km/h; assumed a design speed of 110 km/h.
2. Percentage trucks in Advancing Left Turn Volume are based on the October 2014 Traffic Counts completed by Bunt & Associates.
3. In scenarios where proportion of left turns in advancing left turn volume is less than 3% or the opposing volume is less than 100 vph, a Type I intersection was assumed to be adequate.
4. In scenarios where proportion of left turns in advancing left turn volume is greater than 40%, 40% was assumed.

AT Warrant Analysis for Right Turn Lanes

23 Avenue/Highway 41

Full Build Out

2020 TOTAL TRAFFIC ANALYSIS	2020						
Location	**Main Road AADT**	**Main Road AADT > 1800 vph?**	**Estimated Intersecting Road AADT**	**Intersecting Road AADT > 900 vpd?**	**Estimated AADT Right Turn Volume**	**Daily Right Turn Volume > 360?**	**Right Turn Lane Warranted?**
North Approach							
Highway 41	3373	yes	2147	yes	587	yes	**YES**

2035 TOTAL TRAFFIC ANALYSIS	2035						
Location	**Main Road AADT**	**Main Road AADT > 1800 vph?**	**Estimated Intersecting Road AADT**	**Intersecting Road AADT > 900 vpd?**	**Estimated AADT Right Turn Volume**	**Daily Right Turn Volume > 360?**	**Right Turn Lane Warranted?**
North Approach							
Highway 41	3872	yes	2147	yes	587	yes	**YES**

Notes:

1. "Main Road AADT" is assumed to be the approach from which the right turns are leaving
2. "Intersecting Road Volume" assumed to be volume on leg that right-turning traffic is turning into

AT Warrant Analysis for Right Turn Lanes

Right-In/Right-Out and Highway 41

Full Build Out

2020 TOTAL TRAFFIC ANALYSIS	2020						
Location	**Main Road AADT**	**Main Road AADT > 1800 vph?**	**Estimated Intersecting Road AADT**	**Intersecting Road AADT > 900 vpd?**	**Estimated AADT Right Turn Volume**	**Daily Right Turn Volume > 360?**	**Right Turn Lane Warranted?**
North Approach							
Highway 41	2696	yes	698	no	236	no	**NO**

2035 TOTAL TRAFFIC ANALYSIS	2035						
Location	**Main Road AADT**	**Main Road AADT > 1800 vph?**	**Estimated Intersecting Road AADT**	**Intersecting Road AADT > 900 vpd?**	**Estimated AADT Right Turn Volume**	**Daily Right Turn Volume > 360?**	**Right Turn Lane Warranted?**
North Approach							
Highway 41	3195	yes	698	no	236	no	**NO**

Notes:

1. "Main Road AADT" is assumed to be the approach from which the right turns are leaving
2. "Intersecting Road Volume" assumed to be volume on leg that right-turning traffic is turning into

APPENDIX C

Traffic Signal Warrants

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	**Highway 14**	**Direction (EW or NS)**	**EW**
Side Street (name)	**Highway 41**	**Direction (EW or NS)**	**NS**
Quadrant / Int #		**Comments**	**2014 Existing Traffic Volumes**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**		

Road Authority:	**Alberta Transportation**
City:	**Sturgeon County**
Analysis Date:	**2014 Dec 22, Mon**
Count Date:	**2014 Oct 23, Thu**
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 14	WB		1			1		10,000	2
Highway 14	EB		1			1		400	2
Highway 41	NB		1				1		
Highway 41	SB		1				1		
							n		
							n		

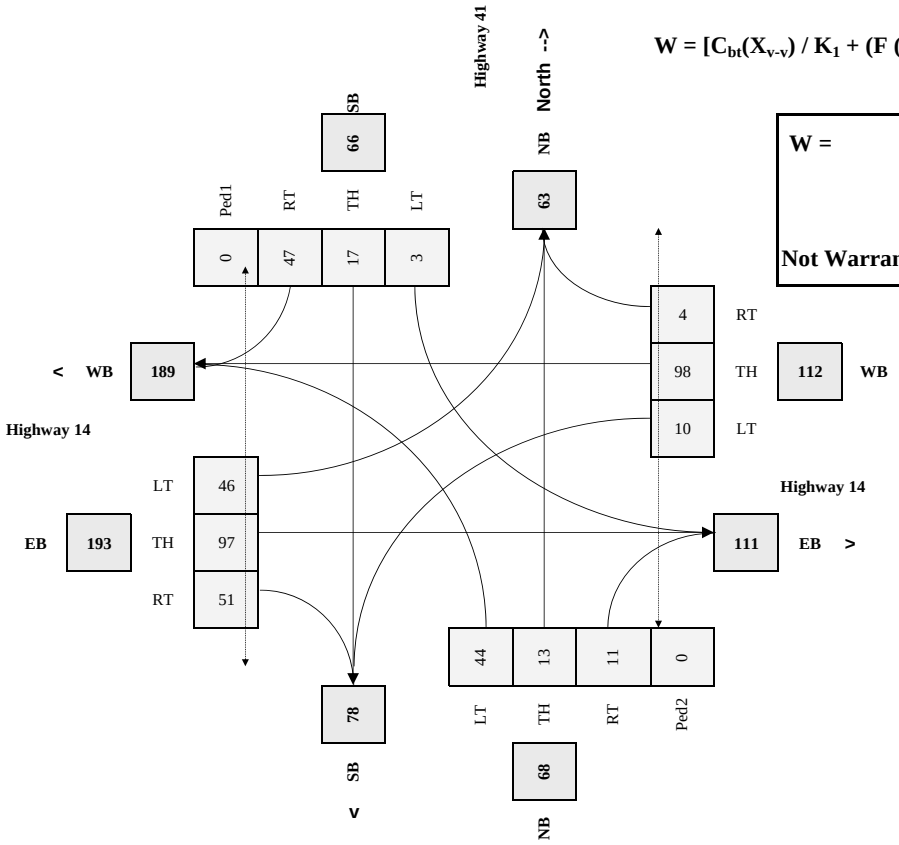
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	4,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 14	EW	100	12.0%	n	
Highway 41	NS		21.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1** **NS**	**Ped2** **NS**	**Ped3** **EW**	**Ped4** **EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 AM - 9:00 AM	75	28	26	5	36	98	21	234	5	74	162	89	0	0	0	0
													0	0	0	0
11:30 AM - 1:30 PM	81	23	14	6	33	69	18	148	12	89	168	95	0	0	0	0
													0	0	0	0
4:00 PM - 6:00 PM	109	29	25	7	30	114	23	207	4	111	250	120	0	0	0	0
													0	0	0	0
Total (6-hour peak)	**265**	**80**	**65**	**18**	**99**	**281**	**62**	**589**	**21**	**274**	**580**	**304**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**44**	**13**	**11**	**3**	**17**	**47**	**10**	**98**	**4**	**46**	**97**	**51**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	**21**	**21**	**0**
		Veh	***Ped***

Not Warranted - Vs<75

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	**Highway 14**	**Direction (EW or NS)**	**EW**
Side Street (name)	**Highway 41**	**Direction (EW or NS)**	**NS**
Quadrant / Int #		**Comments**	**2020 Background Traffic Conditions**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**		

Road Authority:	**Alberta Transportation**
City:	**Sturgeon County**
Analysis Date:	**2014 Dec 22, Mon**
Count Date:	**2014 Oct 23, Thu**
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 14	WB		1			1		10,000	2
Highway 14	EB		1			1		400	2
Highway 41	NB		1				1		
Highway 41	SB		1				1		
							n		
							n		

