TRAFFIC IMPACT ASSESSMENT

NE ¼ SEC 34-39-02-W5M

LACOMBE COUNTY, ALBERTA

Prepared For
FRANK WILSON

Prepared By
A. D. WILLIAMS ENGINEERING INC.

ADWE FILE NO. i15452.00
MAY, 2008

A. D. Williams
Engineering Inc.
Consulting Engineers

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The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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APPENDICES

RECOMMENDATIONS

A. D. Williams Engineering Inc. was retained by Frank Wilson to conduct a traffic impact study for a proposed subdivision in Lacombe County by Sylvan Lake, Alberta. Three intersections were studied for the impact of both existing and future traffic from the development over the next 25 years. The study evaluated the need for turning lanes at the intersections, requirements for signalization and illumination requirements. The other factors we considered, due to the existing roadway alignments was the available sight distance with respect to safety concerns for a driver to safely react to intersection traffic and their ability to safely bring the vehicle to a stop.

This report has been prepared based on the best information available at the time. It is intended to provide conceptual review of the specific issues. Should assumptions or parameters change, amendments to the study should be made.

Based upon the information contained herein, we have the following comments and conclusions based on full build out (25 year horizon):

Rainy Creek Road & Sunbreaker Cove Road

1. Left turn lanes are required for the east and south legs of the intersection.
2. Right turn lane is required for the east, west and south legs of the intersection.
3. Based on the background traffic volumes, a right turn lane is warranted for the south leg of the intersection.
4. Signalization is not required.
5. The current level of service is classified as Type ‘C’ and the level of service stays the same when the subdivision is fully built.
6. Delineated lighting to illuminate cross street traffic when 327 lots are developed or when 48% of the development occurs.
7. Partial lighting is required when 99 lots are developed or when 15% of the development occurs.

Rainy Creek Road & North Subdivision Access Road

1. Left turn lane is required for the east leg of the intersection.
2. Right turn lane is required for the west leg of the intersection.
3. Signalization is not required.
4. Illumination is not required.
5. The level of service when the subdivision is fully built is Type 'A'.

Sunbreaker Cove Road & East Subdivision Access Road

1. Left and right turn lanes are not required.
2. Signalization is not required.
3. Illumination is not required.
4. The level of service when the subdivision is fully built is Type 'B'.

Other factors that should be considered:

- The only sight distance that did not meet specifications was the intersection sight lines on the east leg of the Rainy Creek Road & Sunbreaker Cove Road intersection. This is due to the inclined grade on the east leg of the intersection. To reduce the intersection sight distance required on this leg, it would be recommended to reduce the posted speed limit from 100 kph to 80 kph or to remove the inclined grade out of this leg of the intersection.

- The sight stopping distance on the south leg of Rainy Creek Road & Sunbreaker Cove Road does not meet the minimum requirements for the posted speed limit. This is the portion of Sunbreaker Cove Road from the intersection of Rainy Creek Road to the top of the hill approximately 100 metres to the south. To make the sight stopping distance meet the minimum requirements on this existing crest vertical curve, it would be recommended to reduce the posted speed limit from 80 kph to 60 kph on this portion of Sunbreaker Cove Road.

INTRODUCTION

A. D. Williams Engineering Inc. (ADWE) was retained by Frank Wilson to review the traffic impacts for the proposed development of land in Lacombe County, Alberta. A traffic impact study was conducted for the location and the findings covered in this report. A site map is attached to **Appendix A** showing the location of the proposed subdivision in relation to Sylvan Lake, Alberta.

BACKGROUND

A recreational vehicle park and recreational facility is proposed to be located on land to the north of Sunbreaker Cove, located on the north end of Sylvan Lake. The development site contains approximately 59.71 hectares (147.5 acres). The development will consist of 593 seasonal lease lots and 85 weekend rental lots. The land location is NE ¼ Sec 34-39-02-W5M. The plan area is bounded by Rainy Creek Road to the north and Sunbreaker Cove Road to the east, and agricultural lands to the south and west. The predominant land use of the remainder of this section and most other surrounding lands (to the west and south) is agricultural.

Three intersections will be analyzed within this assessment. The three intersections will include the access into the proposed subdivision from Sunbreaker Cove Road, the access into the proposed subdivision from Rainy Creek Road and Rainy Creek Road & Sunbreaker Cove Road.

EXISTING INFRASTRUCTURE & CONDITIONS

The existing condition of the infrastructure is as follows:

The north and south legs of the intersection consist of Sunbreaker Cove Road. The west and east legs of the intersection consist of Rainy Creek Road. The posted speed limit on the north and south legs is 80 kph. The posted speed limit on the east and west legs of the

intersection is 100 kph. Rainy Creek Road is a two lane paved roadway with a width of 10.0 metres. The south leg of Sunbreaker Cove Road is a two lane paved road with a width of 8.0 metres. The north leg of Sunbreaker Cove is a two lane gravel surface with a width of 7.0 metres. There is residential housing located on the southwest quadrant of the intersection. Rainy Creek Road has a grade of approximately 2-3% decline to the west. The south leg of Sunbreaker Cove Road has a grade of approximately 2.5% for approximately 100 metres to the south. The east west legs of the intersection are classified as a Type IVb intersection configuration. The west leg of the intersection has approximately 65 metres of storage within the left turn lane.

Design Vehicle & Existing Intersection Turning Radius

The design vehicle used to calculate the minimum turning radii is a semi-trailer combination (WB-17). This was selected to accommodate any hauling of equipment in and out of the proposed site. The minimum turning radius for this type of vehicle is 55-18-55 metres with a three centred curve. This value has been taken from the Highway Geometric Design Guide.

Design Speed

The design speeds for the intersections are listed below:

Table 1 - Intersection Design Speed

Intersection	Design Speed
Rainy Creek Road & Sunbreaker Cove Road	110 kph
Rainy Creek Road & North Subdivision Access Road	110 kph
Sunbreaker Cove Road & West Subdivision Access Road	90 kph

Intersection Sight Distance & Stopping Sight Distance

The design should ensure adequate pavement widths of turning roadways and sight distances. Sight distances are factors included in this study. The intersection sight distance

considers the speed and distance required for a vehicle to safely conduct a left hand turning movement at an intersection. The sight stopping distance requirements involve factors such as the driver's perception and reaction time and the safe stopping distance at various speeds. The chart listed below shows the results:

Table 2 – Intersection Sight Distance – Rainy Creek Road & Sunbreaker Cove Road

Intersection	Intersection Sight Distance			
	Driver Side	Passenger Side	Distance Required (Driver Side)	Distance Required (Passenger Side)
Rainy Creek Road & Sunbreaker Cove Road (north leg)	300 m	485 m	516 m	385 m
Rainy Creek Road & Sunbreaker Cove Road (south leg)	485 m	300 m	385 m	516 m

Table 3 - Sight Stopping Distance - Rainy Creek Road & Sunbreaker Cove Road

Intersection	Sight Stopping Distance		
	Driver Side	Passenger Side	Distance Required
Rainy Creek Road & Sunbreaker Cove Road (north leg)	300 m	485 m	235 m
Rainy Creek Road & Sunbreaker Cove Road (south leg)	485 m	300 m	235 m

The minimum distances required are taken from the Highway Geometric Design Guide. A correction factor was used for the effect of grade on the intersection sight distance. The only sight distance that did not meet specifications was the intersection sight lines on the east leg of the intersection. This is due to the inclined grade on the east leg of the intersection. To reduce the intersection sight distance required on this leg, it would be recommended to reduce the posted speed limit from 100 kph to 80 kph.

The sight stopping distance on the south leg of Rainy Creek Road & Sunbreaker Cove Road does not meet the minimum requirements for the posted speed limit. This is the portion of Sunbreaker Cove Road from the intersection of Rainy Creek Road to the top of the hill approximately 100 metres to the south. This section of road has a 2.3% grade on it. To make the sight stopping distance meet the minimum requirements on this crest vertical curve, it would be recommended to reduce the posted speed limit from 80 kph to 60 kph on this portion of Sunbreaker Cove Road.

Site Access

A review of the proposed road intersections were carried out under two considerations: proximity to other access points, and proximity to existing intersections. Separation is based on the end-point of the nearest edge of approach.

Rainy Creek Road & Sunbreaker Cove Road

For the intersection of Rainy Creek Road & Sunbreaker Cove Road there are five approaches within its vicinity. They are as listed below:

- There is a residential approach located on the south side of Rainy Creek Road approximately 74 metres to the west of the intersection.
- There is a residential approach located on the south side of Rainy Creek Road approximately 315 metres to the west of the intersection.
- There is a residential approach located on the north side of Rainy Creek Road approximately 285 metres to the west of the intersection.
- There are two residential approaches located on the west side of Rainy Creek Road approximately 110 metres and 145 metres to the south of the intersection.

Consideration will have to be taken when upgrading the intersection to accommodate the future development traffic on each of these approaches.

Rainy Creek Road & North Subdivision Access Road

When placing the subdivision access road onto Rainy Creek Road, the three residential approaches located on the west leg of the intersection of Rainy Creek Road & Sunbreaker Cove Road will need to be addressed. They are located 74 metres, 285 metres and 315 metres west of the intersection of Rainy Creek Road & Sunbreaker Cove Road. Therefore, when placing the subdivision access road on Rainy Creek Road consideration will be needed to accommodate each of these approaches.

Sunbreaker Cove Road & East Subdivision Access Road

There are two residential approaches to the south of the intersection. They are located 110 metres and 145 metres to the south of the intersection respectively. Therefore, when placing the subdivision access road on Sunbreaker Cove Road consideration will be needed to accommodate these two approaches.

TRAFFIC VOLUMES

Development/ Background Traffic

Lacombe County conducted several traffic counts within the county during 2007. Listed below are three traffic counts that relate to the intersection of Rainy Creek Road & Sunbreaker Cove Road. Since the traffic counts did not address intersection turning movements, contact was made with Phil Lodermeier of Lacombe County to determine reasonable turning movements for this intersection. It is going to be assumed that 10% of the traffic is tractor trailers and 10% of the traffic is recreational vehicles. **Appendix B** contains the 2007 traffic count data obtained from Lacombe County.

- On July 2, 2007 a traffic count was conducted on Rainy Creek Road (west of Sunbreaker Cove Road). The traffic count for this location on this date was 699 vehicles per day.

- On July 2, 2007 a traffic count was conducted on Rainy Creek Road (east of Sunbreaker Cove Road). The traffic count for this location on this date was 1090 vehicles per day.
- On June 25, 2007 a traffic count was conducted on Sunbreaker Cove Road (south of Rainy Creek Road). The traffic count for this location on this date was 730 vehicles per day.

