LETHBRIDGE COUNTY
IN THE PROVINCE OF ALBERTA

BY-LAW NO. 1426

A BY-LAW OF LETHBRIDGE COUNTY BEING A BY-LAW PURSUANT TO SECTION 633(1) OF THE MUNICIPAL GOVERNMENT ACT, REVISED STATUTES OF ALBERTA 2000, CHAPTER M.26

WHEREAS Dar Ray Farms wishes to develop an Agri-Business Park on Lots 1-3, Block 1, Plan 0814065.

AND WHEREAS the County's Municipal Development Plan requires that developers prepare an Area Structure Plan to ensure sound development occurs within the County;

AND WHEREAS the total area of the development will be 138 acres with consideration for the lands to the north (portion of NW 5-8-20-W4).

AND WHEREAS the landowner/developer have prepared the "508 Agri-Business Park - Area Structure Plan" which contains engineering, survey, and geotechnical information to support the above conditions.

NOW THEREFORE BE IT RESOLVED, under the Authority and subject to the provisions of the Municipal Government Act, Revised Statutes of Alberta, 2000, Chapter M-26, as amended, the Council of Lethbridge County in the Province of Alberta duly assembled does hereby enact the following:

1. The "508 Agri-Business Park Area Structure Plan" Bylaw No.1426, attached as "Appendix A".

GIVEN first reading this 7th day of August, 2014.

Reeve

Chief Administrative Officer

GIVEN second reading this 18th day of September 2014.

Reeve

Chief Administrative Officer

GIVEN third reading this 2nd day of October, 2014.

Reeve

Chief Administrative Officer

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AREA STRUCTURE PLAN

508 AGRI-BUSINESS PARK
in
Sec. 05-008-20-W4
Lethbridge County, AB

Submitted to
Lethbridge County

PREPARED FOR:
Ray Taylor
Dar Ray Farms
RR 8 – 18 – 5
Lethbridge, AB
T1J 4P4

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1.0 INTRODUCTION

This Area Structure Plan has been prepared by Hasegawa Engineering Ltd. on behalf of Dar Ray Farms Ltd. to describe the development concept and municipal servicing strategy to be provided for the 508 Agri-Business Park. The site lies at the junction of Highway 4 and Highway 508 in the south of Lethbridge County. (Figure 1) The Area Structure Plan describes the ultimate development of the subject lands, which include portions of Section 5, Range 8, Township 20, west of the 4th Meridian.

As the intended purpose is the development of an industrial area, an Area Structure Plan is required under Section 6.2 of the Municipal Development Plan of Lethbridge County.

This Area Structure Plan is submitted as support for the application to adopt the Plan as a By-Law of Lethbridge County and the subsequent change to the Land Use By-Law. The Area Structure Plan will provide a basis for evaluation of future applications for subdivision of parcels and building development.

Dar Ray Farms Ltd. (Dar Ray Farms) has previously subdivided two lots and created a new public roadway within this quarter. The remaining lands owned by Dar Ray include approximately 39 hectares (90 acres) of land which is actively farmed. The remaining lands also include remnants of the adjacent NE ¼ of Section 5-8-20-4 and the SW ¼ of Section 5-8-20-4.

2.0 PLANS AND DRAWINGS

In order to illustrate the location of the property, site drainage, and the proposed subdivision layout, five figures have been prepared. The figures are provided in Appendix A and are as follows:

1.1 Location Plan
2.1 Proposed Development Phasing Plan
3.1 Proposed Land Use
4.1 Existing Features & Topography
4.2 Section AA Plan & Profiles
4.3 Section BB Plan & Profiles
4.4 Section CC Plan & Profiles

These maps are conceptual in nature and are to be used for planning purposes only. Upon ASP acceptance, detailed design plans will be prepared and submitted with any subdivision application.

3.0 LAND USE CONCEPT

3.1 Existing Conditions

The lands within the boundaries of the proposed Area Structure Plan are currently used for an agri-business development and the major portion is cropped agricultural land. The lands are bordered by the railway and Highway 4 to the east and by Highway 508 to the south. The western edge of the property lies adjacent to a major canal belonging to the St. Mary River Irrigation District. To the north lies agricultural land under irrigation. Acreages lie beyond the border areas to the north, south and west.

3.2 Development Objectives

The objective of the Developer of the 508 Agri-Business Park is:

> "To create a high quality environment that will provide a location for the establishment and growth of businesses which provides services to the agricultural base of Lethbridge County".

Preferred Development Concept

The preferred development concept appears in Figures 2 and 3. The ultimate development will create approximately 55 ha (137 acres) of net developable area. The remainder of the land is dedicated to roads, a public utility lot for a pond providing stormwater retention and fire protection and a green strip along the canal.

Lot sizes will range from 0.8-2.8 ha (2-7 acres) in size. Larger lots may be considered. Based on an average lot size of 1.8 hectares (3.0 acres), this will result in approximately 25 lots.

Figures 2 and 3 indicate the parcel to the northwest as future development. This landowner has expressed interest in being part of the development but at this time this northern area is not part of this Area Structure Plan.

Land Use Classification

The proposed land use classification of the subdivision is Rural General Industrial (RGI) and Business Light Industrial (BLI) per Lethbridge County Land Use Bylaw. A figure depicting the anticipated land use designations within the development is provided on Figure 3.

The intent is to provide developable land for industry and businesses that support the local agricultural sector and to a lesser extent the evolving resource development sector. The western portion is proposed to receive the BLI classification as opposed to the RGI classification to reduce the impact on acreages west of the canal.

Lethbridge County Municipal Development Plan

The Lethbridge County Municipal Development Plan contains policies for industrial development. The location of the proposed development meets these policies for the following reasons:

- The site is located adjacent to the junction of major transportation routes (Highway 4 and Highway 508)
- The site does not contain any sensitive environmental, cultural or historical features
- While the lands involved have been farmed historically, they are not considered high quality. The soils are mapped as class three, but they are not irrigated, the property is an irregular shape and the property contains unusable low areas.
- The site already contains businesses dedicated to supporting the agricultural community

3.3 Proposed Land Use Areas

The distribution of land use within the proposed ASP is shown in Table 1 below.

Table 1: Land Use Statistics

	Hectares (Acres)	Percent of Gross Area
Net Developable Area	44.6 (110.2)	**80%**
Rural General Industrial	35.9 (88.7)	64%
Business Light Industrial	8.7 (21.5)	16%
Public Utility Lot - Ponds	5.0 (12.3)	9%
Roads and Right-of-ways	4.8 (11.8)	9%
Municipal Reserve – Parks/Green-space	1.0 (2.4)	2%
Gross Developable Area	**55.7 (137.7)**	**100%**

4.0 SERVICING

In order to determine the viability of this development, preliminary evaluations have been performed with respect to servicing. Key service items include sewer, water, natural gas, telephone, television, and electric. Additional information on key services is included in this section.

4.1 Sanitary Sewer System

Sanitary sewage will be handled by a communal sewage disposal system and installed in accordance with the Alberta Private Sewage System Standard of Practice.

A preliminary soil study has been performed for this property (refer to Appendix B). As part of that study soil samples were collected and sent for grain size and hydrometer analysis. Four sites were selected and six samples were submitted to AMEC for analysis and the results are included in Table 2 below.

Table 2 Soil Analysis Results

Sample ID	Soil type	Suitable for Septic Field
TH1 8 ft	Silty Clay Loam	possibly
TH1 10 ft	Clay Loam	possibly
TH2 6 ft	Clay Loam	possibly
TH3 4 ft	Silty Clay Loam	possibly
TH3 8 ft	Loam	yes
TH4 4 ft	Silt Loam	possibly

Groundwater was detected at two sites close to the canal at a depth of 1.5 metres. Groundwater was not detected at the other two sites.

The suitability of the soils for a septic field is listed in Table 2 as possibly suitable for septic fields because it was found that the soil structure for the profiles sampled was undeterminable.

The soil types found have high clay content and generally be of medium grade. The soil structure determines the ability of a clay soil to allow infiltration. If the soil structure is platy it is unsuitable for septic fields. If the soil structure is prismatic or blocky it is suitable for septic fields. Further testing is required to determine conclusively the soil structure at the location of a proposed sewage system.

The soils closer to the surface were noted as being of a looser composition and therefore more suitable but are of an insufficient depth for septic fields.

In order to take a conservative approach, it is assumed the soil will be unsuitable for a septic field. The communal septic system will be a treatment mound type of system. This method of sewage treatment will also provide extra protection of the shallow groundwater by increasing the separation distance between the elevation of the sewage treatment area and the groundwater table.

Lethbridge County will assume ownership and responsibility of the sewage treatment system upon completion of the infrastructure.

4.2 Water Systems

It is proposed that each lot will be serviced with limited potable water and non-potable water. This section covers how each of these water supply issues will be addressed.

4.2.1 Potable Water

Potable water services are provided by the Lethbridge South County Rural Water Association to the two existing lots. The developer currently owns three shares from the co-op. Presently, the co-op has no ability to provide new potable water to non-residential users. Therefore the existing shares will be used to provide limited amounts of potable water to the development. It will not be permitted to use this potable water for intensive water operations (truck washing etc.). For the initial phases the existing co-op shares will be a sufficient water supply. If the existing shares are an insufficient supply for the later phase, water will be hauled until additional water becomes available from the co-op.

Cisterns with pressure systems will be required for each property. Provision of individual cisterns for each lot with in the development will allow potable water to be delivered to the lots by truck in the event that the water co-op cannot provide sufficient volumes.

As the development area would be served by the Association, a new water licence would not be required by AESRD.

Since the treated water supply has a definite limit, high water use businesses that require large amounts of treated water should not be permitted within the development area unless a more substantial water supply is established.

Lethbridge County will assume ownership and responsibility of the potable water system upon completion of the infrastructure.

4.2.2 Non-Potable Water / Fire Protection

The proposed development concept will include a non-potable water system with conventional fire hydrants distributed throughout the development. The non-potable water system will include a raw water reservoir (separate from the stormwater management pond) adjacent to the SMRID canal, a pumping station, and distribution piping within the development. The non-potable water system will distribute non potable water to each lot in the subdivision for non-potable use. A stationary pumping system will be provided to maintain pressure in the non-potable water distribution system and to supply water to hydrants for fire-fighting. Fire hydrants will be placed along the public roadways for use by responding emergency services personnel. This pond will also provide water for irrigation of the landscaped area adjacent to the ponds and the green strip along the canal.

An agreement will be required for the use of water from the SMRID canal to maintain volumes within the raw water reservoir. The SMRID has the capacity and legal ability to deliver water for other purposes and an agreement will dictate when and how that operation can occur.

Lethbridge County will assume ownership and responsibility of the raw water system upon completion of the infrastructure.

4.3 Gas

Natural gas distribution infrastructure in the area surrounding the site is operated by Triple W Gas. The developer will pay for the installation of natural gas distribution infrastructure to each lot. Triple W Gas will distribute natural gas within the development and lot purchasers will be able to select a retailer for natural gas supply.

4.4 Electrical Power

Fortis Alberta Inc. will provide services to the proposed subdivision and underground services to each property line.

4.5 Telephone

Telus will provide services to the lots, but each individual owner must apply for the service when building.

4.6 Shaw Cable

There is no cable television available in the area, however, small satellite dishes may be installed by the lot owner.

5.0 ROADS AND TRANSPORTATION

The existing entrance to the area to be developed lied across from the junction of Range Road 20-4 with Highway 508. Alberta Transportation has indicated that it will not support the utilization of this entrance for a new subdivision. Therefore the entrance to the subdivision will be further west closer to the canal. (Figure 2)

A looped road will run through the area to provide access to each lot. Roads within the subdivision will comply with Lethbridge County Engineering Guidelines. The road will consist of a 20 m right-of–way with open drainage to the sides. Roads will be paved and meet County standards to allow for truck access.

Lethbridge County will assume ownership and responsibility of the internal road system upon completion of the infrastructure.

A Traffic Impact Assessment (Appendix C) has been completed to analyze the impact of the development on the adjacent road network.

The TIA also indicated upgraded safety measures are warranted at the railway crossing on Highway 508 and the creation of a right turn lane into the development area is required. It also indicated illumination at the Highway 5/Highway 508, the Highway 4/Highway 508 and the development entrance is warranted.

6.0 SITE DRAINAGE AND GRADING

All drainage onsite must conform to Lethbridge County and Alberta Environment and Sustainable Resource Development requirements. The intent of stormwater management for the development is to contain runoff in a stormpond until it can be released into the SMRID drainage channel leading to Six Mile Coulee located on the west side of the canal. A Site Drainage Analysis was completed for the site (Appendix D) and is summarized below.

6.1 Site Drainage

Stormwater runoff from the subject lands presently flows into the existing roadside ditches or is trapped against the canal and ponds in low areas. Figures 4-7 show the topography of the site.

A storm water management pond will be located in the area of the existing topographic low area along the east side of the irrigation canal. The pond will receive storm water runoff from the subdivision by means of an overland drainage system constructed within the development area. The overland drainage system will consist of roadside ditches and lot line swales to collect and convey storm water runoff to the pond. Roadside ditches will be contained in the road right-of-way. Right-of-ways will be established for the drainage swales along property boundaries.

6.2 Drainage Modeling

As stormwater may not be able to be released immediately into the drainage channel, the pond will be designed to contain the volume generated by the design storms. To determine the required active storage volume of the pond, a hydrologic model of the site was prepared using the PC SWMM hydrologic modeling software package. The hydrologic model of the site post-development was then analyzed using a 1:100 year 24 hour design storm event.

The results of the hydrologic modeling indicate a required storage volume of 57,187 cubic meters to attenuate the runoff from the site. The stormwater management facility was sized to detain runoff volume generated. The hydrologic model will be reviewed during the detailed design stage to confirm the required capacity of the overland drainage system and culverts. Detailed design will also determine sizing and location of pumps and pipes accessing the canal.

6.3 Stormwater agreements and approvals

Storm water runoff collected in the pond will be released to the SMRID drainage channel located to the west of the canal. The County currently has an agreement with the SMRID for the release of stormwater into irrigation canals. (Appendix E) It is assumed this pond can be operated under this agreement.

The storm water management pond will be created on a public utility lot and will be operated by the Lethbridge County

Authorization and/or agreements will have to be obtained from the SMRID and the landowner to the east to install and operate a drainage system for the pond. A pipe will lead under the canal and either directly connect with the drainage channel or be connected with the drainage channel by a new local drainage channel. The drainage system will be operated such that stormwater runoff will be held in the pond and only released when there is downstream capacity to receive the water.

The storm water detention pond will require an approval under the Water Act and a registration under EPEA from AESRD as a municipal storm water management pond prior to construction.

7.0 SOLID WASTE DISPOSAL

Lot purchasers will be responsible for making arrangements for solid waste disposal. The City of Lethbridge Regional Solid waste facility is located approximately 23km driving distance from the development. Alternatively, lot purchasers may contract with a private solid waste hauler.

8.0 OPEN SPACES

The area around the pond will be landscaped so that it can be used as open space by members of the public. This will include grouped areas of trees and shrubs with low moisture demands. There will be a minimum of 1 tree per 130 sq m of greenspace (three shrubs equaling one tree)

Additionally a 10 metre wide green strip will be established between the canal right of way and the nearest lot boundary. Trees and a walkway will be established along this boundary. Tree species will be selected for characteristics of climate tolerance, speed of growth and significant height. Size of trees planted will large as defined in the Lethbridge County Land Use Bylaw Part 3, Section 25 (10) (a)

(vii). The trees will be spaced appropriately to create a sound and visual barrier between the development and acreages to the west.

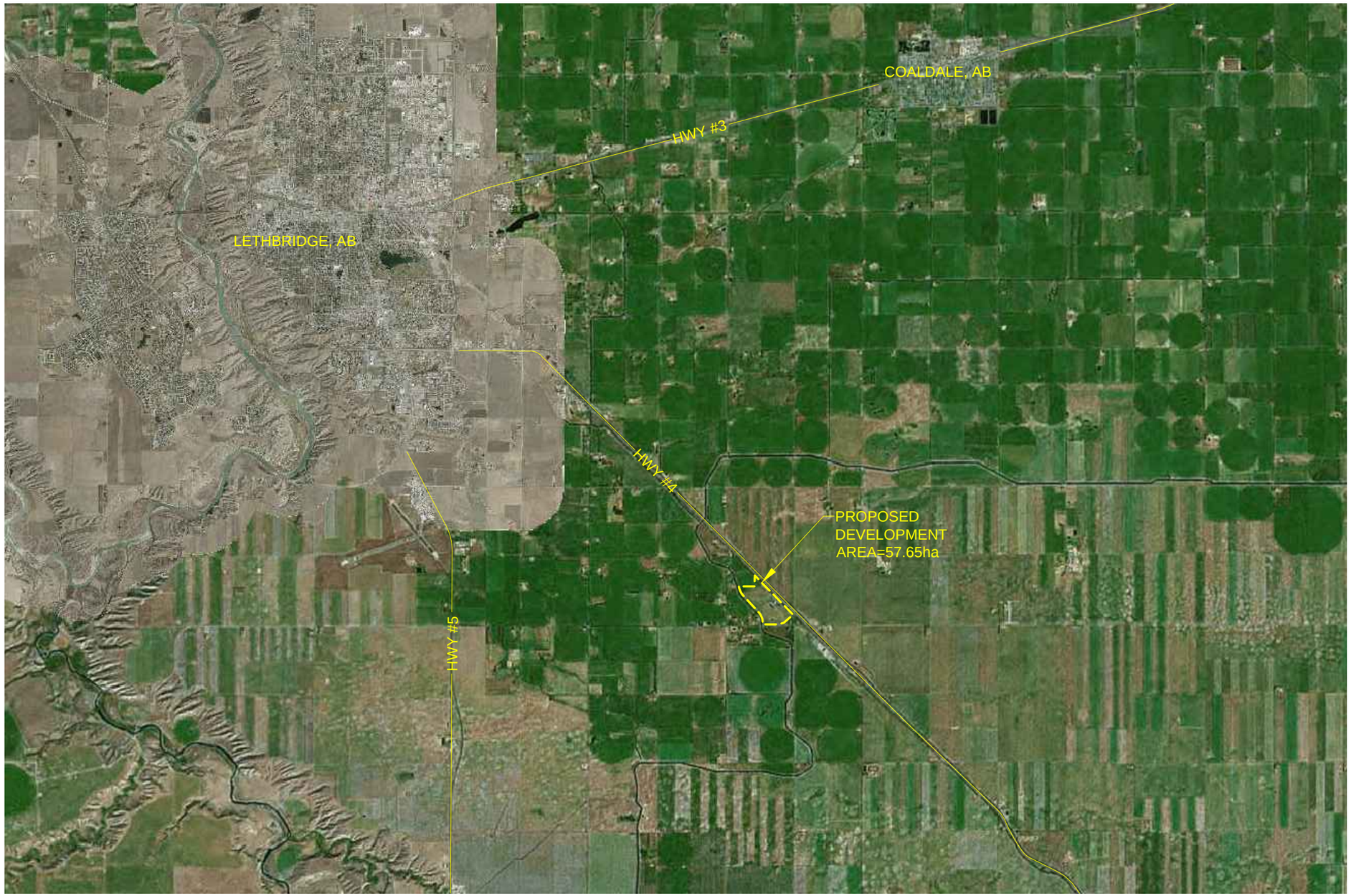
The green strip along the canal will be applied to the Municipal Reserve requirements for the development. The remainder will be supplied through direct payment. The decision on if the green strip is taken as municipal reserve is made at the time of subdivision. If the green strip is taken as municipal reserve, maintenance of the landscaped area will be the responsibility of Lethbridge County. If the green strip is not taken as municipal reserve maintenance of the landscaped area will be the responsibility of the owner association.

9.0 ARCHITECTURAL CONTROLS

The following controls are designed to ensure an environment that reflects the values of the community. These controls will be expanded and detailed at the subdivision stage of the development process. The following criteria will apply:

1. Entrance
   - The entrance to the development will be landscaped with a mix of shrubs and xeriscaping
   - The entrance will have signage of neat and attractive appearance
2. Property Design
   - Each property owner is to be responsible for upkeep of utility right-of-way along property frontage
   - A mandatory area of landscaping will be established for property frontages and will follow the guidelines of the Lethbridge County Land Use Bylaw Part 3 Section 25(10)
   - Signage parameters will be established to enhance the development
   - Parameters for permissible fencing and lighting will be developed
3. Building Design
   - Lots adjacent to the canal will have a 30.5m building setback from the canal
   - Consistent set back distances will be established from front and back property lines
   - Concepts of green building design shall be encouraged
   - Fronts of buildings will have to contain enhancements of color and material so that there is not continuous gray metal building fronts.

APPENDIX A – FIGURES



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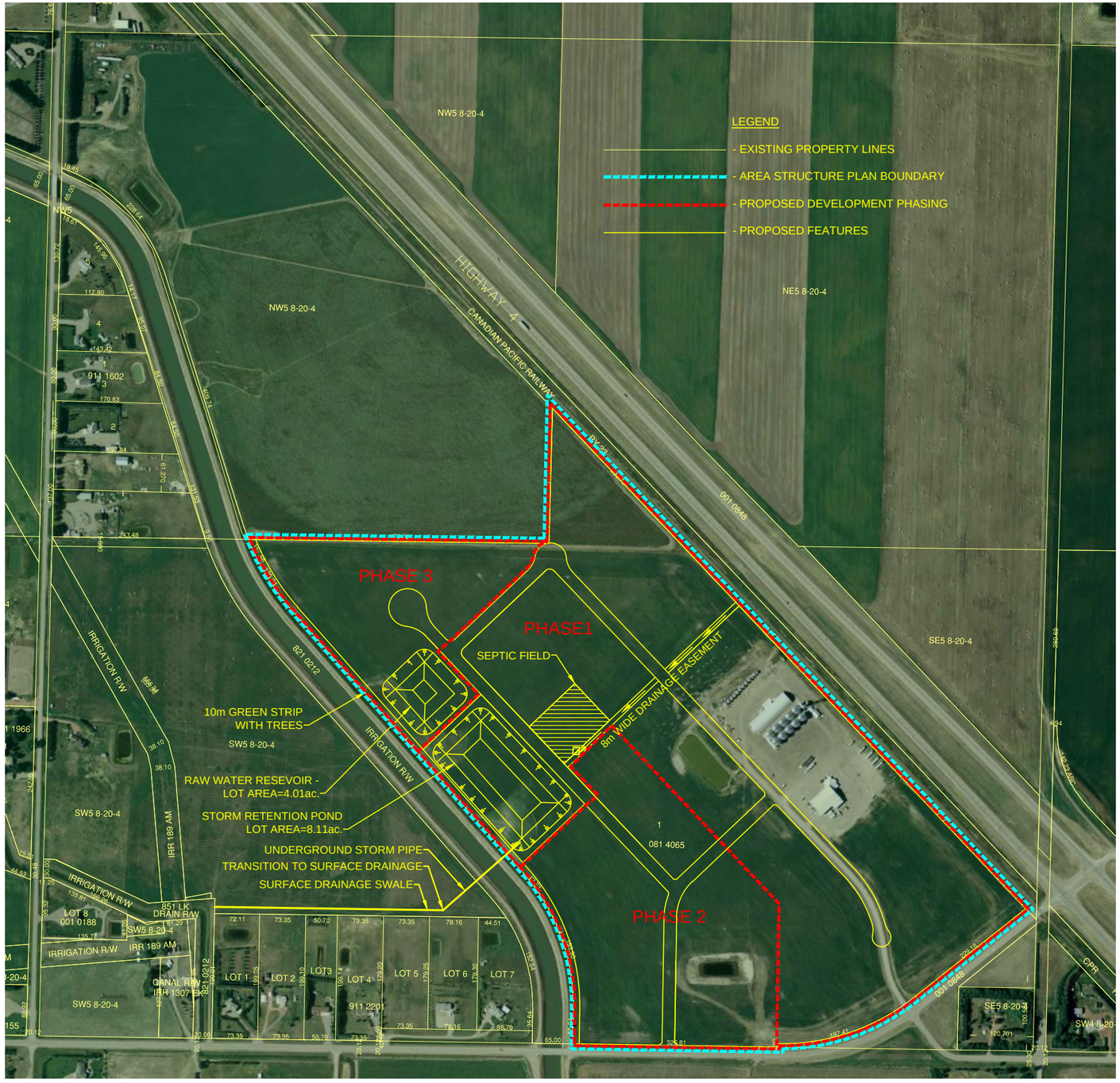
PROJECT TITLE: AGRI-BUSINESS PARK

DRAWING TITLE: LOCATION MAP

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VERSION NUMBER	IFA1
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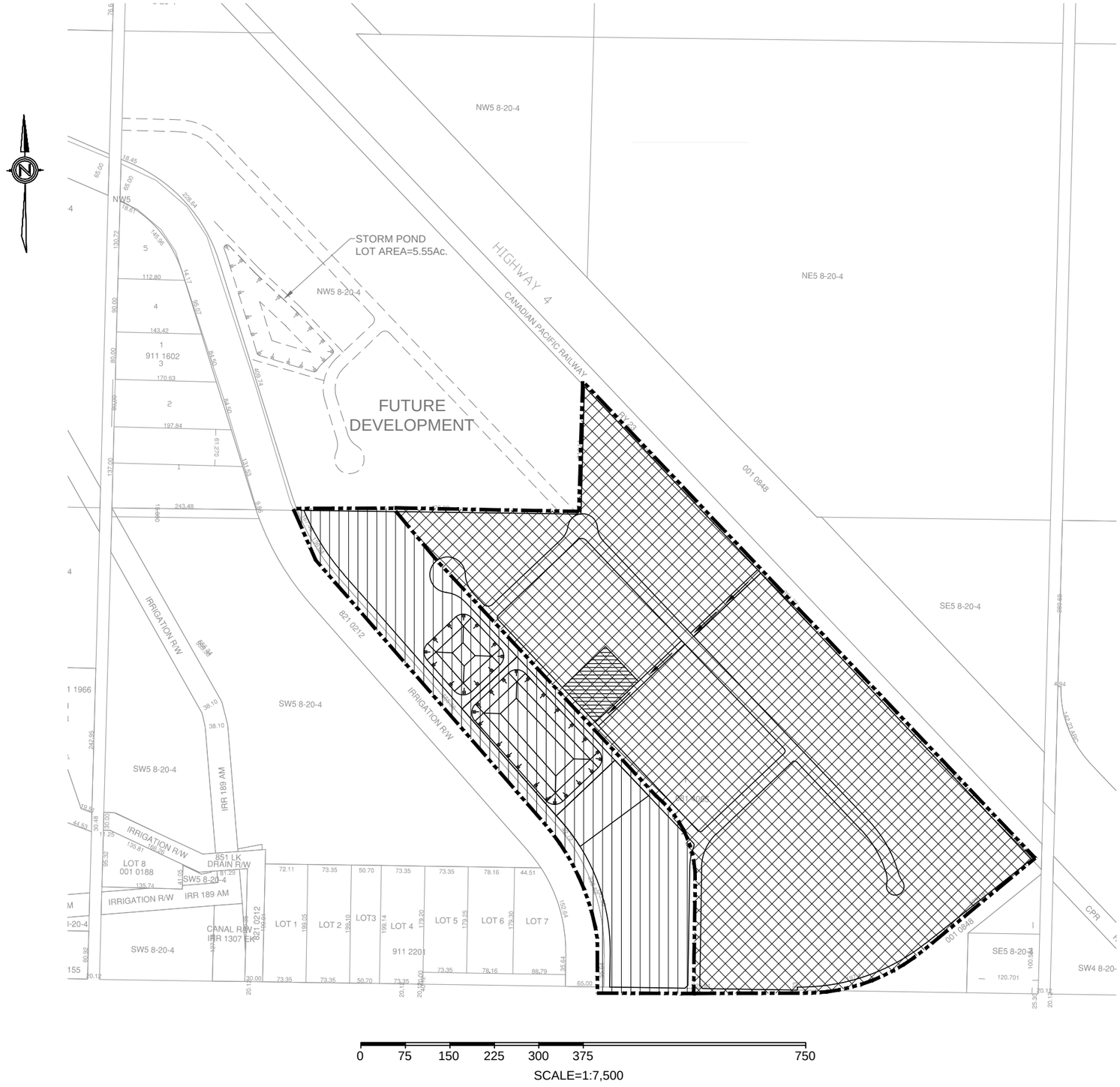
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LEGEND

- BUSINESS LIGHT INDUSTRIAL
- RURAL GENERAL INDUSTRIAL

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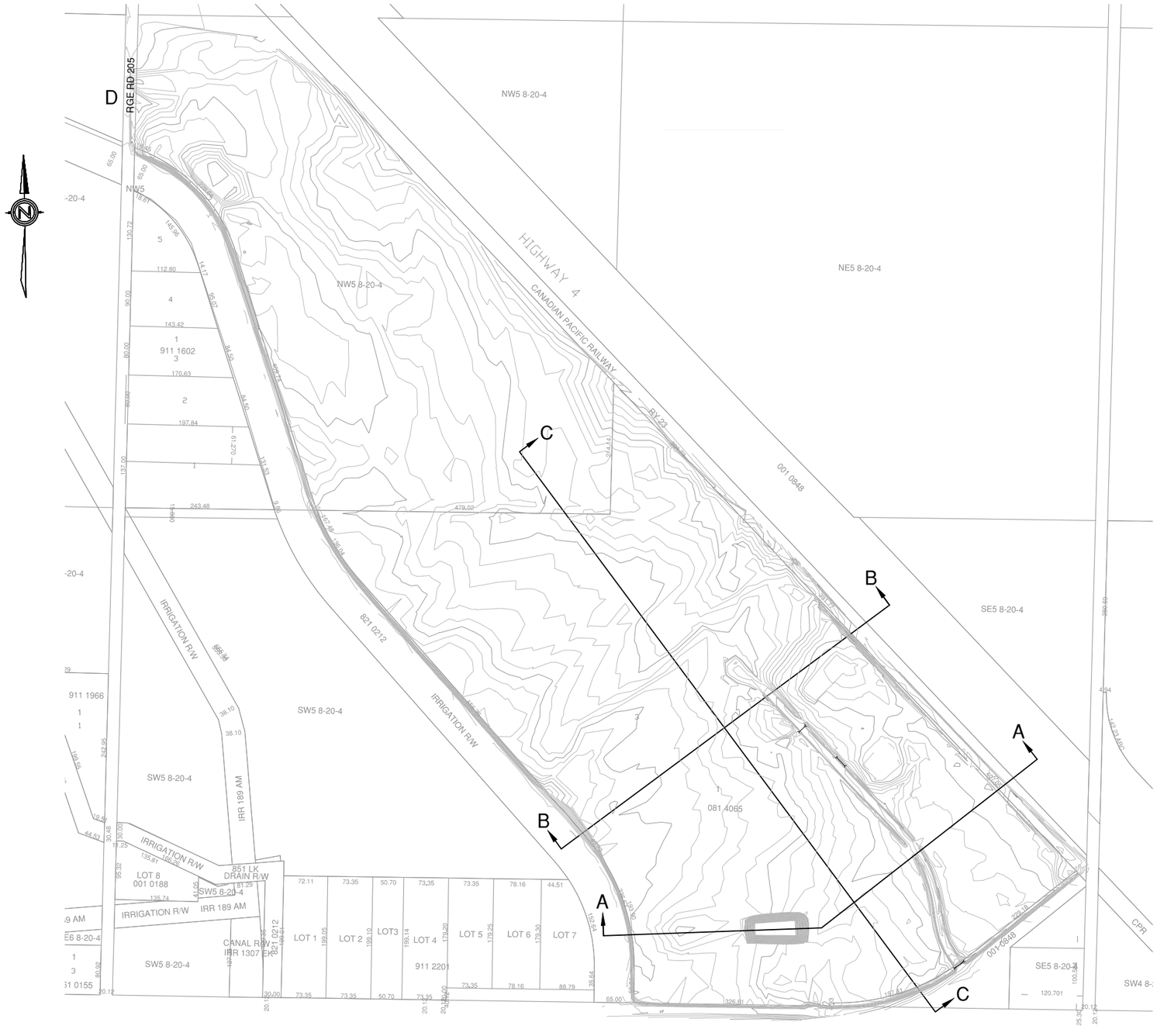
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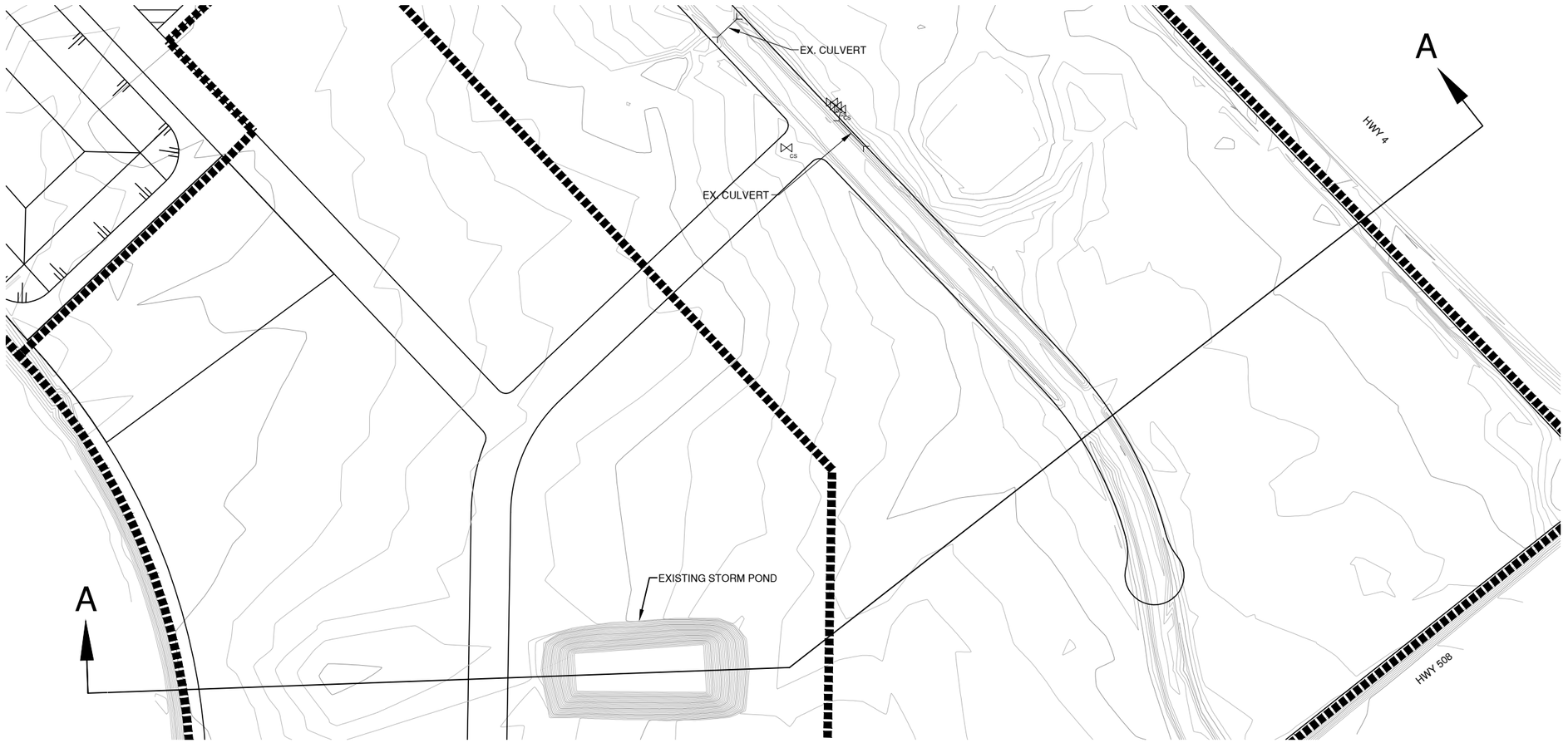
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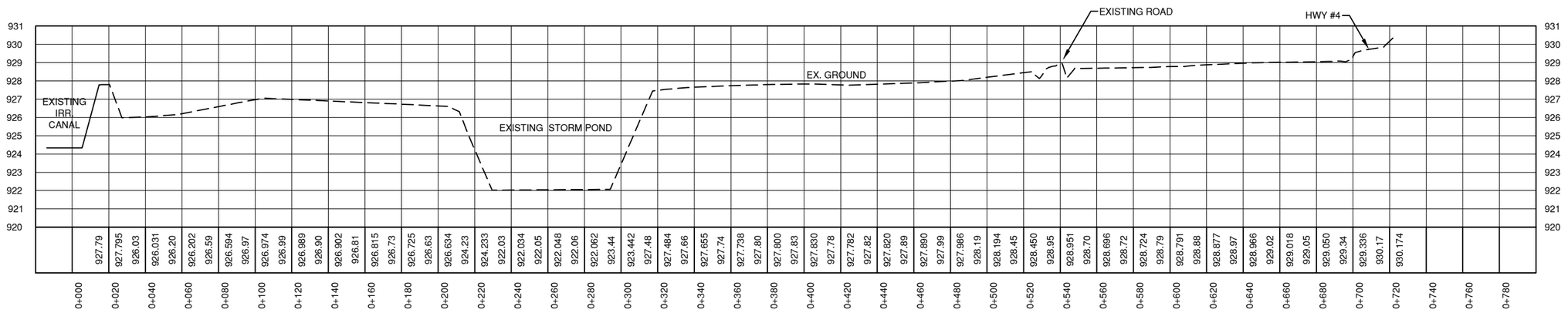
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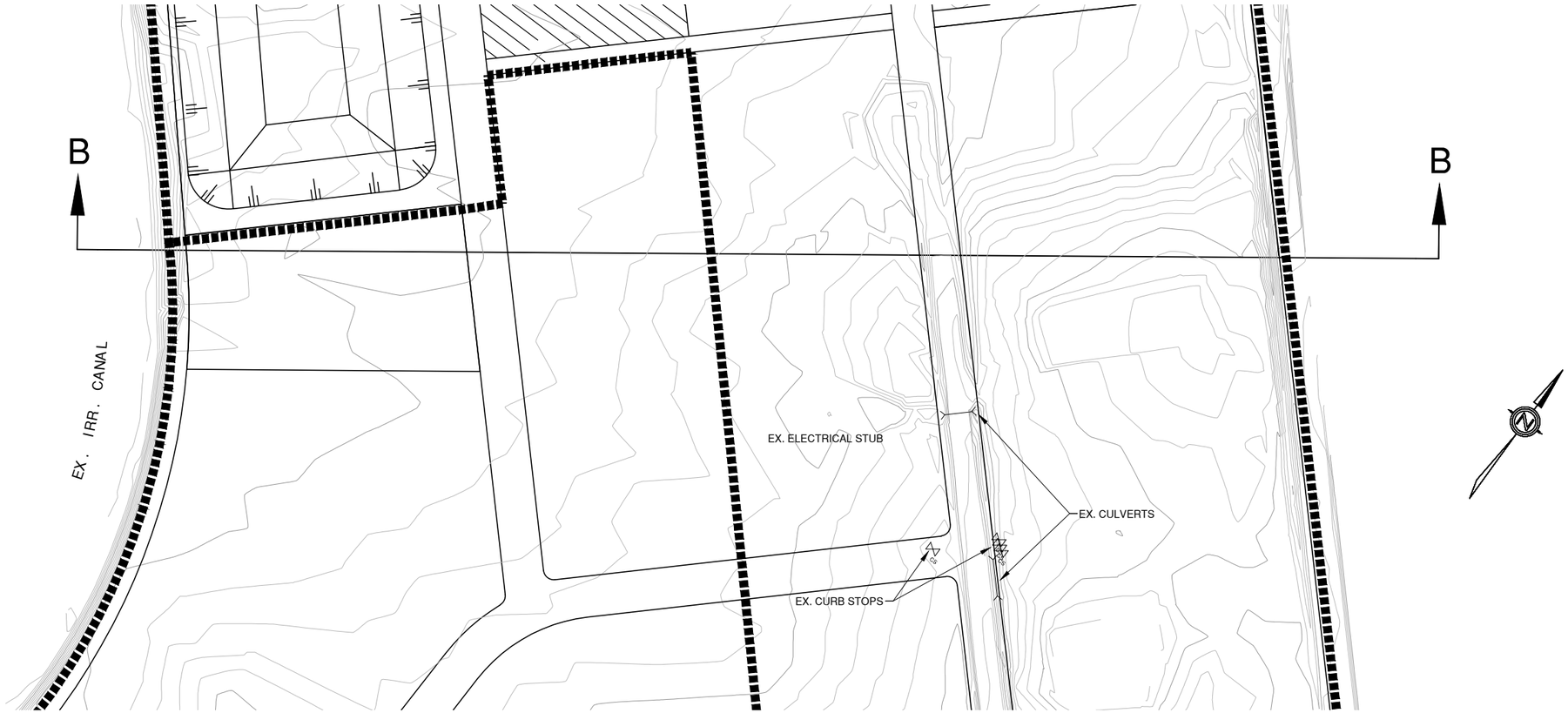
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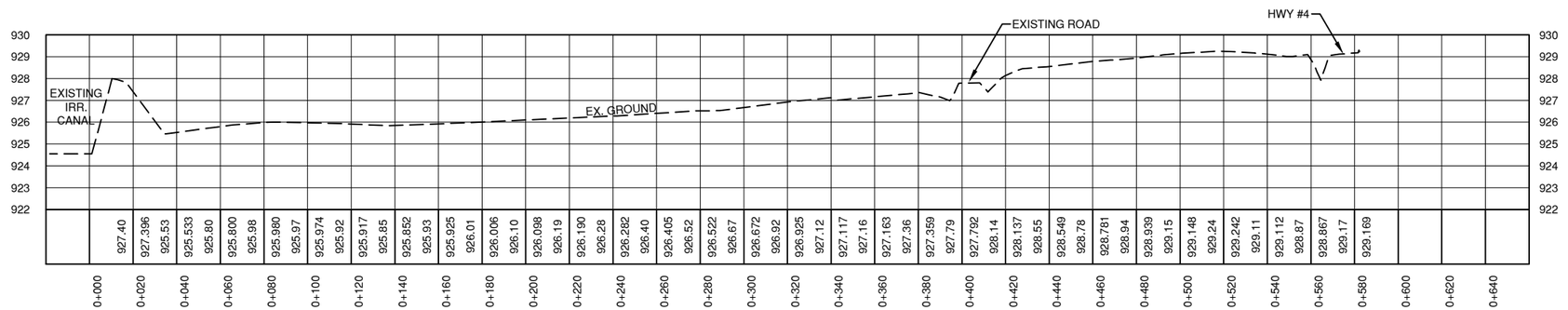
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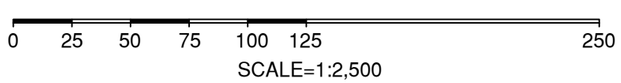
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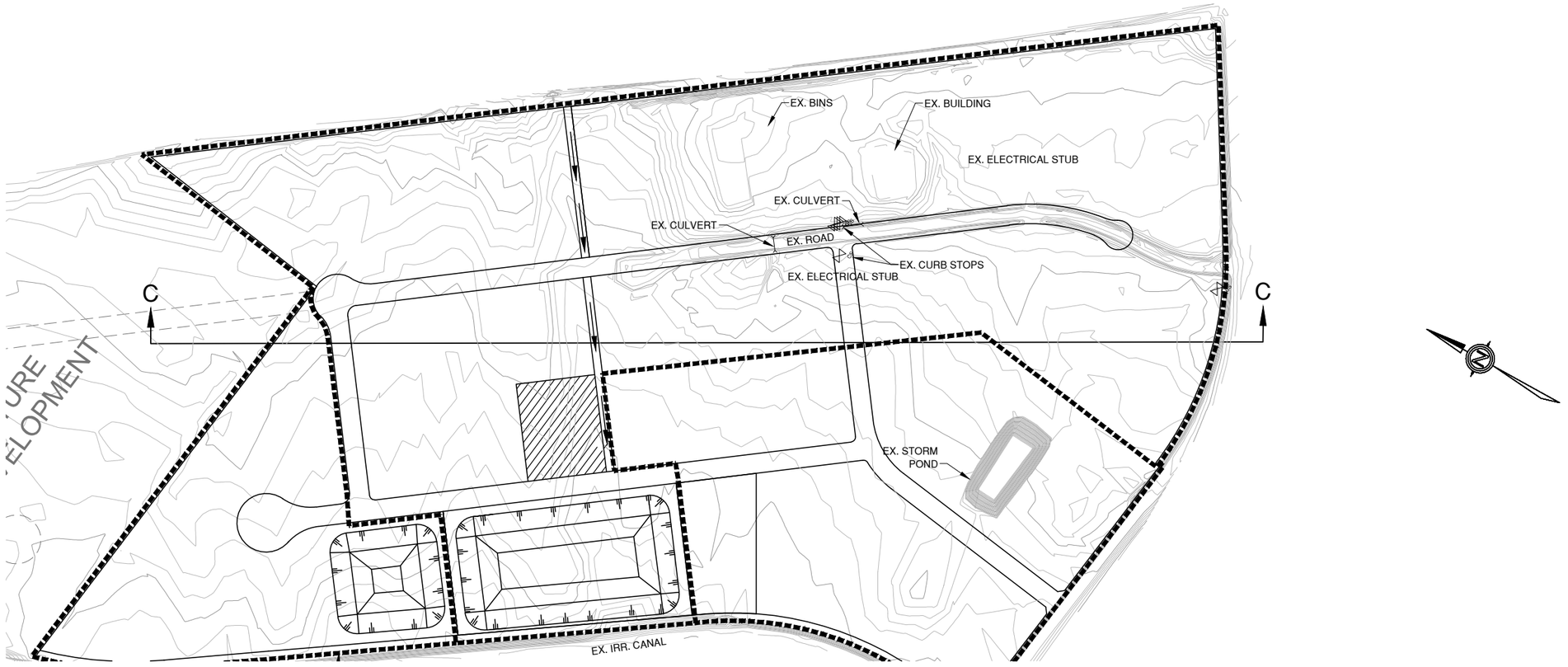
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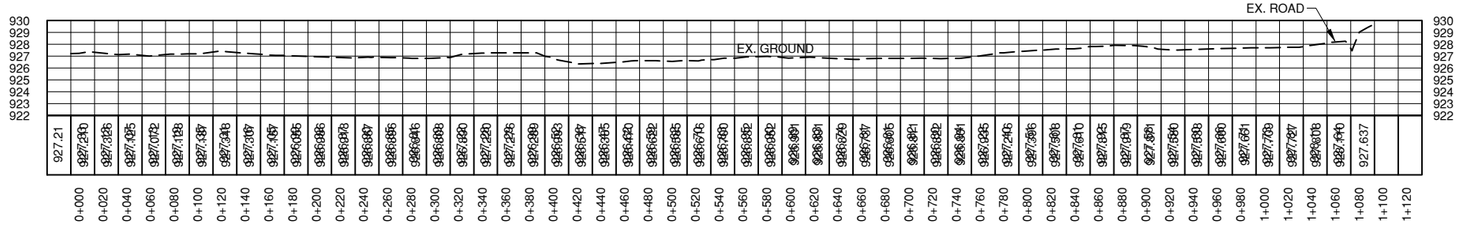
DRAWING TITLE: EXISTING GROUND PLAN & PROFILES

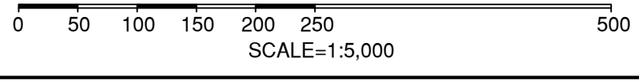
DRAWING STATUS: FOR APPROVAL

#	REVISION	DATE	BY

DESIGN	IF
DRAWN	DPB/MDO
CHECKED	MAH
APPROVED	IF
SCALE	AS SHOWN
PROJECT NUMBER	13-129
VERSION NUMBER	IFA1
DATE DRAWN	JULY 29, 2014
SHEET NUMBER	4.2







SCALE=1:5,000

NOTES

This is a copyright drawing and shall not be reproduced in any form without written permission of the engineer

Contractor to check and verify all dimensions before construction, any errors and omissions shall be reported to the engineer immediately

Drawing shall not be used for construction until approved

Do not scale the drawing

All construction shall be in accordance with the latest codes, may it be construction, mechanical, etc

HASEGAWA
CONSULTING PROFESSIONAL ENGINEERS
330, 3120 - 32nd Street South
Lethbridge, Alberta T1K 7B4
Ph: 403-328-2686
Fax: 403-328-2728
Email: office@hasegawa.ca

CLIENT: RAY TAYLOR

PROJECT TITLE: AGRI-BUSINESS PARK

DRAWING TITLE: EXISTING GROUND PLAN & PROFILES

DRAWING STATUS: FOR APPROVAL

#	REVISION	DATE	BY

DESIGN	IF
DRAWN	DPB/MDO
CHECKED	MAH
APPROVED	IF
SCALE	AS SHOWN
PROJECT NUMBER	13-129
VERSION NUMBER	IFA1
DATE DRAWN	JULY 29, 2014
SHEET NUMBER	4.3

APPENDIX B – SOIL TESTS RESULTS

HASEGAWA
CONSULTING PROFESSIONAL ENGINEERS

330, 3120-32 Street South, Lethbridge, AB. T1K 7B4
Bus: 403-328-2686
Fax: 403-328-2728
E-mail: office@hasegawa.ca

May 5, 2014

Job #: 13-129

Dar Ray Farms Ltd.
Attn: Ray Taylor
RR 8-18-5
Lethbridge, AB T1J 4P4

By Email to: darrayfarms@yahoo.ca

Re: Soil testing for Agri Business Park Subdivision

Dear Ray:

On April 3 and 4, 2014 Hasegawa Engineering collected soil samples for the purpose of determining the suitability of the soil for the installation of septic fields, as well as for the building of roads and houses. The subject property is approximately 140 acres in size and is located in portions of the SE and SW 1/4 of Sec 5-T8-R20 West of the 4th Meridian. It is proposed that the land be subdivided into agri-business lots.