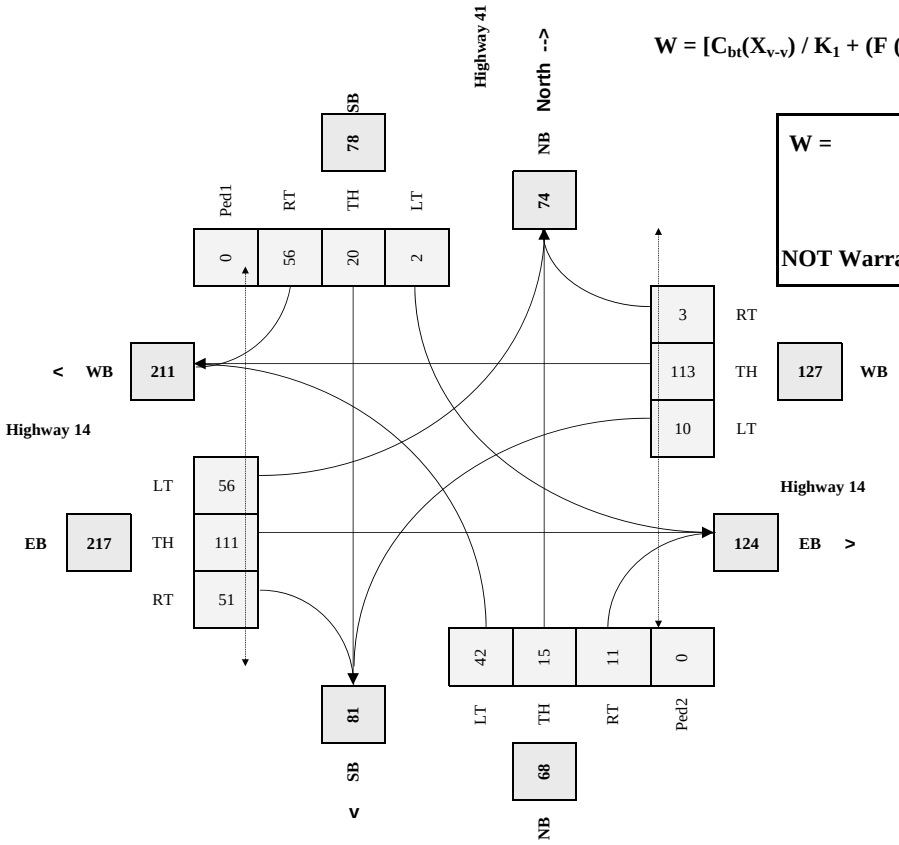
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	4,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 14	EW	100	12.0%	n	
Highway 41	NS		21.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1 NS**	**Ped2 NS**	**Ped3 EW**	**Ped4 EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 AM - 9:00 AM	75	26	26	2	43	119	21	273	2	90	176	89	0	0	0	0
													0	0	0	0
11:30 AM - 1:30 PM	82	28	14	2	40	84	18	173	12	108	197	95	0	0	0	0
													0	0	0	0
4:00 PM - 6:00 PM	96	36	25	7	38	130	23	234	4	135	292	120	0	0	0	0
													0	0	0	0
Total (6-hour peak)	**253**	**90**	**65**	**11**	**121**	**333**	**62**	**680**	**18**	**333**	**665**	**304**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**42**	**15**	**11**	**2**	**20**	**56**	**10**	**113**	**3**	**56**	**111**	**51**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	**26**	**26**	**0**
		Veh	***Ped***

NOT Warranted

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	**Highway 14**	**Direction (EW or NS)**	**EW**
Side Street (name)	**Highway 41**	**Direction (EW or NS)**	**NS**
Quadrant / Int #		**Comments**	**2020 Total Traffic Conditions**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**		

Road Authority:	**Alberta Transportation**
City:	**Sturgeon County**
Analysis Date:	**2014 Dec 22, Mon**
Count Date:	**2014 Oct 23, Thu**
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 14	WB		1			1		10,000	2
Highway 14	EB		1			1		400	2
Highway 41	NB		1				1		
Highway 41	SB		1				1		
							n		
							n		

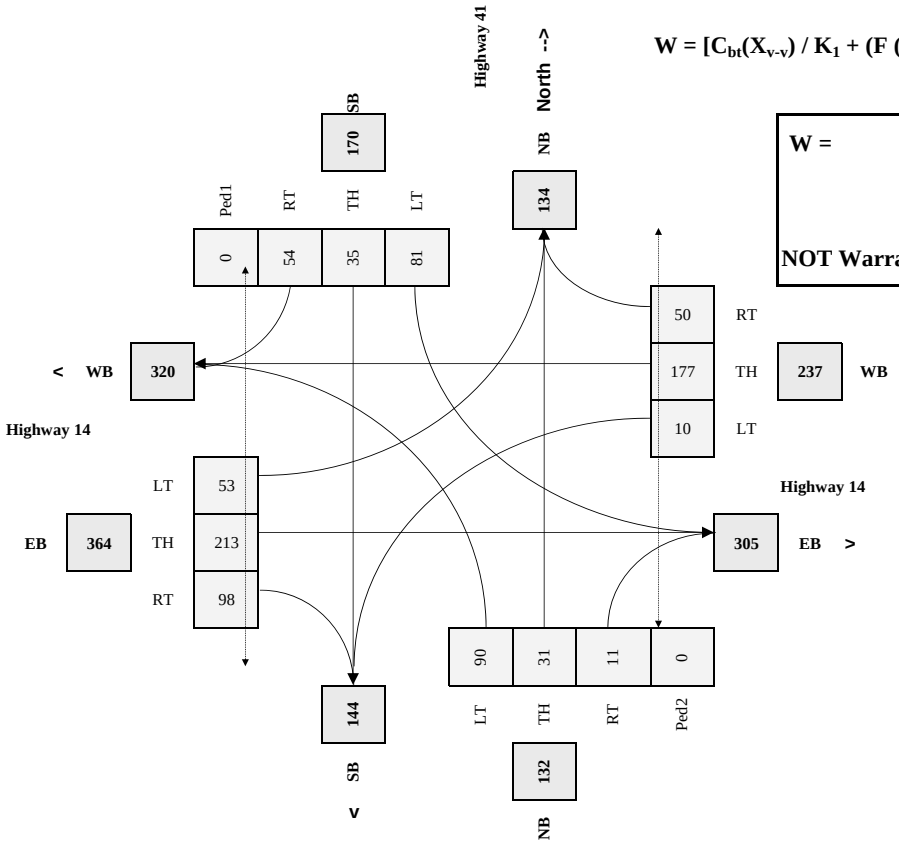
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	4,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 14	EW	100	12.0%	n	
Highway 41	NS		21.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1** **NS**	**Ped2** **NS**	**Ped3** **EW**	**Ped4** **EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 AM - 9:00 AM	173	70	26	20	56	116	21	454	66	86	236	141	0	0	0	0
													0	0	0	0
11:30 AM - 1:30 PM	176	56	14	67	67	81	18	271	200	103	380	184	0	0	0	0
													0	0	0	0
4:00 PM - 6:00 PM	190	59	25	399	88	124	23	334	34	128	660	265	0	0	0	0
													0	0	0	0
Total (6-hour peak)	**539**	**185**	**65**	**486**	**211**	**321**	**62**	**1,059**	**300**	**317**	**1,276**	**590**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**90**	**31**	**11**	**81**	**35**	**54**	**10**	**177**	**50**	**53**	**213**	**98**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	**99**	**99**	**0**
		Veh	***Ped***

NOT Warranted

RESET SHEET

Traffic Signal Warrant Spreadsheet - v3H © 2007 Transportation Association of Canada