Based on discussion with Lacombe County, it was determined that the north leg of the intersection would contribute 350 vehicles per day.

Rainy Creek Road & Sunbreaker Cove Road

Based on this data obtained from Lacombe County, the daily traffic on Rainy Creek Road is 1,789 vehicles per day. The daily traffic on Sunbreaker Cove Road is 1,080 vehicles per day. Based on this data, the daily traffic for the intersection of Rainy Creek Road & Sunbreaker Cove Road is 2,869 vehicles per day.

To calculate the peak hourly volume (DHV) on Rainy Creek Road, Table A.6.1 from the Highway Geometric Design Guide was used. It was determined that Rainy Creek Road is a Class 2A Roadway – Secondary Highway. From this a K-value of 0.117 is used. Therefore, the peak hourly volume for Rainy Creek Road is calculated as followed:

$$DHV = K*(AADT)$$
$$DHV = 0.117*(1,789)$$
$$DHV = 210$$

To calculate the peak hourly volume on Sunbreaker Cove Road, Table A.6.1 from the Highway Geometric Design Guide was used. It was determined that Sunbreaker Cove Road is a Class 2B Roadway – Resource Road. From this a K-value of 0.117 is used. Therefore, the peak hourly volume for Sunbreaker Cove Road is calculated as followed:

$$DHV = K*(AADT)$$
$$DHV = 0.117*(1,080)$$
$$DHV = 127$$

Therefore, the peak hourly volume for the intersection of Rainy Creek Road & Sunbreaker Cove Road is 337 vehicles per hour. This is the combination of the two above peak hourly volumes for each intersecting road. Table 4 summarizes the traffic volumes and peak hourly traffic within this intersection.

Table 4 – Traffic Volumes: Rainy Creek Road & Sunbreaker Cove Road

Road	AADT	Peak Hour
Rainy Creek Road	1,789	210
Sunbreaker Cove Road	1,080	127

Rainy Creek Road & North Subdivision Access Road

Since there currently is no intersection at this location, the background traffic volume for this intersection will be the traffic volume that was counted on Rainy Creek Road west of the intersection of Rainy Creek Road & Sunbreaker Cove Road. To calculate the traffic volumes at this proposed intersection location, the traffic count data obtained from Lacombe County will be used. During the traffic count, there were 1,519 vehicles recorded on Rainy Creek Road.

To calculate the peak hourly volume on Rainy Creek Road, Table A.6.1 from the Highway Geometric Design Guide was used. It was determined that Rainy Creek Road is a Class 2A Roadway – Secondary Highway. From this a K-value of 0.117 is used. Therefore, the peak hourly volume for Rainy Creek Road is calculated as followed:

$$DHV = K*(AADT)$$
$$DHV = 0.117*(1,519)$$
$$DHV = 178$$

Table 5 summarizes the traffic volumes and peak hourly traffic within this proposed intersection.

Table 5 – Traffic Volumes: Rainy Creek Road & North Subdivision Access Road

Road	AADT	Peak Hour
Rainy Creek Road	1,519	178

Sunbreaker Cove Road & East Subdivision Access Road

Since there currently is no intersection at this location, the background traffic volume for this intersection will be the traffic volume that was counted on Sunbreaker Cove Road south of the intersection of Rainy Creek Road & Sunbreaker Cove Road. To calculate the traffic volumes at this proposed intersection location, the traffic count data obtained from Lacombe County will be used. During the traffic count, there were 1,442 vehicles recorded on Sunbreaker Cove Road.

To calculate the peak hourly volume on Sunbreaker Cove Road, Table A.6.1 from the Highway Geometric Design Guide was used. It was determined that Sunbreaker Cove is a Class 2B Roadway – Resource Road. From this a K-value of 0.117 is used. Therefore, the peak hourly volume for Rainy Creek Road is calculated as followed:

$$DHV = K*(AADT)$$
$$DHV = 0.117*(1,442)$$
$$DHV = 169$$

Table 6 summarizes the traffic volumes and peak hourly traffic within this proposed intersection.

Table 6 – Traffic Volumes: Rainy Creek Road & North Subdivision Access Road

Road	AADT	Peak Hour
Sunbreaker Cove Road	1,442	169

Projected Background Traffic

Traffic growth rates are calculated as non-compounded. In order to support the average annual growth rate used for analysis purposes, it is important to consider growth rates over various timeframes (every 5 years). This will ensure that a reasonable average annual growth rate is used for analysis purposes. A growth rate of 3.5% was used.

Table 7 - Projected Traffic Volumes for Rainy Creek Road & Sunbreaker Cove Road

Year	Projected AADT	Projected Peak Hour
Base Year (2008)	2,969	347
2013 (5 year)	3,489	408
2018 (10 year)	4,009	469
2023 (15 year)	4,529	530
2028 (20 year)	5,049	591
2033 (25 year)	5,569	652

Table 8 - Projected Traffic Volumes for Rainy Creek Road & North Subdivision Access Road

Year	Projected AADT	Projected Peak Hour
Base Year (2008)	1,572	184
2013 (5 year)	1,847	216
2018 (10 year)	2,122	248
2023 (15 year)	2,397	280
2028 (20 year)	2,672	313
2033 (25 year)	2,947	345

Table 9 - Projected Traffic Volumes for Sunbreaker Cove Road & East Subdivision Access Road

Year	Projected AADT	Projected Peak Hour
Base Year (2008)	1,492	175
2013 (5 year)	1,753	205
2018 (10 year)	2,014	236
2023 (15 year)	2,275	266
2028 (20 year)	2,536	297
2033 (25 year)	2,797	327

Projected Development Traffic

The Developer has indicated that the development will consist of a recreational vehicle park, a store and a nine hole golf course. The development will consist of approximately

678 recreational vehicle lots. Traffic generation estimates contained herein are therefore based upon the Institute of Transportation Engineers (ITE) Manual, 7th Edition. The manual identifies a number of residential options. For the purpose of this review, we have used the following ITE average trip-end generation: *Campground/Recreational Vehicle Park (Code 416)* and *Golf Course (Code 430).* All relevant charts have been attached to **Appendix C**.

ITE estimates are based upon observed measurement. ITE data provides a range of trip generation rates for the specific types of development, along with suggested averages. Estimates are categorized by typical weekday and AM/PM Peak Hour of the roadway, and can be applied on a "per site" or "per hole" rate.

ITE estimates are based upon observed measurement. ITE data provides a range of trip generation rates for the specific types of development, along with suggested averages. Estimates are categorized by AM/PM Peak Hour of the roadway.

Peak hourly traffic generation rates for the above uses are as follows:

- Peak hourly traffic generation for Campground/ Recreational Vehicle Park (Code 416), is suggested as 0.22 vehicle trip ends per occupied site for the AM peak and 0.41 vehicle trip ends per occupied site for the PM peak.

- Peak hourly traffic generation for Golf Course (Code 430), is suggested as 3.01 vehicle trip ends per hole for the AM peak and 3.56 vehicle trip ends per hole for the PM peak.

Below are tables listing the estimated peak hour volumes that will be generated due to the development traffic.

Table 10 - Estimated Peak Hour Volumes – Campground/Recreational Vehicle Park (Code 416)

Time Period	Units	Trip Rate	% In	% Out	In	Out	Total
AM Peak Hour	678	0.22	42	58	63	86	149
PM Peak Hour	678	0.41	62	38	172	106	278

Table 11 - Estimated Peak Hour Volumes – Golf Course (Code 430)

Time Period	Units	Trip Rate	% In	% Out	In	Out	Total
AM Peak Hour	9	3.01	47	53	13	14	27
PM Peak Hour	9	3.56	43	57	14	18	32

Converting all the Peak Hour Volumes to Average Annual Daily Traffic volumes are shown in Table 12.

Table 12 - Estimated Average Annual Daily Traffic Volumes

Type of Development	Peak Hour (In)	Peak Hour (Out)	AADT
Campground/Recreational Vehicle Park (Code 416)	172	106	2,376
Golf Course (Code 430)	14	18	274
TOTAL	**310**	**310**	**2,650**

Development Traffic Intersection Allotting

In order to establish design traffic flows at the intersections, the following traffic flow assumptions have been made.

- 50% of the golf course traffic will access the subdivision from the north access road, while the other 50% of the golf course traffic will access the development from the east access road. It is estimated that the recreational development traffic

will access the subdivision 60% of the time from the north access road, while the other 40% of the development traffic will access the subdivision from the east access road.

- The traffic accessing the development from the north access road will be utilizing Rainy Creek Road, and 60% of the traffic will go east towards Highway 20, and 40% of the traffic will go west towards Highway 766. The traffic that is heading east towards Highway 20 will approach the intersection of Rainy Creek Road & Sunbreaker Cove Road. From here, 70% of the traffic will pass through the intersection and travel east towards Highway 20, while the other 30% of the development traffic will travel south onto Sunbreaker Cove Road.

- The traffic accessing the development from the east access road will be utilizing Sunbreaker Cove Road, and 30% of the traffic will go south towards Sunbreaker Cove, and 70% of the traffic will go north towards Rainy Creek Road. The traffic that is heading east towards Highway 20 will approach the intersection of Rainy Creek Road & Sunbreaker Cove Road. From here, 40% of the traffic will travel east towards Highway 766, while the other 60% of the development traffic will travel east towards Highway 20.

Background & Development Traffic

The background traffic and development traffic have been combined for the determined projection years. The projected traffic numbers are for the peak hour volumes on each leg of the intersections are shown below.