A backhoe and an auger attachment were used to drill three boreholes on the property. Three of the boreholes (BH1, BH2 and BH4) were drilled to a depth of 10 feet, while borehole three (BH3) was drilled to a depth of almost 15 feet. Soil samples were collected at eight and ten feet from BH1, six feet from BH2, four and eight feet from BH3, and four feet from BH4. All samples collected were submitted to AMEC Earth and Environmental for lab analysis to determine the soil composition and properties.

The lab test results are attached as well as copies from two pages of the Alberta Private Sewage Systems Standard of Practice (2009). The results show that the 8' sample from BH1 is 17% sand, 54% silt and 29% clay, which according to Figure 8.1.1.10. "Soil Texture Classification Triangle" classifies the soil as silty clay loam. The 10' sample from BH1 was 21% sand, 51% silt and 28% clay and would be classified as clay loam. The 6' sample from BH2 was 20% sand, 51% silt, and 29% clay which is classified as clay loam. The 4' sample from BH3 was 18% sand, 51% silt and 31% clay which is classified as silty clay loam. The 8' sample from BH3 was 25% sand, 50% silt and 25% clay and is classified as loam. The 4' sample from BH4 had 11% sand, 67% silt and 22% clay and is classified as silt loam.

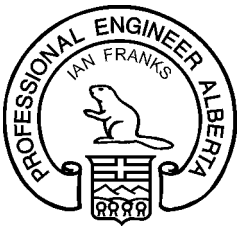
Table A.1.E.1. "Effluent Soil Loading Rates and Linear Loading Rates" from the Standards lists silty clay loam, clay loam and silt loam as having an infiltration rate that is possibly not suitable for use in a private septic field system. The effectiveness of these soils is dependent on the soil structure at a particular location in terms of both shape and grade. Soil structure will have to be determined for each individual site.

Loam is suitable for use in septic field systems. For these soil types if the soil structure is suitable, the effluent loading rate would be a minimum of 7.3 L/day/sq. metre. Different soil structures will yield different loading rates or possibly no permitted rates.

Further testing at specific potential septic field locations will be required to determine the suitability of the soils. It may be found that some sites are unsuitable for septic fields or septic mounds. In these locations other methods of sewage disposal would have to be considered.

The purpose of this letter is to only inform that the tests performed show if the soil on site will be suitable for a septic field. Further design work will need to be done by a certified individual to size an appropriate septic field for an individual property.

Yours truly,



Ian Franks, P. Eng
HASEGAWA ENGINEERING
Consulting Professional Engineers
IF

encl: AMEC test results (7 pages),
Alberta Private Sewage Systems
Standard of Practice (2 pages),
BH Drilling Logs (2 pages)

SOIL DRILLING REPORT

Project Name:	Dar Ray Farms Agri Business Park	Project #:	13-129
Hole Description:	BH1	Bore Hole #:	1
Drilling Procedure:	Backhoe/auger	Hole Size:	6”
SPT Procedure:		SPT Size: OD=	ID=
Sampling Procedure	Bucket/auger	Sampler Size OD=	ID=
Logged By:	Ryan Olsen	Date:	April 3, 2014

Depth (FT)	WT	USGS	Soil Sample Description	Moisture Content, w	Plasticity Index, PI	Dry Unit Weight, γ (pcf)	Friction Angle, Φ	Penetro-meter (psf)	SPT Count, N			Compressive Strength, Cu(psf)
0			Black, wet, top soil/stubble									
6”			Brown, damp, sandy clay till, loose									
4			Brown, moist, sandy clay till, some plastic									
5												
6			Brown, very moist, sandy clay till, soft									
10			End of Borehole									

SOIL DRILLING REPORT

Project Name:	Dar Ray Farms Agri Business Park			Project #:	13-129
Hole Description:	BH2			Bore Hole #:	2
Drilling Procedure:	Backhoe/auger			Hole Size:	6”
SPT Procedure:		SPT Size:	OD=		ID=
Sampling Procedure	Bucket/auger	Sampler Size	OD=		ID=
Logged By:	Ryan Olsen			Date:	April 3, 2014

Depth (FT)	WT	USGS	Soil Sample Description	Moisture Content, w	Plasticity Index, PI	Dry Unit Weight, γ (pcf)	Friction Angle, Φ	Penetro-meter (psf)	SPT Count, N	Compressive Strength, Cu(psf)
0			Black, wet, top soil/stubble							
6”			Brown, damp, sandy clay till, loose							
4			Brown, moist, sandy clay till, slightly firm, some plastic							
5										
8			Brown, very moist, sandy clay till, slightly firm							
			End of Borehole							
10										

SOIL DRILLING REPORT

Project Name:	Dar Ray Farms Agri Business Park			Project #:	13-129
Hole Description:	BH3			Bore Hole #:	3
Drilling Procedure:	Backhoe/auger			Hole Size:	6”
SPT Procedure:		SPT Size:	OD=		ID=
Sampling Procedure	Bucket/auger	Sampler Size	OD=		ID=
Logged By:	Ryan Olsen			Date:	April 4, 2014

Depth (FT)	WT	USGS	Soil Sample Description	Moisture Content, w	Plasticity Index, PI	Dry Unit Weight, γ (pcf)	Friction Angle, Φ	Penetro-meter (psf)	SPT Count, N	Compressive Strength, Cu(psf)
0			Black, wet, top soil/stubble							
6”			Medium brown, moist, sandy clay, loose							
4			Brown, moist, silty sandy clay, soft, some plastic							
5										
			End of Borehole							
10										

SOIL DRILLING REPORT

Project Name:	Dar Ray Farms Agri Business Park			Project #:	13-129
Hole Description:	BH4			Bore Hole #:	4
Drilling Procedure:	Backhoe/auger			Hole Size:	6”
SPT Procedure:		SPT Size:	OD=		ID=
Sampling Procedure	Bucket/auger	Sampler Size	OD=		ID=
Logged By:	Ryan Olsen			Date:	April 4, 2014

Depth (FT)	WT	USGS	Soil Sample Description	Moisture Content, w	Plasticity Index, PI	Dry Unit Weight, γ (pcf)	Friction Angle, Φ	Penetro-meter (psf)	SPT Count, N	Compressive Strength, Cu(psf)
0			Black, wet, top soil/stubble							
6”			Brown, damp, sandy silty clay, loose							
3			Medium brown, moist, sandy clay, slightly loose							
5										
6			Medium brown, very moist, silty sandy clay, soft							
10			End of Borehole							

MOISTURE CONTENT

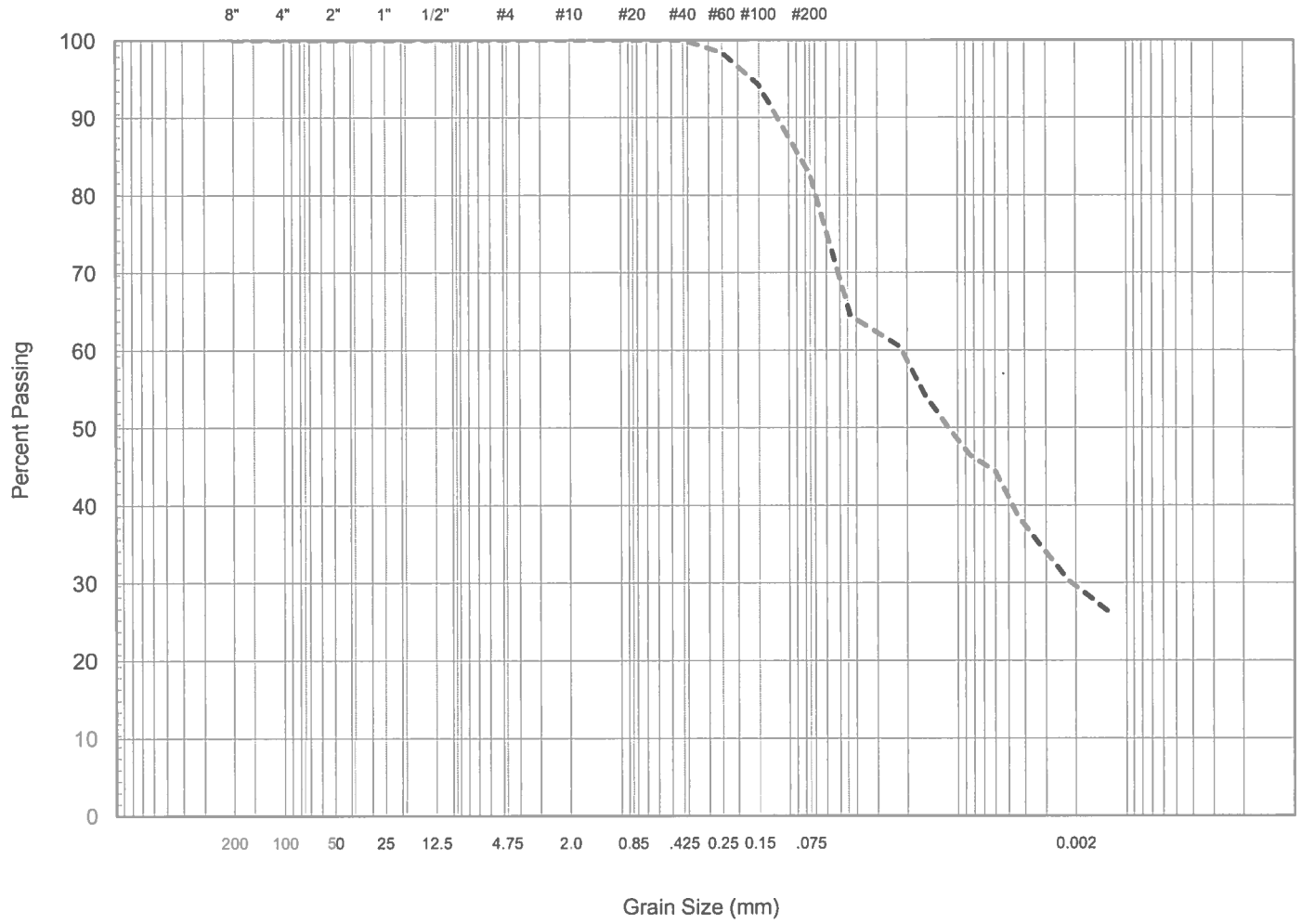
Project: **Dar Ray Farms**
Project #: **BX10990.200**
Technician: Date: **7-Apr-2014**

Hole #	TH1	TH1	TH2	TH3	TH3	TH4
Depth (m)	8'	10'	6'	4'	8'	4'
Sample						
Tare No.						
Wt. Sample Wet	134.1	154.3	206.8	100.9	109.3	134.4
Wt. Sample Dry	115.0	129.1	173.8	84.2	91.3	113.7
Wt. Water	19.1	25.2	33.0	16.7	18.0	20.7
Tare Container	0.0	0.0	0.0	0.0	0.0	0.0
Wt. Dry sample	115.0	129.1	173.8	84.2	91.3	113.7
Moist. Content	***16.6%***	***19.5%***	***19.0%***	***19.8%***	***19.7%***	***18.2%***

HYDROMETER TEST

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited

COBBLES	GRAVEL		SAND			SILT	CLAY
	Coarse	Fine	C	M	F		



Remarks:

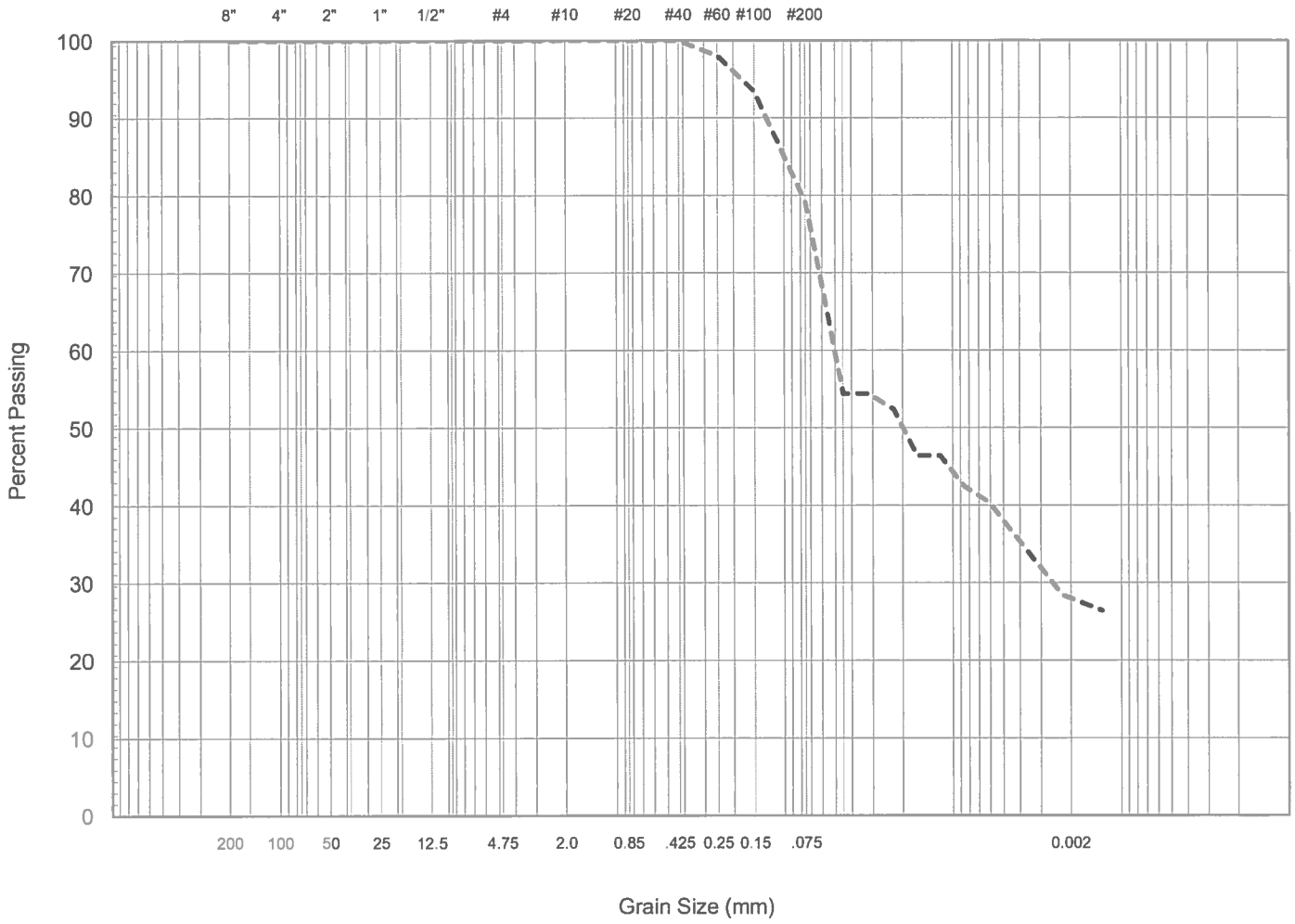
Summary					
D10 =	#N/A	mm	**Gravel**	0	%
D30 =	#DIV/0!	mm	**Sand**	17	%
D60 =	0.0215	mm	**Silt**	54	%
Cu =	#N/A		**Clay**	29	%
Cc =	#DIV/0!				

Project No:	**BX10990.200**	**Client:**	Hasegawa		
Hole No:	**TH1**	**Sample:**	Dar Ray Farms		
Depth (m):	**8'**	**Date:**		**Tech:**	AJ

HYDROMETER TEST

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited

COBBLES	GRAVEL		SAND			SILT	CLAY
	Coarse	Fine	C	M	F		



Remarks:

Summary					
D10 =	#N/A	mm	**Gravel**	0	%
D30 =	0.0026	mm	**Sand**	21	%
D60 =	#DIV/0!	mm	**Silt**	51	%
Cu =	#DIV/0!		**Clay**	28	%
Cc =	#N/A				

Project No: BX10990.200
Hole No: TH1
Depth (m): 10'

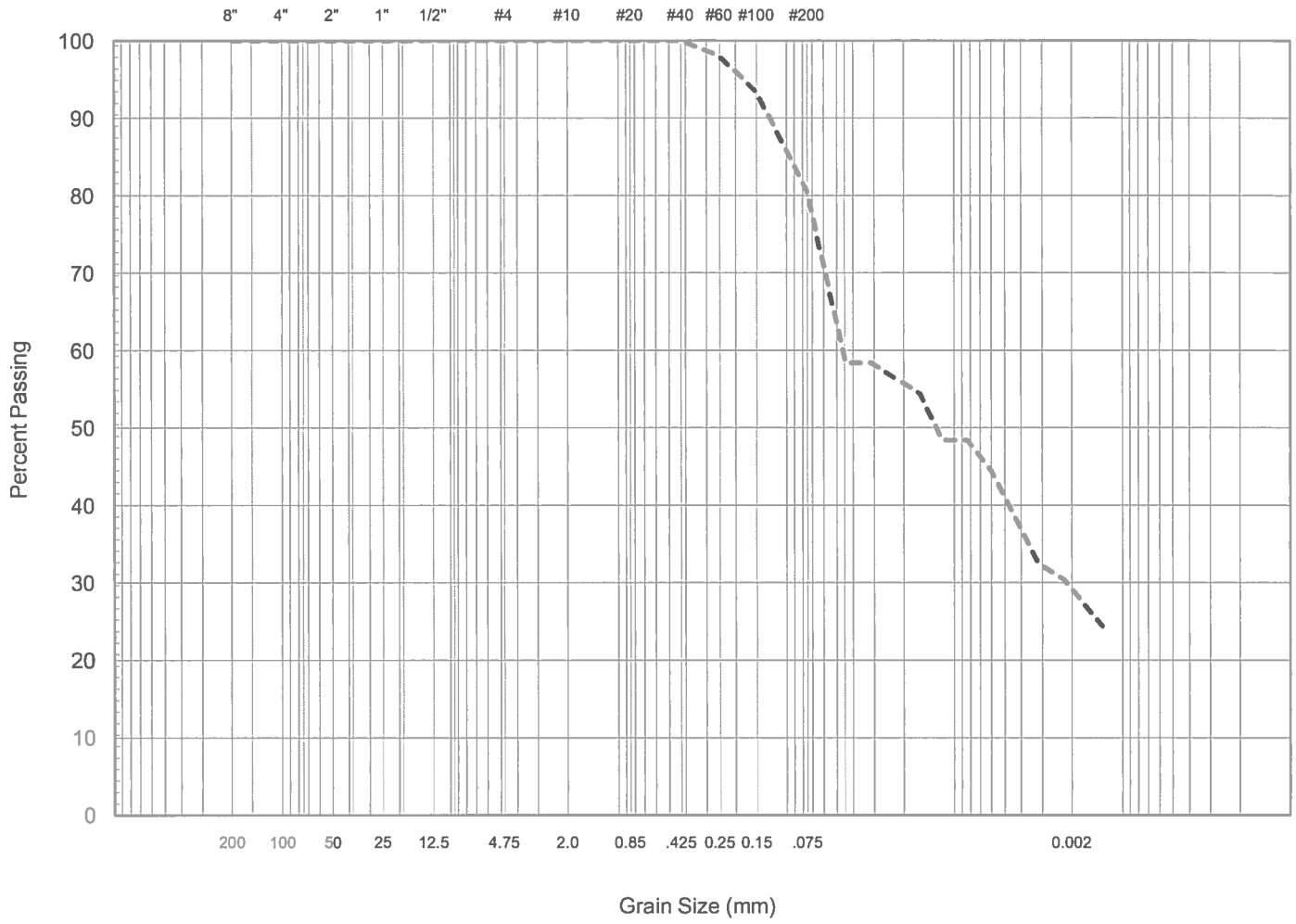
Client: Hasegawa
Sample: Dar Ray Farms
Date:

Tech: AJ

HYDROMETER TEST

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited

COBBLES	GRAVEL		SAND			SILT	CLAY
	Coarse	Fine	C	M	F		



Remarks:

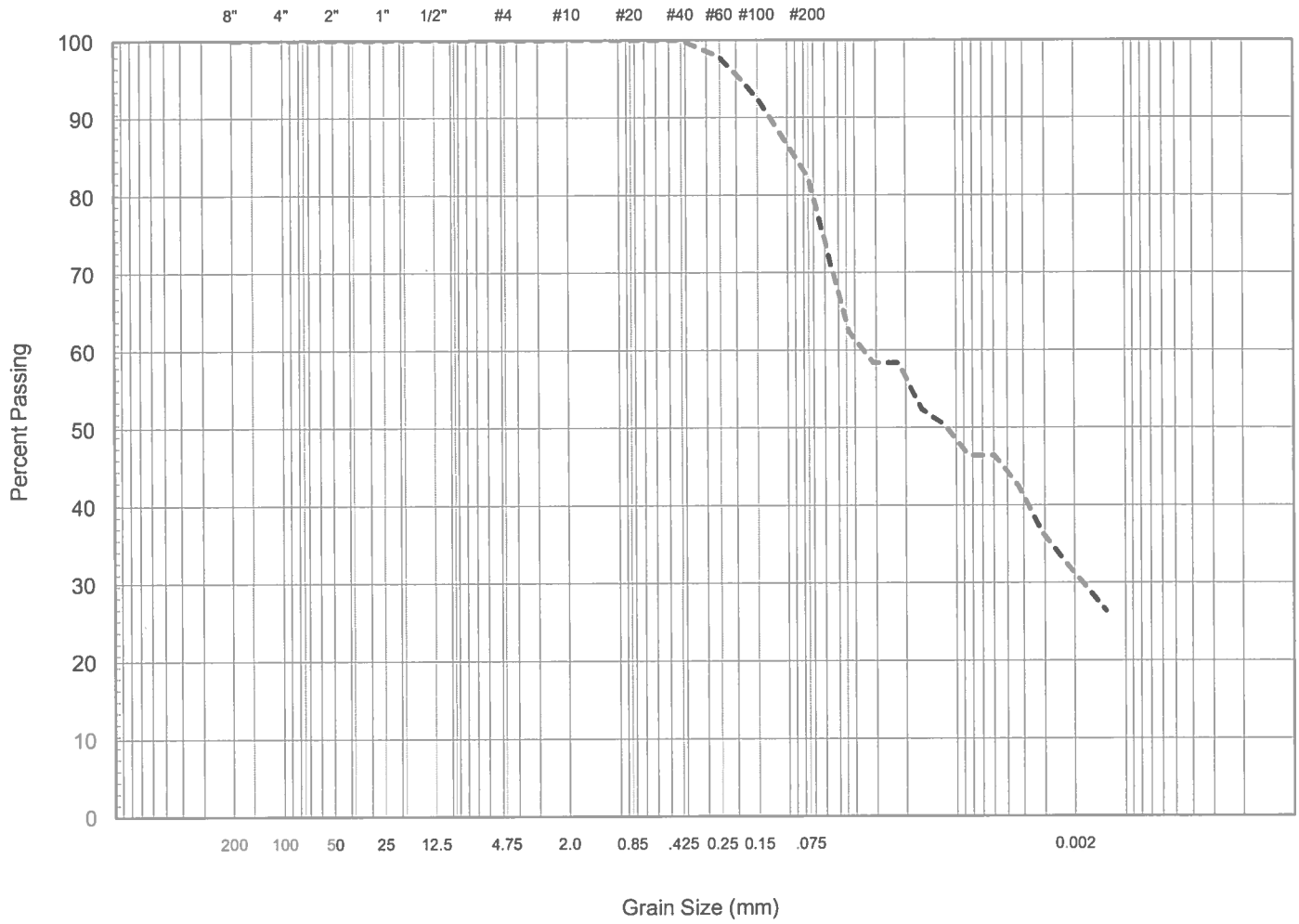
Summary					
D10 =	#N/A	mm	**Gravel**	0	%
D30 =	#DIV/0!	mm	**Sand**	20	%
D60 =	#DIV/0!	mm	**Silt**	51	%
Cu =	#DIV/0!		**Clay**	29	%
Cc =	#DIV/0!				

Project No: BX10990.200 **Client:** Hasegawa
Hole No: TH2 **Sample:** Dar Ray Farms
Depth (m): 6' **Date:** **Tech:** AJ

HYDROMETER TEST

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited

COBBLES	GRAVEL		SAND			SILT	CLAY
	Coarse	Fine	C	M	F		



Remarks:

Summary					
D10 =	#N/A	mm	**Gravel**	0	%
D30 =	#DIV/0!	mm	**Sand**	18	%
D60 =	#DIV/0!	mm	**Silt**	51	%
Cu =	#DIV/0!		**Clay**	31	%
Cc =	#DIV/0!				

Project No: **BX10990.200**
Hole No: **TH3**
Depth (m): **4'**

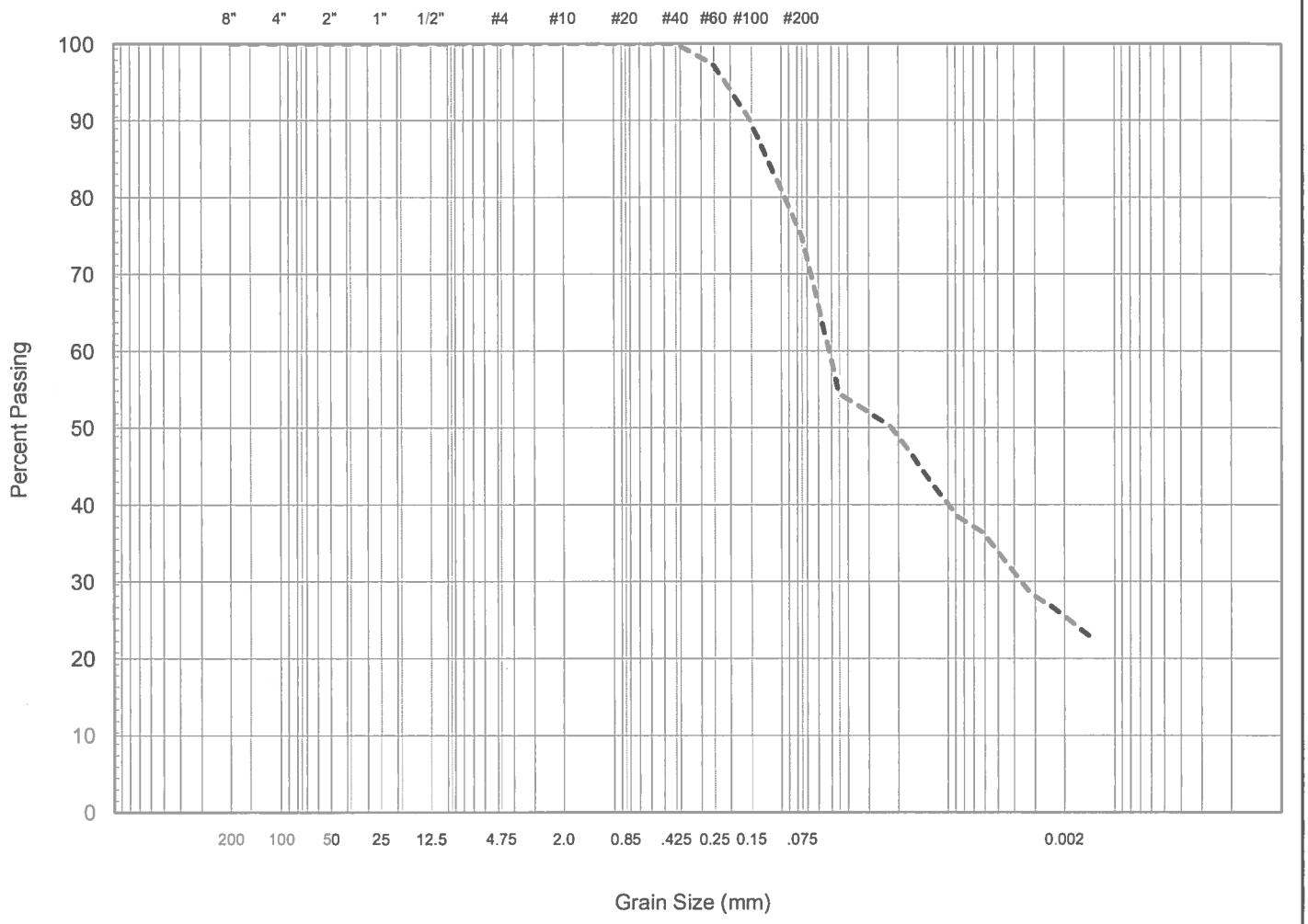
Client: Hasegawa
Sample: Dar Ray Farms
Date:

Tech: AJ

HYDROMETER TEST

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited

COBBLES	GRAVEL		SAND			SILT	CLAY
	Coarse	Fine	C	M	F		



Remarks:

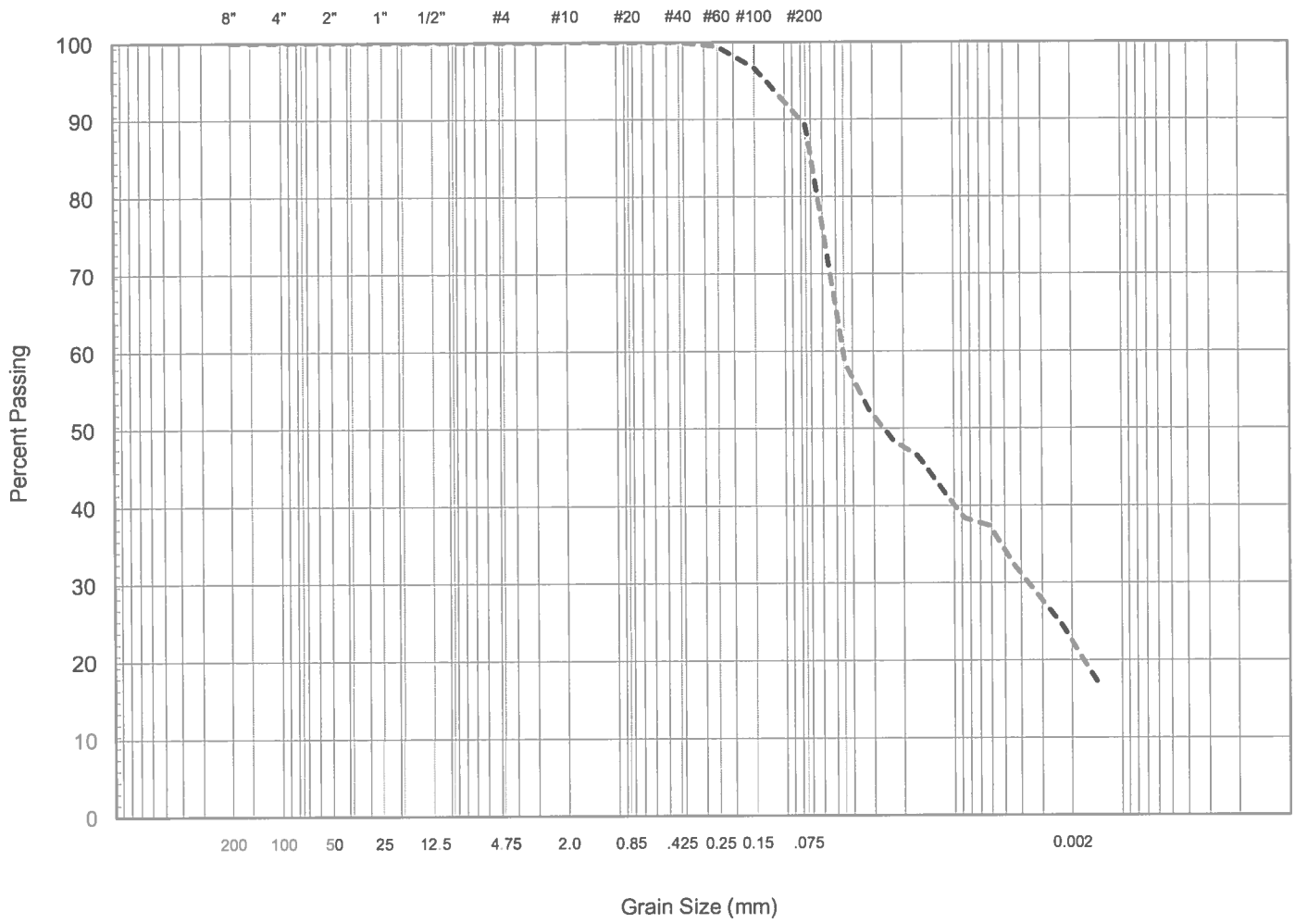
Summary					
D10 =	#N/A	mm	**Gravel**	0	%
D30 =	0.0037	mm	**Sand**	25	%
D60 =	0.0531	mm	**Silt**	50	%
Cu =	#N/A		**Clay**	25	%
Cc =	#N/A				

Project No: BX10990.200 **Client:** Hasegawa
Hole No: TH3 **Sample:** Dar Ray Farms
Depth (m): 8' **Date:** **Tech:** AJ

HYDROMETER TEST

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited

COBBLES	GRAVEL		SAND			SILT	CLAY
	Coarse	Fine	C	M	F		



Remarks:

Summary					
D10 =	#N/A	mm	**Gravel**	0	%
D30 =	0.0037	mm	**Sand**	11	%
D60 =	0.0458	mm	**Silt**	67	%
Cu =	#N/A		**Clay**	22	%
Cc =	#N/A				

Project No: BX10990.200
Hole No: TH4
Depth (m): 4'

Client: Hasegawa
Sample: Dar Ray Farms
Date:

Tech: AJ

ATTERBERG LIMITS TEST

AMEC Earth & Environmental
a Division of AMEC Americas Limited
1430B, 31 Street North
Lethbridge, Alberta
Canada, T1H 5J8
Tel: (403) 327-7474
Fax: (403) 327-7682

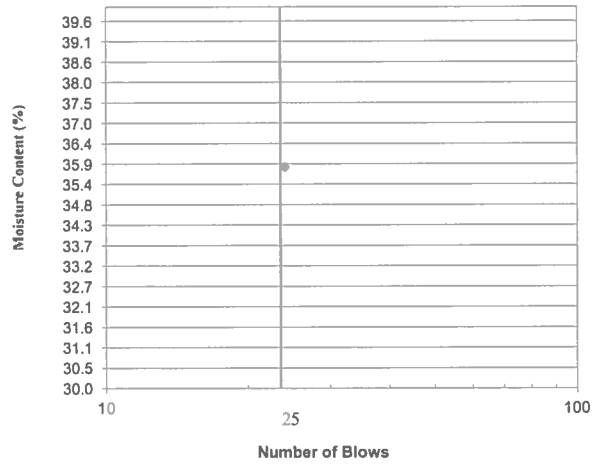
Attention:

Project: Dar Ray Farms

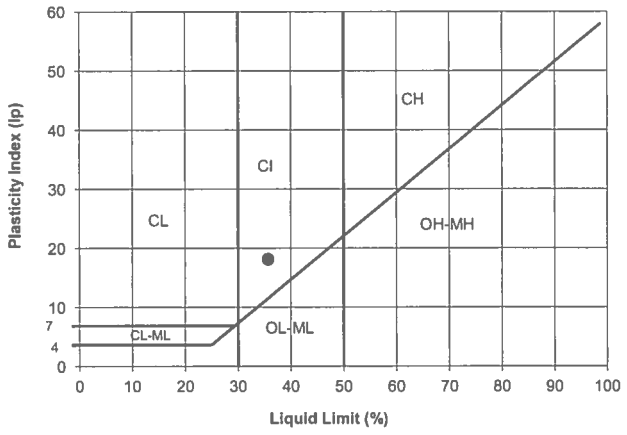
Project No: BX10990.200
Date: 10-Apr-14
CC:

Liquid Limit Test				Plastic Limit Test		
# of Blows	24					
Tare #	26			Tare #	14	
Wet Wt + Tare	32.0533			Wet Wt + Tare	17.1079	
Dry Wt + Tare	27.0434			Dry Wt + Tare	16.5488	
Wt of Tare	13.0507			Wt of Tare	13.3492	
% Moisture	35.8			% Moisture	17.5	

Liquid Limit Test



Plasticity chart for soil passing 425 um sieve



Liquid Limit (%): 35.6 **Plastic Limit (%):** 17.5 **Plasticity Index:** 18.2

Classification : CI **Depth:** 4' **Sample ID:** TH 3

Technician: TH

= Input Data

Per: _____

Reporting of these results constitutes a testing service only. Engineering interpretation or evaluation of these test results is provided only on written request. The data presented is for the sole use of the client stipulated above.

AMEC Earth & Environmental

ATTERBERG LIMITS TEST

AMEC Earth & Environmental
a Division of AMEC Americas Limited
1430B, 31 Street North
Lethbridge, Alberta
Canada, T1H 5J8
Tel: (403) 327-7474
Fax: (403) 327-7682

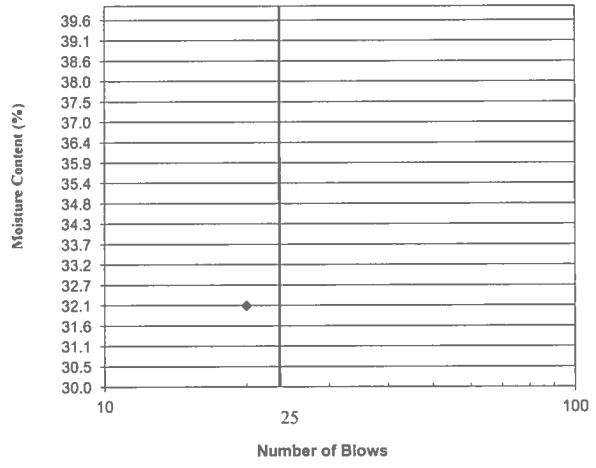
Attention:

Project: Dar Ray Farms

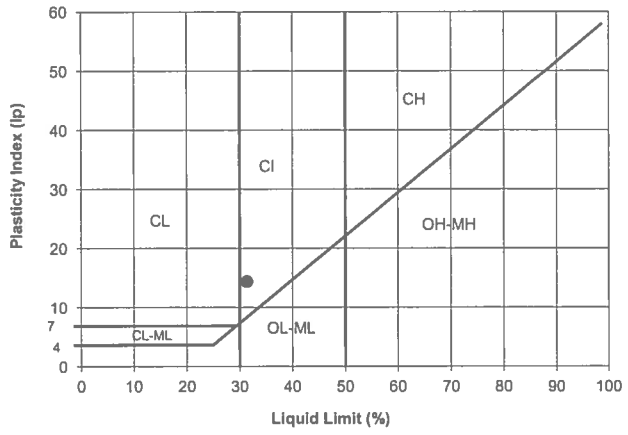
Project No: BX10990.200
Date: 10-Apr-14
CC:

Liquid Limit Test				Plastic Limit Test		
# of Blows	20					
Tare #	27			Tare #	13	
Wet Wt + Tare	37.6851			Wet Wt + Tare	16.8950	
Dry Wt + Tare	31.7585			Dry Wt + Tare	16.3739	
Wt of Tare	13.3162			Wt of Tare	13.2944	
% Moisture	32.1			% Moisture	16.9	

Liquid Limit Test



Plasticity chart for soil passing 425 um sieve



Liquid Limit (%): 31.3 **Plastic Limit (%):** 16.9 **Plasticity Index:** 14.4

Classification : CI **Depth:** 4' **Sample ID:** TH 4

Technician: TH

= Input Data

Per: _____

Reporting of these results constitutes a testing service only. Engineering interpretation or evaluation of these test results is provided only on written request. The data presented is for the sole use of the client stipulated above.

AMEC Earth & Environmental

Appendix C – Traffic Impact Assessment

TRANSPORTATION PLANNERS AND ENGINEERS

Lethbridge Agri-Business Park Transportation Impact Assessment

Final Report

Prepared for:	Hasegawa Consulting Professional Engineers
Date:	June 20, 2014
Prepared by:	Bunt & Associates Engineering (Alberta) Ltd.
Permit No.:	P 7694
Project No.	1283-09

June 20, 2014
1283-09

Ian Franks, P.Eng.

Hasegawa Consulting Professional Engineers
330, 3120 32nd Street South
Lethbridge, AB T1K 7B4

Dear Ian,

Re: Lethbridge Agri-Business Park Development – Traffic Impact Assessment

Please find attached our traffic impact assessment for the Lethbridge Agri-Business Park Development. The analysis summarized in this report was undertaken in accordance with the requirements of Alberta Transportation, and the conclusions and recommendations identify the impacts associated with the projected traffic volumes on the adjacent road network.

Please call if you have any questions or wish to discuss any issue in further detail.