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	**Highway 14**	**Direction (EW or NS)**	**EW**
Side Street (name)	**Highway 41**	**Direction (EW or NS)**	**NS**
Quadrant / Int #		**Comments**	**2035 Background Traffic Conditions**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**		

Road Authority:	**Alberta Transportation**
City:	**Sturgeon County**
Analysis Date:	**2014 Dec 22, Mon**
Count Date:	**2014 Oct 23, Thu**
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 14	WB		1			1		10,000	2
Highway 14	EB		1			1		400	2
Highway 41	NB		1				1		
Highway 41	SB		1				1		
							n		
							n		

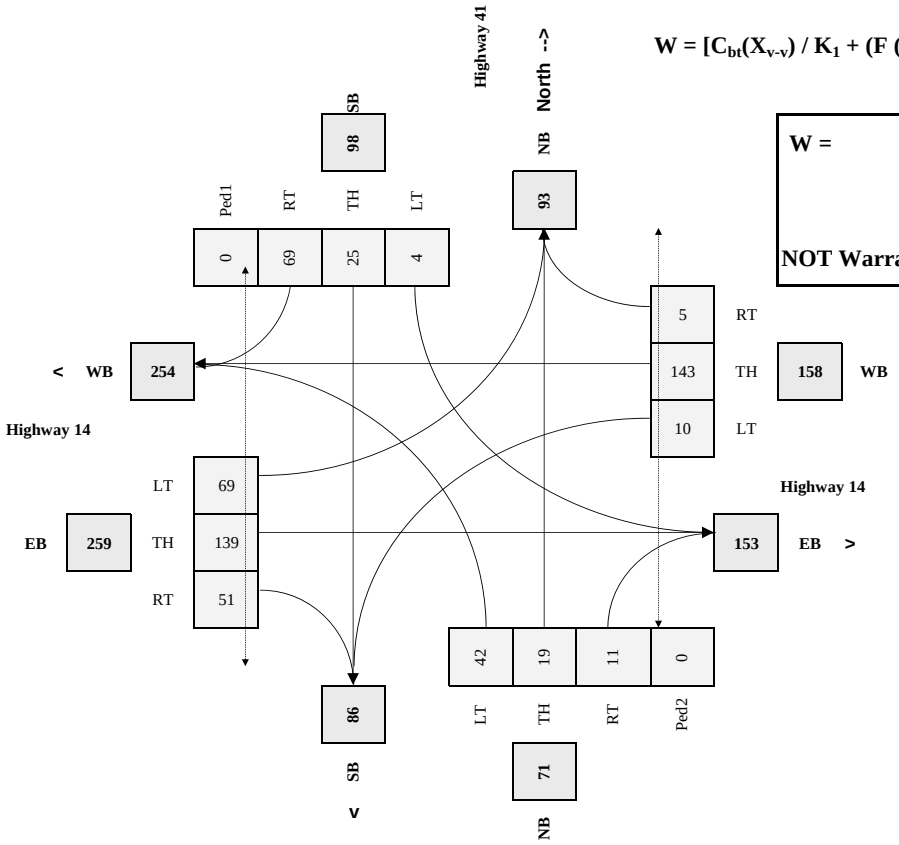
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	4,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 14	EW	100	12.0%	n	
Highway 41	NS		21.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1** **NS**	**Ped2** **NS**	**Ped3** **EW**	**Ped4** **EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 AM - 9:00 AM	75	34	26	4	55	149	21	344	4	113	220	89	0	0	0	0
													0	0	0	0
11:30 AM - 1:30 PM	81	35	14	4	50	105	18	218	20	135	246	95	0	0	0	0
													0	0	0	0
4:00 PM - 6:00 PM	94	44	25	14	45	162	23	294	6	168	366	120	0	0	0	0
													0	0	0	0
Total (6-hour peak)	**250**	**113**	**65**	**22**	**150**	**416**	**62**	**856**	**30**	**416**	**832**	**304**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**42**	**19**	**11**	**4**	**25**	**69**	**10**	**143**	**5**	**69**	**139**	**51**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	**36**	**36**	**0**
		Veh	***Ped***

NOT Warranted

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Highway 14	**Direction (EW or NS)**	EW
Side Street (name)	Highway 41	**Direction (EW or NS)**	NS
Quadrant / Int #		**Comments**	2035 Total Traffic Conditions
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	Alberta Transportation
City:	Sturgeon County
Analysis Date:	2014 Dec 22, Mon
Count Date:	2014 Oct 23, Thu
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 14	WB		1			1		10,000	2
Highway 14	EB		1			1		400	2
Highway 41	NB		1				1		
Highway 41	SB		1				1		
							n		
							n		

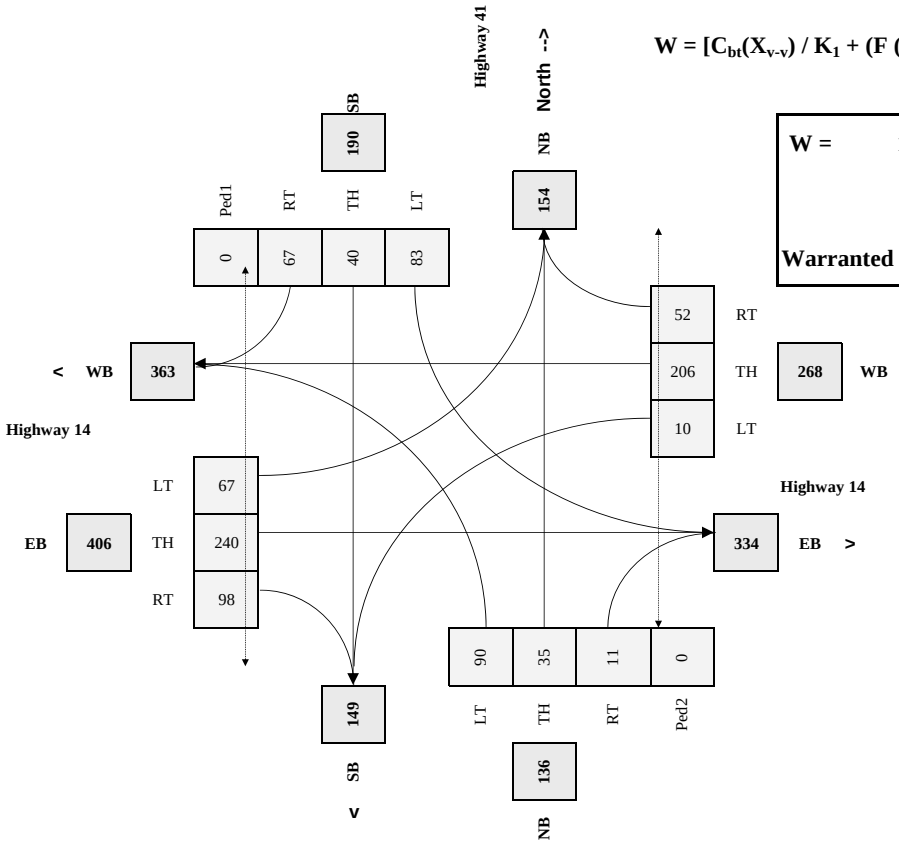
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	4,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 14	EW	100	12.0%	n	
Highway 41	NS		21.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1 NS**	**Ped2 NS**	**Ped3 EW**	**Ped4 EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 AM - 9:00 AM	173	78	26	22	67	146	21	525	68	109	280	141	0	0	0	0
													0	0	0	0
11:30 AM - 1:30 PM	176	63	14	69	77	102	18	316	208	131	429	184	0	0	0	0
													0	0	0	0
4:00 PM - 6:00 PM	190	68	25	406	96	156	23	394	36	163	733	265	0	0	0	0
													0	0	0	0
Total (6-hour peak)	**539**	**209**	**65**	**497**	**240**	**404**	**62**	**1,235**	**312**	**403**	**1,442**	**590**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**90**	**35**	**11**	**83**	**40**	**67**	**10**	**206**	**52**	**67**	**240**	**98**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	**122**	**122**	**0**
		Veh	***Ped***
Warranted			