Table 13 - Projected Traffic Volume Rates for Rainy Creek Road (at Sunbreaker Cove Road)

Year	Background AADT	Development Traffic	Combined Traffic
Base Year (2007)	1,863	1,223	3,086
2013 (5 year)	2,189	1,223	3,412
2018 (10 year)	2,515	1,223	3,738
2022 (15 year)	2,841	1,223	4,064
2028 (20 year)	3,167	1,223	4,390
2033 (25 year)	3,493	1,223	4,716

Table 14 – Projected Traffic Volume Rates for Sunbreaker Cove Road (at Rainy Creek Road)

Year	Projected AADT	Development Traffic	Combined Traffic
Base Year (2007)	1,154	479	1,633
2013 (5 year)	1,356	479	1,835
2018 (10 year)	1,558	479	2,037
2022 (15 year)	1,760	479	2,239
2028 (20 year)	1,962	479	2,441
2033 (25 year)	2,164	479	2,643

Table 15 – Projected Traffic Volume Rates for Rainy Creek Road (at North Access Road)

Year	Projected AADT	Development Traffic	Combined Traffic
Base Year (2007)	786	1,240	2,026
2013 (5 year)	924	1,240	2,164
2018 (10 year)	1,062	1,240	2,302
2022 (15 year)	1,200	1,240	2,440
2028 (20 year)	1,338	1,240	2,578
2033 (25 year)	1,476	1,240	2,716

Table 16 – Projected Traffic Volume Rates for North Access Road (at Rainy Creek Road)

Year	Projected AADT	Development Traffic	Combined Traffic
Base Year (2007)	0	624	624
2013 (5 year)	0	624	624
2018 (10 year)	0	624	624
2022 (15 year)	0	624	624
2028 (20 year)	0	624	624
2033 (25 year)	0	624	624

Table 17 – Projected Traffic Volume Rates for East Access Road (at Sunbreaker Cove Road)

Year	Projected AADT	Development Traffic	Combined Traffic
Base Year (2007)	0	436	436
2013 (5 year)	0	436	436
2018 (10 year)	0	436	436
2022 (15 year)	0	436	436
2028 (20 year)	0	436	436
2033 (25 year)	0	436	436

Table 18 – Projected Traffic Volume Rates for Sunbreaker Cove Road (at East Access Road)

Year	Projected AADT	Development Traffic	Combined Traffic
Base Year (2007)	176	932	1,108
2013 (5 year)	207	932	1,139
2018 (10 year)	238	932	1,170
2022 (15 year)	269	932	1,201
2028 (20 year)	300	932	1,232
2033 (25 year)	331	932	1,263

ANALYSIS

Illumination Warrant Analysis

A warrant for illumination is based on Geometric, Operational, Environmental, and Collision factors. Charts in Transportation Association of Canada's (TAC's) guide for Illumination of Isolated Rural Intersections were used to conduct this analysis. Charts have been attached to **Appendix D**. All intersections have been analyzed and the results are shown below.

The intersections of Rainy Creek Road & North Subdivision Access Road and Sunbreaker Cove Road & East Subdivision Access Road both do not require illumination at the current traffic volumes or at full build out conditions.

The following terminology is used in the illumination warrant:

- Full intersection lighting denotes illumination covering an intersection in a uniform manner over the traveled portion of the roadway.

- Partial lighting refers to the illumination of key decision areas, potential conflict points, and /or hazards in and on the approach to an intersection. Partial lighting may also guide a driver from one key point to the next, and (if sufficient luminaries are used) place the driver on a safe heading after leaving an illuminated area.

- Delineation lighting refers to "sentry" lighting that marks an intersection location for approaching traffic, or to the illumination of vehicles on a cross street or median crossing.

The intersection of Rainy Creek Road & Sunbreaker Cove Road requires the following types of illumination at the following trigger points:

- Delineated lighting to illuminate cross street traffic when 327 lots are developed or when 48% of the development occurs.

- Partial lighting when 99 lots are developed or when 15% of the development occurs.

Pedestrian Analysis

For this site analysis, the location has no pedestrian traffic at the proposed intersection; therefore pedestrian movement accommodation is not warranted.

Intersection Analysis

An intersection configuration was designed for the projected year (2032). Figure D-7.4 from the Highway Geometric Design Guide has been used to represent initial traffic volume warrants for the intersections at the site. This review identifies the need for upgrading of the intersection, and suggests further analysis to determine whether an allowance must be made for left-turn vehicles through provision of a larger intersection configuration. A copy of the intersection types and Figure D-7.4 has been included in **Appendix E**.

Rainy Creek Road & Sunbreaker Cove Road

For the intersection of *Rainy Creek Road & Sunbreaker Cove Road*, the type of intersection needed is as shown below. This was taken from Figure D-7.4 and Figure D-71 of the Highway Geometric Design Guide, which is located in **Appendix E**.

Table 19 - Intersection Types For Rainy Creek Road & Sunbreaker Cove Road

	Current Needs (2007)	Full Build-Out (2032)
South Leg	Type II	Type IV
North Leg	Type II	Type II
East Leg	Type III	Type IV
West Leg	Type II	Type IV

Left turn warrants are based upon the level of probability that a vehicle in the advancing traffic stream in the design hour will not arrive at an intersection when another vehicle, traveling in the same direction, is stopped waiting to make a left turn. The associated hazard represents decreases with decreased design speed. Due to the type of intersection configurations required, a left turn lane is required for the east, and south legs of the intersection.

The Alberta Transportation warrant for a right turn lane requires that that the following three conditions are met: the main road have an average daily volume in excess of 1800 vehicles, the intersecting road have an average daily volume in excess of 900 vehicles, and a right turn volume in excess of 360 vehicles. For this analysis the three conditions were met on the east, west and south legs of the intersection and therefore a dedicated right turn lane is warranted. Based on the background (2007) traffic volumes, a right turn lane is warranted for the south leg of the intersection.

Pavement widths of turning roadways depend jointly upon the dimension of the design vehicle and the radius of the turning roadway. According to Table D.6.3.2, the minimum pavement width to accommodate a WB-21 type of vehicle is 9.1 metres.

Rainy Creek Road & North Subdivision Access Road

For the intersection of *Rainy Creek Road & North Subdivision Access Road,* the type of intersection needed is as shown below. This was taken from Figure D-7.4 and Figure D-71 of the Highway Geometric Design Guide, which is located in **Appendix E**.

Table 20 - Intersection Types For Rainy Creek Road & North Subdivision Access Road

	Current Needs (2007)	Full Build-Out (2032)
South Leg	n/a	Type II
North Leg	n/a	n/a
East Leg	n/a	Type III
West Leg	n/a	Type III

Left turn warrants are based upon the level of probability that a vehicle in the advancing traffic stream in the design hour will not arrive at an intersection when another vehicle, traveling in the same direction, is stopped waiting to make a left turn. The associated hazard represents decreases with decreased design speed. Due to the type of intersection configurations required, a left turn lane is required for the east leg of the intersection.

The Alberta Transportation warrant for a right turn lane requires that the following three conditions are met: the main road have an average daily volume in excess of 1800 vehicles, the intersecting road have an average daily volume in excess of 900 vehicles, and a right turn volume in excess of 360 vehicles. For this analysis the three conditions were met on the west leg of the intersection and therefore a dedicated right lane is warranted.

Pavement widths of turning roadways depend jointly upon the dimension of the design vehicle and the radius of the turning roadway. According to Table D.6.3.2, the minimum pavement width to accommodate a WB-21 type of vehicle is 9.1 metres.

Sunbreaker Cove Road & East Subdivision Access Road

For the intersection of *Sunbreaker Cove Road & East Subdivision Access Road,* the type of intersection needed is as shown below. This was taken from Figure D-7.4 and Figure D-71 of the Highway Geometric Design Guide, which is located in **Appendix E**.

Table 21 - Intersection Types For Sunbreaker Cove Road & East Subdivision Road

	Current Needs (2007)	Full Build-Out (2032)
South Leg	n/a	Type III
North Leg	n/a	Type III
East Leg	n/a	n/a
West Leg	n/a	II

Left turn warrants are based upon the level of probability that a vehicle in the advancing traffic stream in the design hour will not arrive at an intersection when another vehicle, traveling in the same direction, is stopped waiting to make a left turn. The associated hazard represents decreases with decreased design speed. Due to the type of intersection configurations required, a left turn lane is not required for the intersection.

The Alberta Transportation warrant for a right turn lane requires that that the following three conditions are met: the main road have an average daily volume in excess of 1800 vehicles, the intersecting road have an average daily volume in excess of 900 vehicles, and a right turn volume in excess of 360 vehicles. For this analysis the three conditions were not met on any of the legs of the intersection and therefore a dedicated right lane is not warranted.

Pavement widths of turning roadways depend jointly upon the dimension of the design vehicle and the radius of the turning roadway. According to Table D.6.3.2, the minimum pavement width to accommodate a WB-21 type of vehicle is 9.1 metres.

Signalization Analysis

A warrant for signalization was conducted on all of the intersections. Charts in the Manual of Uniform Traffic Control Devices for Canada, 4th Edition were used to conduct this analysis. According to the priority rating worksheet analysis the intersection must generate 80 priority points to trigger the need for signalization. Priority rating worksheets consider traffic volumes, pedestrian volumes, vehicular stops, crossing gaps and collisions; an item that is difficult to forecast over 25 years. Excluding the collision rating, the intersection does not generate enough priority points to warrant signalization. Based on the charts for

warranting signalization, none of the intersections generate enough priority points to warrant signalization.

A copy of the signalization analysis worksheets has been included in **Appendix F**. The trigger for signalization is when the traffic levels generate a level of service that drops to Type 'E'.

Capacity Analysis

The capacity analysis is based on the methods outlined in the Highway Capacity Manual 2000 and HCS 2000 analysis software and includes assessments using Alberta Infrastructure and Transportation intersection configuration warrants where necessary. With respect to the Highway Capacity Manual, intersection operations are typically rated by the intersections Level of Service (LOS). LOS is based on the estimated average delay per vehicle among all traffic passing through the intersection. A low average delay merits a LOS 'A' rating, whereas high average delay merits a LOS rating of 'F'. If the level of service drops below 'D', signalization is warranted. Copies of the LOS analysis worksheets have been included in **Appendix G**.

Table 28 - Capacity Analysis/Level of Service

	Rainy Creek Road & Sunbreaker Cove Road	**Rainy Creek Road & North Access Road**	**Sunbreaker Cove Road & East Access Road**
LOS (2007)	C	n/a	n/a
LOS (Full Build Out)	C	A	B
Warrant Signalization	No	No	No
Trigger Point	n/a	n/a	n/a

Based on the above analysis, none of the intersections have capacity concerns upon full build out of the development.

Operational Analysis

The operational analysis is necessary to ensure that the design vehicle is capable of safely manoeuvring the intersection without interfering with other traffic movements. The design vehicle used to calculate the minimum turning radii is a semi-trailer combination (WB-21). This was selected to accommodate any hauling of equipment in and out of the proposed site. The minimum turning radius for this type of vehicle is 55-18-55 metres with a three centred curve. This value has been taken from the Highway Geometric Design Guide. Therefore, when the new intersection is designed, it should be capable of handling the turning movements of the design vehicle.