Sincerely,

BUNT & ASSOCIATES

A Leibel

Amanda Leibel, P.Eng.
Transportation Engineer

PROFESSIONAL ENGINEER ALBERTA
AMANDA J. LEIBEL

June 20, 2014

PERMIT TO PRACTICE
Bunt & Associates Engineering (Alberta) Ltd.
Signature
Date JUNE 20/14
PERMIT NUMBER: P 7694
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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EXECUTIVE SUMMARY

Hasegawa Engineering is directing the development process for an Agri-Business Park located south of the City of Lethbridge in the northwest corner of the Highway 4/ Highway 508 intersection. The development consists of approximately 120 acres that will be developed as light to medium industrial land use servicing the agriculture and oilfield industries. Within the 120 acres of proposed development, approximately 10 acres are already developed with existing businesses in operation and as such the remaining 110 acres of undeveloped land will only be assessed as part of this transportation analysis.

As part of the permit application process, the County of Lethbridge (County) and Alberta Transportation (AT) required that a Transportation Impact Assessment (TIA) be completed in support of the development. Bunt & Associates was retained by Hasegawa Engineering to determine the necessary roadway improvements required to incorporate the proposed development.

Key Findings and Recommendations

The key findings and recommendations are summarized here, as follows:

Existing Traffic Conditions

All study area intersections are currently operating within the acceptable capacity parameters and study area roadways are currently functioning within their respective environmental capacities.

Bunt & Associates also completed an illumination warrant for the three study area intersections. The intersections on Highway 508 at both Highway 4 and Highway 5 warrant either partial and/or delineated lighting; however, the warrant did not determine which specific or if both types of illumination are warranted and as such it is recommended that further review is undertaken to determine the specific illumination required.

A railway crossing warrant was also completed for the Canadian Pacific rail line that runs parallel to Highway 4 and intersects Highway 508. Based on the cross product of the daily traffic volumes and the maximum number of trains expected to cross at this location, flashing warning lights are to be implemented at the rail crossing on Highway 508.

20-Year Background Traffic Conditions

The 20-year background traffic conditions exhibits the same results as under the existing traffic conditions. As such, all study area intersections and roadways are expected to operate within the acceptable capacity parameters. The intersections of Highway 508 with both Highway 4 and Highway 5 both warrant partial and/or delineation lighting. Flashing warning lights are warranted at the CP rail crossing on Highway 508 just west of Highway 4.

Proposed Development

The proposed Agri-Business Park that will service both agricultural and oil field sectors and is expected to generate 829 trips (688 inbound/ 141 outbound) during the AM peak hour and 802 trips (176 inbound/ 626 outbound) during the PM peak hour.

Post Development Traffic Conditions

Opening Day Post Development Traffic Conditions

Based on the Opening Day post development traffic conditions, Highway 508 at both Highway 5 and the realigned proposed site access requires a westbound right turn lane. The new proposed intersection at the realigned site access with Highway 508 requires a Type IV intersection treatment.

With these additions in place, the west intersection of Highway 4/ Highway 508 is expected to operate at v/c ratio of 0.93 and LOS E. It is highly unlikely that a traffic signal would be implemented at this location due to the high speed on the roadway and based on TAC signal warrant, a traffic signal is in fact not warranted.

With that said, delays will be experienced at this intersection and as such it is likely that traffic will utilize Highway 5 versus Highway 4 to access the south end of the City of Lethbridge. With only a 5-10% shift in traffic from the eastbound movements at Highway 4 to the westbound movements at Highway 5, both intersections will be expected to operate within acceptable capacity parameters.

Even with this shift in traffic, the 95th percentile queue length is expected to extend across the CP railway tracks and as such causes a safety concern. Therefore, Bunt & Associates recommends that warning gates be installed at the railway crossing to ensure safety to eastbound vehicles at this crossing. Given the low number of daily train traffic, the impact of the gates would not decrease the capacity of Highway 508 beyond what would be experienced without the gate.

Based on the road link analysis, all study area roadways are expected to operate within the environmental capacities for their specific road classification. The proposed site access is recommended to be upgraded from gravel to a paved surface.

Illumination warrant was completed for the three study area intersections along Highway 508 and under opening day post development traffic conditions, all three intersections warrant delineated lighting based on operational factors.

The railway crossing warrant was completed for the Canadian Pacific rail line that runs parallel to Highway 4 and intersects Highway 508 based on the opening day traffic conditions. Based on the cross product of the daily traffic volumes and the maximum number of trains expected to cross at this location, warning gates are warranted at the rail crossing on Highway 508. As previously stated, warning gates are also recommended to ensure the safety of vehicles what will queue beyond the railway crossing.

20-Year Post Development Traffic Conditions

The 20-year post development traffic conditions exhibited much the same results as the Opening Day traffic conditions. The new proposed intersection at the realigned site access with Highway 508 warrants a Type IV intersection treatment.

The west intersection of Highway 4/ Highway 508 will continue to operate at v/c ratio of 0.94 and LOS E. Based on TAC signal warrant analysis, a traffic signal is not warranted. However, some delays will be experienced at the intersection and as such it is likely that some non-captive traffic will shift to Highway 5 from Highway 4 to access the south end of the City of Lethbridge. With only a 5-10% shift in traffic from the eastbound movements at Highway 4 to the westbound movements at Highway 5, both intersections are expected to operate within acceptable capacity parameters. Again, even with the shift in traffic, the 95th percentile queue length is expected to extend across the CP railway tracks and as such causes a safety concern. Therefore, Bunt & Associates recommends that warning gates be installed at the railway crossing at the Opening Day to ensure safety of vehicles at this crossing.

Based on the road link analysis, all study area roadways are expected to operate within the environmental capacities for their specific road classification assuming the proposed access has been upgraded to a paved surface based on the Opening Day traffic conditions.

Once again, an illumination warrant was completed for the three study area intersections along Highway 508 and under opening day post development traffic conditions, all three intersections warrant delineated lighting based on operational factors.

The railway crossing warrant was again completed for the Canadian Pacific rail line that runs parallel to Highway 4 and intersects Highway 508 based on the opening day traffic conditions. Based on the cross product of the daily traffic volumes and the maximum number of trains expected to cross at this location, warning gates are warranted at the rail crossing on Highway 508. As previously stated, warning gates are recommended to ensure the safety of vehicles what will queue beyond the railway crossing.

Summary

The proposed Agri-Business Park is anticipated to add a significant amount of traffic to the surrounding road network resulting in road network improvements at each horizon year. With that said **Table E.1** summarizes the improvements required to accommodate the proposed site generated traffic volumes as discussed above.

Table E.1 Summary of Road Network Improvements

Horizon Year Traffic Conditions	Recommended Intersection Improvements				
	Highway 508/ Highway 4 (west intersection)	Highway 508/ Highway 4 (east intersection)	Highway 508/ Highway 5	Highway 508/ Site Access	Highway 508 CP Rail Crossing
Existing	• No intersection improvements required • Partial and/or delineated illumination is warranted	• No intersection improvements required • Partial and/or delineated illumination is warranted	• No improvements are required	• No improvements are required	• Flashing warning lights are warranted
20-Year Background	• No intersection improvements required • Partial and/or delineated illumination is warranted	• No intersection improvements required • Partial and/or delineated illumination is warranted	• No improvements are required	• No improvements are required	• Flashing warning lights are warranted
Opening Day Post Development	• Eastbound movement does not operate within acceptable capacity parameters; however a traffic signal is not warranted. • Traffic may utilize alternate route of Hwy 5 to avoid congestion at Hwy 4, thus a 5-10% shift in traffic will bring the intersection within acceptable parameters. • The queue length extends beyond the rail line and as such warning gates are to be implemented based on the warrant and for safety reasons. • Delineation illumination is warranted	• No intersection improvements required • Delineation illumination is warranted	• Westbound right turn lane required • Delineation illumination is warranted	• Type IV intersection treatment required • Westbound right turn lane required • Site access roadway requires a paved surface • Delineation illumination is warranted	• Rail Crossing Gates are warranted

Table E.1 Summary of Road Network Improvements – Continued

Horizon Year Traffic Conditions	Recommended Intersection Improvements				
	Highway 508/ Highway 4 (west intersection)	Highway 508/ Highway 4 (east intersection)	Highway 508/ Highway 5	Highway 508/ Site Access	Highway 508 CP Rail Crossing
20-Year Post Development	• Eastbound movement does not operate within acceptable capacity parameters; however a traffic signal is not warranted. • Traffic may utilize alternate route of Hwy 5 to avoid congestion at Hwy 4 and thus a 5-10% shift in traffic will bring the intersection within acceptable parameters. • The queue length extends beyond the rail line and as such warning gates are to be implemented based on the warrant and for safety reasons. • Delineation illumination is warranted	• No intersection improvements required • Delineation illumination is warranted	• Westbound right turn lane required • Delineation illumination is warranted	• Type IV intersection treatment required • Westbound right turn lane required • Site access roadway requires a paved surface • Delineation illumination is warranted	• Rail Crossing Gates are warranted

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1. INTRODUCTION

1.1 Background

Hasegawa Engineering is directing the development process for an Agri-Business Park located south of the City of Lethbridge in the northwest corner of the Highway 4/ Highway 508 intersection. The development consists of approximately 120 acres that will be developed as light to medium industrial land use servicing the agriculture and oilfield industries. Within the 120 acres of proposed development, approximately 10 acres is already developed with existing businesses in operation and as such the remaining 110 acres of undeveloped land will only be assessed as part of transportation analysis.

As part of the permit application process, the County of Lethbridge and Alberta Transportation (AT) required that a Transportation Impact Assessment (TIA) be completed in support of the development. The primary objective of the assessment was to confirm that the development could be supported by the existing infrastructure and to determine if any improvements are required. Bunt & Associates was retained by Hasegawa Engineering to determine the necessary roadway improvements required to incorporate the proposed development.

1.2 Study Objectives

The following scope of work for the assessment was agreed upon in discussion with Alberta Transportation:

- Conduct intersection capacity analysis for the AM and PM peak hour for the existing traffic conditions at the current access with Highway 508. The intersections of Highway 508 with both Highway 4 and Highway 5 will also be analyzed; however the traffic counts from Alberta Transportation's website will be utilized.
- Conduct intersection capacity analysis for the AM and PM peak hour for the 20-year horizon traffic conditions at the following intersections:
    - Highway 508/ Highway 4
    - Highway 508/ Highway 5
    - Highway 508/ Future Access
- Develop trip generation forecasts for the proposed development.
- Develop distribution patterns for the site based on a combination of review of the existing distribution of the on-site businesses, the anticipated market draw for the area as well as travel times completed on site.

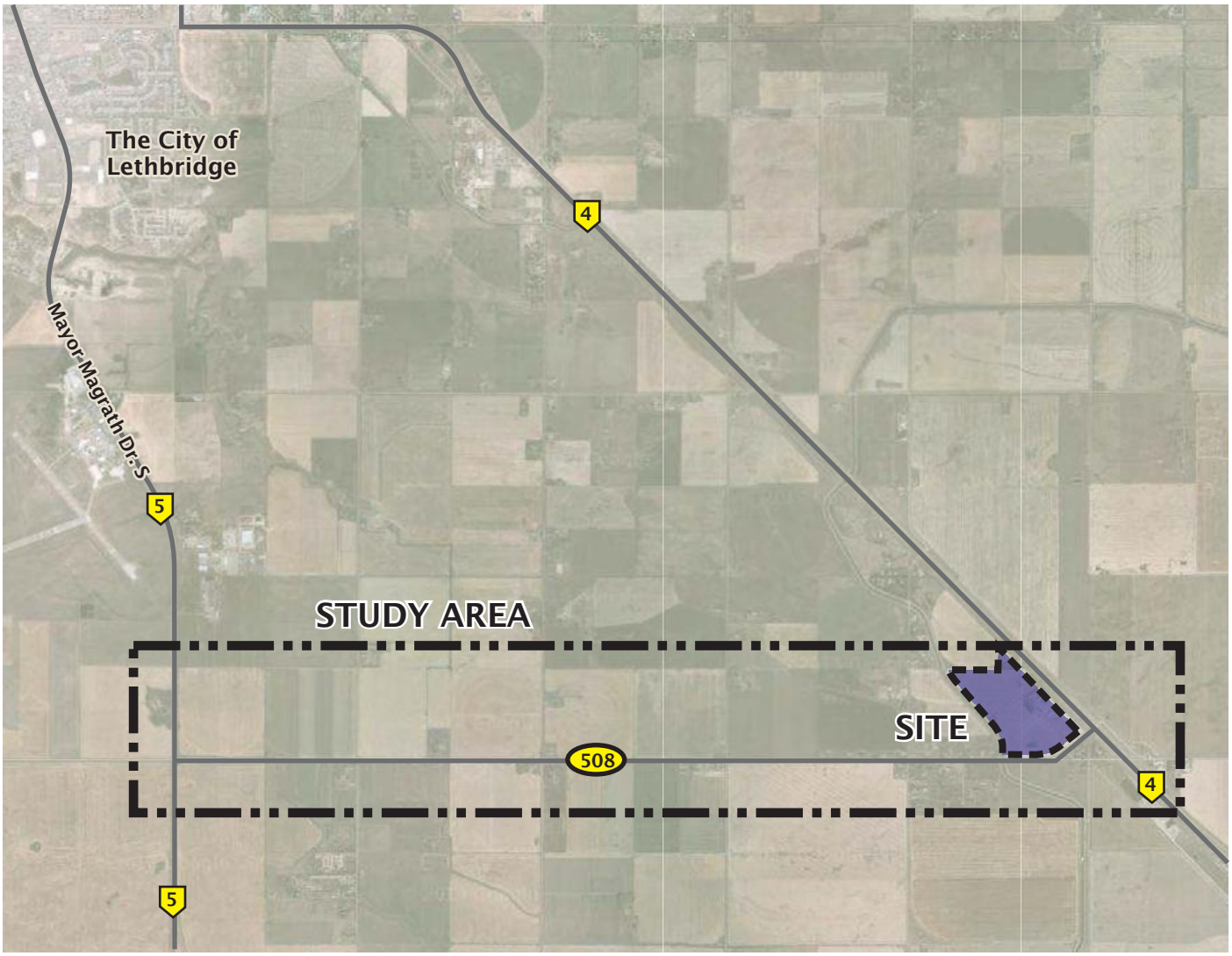
- Analyse the study area intersections to confirm operating conditions and the lane requirements for the existing, Opening Day and 20-year horizon post-development traffic conditions.
- Complete an illumination warrant for the intersections of Highway 508/ Highway 4 and Highway 508/ Highway 5 for the existing, Opening Day and 20-year horizons.
- Complete a railway crossing warrant for the intersection of Highway 508/ Highway 4 for the existing, Opening Day and 20-year horizons.
- Review daily traffic volumes on Highway 4, Highway 5 and Highway 508 for existing, Opening Day and 20-Year background and post development traffic conditions.

The approved scope and correspondence with Alberta Transportation is attached in **Appendix A.**

1.3 Subject Site Description

The proposed site is located west south of the City of Lethbridge on the west side of Highway 4 and north of Highway 508. The development includes approximately 120 acres of light to medium industrial uses, which are anticipated to service the agricultural and oilfield sectors. There is approximately 10 acres of land, which are already occupied by existing buildings and as such only 110 acres will be analyzed as part of the proposed future development.

The subject site and surrounding area is illustrated in **Exhibit 1.1.** Access to the site will be provided at one intersection along Highway 508. The proposed site plan is shown in **Exhibit 1.2.**



Base Map Source: Google Maps

Exhibit 1.1

Subject Site & Surrounding Area

Lethbridge Agri-Business Park
June 2014 Scale NTS

bunt & associates



Base Map Source: Hasegawa Consulting Professional Engineers

LEGEND

- EXISTING PROPERTY LINES
- PROPOSED LOTS
- FUTURE DEVELOPMENT

Exhibit 1.2

Proposed Site

Lethbridge Agri-Business Park
June 2014 Scale NTS

bunt & associates

2. EXISTING TRAFFIC CONDITIONS

2.1 Study Area Road Network

The adjacent road network within the vicinity of the subject site is as follows:

Highway 4 is a four-lane divided highway within the vicinity of the site, which runs in the north-south direction on the east side of the site. Highway 4 intersects with Highway 508 at an unsignalized intersection and exhibits left and right turn bays in both the north and south directions, thus exhibiting a Type IV intersection treatment. The posted speed limit is 110 km/hr. There is also a Canadian Pacific Railway line that runs adjacent to the highway within the vicinity of the site. Highway 4 within the vicinity of the site is currently carrying approximately 6,200 vehicles per day (vpd).

Highway 5 is a two lane undivided highway, which runs in the north-south direction. This road intersects with Highway 508 at an unsignalized intersection and exhibits a southbound left turn lane and a northbound right turn lane, which reflects a Type IV intersection treatment. The posted speed limit is 100 km/hr. Highway 5 is currently carrying approximately 5,400 vpd in the vicinity of the proposed site.

Highway 508 is a two-lane undivided highway, which runs in the east-west direction. The road provides a connection to the proposed site from both the east and the west side. The posted speed limit is 100 km/hr, with a speed reduction to 85 km/hr through the horizontal curve adjacent to the site and reduces further to 45 km/hr at the railway crossing. Highway 508 is currently carrying approximately 400 vpd within the vicinity of the proposed site.

Existing Access is a two-lane gravel local roadway, which runs in the north-south direction. The existing access is located on the horizontal curve located prior to the Highway 4 intersection and exhibits a Type I intersection treatment. Based on discussions with Alberta Transportation it was recommended that the access is moved further west along the tangent of the curve and as close to the canal as possible. As such, the client has relocated the access in the proposed plans for the future development.

The existing lane configurations and traffic control arrangements within the study area are summarized in **Exhibit 2.1.**

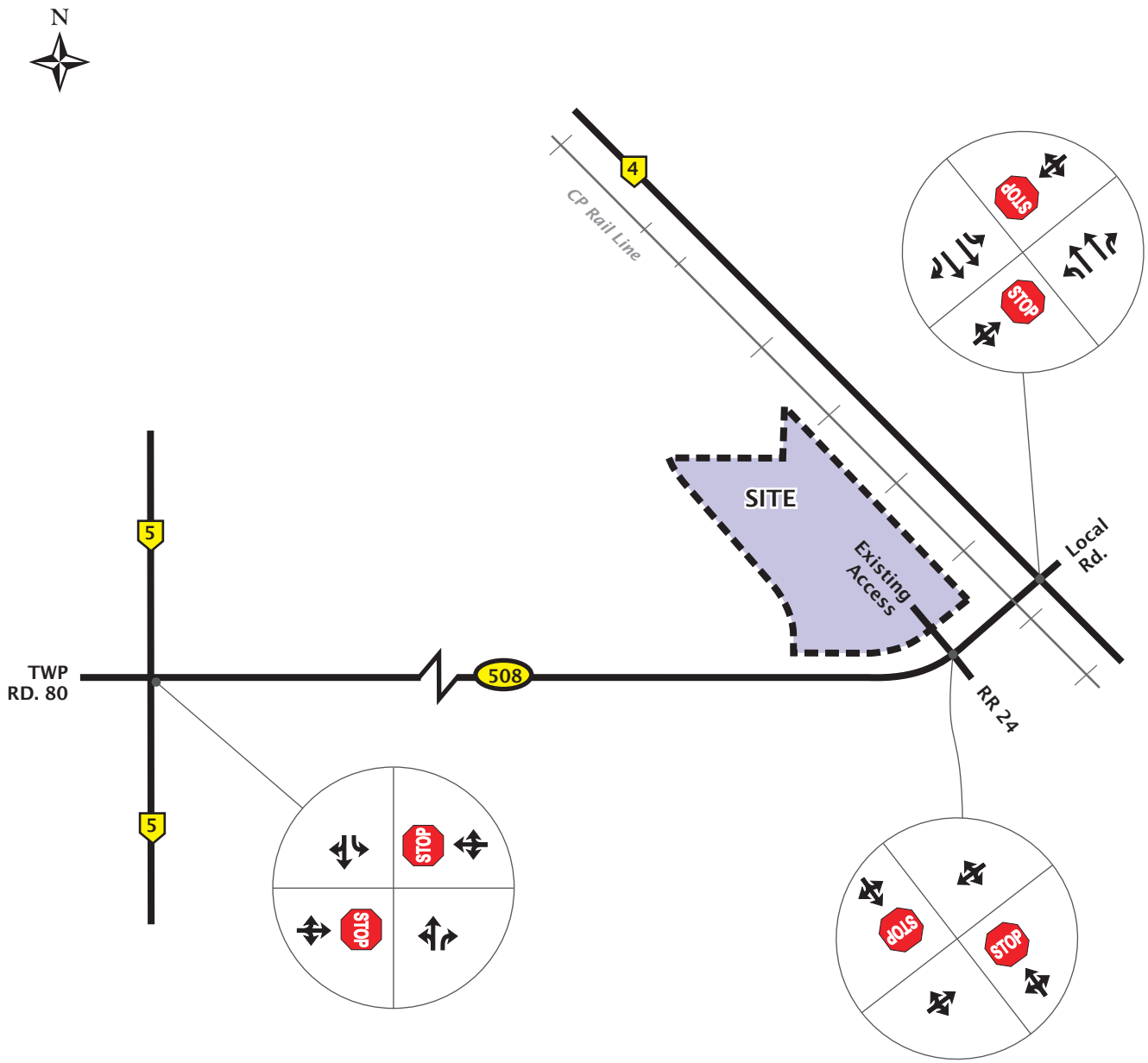


Exhibit 2.1

Existing Lane Configuration & Traffic Controls

Lethbridge Agri-Business Park
June 2014 Scale NTS

bunt & associates

2.2 Existing Traffic Volumes

2.2.1 Traffic Volumes

Bunt & Associates conducted obtained the traffic count information from the Alberta Transportation website for the intersections of Highway 508/ Highway 4 and Highway 508/ Highway 5. A manual intersection turning movement counts for both the AM and PM peak periods was completed at the Highway 508/ existing access intersection for the turning movements only on Tuesday, May 20th, 2014. The through volumes at the intersection were determined based on the traffic count at Highway 508/ Highway 4.

The existing turning movement volumes are shown in **Exhibit 2.2.** The raw count data is included in **Appendix B.**

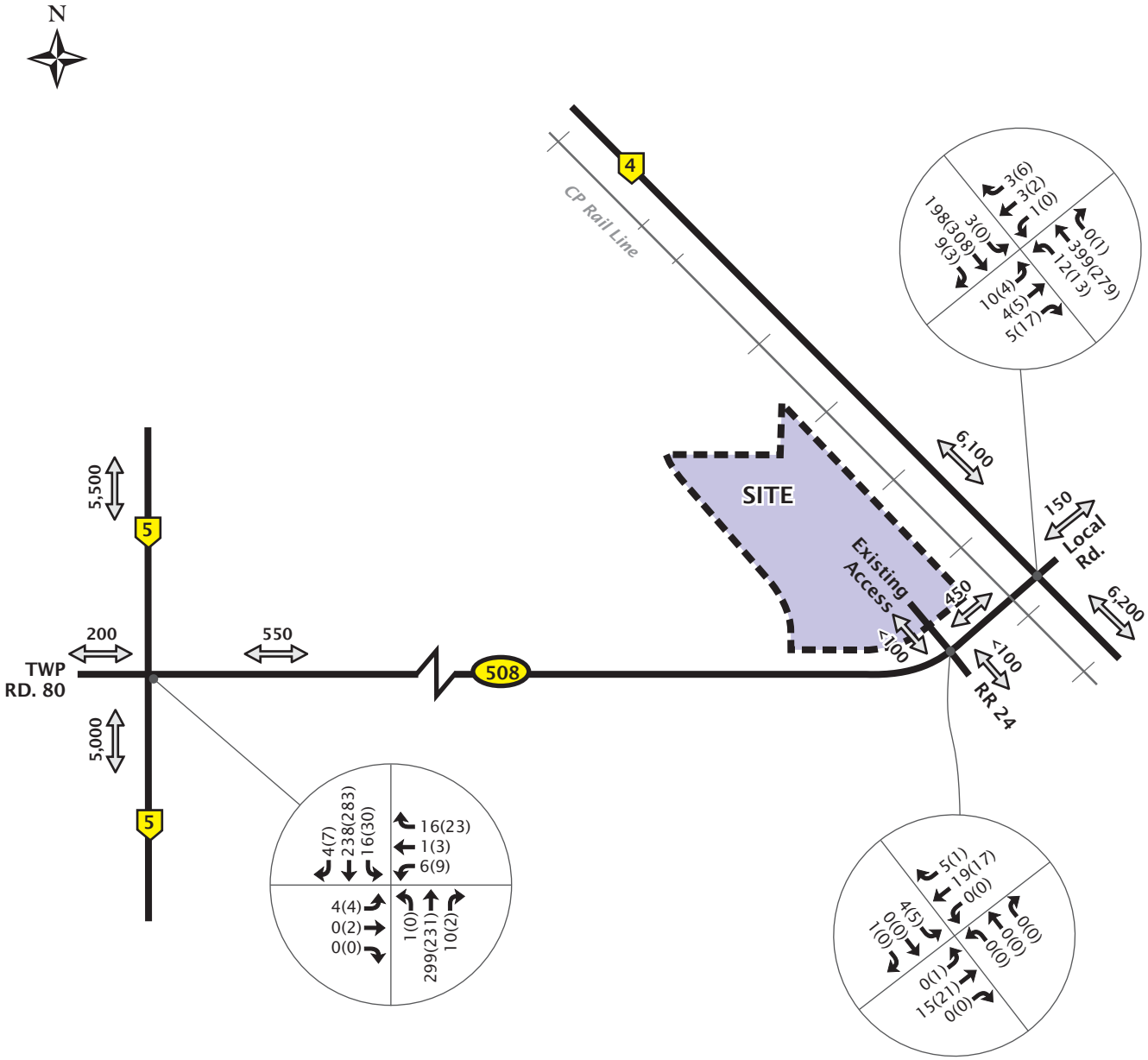
2.2.2 Intersection Capacity Analysis

To evaluate the existing traffic operation conditions during the peak hour periods, an intersection capacity analysis was undertaken for the study area intersections using Synchro 8.0, a traffic analysis software package based on the methods outlined in the Highway Capacity Manual.

Individual critical movements are assessed based on proportion of utilized capacity (a volume to capacity or v/c ratio) and on delay (the level of service or LOS). In general terms, a v/c of 0.90 or less is acceptable, as is a LOS of D or better, which represents optimized conditions. If the volume-to-capacity ratios are greater than 0.90 or the movements have LOS values of D, E or F, then intersection/road improvements may be warranted. With respect to delay, a Level of Service of "A" represents minimal delay, and a LOS of "F" represents significant delay to the critical movement.

The results for the existing intersection capacity analysis are summarized in **Table 2.1**; the existing lane configurations and traffic control arrangements were applied. Additionally, the analysis followed the methodologies and incorporated the traffic factors as outlined by the Alberta Transportation TIA Guidelines and Synchro parameters are based on the City of Lethbridge TIA Guidelines due to the close proximity to the City.

The Synchro output summaries are included in **Appendix C.**



LEGEND

↰ ↑ ↱	Vehicle Volumes
0,000	Daily Vehicle Volumes
XX	AM Peak
(YY)	PM Peak

Exhibit 2.2

Existing Traffic Volumes

Lethbridge Agri-Business Park
June 2014 Scale NTS

Table 2.1: Existing Intersection Capacity Analysis

Intersection	Movement	AM Peak				PM Peak			
		v/c	LOS	Delay (s)	Queue (m)	v/c	LOS	Delay (s)	Queue (m)
Highway 508/Highway 4 (west intersection)	EBT	0.02	B	10.2	0.6	0.02	B	10.2	0.6
	EBR	0.02	B	10.2	0.6	0.02	B	10.2	0.6
	WBL/T	0.03	B	10.6	0.7	0.03	B	11.5	0.7
	SBL	< 0.01	A	7.3	0.1	< 0.01	A	0.0	0.0
	SBT	0.07	A	0.0	0.0	0.10	A	0.0	0.0
	SBR	0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
Highway 508/Highway 4 (east intersection)	EBL/T	0.03	B	11.6	0.9	0.02	B	10.9	0.4
	WBT/R	0.01	B	11.5	0.3	0.01	A	9.8	0.3
	NBL	0.01	A	7.3	0.2	0.01	A	7.4	0.2
	NBT	0.13	A	0.0	0.0	0.09	A	0.0	0.0
	NBR	< 0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
Highway 508/Existing Access	EB	< 0.01	A	0.0	0.0	< 0.01	A	0.3	0.0
	WB	< 0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
	NB	< 0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
	SB	0.01	A	8.8	0.1	0.01	A	8.9	0.1
Highway 508/Highway 5	EB	0.01	C	15.3	0.3	0.02	C	15.5	0.5
	WB	0.05	B	11.9	1.2	0.07	B	11.9	1.8
	NBL/T	< 0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
	NBR	0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
	SBL	0.02	A	8.1	0.4	0.03	A	7.9	0.6
	SBT/R	0.16	A	0.0	0.0	0.19	A	0.0	0.0

As shown in Table 2.1, the results indicated that all study area intersections are currently operating within acceptable capacity parameters, therefore no improvements are required to accommodate the existing traffic volumes.

2.2.3 Illumination Warrant

Bunt & Associates undertook an illumination warrant for the three existing intersections based on the Transportation Association of Canada (TAC) methodology for Illumination of Isolated Rural Intersections[1]. The illumination warrant review the geometric, operational, environmental and collision factors for the study area intersections. Illumination is warranted based on the following criteria:

- Total Points ≥ 240 points: Full illumination is warranted
- 120 ≤ Total Points < 240: Partial and/or delineation lighting warranted:
    - if Geometric Factors Subtotal ≥ 80 points: partial lighting to illuminate key decision areas, potential conflict points, and/or hazards,
    - if Operational Factors Subtotal ≥ 120 points: delineation lighting to illuminate pedestrians or cross street traffic,
    - if Collision History Subtotal = 120 points: review collisions to determine appropriate lighting strategy.
- < 120 Points: Illumination is not warranted

Based on Bunt & Associates site visit along with traffic data and collision data from Alberta Transportation, the illumination warrants were completed based on the above criteria.

Highway 508/ Highway 4

Based on the illumination warrant under existing traffic conditions, the intersection of Highway 508/ Highway 4 scored 156 points. As a result, the intersection warrants partial and/or delineation lighting; however the individual criteria for geometric, operational and collision history are not met to determine whether partial and/or delineated lighting is warranted. As such, it is recommended that the intersection is reviewed and that partial and/or delineated lighting is implemented.

Highway 508/ Highway 5

Based on the illumination warrant under existing traffic conditions, the intersection of Highway 508/ Highway 4 scored 131 points. As a result, the intersection warrants partial and/or delineation lighting; however the individual criteria for geometric, operational and collision history are not met to determine whether partial and/or delineated lighting is warranted. As such, it is recommended that the intersection is reviewed and that either partial and/or delineated lighting is implemented.

[1] Illumination of Isolated Rural Intersections, Transportation Association of Canada (TAC), February 2001.

Highway 508/ Existing Access

Based on the illumination warrant under existing traffic conditions, the intersection of Highway 508/ Highway 4 scored 46 points. As a result, no illumination is warranted at the intersection.

The illumination warrant summaries are included in **Appendix D.**

2.2.4 Rail Crossing Warrant

The Canadian Pacific (CP) Railway has a line that runs adjacent to Highway 4 on the west side. Based on information obtained from CP, this rail line is considered to be a part of the main line, which has unscheduled traffic but has an estimated frequency of 3 to 8 fright trains per 24-hour period and can be expected any time during the day or night. A typical train is 125 railcars in length with 2-4 engines and operates at a speed of 55 km/h (35mph) along this section of track.

Rail/road crossings are classified as either grade-separated or at-grade; and at-grade rail/road crossings can be further classified into two separate categories, passive or active. A review of the existing conditions confirmed that the Highway 508 at-grade rail/road crossings exhibit passive control (i.e., no warning signal or gate arms).

A review of Transport Canada's[2] requirements for rail crossings determines that lights are required at a rail crossing when the forecast cross product[3] is 1,000 or more and gates are required when the forecast cross product is 50,000 or more. The cross product for the crossing at Highway 508 is 3,600[4], therefore, warning lights are warranted as the cross product is greater than 1,000 based on existing conditions at the Highway 508 crossing.

2.2.5 Stopping Sight Distance

Bunt & Associates completed a stopping sight distance (SSD) review based on Alberta Transportation's Highway Geometric Design Guide. The minimum stopping sight distance is the length of roadway ahead visible to the driver. The minimum sight distance available on a roadway should allow a vehicle to stop prior to reaching a fixed object such as a stop sign when travelling at an assumed speed, which is based on the design speed of the roadway.

[2] RTD 10 Road/Railway Grade Crossings Technical Standards and Inspection, Testing and Maintenance Requirements, Transport Canada, March 2002.
[3] Forecast cross product = number of trains per day * daily traffic volume on the roadway
[4] The cross product was calculated on the maximum number of expected trains per day (8 trains per day) to utilize the most conservative estimate.

Highway 4

The posted speed limit on Highway 4 is 110 km/hr and as such the design speed is likely 120 km/hr, which requires a minimum SSD of 270 metres. Based on Bunt & Associates site visit, the minimum stopping sight distance was observed at greater than 500 metres in both the north and south directions at the intersection with Highway 508. As such, the minimum stopping sight distance is achieved and therefore no improvements are required at this time.

Highway 508

The posted speed limit on Highway 508 as it approaches is 45 km/h due to the railway crossing which, is approximately 35-40 metres from the intersection with Highway 4. Based on a design speed of 50-60 km/hr, the minimum SSD is 65-85 metres. Based on Bunt & Associates site visit, the minimum stopping sight distance was observed at greater than 100 metres in the eastbound direction at the intersection with Highway 4. As such, the minimum stopping sight distance is achieved and therefore no improvements are required at this time.

The posted speed limit on Highway 508 in the vicinity of Highway 5 is 100 km/hr and as such the design speed is likely 110 km/hr which requires a minimum SSD of 235 metres. Based on Bunt & Associates site visit, the minimum stopping sight distance was observed at greater than 500 metres in both the east and west directions at the intersection with Highway 5. As such, the minimum stopping sight distance is achieved and therefore no improvements are required at this time.

The intersection of Highway 508 at the existing access has a posted speed limit of 85km/hr due to the horizontal curve within the vicinity of the access location. The minimum SSD for a design speed of 90-100km/hr which is typical for a 85km/h posted speed limit is 170 – 200 metres. Again, based on Bunt & Associates site visit, the minimum stopping sight distance was observed at greater than 200 metres in both the east and west directions at the intersection of Highway 508 and the existing access. As such, the minimum stopping sight distance is achieved and therefore no improvements are required at this time.

Highway 5

The posted speed limit on Highway 5 is 100 km/hr and as such the design speed is likely 110 km/hr., which requires a minimum SSD of 235 metres. Based on Bunt & Associates site visit, the minimum stopping sight distance was observed at greater than 500 metres in both the north and south directions at the intersection with Highway 508. As such, the minimum stopping sight distance is achieved and therefore no improvements are required at this time.

2.2.6 Road Link Analysis

The existing link volumes were assessed based on typical Alberta Transportation highway standards. In general terms, this analysis was intended to assess the daily traffic volumes on all germane roadway links in the study area and to confirm the current roadway classification and/or identify any need for reclassification based solely on existing traffic. The results of the assessment are summarized in **Table 2.2**.

Table 2.2: Existing Road Link Analysis

Road Link	Road Classification	Recommended Daily Traffic Volume (vehicles per day)	Existing Daily Traffic Volume[5] (vehicles per day)
Highway 4	4-lane Primary Highway	> 12,000	6,200
Highway 508	2-lane Secondary Highway	< 12,000	450 - 550
Highway 5	2-lane Primary Highway	< 12,000	5,500
Existing Access	Rural Local Road (gravel)	< 500	< 100

Based on the road link analysis, all of the road links within the vicinity of the site are within the recommended daily traffic volume design guidelines for the various classifications of roadways.

[5] Traffic volumes are rounded to the nearest 100 for volumes greater than 1,000 vpd and to the nearest 10 for volumes less than 1,000vpd.

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3. 20-YEAR BACKGROUND TRAFFIC CONDITIONS

3.1 Study Area Road Network

The adjacent road network within the vicinity of the subject site at the 20-Year horizon is anticipated to remain the same as under existing conditions with the exception of the proposed access shifting to the west as previously discussed.

3.2 20-Year Horizon Traffic Volumes

3.2.1 Forecast Traffic Volumes

Bunt & Associates determined the 20-year target forecast traffic volumes based on the highway growth that has occurred over the last 5 years based on the traffic counts from the AT website. Based on that information, Highway 4 has an average of 2.01% yearly growth over the last five years and thus a 2% yearly linear growth rate was applied. Hwy 5 yearly data only increased in 2012 over the last five years when an update count was completed and as such had a large increase of roughly 13% with no growth in the other previous years. As such an average of 3.44% was found over the last five years. Therefore a linear growth rate of 3.5% was applied on Highway 5. It should be noted that this growth rate is higher than the typical growth rate that Alberta Transportation applies (2.5% is typical) on most highways and ambient traffic likely cannot increase as much as 3.5%; however since this is the observed increase Bunt & Associates chose to use the 3.5% and thus through traffic on Highway 5 is likely on the conservative side. Highway 508 showed a yearly growth rate of 0.46% over the last year; however Bunt feels it is prudent to utilize a more conservative growth rate of 2% per year on Highway 508.

The 20-year horizon forecast background traffic turning movement volumes are shown in **Exhibit 3.1**. The background traffic growth calculations are included in **Appendix E**.

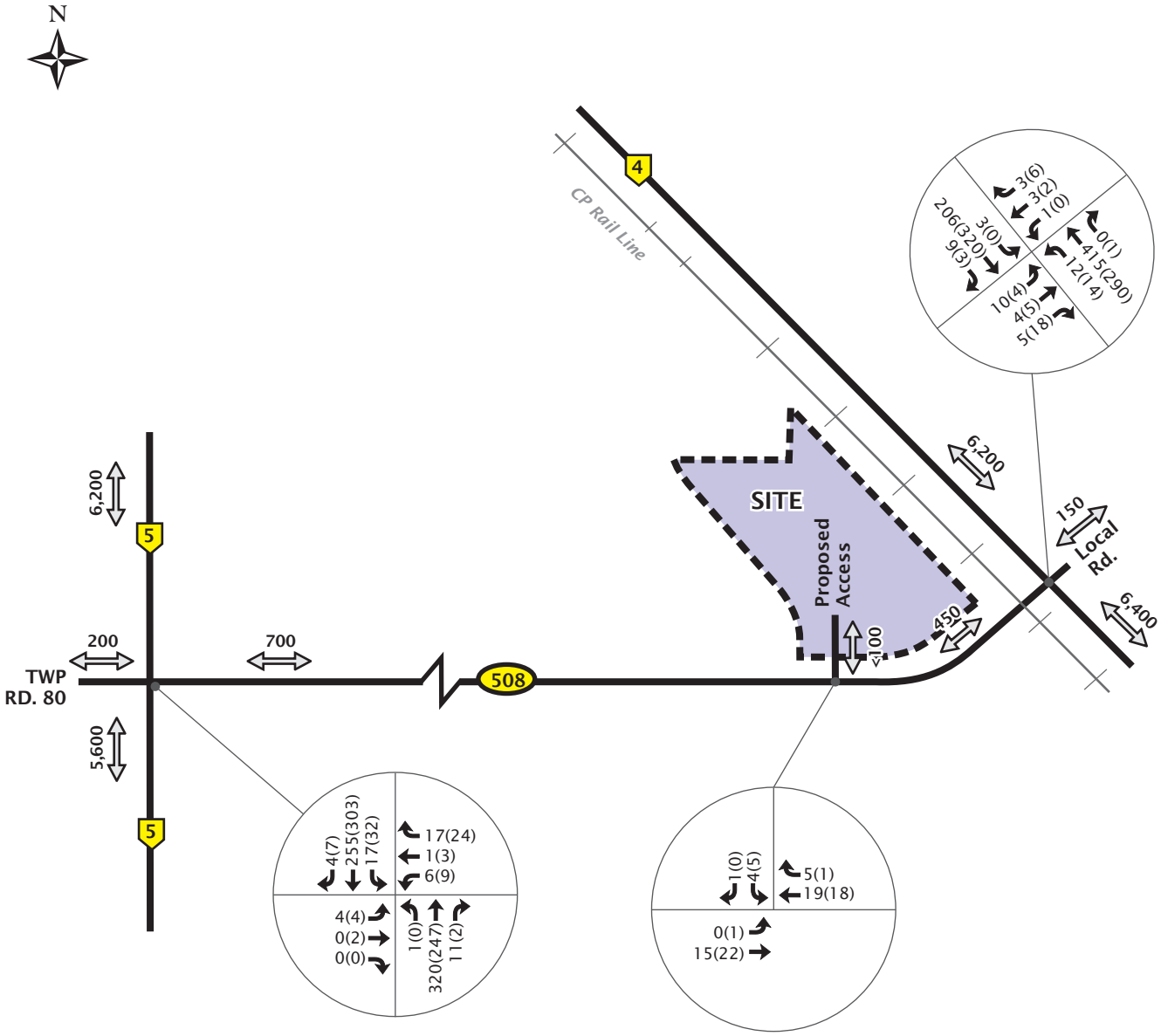
3.2.2 Intersection Treatment Type

The Alberta Transportation Intersection Treatment type was determined for Highway 508 at both the realigned proposed site access and at Highway 5.

Highway 508 at Realigned Proposed Site Access

Left Turn Lane Warrant

Based on the Alberta Transportation Highway Geometric Design Guide, the warrant for left turns lanes on a two-lane highway determines the intersection treatment type that should be applied.



LEGEND

↰ ↑ ↱	Vehicle Volumes
0,000	Daily Vehicle Volumes
XX	AM Peak
(YY)	PM Peak

Exhibit 3.1

20 Year Background Traffic Volumes

Lethbridge Agri-Business Park
June 2014 Scale NTS

Utilizing the 20-year background traffic volumes at the intersection of Highway 508 and the realigned proposed site access, the PM peak hour traffic volumes are the worst case scenario and as such were the traffic volumes used for this analysis. The volume of left turn vehicles is 1 vph, the approaching volume is 23 vph, resulting in 4% left turn vehicles in the approaching volume and the opposing traffic is 19 vph. Based on D-7.6-7a with a design speed of 110 km/hr on Highway 508, a Type I intersection is warranted.

Right Turn Lane Warrant

An exclusive right turn lane is warranted when all of the following criteria are met:

- Main (or through) road AADT ≥ 1800
- Intersecting road AADT ≥ 900, and
- Right turn daily traffic volume ≥ 360 for the movement in question

Based on the above criteria a right turn lane is not warranted for the westbound direction as the main road AADT is 450 vpd, the intersecting road AADT is less than 100 and the right turn lane volume is 10 vpd.

Highway 508 at Highway 5

Left Turn Lane Warrant

Utilizing the 20-year background traffic volumes on Highway 508 at the intersection with Highway 5, the AM peak hour traffic volumes are the worst case scenario and as such were the traffic volumes used for this analysis. The volume of left turn vehicles is 6 vph, the approaching volume is 24 vph, resulting in 25% left turn vehicles in the approaching volume and the opposing traffic is 4 vph. Based on D-7.6-7c with a design speed of 110 km/hr on Highway 508, a Type I intersection is warranted.

Right Turn Lane Warrant

Based on the right turn lane warrant stated earlier, a right turn lane is not warranted for the westbound direction on Highway 508 at Highway 5 as the main road AADT is 6,200 vpd, the intersecting road AADT is 700 vpd and the right turn lane volume is 240 vpd.

3.2.3 Intersection Capacity Analysis

To evaluate the 20-year horizon total background traffic operation conditions during the peak hour periods, an intersection capacity analysis was undertaken for the study area intersections using Synchro 8.0, a traffic analysis software package based on the methods outlined in the Highway Capacity Manual.

The results for the 20-year horizon background intersection capacity analysis are summarized in **Table 3.1**. The analysis was based on the existing intersection lane configurations with the shifted access point and traffic controls. Additionally, the analysis followed the methodologies and incorporated the traffic factors as outlined by the Alberta Transportation TIA Guidelines and Synchro parameters are based on the City of Lethbridge TIA Guidelines due to the close proximity to the City.

The Synchro output summaries are included in **Appendix C.**

Table 3.1: 20-Year Total Background Intersection Capacity Analysis

Intersection	Movement	AM Peak				PM Peak			
		v/c	LOS	Delay (s)	Queue (m)	v/c	LOS	Delay (s)	Queue (m)
Highway 508/Highway 4 (west intersection)	EBT	0.02	B	10.2	0.6	0.02	B	10.2	0.6
	EBR	0.02	B	10.2	0.6	0.02	B	10.2	0.6
	WBL/T	0.03	B	10.7	0.7	0.03	B	11.6	0.8
	SBL	< 0.01	A	7.3	0.1	< 0.01	A	0.0	0.0
	SBT	0.07	A	0.0	0.0	0.11	A	0.0	0.0
	SBR	0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
Highway 508/Highway 4 (east intersection)	EBL/T	0.03	B	11.7	0.9	0.02	B	11.0	0.4
	WBT/R	0.01	B	11.6	0.3	0.01	A	9.8	0.3
	NBL	0.01	A	7.3	0.2	0.01	A	7.4	0.3
	NBT	0.14	A	0.0	0.0	0.10	A	0.0	0.0
	NBR	< 0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
Highway 508/ Future Realigned Access	EB	< 0.01	A	0.0	0.0	< 0.01	A	0.3	0.0
	WB	0.02	A	0.0	0.0	0.01	A	0.0	0.0
	SB	0.01	A	8.8	0.1	0.01	A	8.9	0.1
Highway 508/Highway 5	EB	0.01	C	16.1	0.3	0.02	C	16.3	0.5
	WB	0.05	B	12.2	1.3	0.08	B	12.2	2.0
	NBL/T	< 0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
	NBR	0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
	SBL	0.02	A	8.2	0.4	0.03	A	7.9	0.7
	SBT/R	0.17	A	0.0	0.0	0.21	A	0.0	0.0

As shown in Table 3.1, the results indicated that all study area intersections continue to operate within acceptable capacity parameters based on the increase in traffic for the 20-year background traffic volumes; as such no improvements are required to accommodate the 20-year background traffic volumes.