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	**Highway 41**	**Direction (EW or NS)**	**NS**
Side Street (name)	**23 Avenue**	**Direction (EW or NS)**	**EW**
Quadrant / Int #		**Comments**	**2020 Total Traffic Volumes**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**		

Road Authority:	**Alberta Transportation**
City:	**Sturgeon County**
Analysis Date:	**2014 Dec 22, Mon**
Count Date:	**2014 Oct 23, Thu**
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 41	NB		1					10,000	1
Highway 41	SB					1		10,000	1
23 Avenue	WB								
23 Avenue	EB				1				
							n		
Are the 23 Avenue EB right turns significantly impeded by through movements? (y/n)							n		

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	4,000
Central Business District	(y/n)	n

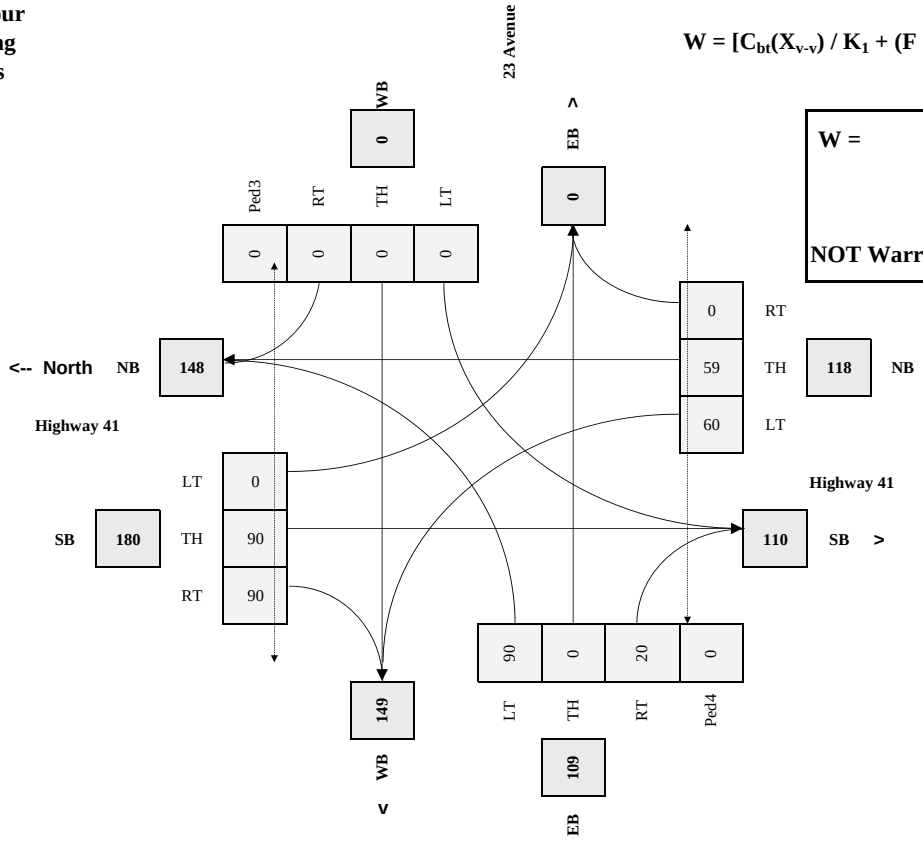
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 41	NS	100	12.0%	n	
23 Avenue	EW		10.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1** **NS**	**Ped2** **NS**	**Ped3** **EW**	**Ped4** **EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 AM - 9:00 AM	128	105	0	0	196	258	0	0	0	100	0	16	0	0	0	0
													0	0	0	0
11:30 AM - 1:30 PM	119	116	0	0	147	179	0	0	0	179	0	39	0	0	0	0
													0	0	0	0
4:00 PM - 6:00 PM	110	131	0	0	199	100	0	0	0	258	0	62	0	0	0	0
													0	0	0	0
Total (6-hour peak)	**357**	**352**	**0**	**0**	**542**	**537**	**0**	**0**	**0**	**537**	**0**	**117**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**60**	**59**	**0**	**0**	**90**	**90**	**0**	**0**	**0**	**90**	**0**	**20**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	**28**	**28**	**0**
		Veh	***Ped***

NOT Warranted

RESET SHEET

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	**Highway 41**	**Direction (EW or NS)**	**NS**
Side Street (name)	**23 Avenue**	**Direction (EW or NS)**	**EW**
Quadrant / Int #		**Comments**	**2035 Total Traffic Conditions**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**		

Road Authority:	**Alberta Transportation**
City:	**Sturgeon County**
Analysis Date:	**2014 Dec 22, Mon**
Count Date:	**2014 Oct 23, Thu**
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 41	NB		1					10,000	1
Highway 41	SB					1		10,000	1
23 Avenue	WB								
23 Avenue	EB				1				
							n		

Are the 23 Avenue EB right turns significantly impeded by through movements? (y/n) n

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	4,000
Central Business District	(y/n)	n

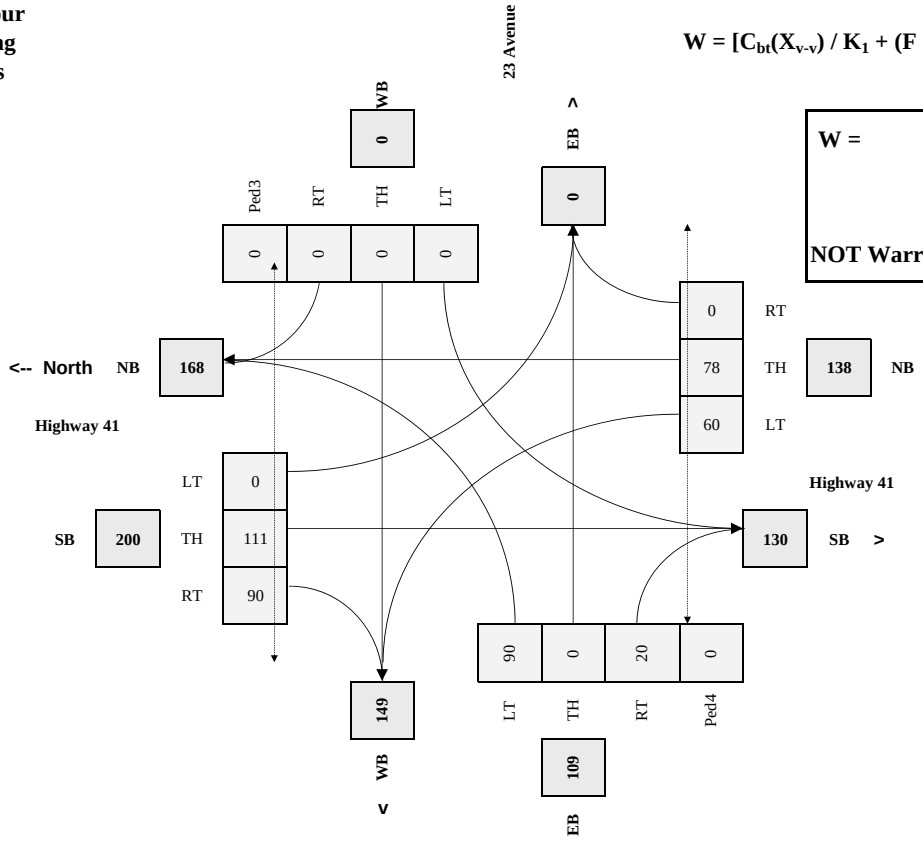
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 41	NS	100	12.0%	n	
23 Avenue	EW		10.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1 NS**	**Ped2 NS**	**Ped3 EW**	**Ped4 EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 AM - 9:00 AM	128	141	0	0	240	258	0	0	0	100	0	16	0	0	0	0
													0	0	0	0
11:30 AM - 1:30 PM	119	155	0	0	181	179	0	0	0	179	0	39	0	0	0	0
													0	0	0	0
4:00 PM - 6:00 PM	110	174	0	0	244	100	0	0	0	258	0	62	0	0	0	0
													0	0	0	0
Total (6-hour peak)	**357**	**470**	**0**	**0**	**665**	**537**	**0**	**0**	**0**	**537**	**0**	**117**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**60**	**78**	**0**	**0**	**111**	**90**	**0**	**0**	**0**	**90**	**0**	**20**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