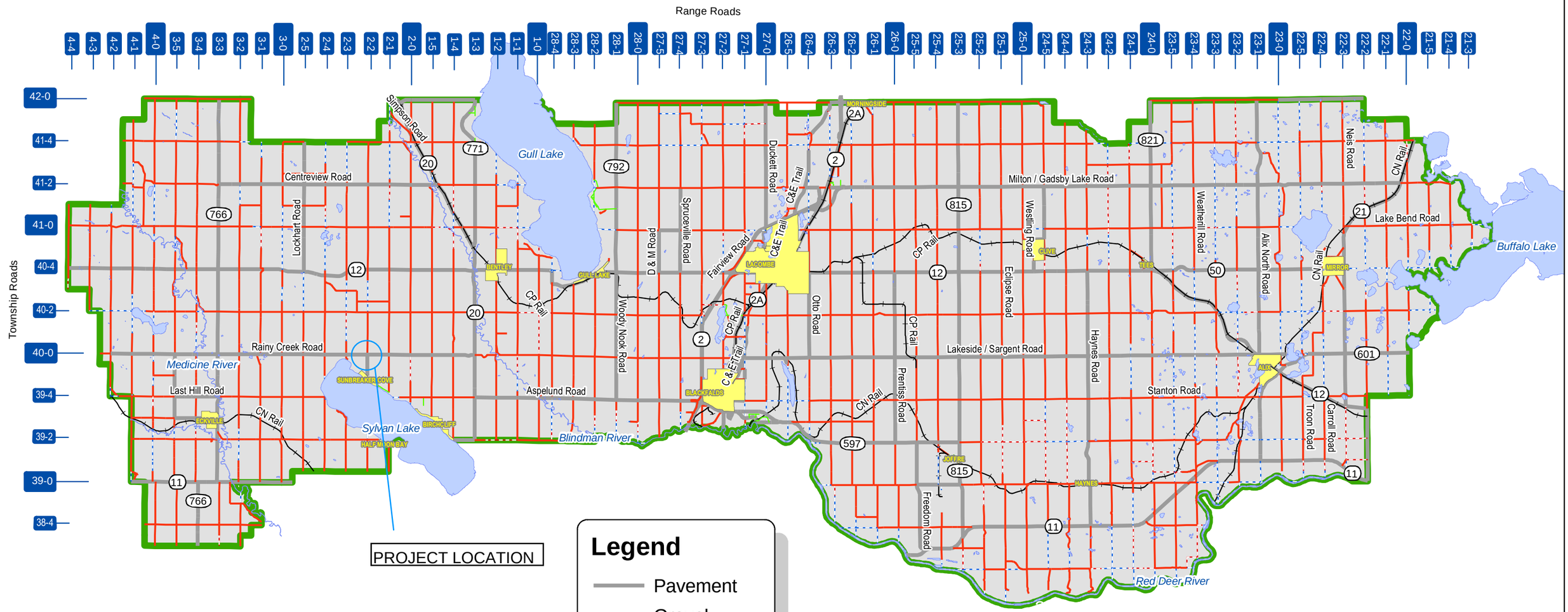
CLOSURE

This report has been prepared based upon the information referenced herein. It has been prepared in a manner consistent with good engineering judgement. Should new information come to light, A. D. Williams Engineering Inc. requests the opportunity to review this information, and our conclusions contained in this report. This report has been prepared for the exclusive use of Frank Wilson and there are no representations made by A. D. Williams Engineering Inc. to any other party. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

A P P E N D I X A

SITE MAP

Lacombe County Transportation Network



PROJECT LOCATION

Legend

- Pavement
- Gravel
- Cold Mix
- Fair Weather
- Unbuilt
- Railroad

Provincial Primary Highways
- Highways 2, 2A, 12, 50, 21, 11
- Total of 307 Kilometres

Provincial Secondary Highways
- Highways 766, 597, 601, 792, 821, 815, 604
- Total of 163 Kilometres

Local Road System
- 314 Kilometres of Paved Roads
- 1,714 Kilometres of Gravel Roads

Rail Line Infrastructure: County serviced by Canadian Pacific (CP) and Canadian National (CN) Rail Lines
- CP Rail: main line runs north and south through County
- CN & CP: lines run east and west through County

Lacombe County roads are situated such that no person should have to drive more than four miles to reach a paved road.

LACOMBE COUNTY

FRANK WILSON

PLAN SHOWING

PROPOSED R.V. PARK AND RECREATIONAL FACILITY

WITHIN THE

N.E. 1/4 Sec. 34-39-2-5

LACOMBE COUNTY, ALBERTA

DATE OF SURVEY: OCTOBER 2 to 4, 2004

- 20 m. WIDE ROADS
- 15 m. WIDE ROADS
- PARKING
- OPEN SPACE / GOLF COURSE
- BUSINESS AREAS
- BOAT, TRAILER & R.V. STORAGE
- SEASONAL LEASE LOTS (582 UNITS)
- WEEKEND RENTAL LOTS (85 UNITS)

NOTES:

Existing grades are shown thus: 99.91

Elevations are geodetic and are referred to ASCM # 244186

Survey evidence found is shown thus ..... ● FD I.

Distances are shown in metres.

Contours are at 0.5m intervals.

Area shown bounded thus: – – – – – –

and contains ±59.71 ha (147.5 AC)

N

SCALE = 1:2000

Drawn By: RH	Bemoco Land Surveying Ltd.
Date: March 18, 2008	#100 6040 – 47th Avenue
File No.: M-039-04rvpark	Red Deer, Alberta

A P P E N D I X B

TRAFFIC COUNT DATA & AADT'S

Intersection of:	Rainy Creek Road & North Access Road
Date:	2007
Time:	Peak Hour

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

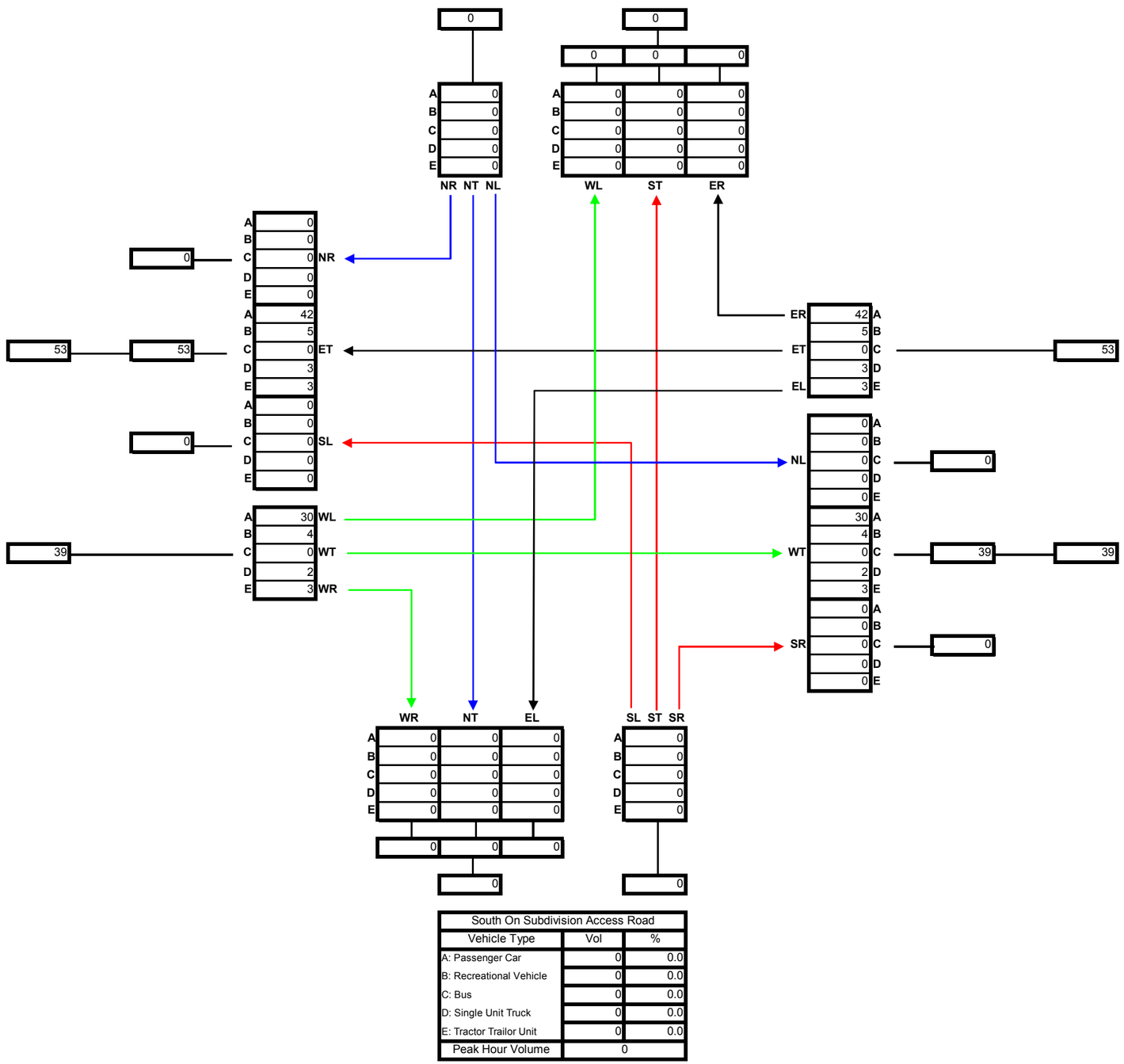
WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On N/A		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	

West On Rainy Creek Road		
Vehicle Type	Vol	%
A: Passenger Car	30	76.9
B: Recreational Vehicle	4	10.3
C: Bus	0	0.0
D: Single Unit Truck	2	5.1
E: Tractor Trailor Unit	3	7.7
Peak Hour Volume	39	

East On Rainy Creek Road		
Vehicle Type	Vol	%
A: Passenger Car	42	79.2
B: Recreational Vehicle	5	9.4
C: Bus	0	0.0
D: Single Unit Truck	3	5.7
E: Tractor Trailor Unit	3	5.7
Peak Hour Volume	53	

South On Subdivision Access Road		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	