3.2.4 Illumination Warrant

Once again, Bunt & Associates undertook an illumination warrant for the three existing intersections based on the Transportation Association of Canada (TAC) methodology for Illumination of Isolated Rural Intersections[6] utilizing the 20-year background traffic volumes. The illumination warrant again reviewed the geometric, operational, environmental and collision factors for the study area intersections.

Highway 508/ Highway 4

Based on the illumination warrant under 20-year background traffic conditions, the intersection of Highway 508/ Highway 4 continued to score 156 points based on the 20-year background traffic volumes. One again as a result, the intersection warrants partial and/or delineation lighting; however the individual criteria for geometric, operational and collision history are not met to determine whether partial and/or delineated lighting is warranted. As such, it is recommended that the intersection is reviewed and that partial and/or delineated lighting is implemented.

Highway 508/ Highway 5

Based on the illumination warrant under 20-year background traffic conditions, the intersection of Highway 508/ Highway 4 continues to score 131 points based on the 20-year background traffic volumes. Once again as a result, the intersection warrants partial and/or delineation lighting; however the individual criteria for geometric, operational and collision history are not met to determine whether partial and/or delineated lighting is warranted. As such, it is recommended that the intersection is reviewed and that partial and/or delineated lighting is implemented.

Highway 508/ Existing Access

Based on the illumination warrant under 20-year background traffic conditions, the intersection of Highway 508/ Highway 4 scored 46 points based on the 20-year background traffic volumes. As a result, no illumination is warranted at the intersection.

The 20-year background traffic illumination warrant summaries are included in **Appendix D.**

3.2.5 Rail Crossing Warrant

The rail crossing warrant was once again completed based on the 20-year background traffic volumes. Again, Transport Canada's[7] requirements for rail crossings determines that lights are required at a rail crossing when the forecast cross-product[8] is 1,000 or more and gates are required when the forecast cross product is 50,000 or more. The cross product for the crossing at Highway 508 remains at 3,600[9] based on

[6] Illumination of Isolated Rural Intersections, Transportation Association of Canada (TAC), February 2001.
[7] RTD 10 Road/Railway Grade Crossings Technical Standards and Inspection, Testing and Maintenance Requirements, Transport Canada, March 2002.
[8] Forecast cross product = number of trains per day * daily traffic volume on the roadway
[9] The cross product was calculated on the maximum number of expected trains per day (8 trains per day) to utilize the most conservative estimate.

the 20-year background traffic volumes, thus once again warning lights continue to be warranted as the cross product remains greater than 1,000 based on the 20-year background traffic conditions at the Highway 508 crossing.

3.2.6 Road Link Analysis

The 20-year background link volumes were assessed based on typical Alberta Transportation highway standards. In general terms, this analysis was intended to assess the daily traffic volumes on all germane roadway links in the study area and to confirm the current roadway classification and/or identify any need for reclassification based solely on background traffic. The results of the assessment are summarized in **Table 3.2** and also illustrated previously on Exhibit 3.1.

Table 3.2: 20-Year Background Road Link Analysis

Road Link	Road Classification	Recommended Daily Traffic Volume (vehicles per day)	20-Year Background Daily Traffic Volume[10] (vehicles per day)
Highway 4	4-lane Primary Highway	> 12,000	6,400
Highway 508	2-lane Secondary Highway	< 12,000	450 – 700
Highway 5	2-lane Primary Highway	< 12,000	6,200
Re-aligned Access	Rural Local Road (gravel)	< 500	< 100

Based on the road link analysis, all of the road links within the vicinity of the site are within the recommended daily traffic volume design guidelines for the various classifications of roadways.

[10] For the purpose of this study, the daily traffic volumes estimates were based on ten times the PM peak hour volumes. Again rounding took place as under existing traffic conditions.

4. SITE TRAFFIC VOLUMES

4.1 Proposed Land Use

The proposed development concept is expected to contain approximately 120 acres that will be developed as light to medium industrial land use servicing the agriculture and oilfield industries. Within the 120 acres of proposed development, approximately 10 acres is already developed with existing businesses in operation and as such the remaining 110 acres of undeveloped land will only be assessed as part of the transportation analysis.

The development will have one access location as previously discussed; the existing access will be shifted to the west along the tangent on the curve closer to the canal crossing.

4.2 Site Traffic Generation

The trip generation rates used in this study were sourced from the Institute of Transportation Engineers (ITE) Trip Generation Handbook, 8th Edition Land Use Code 110, General Light Industrial. The AM Peak hour trip rate utilized was 7.51 trips / acre (83% inbound/ 17% outbound) while the PM peak hour rate utilized was 7.26 trips / acre (22% inbound/ 78% outbound).

The selected trip generation rates were applied to the proposed land use, and the results of trip generation calculations are summarized in **Table 4.1**.

Table 4.1: Peak Hour Site Traffic Generation

Land Use	Size	Trip Generation Rate	Inbound Trips	Outbound Trips	Total Trips
AM Peak Hour					
General Light Industrial	110.4 acres	7.51 trips/acre	688	141	829
PM Peak Hour					
General Light Industrial	110.4 acres	7.26 trips/acre	176	626	802

4.3 Site Traffic Distribution

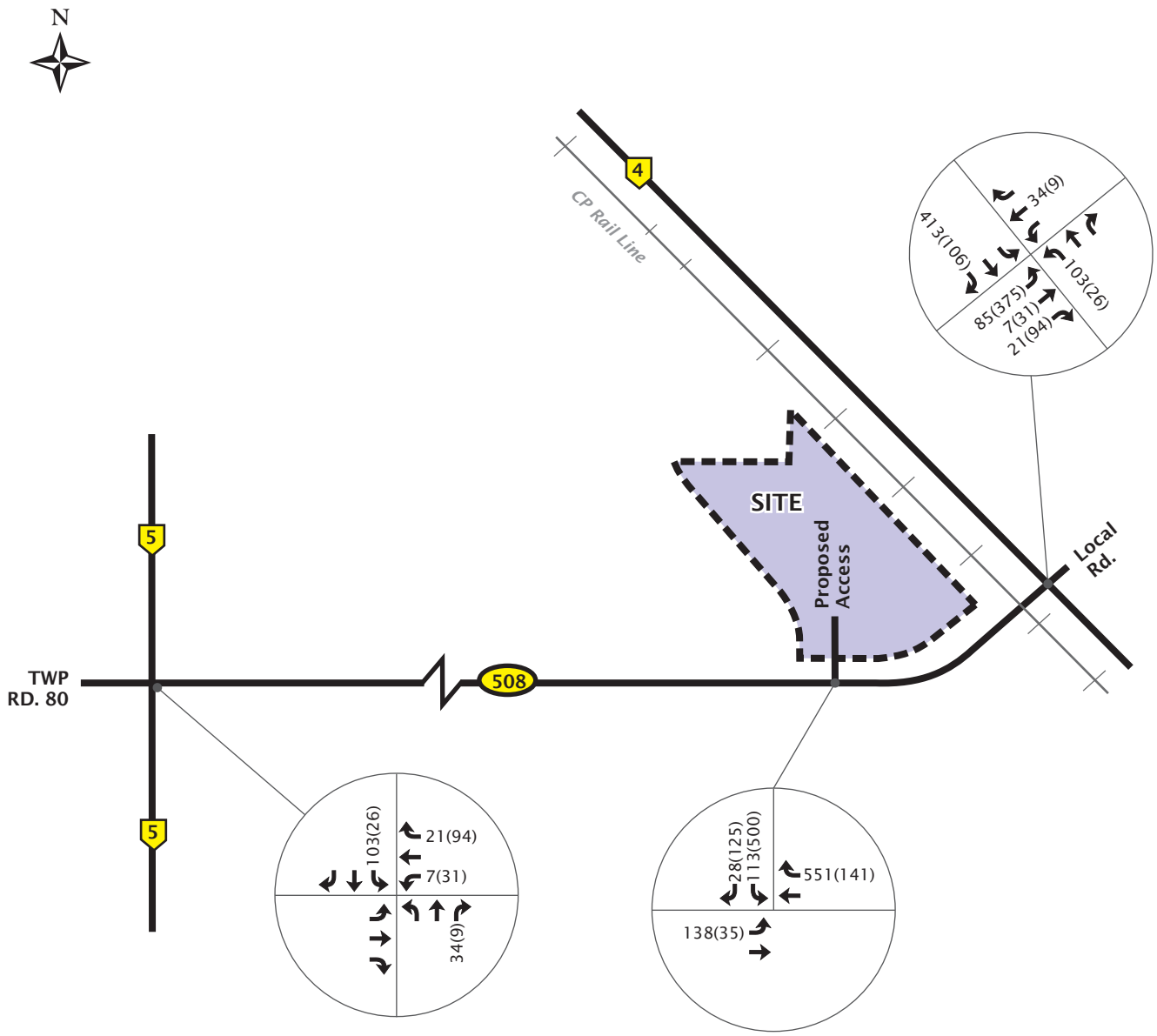
The site traffic trip distribution was based on several factors. Based on the existing traffic count for the few businesses on site, the majority of traffic is coming from the north on Hwy 4, traffic coming from Hwy 5 and from the south on Hwy 4 is about the same and a small portion is coming from the east. With that said, the client has stated that employees will likely come from south Lethbridge and customers will likely come from outside of Lethbridge and/or have interactions with the industrial area. Bunt & Associates also completed time trials during the site visit and from the proposed site to the intersection of Mayor Magrath Drive and 24th Avenue S, which is common point in the south part of Lethbridge, it is faster to take Hwy 4 to this location versus Hwy 5 by approximately 3 minutes.

Based on a combination of these factors and in Bunt & Associates experience, the site traffic distribution is shown in **Table 4.2.**

Table 4.2: Site Traffic Distribution

Direction	Distribution
To/from the north on Highway 4	60%
To/from the south on Highway 4	15%
To/from the west on Highway 5 via Highway 5 North	15%
To/from the west on Highway 5 via Highway 5 South	5%
To/from the east Hn highway 508	5%
Total	**100%**

The resulting site generated traffic volumes are illustrated in **Exhibit 4.1.**



LEGEND

↰ ↑ ↱	Vehicle Volumes
XX	AM Peak
(YY)	PM Peak

Exhibit 4.1

Site Generated Traffic Volumes

Lethbridge Agri-Business Park
June 2014 Scale NTS

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5. POST DEVELOPMENT TRAFFIC CONDITIONS

The post development traffic volumes were developed by adding the site generated traffic to both the existing traffic and 20-year background traffic volumes.

5.1 Opening Day Post Development Conditions

The Opening Day post development traffic volumes were developed by adding the site generated traffic volumes to the existing traffic volumes. The Opening Day Post Development traffic volumes are illustrated in **Exhibit 5.1**

5.1.1 Intersection Treatment Type

The Alberta Transportation Intersection Treatment type was determined on Highway 508 at both the realigned proposed site access and at Highway 5 based on the Opening Day post development traffic volumes.

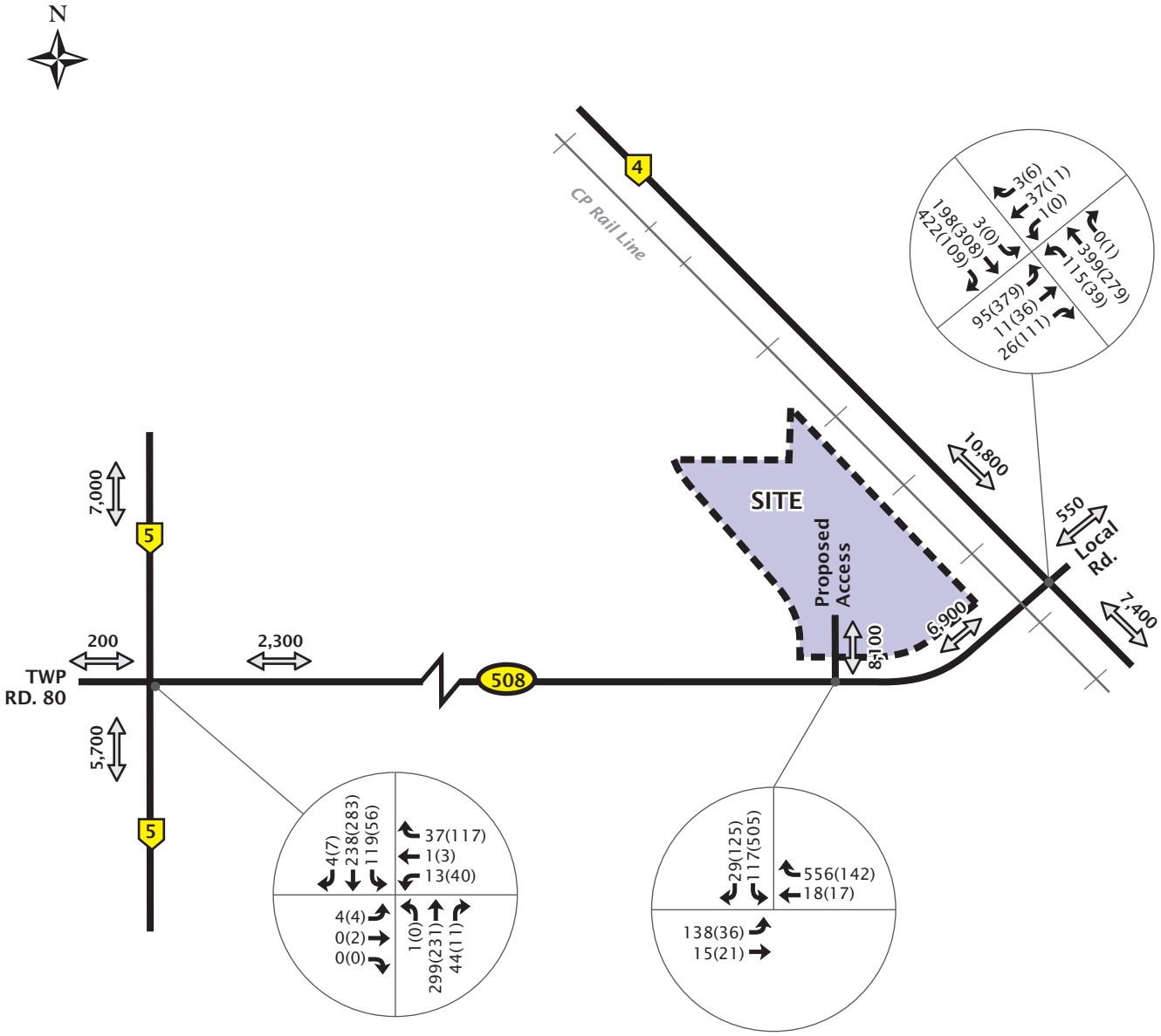
Highway 508 at Realigned Proposed Site Access

Left Turn Lane Warrant

Utilizing the Opening Day post development traffic volumes at the intersection of Highway 508 and the realigned proposed site access, the AM peak hour traffic volumes are the worst case scenario and as such were the traffic volumes used for this analysis. The volume of left turn vehicles is 138 vph, the approaching volume is 153 vph, resulting in 90% left turn vehicles in the approaching volume and the opposing traffic is 574 vph. Based on D-7.6-7d (the highest left turn lane volume graph is for 40%) with a design speed of 110 km/hr on Highway 508, a Type IV intersection is warranted.

Right Turn Lane Warrant

Based on the right turn lane warrant stated earlier, a right turn lane is warranted for the westbound direction on Highway 508 at the realigned proposed site access because the main road AADT is 6,900 vpd, the intersecting road AADT is 8,100 vpd and the right turn lane volume is 1,420 vpd.



LEGEND

↰ ↑ ↱	Vehicle Volumes
0,000	Daily Vehicle Volumes
XX	AM Peak
(YY)	PM Peak

Exhibit 5.1

Opening Day Post Development Traffic Volumes

Lethbridge Agri-Business Park
June 2014 Scale NTS

bunt & associates

Highway 508 at Highway 5

Left Turn Lane Warrant

Utilizing the Opening Day post development traffic volumes on Highway 508 at the intersection with Highway 5, the PM peak hour traffic volumes are the worst case scenario and as such were the traffic volumes used for this analysis. The volume of left turn vehicles is 40 vph, the approaching volume is 160 vph, resulting in 25% left turn vehicles in the approaching volume and the opposing traffic is 6 vph. Based on D-7.6-7c with a design speed of 110 km/hr on Highway 508, a Type I intersection is warranted.

Right Turn Lane Warrant

Based on the right turn lane warrant stated earlier, a right turn lane is warranted for the westbound direction on Highway 508 at Highway 5 as the main road AADT is 7,000 vpd, the intersecting road AADT is 2,300 vpd and the right turn lane volume is 1,170 vpd.

5.1.2 Intersection Capacity Analysis

The Synchro 8.0 software package was used to assess the study area intersections based on the Opening Day post development traffic conditions. The Opening Day post development traffic analysis was completed assuming the existing lane arrangements with the realignment of the proposed access as previously discussed along with the intersection treatment types determined above and the existing traffic controls. The intersection capacity results for the Opening Day post development traffic conditions are summarized in **Table 5.1.** The Synchro outputs are attached in Appendix C**.**

Table 5.1: Opening Day Post Development Intersection Capacity Analysis

Intersection	Movement	AM Peak				PM Peak			
		v/c	LOS	Delay (s)	Queue (m)	v/c	LOS	Delay (s)	Queue (m)
Highway 508/Highway 4 (west intersection)	EBT	0.18	B	11.2	5.3	**0.93**	**E**	**45.5**	**99.0**
	EBR	0.18	B	11.2	5.3	**0.93**	**E**	**45.5**	**99.0**
	WBL/T	0.50	C	24.9	21.1	0.12	B	13.4	3.1
	SBL	< 0.01	A	7.3	0.1	< 0.01	A	0.0	0.0
	SBT	0.07	A	0.0	0.0	0.10	A	0.0	0.0
	SBR	0.28	A	0.0	0.0	0.07	A	0.0	0.0
Highway 508/Highway 4 (east intersection)	EBL/T	0.34	C	20.2	12.0	**0.76**	**D**	**26.9**	**55.6**
	WBT/R	0.14	C	17.5	3.8	0.03	B	11.2	0.8
	NBL	0.08	A	7.5	2.2	0.03	A	7.4	0.7
	NBT	0.13	A	0.0	0.0	0.09	A	0.0	0.0
	NBR	< 0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
Highway 508/ Future Realigned Access	EBL	0.17	A	9.7	4.9	0.03	A	7.7	0.7
	EBT	0.01	A	0.0	0.0	0.01	A	0.0	0.0
	WBT	0.01	A	0.0	0.0	0.01	A	0.0	0.0
	WBR	0.37	A	0.0	0.0	0.09	A	0.0	0.0
	SB	0.29	B	13.7	13.7	**0.83**	**D**	**26.1**	**77.4**
Highway 508/Highway 5	EB	0.02	C	21.8	0.5	0.03	C	18.7	0.6
	WBL/T	0.07	B	13.5	1.7	0.17	B	12.5	5.0
	WBR	0.07	B	13.5	1.7	0.17	B	12.5	5.0
	NBL/T	< 0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
	NBR	0.03	A	0.0	0.0	0.01	A	0.0	0.0
	SBL	0.12	A	8.6	3.2	0.05	A	8.0	1.3
	SBT/R	0.16	A	0.0	0.0	0.19	A	0.0	0.0

As can be seen in the Table 5.1, with the addition of site generated traffic from the proposed development, the west intersection of Highway 4/ Highway 508 experiences LOS E and v/c ratio of 0.93 during the PM peak hour. Due to the location of this intersection, it is unlikely that a traffic signal would be implemented. Bunt & Associates completed a traffic signal warrant for the intersection which resulted in a score of 74 points out of the required 100 points. Therefore a traffic signal is not warranted. The signal warrant analysis is attached in **Appendix F**.

Bunt & Associates also completed a sensitivity analysis as it is likely that drivers may avoid the congestion at Highway 4/ Highway 508 if they are not captive to the route and will shift to utilize Highway 5 to the west and then head north towards the City of Lethbridge. If approximately 5-10% of the eastbound site generated traffic on Highway 508 in fact shifted to head to the west and utilize Highway 5 versus Highway 4 to head north, the west intersection at Highway 4/ Highway 508 would be within the acceptable capacity parameters and the increase in traffic volumes at the Highway 5/ Highway 508 intersection would continue to be accommodated with the intersection still operating within the acceptable capacity parameters.

Bunt & Associates therefore recommends that the intersection of Highway 4/ Highway 508 be reviewed as each stage of the proposed development is implemented to determine the impacts on the intersection of Highway 4/ Highway 508. This is crucial as trip rates applied to the site may be conservative, and the actual trip ends may be much lower than used in this analysis.

The queue length for the west intersection at Highway 508/ Highway 4 also was reviewed as the 95th percentile queue extends back to the west approximately 100 metres back to the west, crossing the CP rail line. A SimTraffic simulation run was completed, which resulted in a 53 metre 95th percentile queue length. The existing distance between the stop line on Highway 508 at Highway 4 to the railway crossing is approximately 30 metres and as such traffic will queue across the railway tracks resulting in a major safety concern. Bunt & Associates therefore recommends the implementation of warning gates at the railway crossing as a safety measure. It should be noted that the railway crossing warrant was subsequently completed and warning gates are in fact warranted at this crossing.

The east intersection of Highway 4/ Highway 508 experiences a LOS D for the eastbound movement; however the v/c ratio is only 0.76 and the queue length is less than the existing spacing between the east and west intersections. With that said, Bunt & Associates does not feel that any improvements are required at this time for the east intersection at Highway 4/ Highway 508.

The future realigned access with Highway 508 also experiences a LOS D during the PM peak hour for the southbound movements however the v/c ratio is 0.83. A southbound right turn lane of approximately 50 metres in length could be implemented to bring the LOS down to a LOS C, however in Bunt & Associates opinion it is not required since the southbound leg is within the proposed site.

5.1.3 Illumination Warrant

Once again, Bunt & Associates undertook an illumination warrant for the three study area intersections based on the Transportation Association of Canada (TAC) methodology for Illumination of Isolated Rural Intersections[11] utilizing the Opening Day post development traffic volumes. The illumination warrant again reviewed the geometric, operational, environmental and collision factors for the study area intersections.

Highway 508/ Highway 4

Based on the illumination warrant under the Opening Day post development traffic conditions, the intersection of Highway 508/ Highway 4 scored 236 points. As a result the intersection warrants partial and/or delineation lighting. Based on the above criteria and the results of the illumination warrant, the operational factors scored 180 points and thus is greater than the 120 points which warrants delineation lighting to illuminate pedestrians and or cross street traffic which is the case at this intersection.

As previously found under existing traffic conditions it was determined that illumination was warranted; however it was undetermined as to whether partial or delineated lighting was required. Now based on the post development traffic analysis, it is has been determined that delineation lighting required and thus is recommended to be installed at the intersection of Highway 4/Highway 508.

Highway 508/ Highway 5

Based on the illumination warrant under Opening Day traffic conditions, the intersection of Highway 508/ Highway 4 now scores 191 points. As a result the intersection warrants partial and/or delineation lighting. Based on the above criteria and the results of the illumination warrant, the operational factors scored 170 points and thus is greater than the 120 points which warrants delineation lighting to illuminate pedestrians and or cross street traffic which again is the case at this intersection.

It was determined that illumination was warranted under the existing traffic conditions; however it was undetermined as to whether partial or delineated lighting was required. Now based on the post development traffic analysis, it is has been determined that delineation lighting is required and is therefore recommended to be installed at the intersection of Highway 5/Highway 508.

Highway 508/ Realigned Access

Based on the illumination warrant under Opening Day traffic conditions, the intersection of Highway 508/ realigned access now scores 166 points. As a result the intersection warrants partial and/or delineation lighting. Based on the above criteria and the results of the illumination warrant, the operational factors scored 140 points and thus is greater than the 120 points which warrants delineation lighting to illuminate pedestrians and or cross street traffic which again is the case at this intersection.

[11] Illumination of Isolated Rural Intersections, Transportation Association of Canada (TAC), February 2001.

As a result, Bunt & Associates recommends that delineation lighting be installed at the intersection of Highway 508 at the realigned access.

The Opening Day post development traffic illumination warrant summaries are included in **Appendix D.**

5.1.4 Rail Crossing Warrant

The rail crossing warrant was once again completed based on the Opening Day post development traffic volumes. Again, Transport Canada's[12] requirements for rail crossings determines that lights are required at a rail crossing when the forecast cross-product[13] is 1,000 or more and gates are required when the forecast cross product is 50,000 or more. The cross product for the crossing at Highway 508 is now 55,200[14] based on the Opening Day post development traffic volumes. As a result of the cross product being greater than 50,000, gates are now warranted at the railway crossing on Highway 508 with the inclusion of the proposed site generated traffic volumes. In addition, the warning gates will provide a safety measure for the queue that is expected to extend back towards the railway tracks as previously discussed.

5.1.5 Road Link Analysis

The Opening Day post development link volumes were again assessed based on typical Alberta Transportation highway standards. In general terms, this analysis was intended to assess the daily traffic volumes on all germane roadway links in the study area and to confirm the current roadway classification and/or identify any need for reclassification based on the addition of the proposed site generated traffic volumes to the existing traffic volumes. The results of the assessment are summarized in **Table 5.2** and also illustrated previously on Exhibit 5.1.

Table 5.2: Opening Day Post Development Road Link Analysis

Road Link	Road Classification	Recommended Daily Traffic Volume (vehicles per day)	Opening Day Post Development Daily Traffic Volume[15] (vehicles per day)
Highway 4	4-lane Primary Highway	> 12,000	10,800
Highway 508	2-lane Secondary Highway	< 12,000	6,900
Highway 5	2-lane Primary Highway	< 12,000	7,000
Re-aligned Access	Rural Local Road (gravel)	< 500	8,100

[12] RTD 10 Road/Railway Grade Crossings Technical Standards and Inspection, Testing and Maintenance Requirements, Transport Canada, March 2002.
[13] Forecast cross product = number of trains per day * daily traffic volume on the roadway
[14] The cross product was calculated on the maximum number of expected trains per day (8 trains per day) to utilize the most conservative estimate.
[15] For the purpose of this study, the daily traffic volumes estimates were based on ten times the PM peak hour volumes. Again rounding took place as under existing traffic conditions.

Based on the road link analysis, the majority of the road links within the vicinity of the site are within the recommended daily traffic volume design guidelines for the various classifications of roadways. However with the addition of the site generated traffic volumes to the proposed access, Bunt & Associates recommends that the access roads within the site be upgraded from a gravel surface to a paved surface roadway.

5.2 20-Year Post Development Conditions

The 20-year post development traffic volumes were developed by adding the site generated traffic volumes onto the 20-year background traffic volumes. The 20-year Post Development traffic volumes are illustrated in **Exhibit 5.2.**

5.2.1 Intersection Treatment Type

The Alberta Transportation Intersection Treatment type was determined on Highway 508 at both the realigned proposed site access and at Highway 5 based on the 20-year post development traffic volumes.

Highway 508 at Realigned Proposed Site Access

The left turn lane warrant was once again completed based on the 20-year post development traffic volumes however due to the minimal increase in traffic volumes the warrant continued to result in the need of a Type IV intersection.

With the implementation of a right turn lane already in place at the Opening Day horizon, the right turn lane warrant was not completed for the 20-year post development horizon.

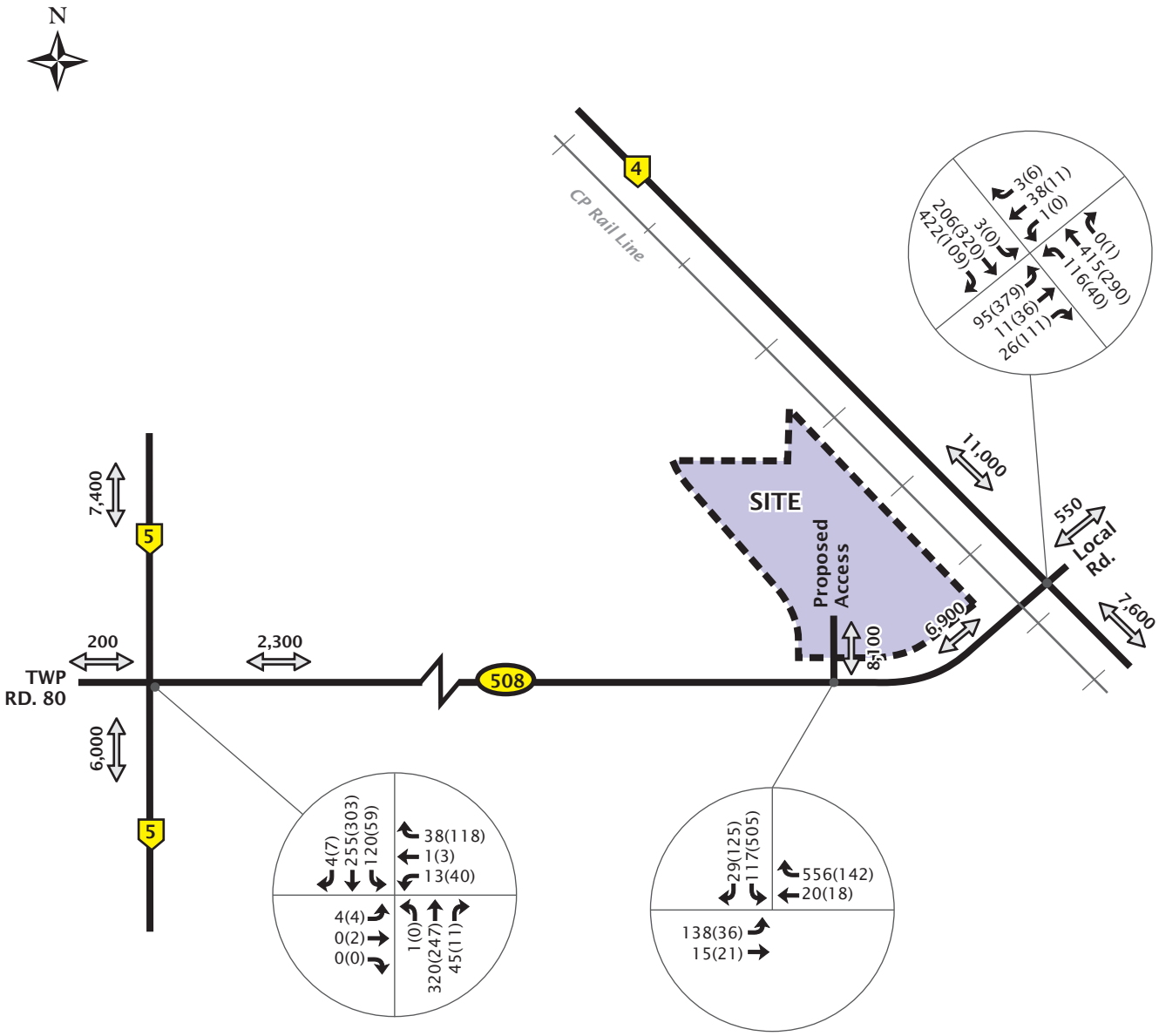
Highway 508 at Highway 5

Again, the left turn lane warrant was once again completed based on the 20-year post development traffic volumes however due to the minimal increase in traffic volumes the warrant continued to result in the need of a Type I intersection.

With the implementation of a right turn lane already in place at the Opening Day horizon, the right turn lane warrant was not completed for the 20-year post development horizon.

5.2.2 Intersection Capacity Analysis

The Synchro 8.0 software package was used to assess the study area intersections based on the 20-year post development traffic conditions. The 20-year post development traffic analysis was completed assuming the existing lane arrangements with the realignment of the proposed access as previously discussed along with the intersection treatment types determined above and the existing traffic controls. The intersection capacity results for the 20-year post development traffic conditions are summarized in **Table 5.3.** The Synchro outputs are attached in Appendix C.



LEGEND

↰ ↑ ↱	Vehicle Volumes
0,000	Daily Vehicle Volumes
XX	AM Peak
(YY)	PM Peak

Exhibit 5.2

20 Year Post Development Traffic Volumes

Lethbridge Agri-Business Park
June 2014 Scale NTS

Table 5.3: 20-Year Post Development Intersection Capacity Analysis

Intersection	Movement	AM Peak				PM Peak			
		v/c	LOS	Delay (s)	Queue (m)	v/c	LOS	Delay (s)	Queue (m)
Highway 508/Highway 4 (west intersection)	EBT	0.19	B	11.3	5.4	**0.94**	**E**	**49.0**	**103.6**
	EBR	0.19	B	11.3	5.4	**0.94**	**E**	**49.0**	**103.6**
	WBL/T	0.51	D	25.7	22.0	0.12	B	13.5	3.3
	SBL	< 0.01	A	7.3	0.1	< 0.01	A	0.0	0.0
	SBT	0.07	A	0.0	0.0	0.11	A	0.0	0.0
	SBR	0.28	A	0.0	0.0	0.07	A	0.0	0.0
Highway 508/Highway 4 (east intersection)	EBL/T	0.35	C	20.8	12.5	**0.77**	**D**	**28.1**	**57.8**
	WBT/R	0.15	C	18.0	4.1	**0.03**	**D**	**11.3**	**0.8**
	NBL	0.08	A	7.5	2.2	0.03	B	7.4	0.7
	NBT	0.14	A	0.0	0.0	0.10	A	0.0	0.0
	NBR	< 0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
Highway 508/ Future Realigned Access	EBL	0.17	A	9.7	4.9	0.03	A	7.7	A
	EBT	0.01	A	0.0	0.0	0.01	A	0.0	A
	WBT	0.01	A	0.0	0.0	0.01	A	0.0	A
	WBR	0.37	A	0.0	0.0	0.09	A	0.0	A
	SB	0.29	B	13.7	9.4	**0.83**	**D**	**26.3**	**D**
Highway 508/Highway 5	EB	0.02	C	23.3	0.6	0.02	C	16.1	0.5
	WBL/T	0.07	B	14.0	1.9	0.04	B	11.9	1.0
	WBR	0.07	B	14.0	1.9	0.04	B	11.9	1.0
	NBL/T	< 0.01	A	0.0	0.0	< 0.01	A	0.0	0.0
	NBR	0.03	A	0.0	0.0	< 0.01	A	0.0	0.0
	SBL	0.12	A	8.6	3.3	0.03	A	7.9	0.7
	SBT/R	0.17	A	0.0	0.0	0.21	A	0.0	0.0

As can be seen in the Table 5.3, with the addition of site generated traffic from the proposed development, the west intersection of Highway 4/ Highway 508 experiences LOS E and v/c ratio of 0.94 during the PM peak hour. Again, due to the location of this intersection and the high speed limit on the highway it is unlikely that a traffic signal would be implemented; however with that said Bunt & Associates did complete a traffic signal warrant for the intersection which resulted in a score of 76 points out of the required 100 points and thus a traffic signal is not warranted. The signal warrant analysis is attached in **Appendix F**.

Again, Bunt & Associates completed a sensitivity analysis as it is likely that drivers may avoid the congestion at Highway 4/ Highway 508 if they are not captive to the route and will shift to utilize Highway 5 to the west and then head north towards the City of Lethbridge. If approximately 5-10% of the eastbound site generated traffic on Highway 508 in fact shifted to head to the west and utilize Highway 5 versus Highway 4 to head north, the west intersection at Highway 4/ Highway 508 would operate within the acceptable capacity parameters. The increase in traffic volumes at the intersection of Highway 5/ Highway 508 can be accommodated and the intersection will continue to operate within acceptable capacity parameters.

Bunt & Associates however, recommends that the intersection of Highway 4/ Highway 508 be reviewed as each stage of the proposed development is implemented to determine the impacts on the intersection of Highway 4/ Highway 508. Again, this is crucial as trip rates applied to the site may be conservative, and the actual trip ends may be much lower than used in this analysis.

The queue length of the west approach of the west intersection at Highway 508/ Highway 4 also was reviewed as the 95th percentile queue extends back approximately 105 metres crossing the CP rail line. SimTraffic simulation run was completed which resulted in a 69-metre 95th percentile queue length. The existing distance between the stop line on Highway 508 at Highway 4 to the railway crossing is approximately 30 metres and as such traffic will queue across the railway tracks resulting in a major safety concern.

Bunt & Associates therefore recommends the implementation of warning gates at the railway crossing as a safety measure. It should be noted that the railway crossing warrant was completed subsequently and warning gates are in fact warranted at this crossing.

The east intersection of Highway 4/ Highway 508 experiences a LOS D for the eastbound and westbound movements; however the v/c ratio is only 0.77 and 0.03 respectively and the queue length is less than the existing spacing between the east and west intersections. With that said, Bunt & Associates does not recommend any improvements at this time for the east intersection at Highway 4/ Highway 508.

Again, the future realigned access with Highway 508 will experience a LOS D during the PM peak hour for the southbound movements, however the v/c ratio is 0.83. As such, changes are not recommended to the intersection configuration.

5.2.3 Illumination Warrant

Once again, Bunt & Associates undertook an illumination warrant for the three study area intersections based on the Transportation Association of Canada (TAC) methodology for Illumination of Isolated Rural Intersections[16] utilizing the 20-year post development traffic volumes. The illumination warrant again reviewed the geometric, operational, environmental and collision factors for the study area intersections.

Highway 508/ Highway 4

Based on the illumination warrant under the 20-year post development traffic conditions, the intersection of Highway 508/ Highway 4 scored 236 points which is unchanged from the Opening Day warrant analysis. As such the operational factors again scored 180 points resulting in the warrant for delineation lighting to illuminate pedestrians and or cross street traffic.

Highway 508/ Highway 5

Based on the illumination warrant under 20-year post development traffic conditions, the intersection of Highway 508/ Highway 4 scored 191 points which again is unchanged form the Opening Day warrant analysis. As such the operational factors again scored 170 points resulting in the warrant for delineation lighting to illuminate pedestrians and or cross street traffic.

Highway 508/ Realigned Access

Based on the illumination warrant under 20-year post development traffic conditions, the intersection of Highway 508/ realigned access again scored 166 points, same as the Opening Day warrant analysis. As such the operational factors continue to score 140 points resulting in the warrant for delineation lighting to illuminate pedestrians and or cross street traffic.

The 20-year post development traffic illumination warrant summaries are included in **Appendix D.**

5.2.4 Rail Crossing Warrant

The rail crossing warrant was once again completed based on the 20-year post development traffic volumes. As stated, Transport Canada's[17] requirements for rail crossings determines that lights are required at a rail crossing when the forecast cross-product[18] is 1,000 or more and gates are required when the forecast cross product is 50,000 or more. The cross product for the crossing at Highway 508 is again 55,200[19] based on the 20-year post development traffic volumes. As a result of the cross product being greater than 50,000, gates are now warranted at the railway crossing on Highway 508 with the inclusion of

[16] Illumination of Isolated Rural Intersections, Transportation Association of Canada (TAC), February 2001.
[17] RTD 10 Road/Railway Grade Crossings Technical Standards and Inspection, Testing and Maintenance Requirements, Transport Canada, March 2002.
[18] Forecast cross product = number of trains per day * daily traffic volume on the roadway
[19] The cross product was calculated on the maximum number of expected trains per day (8 trains per day) to utilize the most conservative estimate.

the proposed site generated traffic volumes as was the case under the 20-year post development traffic volumes. In addition, the warning gates will provide a safety measure for the queue that is expected to extend back towards the railway tracks as previously discussed.

5.2.5 Road Link Analysis

The 20-year post development link volumes were again assessed based on typical Alberta Transportation highway standards. In general terms, this analysis was intended to assess the daily traffic volumes on all germane roadway links in the study area and to confirm the current roadway classification and/or identify any need for reclassification based on the addition of the proposed site generated traffic volumes to the existing traffic volumes. The results of the assessment are summarized in **Table 5.4** and also illustrated previously on Exhibit 5.2.

Table 5.4: 20-Year Post Development Road Link Analysis

Road Link	Road Classification	Recommended Daily Traffic Volume (vehicles per day)	Opening Day Post Development Daily Traffic Volume[20] (vehicles per day)
Highway 4	4-lane Primary Highway	> 12,000	11,000
Highway 508	2-lane Secondary Highway	< 12,000	6,900
Highway 5	2-lane Primary Highway	< 12,000	7,400
Re-aligned Access	Rural Local Road (gravel)	< 500	8,100

Based on the road link analysis, the majority of the road links within the vicinity of the site are within the recommended daily traffic volume design guidelines for the various classifications of roadways. However as was the case under the Opening Day post development road link analysis, Bunt & Associates recommends that the access roads within the site be upgraded from a gravel surface to a paved surface roadway.

[20] For the purpose of this study, the daily traffic volumes estimates were based on ten times the PM peak hour volumes. Again rounding took place as under existing traffic conditions.

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6. CONCLUSIONS AND RECOMMENDATIONS

The key findings and recommendations are summarized as follows:

6.1 Key Findings and Recommendations

The key findings and recommendations are summarized here, as follows:

Existing Traffic Conditions

All study area intersections are currently operating within the acceptable capacity parameters and study area roadways are currently functioning within their respective environmental capacities.

Bunt & Associates also completed an illumination warrant for the three study area intersections. The intersections on Highway 508 at both Highway 4 and Highway 5 warrant either partial and/or delineated lighting; however, the warrant did not determine which specific or if both types of illumination are warranted and as such it is recommended that further review is undertaken to determine the specific illumination required.

A railway crossing warrant was also completed for the Canadian Pacific rail line that runs parallel to Highway 4 and intersects Highway 508. Based on the cross product of the daily traffic volumes and the maximum number of trains expected to cross at this location, flashing warning lights are to be implemented at the rail crossing on Highway 508.

20-Year Background Traffic Conditions

The 20-year background traffic conditions exhibits the same results as under the existing traffic conditions. As such, all study area intersections and roadways are expected to operate within the acceptable capacity parameters. The intersections of Highway 508 with both Highway 4 and Highway 5 both warrant partial and/or delineation lighting. Flashing warning lights are warranted at the CP rail crossing on Highway 508 just west of Highway 4.

Proposed Development

The proposed Agri-Business Park that will service both agricultural and oil field sectors and is expected to generate 829 trips (688 inbound/ 141 outbound) during the AM peak hour and 802 trips (176 inbound/ 626 outbound) during the PM peak hour.

Post Development Traffic Conditions

Opening Day Post Development Traffic Conditions

Based on the Opening Day post development traffic conditions, Highway 508 at both Highway 5 and the realigned proposed site access requires a westbound right turn lane. The new proposed intersection at the realigned site access with Highway 508 requires a Type IV intersection treatment.

With these additions in place, the west intersection of Highway 4/ Highway 508 is expected to operate at v/c ratio of 0.93 and LOS E. It is highly unlikely that a traffic signal would be implemented at this location due to the high speed on the roadway and based on TAC signal warrant, a traffic signal is in fact not warranted.

With that said, delays will be experienced at this intersection and as such it is likely that traffic will utilize Highway 5 versus Highway 4 to access the south end of the City of Lethbridge. With only a 5-10% shift in traffic from the eastbound movements at Highway 4 to the westbound movements at Highway 5, both intersections will be expected to operate within acceptable capacity parameters.

Even with this shift in traffic, the 95th percentile queue length is expected to extend across the CP railway tracks and as such causes a safety concern. Therefore, Bunt & Associates recommends that warning gates be installed at the railway crossing to ensure safety to eastbound vehicles at this crossing. Given the low number of daily train traffic, the impact of the gates would not decrease the capacity of Highway 508 beyond what would be experienced without the gate.

Based on the road link analysis, all study area roadways are expected to operate within the environmental capacities for their specific road classification. The proposed site access is recommended to be upgraded from gravel to a paved surface.

Illumination warrant was completed for the three study area intersections along Highway 508 and under opening day post development traffic conditions, all three intersections warrant delineated lighting based on operational factors.

The railway crossing warrant was completed for the Canadian Pacific rail line that runs parallel to Highway 4 and intersects Highway 508 based on the opening day traffic conditions. Based on the cross product of the daily traffic volumes and the maximum number of trains expected to cross at this location, warning gates are warranted at the rail crossing on Highway 508. As previously stated, warning gates are also recommended to ensure the safety of vehicles what will queue beyond the railway crossing.

20-Year Post Development Traffic Conditions

The 20-year post development traffic conditions exhibited much the same results as the Opening Day traffic conditions. The new proposed intersection at the realigned site access with Highway 508 warrants a Type IV intersection treatment.