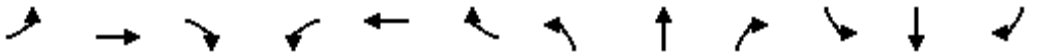
W =	**32**	**32**	**0**
		Veh	***Ped***

NOT Warranted

RESET SHEET

APPENDIX D

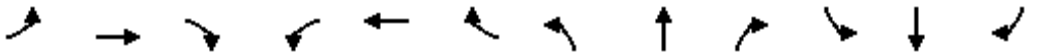
Synchro Reports



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	42	75	48	7	149	1	48	11	12	1	29	61
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.75	0.89	0.75	0.58	0.83	0.25	0.80	0.55	0.75	0.25	0.91	0.69
Hourly flow rate (vph)	56	84	64	12	180	4	60	20	16	4	32	88
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									9			11
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	184			148			358	436	74	378	466	92
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	184			148			358	436	74	378	466	92
tC, single (s)	4.5			4.1			8.0	7.6	7.4	7.5	7.4	7.2
tC, 2 stage (s)												
tF (s)	2.4			2.2			3.7	4.5	3.5	3.5	4.5	3.4
p0 queue free %	96			99			86	95	98	99	92	90
cM capacity (veh/h)	1273			1431			426	390	903	503	387	913

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	98	106	102	94	96	124
Volume Left	56	0	12	0	60	4
Volume Right	0	64	0	4	16	88
cSH	1273	1700	1431	1700	500	1284
Volume to Capacity	0.04	0.06	0.01	0.06	0.19	0.10
Queue Length 95th (m)	1.1	0.0	0.2	0.0	5.6	2.6
Control Delay (s)	4.7	0.0	1.0	0.0	14.6	11.0
Lane LOS	A		A		B	B
Approach Delay (s)	2.3		0.5		14.6	11.0
Approach LOS					B	B

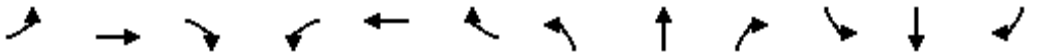
Intersection Summary				
Average Delay	5.4			
Intersection Capacity Utilization	29.1%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	64	136	64	18	100	2	43	18	15	1	16	53
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.76	0.90	0.75	0.75	0.86	0.50	0.59	0.66	0.67	0.25	0.57	0.78
Hourly flow rate (vph)	84	151	85	24	116	4	73	27	22	4	28	68
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									9			11
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	120			236			482	530	118	435	571	60
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	120			236			482	530	118	435	571	60
tC, single (s)	4.2			4.9			7.7	6.8	7.0	7.5	7.2	7.1
tC, 2 stage (s)												
tF (s)	2.2			2.6			3.6	4.1	3.4	3.5	4.4	3.4
p0 queue free %	94			98			80	93	98	99	92	93
cM capacity (veh/h)	1443			1097			371	394	899	438	334	970

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	160	161	82	62	123	100
Volume Left	84	0	24	0	73	4
Volume Right	0	85	0	4	22	68
cSH	1443	1700	1097	1700	462	1081
Volume to Capacity	0.06	0.09	0.02	0.04	0.27	0.09
Queue Length 95th (m)	1.5	0.0	0.5	0.0	8.5	2.4
Control Delay (s)	4.3	0.0	2.6	0.0	16.3	11.4
Lane LOS	A		A		C	B
Approach Delay (s)	2.1		1.5		16.3	11.4
Approach LOS					C	B

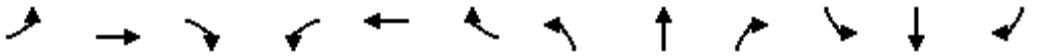
Intersection Summary				
Average Delay	5.9			
Intersection Capacity Utilization	31.0%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	51	88	48	7	174	1	48	13	12	1	35	74
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.75	0.89	0.75	0.58	0.83	0.25	0.80	0.55	0.75	0.25	0.91	0.69
Hourly flow rate (vph)	68	99	64	12	210	4	60	24	16	4	38	107
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									9			11
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	214			163			415	505	81	441	535	107
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	214			163			415	505	81	441	535	107
tC, single (s)	4.5			4.1			8.0	7.6	7.4	7.5	7.4	7.2
tC, 2 stage (s)												
tF (s)	2.4			2.2			3.7	4.5	3.5	3.5	4.5	3.4
p0 queue free %	95			99			84	93	98	99	89	88
cM capacity (veh/h)	1238			1413			364	347	893	443	345	893

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	117	113	117	109	100	150
Volume Left	68	0	12	0	60	4
Volume Right	0	64	0	4	16	107
cSH	1238	1700	1413	1700	428	1246
Volume to Capacity	0.05	0.07	0.01	0.06	0.23	0.12
Queue Length 95th (m)	1.4	0.0	0.2	0.0	7.1	3.3
Control Delay (s)	4.9	0.0	0.8	0.0	16.6	11.6
Lane LOS	A		A		C	B
Approach Delay (s)	2.5		0.4		16.6	11.6
Approach LOS					C	B

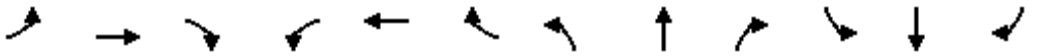
Intersection Summary				
Average Delay	5.7			
Intersection Capacity Utilization	30.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	78	159	64	18	117	2	47	26	16	1	20	65
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.76	0.90	0.75	0.75	0.86	0.50	0.59	0.66	0.67	0.25	0.57	0.78
Hourly flow rate (vph)	103	177	85	24	136	4	80	39	24	4	35	83
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									9			11
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	140			262			558	613	131	511	653	70
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	140			262			558	613	131	511	653	70
tC, single (s)	4.2			4.9			7.7	6.8	7.0	7.5	7.2	7.1
tC, 2 stage (s)												
tF (s)	2.2			2.6			3.6	4.1	3.4	3.5	4.4	3.4
p0 queue free %	93			98			74	89	97	99	88	91
cM capacity (veh/h)	1419			1069			308	347	882	368	291	956

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	191	174	92	72	143	122
Volume Left	103	0	24	0	80	4
Volume Right	0	85	0	4	24	83
cSH	1419	1700	1069	1700	385	936
Volume to Capacity	0.07	0.10	0.02	0.04	0.37	0.13
Queue Length 95th (m)	1.9	0.0	0.6	0.0	13.4	3.6
Control Delay (s)	4.4	0.0	2.3	0.0	20.4	12.2
Lane LOS	A		A		C	B
Approach Delay (s)	2.3		1.3		20.4	12.2
Approach LOS					C	B