Intersection of:	Rainy Creek Road & North Access Road
Date:	2032
Time:	Peak Hour

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

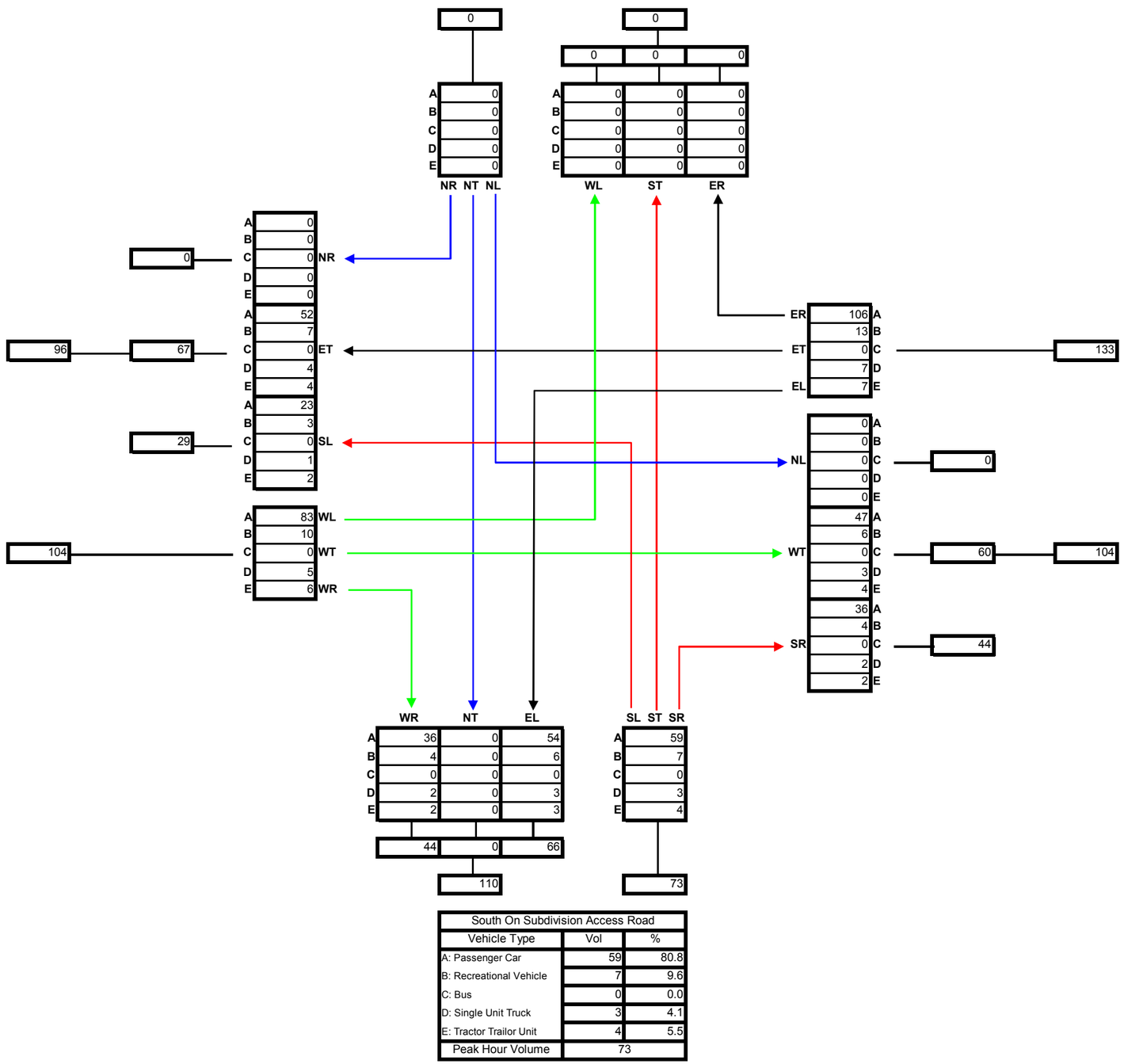
WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On N/A		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	

West On Rainy Creek Road		
Vehicle Type	Vol	%
A: Passenger Car	83	79.8
B: Recreational Vehicle	10	9.6
C: Bus	0	0.0
D: Single Unit Truck	5	4.8
E: Tractor Trailor Unit	6	5.8
Peak Hour Volume	104	

East On Rainy Creek Road		
Vehicle Type	Vol	%
A: Passenger Car	106	79.7
B: Recreational Vehicle	13	9.8
C: Bus	0	0.0
D: Single Unit Truck	7	5.3
E: Tractor Trailor Unit	7	5.3
Peak Hour Volume	133	

South On Subdivision Access Road		
Vehicle Type	Vol	%
A: Passenger Car	59	80.8
B: Recreational Vehicle	7	9.6
C: Bus	0	0.0
D: Single Unit Truck	3	4.1
E: Tractor Trailor Unit	4	5.5
Peak Hour Volume	73	



Intersection of:	Sunbreaker Cove Road & East Access Road
Date:	2007
Time:	Peak Hour

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

North On Sunbreaker Cove Road		
Vehicle Type	Vol	%
A: Passenger Car	67	76.1
B: Recreational Vehicle	9	10.2
C: Bus	0	0.0
D: Single Unit Truck	4	4.5
E: Tractor Trailor Unit	8	9.1
Peak Hour Volume	88	

West On East Subdivision Access Road		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	

East On N/A		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	

South On Sunbreaker Cove Road		
Vehicle Type	Vol	%
A: Passenger Car	69	78.4
B: Recreational Vehicle	9	10.2
C: Bus	0	0.0
D: Single Unit Truck	3	3.4
E: Tractor Trailor Unit	7	8.0
Peak Hour Volume	88	

Intersection of:	Sunbreaker Cove Road & East Access Road
Date:	2032
Time:	Peak Hour

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

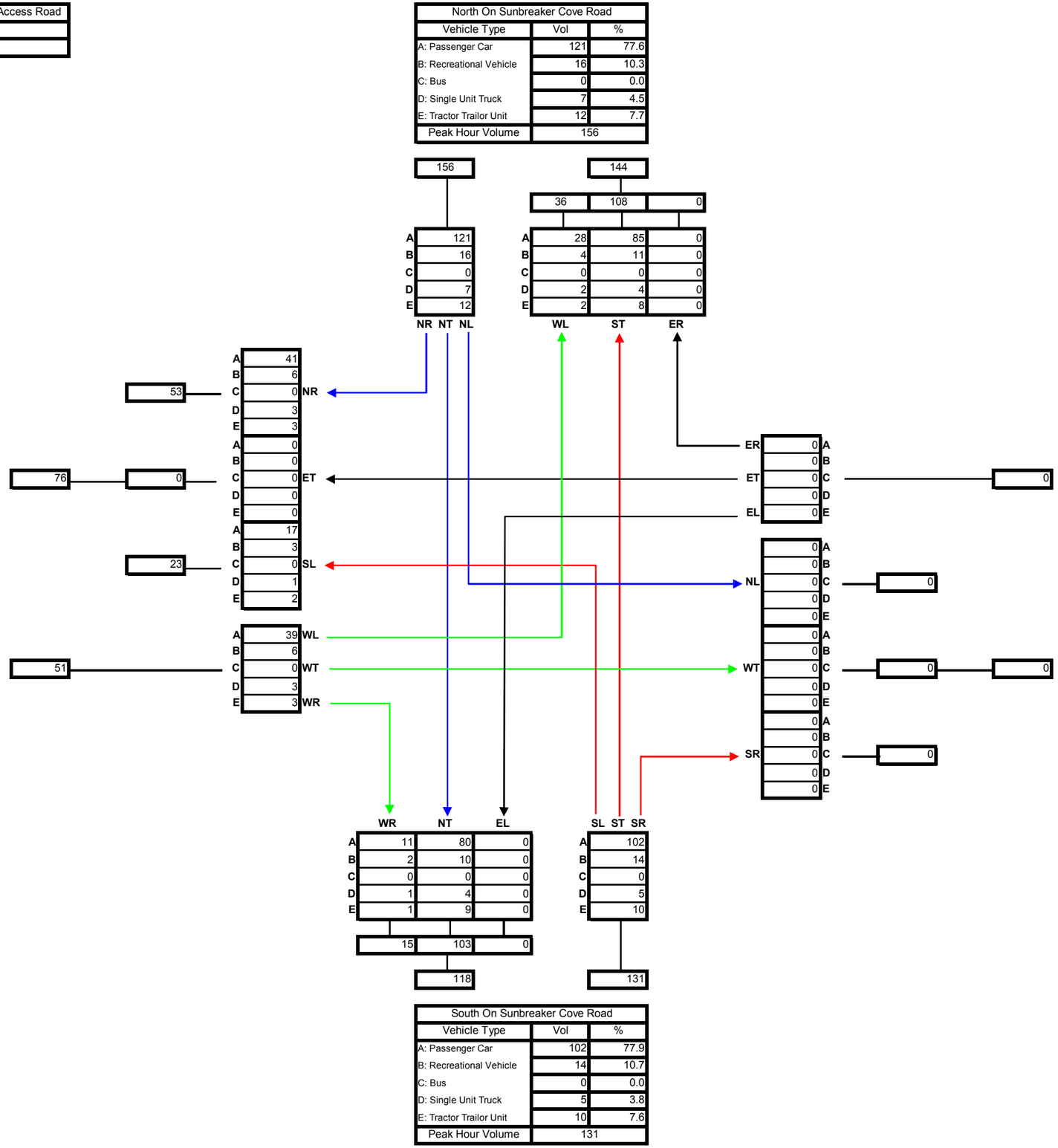
WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Sunbreaker Cove Road		
Vehicle Type	Vol	%
A: Passenger Car	121	77.6
B: Recreational Vehicle	16	10.3
C: Bus	0	0.0
D: Single Unit Truck	7	4.5
E: Tractor Trailor Unit	12	7.7
Peak Hour Volume	156	

West On East Subdivision Access Road		
Vehicle Type	Vol	%
A: Passenger Car	39	76.5
B: Recreational Vehicle	6	11.8
C: Bus	0	0.0
D: Single Unit Truck	3	5.9
E: Tractor Trailor Unit	3	5.9
Peak Hour Volume	51	

East On N/A		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	

South On Sunbreaker Cove Road		
Vehicle Type	Vol	%
A: Passenger Car	102	77.9
B: Recreational Vehicle	14	10.7
C: Bus	0	0.0
D: Single Unit Truck	5	3.8
E: Tractor Trailor Unit	10	7.6
Peak Hour Volume	131	



Intersection of:	Rainy Creek Road & Sunbreaker Cove Road
Date:	2007
Time:	Peak Hour