The west intersection of Highway 4/ Highway 508 will continue to operate at v/c ratio of 0.94 and LOS E. Based on TAC signal warrant analysis, a traffic signal is not warranted. However, some delays will be experienced at the intersection and as such it is likely that some non-captive traffic will shift to Highway 5 from Highway 4 to access the south end of the City of Lethbridge. With only a 5-10% shift in traffic from the eastbound movements at Highway 4 to the westbound movements at Highway 5, both intersections are expected to operate within acceptable capacity parameters. Again, even with the shift in traffic, the 95th percentile queue length is expected to extend across the CP railway tracks and as such causes a safety concern. Therefore, Bunt & Associates recommends that warning gates be installed at the railway crossing at the Opening Day to ensure safety of vehicles at this crossing.

Based on the road link analysis, all study area roadways are expected to operate within the environmental capacities for their specific road classification assuming the proposed access has been upgraded to a paved surface based on the Opening Day traffic conditions.

Once again, an illumination warrant was completed for the three study area intersections along Highway 508 and under opening day post development traffic conditions, all three intersections warrant delineated lighting based on operational factors.

The railway crossing warrant was again completed for the Canadian Pacific rail line that runs parallel to Highway 4 and intersects Highway 508 based on the opening day traffic conditions. Based on the cross product of the daily traffic volumes and the maximum number of trains expected to cross at this location, warning gates are warranted at the rail crossing on Highway 508. As previously stated, warning gates are recommended to ensure the safety of vehicles what will queue beyond the railway crossing.

Summary

The proposed Agri-Business Park is anticipated to add a significant amount of traffic to the surrounding road network resulting in road network improvements at each horizon year. With that said **Table 6.1** summarizes the improvements required to accommodate the proposed site generated traffic volumes as discussed above.

Table 6.1 Summary of Road Network Improvements

Horizon Year Traffic Conditions	Recommended Intersection Improvements				
	Highway 508/ Highway 4 (west intersection)	Highway 508/ Highway 4 (east intersection)	Highway 508/ Highway 5	Highway 508/ Site Access	Highway 508 CP Rail Crossing
Existing	• No intersection improvements required • Partial and/or delineated illumination is warranted	• No intersection improvements required • Partial and/or delineated illumination is warranted	• No improvements are required	• No improvements are required	• Flashing warning lights are warranted
20-Year Background	• No intersection improvements required • Partial and/or delineated illumination is warranted	• No intersection improvements required • Partial and/or delineated illumination is warranted	• No improvements are required	• No improvements are required	• Flashing warning lights are warranted
Opening Day Post Development	• Eastbound movement does not operate within acceptable capacity parameters; however a traffic signal is not warranted. • Traffic may utilize alternate route of Hwy 5 to avoid congestion at Hwy 4, thus a 5-10% shift in traffic will bring the intersection within acceptable parameters. • The queue length extends beyond the rail line and as such warning gates are to be implemented based on the warrant and for safety reasons. • Delineation illumination is warranted	• No intersection improvements required • Delineation illumination is warranted	• Westbound right turn lane required • Delineation illumination is warranted	• Type IV intersection treatment required • Westbound right turn lane required • Site access roadway requires a paved surface • Delineation illumination is warranted	• Rail Crossing Gates are warranted

Table 6.1 Summary of Road Network Improvements – Continued

Horizon Year Traffic Conditions	Recommended Intersection Improvements				
	Highway 508/ Highway 4 (west intersection)	Highway 508/ Highway 4 (east intersection)	Highway 508/ Highway 5	Highway 508/ Site Access	Highway 508 CP Rail Crossing
20-Year Post Development	• Eastbound movement does not operate within acceptable capacity parameters; however a traffic signal is not warranted. • Traffic may utilize alternate route of Hwy 5 to avoid congestion at Hwy 4 and thus a 5-10% shift in traffic will bring the intersection within acceptable parameters. • The queue length extends beyond the rail line and as such warning gates are to be implemented based on the warrant and for safety reasons. • Delineation illumination is warranted	• No intersection improvements required • Delineation illumination is warranted	• Westbound right turn lane required • Delineation illumination is warranted	• Type IV intersection treatment required • Westbound right turn lane required • Site access roadway requires a paved surface • Delineation illumination is warranted	• Rail Crossing Gates are warranted

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APPENDIX A

Scope of Work Correspondence

Subject: RE: Lethbridge Agri-Business Park
Date: Tuesday, May 27, 2014 11:47:10 AM GMT-06:00
From: Amanda Leibel
To: John Thomas

HI John

I just wanted to follow up on the below for your scope approval.

Thanks!

Amanda Leibel, P.Eng.
Transportation Engineer

306-315-9447
www.bunteng.com

From: Amanda Leibel
Sent: Thursday, May 22, 2014 11:07 AM
To: John Thomas
Subject: Re: Lethbridge Agri-Business Park

Hi John

I just wanted to follow up with our phone conversation, sorry it has taken so long but I just needed to confirm a few things so I could send one email. The following is the updated scope of work based on our conversation and I have a few other questions as follows:

- Trip rates will be based on ITE Land Use 110, General Light Industrial AM peak = 7.51 trips/acre (83%in/17% out) and PM peak = 7.26 trips/acre (22% in/ 78% out). The proposed land use for the sight is light to medium industrial servicing the agricultural/ oil sectors.
- The intersections at Hwy 4 and Hwy 5 with Hwy 508 will be reviewed and the existing AT counts will be utilized. The AM and PM peak counts are for the 100th highest hour. We counted the existing access point since there are currently a few businesses in operation and there are less than 10 vehicles entering/exiting during the peak hour and thus factoring this to the 100th highest hour likely is not much different and thus the peak hour volumes will just be utilized.
- Are there any other developments in the area that set to occur and should be included in this TIA?
- The site access has been moved to one access along the tangent, please see attached updated plan.
- Do you know the radius of the horizontal curve on Hwy 508 at this location?
- I assume Hwy 508 is under AT jurisdiction?
- Yearly growth rate – Hwy 4 has an average of 2.01% yearly growth over the last five years and thus a 2% yearly linear growth rate will be applied. Hwy 5 yearly data only increased in 2012 over the last five years when an update count was completed and as such had a large

increase of roughly 13% with no 0% growth in the other years. As such an average of 3.44% was found over the last five years. Therefore a linear growth rate of 3.5% will be applied on Hwy 5. Highway 508 showed a yearly growth rate of 0.46% over the last year; however Bunt feels it is prudent to utilize a growth rate of 2%/ year on Hwy 508.

- Trip Distribution – based on the existing traffic count for the few businesses on site, the majority of traffic is coming from the north on Hwy 4, traffic coming from Hwy 5 and from the south on Hwy 4 is about the same and a small portion is coming from the east. With that said, the client has stated that employees will likely come from south Lethbridge and customers will likely come from outside of Lethbridge and/or have interactions with the industrial area. I completed time trials while I was in Lethbridge and from the site to the intersection of Mayor Magrath/ 24th Avenue S, it is faster to take Hwy 4 to this location versus Hwy 5 by approximately 3 mins. With all of this taken into consideration, I propose the following distribution for site traffic:
    - To/from the north on Hwy 4 – 60%
    - To/From the south on Hwy 4 – 15%
    - To/ From the West via Hwy 5 – 20% (of this traffic 15% will come from the north and 5% from the south)
    - To/From the East – 5%

I believe this covers the entire scope of work. Please review and if you could answer the remaining questions it would be greatly appreciated.

Thanks!

Amanda Leibel, P.Eng. | Transportation Engineer

Bunt & Associates Engineering (Alberta) Ltd.
Suite 380 11012 Macleod Trail SE, Calgary, AB, Canada T2J 6A5
p 403 252 3343 | www.bunteng.com



From: John Thomas <John.Thomas@gov.ab.ca>
Date: Thursday, May 8, 2014 2:25 PM
To: Amanda Leibel <aleibel@bunteng.com>
Subject: RE: Lethbridge Agri-Business Park

Amanda:

Is your extension 101? I would like to give you a quick call to discuss.

thanks

John Thomas
Development/Planning Technologist
Southern Region - Lethbridge
Alberta Transportation Regional Services

ph: 403-381-5426 | john.thomas@gov.ab.ca

Alberta Government

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From: Amanda Leibel [mailto:aleibel@bunteng.com]
Sent: Thursday, May 08, 2014 11:29 AM
To: John Thomas
Subject: FW: Lethbridge Agri-Business Park

Hi John!

I just wanted to follow up on my below email, I am heading out of town to do the site visit on Monday so was hoping for a response from you prior to that so I don't miss any data collection while completing my site visit.

Thanks again!

Amanda Leibel, P.Eng. | Transportation Engineer

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From: Amanda Leibel <aleibel@bunteng.com>
Date: Monday, May 5, 2014 6:37 PM
To: John Thomas <John.Thomas@gov.ab.ca>
Subject: Lethbridge Agri-Business Park

Hi John!

We are completing a TIA on behalf of Hasegawa Engineering for an Agri-Business Park located just south of Lethbridge. The site is located in the NW corner of Hwy 4/ Hwy 508 as shown in the attached plan.

I am proposing the following scope for the TIA:

- Opening day analysis (Existing Traffic + Site Generated Traffic) at the intersections of Hwy 4/ Hwy 508 and Hwy 508/site accesses
- 20-Year analysis at the intersections of Hwy 4/ Hwy 508 and Hwy 508/site accesses
- We will utilize the existing AT traffic count at the intersection of Hwy 4/ Hwy 508.
- Distribution will be based on existing traffic patterns at the study area intersection.
- Trip Generation rates will be based on ITE Trip Generation Manual for a similar site, business park. Once I receive more details from the client on potential developments within the area I will determine the exact

rate.

- 20-year volumes will be determined based on the yearly % of traffic increase on Hwy 4 and Hwy 508 for the last 5 years.
- Illumination warrant will be completed
- Rail Crossing warrant will be completed

Lastly, are you aware of any other developments occurring in this area that should be included as background traffic? Is this intersection expected to remain as is within the 20-year horizon?

I look forward to your review of the scope, please let me know if this is acceptable to AT and if there are any questions/comments/additions on the scope of work.

Thanks!

Amanda Leibel, P.Eng. | Transportation Engineer

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p 403 252 3343 | www.bunteng.com



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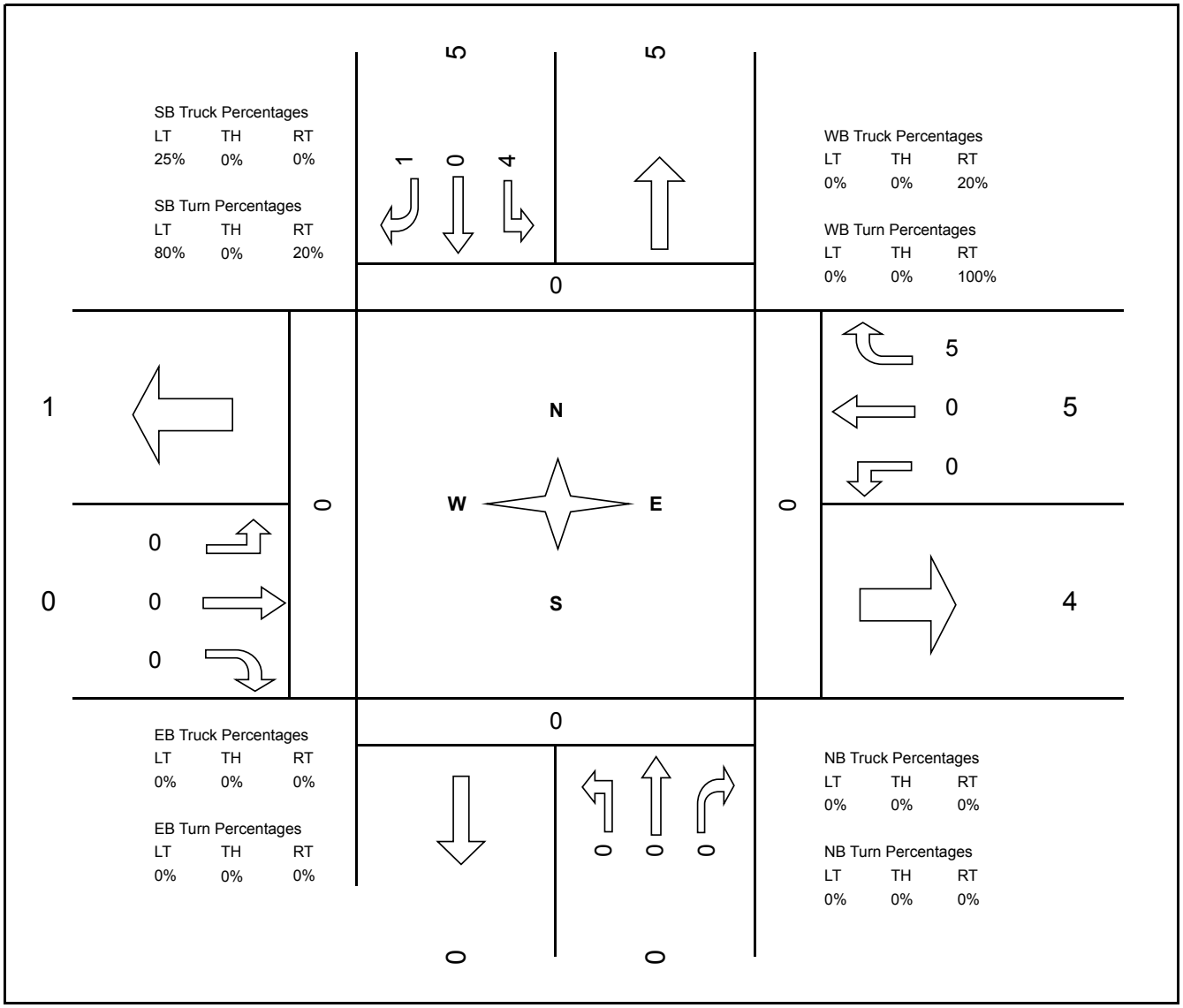
APPENDIX B

Existing Traffic Count

Existing Access & Highway 508 (AM)

Project #: 1283-09
Peak Hour: 08:00 - 09:00 Date: Tuesday, May 20, 201
Overall PHF: 0.83 Day of Week: Tuesday, May 20, 201
Weather: sunny Road Cond: Dry

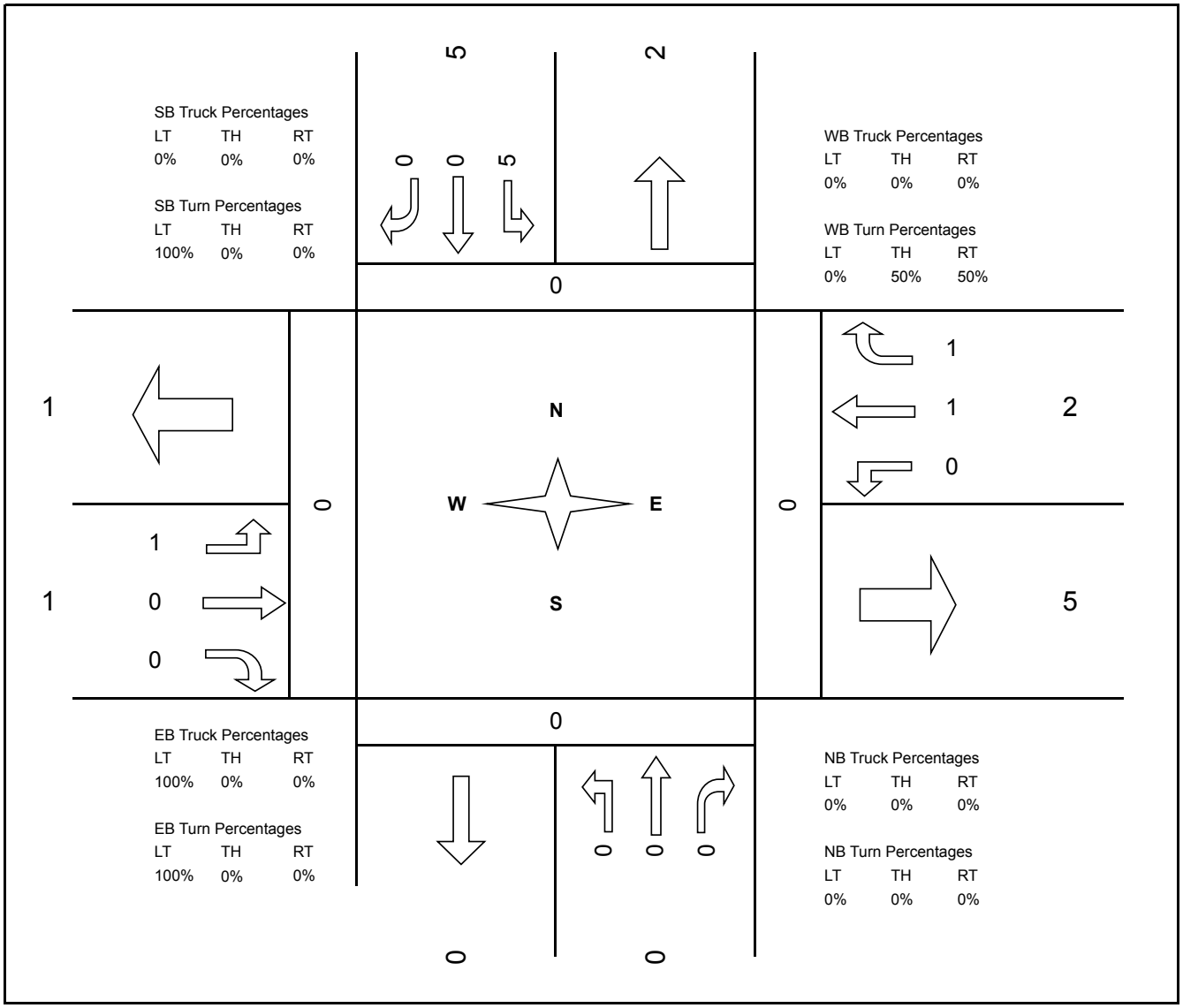
	Traffic Movements												Pedestrians			
Time Intervals	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	N	S	E	W
07:00 - 07:15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 - 07:30	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
07:30 - 07:45	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
07:45 - 08:00	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
08:00 - 08:15	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0
08:15 - 08:30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
08:30 - 08:45	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0
08:45 - 09:00	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0
PHF				0.50		0.25						0.63				
Peak V_{15min}				2		1						2				



Existing Access & Highway 508 (PM)

Project #: 1283-09
Peak Hour: 17:00 - 18:00 Date: Tuesday, May 20, 201
Overall PHF: 0.67 Day of Week: Tuesday, May 20, 201
Weather: sunny Road Cond: Dry

	Traffic Movements												Pedestrians			
Time Intervals	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	N	S	E	W
16:00 - 16:15	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0
16:15 - 16:30	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
16:30 - 16:45	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
16:45 - 17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00 - 17:15	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
17:15 - 17:30	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
17:30 - 17:45	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0
17:45 - 18:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PHF				0.42			0.25				0.25	0.25				
Peak V_{15min}				3			1				1	1				



Turning Movement Summary Diagram

Reference No.: 105050

Intersection of:
4 & 508 SE OF LETHBRIDGE

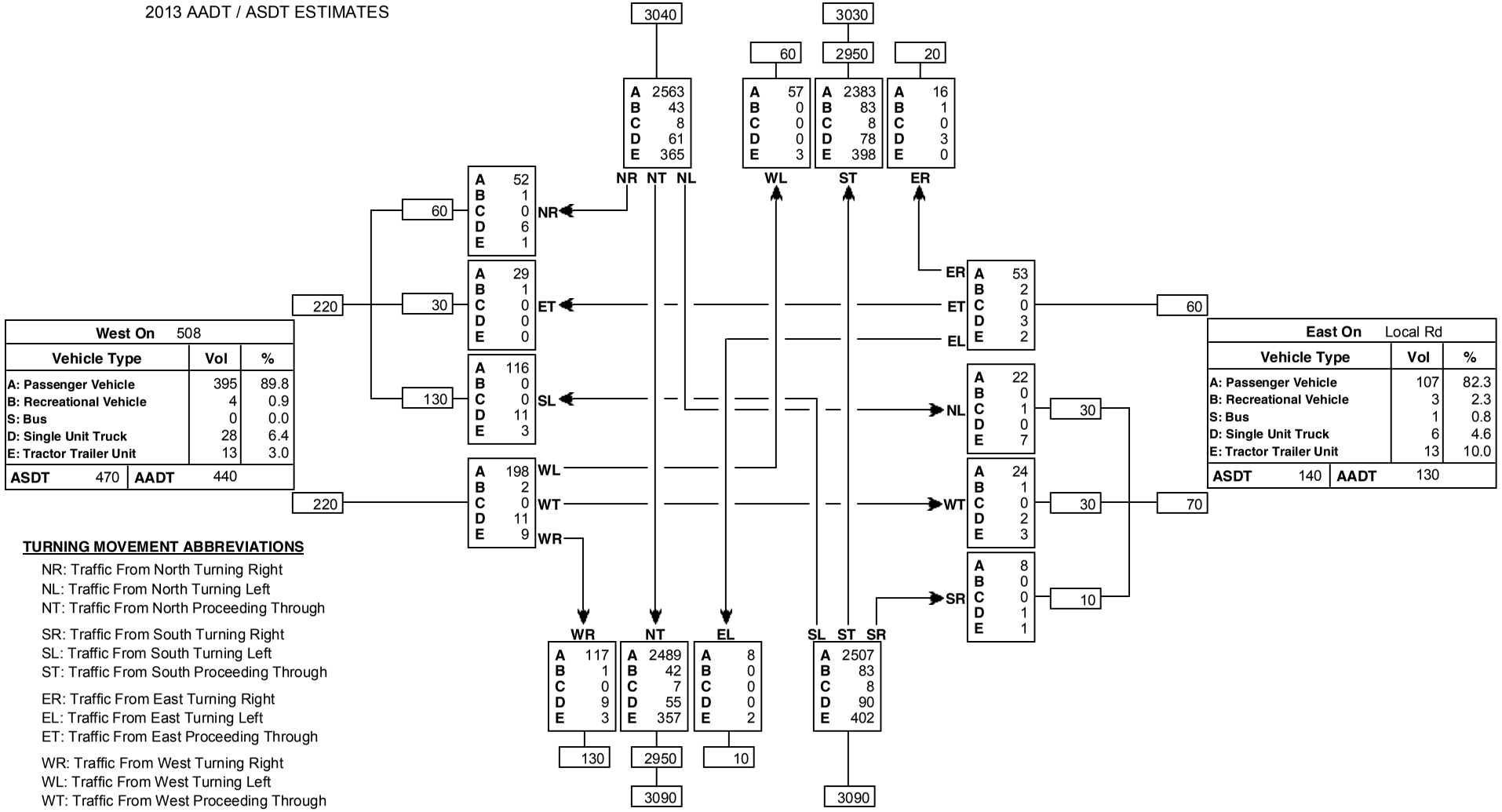
2013 AADT / ASDT ESTIMATES

North On 4		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	5019	82.7
B: Recreational Vehicle	127	2.1
S: Bus	16	0.3
D: Single Unit Truck	142	2.3
E: Tractor Trailer Unit	766	12.6
ASDT 6420	**AADT** 6070	

West On 508		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	395	89.8
B: Recreational Vehicle	4	0.9
S: Bus	0	0.0
D: Single Unit Truck	28	6.4
E: Tractor Trailer Unit	13	3.0
ASDT 470	**AADT** 440	

East On Local Rd		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	107	82.3
B: Recreational Vehicle	3	2.3
S: Bus	1	0.8
D: Single Unit Truck	6	4.6
E: Tractor Trailer Unit	13	10.0
ASDT 140	**AADT** 130	

South On 4		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	5121	82.9
B: Recreational Vehicle	126	2.0
S: Bus	15	0.2
D: Single Unit Truck	154	2.5
E: Tractor Trailer Unit	764	12.4
ASDT 6540	**AADT** 6180	



TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of May 1 to September 30 (153 days)

Turning Movement Summary Diagram

Reference No.: 105050

Intersection of:
4 & 508 SE OF LETHBRIDGE

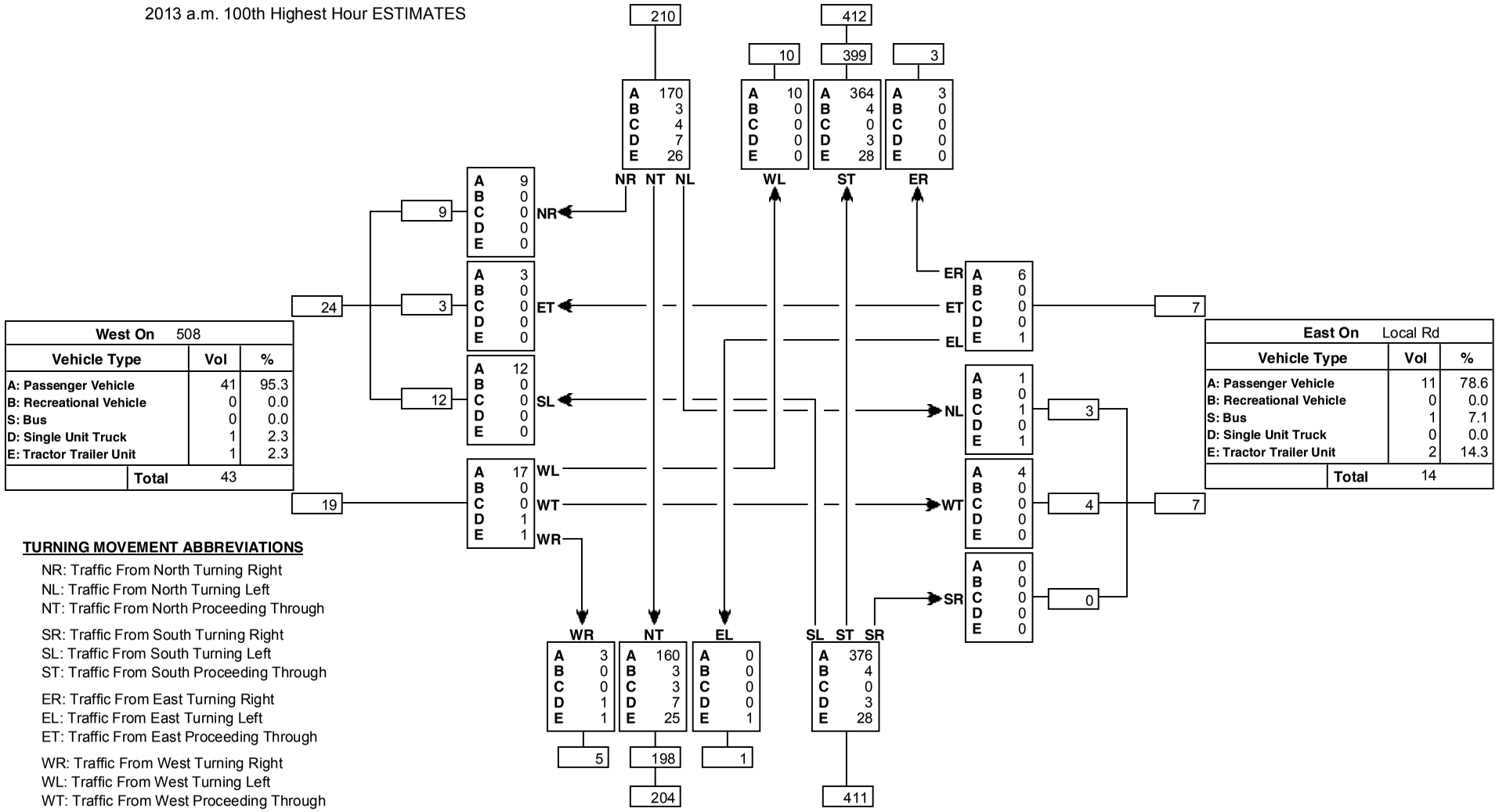
2013 a.m. 100th Highest Hour ESTIMATES

North On 4		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	547	87.9
B: Recreational Vehicle	7	1.1
S: Bus	4	0.6
D: Single Unit Truck	10	1.6
E: Tractor Trailer Unit	54	8.7
Total	622	

West On 508		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	41	95.3
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	1	2.3
E: Tractor Trailer Unit	1	2.3
Total	43	

East On Local Rd		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	11	78.6
B: Recreational Vehicle	0	0.0
S: Bus	1	7.1
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	2	14.3
Total	14	

South On 4		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	539	87.6
B: Recreational Vehicle	7	1.1
S: Bus	3	0.5
D: Single Unit Truck	11	1.8
E: Tractor Trailer Unit	55	8.9
Total	615	



TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 105050

Intersection of:
4 & 508 SE OF LETHBRIDGE

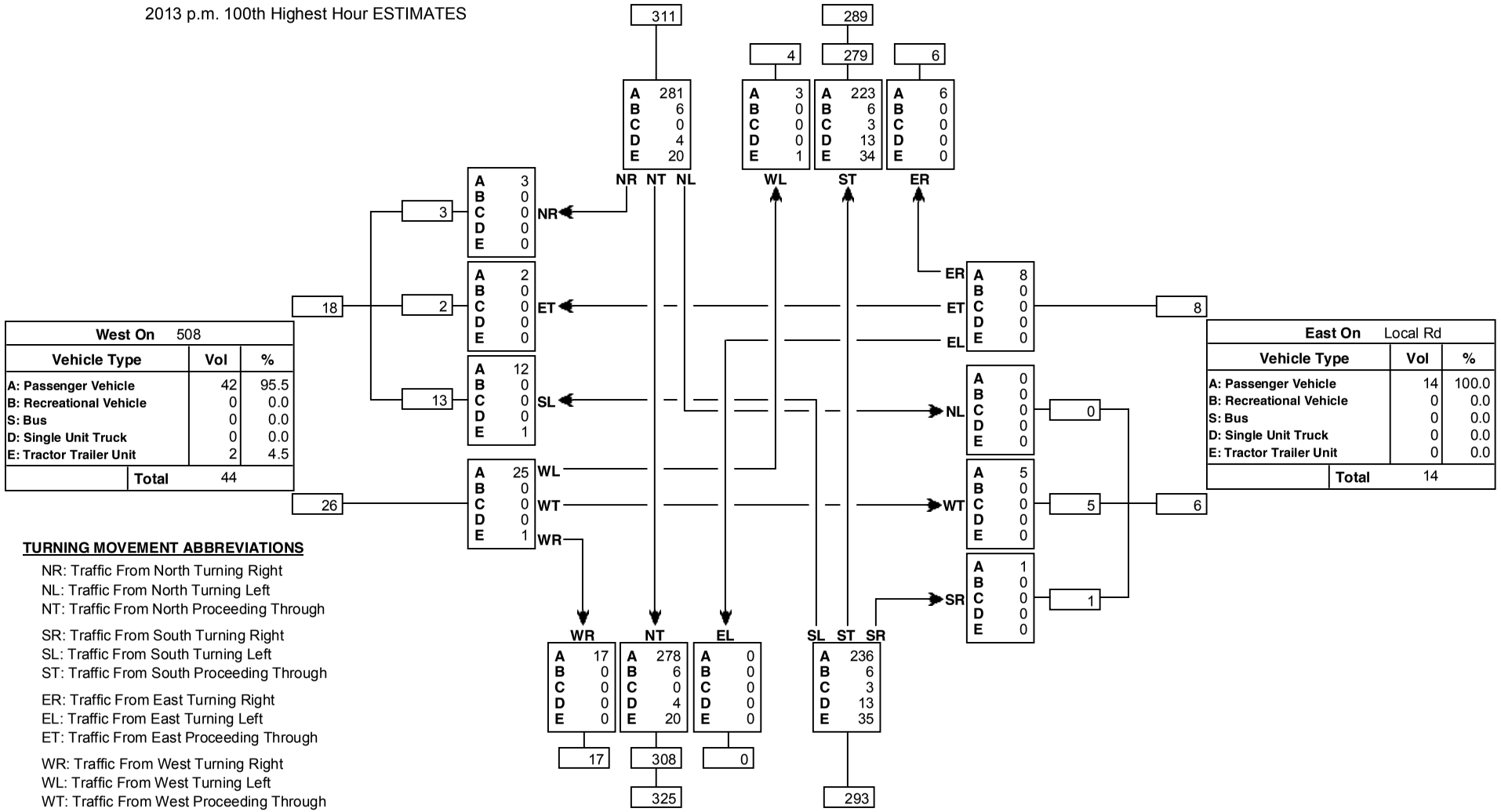
2013 p.m. 100th Highest Hour ESTIMATES

North On 4		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	513	85.5
B: Recreational Vehicle	12	2.0
S: Bus	3	0.5
D: Single Unit Truck	17	2.8
E: Tractor Trailer Unit	55	9.2
Total	600	

West On 508		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	42	95.5
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	2	4.5
Total	44	

East On Local Rd		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	14	100.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	14	

South On 4		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	531	85.9
B: Recreational Vehicle	12	1.9
S: Bus	3	0.5
D: Single Unit Truck	17	2.8
E: Tractor Trailer Unit	55	8.9
Total	618	



TURNING MOVEMENT ABBREVIATIONS

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ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

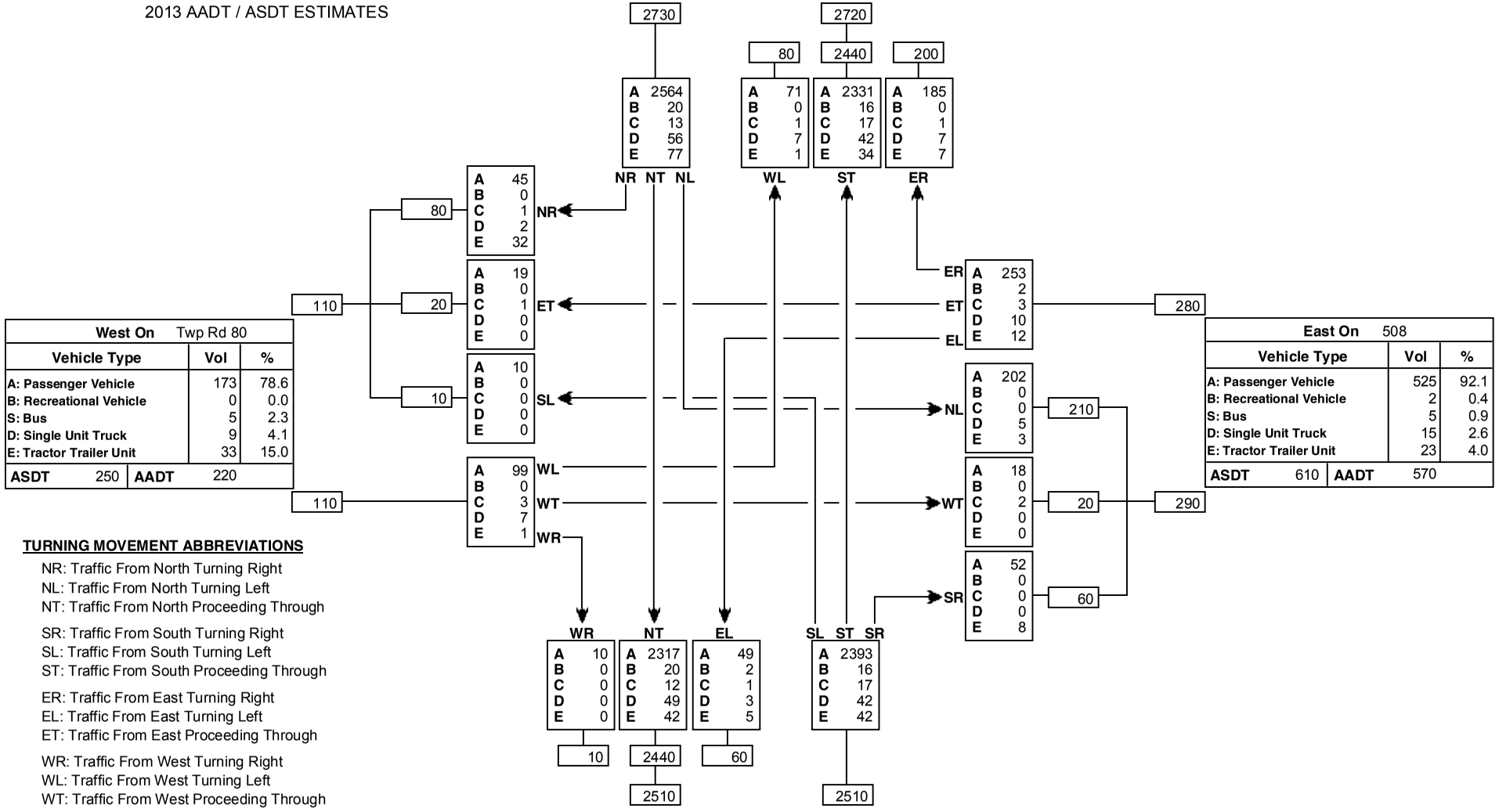
Turning Movement Summary Diagram

Reference No.: 104050

Intersection of:
5 & 508 S OF LETHBRIDGE

2013 AADT / ASDT ESTIMATES

North On 5		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	5151	94.5
B: Recreational Vehicle	36	0.7
S: Bus	32	0.6
D: Single Unit Truck	112	2.1
E: Tractor Trailer Unit	119	2.2
ASDT 6200	**AADT** 5450	



West On Twp Rd 80		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	173	78.6
B: Recreational Vehicle	0	0.0
S: Bus	5	2.3
D: Single Unit Truck	9	4.1
E: Tractor Trailer Unit	33	15.0
ASDT 250	**AADT** 220	

East On 508		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	525	92.1
B: Recreational Vehicle	2	0.4
S: Bus	5	0.9
D: Single Unit Truck	15	2.6
E: Tractor Trailer Unit	23	4.0
ASDT 610	**AADT** 570	

TURNING MOVEMENT ABBREVIATIONS

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EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of May 1 to September 30 (153 days)

South On 5		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	4769	95.0
B: Recreational Vehicle	38	0.8
S: Bus	30	0.6
D: Single Unit Truck	94	1.9
E: Tractor Trailer Unit	89	1.8
ASDT 5710	**AADT** 5020	

Turning Movement Summary Diagram

Reference No.: 104050

Intersection of:
5 & 508 S OF LETHBRIDGE

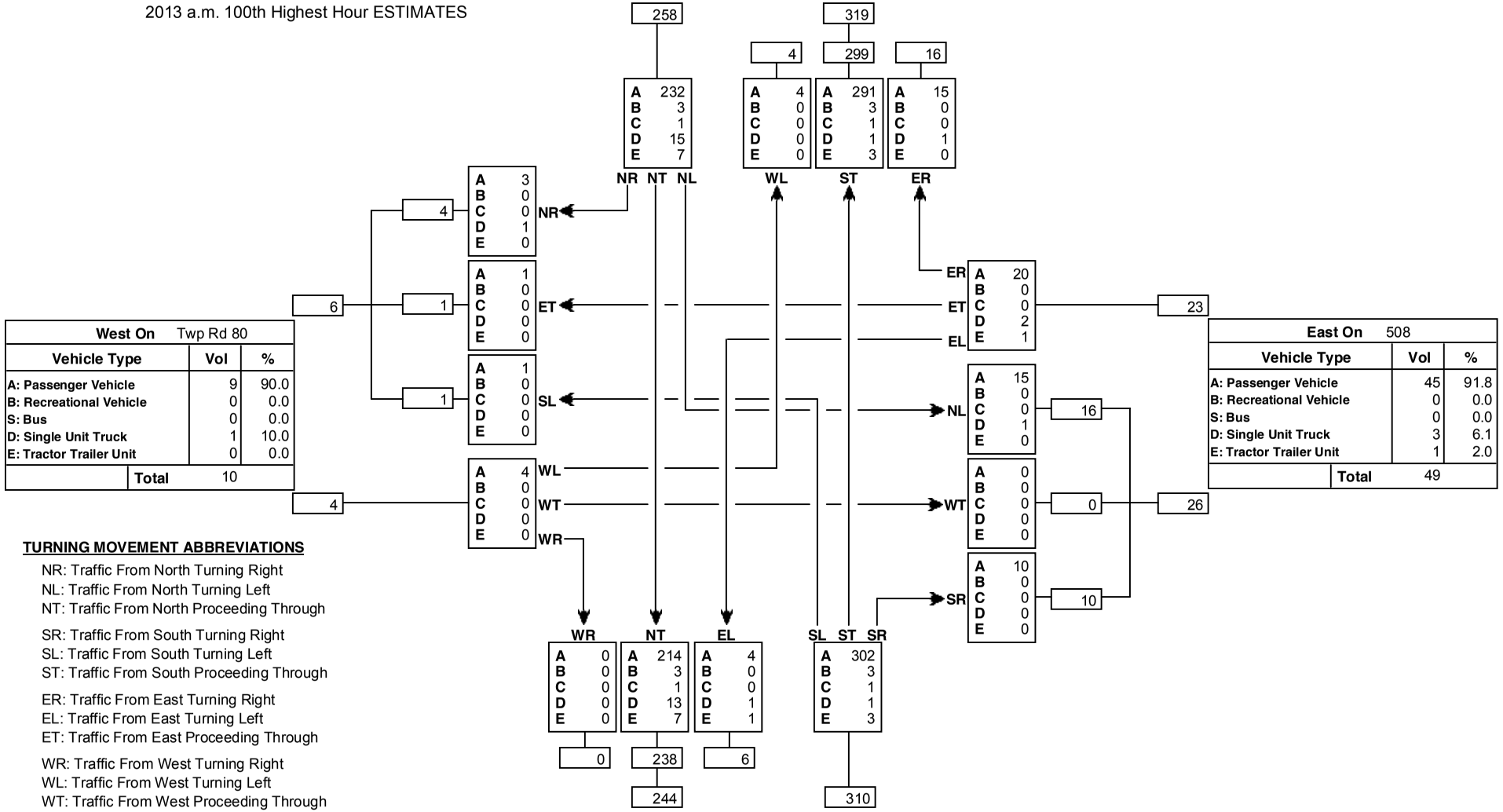
2013 a.m. 100th Highest Hour ESTIMATES

North On 5		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	542	93.9
B: Recreational Vehicle	6	1.0
S: Bus	2	0.3
D: Single Unit Truck	17	2.9
E: Tractor Trailer Unit	10	1.7
Total	577	

West On Twp Rd 80		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	9	90.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	1	10.0
E: Tractor Trailer Unit	0	0.0
Total	10	

East On 508		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	45	91.8
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	3	6.1
E: Tractor Trailer Unit	1	2.0
Total	49	

South On 5		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	520	93.9
B: Recreational Vehicle	6	1.1
S: Bus	2	0.4
D: Single Unit Truck	15	2.7
E: Tractor Trailer Unit	11	2.0
Total	554	



TURNING MOVEMENT ABBREVIATIONS

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WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 104050

Intersection of:
5 & 508 S OF LETHBRIDGE

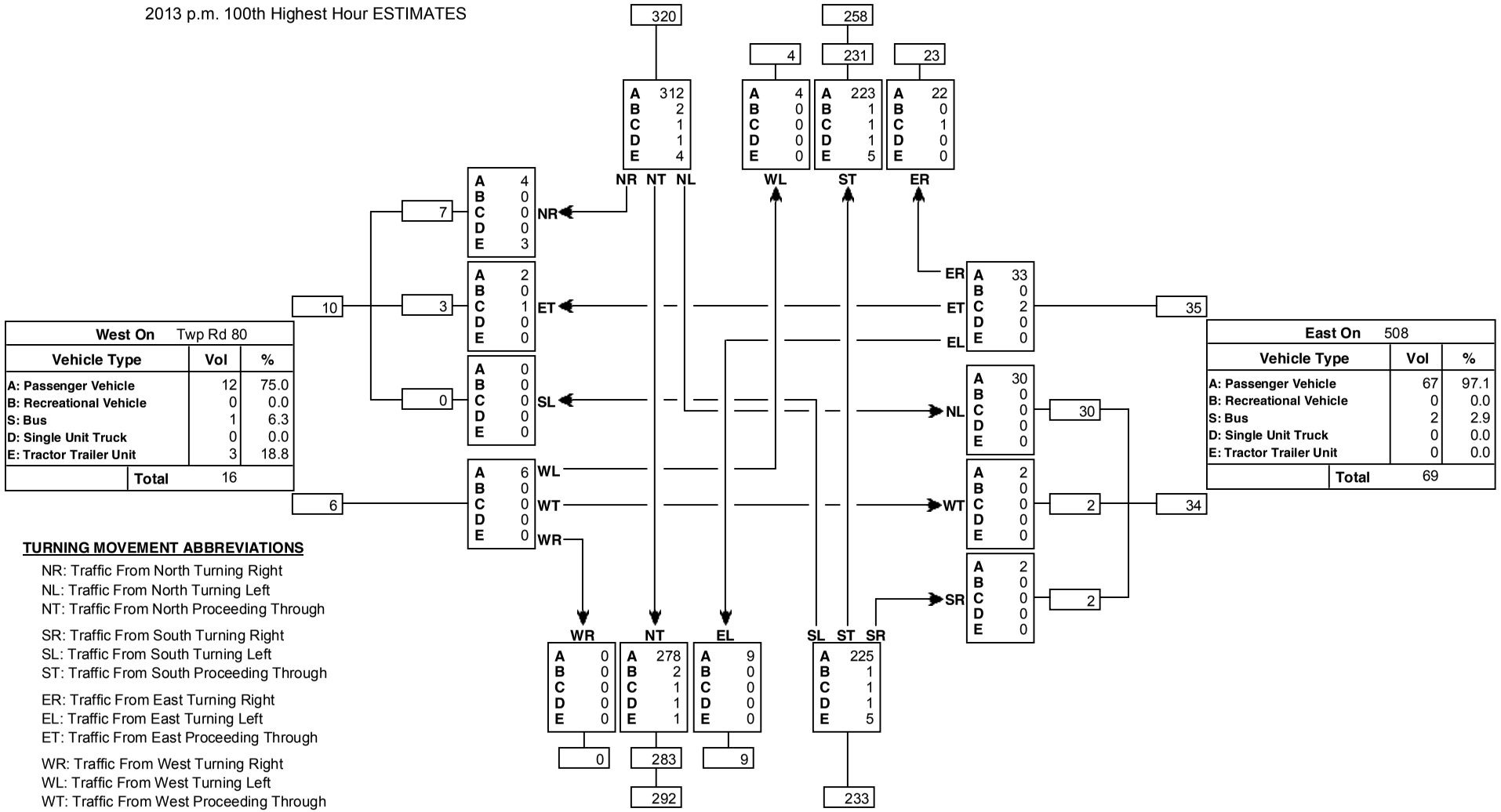
2013 p.m. 100th Highest Hour ESTIMATES

North On 5		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	561	97.1
B: Recreational Vehicle	3	0.5
S: Bus	3	0.5
D: Single Unit Truck	2	0.3
E: Tractor Trailer Unit	9	1.6
Total	578	