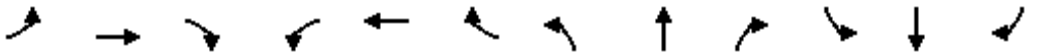
Intersection Summary				
Average Delay	6.9			
Intersection Capacity Utilization	33.2%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	49	118	76	7	289	33	111	35	12	10	45	72
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	56	134	86	8	328	38	126	40	14	11	51	82
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									9			11
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	366			220			494	670	110	568	695	183
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	366			220			494	670	110	568	695	183
tC, single (s)	4.5			4.1			8.0	7.6	7.4	7.5	7.4	7.2
tC, 2 stage (s)												
tF (s)	2.4			2.2			3.7	4.5	3.5	3.5	4.5	3.4
p0 queue free %	95			99			58	85	98	97	81	90
cM capacity (veh/h)	1076			1346			304	270	853	339	272	795

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	123	153	172	202	180	144
Volume Left	56	0	8	0	126	11
Volume Right	0	86	0	38	14	82
cSH	1076	1700	1346	1700	320	657
Volume to Capacity	0.05	0.09	0.01	0.12	0.56	0.22
Queue Length 95th (m)	1.3	0.0	0.1	0.0	25.9	6.7
Control Delay (s)	4.1	0.0	0.4	0.0	30.0	14.9
Lane LOS	A		A		D	B
Approach Delay (s)	1.8		0.2		30.0	14.9
Approach LOS					D	B

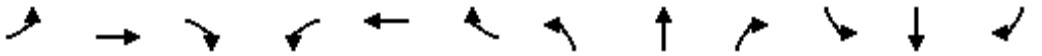
Intersection Summary				
Average Delay	8.3			
Intersection Capacity Utilization	41.0%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	74	359	139	18	167	17	95	43	16	57	47	62
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	84	408	158	20	190	19	108	49	18	65	53	70
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									9			11
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	209			566			818	905	283	646	974	105
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	209			566			818	905	283	646	974	105
tC, single (s)	4.2			4.9			7.7	6.8	7.0	7.5	7.2	7.1
tC, 2 stage (s)												
tF (s)	2.2			2.6			3.6	4.1	3.4	3.5	4.4	3.4
p0 queue free %	94			97			37	79	97	76	70	92
cM capacity (veh/h)	1337			786			172	232	702	272	181	908

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	288	362	115	114	175	189
Volume Left	84	0	20	0	108	65
Volume Right	0	158	0	19	18	70
cSH	1337	1700	786	1700	213	369
Volume to Capacity	0.06	0.21	0.03	0.07	0.82	0.51
Queue Length 95th (m)	1.6	0.0	0.6	0.0	48.6	22.4
Control Delay (s)	2.7	0.0	1.9	0.0	69.7	25.9
Lane LOS	A		A		F	D
Approach Delay (s)	1.2		1.0		69.7	25.9
Approach LOS					F	D

Intersection Summary				
Average Delay	14.5			
Intersection Capacity Utilization	46.4%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	64	110	48	7	219	2	48	17	12	2	44	93
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.75	0.89	0.75	0.58	0.83	0.25	0.80	0.55	0.75	0.25	0.91	0.69
Hourly flow rate (vph)	85	124	64	12	264	8	60	31	16	8	48	135
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									9			11
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	272			188			507	622	94	548	650	136
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	272			188			507	622	94	548	650	136
tC, single (s)	4.5			4.1			8.0	7.6	7.4	7.5	7.4	7.2
tC, 2 stage (s)												
tF (s)	2.4			2.2			3.7	4.5	3.5	3.5	4.5	3.4
p0 queue free %	93			99			78	89	98	98	83	84
cM capacity (veh/h)	1174			1384			279	284	876	354	284	854

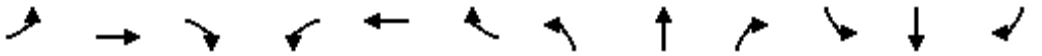
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	147	126	144	140	107	191
Volume Left	85	0	12	0	60	8
Volume Right	0	64	0	8	16	135
cSH	1174	1700	1384	1700	330	998
Volume to Capacity	0.07	0.07	0.01	0.08	0.32	0.19
Queue Length 95th (m)	1.9	0.0	0.2	0.0	11.0	5.6
Control Delay (s)	5.1	0.0	0.7	0.0	21.7	13.0
Lane LOS	A		A		C	B
Approach Delay (s)	2.7		0.4		21.7	13.0
Approach LOS					C	B

Intersection Summary				
Average Delay	6.6			
Intersection Capacity Utilization	33.0%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	97	199	64	18	147	3	47	32	16	2	24	81
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.76	0.90	0.75	0.75	0.86	0.50	0.59	0.66	0.67	0.25	0.57	0.78
Hourly flow rate (vph)	128	221	85	24	171	6	80	48	24	8	42	104
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									9			11
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	177			306			674	744	153	624	784	88
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	177			306			674	744	153	624	784	88
tC, single (s)	4.2			4.9			7.7	6.8	7.0	7.5	7.2	7.1
tC, 2 stage (s)												
tF (s)	2.2			2.6			3.6	4.1	3.4	3.5	4.4	3.4
p0 queue free %	91			98			65	83	97	97	82	89
cM capacity (veh/h)	1375			1022			231	282	853	286	234	930

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	238	196	109	91	152	154
Volume Left	128	0	24	0	80	8
Volume Right	0	85	0	6	24	104
cSH	1375	1700	1022	1700	297	744
Volume to Capacity	0.09	0.12	0.02	0.05	0.51	0.21
Queue Length 95th (m)	2.5	0.0	0.6	0.0	21.9	6.2
Control Delay (s)	4.6	0.0	2.1	0.0	29.8	14.0
Lane LOS	A		A		D	B
Approach Delay (s)	2.5		1.1		29.8	14.0
Approach LOS					D	B

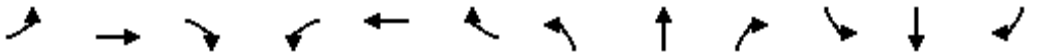
Intersection Summary				
Average Delay	8.5			
Intersection Capacity Utilization	36.0%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	62	140	76	7	334	34	111	39	12	11	54	91
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	70	159	86	8	380	39	126	44	14	12	61	103
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									9			11
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	418			245			580	777	123	664	801	209
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	418			245			580	777	123	664	801	209
tC, single (s)	4.5			4.1			8.0	7.6	7.4	7.5	7.4	7.2
tC, 2 stage (s)												
tF (s)	2.4			2.2			3.7	4.5	3.5	3.5	4.5	3.4
p0 queue free %	93			99			45	80	98	95	73	86
cM capacity (veh/h)	1025			1318			231	224	837	273	227	764

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	150	166	198	228	184	177
Volume Left	70	0	8	0	126	12
Volume Right	0	86	0	39	14	103
cSH	1025	1700	1318	1700	247	564
Volume to Capacity	0.07	0.10	0.01	0.13	0.74	0.31
Queue Length 95th (m)	1.8	0.0	0.1	0.0	42.0	10.7
Control Delay (s)	4.5	0.0	0.4	0.0	52.4	17.4
Lane LOS	A		A		F	C
Approach Delay (s)	2.1		0.2		52.4	17.4
Approach LOS					F	C