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

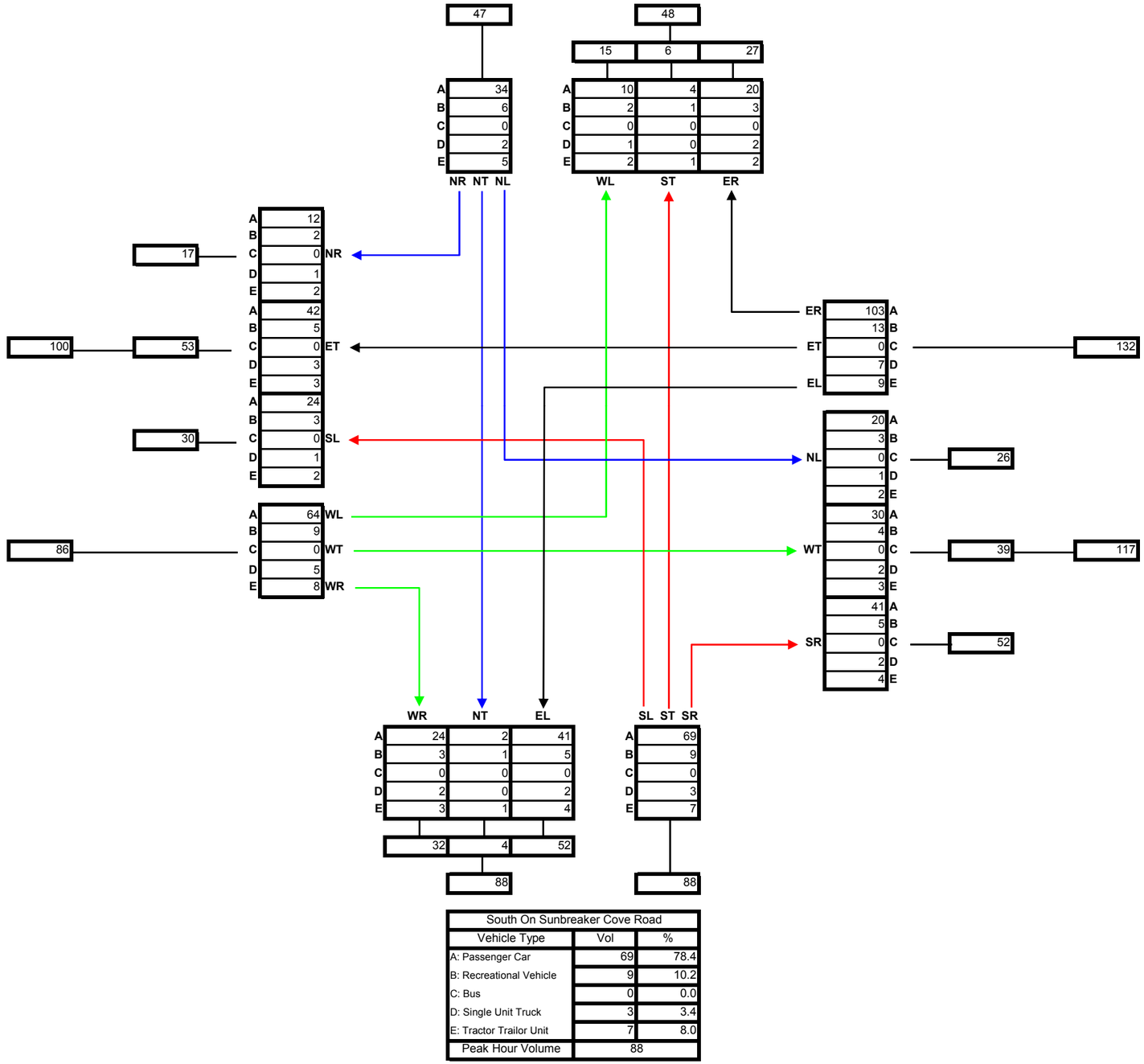
WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Sunbreaker Cove Road		
Vehicle Type	Vol	%
A: Passenger Car	34	72.3
B: Recreational Vehicle	6	12.8
C: Bus	0	0.0
D: Single Unit Truck	2	4.3
E: Tractor Trailor Unit	5	10.6
Peak Hour Volume	47	

West On Rainy Creek Road		
Vehicle Type	Vol	%
A: Passenger Car	64	74.4
B: Recreational Vehicle	9	10.5
C: Bus	0	0.0
D: Single Unit Truck	5	5.8
E: Tractor Trailor Unit	8	9.3
Peak Hour Volume	86	

East On Rainy Creek Road		
Vehicle Type	Vol	%
A: Passenger Car	103	78.0
B: Recreational Vehicle	13	9.8
C: Bus	0	0.0
D: Single Unit Truck	7	5.3
E: Tractor Trailor Unit	9	6.8
Peak Hour Volume	132	

South On Sunbreaker Cove Road		
Vehicle Type	Vol	%
A: Passenger Car	69	78.4
B: Recreational Vehicle	9	10.2
C: Bus	0	0.0
D: Single Unit Truck	3	3.4
E: Tractor Trailor Unit	7	8.0
Peak Hour Volume	88	



Intersection of:	Rainy Creek Road & Sunbreaker Cove Road
Date:	2032
Time:	Peak Hour

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

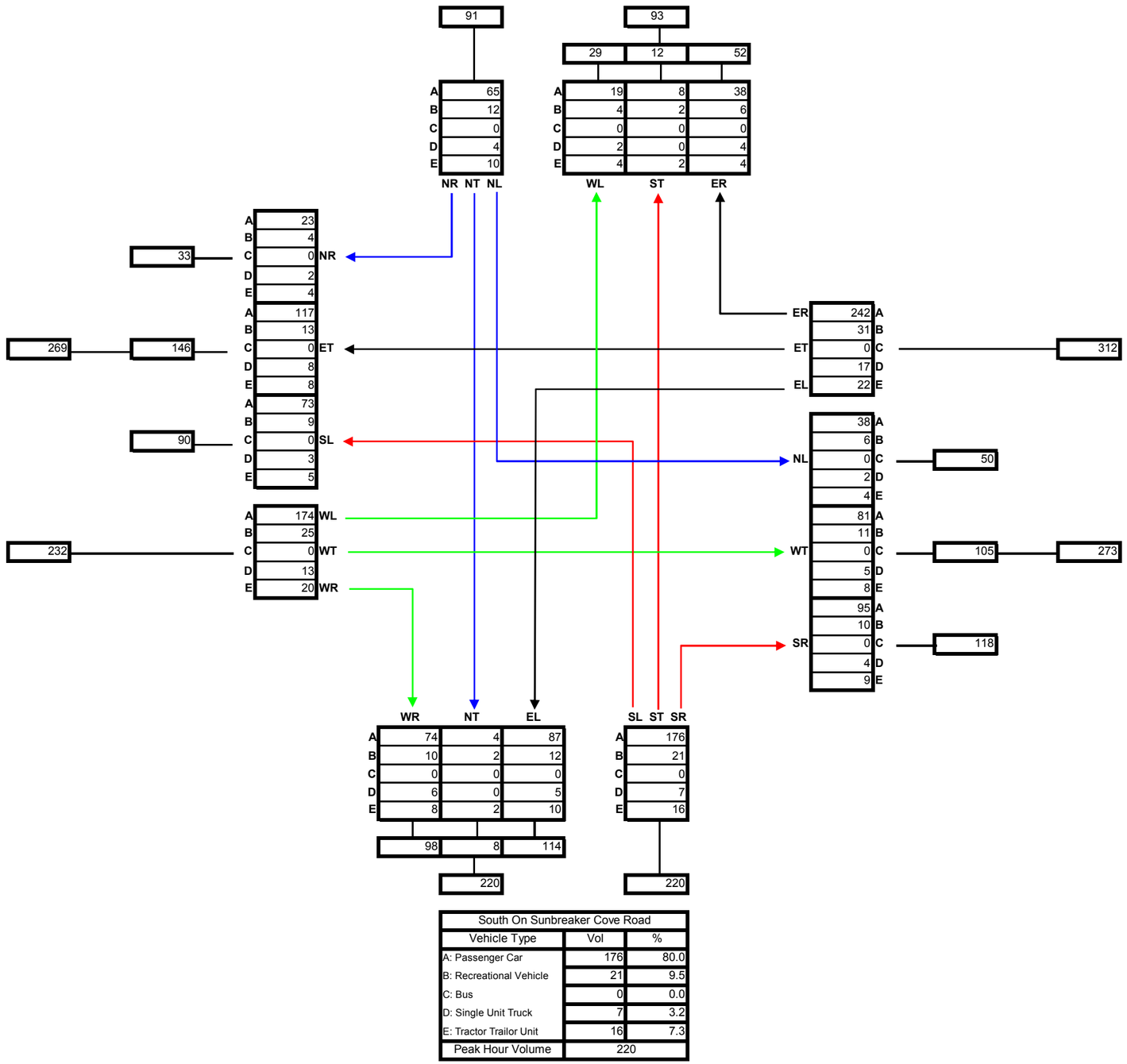
WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Sunbreaker Cove Road		
Vehicle Type	Vol	%
A: Passenger Car	65	71.4
B: Recreational Vehicle	12	13.2
C: Bus	0	0.0
D: Single Unit Truck	4	4.4
E: Tractor Trailor Unit	10	11.0
Peak Hour Volume	91	

West On Rainy Creek Road		
Vehicle Type	Vol	%
A: Passenger Car	174	75.0
B: Recreational Vehicle	25	10.8
C: Bus	0	0.0
D: Single Unit Truck	13	5.6
E: Tractor Trailor Unit	20	8.6
Peak Hour Volume	232	

East On Rainy Creek Road		
Vehicle Type	Vol	%
A: Passenger Car	242	77.6
B: Recreational Vehicle	31	9.9
C: Bus	0	0.0
D: Single Unit Truck	17	5.4
E: Tractor Trailor Unit	22	7.1
Peak Hour Volume	312	

South On Sunbreaker Cove Road		
Vehicle Type	Vol	%
A: Passenger Car	176	80.0
B: Recreational Vehicle	21	9.5
C: Bus	0	0.0
D: Single Unit Truck	7	3.2
E: Tractor Trailor Unit	16	7.3
Peak Hour Volume	220	



A P P E N D I X C

TRIP GENERATION SHEETS

Land Use: 416
Campground/Recreational Vehicle Park

Description

Campgrounds and recreational vehicle parks are recreational sites that accommodate campers, trailers, tents and recreational vehicles on a transient basis. They are found in a variety of locations and provide a variety of facilities, often including rest rooms with showers, recreational facilities such as a swimming pool, convenience store and laundromat.

Additional Data

The sites were surveyed in the late 1980s, 1990s and 2000s in California, Rhode Island and Washington.