West On Twp Rd 80		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	12	75.0
B: Recreational Vehicle	0	0.0
S: Bus	1	6.3
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	3	18.8
Total	16	

East On 508		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	67	97.1
B: Recreational Vehicle	0	0.0
S: Bus	2	2.9
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	69	

South On 5		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	512	97.5
B: Recreational Vehicle	3	0.6
S: Bus	2	0.4
D: Single Unit Truck	2	0.4
E: Tractor Trailer Unit	6	1.1
Total	525	



TURNING MOVEMENT ABBREVIATIONS

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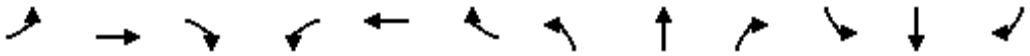
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

APPENDIX C

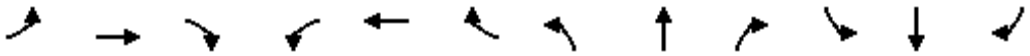
Synchro Outputs



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	0	0	6	1	16	1	299	10	16	238	4
Sign Control		Stop			Stop			Free			Free	
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)	5	0	0	7	1	18	1	340	11	18	270	5
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	670	662	273	649	653	340	275			351		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	670	662	273	649	653	340	275			351		
tC, single (s)	7.1	6.5	6.2	7.2	6.6	6.3	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	99	100	100	98	100	97	100			98		
cM capacity (veh/h)	356	376	766	370	373	689	1265			1186		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	5	26	341	11	18	275
Volume Left	5	7	1	0	18	0
Volume Right	0	18	0	11	0	5
cSH	356	546	1265	1700	1186	1700
Volume to Capacity	0.01	0.05	0.00	0.01	0.02	0.16
Queue Length 95th (m)	0.3	1.2	0.0	0.0	0.4	0.0
Control Delay (s)	15.3	11.9	0.0	0.0	8.1	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	15.3	11.9	0.0		0.5	
Approach LOS	C	B				

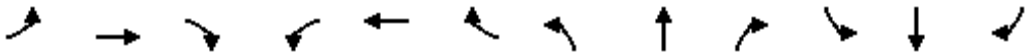
Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	30.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	7	0	0	4	3	12	399	0	0	0	0
Sign Control		Yield			Stop			Free			Free	
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)	11	8	0	0	5	3	14	453	0	0	0	0
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	260	481	0	485	481	227	0			453		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	260	481	0	485	481	227	0			453		
tC, single (s)	7.6	6.6	7.0	7.6	6.6	7.0	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.6	4.0	3.4	2.3			2.2		
p0 queue free %	98	98	100	100	99	100	99			100		
cM capacity (veh/h)	652	473	1075	450	473	767	1552			1104		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4
Volume Total	19	8	14	227	227	0
Volume Left	11	0	14	0	0	0
Volume Right	0	3	0	0	0	0
cSH	564	566	1552	1700	1700	1700
Volume to Capacity	0.03	0.01	0.01	0.13	0.13	0.00
Queue Length 95th (m)	0.9	0.3	0.2	0.0	0.0	0.0
Control Delay (s)	11.6	11.5	7.3	0.0	0.0	0.0
Lane LOS	B	B	A			
Approach Delay (s)	11.6	11.5	0.2			
Approach LOS	B	B				

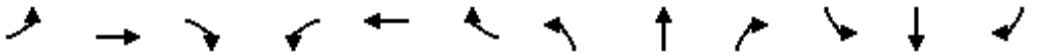
Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	26.3%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	15	0	0	19	5	0	0	0	4	0	1
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)	0	17	0	0	22	6	0	0	0	5	0	1
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	27			17			43	44	17	41	41	24
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	27			17			43	44	17	41	41	24
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.2	6.6	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.6	4.1	3.4
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1567			1581			959	847	1062	942	835	1029

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	17	27	0	6
Volume Left	0	0	0	5
Volume Right	0	6	0	1
cSH	1567	1581	1700	958
Volume to Capacity	0.00	0.00	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.0	0.1
Control Delay (s)	0.0	0.0	0.0	8.8
Lane LOS			A	A
Approach Delay (s)	0.0	0.0	0.0	8.8
Approach LOS			A	A

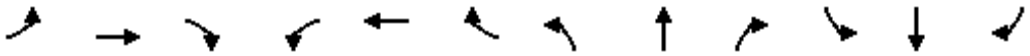
Intersection Summary				
Average Delay	1.0			
Intersection Capacity Utilization	13.3%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	14	5	1	15	0	0	0	0	3	198	9
Sign Control		Stop			Yield			Free			Free	
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)	0	16	6	1	17	0	0	0	0	3	225	10
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			2									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	240	232	112	130	242	0	235			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	240	232	112	130	242	0	235			0		
tC, single (s)	7.6	6.6	7.0	7.6	6.6	7.0	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.6	4.0	3.4	2.2			2.3		
p0 queue free %	100	98	99	100	97	100	100			100		
cM capacity (veh/h)	671	659	909	799	650	1075	1329			1552		

Direction, Lane #	EB 1	WB 1	SB 1	SB 2	SB 3	SB 4
Volume Total	22	18	3	112	112	10
Volume Left	0	1	3	0	0	0
Volume Right	6	0	0	0	0	10
cSH	894	658	1552	1700	1700	1700
Volume to Capacity	0.02	0.03	0.00	0.07	0.07	0.01
Queue Length 95th (m)	0.6	0.7	0.1	0.0	0.0	0.0
Control Delay (s)	10.2	10.6	7.3	0.0	0.0	0.0
Lane LOS	B	B	A			
Approach Delay (s)	10.2	10.6	0.1			
Approach LOS	B	B				

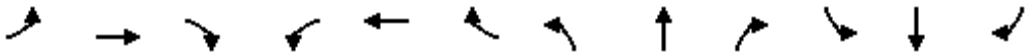
Intersection Summary				
Average Delay	1.6			
Intersection Capacity Utilization	22.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	2	0	9	3	23	0	231	2	30	283	7
Sign Control		Stop			Stop			Free			Free	
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)	5	2	0	10	3	26	0	262	2	34	322	8
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	684	659	326	653	660	262	330			265		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	684	659	326	653	660	262	330			265		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	100	97	99	97	100			97		
cM capacity (veh/h)	341	374	716	370	372	774	1224			1293		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	7	40	262	2	34	330
Volume Left	5	10	0	0	34	0
Volume Right	0	26	0	2	0	8
cSH	351	563	1224	1700	1293	1700
Volume to Capacity	0.02	0.07	0.00	0.00	0.03	0.19
Queue Length 95th (m)	0.5	1.8	0.0	0.0	0.6	0.0
Control Delay (s)	15.5	11.9	0.0	0.0	7.9	0.0
Lane LOS	C	B			A	
Approach Delay (s)	15.5	11.9	0.0		0.7	
Approach LOS	C	B				

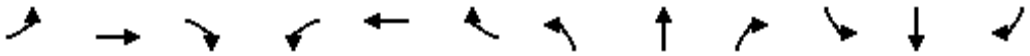
Intersection Summary				
Average Delay	1.3			
Intersection Capacity Utilization	37.1%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	5	0	0	2	6	13	279	1	0	0	0
Sign Control		Yield			Stop			Free			Free	
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)	5	6	0	0	2	7	15	317	1	0	0	0
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	196	348	0	349	347	159	0			318		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	196	348	0	349	347	159	0			318		
tC, single (s)	7.6	6.6	7.0	7.5	6.5	6.9	4.4			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.5	4.0	3.3	2.3			2.2		
p0 queue free %	99	99	100	100	100	99	99			100		
cM capacity (veh/h)	724	562	1075	572	570	859	1538			1239		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4
Volume Total	10	9	15	159	159	1
Volume Left	5	0	15	0	0	0
Volume Right	0	7	0	0	0	1
cSH	624	762	1538	1700	1700	1700
Volume to Capacity	0.02	0.01	0.01	0.09	0.09	0.00
Queue Length 95th (m)	0.4	0.3	0.2	0.0	0.0	0.0
Control Delay (s)	10.9	9.8	7.4	0.0	0.0	0.0
Lane LOS	B	A	A			
Approach Delay (s)	10.9	9.8	0.3			
Approach LOS	B	A				

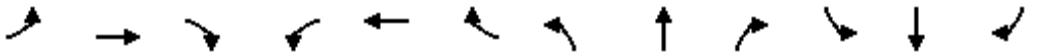
Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	19.2%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	1	21	0	0	17	1	0	0	0	5	0	0
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)	1	24	0	0	19	1	0	0	0	6	0	0
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	20			24			46	47	24	46	46	20
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	20			24			46	47	24	46	46	20
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.2	6.6	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.6	4.1	3.4
p0 queue free %	100			100			100	100	100	99	100	100
cM capacity (veh/h)	1576			1572			955	844	1053	935	830	1035

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	25	20	0	6
Volume Left	1	0	0	6
Volume Right	0	1	0	0
cSH	1576	1572	1700	935
Volume to Capacity	0.00	0.00	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.0	0.1
Control Delay (s)	0.3	0.0	0.0	8.9
Lane LOS	A		A	A
Approach Delay (s)	0.3	0.0	0.0	8.9
Approach LOS			A	A

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	13.3%	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)	0	9	17	0	15	0	0	0	0	0	308	3
Sign Control		Stop			Yield			Free			Free	
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)	0	10	19	0	17	0	0	0	0	0	350	3
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			2									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	359	350	175	190	353	0	353			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	359	350	175	190	353	0	353			0		
tC, single (s)	7.6	6.6	7.0	7.5	6.5	6.9	4.1			4.4		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.5	4.0	3.3	2.2			2.3		
p0 queue free %	100	98	98	100	97	100	100			100		
cM capacity (veh/h)	552	566	829	725	570	1084	1202			1538		

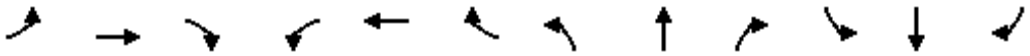
Direction, Lane #	EB 1	WB 1	SB 1	SB 2	SB 3	SB 4
Volume Total	30	17	0	175	175	3
Volume Left	0	0	0	0	0	0
Volume Right	19	0	0	0	0	3
cSH	1267	570	1700	1700	1700	1700
Volume to Capacity	0.02	0.03	0.00	0.10	0.10	0.00
Queue Length 95th (m)	0.6	0.7	0.0	0.0	0.0	0.0
Control Delay (s)	10.2	11.5	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	10.2	11.5	0.0			
Approach LOS	B	B				

Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	25.9%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	0	0	6	1	17	1	320	11	17	255	4
Sign Control		Stop			Stop			Free			Free	
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)	5	0	0	7	1	19	1	364	12	19	290	5
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	716	709	292	694	699	364	294			376		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	716	709	292	694	699	364	294			376		
tC, single (s)	7.1	6.5	6.2	7.2	6.6	6.3	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	99	100	100	98	100	97	100			98		
cM capacity (veh/h)	330	353	747	344	350	668	1245			1161		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	5	27	365	12	19	294
Volume Left	5	7	1	0	19	0
Volume Right	0	19	0	12	0	5
cSH	330	525	1245	1700	1161	1700
Volume to Capacity	0.01	0.05	0.00	0.01	0.02	0.17
Queue Length 95th (m)	0.3	1.3	0.0	0.0	0.4	0.0
Control Delay (s)	16.1	12.2	0.0	0.0	8.2	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	16.1	12.2	0.0		0.5	
Approach LOS	C	B				

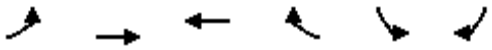
Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	31.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	7	0	0	4	3	12	415	0	0	0	0
Sign Control		Yield			Stop			Free			Free	
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)	11	8	0	0	5	3	14	472	0	0	0	0
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	269	499	0	503	499	236	0			472		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	269	499	0	503	499	236	0			472		
tC, single (s)	7.6	6.6	7.0	7.6	6.6	7.0	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.6	4.0	3.4	2.3			2.2		
p0 queue free %	98	98	100	100	99	100	99			100		
cM capacity (veh/h)	642	461	1075	436	461	757	1552			1087		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4
Volume Total	19	8	14	236	236	0
Volume Left	11	0	14	0	0	0
Volume Right	0	3	0	0	0	0
cSH	553	554	1552	1700	1700	1700
Volume to Capacity	0.03	0.01	0.01	0.14	0.14	0.00
Queue Length 95th (m)	0.9	0.3	0.2	0.0	0.0	0.0
Control Delay (s)	11.7	11.6	7.3	0.0	0.0	0.0
Lane LOS	B	B	A			
Approach Delay (s)	11.7	11.6	0.2			
Approach LOS	B	B				

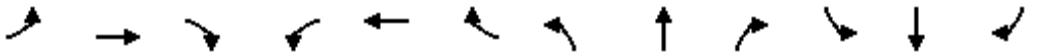
Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	26.8%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	15	19	5	4	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	0	17	22	6	5	1
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	27				41	24
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	27				41	24
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	100				100	100
cM capacity (veh/h)	1567				950	1029

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	17	27	6
Volume Left	0	0	5
Volume Right	0	6	1
cSH	1567	1700	965
Volume to Capacity	0.00	0.02	0.01
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.0	0.0	8.8
Lane LOS			A
Approach Delay (s)	0.0	0.0	8.8
Approach LOS			A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	13.3%	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)	0	14	5	1	15	0	0	0	0	3	206	9
Sign Control		Stop			Yield			Free			Free	
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)	0	16	6	1	17	0	0	0	0	3	234	10
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			2									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	249	241	117	135	251	0	244			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	249	241	117	135	251	0	244			0		
tC, single (s)	7.6	6.6	7.0	7.6	6.6	7.0	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.6	4.0	3.4	2.2			2.3		
p0 queue free %	100	98	99	100	97	100	100			100		
cM capacity (veh/h)	661	651	903	793	642	1075	1319			1552		

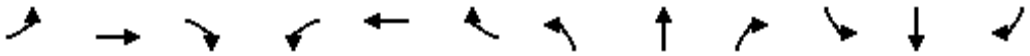
Direction, Lane #	EB 1	WB 1	SB 1	SB 2	SB 3	SB 4
Volume Total	22	18	3	117	117	10
Volume Left	0	1	3	0	0	0
Volume Right	6	0	0	0	0	10
cSH	884	650	1552	1700	1700	1700
Volume to Capacity	0.02	0.03	0.00	0.07	0.07	0.01
Queue Length 95th (m)	0.6	0.7	0.1	0.0	0.0	0.0
Control Delay (s)	10.2	10.7	7.3	0.0	0.0	0.0
Lane LOS	B	B	A			
Approach Delay (s)	10.2	10.7	0.1			
Approach LOS	B	B				

Intersection Summary				
Average Delay	1.5			
Intersection Capacity Utilization	22.8%	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)	4	2	0	9	3	24	0	247	2	32	303	7
Sign Control		Stop			Stop			Free			Free	
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)	5	2	0	10	3	27	0	281	2	36	344	8
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	731	704	348	699	706	281	352			283		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	731	704	348	699	706	281	352			283		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	100	97	99	96	100			97		
cM capacity (veh/h)	316	351	695	344	349	756	1201			1274		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	7	41	281	2	36	352
Volume Left	5	10	0	0	36	0
Volume Right	0	27	0	2	0	8
cSH	327	541	1201	1700	1274	1700
Volume to Capacity	0.02	0.08	0.00	0.00	0.03	0.21
Queue Length 95th (m)	0.5	2.0	0.0	0.0	0.7	0.0
Control Delay (s)	16.3	12.2	0.0	0.0	7.9	0.0
Lane LOS	C	B			A	
Approach Delay (s)	16.3	12.2	0.0		0.7	
Approach LOS	C	B				

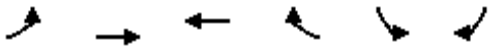
Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	38.9%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	5	0	0	2	6	14	290	1	0	0	0
Sign Control		Yield			Stop			Free			Free	
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)	5	6	0	0	2	7	16	330	1	0	0	0
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	205	362	0	364	361	165	0			331		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	205	362	0	364	361	165	0			331		
tC, single (s)	7.6	6.6	7.0	7.5	6.5	6.9	4.4			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.5	4.0	3.3	2.3			2.2		
p0 queue free %	99	99	100	100	100	99	99			100		
cM capacity (veh/h)	713	551	1075	558	559	851	1538			1226		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4
Volume Total	10	9	16	165	165	1
Volume Left	5	0	16	0	0	0
Volume Right	0	7	0	0	0	1
cSH	613	752	1538	1700	1700	1700
Volume to Capacity	0.02	0.01	0.01	0.10	0.10	0.00
Queue Length 95th (m)	0.4	0.3	0.3	0.0	0.0	0.0
Control Delay (s)	11.0	9.8	7.4	0.0	0.0	0.0
Lane LOS	B	A	A			
Approach Delay (s)	11.0	9.8	0.3			
Approach LOS	B	A				

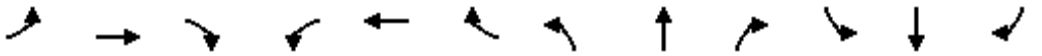
Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	19.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	1	22	18	1	5	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	1	25	20	1	6	0
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	22				48	21
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	22				48	21
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	100				99	100
cM capacity (veh/h)	1575				941	1034

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	26	22	6
Volume Left	1	0	6
Volume Right	0	1	0
cSH	1575	1700	941
Volume to Capacity	0.00	0.01	0.01
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.3	0.0	8.9
Lane LOS	A		A
Approach Delay (s)	0.3	0.0	8.9
Approach LOS			A

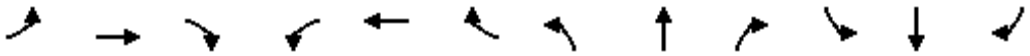
Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	9	18	0	16	0	0	0	0	0	320	3
Sign Control		Stop			Yield			Free			Free	
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)	0	10	20	0	18	0	0	0	0	0	364	3
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			2									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	373	364	182	197	367	0	367			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	373	364	182	197	367	0	367			0		
tC, single (s)	7.6	6.6	7.0	7.5	6.5	6.9	4.1			4.4		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.5	4.0	3.3	2.2			2.3		
p0 queue free %	100	98	98	100	97	100	100			100		
cM capacity (veh/h)	538	556	820	715	560	1084	1188			1538		

Direction, Lane #	EB 1	WB 1	SB 1	SB 2	SB 3	SB 4
Volume Total	31	18	0	182	182	3
Volume Left	0	0	0	0	0	0
Volume Right	20	0	0	0	0	3
cSH	1230	560	1700	1700	1700	1700
Volume to Capacity	0.02	0.03	0.00	0.11	0.11	0.00
Queue Length 95th (m)	0.6	0.8	0.0	0.0	0.0	0.0
Control Delay (s)	10.2	11.6	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	10.2	11.6	0.0			
Approach LOS	B	B				

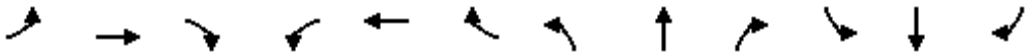
Intersection Summary				
Average Delay	1.3			
Intersection Capacity Utilization	26.3%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	0	0	13	1	37	1	299	44	119	238	4
Sign Control		Stop			Stop			Free			Free	
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)	5	0	0	15	1	42	1	340	50	135	270	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)						4						
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	907	935	273	883	887	340	275			390		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	907	935	273	883	887	340	275			390		
tC, single (s)	7.1	6.5	6.2	7.2	6.6	6.3	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	98	100	100	94	100	94	100			88		
cM capacity (veh/h)	218	234	766	236	244	689	1265			1147		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	5	58	341	50	135	275
Volume Left	5	15	1	0	135	0
Volume Right	0	42	0	50	0	5
cSH	218	863	1265	1700	1147	1700
Volume to Capacity	0.02	0.07	0.00	0.03	0.12	0.16
Queue Length 95th (m)	0.5	1.7	0.0	0.0	3.2	0.0
Control Delay (s)	21.8	13.5	0.0	0.0	8.6	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	21.8	13.5	0.0		2.8	
Approach LOS	C	B				

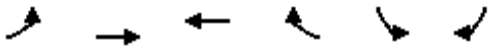
Intersection Summary				
Average Delay	2.4			
Intersection Capacity Utilization	44.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	95	14	0	0	38	3	115	399	0	0	0	0
Sign Control		Yield			Stop			Free			Free	
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)	108	16	0	0	43	3	131	453	0	0	0	0
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	513	715	0	723	715	227	0			453		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	513	715	0	723	715	227	0			453		
tC, single (s)	7.6	6.6	7.0	7.6	6.6	7.0	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.6	4.0	3.4	2.3			2.2		
p0 queue free %	70	95	100	100	86	100	92			100		
cM capacity (veh/h)	366	320	1075	278	320	767	1552			1104		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4
Volume Total	124	47	131	227	227	0
Volume Left	108	0	131	0	0	0
Volume Right	0	3	0	0	0	0
cSH	359	334	1552	1700	1700	1700
Volume to Capacity	0.34	0.14	0.08	0.13	0.13	0.00
Queue Length 95th (m)	12.0	3.8	2.2	0.0	0.0	0.0
Control Delay (s)	20.2	17.5	7.5	0.0	0.0	0.0
Lane LOS	C	C	A			
Approach Delay (s)	20.2	17.5	1.7			
Approach LOS	C	C				

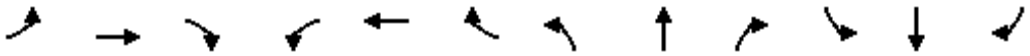
Intersection Summary				
Average Delay	5.7			
Intersection Capacity Utilization	31.8%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	138	15	18	556	117	29
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	157	17	20	632	133	33
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	652				351	20
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	652				351	20
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	83				75	97
cM capacity (veh/h)	920				523	1035

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	157	17	20	632	166
Volume Left	157	0	0	0	133
Volume Right	0	0	0	632	33
cSH	920	1700	1700	1700	580
Volume to Capacity	0.17	0.01	0.01	0.37	0.29
Queue Length 95th (m)	4.9	0.0	0.0	0.0	9.4
Control Delay (s)	9.7	0.0	0.0	0.0	13.7
Lane LOS	A				B
Approach Delay (s)	8.8		0.0		13.7
Approach LOS					B

Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	52.3%	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)	0	106	26	1	152	0	0	0	0	3	198	422
Sign Control		Stop			Yield			Free			Free	
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)	0	120	30	1	173	0	0	0	0	3	225	480
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			2									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	318	232	112	194	711	0	705			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	318	232	112	194	711	0	705			0		
tC, single (s)	7.6	6.6	7.0	7.6	6.6	7.0	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.6	4.0	3.4	2.2			2.3		
p0 queue free %	100	82	97	100	51	100	100			100		
cM capacity (veh/h)	369	659	909	614	350	1075	889			1552		

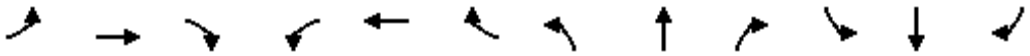
Direction, Lane #	EB 1	WB 1	SB 1	SB 2	SB 3	SB 4
Volume Total	150	174	3	112	112	480
Volume Left	0	1	3	0	0	0
Volume Right	30	0	0	0	0	480
cSH	820	351	1552	1700	1700	1700
Volume to Capacity	0.18	0.50	0.00	0.07	0.07	0.28
Queue Length 95th (m)	5.3	21.1	0.1	0.0	0.0	0.0
Control Delay (s)	11.2	24.9	7.3	0.0	0.0	0.0
Lane LOS	B	C	A			
Approach Delay (s)	11.2	24.9	0.0			
Approach LOS	B	C				

Intersection Summary				
Average Delay	5.9			
Intersection Capacity Utilization	43.8%	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)	4	2	0	40	3	117	0	231	11	56	283	7
Sign Control		Stop			Stop			Free			Free	
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)	5	2	0	45	3	133	0	262	12	64	322	8
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)						4						
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	784	728	326	712	719	262	330			275		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	784	728	326	712	719	262	330			275		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	99	100	86	99	83	100			95		
cM capacity (veh/h)	246	333	716	331	335	774	1224			1282		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	7	182	262	12	64	330
Volume Left	5	45	0	0	64	0
Volume Right	0	133	0	12	0	8
cSH	269	1058	1224	1700	1282	1700
Volume to Capacity	0.03	0.17	0.00	0.01	0.05	0.19
Queue Length 95th (m)	0.6	5.0	0.0	0.0	1.3	0.0
Control Delay (s)	18.7	12.5	0.0	0.0	8.0	0.0
Lane LOS	C	B			A	
Approach Delay (s)	18.7	12.5	0.0		1.3	
Approach LOS	C	B				

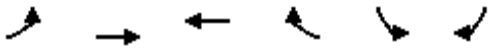
Intersection Summary				
Average Delay	3.4			
Intersection Capacity Utilization	43.8%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	379	36	0	0	11	6	39	279	1	0	0	0
Sign Control		Yield			Stop			Free			Free	
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)	431	41	0	0	12	7	44	317	1	0	0	0
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	260	407	0	426	406	159	0			318		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	260	407	0	426	406	159	0			318		
tC, single (s)	7.6	6.6	7.0	7.5	6.5	6.9	4.4			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.5	4.0	3.3	2.3			2.2		
p0 queue free %	32	92	100	100	98	99	97			100		
cM capacity (veh/h)	632	510	1075	470	518	859	1538			1239		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4
Volume Total	472	19	44	159	159	1
Volume Left	431	0	44	0	0	0
Volume Right	0	7	0	0	0	1
cSH	619	602	1538	1700	1700	1700
Volume to Capacity	0.76	0.03	0.03	0.09	0.09	0.00
Queue Length 95th (m)	55.6	0.8	0.7	0.0	0.0	0.0
Control Delay (s)	26.9	11.2	7.4	0.0	0.0	0.0
Lane LOS	D	B	A			
Approach Delay (s)	26.9	11.2	0.9			
Approach LOS	D	B				

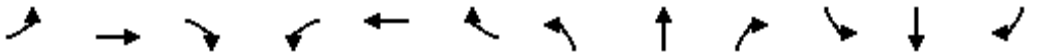
Intersection Summary				
Average Delay	15.5			
Intersection Capacity Utilization	46.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	36	21	17	142	505	125
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	41	24	19	161	574	142
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	181				125	19
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	181				125	19
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	97				31	86
cM capacity (veh/h)	1377				826	1036

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	41	24	19	161	716
Volume Left	41	0	0	0	574
Volume Right	0	0	0	161	142
cSH	1377	1700	1700	1700	860
Volume to Capacity	0.03	0.01	0.01	0.09	0.83
Queue Length 95th (m)	0.7	0.0	0.0	0.0	77.4
Control Delay (s)	7.7	0.0	0.0	0.0	26.1
Lane LOS	A				D
Approach Delay (s)	4.9		0.0		26.1
Approach LOS					D

Intersection Summary			
Average Delay	19.8		
Intersection Capacity Utilization	54.2%	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)	0	415	111	0	50	0	0	0	0	0	308	109
Sign Control		Stop			Yield			Free			Free	
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)	0	472	126	0	57	0	0	0	0	0	350	124
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			2									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	378	350	175	474	474	0	474			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	378	350	175	474	474	0	474			0		
tC, single (s)	7.6	6.6	7.0	7.5	6.5	6.9	4.1			4.4		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.5	4.0	3.3	2.2			2.3		
p0 queue free %	100	17	85	100	88	100	100			100		
cM capacity (veh/h)	498	566	829	121	488	1084	1084			1538		

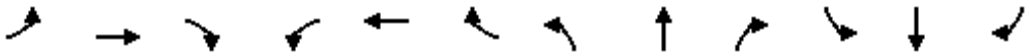
Direction, Lane #	EB 1	WB 1	SB 1	SB 2	SB 3	SB 4
Volume Total	598	57	0	175	175	124
Volume Left	0	0	0	0	0	0
Volume Right	126	0	0	0	0	124
cSH	644	488	1700	1700	1700	1700
Volume to Capacity	0.93	0.12	0.00	0.10	0.10	0.07
Queue Length 95th (m)	99.0	3.1	0.0	0.0	0.0	0.0
Control Delay (s)	45.5	13.4	0.0	0.0	0.0	0.0
Lane LOS	E	B				
Approach Delay (s)	45.5	13.4	0.0			
Approach LOS	E	B				

Intersection Summary				
Average Delay	24.8			
Intersection Capacity Utilization	39.6%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	0	0	13	1	38	1	320	45	120	255	4
Sign Control		Stop			Stop			Free			Free	
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)	5	0	0	15	1	43	1	364	51	136	290	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)						4						
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	953	982	292	928	933	364	294			415		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	953	982	292	928	933	364	294			415		
tC, single (s)	7.1	6.5	6.2	7.2	6.6	6.3	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	98	100	100	93	100	94	100			88		
cM capacity (veh/h)	202	219	747	219	228	668	1245			1123		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	5	59	365	51	136	294
Volume Left	5	15	1	0	136	0
Volume Right	0	43	0	51	0	5
cSH	202	817	1245	1700	1123	1700
Volume to Capacity	0.02	0.07	0.00	0.03	0.12	0.17
Queue Length 95th (m)	0.6	1.9	0.0	0.0	3.3	0.0
Control Delay (s)	23.3	14.0	0.0	0.0	8.6	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	23.3	14.0	0.0		2.7	
Approach LOS	C	B				

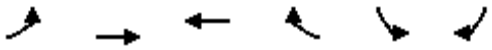
Intersection Summary				
Average Delay	2.3			
Intersection Capacity Utilization	46.8%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	95	14	0	0	39	3	116	415	0	0	0	0
Sign Control		Yield			Stop			Free			Free	
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)	108	16	0	0	44	3	132	472	0	0	0	0
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	525	735	0	743	735	236	0			472		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	525	735	0	743	735	236	0			472		
tC, single (s)	7.6	6.6	7.0	7.6	6.6	7.0	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.6	4.0	3.4	2.3			2.2		
p0 queue free %	70	95	100	100	86	100	92			100		
cM capacity (veh/h)	356	311	1075	268	311	757	1552			1087		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4
Volume Total	124	48	132	236	236	0
Volume Left	108	0	132	0	0	0
Volume Right	0	3	0	0	0	0
cSH	350	324	1552	1700	1700	1700
Volume to Capacity	0.35	0.15	0.08	0.14	0.14	0.00
Queue Length 95th (m)	12.5	4.1	2.2	0.0	0.0	0.0
Control Delay (s)	20.8	18.0	7.5	0.0	0.0	0.0
Lane LOS	C	C	A			
Approach Delay (s)	20.8	18.0	1.6			
Approach LOS	C	C				

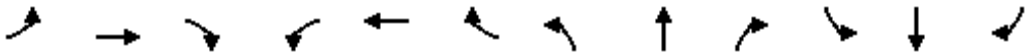
Intersection Summary				
Average Delay	5.7			
Intersection Capacity Utilization	32.3%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	138	15	20	556	117	29
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	157	17	23	632	133	33
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	655				353	23
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	655				353	23
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	83				74	97
cM capacity (veh/h)	918				521	1031

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	157	17	23	632	166
Volume Left	157	0	0	0	133
Volume Right	0	0	0	632	33
cSH	918	1700	1700	1700	578
Volume to Capacity	0.17	0.01	0.01	0.37	0.29
Queue Length 95th (m)	4.9	0.0	0.0	0.0	9.4
Control Delay (s)	9.7	0.0	0.0	0.0	13.7
Lane LOS	A				B
Approach Delay (s)	8.8		0.0		13.7
Approach LOS					B

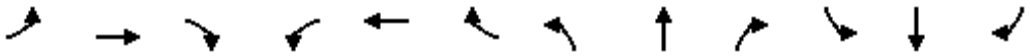
Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	52.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	106	26	1	154	0	0	0	0	3	206	422
Sign Control		Stop			Yield			Free			Free	
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)	0	120	30	1	175	0	0	0	0	3	234	480
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			2									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	328	241	117	199	720	0	714			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	328	241	117	199	720	0	714			0		
tC, single (s)	7.6	6.6	7.0	7.6	6.6	7.0	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.6	4.0	3.4	2.2			2.3		
p0 queue free %	100	81	97	100	49	100	100			100		
cM capacity (veh/h)	356	651	903	608	345	1075	882			1552		

Direction, Lane #	EB 1	WB 1	SB 1	SB 2	SB 3	SB 4
Volume Total	150	176	3	117	117	480
Volume Left	0	1	3	0	0	0
Volume Right	30	0	0	0	0	480
cSH	811	346	1552	1700	1700	1700
Volume to Capacity	0.19	0.51	0.00	0.07	0.07	0.28
Queue Length 95th (m)	5.4	22.0	0.1	0.0	0.0	0.0
Control Delay (s)	11.3	25.7	7.3	0.0	0.0	0.0
Lane LOS	B	D	A			
Approach Delay (s)	11.3	25.7	0.0			
Approach LOS	B	D				

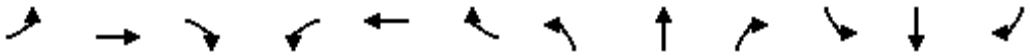
Intersection Summary				
Average Delay	6.0			
Intersection Capacity Utilization	43.9%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	2	0	9	3	24	0	247	2	32	303	7
Sign Control		Stop			Stop			Free			Free	
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)	5	2	0	10	3	27	0	281	2	36	344	8
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)						4						
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	717	704	348	699	706	281	352			283		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	717	704	348	699	706	281	352			283		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	100	97	99	96	100			97		
cM capacity (veh/h)	323	351	695	344	349	756	1201			1274		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	7	41	281	2	36	352
Volume Left	5	10	0	0	36	0
Volume Right	0	27	0	2	0	8
cSH	332	1035	1201	1700	1274	1700
Volume to Capacity	0.02	0.04	0.00	0.00	0.03	0.21
Queue Length 95th (m)	0.5	1.0	0.0	0.0	0.7	0.0
Control Delay (s)	16.1	11.9	0.0	0.0	7.9	0.0
Lane LOS	C	B			A	
Approach Delay (s)	16.1	11.9	0.0		0.7	
Approach LOS	C	B				

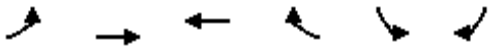
Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	39.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	379	36	0	0	11	6	40	290	1	0	0	0
Sign Control		Yield			Stop			Free			Free	
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)	431	41	0	0	12	7	45	330	1	0	0	0
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	269	422	0	441	420	165	0			331		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	269	422	0	441	420	165	0			331		
tC, single (s)	7.6	6.6	7.0	7.5	6.5	6.9	4.4			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.5	4.0	3.3	2.3			2.2		
p0 queue free %	31	92	100	100	98	99	97			100		
cM capacity (veh/h)	623	500	1075	458	507	851	1538			1226		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4
Volume Total	472	19	45	165	165	1
Volume Left	431	0	45	0	0	0
Volume Right	0	7	0	0	0	1
cSH	610	592	1538	1700	1700	1700
Volume to Capacity	0.77	0.03	0.03	0.10	0.10	0.00
Queue Length 95th (m)	57.8	0.8	0.7	0.0	0.0	0.0
Control Delay (s)	28.1	11.3	7.4	0.0	0.0	0.0
Lane LOS	D	B	A			
Approach Delay (s)	28.1	11.3	0.9			
Approach LOS	D	B				

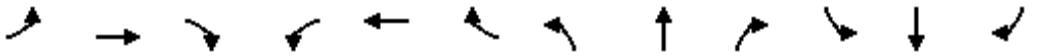
Intersection Summary				
Average Delay	15.9			
Intersection Capacity Utilization	46.9%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	36	21	18	142	505	125
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	41	24	20	161	574	142
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	182				126	20
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	182				126	20
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	97				30	86
cM capacity (veh/h)	1375				825	1035

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	41	24	20	161	716
Volume Left	41	0	0	0	574
Volume Right	0	0	0	161	142
cSH	1375	1700	1700	1700	859
Volume to Capacity	0.03	0.01	0.01	0.09	0.83
Queue Length 95th (m)	0.7	0.0	0.0	0.0	77.8
Control Delay (s)	7.7	0.0	0.0	0.0	26.3
Lane LOS	A				D
Approach Delay (s)	4.9		0.0		26.3
Approach LOS					D

Intersection Summary			
Average Delay	19.9		
Intersection Capacity Utilization	54.2%	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)	0	415	111	0	51	0	0	0	0	0	320	109
Sign Control		Stop			Yield			Free			Free	
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)	0	472	126	0	58	0	0	0	0	0	364	124
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)			2									
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	393	364	182	481	488	0	488			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	393	364	182	481	488	0	488			0		
tC, single (s)	7.6	6.6	7.0	7.5	6.5	6.9	4.1			4.4		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.4	3.5	4.0	3.3	2.2			2.3		
p0 queue free %	100	15	85	100	88	100	100			100		
cM capacity (veh/h)	484	556	820	113	479	1084	1072			1538		

Direction, Lane #	EB 1	WB 1	SB 1	SB 2	SB 3	SB 4
Volume Total	598	58	0	182	182	124
Volume Left	0	0	0	0	0	0
Volume Right	126	0	0	0	0	124
cSH	633	479	1700	1700	1700	1700
Volume to Capacity	0.94	0.12	0.00	0.11	0.11	0.07
Queue Length 95th (m)	103.6	3.3	0.0	0.0	0.0	0.0
Control Delay (s)	49.0	13.5	0.0	0.0	0.0	0.0
Lane LOS	E	B				
Approach Delay (s)	49.0	13.5	0.0			
Approach LOS	E	B				

Intersection Summary				
Average Delay	26.3			
Intersection Capacity Utilization	40.0%	ICU Level of Service	A	
Analysis Period (min)	15			

APPENDIX D

Illumination Warrant Spreadsheets

Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 508	Main Road	**Date**	Existing Traffic Conditions
Existing Access	Minor Road	**Other**	Site visit completed on May 12, 2014
County of Lethbridge	City/Town		Intersection turning movement volumes obtained from AT

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		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)	0		5		OK	
Channelization Factor					OK	0
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)	90				OK	
Radius of Horizontal Curve (m)	400			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	4				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		4	5		OK	20
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**26**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	450	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)	100	0	20		OK	0
Signalization Warrant	Descriptive	0	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	0	5	Refer to Table 1(B) for ratings.	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	90	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	**20**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

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	26
Operational Factor Subtotal	20
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**46**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 4	Main Road
Highway 508	Minor Road
County of Lethbridge	City/Town

Date	Existing Traffic Conditions
Other	Site visit completed on May 12, 2014
	Intersection turning movement volumes obtained from AT

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)	0		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)	100				OK	
Radius of Horizontal Curve (m)	400			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	4				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		4	5		OK	20
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**41**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	6200	4	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	40
AADT on Minor Road (2-way)	450	0	20		OK	0
Signalization Warrant	Descriptive	0	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	4	5	Refer to Table 1(B) for ratings.	OK	20
Operating Speed or Posted Speed on Major Road (km/h)	110	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
					Operational Factors Subtotal	**100**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	1.0	1	15	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	15
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	**15**

Check Intersection Signalization:
Intersection is not Signalized

ILLUMINATION WARRANTED
REVIEW SITE AND COLLISIONS TO DETERMINE LIGHTING TYPE (PARTIAL OR DELINEATION)

SUMMARY

Geometric Factors Subtotal	41
Operational Factor Subtotal	100
Environmental Factor Subtotal	0
Collision History Subtotal	15
TOTAL POINTS	**156**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

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INTERSECTION CHARACTERISTICS

Highway 5	Main Road	**Date**	Exisitng Traffic Conditions
Highway 508	Minor Road	**Other**	Site visit completed on May 12, 2014
County of Lethbridge	City/Town		Intersection turning movement volumes obtained from AT

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)	0		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)	100				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 =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		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%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**21**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	5500	4	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	40
AADT on Minor Road (2-way)	550	1	20		OK	20
Signalization Warrant	Descriptive	0	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	2	5	Refer to Table 1(B) for ratings.	OK	10
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)	100	4	5	Refer to Table 1(B), note #3	OK	20
					Operational Factors Subtotal	**110**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

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

ILLUMINATION WARRANTED
REVIEW SITE AND COLLISIONS TO DETERMINE LIGHTING TYPE (PARTIAL OR DELINEATION)

SUMMARY

Geometric Factors Subtotal	21
Operational Factor Subtotal	110
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**131**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

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INTERSECTION CHARACTERISTICS

Highway 508	Main Road	**Date**	20-Year Background Traffic Conditions
Existing Access	Minor Road	**Other**	Site visit completed on May 12, 2014
County of Lethbridge	City/Town		Intersection turning movement volumes obtained from AT

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		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)	0		5		OK	
Channelization Factor					OK	0
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)	90				OK	
Radius of Horizontal Curve (m)	400			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	4				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		4	5		OK	20
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**26**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	450	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)	100	0	20		OK	0
Signalization Warrant	Descriptive	0	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	0	5	Refer to Table 1(B) for ratings.	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	90	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	**20**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

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	26
Operational Factor Subtotal	20
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**46**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

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INTERSECTION CHARACTERISTICS

Highway 4	Main Road	**Date**	20-Year Background Traffic Conditions
Highway 508	Minor Road	**Other**	Site visit completed on May 12, 2014
County of Lethbridge	City/Town		Intersection turning movement volumes obtained from AT

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)	0		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)	100				OK	
Radius of Horizontal Curve (m)	400			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	4				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		4	5		OK	20
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**41**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	6400	4	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	40
AADT on Minor Road (2-way)	450	0	20		OK	0
Signalization Warrant	Descriptive	0	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	4	5	Refer to Table 1(B) for ratings.	OK	20
Operating Speed or Posted Speed on Major Road (km/h)	110	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
					Operational Factors Subtotal	**100**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	1.0	1	15	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	15
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	**15**

Check Intersection Signalization:
Intersection is not Signalized

ILLUMINATION WARRANTED
REVIEW SITE AND COLLISIONS TO DETERMINE LIGHTING TYPE (PARTIAL OR DELINEATION)

SUMMARY	
Geometric Factors Subtotal	41
Operational Factor Subtotal	100
Environmental Factor Subtotal	0
Collision History Subtotal	15
TOTAL POINTS	**156**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

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INTERSECTION CHARACTERISTICS

Highway 5	Main Road
Highway 508	Minor Road
County of Lethbridge	City/Town

Date	20-Year Background Traffic Conditions
Other	Site visit completed on May 12, 2014
	Intersection turning movement volumes obtained from AT

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)	0		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)	100				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 =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		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%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**21**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	6200	4	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	40
AADT on Minor Road (2-way)	700	1	20		OK	20
Signalization Warrant	Descriptive	0	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	2	5	Refer to Table 1(B) for ratings.	OK	10
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)	100	4	5	Refer to Table 1(B), note #3	OK	20
					Operational Factors Subtotal	**110**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

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

ILLUMINATION WARRANTED
REVIEW SITE AND COLLISIONS TO DETERMINE LIGHTING TYPE (PARTIAL OR DELINEATION)

SUMMARY

Geometric Factors Subtotal	21
Operational Factor Subtotal	110
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**131**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

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INTERSECTION CHARACTERISTICS

Highway 508	Main Road	**Date**	Opening Day Traffic Conditions
Existing Access	Minor Road	**Other**	Site visit completed on May 12, 2014
County of Lethbridge	City/Town		Intersection turning movement volumes obtained from AT

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		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)	0		5		OK	
Channelization Factor					OK	0
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)	90				OK	
Radius of Horizontal Curve (m)	400			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	4				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		4	5		OK	20
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**26**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	6900	4	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	40
AADT on Minor Road (2-way)	8100	4	20		OK	80
Signalization Warrant	Descriptive	0	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	0	5	Refer to Table 1(B) for ratings.	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	90	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	**140**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

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

ILLUMINATION WARRANTED
DELINEATION LIGHTING TO ILLUMINATE PEDESTRIANS OR CROSS STREET TRAFFIC

SUMMARY

Geometric Factors Subtotal	26
Operational Factor Subtotal	140
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**166**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

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INTERSECTION CHARACTERISTICS