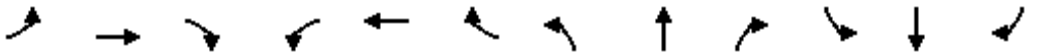
Intersection Summary				
Average Delay	12.2			
Intersection Capacity Utilization	43.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	94	399	139	18	197	18	95	49	16	58	51	78
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	107	453	158	20	224	20	108	56	18	66	58	89
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									9			11
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	244			611			928	1031	306	752	1100	122
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	244			611			928	1031	306	752	1100	122
tC, single (s)	4.2			4.9			7.7	6.8	7.0	7.5	7.2	7.1
tC, 2 stage (s)												
tF (s)	2.2			2.6			3.6	4.1	3.4	3.5	4.4	3.4
p0 queue free %	92			97			12	71	97	68	60	90
cM capacity (veh/h)	1297			750			123	190	679	207	146	884

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	334	385	132	132	182	212
Volume Left	107	0	20	0	108	66
Volume Right	0	158	0	20	18	89
cSH	1297	1700	750	1700	162	306
Volume to Capacity	0.08	0.23	0.03	0.08	1.12	0.69
Queue Length 95th (m)	2.1	0.0	0.7	0.0	76.8	38.5
Control Delay (s)	3.1	0.0	1.8	0.0	156.6	39.7
Lane LOS	A		A		F	E
Approach Delay (s)	1.4		0.9		156.6	39.7
Approach LOS					F	E

Intersection Summary				
Average Delay	27.7			
Intersection Capacity Utilization	49.2%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	62	140	76	7	334	34	111	39	12	11	54	91
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	70	159	86	8	380	39	126	44	14	12	61	103

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	150	166	198	228	170	14	74	103
Volume Left (vph)	70	0	8	0	126	0	13	0
Volume Right (vph)	0	86	0	39	0	14	0	103
Hadj (s)	0.63	0.01	0.15	0.00	0.90	-0.27	0.73	-0.48
Departure Headway (s)	6.9	6.3	6.3	6.2	7.7	6.5	7.6	6.3
Degree Utilization, x	0.29	0.29	0.35	0.39	0.36	0.02	0.15	0.18
Capacity (veh/h)	493	543	546	561	438	516	445	526
Control Delay (s)	11.6	10.7	11.5	11.9	13.8	8.4	10.7	9.6
Approach Delay (s)	11.1		11.7		13.4		10.0	
Approach LOS	B		B		B		B	

Intersection Summary				
Delay	11.6			
Level of Service	B			
Intersection Capacity Utilization	43.5%	ICU Level of Service	A	
Analysis Period (min)	15			

Intersection: 1: Highway 41 & Highway 14

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	LT	R	LT	R
Maximum Queue (m)	29.4	25.5	32.5	25.2	32.0	19.5	26.7	23.5
Average Queue (m)	15.6	9.2	14.9	8.8	17.4	3.7	12.8	11.2
95th Queue (m)	25.4	18.2	26.2	18.3	28.7	13.0	24.4	19.3
Link Distance (m)			518.3		664.7		447.3	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)				125.0		75.0		85.0
Storage Blk Time (%)								
Queuing Penalty (veh)								

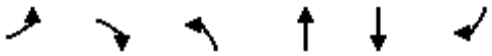
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	94	399	139	18	197	18	95	49	16	58	51	78
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	107	453	158	20	224	20	108	56	18	66	58	89

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	334	385	132	132	164	18	124	89
Volume Left (vph)	107	0	20	0	108	0	66	0
Volume Right (vph)	0	158	0	20	0	18	0	89
Hadj (s)	0.26	-0.21	0.35	0.07	0.50	-0.60	0.58	-0.55
Departure Headway (s)	6.6	6.1	7.2	6.9	7.8	6.7	7.9	6.8
Degree Utilization, x	0.61	0.65	0.27	0.26	0.36	0.03	0.27	0.17
Capacity (veh/h)	536	572	475	493	427	496	431	498
Control Delay (s)	17.9	18.5	11.6	11.1	13.9	8.8	12.6	9.9
Approach Delay (s)	18.2		11.4		13.4		11.5	
Approach LOS	C		B		B		B	

Intersection Summary				
Delay	15.2			
Level of Service	C			
Intersection Capacity Utilization	49.2%	ICU Level of Service	A	
Analysis Period (min)	15			

Intersection: 1: Highway 41 & Highway 14

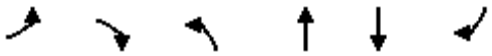
Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	LT	R	LT	R
Maximum Queue (m)	36.1	38.5	26.8	14.3	30.7	12.3	25.4	21.9
Average Queue (m)	19.2	13.5	12.3	5.3	13.6	3.7	13.7	10.3
95th Queue (m)	30.7	26.5	22.0	11.6	23.1	10.7	23.5	18.0
Link Distance (m)			518.3		664.7		447.3	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)				125.0		75.0		85.0
Storage Blk Time (%)								
Queuing Penalty (veh)								



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	50	8	64	53	128	129
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	1.00	0.92	0.84	0.73	0.92
Hourly flow rate (vph)	54	8	70	63	175	140
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	378	175	316			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	378	175	316			
tC, single (s)	6.5	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.3			
p0 queue free %	91	99	94			
cM capacity (veh/h)	573	848	1201			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	62	70	63	175	140
Volume Left	54	70	0	0	0
Volume Right	8	0	0	0	140
cSH	598	1201	1700	1700	1700
Volume to Capacity	0.10	0.06	0.04	0.10	0.08
Queue Length 95th (m)	2.8	1.5	0.0	0.0	0.0
Control Delay (s)	11.7	8.2	0.0	0.0	0.0
Lane LOS	B	A			
Approach Delay (s)	11.7	4.3		0.0	
Approach LOS	B				

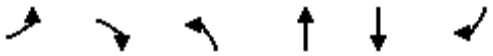
Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	23.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	129	31	55	79	92	50
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.83	0.83	0.92
Hourly flow rate (vph)	140	34	60	95	111	54
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	326	111	165			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	326	111	165			
tC, single (s)	6.5	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.3			
p0 queue free %	78	96	96			
cM capacity (veh/h)	624	921	1366			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	174	60	95	111	54
Volume Left	140	60	0	0	0
Volume Right	34	0	0	0	54
cSH	665	1366	1700	1700	1700
Volume to Capacity	0.26	0.04	0.06	0.07	0.03
Queue Length 95th (m)	8.3	1.1	0.0	0.0	0.0
Control Delay (s)	12.3	7.8	0.0	0.0	0.0
Lane LOS	B	A			
Approach Delay (s)	12.3	3.0		0.0	
Approach LOS	B				

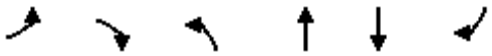
Intersection Summary				
Average Delay	5.3			
Intersection Capacity Utilization	25.4%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	50	8	64	71	157	129
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	1.00	0.92	0.84	0.73	0.92
Hourly flow rate (vph)	54	8	70	85	215	140
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	439	215	355			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	439	215	355			
tC, single (s)	6.5	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.3			
p0 queue free %	90	99	94			
cM capacity (veh/h)	527	805	1160			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	62	70	85	215	140
Volume Left	54	70	0	0	0
Volume Right	8	0	0	0	140
cSH	552	1160	1700	1700	1700
Volume to Capacity	0.11	0.06	0.05	0.13	0.08
Queue Length 95th (m)	3.0	1.5	0.0	0.0	0.0
Control Delay (s)	12.4	8.3	0.0	0.0	0.0
Lane LOS	B	A			
Approach Delay (s)	12.4	3.7		0.0	
Approach LOS	B				