Source Numbers

264, 401, 559

Campground/Recreational Vehicle Park
(416)

Average Vehicle Trip Ends vs: Occupied Camp Sites
On a: Weekday,
A.M. Peak Hour of Generator

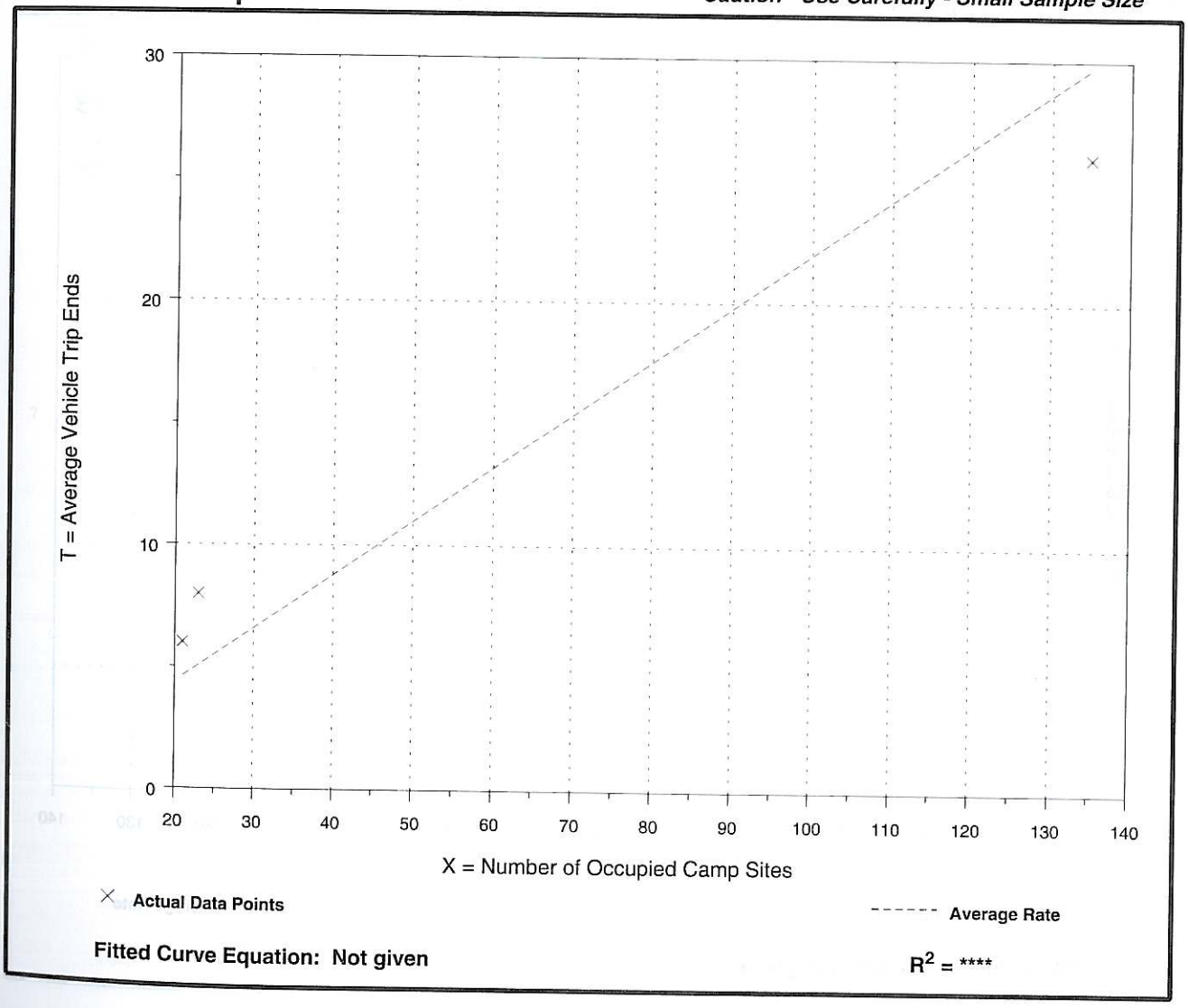
Number of Studies: 3
Average Number of Occupied Camp Sites: 60
Directional Distribution: 42% entering, 58% exiting

Trip Generation per Occupied Camp Site

Average Rate	Range of Rates	Standard Deviation
0.22	0.19 - 0.35	0.47

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Not given

R^2 = ****

Campground/Recreational Vehicle Park
(416)

Average Vehicle Trip Ends vs: **Occupied Camp Sites**
On a: **Weekday,**
P.M. Peak Hour of Generator

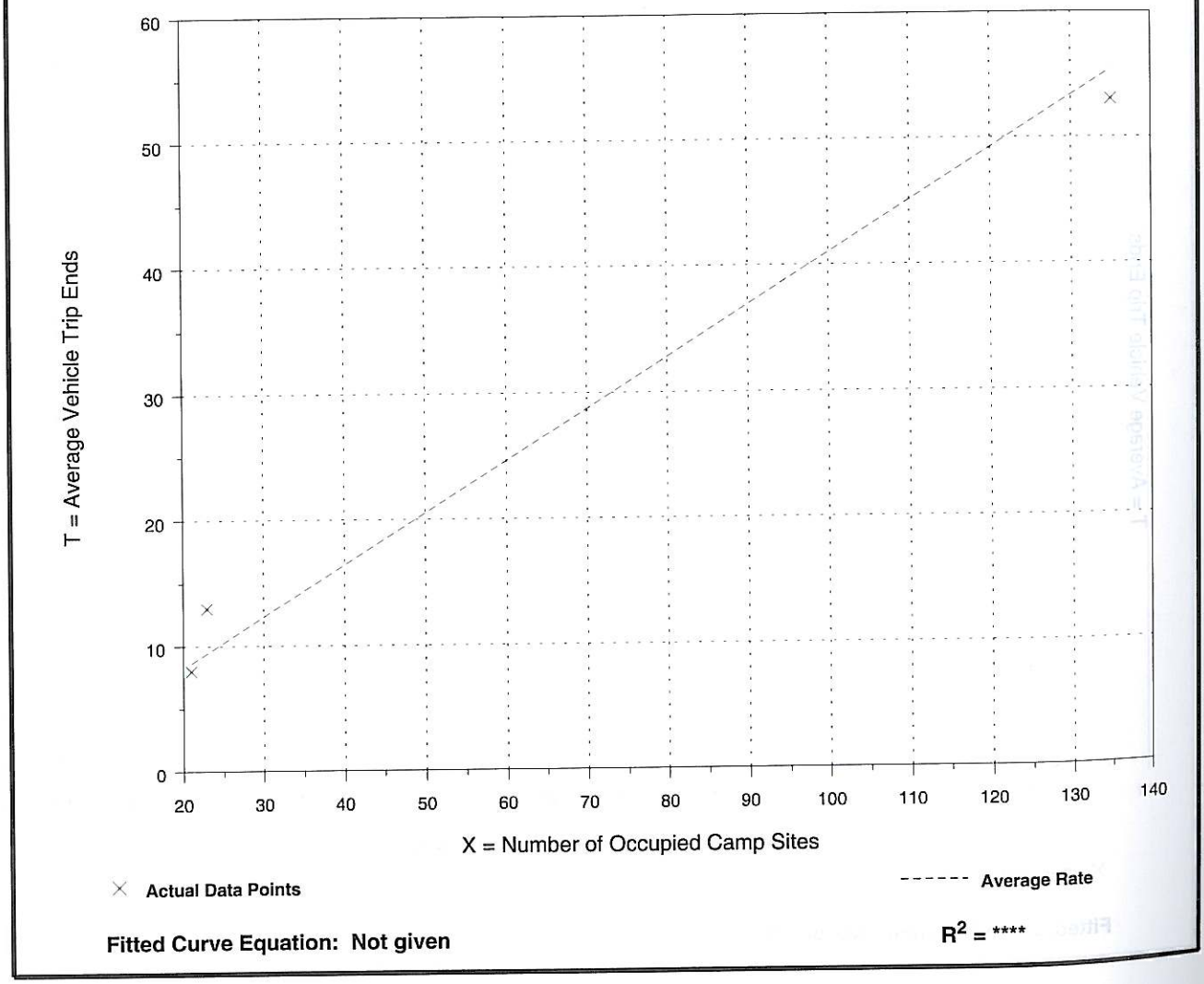
Number of Studies: 3
Average Number of Occupied Camp Sites: 60
Directional Distribution: 62% entering, 38% exiting

Trip Generation per Occupied Camp Site

Average Rate	Range of Rates	Standard Deviation
0.41	0.38 - 0.57	0.64

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Not given

R^2 = ****

Land Use: 430
Golf Course

Description

The golf courses contained in this land use include 9-, 18-, 27- and 36-hole municipal courses and private country clubs. Some sites have driving ranges and clubhouses with a pro shop and/or restaurant, lounge and banquet facilities. Many of the municipal courses do not have any of these facilities. Miniature golf course (Land Use 431), golf driving range (Land Use 432) and multipurpose recreational facility (Land Use 435) are related uses.

Additional Data

The sites were surveyed from the late 1960s to the mid-1990s throughout the United States. Most of the facilities were located in suburban areas; a few were in scenic, rural areas.

Source Numbers

7, 11, 12, 13, 18, 98, 102, 214, 378, 407, 440

Golf Course
(430)