Highway 4	Main Road
Highway 508	Minor Road
County of Lethbridge	City/Town

Date	Opening Day Traffic Conditions
Other	Site visit completed on May 12, 2014
	Intersection turning movement volumes obtained from AT

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)	0		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)	100				OK	
Radius of Horizontal Curve (m)	400			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	4				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		4	5		OK	20
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**41**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	10800	4	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	40
AADT on Minor Road (2-way)	6900	4	20		OK	80
Signalization Warrant	Descriptive	0	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	4	5	Refer to Table 1(B) for ratings.	OK	20
Operating Speed or Posted Speed on Major Road (km/h)	110	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
					Operational Factors Subtotal	**180**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	1.0	1	15	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	15
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	**15**

Check Intersection Signalization:
Intersection is not Signalized

ILLUMINATION WARRANTED
DELINEATION LIGHTING TO ILLUMINATE PEDESTRIANS OR CROSS STREET TRAFFIC

SUMMARY	
Geometric Factors Subtotal	41
Operational Factor Subtotal	180
Environmental Factor Subtotal	0
Collision History Subtotal	15
TOTAL POINTS	**236**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

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INTERSECTION CHARACTERISTICS

Highway 5	Main Road
Highway 508	Minor Road
County of Lethbridge	City/Town

Date	Opening Day Traffic Conditions
Other	Site visit completed on May 12, 2014
	Intersection turning movement volumes obtained from AT

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)	0		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)	100				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 =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		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%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**21**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	7000	4	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	40
AADT on Minor Road (2-way)	2300	4	20		OK	80
Signalization Warrant	Descriptive	0	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	2	5	Refer to Table 1(B) for ratings.	OK	10
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)	100	4	5	Refer to Table 1(B), note #3	OK	20
					Operational Factors Subtotal	**170**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

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

ILLUMINATION WARRANTED
DELINEATION LIGHTING TO ILLUMINATE PEDESTRIANS OR CROSS STREET TRAFFIC

SUMMARY

Geometric Factors Subtotal	21
Operational Factor Subtotal	170
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**191**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

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Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 508	Main Road	**Date**	20-Year Post Development Traffic Conditions
Existing Access	Minor Road	**Other**	Site visit completed on May 12, 2014
County of Lethbridge	City/Town		Intersection turning movement volumes obtained from AT

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		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)	0		5		OK	
Channelization Factor					OK	0
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)	90				OK	
Radius of Horizontal Curve (m)	400			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	4				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		4	5		OK	20
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**26**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	6900	4	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	40
AADT on Minor Road (2-way)	8100	4	20		OK	80
Signalization Warrant	Descriptive	0	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	0	5	Refer to Table 1(B) for ratings.	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	90	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	**140**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

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

ILLUMINATION WARRANTED
DELINEATION LIGHTING TO ILLUMINATE PEDESTRIANS OR CROSS STREET TRAFFIC

SUMMARY

Geometric Factors Subtotal	26
Operational Factor Subtotal	140
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**166**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

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Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 4	Main Road
Highway 508	Minor Road
County of Lethbridge	City/Town

Date	20-Year Post Development Traffic Conditions
Other	Site visit completed on May 12, 2014
	Intersection turning movement volumes obtained from AT

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)	0		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)	100				OK	
Radius of Horizontal Curve (m)	400			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	4				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		4	5		OK	20
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**41**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	11000	4	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	40
AADT on Minor Road (2-way)	6900	4	20		OK	80
Signalization Warrant	Descriptive	0	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	4	5	Refer to Table 1(B) for ratings.	OK	20
Operating Speed or Posted Speed on Major Road (km/h)	110	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
					Operational Factors Subtotal	**180**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	1.0	1	15	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	15
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	**15**

Check Intersection Signalization:
Intersection is not Signalized

ILLUMINATION WARRANTED
DELINEATION LIGHTING TO ILLUMINATE PEDESTRIANS OR CROSS STREET TRAFFIC

SUMMARY	
Geometric Factors Subtotal	41
Operational Factor Subtotal	180
Environmental Factor Subtotal	0
Collision History Subtotal	15
TOTAL POINTS	**236**

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Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

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INTERSECTION CHARACTERISTICS

Highway 5	Main Road	**Date**	20-Year Post Development Traffic Conditions
Highway 508	Minor Road	**Other**	Site visit completed on May 12, 2014
County of Lethbridge	City/Town		Intersection turning movement volumes obtained from AT

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)	0		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)	100				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 =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		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%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**21**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	7400	4	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	40
AADT on Minor Road (2-way)	2300	4	20		OK	80
Signalization Warrant	Descriptive	0	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	2	5	Refer to Table 1(B) for ratings.	OK	10
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)	100	4	5	Refer to Table 1(B), note #3	OK	20
					Operational Factors Subtotal	**170**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

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

ILLUMINATION WARRANTED
DELINEATION LIGHTING TO ILLUMINATE PEDESTRIANS OR CROSS STREET TRAFFIC

SUMMARY

Geometric Factors Subtotal	21
Operational Factor Subtotal	170
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**191**

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APPENDIX E

Background Growth Calculations

1283-09 Lethbridge Agri-Business Park

Highway 4 (N of Hwy 508)Yearly Traffic Growth

Year	AADT	% Growth
2013	6052	1.32%
2012	5973	3.86%
2011	5751	0.02%
2010	5750	2.10%
2009	5632	
	Average	1.82%

Highway 4 (S of Hwy 508)Yearly Traffic Growth

Year	AADT	% Growth
2013	6180	1.64%
2012	6080	5.74%
2011	5750	0.17%
2010	5740	1.23%
2009	5670	
	Average	2.20%

Hwy 4 Average = 2.01%

Highway 5 Yearly Traffic Growth

Year	AADT	% Growth
2013	5450	0.00%
2012	5450	0.00%
2011	5450	0.00%
2010	5450	1.87%
2009	5350	
	Average	0.47%

Highway 5 (S ofHwy 508) Yearly Traffic Growth

Year	AADT	% Growth
2013	5020	0.00%
2012	5020	-0.20%
2011	5030	0.00%
2010	5030	2.03%
2009	4930	
	Average	0.46%

Hwy 5 Average = 0.46%

Highway 508 @ Hwy 4 Yearly Traffic Growth

Year	AADT	% Growth
2013	440	0.00%
2012	440	15.79%
2011	380	0.00%
2010	380	0.00%
2009	380	
	Average	3.95%

Highway 508 @ Hwy 5 Yearly Traffic Growth

Year	AADT	% Growth
2013	570	0.00%
2012	570	11.76%
2011	510	0.00%
2010	510	0.00%
2009	510	
	Average	2.94%

Hwy 508 Average = 3.44%

APPENDIX F

TAC SIGNAL WARRANT SPREADSHEETS

Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Highway 4	Direction (EW or NS)	NS	Road Authority:	Alberta Transportation
Side Street (name)	Highway 508	Direction (EW or NS)	EW	City:	County of Lethbridge
Quadrant / Int #	NW	Comments	Weekday Long Term Background (AM+PM) x 2.61	Analysis Date:	2014 Jun 01, Sun
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	AT Count
				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 4	NB								0
Highway 4	SB	1		2			1		2
Highway 508	WB		1						
Highway 508	EB			1			1		
							n		
							n		

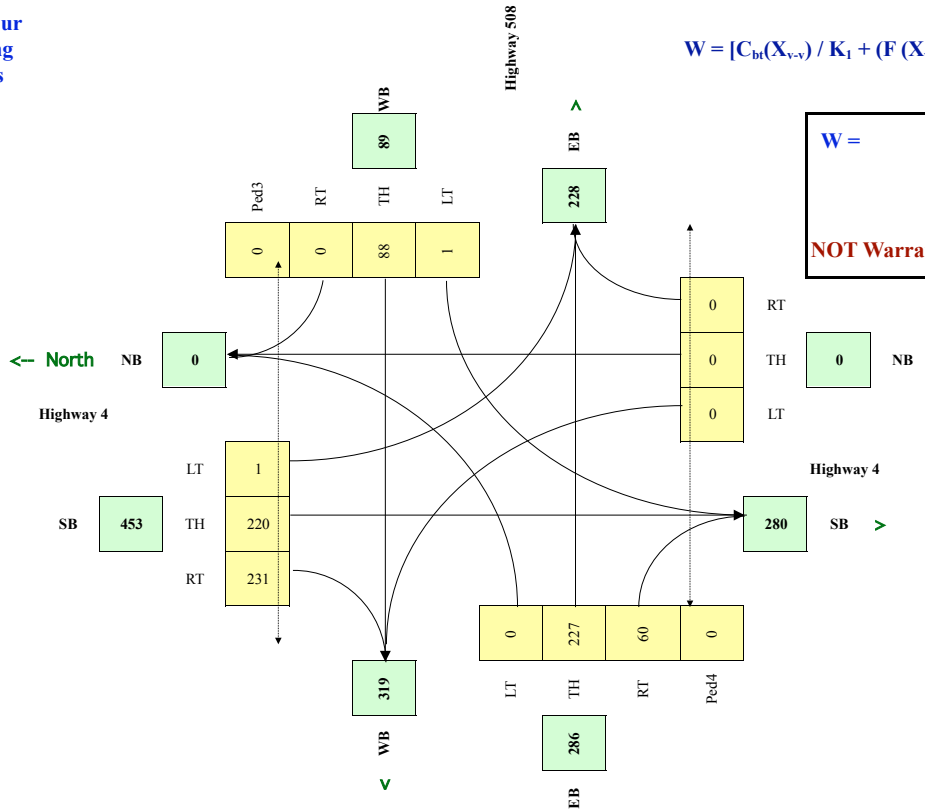
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	90,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 4	NS	110	12.0%	n	6.0
Highway 508	EW		5.0%	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 - 8:00																
8:00 - 9:00																
11:00 - 12:00																
12:00 - 13:00																
16:00 - 17:00																
17:00 - 18:00				8	1321	1386	3	530			1360	358				
Total (6-hour peak)	**0**	**0**	**0**	**8**	**1,321**	**1,386**	**3**	**530**	**0**	**0**	**1,360**	**358**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**1**	**220**	**231**	**1**	**88**	**0**	**0**	**227**	**60**	**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 =	74	74	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 4	Direction (EW or NS)	NS
Side Street (name)	Highway 508	Direction (EW or NS)	EW
Quadrant / Int #	NW	Comments	Weekday 20-year Total (AM+PM) x 2.61
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	Alberta Transportation
City:	County of Lethbridge
Analysis Date:	2014 Jun 01, Sun
Count Date:	AT Count
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 4	NB								0
Highway 4	SB	1		2			1		2
Highway 508	WB		1						
Highway 508	EB			1			1		
							n		
							n		

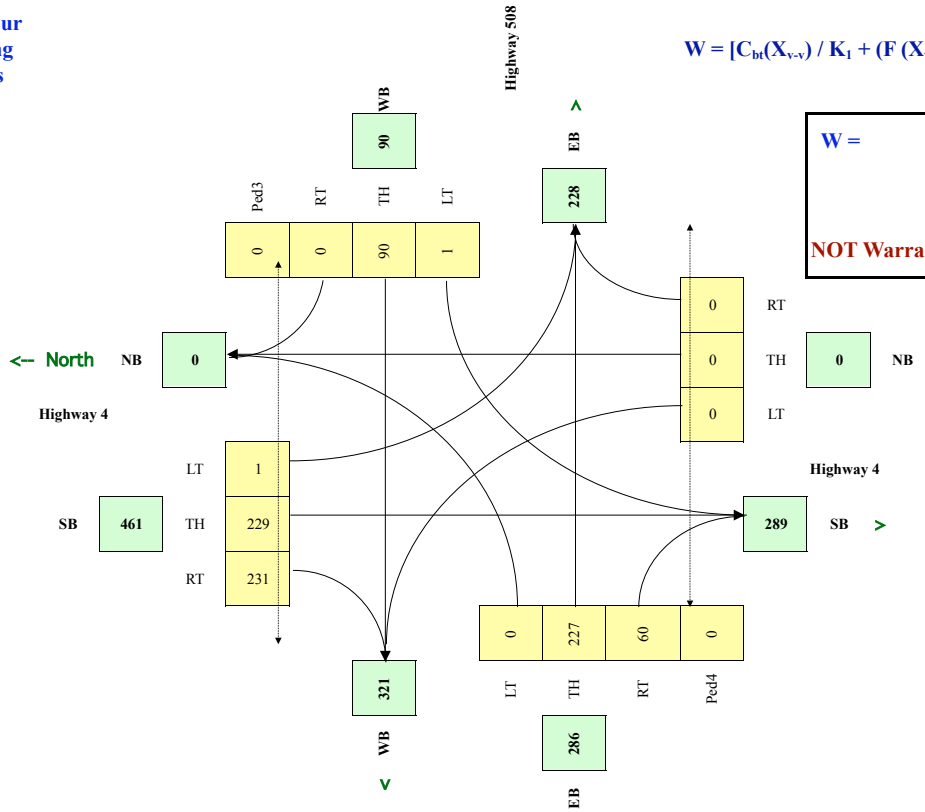
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	90,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 4	NS	110	12.0%	n	6.0
Highway 508	EW		5.0%	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 - 8:00																
8:00 - 9:00																
11:00 - 12:00																
12:00 - 13:00																
16:00 - 17:00																
17:00 - 18:00				8	1373	1386	3	538			1360	358				
Total (6-hour peak)	**0**	**0**	**0**	**8**	**1,373**	**1,386**	**3**	**538**	**0**	**0**	**1,360**	**358**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**1**	**229**	**231**	**1**	**90**	**0**	**0**	**227**	**60**	**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 =	76	76	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

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

Appendix D – Site Drainage Analysis

HYDROLOGICAL and SITE DRAINAGE ANALYSIS

Proposed Subdivision Located Within **SE ¼ 5-8-20-W4**

County of Lethbridge, AB

PREPARED FOR:
Dar Ray Farms Ltd.

PREPARED BY:
Hasegawa Engineering
Consulting Professional Engineers
A Division of 993997 Alberta Ltd.
1220 31st Street North
Lethbridge, AB T1H 5J8

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2.1 Existing 3
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3.0 Surface Runoff Design Criteria 4
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1.0 Introduction

On behalf of the Dar Ray Farms Ltd., Hasegawa Engineering (HE) has completed this preliminary hydrological analysis of the subject site. The hydrological analysis includes the following major aspects:

1. Overall site layout and conditions
2. Offsite topography
3. Precipitation and runoff analysis
4. Retention Pond calculations for storing all runoff up to a 100 year storm event

The legal land description for the site is SE 5-8-20-W4, County of Lethbridge, AB. The site is situated on approximately 8 kilometers southeast of Lethbridge at the intersection of Highways 4 and 508 as shown in Figure 1 (Appendix A.)

2.0 Site Conditions

2.1 Existing

The site consists of approximately 144 acres (58 ha.) of primarily agricultural land with an existing farmstead. There are 2 lots which have been divided out and developed; they have access roads and structures including grain silos with the remainder of the lot essentially graveled to accommodate storage and vehicle traffic. The site is bordered on the north by agricultural land, on the northeast by train tracks and Highway 4, on the southwest by an irrigation main canal and on the south by Highway 508. Adjacent ditches are variably defined and surface water tends to end up trapped in a low areas adjacent to the irrigation canal where it must be pumped out.

2.2 Proposed

The proposed development would further divide the site creating a total of about 25 agribusiness lots and two ponds, one for raw water/fire water and one for storm water management.

The site has poor existing drainage - all storm water will collect and need to be pumped into the irrigation ditch as permitted. It is anticipated that permission to release storm water will not be given until major storm events have ended; therefore, the development needs the capacity to store all storm runoff up to the 100 year design storm.

3.0 Surface Runoff Design Criteria

3.1 Onsite Runoff

Predevelopment

Normally, a predevelopment model would be developed to generate baseline storm water volumes and flow rates – allowable post development release rates during storm events would be dictated by these predevelopment results. In this case, all storm water needs to be stored prior to release and the predevelopment model becomes unnecessary.

Post-Development

A topographic survey of the area provided contour data to determine existing drainage patterns and slopes. Post development flows will generally be able to use existing topography and the site was divided into 16 post development catchments also shown in Figure 2 – Appendix A. Subcatchment boundaries are based on the existing drainage (direction and slope of overland drainage) along with proposed drainage through ditches. The proposed development has agribusiness lots ranging from 2-7 acres in size accessed from gravel service roads. Since overland flow is generally to the west, the model uses ditches on the west boundaries of lots (i.e. either in road allowances or along lots) to intercept storm water and drain it to roadside ditches. All ditches have been modeled as 0.5 meters deep and 5 meters across at the top with 3h:1v side slopes. Existing topography will generally drain storm water in the ditches to the storm pond although several areas require cuts or fills as part of final design elevations (especially for lots backing onto the irrigation canal.)

The retention pond is modelled with 0.6 meters of freeboard followed by 2 meters of active storage although it will actually be deeper to accommodate fire protection water and raw water storage. Pond side slopes are 5h:1v in the freeboard and active storage range.

The existing homestead is modeled as is while remaining areas are modelled with the following assumptions:

- Developed lots will have 25% of the lot area covered with buildings (modeled as 100% impervious surface) with the remaining 75% of the lot graveled for traffic and storage areas (modeled as 70% impervious surface.) These figures are the resulting average after checking 12 business lots in the Lethbridge industrial area ranging from 0.36 – 25.8 hectares in size.
- Subcatchment areas include the adjoining service roads up to the centerline. Assumptions for the model are based on a 10 meter gravel road (70% impervious) within a 20 meter road allowance that is otherwise 0% impervious for an overall average of 35% impervious.
- Pond surface is modeled as 100% impervious areas.

The post development model assumes a 100 year/24 hour storm event but the modeling period may be extended to allow runoff from all subcatchments to fully drain to the pond. The 100 year storm is a design storm that produces 109 mm of rain with a peak rate of 255 mm/hour (Figure 3 – Appendix A.) The final model is shown in Figure 4 of Appendix A. Results of the computer simulation are discussed in section 4 below. Key input parameters for SWMM analysis along with summaries of the computer simulations are attached in Appendix B.

3.2 Storm Water from Off-site

Runoff from agricultural land north of the property should generally drain away from the development. On the remaining sides, the development is generally isolated from off-site storm water by the surrounding roads and irrigation canal although runoff from adjacent roads (highway, secondary and canal road) is included where appropriate.

4.0 Surface Runoff Results

Results of initial runoff modelling show that the active storage volume in the pond is adequate to store the 100 year storm. Performance of the retention pond is shown in Table 1 below and shows the pond fills to 100% full.

Table 1 Post Development Results – Retention Pond Storage

	Maximum Volume m^3	**Change In Pond Height** m	**Total Volume (including ditches)** m^3
Retention Pond	57184 (100% full)	2.00	57198

Results show the ditches are generally sufficient to route storm water to the retention ponds - final design will address flow and velocity within the ditches. Note that the 100 year storm generates significant storm flows; where drainage ditches are intersected by cross roads it will not be practical to convey the storm water under the road in culverts. Any culverts will be designed to convey a 100 year storm.

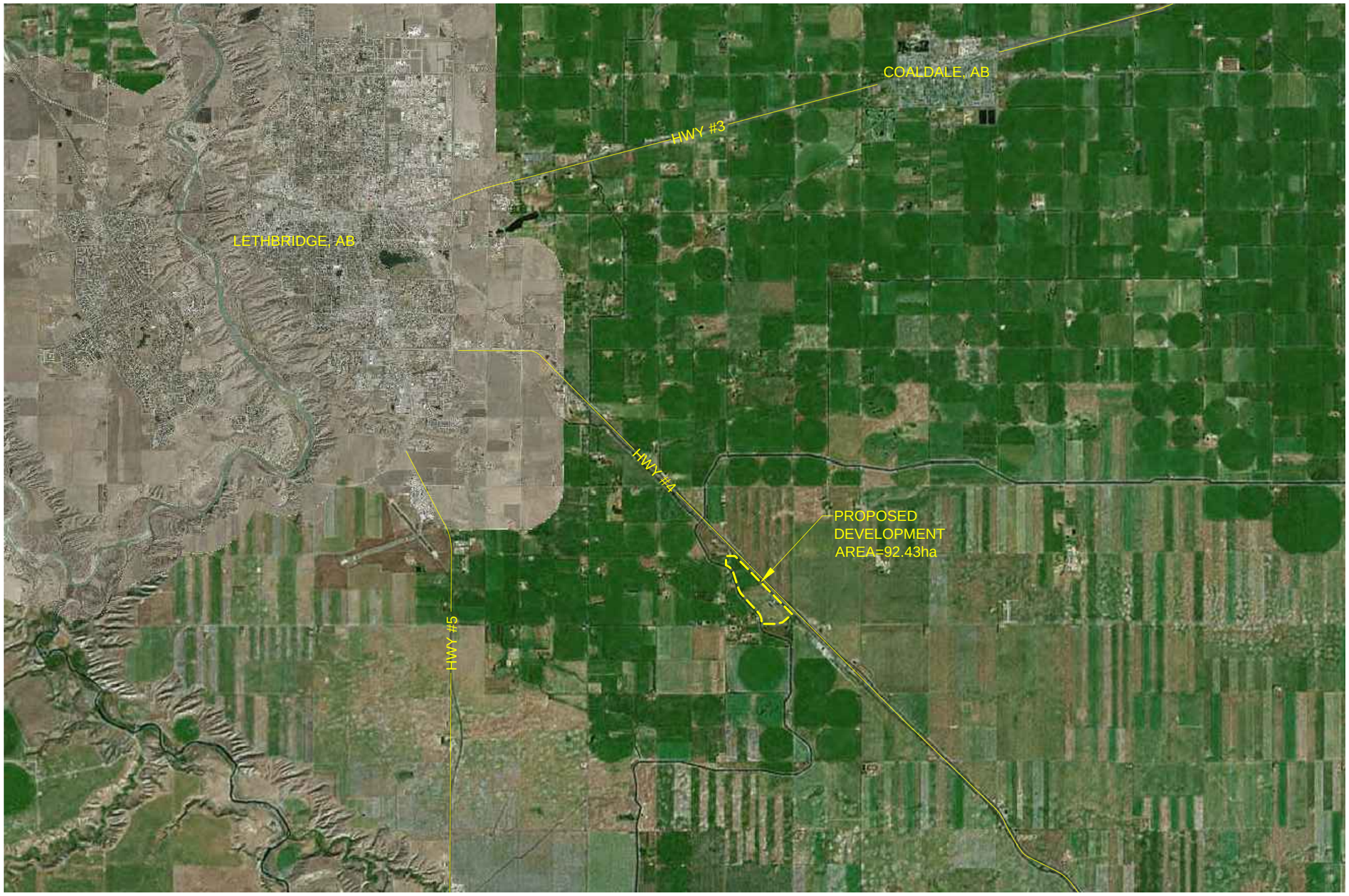
5.0 Conclusion

Results from computer modeling using inputs appropriate for the Lethbridge area have been used to design storm water retention facilities for the proposed development. Significant factors affecting the volume of storm water to be stored are:

- The proposed land use indicates more impervious surface and higher volumes of runoff.
- There is no release during the storm – all runoff must be stored until release into the irrigation ditch is permitted.

This results in large storm water retention areas located in the lower elevations of the development next to the irrigation canal. Existing topography is generally adequate to allow drainage to the retention ponds although some final design will be needed. Because all release will be done by mechanically pumping the retention ponds after the storm has ended, there has been no modeling of the site to establish predevelopment runoff rates.

APPENDIX A - FIGURES



NOTES

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Drawing shall not be used for construction until approved

Do not scale the drawing

All construction shall be in accordance with the latest codes, may it be construction, mechanical, etc

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Ph: 403-328-2686
Fax: 403-328-2728
Email: office@hasegawa.ca

CLIENT: RAY TAYLOR

PROJECT TITLE: AGRI-BUISNESS PARK

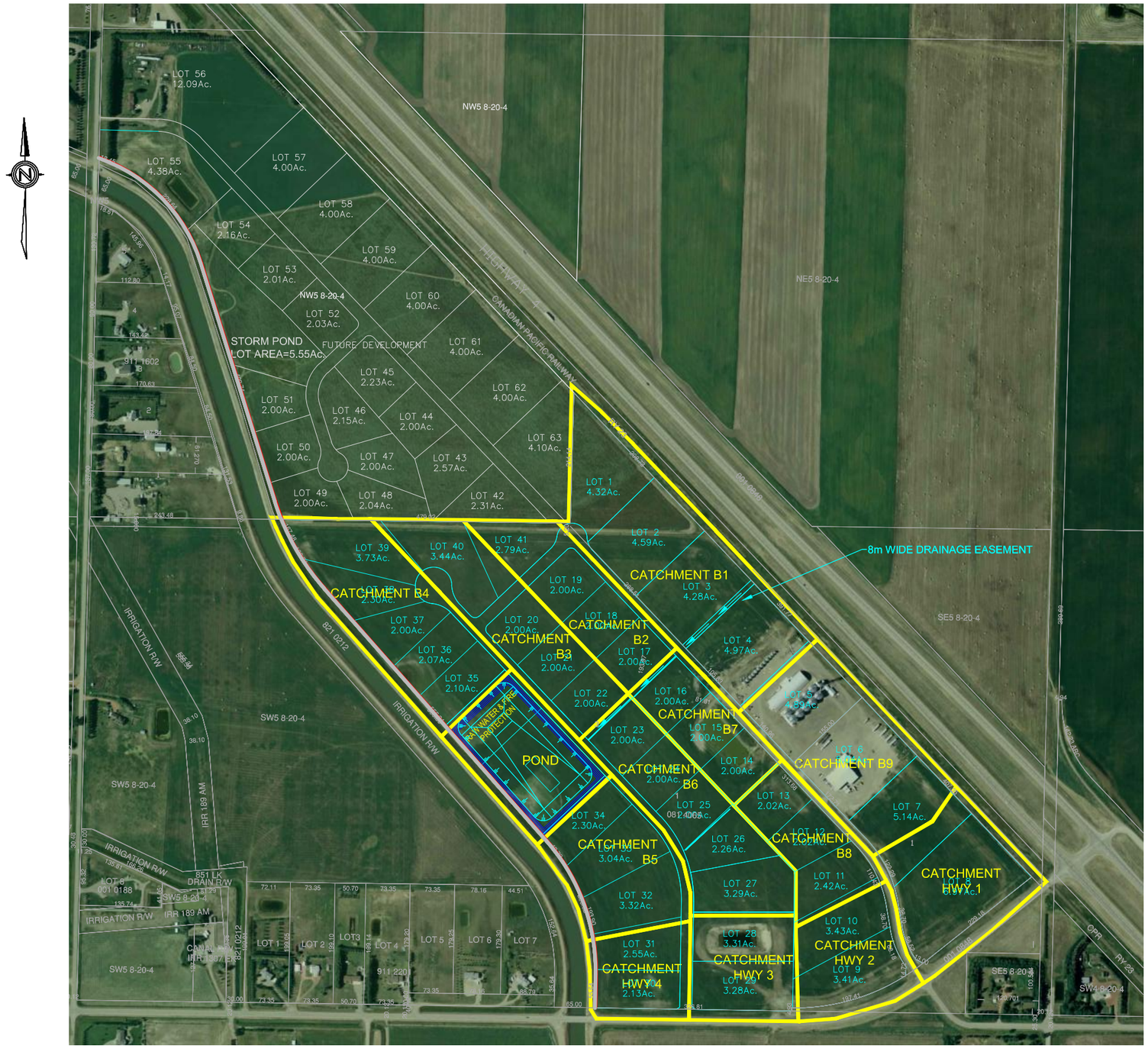
DRAWING TITLE: FIGURE 1
LOCATION MAP

DRAWING STATUS: FOR APPROVAL

#	REVISION	DATE	BY

DESIGN	MAH
DRAWN	MDO
CHECKED	MAH
APPROVED	MAH
SCALE	AS SHOWN

PROJECT NUMBER	13-129
VERSION NUMBER	IFA1
DATE DRAWN	FEB. 12, 2014
SHEET NUMBER	1



0 75 150 225 300 375 750

SCALE=1:7,500

NOTES

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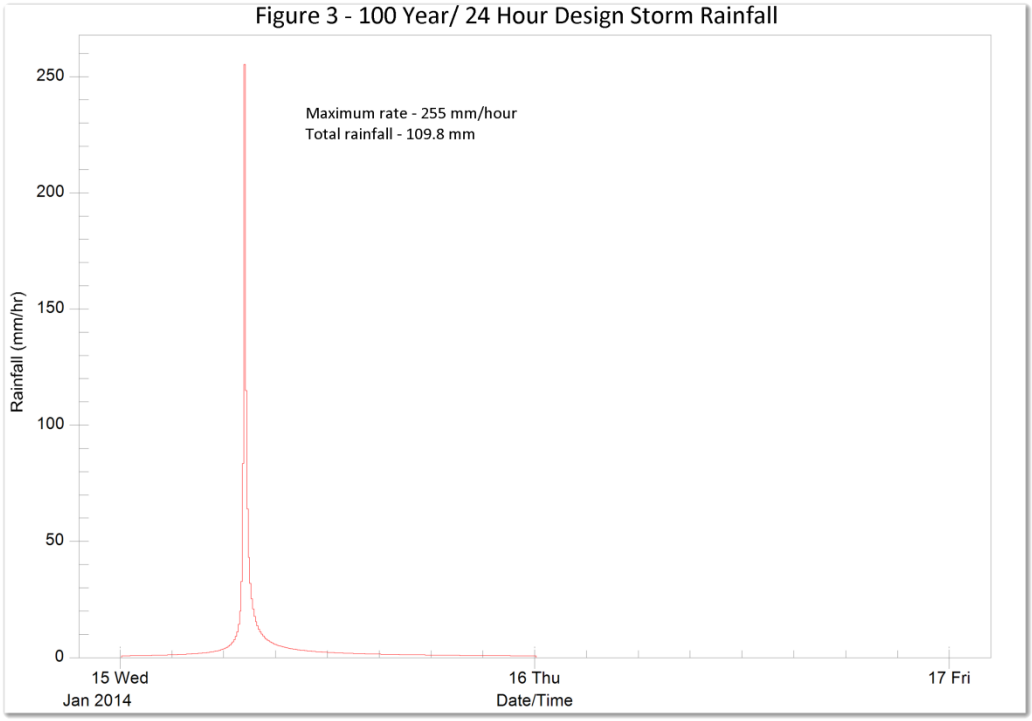
DRAWING TITLE: FIG. 2 - PROPOSED DEVELOPMENT & STORM CATCHMENTS

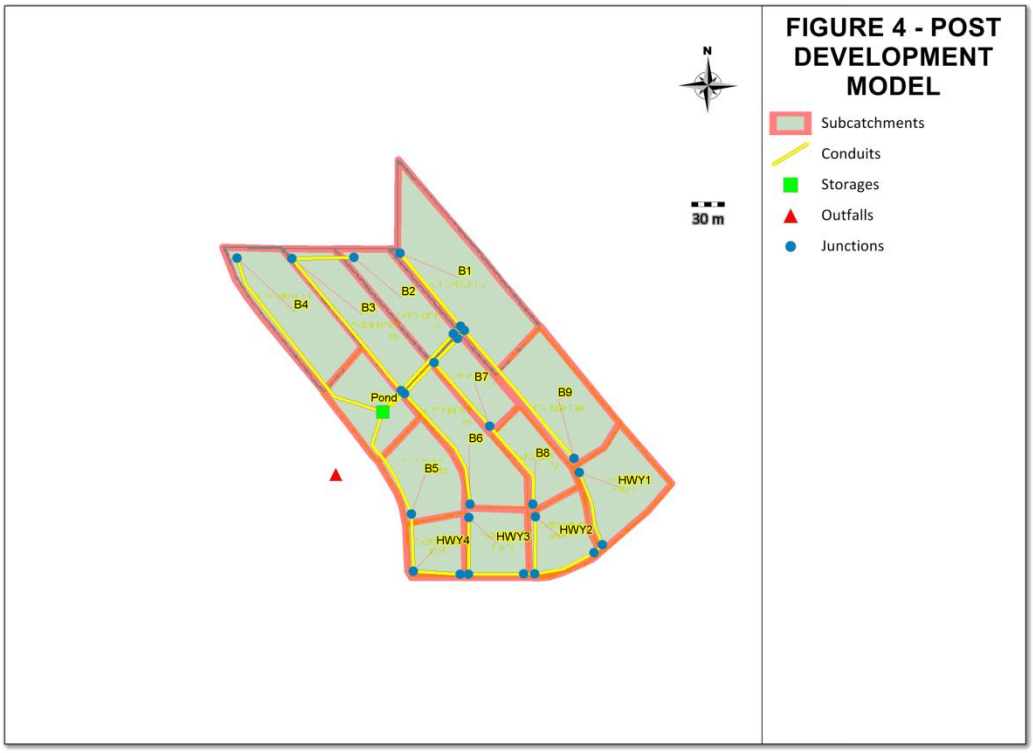
DRAWING STATUS: FOR APPROVAL

#	REVISION	DATE	BY

DESIGN	MAH	PROJECT NUMBER	13-129
DRAWN	DPB/MDO	VERSION NUMBER	IFA1
CHECKED	MAH	DATE DRAWN	FEB. 12, 2014
APPROVED	MAH	SHEET NUMBER	2
SCALE	1:7500		

Figure 3 - 100 Year/ 24 Hour Design Storm Rainfall




FIGURE 4 - POST DEVELOPMENT MODEL
Subcatchments
Conduits
Storages
Outfalls
Junctions
N
30 m
B1
B2
B3
B4
B5
B6
B7
B8
B9
Pond
HWY1
HWY2
HWY3
HWY4

APPENDIX B - MODELING SUMMARIES

```
[TITLE]
13-129 AgriBusiness Post Develop 100yr


[OPTIONS]
FLOW_UNITS           CMS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         DYNWAVE
START_DATE           01/15/2014
START_TIME           00:00:00
REPORT_START_DATE    01/15/2014
REPORT_START_TIME    00:00:00
END_DATE             01/17/2014
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          0:01:00
WET_STEP             0:05:00
DRY_STEP             0:05:00
ROUTING_STEP         5
ALLOW_PONDING        YES
INERTIAL_DAMPING     PARTIAL
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
NORMAL_FLOW_LIMITED  BOTH
SKIP_STEADY_STATE    NO
FORCE_MAIN_EQUATION  H-W
LINK_OFFSETS         DEPTH
MIN_SLOPE            0

[EVAPORATION]
;;Type          Parameters
;;------------- ----------
CONSTANT     0.0
DRY_ONLY     NO

[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
100yr/24hr       INTENSITY 0:05   1.0    TIMESERIES 100yr/24hr

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.             Pcnt.    Curb     S
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   P
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- -
B1               100yr/24hr       JB1_1            8.8797   64.9     479.984  0.84     0
B2               100yr/24hr       JB2_1            3.7601   73.8     372.287  0.49     0
B3               100yr/24hr       JB3_1            4.9242   61.7     437.707  0.36     0
B4               100yr/24hr       JB4_1            6.1524   64       435.568  0.44     0
B5               100yr/24hr       JB5_1            4.1604   69       237.06   0.34     0
B6               100yr/24hr       JB6_1            5.2665   71       406.366  0.48     0
B7               100yr/24hr       JB7_2            2.7945   69.4     251.011  0.96     0
B8               100yr/24hr       JB8_1            2.9698   71.9     227.868  0.8      0
B9               100yr/24hr       JB9_1            6.0132   68.5     470.996  0.78     0
HWY1             100yr/24hr       JHWY1_1          4.6471   63.9     320.49   0.55     0
HWY2             100yr/24hr       JHWY2_1          3.2559   69.1     190.962  0.56     0
HWY3             100yr/24hr       JHWY3_1          3.0587   69.8     299.873  0.83     0
HWY4             100yr/24hr       JHWY4_2          2.3915   65.8     235.616  0.83     0
Pond             100yr/24hr       RetPond          3.9423   82.7     3942.3   1        0

[SUBAREAS]
```

;;Subcatchment	N-Imperv	N-Perv	S-Imperv	S-Perv	PctZero	RouteTo	PctRouted
B1	0.02	0.1	2	4	25	OUTLET	
B2	0.02	0.1	2	4	25	OUTLET	
B3	0.02	0.1	2	4	25	OUTLET	
B4	0.02	0.1	2	4	25	OUTLET	
B5	0.02	0.1	2	4	25	OUTLET	
B6	0.02	0.1	2	4	25	OUTLET	
B7	0.02	0.1	2	4	25	OUTLET	
B8	0.02	0.1	2	4	25	OUTLET	
B9	0.02	0.1	2	4	25	OUTLET	
HWY1	0.02	0.1	2	4	25	OUTLET	
HWY2	0.02	0.1	2	4	25	OUTLET	
HWY3	0.02	0.1	2	4	25	OUTLET	
HWY4	0.02	0.1	2	4	25	OUTLET	
Pond	0.02	0.1	2	4	25	OUTLET	

[INFILTRATION]

;;Subcatchment	Suction	HydCon	IMDmax
B1	295	1	0.3
B2	295	1	0.3
B3	295	1	0.3
B4	295	1	0.3
B5	295	1	0.3
B6	295	1	0.3
B7	295	1	0.3
B8	295	1	0.3
B9	295	1	0.3
HWY1	295	1	0.3
HWY2	295	1	0.3
HWY3	295	1	0.3
HWY4	295	1	0.3
Pond	295	1	0.3

[JUNCTIONS]

;;Name	Invert Elev.	Max. Depth	Init. Depth	Surcharge Depth	Ponded Area
JB1_1	927.1	0.5	0	0	100
JB1_2	926.5	0.5	0	0	1000
JB1_3	926.5	0.5	0	0	1000
JB2_1	926.6	0.5	0	0	100
JB2_2	926.2	0.5	0	0	100
JB3_1	925.9	0.5	0	0	100
JB3_2	925.4	0.5	0	0	100
JB4_1	926.7	0.5	0	0	100
JB5_1	925.5	0.5	0	0	100
JB6_1	926.2	0.5	0	0	100
JB6_2	925.4	0.5	0	0	100
JB7_1	926.2	0.5	0	0	100
JB7_2	926.3	0.5	0	0	100
JB7_3	925.7	0.5	0	0	100
JB8_1	927.3	0.5	0	0	100
JB9_1	928.1	0.5	0	0	1000
JHWY1_1	928.1	0.5	0	0	100
JHWY1_2	927.3	0.5	0	0	100
JHWY2_1	927.1	0.5	0	0	100
JHWY2_2	927.2	0.5	0	0	100
JHWY2_3	926.7	0.5	0	0	100
JHWY3_1	926.2	0.5	0	0	100
JHWY3_2	926.5	0.5	0	0	100
JHWY3_3	926	0.5	0	0	100
JHWY4_1	925.9	0.5	0	0	100

```
JHWY4_2          925.35     0.75       0          0          100

[OUTFALLS]
;;               Invert     Outfall    Stage/Table      Tide
;;Name           Elev.      Type       Time Series      Gate
;;-------------- ---------- ---------- ---------------- ----
OF2              923.2      FREE                         NO

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve                    Ponded   Evap.
;;Name           Elev.    Depth    Depth    Curve      Params                   Area     Frac.
;;-------------- -------- -------- -------- ---------- -------- -------- -------- -------- ------
RetPond          923.1    2        0        TABULAR    PondBRawWater2            16540    0

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet      Outlet     In
;;Name           Node             Node             Length     N          Offset     Offset     Fl
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- --
C11              JB4_1            RetPond          607        0.1        0          2          0
C13              JB1_1            JB1_2            233        0.1        0          0          0
C14              JB1_3            JB7_1            15         0.1        0          0          0
C15              JB7_1            JB7_3            96         0.1        0          0          0
C16              JB7_3            JB6_2            96         0.1        0          0          0
C17              JB6_2            RetPond          15         0.1        0          2          0
C18              JB2_1            JB3_1            125        0.1        0          0          0
C19              JB3_1            JB3_2            474        0.1        0          0          0
C20              JB3_2            RetPond          15         0.1        0          2          0
C21              JB9_1            JB1_3            450        0.1        0          0          0
C22              JB7_2            JB7_3            213        0.1        0          0          0
C23              JB6_1            JB6_2            230        0.1        0          0          0
C24              JB5_1            RetPond          209        0.1        0          2          0
C25              JHWY4_2          JB5_1            110        0.1        0          0          0
C26              JB8_1            JB7_2            215        0.1        0          0          0
C27              JHWY3_1          JHWY3_3          158        0.1        0          0          0
C28              JHWY2_1          JHWY2_3          119        0.1        0          0          0
C29              JHWY1_1          JHWY1_2          195        0.1        0          0          0
C30              JHWY1_2          JHWY2_2          15         0.1        0          0          0
C31              JHWY2_2          JHWY2_3          198        0.1        0          0          0
C32              JHWY2_3          JHWY3_2          15         0.1        0          0          0
C33              JHWY3_2          JHWY3_3          164        0.1        0          0          0
C34              JHWY3_3          JHWY4_1          15         0.1        0          0          0
C35              JHWY4_1          JHWY4_2          144        0.1        0          0          0
C39              JB2_2            JB3_2            193        0.01       0          0          0
C6               JB1_2            JB2_2            15         0.01       0          0          0

[XSECTIONS]
;;Link            Shape        Geom1            Geom2      Geom3      Geom4      Barrels
;;-------------- ------------ ---------------- ---------- ---------- ---------- ----------
C11              IRREGULAR    Ditch3:1         0          0          0          1
C13              IRREGULAR    Ditch3:1         0          0          0          1
C14              IRREGULAR    Ditch3:1         0          0          0          1
C15              IRREGULAR    Ditch3:1         0          0          0          1
C16              IRREGULAR    Ditch3:1         0          0          0          1
C17              IRREGULAR    Ditch3:1         0          0          0          1
C18              IRREGULAR    Ditch3:1         0          0          0          1
C19              IRREGULAR    Ditch3:1         0          0          0          1
C20              IRREGULAR    Ditch3:1         0          0          0          1
C21              IRREGULAR    Ditch3:1         0          0          0          1
C22              IRREGULAR    Ditch3:1         0          0          0          1
C23              IRREGULAR    Ditch3:1         0          0          0          1
C24              IRREGULAR    Ditch3:1         0          0          0          1
C25              IRREGULAR    Ditch3:1         0          0          0          1
C26              IRREGULAR    Ditch3:1         0          0          0          1
C27              IRREGULAR    Ditch3:1         0          0          0          1
```

```
C28              IRREGULAR    Ditch3:1         0          0          0          1
C29              IRREGULAR    Ditch3:1         0          0          0          1
C30              IRREGULAR    Ditch3:1         0          0          0          1
C31              IRREGULAR    Ditch3:1         0          0          0          1
C32              IRREGULAR    Ditch3:1         0          0          0          1
C33              IRREGULAR    Ditch3:1         0          0          0          1
C34              IRREGULAR    Ditch3:1         0          0          0          1
C35              IRREGULAR    Ditch3:1         0          0          0          1
C39              IRREGULAR    Ditch3:1         0          0          0          1
C6               IRREGULAR    Ditch3:1         0          0          0          1

[TRANSECTS]

NC 0.1      0.1      0.05
X1 Ditch            4        0.0      0.0      0.0       0.0       0.0      0.0      0.0
GR 0        0        -0.5     2        -0.5     3         0        5

NC 0.01     0.01     0.01
X1 Ditch3:1         4        0.0      0.0      0.0       0.0       0.0      0.0      0.0
GR 0        0        -0.75    2.25     -0.75    2.75      0        5

NC 0.1      0.1      0.05
X1 Swale            3        0.0      0.0      0.0       0.0       0.0      0.0      0.0
GR 0        0        -0.3     1.5      0        3

[LOSSES]
;;Link           Inlet      Outlet     Average    Flap Gate
;;-------------- ---------- ---------- ---------- ----------

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
PondB            Storage    0          13605
PondB                        .5         14184
PondB                        1          15342
PondB                        1.5        16540

PondB2           Storage    0          11985
PondB2                       .5         13605
PondB2                       1          14184
PondB2                       1.5        15342
PondB2                       2          16540

PondBRawWater1.5 Storage    0          26500
PondBRawWater1.5             .5         28224
PondBRawWater1.5             1          29998
PondBRawWater1.5             1.5        31823

PondBRawWater2   Storage    0          25086
PondBRawWater2               2          32226

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
100yr/24hr                   0:00       0
100yr/24hr                   0:05       0.763
100yr/24hr                   0:10       0.771
100yr/24hr                   0:15       0.779
100yr/24hr                   0:20       0.787
100yr/24hr                   0:25       0.796
100yr/24hr                   0:30       0.804
100yr/24hr                   0:35       0.813
100yr/24hr                   0:40       0.822
100yr/24hr                   0:45       0.831
```