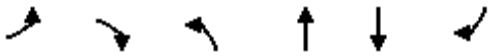
Intersection Summary				
Average Delay	2.4			
Intersection Capacity Utilization	25.1%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	129	31	55	105	113	50
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.83	0.83	0.92
Hourly flow rate (vph)	140	34	60	127	136	54
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	382	136	190			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	382	136	190			
tC, single (s)	6.5	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.3			
p0 queue free %	76	96	96			
cM capacity (veh/h)	578	892	1337			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	174	60	127	136	54
Volume Left	140	60	0	0	0
Volume Right	34	0	0	0	54
cSH	620	1337	1700	1700	1700
Volume to Capacity	0.28	0.04	0.07	0.08	0.03
Queue Length 95th (m)	9.2	1.1	0.0	0.0	0.0
Control Delay (s)	13.1	7.8	0.0	0.0	0.0
Lane LOS	B	A			
Approach Delay (s)	13.1	2.5		0.0	
Approach LOS	B				

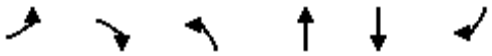
Intersection Summary				
Average Delay	5.0			
Intersection Capacity Utilization	25.4%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	25	0	117	102	34
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.84	0.73	0.92
Hourly flow rate (vph)	0	27	0	139	140	37
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	297	158	177			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	297	158	177			
tC, single (s)	6.5	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.3			
p0 queue free %	100	97	100			
cM capacity (veh/h)	677	867	1352			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	27	139	177
Volume Left	0	0	0
Volume Right	27	0	37
cSH	867	1700	1700
Volume to Capacity	0.03	0.08	0.10
Queue Length 95th (m)	0.8	0.0	0.0
Control Delay (s)	9.3	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.3	0.0	0.0
Approach LOS	A		

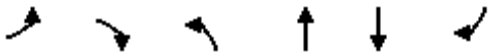
Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	17.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	68	0	134	98	25
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.83	0.83	0.92
Hourly flow rate (vph)	0	74	0	161	118	27
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	293	132	145			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	293	132	145			
tC, single (s)	6.5	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.3			
p0 queue free %	100	92	100			
cM capacity (veh/h)	681	897	1389			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	74	161	145
Volume Left	0	0	0
Volume Right	74	0	27
cSH	897	1700	1700
Volume to Capacity	0.08	0.09	0.09
Queue Length 95th (m)	2.2	0.0	0.0
Control Delay (s)	9.4	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.4	0.0	0.0
Approach LOS	A		

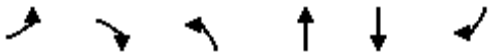
Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	17.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	25	0	135	131	34
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.84	0.73	0.92
Hourly flow rate (vph)	0	27	0	161	179	37
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	359	198	216			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	359	198	216			
tC, single (s)	6.5	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.3			
p0 queue free %	100	97	100			
cM capacity (veh/h)	624	823	1307			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	27	161	216
Volume Left	0	0	0
Volume Right	27	0	37
cSH	823	1700	1700
Volume to Capacity	0.03	0.09	0.13
Queue Length 95th (m)	0.8	0.0	0.0
Control Delay (s)	9.5	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.5	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	19.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	68	0	160	119	25
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.83	0.83	0.92
Hourly flow rate (vph)	0	74	0	193	143	27
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	350	157	171			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	350	157	171			
tC, single (s)	6.5	6.3	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.3			
p0 queue free %	100	91	100			
cM capacity (veh/h)	632	868	1360			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	74	193	171
Volume Left	0	0	0
Volume Right	74	0	27
cSH	868	1700	1700
Volume to Capacity	0.09	0.11	0.10
Queue Length 95th (m)	2.2	0.0	0.0
Control Delay (s)	9.5	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.5	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	18.7%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX E

Illumination Warrants

GUIDE FOR THE DESIGN OF ROADWAY LIGHTING
LIGHTING WARRANT SPREADSHEET

This spreadsheet is to be used in conjunction with *Guide for the Design of Roadway Lighting* , Transportation Association of Canada, 2006 Edition.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 41	Main Road	**Date**	December 22, 2014
23 Avenue	Minor Road	**Other**	2020 Total Traffic
Town of Wainwright	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	3		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	100		5		OK	
Channelization Factor					OK	15
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	10				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Posted Speed Category =	D	0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	0.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	3	1	3	Number of legs = 3 or more	OK	3
				Geometric Factors Subtotal		**18**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)		0	10	Either Use the two AADT inputs **OR** the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	0
AADT on Minor Road (2-way)		0	20		OK	0
Signalization Warrant	Descriptive	1	30		OK	30
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
				Operational Factors Subtotal		**55**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	2	2	5	Maximum of 4 quadrants	OK	10
				Environmental Factor Subtotal		**10**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4)	OK	0
OR				**OR** the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
				Collision History Subtotal		**0**

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	18
Operational Factor Subtotal	55
Environmental Factor Subtotal	10
Collision History Subtotal	0
TOTAL POINTS	**83**

GUIDE FOR THE DESIGN OF ROADWAY LIGHTING
LIGHTING WARRANT SPREADSHEET

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Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 41	Main Road	**Date**	December 22, 2014
23 Avenue	Minor Road	**Other**	2035 Total Traffic
Town of Wainwright	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	3		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	100		5		OK	
Channelization Factor					OK	15
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	10				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Posted Speed Category =	D	0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	0.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	3	1	3	Number of legs = 3 or more	OK	3
				Geometric Factors Subtotal		**18**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)		0	10	Either Use the two AADT inputs **OR** the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	0
AADT on Minor Road (2-way)		0	20		OK	0
Signalization Warrant	Descriptive	1	30		OK	30
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
				Operational Factors Subtotal		**55**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	2	2	5	Maximum of 4 quadrants	OK	10
				Environmental Factor Subtotal		**10**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4)	OK	0
OR				**OR** the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
				Collision History Subtotal		**0**

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	18
Operational Factor Subtotal	55
Environmental Factor Subtotal	10
Collision History Subtotal	0
TOTAL POINTS	**83**

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INTERSECTION CHARACTERISTICS

Highway 41	Main Road	**Date**	December 22, 2014
RIRO	Minor Road	**Other**	2020 Total Traffic
Town of Wainwright	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	2		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	100		5		OK	
Channelization Factor					OK	10
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	10				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Posted Speed Category =	D	0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	0.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	3	1	3	Number of legs = 3 or more	OK	3
				Geometric Factors Subtotal		**13**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	2922	2	10	Either Use the two AADT inputs **OR** the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	20
AADT on Minor Road (2-way)	698	1	20		OK	20
Signalization Warrant	Descriptive		30		OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
				Operational Factors Subtotal		**65**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	2	2	5	Maximum of 4 quadrants	OK	10
				Environmental Factor Subtotal		**10**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4)	OK	0
OR				**OR** the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
				Collision History Subtotal		**0**

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	13
Operational Factor Subtotal	65
Environmental Factor Subtotal	10
Collision History Subtotal	0
TOTAL POINTS	**88**

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INTERSECTION CHARACTERISTICS

Highway 41	Main Road	**Date**	December 22, 2014
RIRO	Minor Road	**Other**	2035 Total Traffic
Town of Wainwright	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	2		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	100		5		OK	
Channelization Factor					OK	10
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	10				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Posted Speed Category =	D	0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	0.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	3	1	3	Number of legs = 3 or more	OK	3
				Geometric Factors Subtotal		**13**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	3421	3	10	Either Use the two AADT inputs **OR** the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	30
AADT on Minor Road (2-way)	698	1	20		OK	20
Signalization Warrant	Descriptive		30		OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
				Operational Factors Subtotal		**75**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	2	2	5	Maximum of 4 quadrants	OK	10
				Environmental Factor Subtotal		**10**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4) **OR** the number of collisions / MEV (Unused values should be set to Zero)	OK	0
OR						
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0		OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
				Collision History Subtotal		**0**

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	13
Operational Factor Subtotal	75
Environmental Factor Subtotal	10
Collision History Subtotal	0
TOTAL POINTS	**98**