100yr/24hr	0:50	0.841
100yr/24hr	0:55	0.851
100yr/24hr	1:00	0.861
100yr/24hr	1:05	0.871
100yr/24hr	1:10	0.881
100yr/24hr	1:15	0.892
100yr/24hr	1:20	0.903
100yr/24hr	1:25	0.914
100yr/24hr	1:30	0.926
100yr/24hr	1:35	0.938
100yr/24hr	1:40	0.95
100yr/24hr	1:45	0.963
100yr/24hr	1:50	0.976
100yr/24hr	1:55	0.99
100yr/24hr	2:00	1.004
100yr/24hr	2:05	1.018
100yr/24hr	2:10	1.033
100yr/24hr	2:15	1.048
100yr/24hr	2:20	1.064
100yr/24hr	2:25	1.08
100yr/24hr	2:30	1.097
100yr/24hr	2:35	1.114
100yr/24hr	2:40	1.132
100yr/24hr	2:45	1.151
100yr/24hr	2:50	1.17
100yr/24hr	2:55	1.191
100yr/24hr	3:00	1.211
100yr/24hr	3:05	1.233
100yr/24hr	3:10	1.256
100yr/24hr	3:15	1.279
100yr/24hr	3:20	1.304
100yr/24hr	3:25	1.329
100yr/24hr	3:30	1.356
100yr/24hr	3:35	1.384
100yr/24hr	3:40	1.413
100yr/24hr	3:45	1.443
100yr/24hr	3:50	1.475
100yr/24hr	3:55	1.509
100yr/24hr	4:00	1.544
100yr/24hr	4:05	1.581
100yr/24hr	4:10	1.62
100yr/24hr	4:15	1.661
100yr/24hr	4:20	1.705
100yr/24hr	4:25	1.751
100yr/24hr	4:30	1.8
100yr/24hr	4:35	1.853
100yr/24hr	4:40	1.908
100yr/24hr	4:45	1.967
100yr/24hr	4:50	2.031
100yr/24hr	4:55	2.099
100yr/24hr	5:00	2.172
100yr/24hr	5:05	2.251
100yr/24hr	5:10	2.337
100yr/24hr	5:15	2.43
100yr/24hr	5:20	2.532
100yr/24hr	5:25	2.643
100yr/24hr	5:30	2.765
100yr/24hr	5:35	2.9
100yr/24hr	5:40	3.051
100yr/24hr	5:45	3.219
100yr/24hr	5:50	3.409
100yr/24hr	5:55	3.625
100yr/24hr	6:00	3.873
100yr/24hr	6:05	4.159

100yr/24hr	6:10	4.496
100yr/24hr	6:15	4.897
100yr/24hr	6:20	5.383
100yr/24hr	6:25	5.985
100yr/24hr	6:30	6.748
100yr/24hr	6:35	7.75
100yr/24hr	6:40	9.123
100yr/24hr	6:45	11.117
100yr/24hr	6:50	14.266
100yr/24hr	6:55	19.931
100yr/24hr	7:00	32.779
100yr/24hr	7:05	83.515
100yr/24hr	7:10	255.206
100yr/24hr	7:15	114.934
100yr/24hr	7:20	63.946
100yr/24hr	7:25	43.017
100yr/24hr	7:30	31.998
100yr/24hr	7:35	25.321
100yr/24hr	7:40	20.889
100yr/24hr	7:45	17.754
100yr/24hr	7:50	15.429
100yr/24hr	7:55	13.641
100yr/24hr	8:00	12.226
100yr/24hr	8:05	11.08
100yr/24hr	8:10	10.134
100yr/24hr	8:15	9.34
100yr/24hr	8:20	8.665
100yr/24hr	8:25	8.083
100yr/24hr	8:30	7.577
100yr/24hr	8:35	7.133
100yr/24hr	8:40	6.74
100yr/24hr	8:45	6.39
100yr/24hr	8:50	6.077
100yr/24hr	8:55	5.794
100yr/24hr	9:00	5.538
100yr/24hr	9:05	5.304
100yr/24hr	9:10	5.091
100yr/24hr	9:15	4.895
100yr/24hr	9:20	4.714
100yr/24hr	9:25	4.547
100yr/24hr	9:30	4.392
100yr/24hr	9:35	4.248
100yr/24hr	9:40	4.114
100yr/24hr	9:45	3.989
100yr/24hr	9:50	3.871
100yr/24hr	9:55	3.761
100yr/24hr	10:00	3.657
100yr/24hr	10:05	3.559
100yr/24hr	10:10	3.467
100yr/24hr	10:15	3.38
100yr/24hr	10:20	3.297
100yr/24hr	10:25	3.219
100yr/24hr	10:30	3.144
100yr/24hr	10:35	3.073
100yr/24hr	10:40	3.006
100yr/24hr	10:45	2.941
100yr/24hr	10:50	2.88
100yr/24hr	10:55	2.821
100yr/24hr	11:00	2.765
100yr/24hr	11:05	2.711
100yr/24hr	11:10	2.659
100yr/24hr	11:15	2.61
100yr/24hr	11:20	2.562
100yr/24hr	11:25	2.516

100yr/24hr	11:30	2.472
100yr/24hr	11:35	2.43
100yr/24hr	11:40	2.389
100yr/24hr	11:45	2.35
100yr/24hr	11:50	2.312
100yr/24hr	11:55	2.275
100yr/24hr	12:00	2.24
100yr/24hr	12:05	2.205
100yr/24hr	12:10	2.172
100yr/24hr	12:15	2.14
100yr/24hr	12:20	2.109
100yr/24hr	12:25	2.079
100yr/24hr	12:30	2.05
100yr/24hr	12:35	2.021
100yr/24hr	12:40	1.994
100yr/24hr	12:45	1.967
100yr/24hr	12:50	1.941
100yr/24hr	12:55	1.916
100yr/24hr	13:00	1.892
100yr/24hr	13:05	1.868
100yr/24hr	13:10	1.845
100yr/24hr	13:15	1.822
100yr/24hr	13:20	1.8
100yr/24hr	13:25	1.779
100yr/24hr	13:30	1.758
100yr/24hr	13:35	1.738
100yr/24hr	13:40	1.718
100yr/24hr	13:45	1.699
100yr/24hr	13:50	1.68
100yr/24hr	13:55	1.661
100yr/24hr	14:00	1.643
100yr/24hr	14:05	1.626
100yr/24hr	14:10	1.609
100yr/24hr	14:15	1.592
100yr/24hr	14:20	1.576
100yr/24hr	14:25	1.56
100yr/24hr	14:30	1.544
100yr/24hr	14:35	1.529
100yr/24hr	14:40	1.514
100yr/24hr	14:45	1.499
100yr/24hr	14:50	1.485
100yr/24hr	14:55	1.47
100yr/24hr	15:00	1.457
100yr/24hr	15:05	1.443
100yr/24hr	15:10	1.43
100yr/24hr	15:15	1.417
100yr/24hr	15:20	1.404
100yr/24hr	15:25	1.392
100yr/24hr	15:30	1.38
100yr/24hr	15:35	1.368
100yr/24hr	15:40	1.356
100yr/24hr	15:45	1.344
100yr/24hr	15:50	1.333
100yr/24hr	15:55	1.322
100yr/24hr	16:00	1.311
100yr/24hr	16:05	1.3
100yr/24hr	16:10	1.289
100yr/24hr	16:15	1.279
100yr/24hr	16:20	1.269
100yr/24hr	16:25	1.259
100yr/24hr	16:30	1.249
100yr/24hr	16:35	1.239
100yr/24hr	16:40	1.23
100yr/24hr	16:45	1.221

100yr/24hr	16:50	1.211
100yr/24hr	16:55	1.202
100yr/24hr	17:00	1.193
100yr/24hr	17:05	1.185
100yr/24hr	17:10	1.176
100yr/24hr	17:15	1.168
100yr/24hr	17:20	1.159
100yr/24hr	17:25	1.151
100yr/24hr	17:30	1.143
100yr/24hr	17:35	1.135
100yr/24hr	17:40	1.127
100yr/24hr	17:45	1.119
100yr/24hr	17:50	1.112
100yr/24hr	17:55	1.104
100yr/24hr	18:00	1.097
100yr/24hr	18:05	1.089
100yr/24hr	18:10	1.082
100yr/24hr	18:15	1.075
100yr/24hr	18:20	1.068
100yr/24hr	18:25	1.061
100yr/24hr	18:30	1.055
100yr/24hr	18:35	1.048
100yr/24hr	18:40	1.041
100yr/24hr	18:45	1.035
100yr/24hr	18:50	1.028
100yr/24hr	18:55	1.022
100yr/24hr	19:00	1.015
100yr/24hr	19:05	1.01
100yr/24hr	19:10	1.004
100yr/24hr	19:15	0.998
100yr/24hr	19:20	0.992
100yr/24hr	19:25	0.986
100yr/24hr	19:30	0.98
100yr/24hr	19:35	0.974
100yr/24hr	19:40	0.969
100yr/24hr	19:45	0.963
100yr/24hr	19:50	0.958
100yr/24hr	19:55	0.952
100yr/24hr	20:00	0.947
100yr/24hr	20:05	0.942
100yr/24hr	20:10	0.936
100yr/24hr	20:15	0.931
100yr/24hr	20:20	0.926
100yr/24hr	20:25	0.921
100yr/24hr	20:30	0.916
100yr/24hr	20:35	0.911
100yr/24hr	20:40	0.908
100yr/24hr	20:45	0.901
100yr/24hr	20:50	0.897
100yr/24hr	20:55	0.892
100yr/24hr	21:00	0.887
100yr/24hr	21:05	0.883
100yr/24hr	21:10	0.878
100yr/24hr	21:15	0.874
100yr/24hr	21:20	0.869
100yr/24hr	21:25	0.865
100yr/24hr	21:30	0.861
100yr/24hr	21:35	0.856
100yr/24hr	21:40	0.852
100yr/24hr	21:45	0.848
100yr/24hr	21:50	0.844
100yr/24hr	21:55	0.84
100yr/24hr	22:00	0.835
100yr/24hr	22:05	0.831

```
100yr/24hr                 22:10      0.827
100yr/24hr                 22:15      0.823
100yr/24hr                 22:20      0.82
100yr/24hr                 22:25      0.816
100yr/24hr                 22:30      0.812
100yr/24hr                 22:35      0.808
100yr/24hr                 22:40      0.804
100yr/24hr                 22:45      0.801
100yr/24hr                 22:50      0.797
100yr/24hr                 22:55      0.793
100yr/24hr                 23:00      0.79
100yr/24hr                 23:05      0.786
100yr/24hr                 23:10      0.783
100yr/24hr                 23:15      0.779
100yr/24hr                 23:20      0.776
100yr/24hr                 23:25      0.772
100yr/24hr                 23:30      0.769
100yr/24hr                 23:35      0.766
100yr/24hr                 23:40      0.762
100yr/24hr                 23:45      0.759
100yr/24hr                 23:50      0.756
100yr/24hr                 23:55      0.752
100yr/24hr                 24:00      0.749

[REPORT]
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS       484.423998361705 -716.515824588729 982.219750200746 -253.463683636686
UNITS            Meters

[COORDINATES]
;;Node           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
JB1_1            686.035          -368.798
JB1_2            747.09           -442.227
JB1_3            750.832          -446.568
JB2_1            639.369          -372.979
JB2_2            739.806          -449.717
JB3_1            576.978          -374.104
JB3_2            687.282          -506.878
JB4_1            521.572          -373.582
JB5_1            697.608          -631.294
JB6_1            756.639          -621.368
JB6_2            690.444          -510.009
JB7_1            743.786          -454.506
JB7_2            776.546          -542.977
JB7_3            720.227          -478.98
JB8_1            820.005          -621.481
JB9_1            861.492          -575.48
JHWY1_1          866.722          -589.351
JHWY1_2          890.146          -662.104
JHWY2_1          822.423          -633.927
JHWY2_2          881.525          -670.41
JHWY2_3          821.856          -691.469
JHWY3_1          755.251          -634.588
JHWY3_2          810.726          -691.653
JHWY3_3          754.89           -691.983
```

```
JHWY4_1          746.585          -692.127
JHWY4_2          699.405          -688.815
OF2              621.152          -591.325
RetPond          668.481          -528.515

[VERTICES]
;;Link           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
C11              529.951          -399.568
C11              619.431          -512.772
C23              752.132          -584.835
C23              741.247          -565.009
C24              681.003          -593.444
C24              671.909          -579.045
C24              657.51           -561.11
C26              820.421          -593.647
C29              879.228          -621.141
C29              881.95           -641.745
C31              850.342          -686.665

[Polygons]
;;Subcatchment   X-Coord          Y-Coord
;;-------------- ---------------- ----------------
B1               683.475          -364.144
B1               683.952          -274.512
B1               751.593          -353.082
B1               769.889          -374.068
B1               787.468          -395.952
B1               827.185          -442.539
B1               781.563          -490.069
B1               674.626          -363.982
B1               683.475          -364.144
B2               674.744          -364.452
B2               744.478          -448.133
B2               716.277          -477.883
B2               619.483          -364.189
B2               674.744          -364.452
B3               566.793          -364.094
B3               619.243          -364.491
B3               716.028          -477.746
B3               687.664          -510.269
B3               566.793          -364.094
B4               511.038          -372.469
B4               507.051          -362.369
B4               566.588          -363.964
B4               647.921          -462.307
B4               608.583          -507.491
B4               544.528          -429.88
B4               530.972          -411.541
B4               519.809          -394.796
B4               511.038          -372.469
B5               663.846          -578.594
B5               706.842          -533.047
B5               737.327          -568.277
B5               748.091          -588.384
B5               750.7            -598.906
B5               751.131          -605.521
B5               750.843          -630.254
B5               691.024          -640.895
B5               687.708          -622.621
B5               682.646          -610.008
B5               676.701          -600.608
B5               663.846          -578.594
B6               686.992          -510.681
```

B6	715.963	-478.254
B6	814.04	-592.81
B6	814.572	-627.629
B6	751.749	-624.819
B6	751.432	-602.8
B6	746.586	-584.889
B6	737.104	-567.821
B6	686.992	-510.681
B7	716.277	-478.117
B7	744.215	-448.396
B7	806.581	-521.288
B7	776.582	-550.234
B7	716.277	-478.117
B8	777.948	-550.619
B8	806.782	-521.507
B8	858.628	-583.889
B8	866.941	-602.73
B8	815.188	-632.429
B8	814.268	-592.761
B8	777.948	-550.619
B9	781.563	-489.687
B9	826.994	-441.966
B9	907.497	-540.031
B9	891.153	-564.802
B9	859.636	-584.749
B9	781.563	-489.687
HWY1	858.976	-584.466
HWY1	891.664	-564.291
HWY1	906.731	-539.52
HWY1	959.593	-600.299
HWY1	935.588	-628.39
HWY1	911.072	-649.586
HWY1	887.716	-669.67
HWY1	876.852	-646.266
HWY1	873.277	-622.516
HWY1	870.723	-611.024
HWY1	866.893	-601.576
HWY1	858.976	-584.466
HWY2	814.538	-631.644
HWY2	867.278	-602.997
HWY2	870.618	-612.006
HWY2	873.022	-622.005
HWY2	875.32	-636.562
HWY2	877.123	-647.603
HWY2	887.578	-669.76
HWY2	881.023	-675.572
HWY2	872.22	-680.312
HWY2	859.626	-685.999
HWY2	847.838	-690.891
HWY2	835.331	-694.649
HWY2	824.33	-695.468
HWY2	814.955	-695.11
HWY2	814.538	-631.644
HWY3	751.671	-624.944
HWY3	814.211	-626.994
HWY3	816.236	-694.831
HWY3	751.831	-695.019
HWY3	751.671	-624.944
HWY4	691.303	-640.239
HWY4	750.325	-629.773
HWY4	751.354	-694.971
HWY4	697.429	-695.115
HWY4	693.711	-688.564
HWY4	691.303	-640.239

```
Pond             706.358          -533.229
Pond             663.485          -577.943
Pond             657.492          -571.816
Pond             608.529          -508.146
Pond             647.955          -462.721
Pond             706.358          -533.229

[SYMBOLS]
;;Gage           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

13-129 AgriBusiness Post Develop 100yr

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... DYNWAVE
Starting Date ............ JAN-15-2014 00:00:00
Ending Date .............. JAN-17-2014 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 5.00 sec

WARNING 02: maximum depth increased for Node JB1_1
WARNING 02: maximum depth increased for Node JB1_2
WARNING 02: maximum depth increased for Node JB1_3
WARNING 02: maximum depth increased for Node JB2_1
WARNING 02: maximum depth increased for Node JB2_2
WARNING 02: maximum depth increased for Node JB3_1
WARNING 02: maximum depth increased for Node JB3_2
WARNING 02: maximum depth increased for Node JB4_1
WARNING 02: maximum depth increased for Node JB5_1
WARNING 02: maximum depth increased for Node JB6_1
WARNING 02: maximum depth increased for Node JB6_2
WARNING 02: maximum depth increased for Node JB7_1
WARNING 02: maximum depth increased for Node JB7_2
WARNING 02: maximum depth increased for Node JB7_3
WARNING 02: maximum depth increased for Node JB8_1
WARNING 02: maximum depth increased for Node JB9_1
WARNING 02: maximum depth increased for Node JHWY1_1
WARNING 02: maximum depth increased for Node JHWY1_2
WARNING 02: maximum depth increased for Node JHWY2_1
WARNING 02: maximum depth increased for Node JHWY2_2
WARNING 02: maximum depth increased for Node JHWY2_3
WARNING 02: maximum depth increased for Node JHWY3_1
WARNING 02: maximum depth increased for Node JHWY3_2
WARNING 02: maximum depth increased for Node JHWY3_3
WARNING 02: maximum depth increased for Node JHWY4_1

**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         6.835       109.858
Evaporation Loss .........         0.000         0.000
```

Infiltration Loss	1.093	17.567
Surface Runoff	5.719	91.914
Final Surface Storage	0.064	1.030
Continuity Error (%)	-0.594	

Flow Routing Continuity	Volume hectare-m	Volume 10^6 ltr
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	5.719	57.186
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.000	0.000
Internal Outflow	0.000	0.000
Storage Losses	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	5.720	57.198
Continuity Error (%)	-0.020	

Time-Step Critical Elements

Link C20 (3.99%)
Link C17 (1.32%)

Highest Flow Instability Indexes

All links are stable.

Routing Time Step Summary

Minimum Time Step	:	1.38 sec
Average Time Step	:	4.83 sec
Maximum Time Step	:	5.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.00

Subcatchment Runoff Summary

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Pea Runof CM
B1	109.86	0.00	0.00	19.53	90.00	7.99	3.8
B2	109.86	0.00	0.00	14.44	95.07	3.57	1.9
B3	109.86	0.00	0.00	21.32	88.27	4.35	2.1
B4	109.86	0.00	0.00	20.06	89.46	5.50	2.6
B5	109.86	0.00	0.00	17.36	92.00	3.83	1.5
B6	109.86	0.00	0.00	16.06	93.42	4.92	2.4
B7	109.86	0.00	0.00	16.85	92.76	2.59	1.5
B8	109.86	0.00	0.00	15.50	94.03	2.79	1.5
B9	109.86	0.00	0.00	17.40	92.17	5.54	3.0
HWY1	109.86	0.00	0.00	20.08	89.47	4.16	2.0

HWY2	109.86	0.00	0.00	17.19	92.25	3.00	1.3
HWY3	109.86	0.00	0.00	16.62	92.98	2.84	1.6
HWY4	109.86	0.00	0.00	18.85	90.80	2.17	1.2
Pond	109.86	0.00	0.00	9.42	99.35	3.92	2.7

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min
JB1_1	JUNCTION	0.06	0.66	927.76	0 07:15
JB1_2	JUNCTION	0.03	0.46	926.96	0 07:16
JB1_3	JUNCTION	0.03	0.40	926.90	0 07:17
JB2_1	JUNCTION	0.03	0.40	927.00	0 07:15
JB2_2	JUNCTION	0.05	0.60	926.80	0 07:16
JB3_1	JUNCTION	0.07	0.78	926.68	0 07:17
JB3_2	JUNCTION	0.04	0.55	925.95	0 07:17
JB4_1	JUNCTION	0.04	0.50	927.20	0 07:19
JB5_1	JUNCTION	0.08	0.99	926.49	0 07:25
JB6_1	JUNCTION	0.04	0.51	926.71	0 07:15
JB6_2	JUNCTION	0.04	0.57	925.97	0 07:18
JB7_1	JUNCTION	0.04	0.53	926.73	0 07:17
JB7_2	JUNCTION	0.04	0.58	926.88	0 07:16
JB7_3	JUNCTION	0.06	0.73	926.43	0 07:18
JB8_1	JUNCTION	0.03	0.37	927.67	0 07:15
JB9_1	JUNCTION	0.04	0.57	928.67	0 07:15
JHWY1_1	JUNCTION	0.03	0.45	928.55	0 07:15
JHWY1_2	JUNCTION	0.03	0.45	927.75	0 07:16
JHWY2_1	JUNCTION	0.03	0.40	927.50	0 07:15
JHWY2_2	JUNCTION	0.04	0.50	927.70	0 07:16
JHWY2_3	JUNCTION	0.03	0.49	927.19	0 07:17
JHWY3_1	JUNCTION	0.04	0.58	926.78	0 07:22
JHWY3_2	JUNCTION	0.05	0.60	927.10	0 07:17
JHWY3_3	JUNCTION	0.05	0.76	926.76	0 07:23
JHWY4_1	JUNCTION	0.06	0.85	926.75	0 07:23
JHWY4_2	JUNCTION	0.24	1.28	926.63	0 07:24
OF2	OUTFALL	0.00	0.00	923.20	0 00:00
RetPond	STORAGE	1.61	2.00	925.10	2 00:00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr
JB1_1	JUNCTION	3.885	3.885	0 07:15	7.993	7.992
JB1_2	JUNCTION	0.000	3.939	0 07:16	0.000	7.995
JB1_3	JUNCTION	0.000	2.993	0 07:16	0.000	5.549
JB2_1	JUNCTION	1.962	1.962	0 07:15	3.575	3.575
JB2_2	JUNCTION	0.000	3.924	0 07:16	0.000	7.992
JB3_1	JUNCTION	2.170	4.055	0 07:15	4.347	7.925
JB3_2	JUNCTION	0.000	7.593	0 07:17	0.000	15.930
JB4_1	JUNCTION	2.617	2.617	0 07:15	5.505	5.504
JB5_1	JUNCTION	1.562	5.918	0 07:19	3.828	15.990

JB6_1	JUNCTION	2.465	2.465	0	07:15	4.921	4.920
JB6_2	JUNCTION	0.000	7.919	0	07:17	0.000	15.851
JB7_1	JUNCTION	0.000	2.961	0	07:17	0.000	5.543
JB7_2	JUNCTION	1.536	2.954	0	07:15	2.593	5.386
JB7_3	JUNCTION	0.000	5.908	0	07:17	0.000	10.935
JB8_1	JUNCTION	1.530	1.530	0	07:15	2.793	2.792
JB9_1	JUNCTION	3.049	3.049	0	07:15	5.544	5.543
JHWY1_1	JUNCTION	2.046	2.046	0	07:15	4.158	4.158
JHWY1_2	JUNCTION	0.000	2.069	0	07:15	0.000	4.160
JHWY2_1	JUNCTION	1.390	1.390	0	07:15	3.004	3.004
JHWY2_2	JUNCTION	0.000	2.007	0	07:16	0.000	4.158
JHWY2_3	JUNCTION	0.000	3.350	0	07:17	0.000	7.164
JHWY3_1	JUNCTION	1.692	1.692	0	07:15	2.845	2.844
JHWY3_2	JUNCTION	0.000	3.320	0	07:17	0.000	7.161
JHWY3_3	JUNCTION	0.000	4.775	0	07:17	0.000	10.019
JHWY4_1	JUNCTION	0.000	4.283	0	07:18	0.000	10.005
JHWY4_2	JUNCTION	1.295	4.964	0	07:18	2.172	12.180
OF2	OUTFALL	0.000	0.000	0	00:00	0.000	0.000
RetPond	STORAGE	2.781	24.033	0	07:18	3.918	57.191

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
JHWY4_1	JUNCTION	0.01	0.099	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CMS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 ltr	Maximum Ponded Depth Meters
JB3_1	0.07	1.004	0 07:15	0.047	0.78
JB5_1	0.31	1.137	0 07:16	0.345	0.99
JHWY3_3	0.11	0.364	0 07:18	0.016	0.76
JHWY4_1	0.21	0.508	0 07:17	0.051	0.85
JHWY4_2	0.52	1.152	0 07:14	0.374	1.28

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	E&I Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
RetPond	45.843	80	0	57.184	100	2 00:00	0.000

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CMS	Max. Flow CMS	Total Volume 10^6 ltr
OF2	0.00	0.000	0.000	0.000
System	0.00	0.000	0.000	0.000

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
C11	CHANNEL	2.161	0 07:20	2.16	0.38	0.67
C13	CHANNEL	3.939	0 07:16	3.30	0.70	0.74
C14	CHANNEL	2.961	0 07:17	3.50	0.19	0.62
C15	CHANNEL	3.008	0 07:17	2.04	0.38	0.83
C16	CHANNEL	5.739	0 07:18	3.64	0.93	0.86
C17	CHANNEL	7.929	0 07:18	6.39	0.51	0.75
C18	CHANNEL	1.915	0 07:15	1.54	0.23	0.77
C19	CHANNEL	3.762	0 07:19	2.41	1.05	0.87
C20	CHANNEL	7.464	0 07:18	6.29	0.48	0.73
C21	CHANNEL	2.993	0 07:16	3.26	0.45	0.64
C22	CHANNEL	2.941	0 07:17	1.90	0.50	0.86
C23	CHANNEL	2.498	0 07:16	2.39	0.38	0.70
C24	CHANNEL	4.867	0 07:26	2.40	1.01	1.00
C25	CHANNEL	4.537	0 07:19	2.20	1.11	1.00
C26	CHANNEL	1.466	0 07:15	1.64	0.19	0.63
C27	CHANNEL	1.678	0 07:16	1.48	0.43	0.89
C28	CHANNEL	1.407	0 07:15	1.89	0.22	0.58
C29	CHANNEL	2.069	0 07:15	2.51	0.29	0.60
C30	CHANNEL	2.007	0 07:16	2.20	0.22	0.64
C31	CHANNEL	2.058	0 07:17	2.11	0.37	0.66
C32	CHANNEL	3.320	0 07:17	2.86	0.26	0.73
C33	CHANNEL	3.366	0 07:18	2.04	0.55	0.90
C34	CHANNEL	4.283	0 07:18	2.76	0.47	1.00
C35	CHANNEL	4.039	0 07:19	1.96	0.59	1.00
C39	CHANNEL	4.011	0 07:16	3.20	0.56	0.76
C6	CHANNEL	3.924	0 07:16	3.58	0.25	0.70

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	--- Fraction of Time in Flow Class ---- Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
C11	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.82	0.0000
C13	1.00	0.00	0.00	0.00	0.43	0.57	0.00	0.00	1.04	0.0000
C14	1.00	0.01	0.00	0.00	0.27	0.72	0.00	0.00	1.39	0.0000
C15	1.00	0.01	0.00	0.00	0.96	0.03	0.00	0.00	0.60	0.0000

C16	1.00	0.01	0.00	0.00	0.45	0.54	0.00	0.00	1.04	0.0001
C17	1.00	0.01	0.00	0.00	0.00	0.00	0.00	0.99	2.12	0.0000
C18	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.34	0.0000
C19	1.00	0.00	0.00	0.00	0.94	0.06	0.00	0.00	0.59	0.0001
C20	1.00	0.01	0.00	0.00	0.00	0.00	0.00	0.99	2.12	0.0000
C21	1.00	0.00	0.00	0.00	0.41	0.59	0.00	0.00	1.12	0.0000
C22	1.00	0.00	0.00	0.00	0.98	0.02	0.00	0.00	0.53	0.0000
C23	1.00	0.00	0.00	0.00	0.88	0.12	0.00	0.00	0.78	0.0000
C24	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.77	0.0001
C25	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.13	0.0001
C26	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.60	0.0000
C27	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.37	0.0000
C28	1.00	0.00	0.00	0.00	0.88	0.12	0.00	0.00	0.78	0.0000
C29	1.00	0.00	0.00	0.00	0.46	0.54	0.00	0.00	0.99	0.0000
C30	1.00	0.01	0.00	0.00	0.52	0.48	0.00	0.00	0.87	0.0000
C31	1.00	0.01	0.00	0.00	0.78	0.21	0.00	0.00	0.78	0.0000
C32	1.00	0.01	0.00	0.00	0.42	0.58	0.00	0.00	1.12	0.0000
C33	1.00	0.01	0.00	0.00	0.64	0.35	0.00	0.00	0.85	0.0000
C34	1.00	0.01	0.00	0.00	0.44	0.55	0.00	0.00	1.06	0.0000
C35	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.13	0.0000
C39	1.00	0.01	0.00	0.00	0.46	0.53	0.00	0.00	1.01	0.0000
C6	1.00	0.01	0.00	0.00	0.30	0.70	0.00	0.00	1.34	0.0000

****
Conduit Surcharge Summary
****

	Hours Full			Hours Above Full	Hours Capacity
Conduit	Both Ends	Upstream	Dnstream	Normal Flow	Limited
C19	0.01	0.01	0.01	0.06	0.01
C24	0.01	0.01	0.01	0.28	0.01
C25	0.31	0.31	0.31	0.09	0.01
C34	0.11	0.11	0.11	0.01	0.01
C35	0.21	0.21	0.21	0.01	0.01

Analysis begun on: Tue May 27 17:29:58 2014
Analysis ended on: Tue May 27 17:30:03 2014
Total elapsed time: 00:00:05

Appendix E – SMRID Agreement

WATER CONVEYANCE AGREEMENT

Municipal and Rural Drainage
(*Irrigation Districts Act*, Section 21)

This agreement is made this 18 day of AUGUST 2011.

BETWEEN:

ST. MARY RIVER IRRIGATION DISTRICT

(the "District")

-and-

COUNTY OF LETHBRIDGE

(the "Applicant")

BACKGROUND:

1. The District is the owner and operator of a system of open ditch canals, buried pipelines and drainage channels and associated structures and infrastructure (the "Irrigation Works") used by the District for the conveyance and drainage of water for irrigation and other licenced purposes under the *Water Act* and the *Irrigation Districts Act.*

2. Section 21 of the Irrigation Districts Act authorizes the District to enter into a Water Conveyance Agreement with any person for the removal of drainage water, storm water or wastewater (the "Drainage") from an area.

3. The Applicant applies for permission to continue to outlet historic Drainage flows into the Irrigation Works (the "Drainage Flows") or to outlet flows into the Irrigation Works in the future (the "Prospective Drainage Flows").

4. The Drainage is not natural flow and as such an Approval under the *Water Act* issued by Alberta Environment ("AE") to outlet that flow into the Irrigation Works is required.

5. The District requires assurances that the outlet for the Drainage into the Irrigation Works will not have adverse consequences on the Irrigation Works or on the persons or property of any person whose lands are adjacent to the Irrigation Works, or will not cause the flows in the Irrigation Works to exceed the Operational Capacity of those Irrigation Works.

6. In exchange for the ability to outlet Drainage Flows, or the opportunity to outlet Prospective Drainage Flows into the Irrigation Works, the Applicant, has agreed to accept responsibility for adverse consequences on the Irrigation Works or on persons or property of any person whose lands are adjacent to the Irrigation Works.

AGREEMENT:

IN CONSIDERATION OF THE COVENANTS AND MUTUAL OBLIGATIONS HEREIN CONTAINED AND SUBJECT TO THE COVENANTS, CONDITIONS AND STIPULATIONS HEREINAFTER SET OUT THE PARTIES AGREE AS FOLLOWS:

1 Definitions

Wherever used in this Agreement, the following terms have the meaning set opposite them except where the context otherwise requires:

a) "Agreement" includes all components of this Agreement including the Background, Agreement and any Schedules hereto;

b) "Approval" has the same meaning as in the *Water Act;*

c) "Drainage Flows" means the water which the Applicant has caused or allowed to outlet into the Irrigation Works at any time prior to this Agreement.

d) "Free-Board" means the difference in elevation between the normal operating surface level of water in an open ditch canal and the elevation at which an uncontrolled flow of water would occur out of the canal onto the adjoining lands by flowing over the canal banks and over and around any other Irrigation Works;

e) "Highway" means roads, public places and public works that are subject to the direction, control and management of the Applicant as those terms are used in the *Municipal Government Act*;

f) "Irrigation Works" has the same meaning as in the *Irrigation Districts Act;*

g) "Operational Capacity" means that capacity of the Irrigation Works, both in terms of volume and rate of flow:
   i) sufficient to meet the operating requirements of the District for delivery demands of all the irrigation systems served, irrigation drainage and return flows, and the amount of water needed to cover the estimated conveyance losses; plus
   ii) capable of conveying surface runoff entering the Irrigation Works from any source, including Drainage Flows or Prospective Drainage Flows from the Applicant, whether or not such drainage is the subject of an express authorization by the District; plus
   iii) sufficient Free-Board to prevent damage to the Irrigation Works and to prevent the uncontrolled escape of water from the Irrigation Works onto lands adjacent to the Irrigation Works.

h) "Operational Plan" means the specific policies and procedures implemented by the Applicant regulating the outlet of Drainage including but not limited to the timing, rate and duration of any outlets of Drainage by the Applicant to the Irrigation Works to ensure the Drainage does not cause any adverse effects on the Irrigation Works or persons or property located adjacent to the Irrigation Works including the provision that the Applicant will obtain the specific express consent of the District prior to the outlet of any Drainage.

i) "Prospective Drainage Flows" means Drainage Flows which the Applicant proposes to outlet into the Irrigation Works at any time hereafter arising from future construction, modification, maintenance, or repair of a Highway, or future subdivision, or future development, or for any other reason or purpose;

2 Governing Agreement

a) The Parties agree that this Agreement shall be the sole agreement governing the right of the Applicant to outlet Drainage into the Irrigation Works of the District.

b) The Parties agree that this Agreement applies to all locations at which such outlet of Drainage occurs regardless of whether that outlet is regulated or controlled by any structure or device.

c) The Parties agree that in absence of this Agreement the Applicant has no legal right, entitlement, privilege or permission to permit or allow the outlet of Drainage to the Irrigation Works of the District at any location or by any means.

3 Authorized Drainage Flow

The Applicant is authorized to permit or allow the outlet of Drainage Flows into the Irrigation Works subject to the terms and conditions of this agreement and the following conditions precedent:

a) The Drainage Flow from the Applicant is the subject of an Operational Plan and a copy of which has been provided to the District;

b) No Drainage Flows are permitted or allowed to enter the Irrigation Works without the express prior permission of the District.

4 Authorized Prospective Drainage Flow

a) The Applicant is authorized to permit or allow the outlet of Prospective Drainage Flows into the Irrigation Works after it has complied with section 21(6) of the *Irrigation Districts Act* which provides that:

21 (6) If a water conveyance agreement is entered into under this section, the district must not deliver or remove water under the agreement until the other party to the agreement has complied with the requirements, if any, of the Water Act, the Environmental Protection and Enhancement Act and the regulations under those Acts.

b) The Applicant agrees:
   i) to apply to Alberta Environment ("AE") pursuant to the *Water Act* for an Approval for Prospective Drainage Flows into the Irrigation Works;
   ii) to abide by the terms and conditions imposed by AE and to at all times material hereto maintain the Approval in good standing;
   iii) to provide the District with copies of all applications and correspondence with AE and the Approval so received, and all terms and conditions of the Approval;
   iv) to ensure the Approval terms and conditions are included in any subdivision or development approvals issued by it for any subdivision or development from which Prospective Drainage Flows will outlet to the Irrigation Works;
   v) all outlets of Prospective Drainage Flows into the Irrigation Works will comply with the Approvals issued by AE;
   vi) the Prospective Drainage Flows from the Applicant are the subject of an Operational Plan;
   vii) no Prospective Drainage Flows are permitted or allowed to enter the Irrigation Works without the express prior permission of the District;
   viii) to provide the District with a complete copy of all Operational Plans; and
   ix) to ensure all outlets of Drainage are in compliance with the applicable Operational Plan.

5 Control and Ownership

a) At all times material hereto the Irrigation Works shall be owned by the District and, subject to this Agreement, shall be under the direction and control of the District.

b) The Applicant acknowledges that the District uses the Irrigation Works primarily for irrigation purposes and that use will result in fluctuations in the water levels and flows, which fluctuations are a natural consequence of the District's use of the Irrigation Works which the Applicant agrees it will accept as incident to access to the Irrigation Works and that the Applicant shall make no claims or demands upon the District of any nature or kind whatsoever arising directly or indirectly from the fluctuation of or the level of the water in the Irrigation Works. Provided however, that at all times the District agrees to operate the Irrigation Works in a reasonable and diligent manner and that the fluctuation in the water level is not caused by the negligence of the District, its servants, employees or agents. The District has no obligation to take any action or to refrain from taking any action to alter or control the fluctuation of or the water level of the Irrigation Works under any circumstances whatsoever, and the Applicant agrees not to bring any claims or demands of any nature or kind, including any claims for indemnity or contribution under the *Tort-Feasors Act* or the *Contributory Negligence Act* arising directly or indirectly from the fluctuation or change in the water level of the Irrigation Works which may affect the ability to outlet Drainage and the Applicant agrees to indemnify and save harmless the District from all such claims and demands by whosoever brought.

c) The District reserves the right to make any changes to the operating conditions of the Irrigation Works from time to time as in its sole discretion it deems advisable in the management and operation of its system of irrigation works which changes may result in an alteration of the water level and flows in the Irrigation Works, and the Applicant shall make no claims or demands upon the District whatsoever including any claims for indemnity or contribution under the *Tort-Feasors Act* or the *Contributory Negligence Act* arising directly or indirectly from the alteration in the water level of the Irrigation Works and the Applicant agrees to indemnify and save harmless the District from all such claims and demands by whosoever brought.

d) The District may in its absolute discretion:
   i) require the Applicant to install structures or control devices at uncontrolled outlet locations; or
   ii) close any structures which outlet Drainage into the Irrigation Works and prohibit any or further Drainage from the Applicant into the Irrigation Works without providing notice to the Applicant under circumstances where:
      (1) the District is aware of conditions which it has reasonable grounds to believe are or may pose a danger to property, human health or public safety;
      (2) the inlet structures are being operated contrary to the AE Approvals or contrary to the applicable Operational Plan;

and such closures may be for such time or times and may be subject to such conditions as the District may determine in its absolute and unfettered discretion.

6 Contamination

The Applicant acknowledges that they are aware that the Drainage outletted into the Irrigation Works enters the main water conveyance system of the District and that that the District conveys and delivers water for irrigation, domestic, municipal, industrial and other purposes and that contaminants in the water may cause significant adverse effects to the environment, animal health or human health. The Applicant shall not allow or permit the outlet of Drainage that may contain a substance or substances in an amount, concentration or level or at a rate of release that causes or may cause a significant adverse effect to the environment, animal health or human health, and they each shall at all times material hereto comply with all release and reporting requirements and regulatory requirements of the *Environmental Protection and Enhancement Act* and regulations.

7 Liability, Indemnity and Hold Harmless

a) Each party (the "Indemnifying Party") agrees to indemnify and save harmless the other party, its agents and employees from and against any and all damage, injury, loss, costs, causes of action, and claims suffered or incurred by the other party, its agents or employees and which are caused either directly or indirectly or contributed to in whole or in part by the negligence or breach of this Agreement by the Indemnifying Party, its agents and employees and in respect of which the indemnifying party, its agents or employees is held liable or is otherwise responsible in law and to the extent of that responsibility in whole or in part.

b) The Applicant shall indemnify and hold the District harmless from any claim, action, cause of action or demand, including any fees and disbursements of counsel for the District or its liability insurer, as a result of any water which may escape or overflow from or be diverted to and fail to enter or be retained in the Irrigation Works or escape by overflow or otherwise in any manner from the Irrigation Works and for all damage caused by said escape or release of water in any manner, including erosion, land instability, or by flowing water, and the Applicant indemnifies and holds harmless the District from all liability with respect to any losses or damage incurred by any person as a direct or indirect result thereof, **provided however** that such escape or release is due to or contributed to in any degree by the outlets of Drainage by the Applicant into the Irrigation Works, or the breach or non-compliance of the Applicant with any of the terms or conditions of this agreement or the applicable Operations Plan.

c) The Applicant assumes full responsibility for and agrees to indemnify and save harmless the District and its agents and employees from all claims for bodily injury or property damage or clean-up or mitigation costs arising out of the discharge, dispersal, release or escape of acids, alkalis, toxic chemicals, fossil fuels, fossil or synthetic lubricants, liquids or gases, waste materials or other irritants, contaminants or pollutants into the Irrigation Works which cause or may cause a significant adverse effect to the environment, animal health or human health **provided however** that such escape or release is caused by or contributed to in any degree by the outlets of Drainage by the Applicant into the Irrigation Works.

d) The District shall not be liable to the Applicant for any claim direct, indirect or consequential, for loss, injury or damage whatsoever arising out of the inability of the District to have any Operational Capacity available at any time material hereto in the Irrigation Works and the Applicant shall indemnify and save harmless the District from and against all damages, costs or expense of any kind whatsoever, brought by anyone against the District or incurred by the District in any way, including any fees and disbursements of counsel for the District or its liability insurer, resulting directly or indirectly by reason of any lack of Operational Capacity in the Irrigation Works or from the decision, and the consequences thereof, of the District in closing access to the Irrigation Works and prohibit any or further outlets of Drainage from the Applicant into the Irrigation Works as provided for elsewhere in this Agreement, including all costs and expenses incurred by the District in investigating, adjusting, and defending such claims on a solicitor and own client basis.

8 Fee

The District reserves the right, in its absolute unfettered discretion and subject to the Irrigation Districts Act (the "Act"), to impose by Bylaw a fee for the conveyance of the Drainage pursuant to section 115 of the Act which fee will be payable by the Applicant as specified in the Bylaw from and after the date upon which the Applicant is given notice of the passage of the Bylaw.

9 Termination and Default

a) The Applicant may terminate its participation in this Agreement by giving 180 days written notice in advance to the District of its intention to so terminate setting out the date on which its participation will terminate (the

"Termination Date"), and from and after the Termination Date the Applicant shall no longer be entitled to outlet any Drainage into the Irrigation Works.

b) In the event the Applicant defaults in the performance of any of it obligations hereunder, the District may, without terminating this Agreement, remedy such defaults, after giving the Applicant thirty (30) days notice of its intention to do so, except in the case of emergency, which can be remedied without notice. All costs and expenses incurred by the District in remedying such defaults shall be recovered from the Applicant as a debt due by the Applicant to the District.

c) In the event that the District defaults in the performance of any of its obligations hereunder, the Applicant may, without terminating this Agreement remedy such defaults, after giving the District thirty (30) days notice of its intention to do so, except in the case of an emergency, which can be remedied without notice. All costs and expenses incurred by the Applicant in remedying such defaults shall be recovered from the District as a debt due the Applicant by the District.

d) In the event the Applicant commits a continuing course of defaults or multiple unrelated defaults, the cumulative effect of which is to evidence a failure to comply with the applicable Operation Plans or the performance of any of its obligations hereunder, the District may, terminate this Agreement, after giving the Applicant thirty (180) days notice of its intention to do so.

10 Entire Agreement

a) This Agreement contains the entire agreement between the parties and supersedes all prior agreements, communications or representations between the parties, whether in writing or orally, dealing with the same subject matter, and the Parties have no other rights therein, save those hereby conferred, or those by implication of law.

b) In consideration of the performances of the parties and the covenants and agreements under this Agreement, all matters connected with any former agreements of earlier dates dealing with Drainage are cancelled and disposed of, and this Agreement is substituted for those former agreements effective the date of the signing of this Agreement and hereafter neither party shall be further obliged under the former agreements.

11 Assignment

Assignment or transfer of this agreement by the Parties is prohibited.

12 Notices

a) Wherever in this Agreement it shall be required or permitted that notice or demand be given or served by either party to or on the other, such notice or demand shall not be duly given or served unless it is in writing and sent by registered mail or hand delivered, addressed as follows:

To the District at:	General Manager 1210 - 36 Street North P. O. Box 278 Lethbridge, Alberta T1J 3Y7
To the Applicant at:	County Manager #100, 905 - 4th Avenue South Lethbridge AB T1J 4E4 Fax: 403-328-5602

Each such notice or demand shall be deemed given on the date of delivery if hand delivered, or by fax, or email, or five (5) days after the date of mailing if sent by registered mail. Any party may change their address for service from time to time by notice as above provided.

b) In the event of interruption of postal service notices as aforesaid will be deemed effectively served upon the parties hereto by hand delivery of such notice to the street address of the parties as aforesaid and the notices shall be deemed to have been served on the date on which they were actually delivered to the offices of the parties.

13 Enurement

This Agreement shall be binding upon the parties hereto and their successors from and after it having been executed.

14 Amendments

This Agreement shall not be changed or modified except in writing signed by all parties hereto.

15 Arbitration of Disputes

It is agreed by the Parties that either Party may upon notice to the other Party refer disputes in matters of difference between them under this Agreement, except those matters included in sections 5, 7 and 8 hereof, that may arise throughout the term of this Agreement that cannot be resolved in negotiations between them to the award and determination of a single arbitrator which will be appointed with the consent of the parties who shall have all powers given to arbitrators pursuant to the provisions of the *Arbitration Act* of Alberta and who shall proceed to enter the procedures thereunder upon the request of the parties towards the resolution of the dispute.

IN WITNESS WHEREOF the Parties have by their proper officers signed these presents and have affixed their seals as of the day and year first above written.

St. Mary River Irrigation District

Per: _____

Per: _____

County of Lethbridge

Per: _____

Per: _____