Average Vehicle Trip Ends vs: Holes
On a: Weekday,
A.M. Peak Hour of Generator

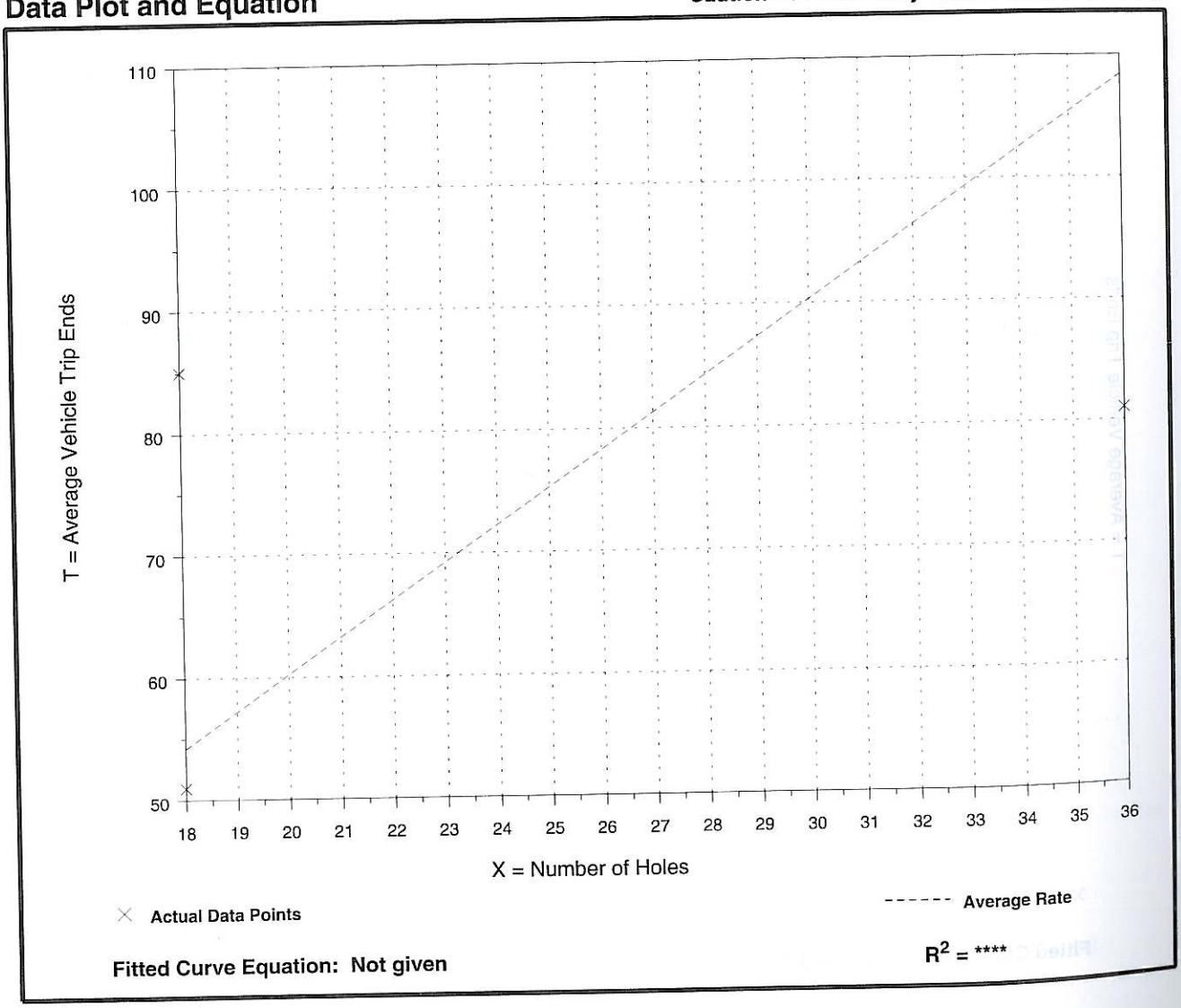
Number of Studies: 3
Average Number of Holes: 24
Directional Distribution: 47% entering, 53% exiting

Trip Generation per Hole

Average Rate	Range of Rates	Standard Deviation
3.01	2.25 - 4.72	1.99

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Not given

R^2 = ****

Golf Course
(430)

Average Vehicle Trip Ends vs: Holes
On a: Weekday,
P.M. Peak Hour of Generator

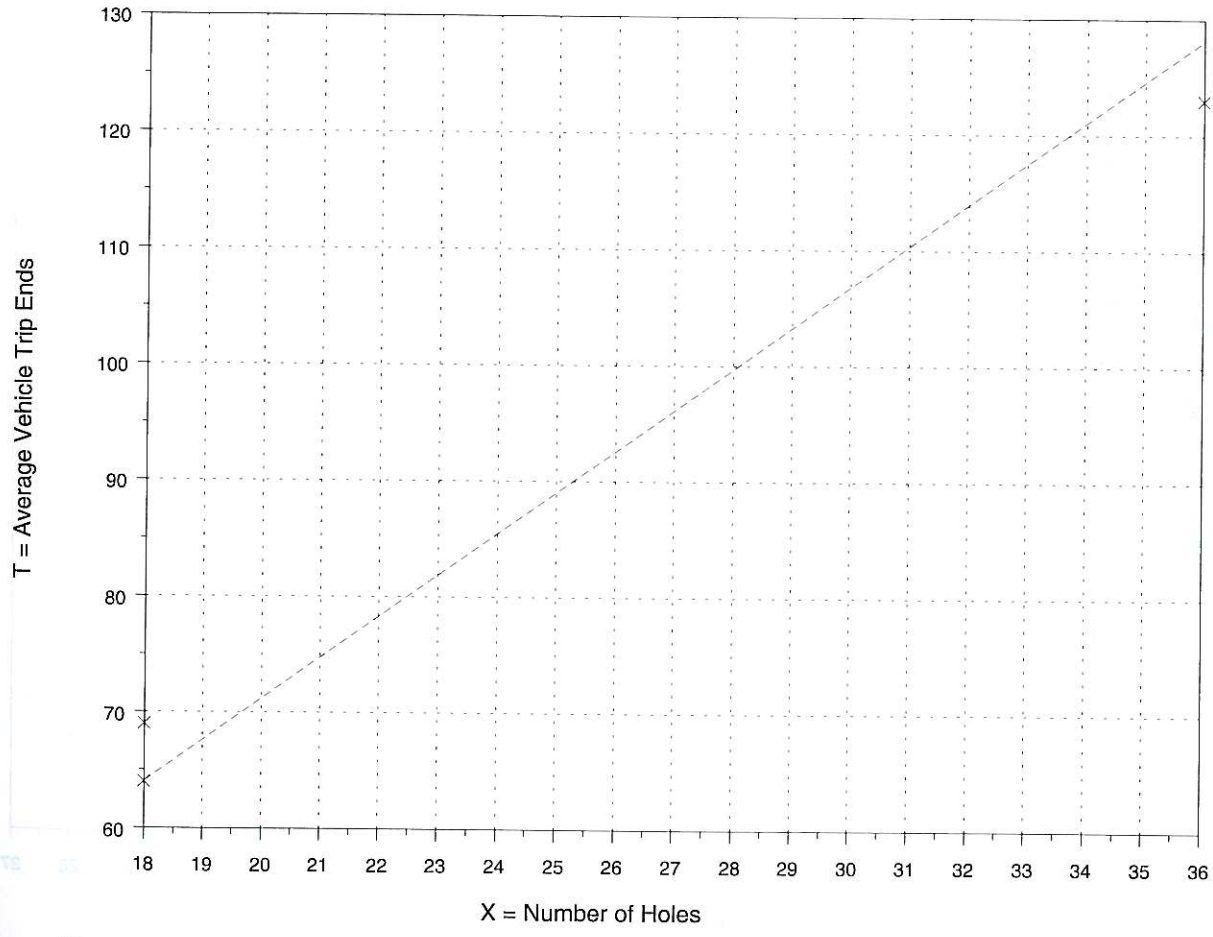
Number of Studies: 3
Average Number of Holes: 24
Directional Distribution: 43% entering, 57% exiting

Trip Generation per Hole

Average Rate	Range of Rates	Standard Deviation
3.56	3.42 - 3.83	1.87

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Not given

R^2 = ****

A P P E N D I X D

ILLUMINATION WARRANT WORKSHEET

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

Rainy Creek Road	Main Road
North Access Road	Minor Road
Sunbreaker Cove, Alberta	City/Town

Date April 17, 2008
Other Full Build Out - 2032

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 (%)	80	1	10	Relative to the recommended minimum sight distance	OK	10
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	3	1	3	Number of legs = 3 or more	OK	3
				Geometric Factors Subtotal		**13**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	2716	2	10	Either Use the two AADT inputs **OR** the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	20
AADT on Minor Road (2-way)	624	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	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
				Operational Factors Subtotal		**65**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	1	1	5	Maximum of 4 quadrants	OK	5
				Environmental Factor Subtotal		**5**

COLLISION HISTORY

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

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY

Geometric Factors Subtotal	13
Operational Factor Subtotal	65
Environmental Factor Subtotal	5
Collision History Subtotal	0
TOTAL POINTS	**83**

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

Rainy Creek Road	Main Road
Sunbreaker Cove Road	Minor Road
Sunbreaker Cove, Alberta	City/Town

Date April 17, 2008
Other Base year - 2007

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 (%)	80	1	10	Relative to the recommended minimum sight distance	OK	10
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		**16**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	1863	1	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	10
AADT on Minor Road (2-way)	1154	2	20		OK	40
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	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
				Operational Factors Subtotal		**90**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	1	1	5	Maximum of 4 quadrants	OK	5
				Environmental Factor Subtotal		**5**

COLLISION HISTORY

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

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	16
Operational Factor Subtotal	90
Environmental Factor Subtotal	5
Collision History Subtotal	0
TOTAL POINTS	**111**

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

Rainy Creek Road	Main Road
Sunbreaker Cove Road	Minor Road
Sunbreaker Cove, Alberta	City/Town

Date April 17, 2008
Other Full Build Out - 2032

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 (%)	80	1	10	Relative to the recommended minimum sight distance	OK	10
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	**16**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	4716	3	10	Either Use the two AADT inputs **OR** the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	30
AADT on Minor Road (2-way)	2643	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	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
					Operational Factors Subtotal	**150**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	1	1	5	Maximum of 4 quadrants	OK	5
					Environmental Factor Subtotal	**5**

COLLISION HISTORY

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

Check Intersection Signalization:
Intersection is not Signalized

ILLUMINATION WARRANTED
DELINEATION LIGHTING TO ILLUMINATE PEDESTRIANS OR CROSS STREET TRAFFIC

SUMMARY

Geometric Factors Subtotal	16
Operational Factor Subtotal	150
Environmental Factor Subtotal	5
Collision History Subtotal	0
TOTAL POINTS	**171**

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

Sunbreaker Cove Road	Main Road
East Access Road	Minor Road
Sunbreaker Cove, Alberta	City/Town

Date April 17, 2008
Other Full Build Out - 2032

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 (%)	80	1	10	Relative to the recommended minimum sight distance	OK	10
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	3	1	3	Number of legs = 3 or more	OK	3
				Geometric Factors Subtotal		**13**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	436	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)	1263	2	20		OK	40
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	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
				Operational Factors Subtotal		**60**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	1	1	5	Maximum of 4 quadrants	OK	5
				Environmental Factor Subtotal		**5**

COLLISION HISTORY

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

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY

Geometric Factors Subtotal	13
Operational Factor Subtotal	60
Environmental Factor Subtotal	5
Collision History Subtotal	0
TOTAL POINTS	**78**

A P P E N D I X E

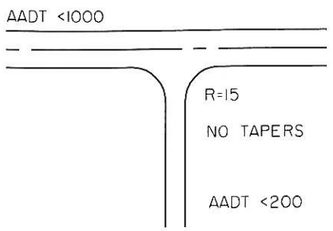
INTERSECTION ANALYSIS CHARTS & TYPES

Table D.6.3.2 Design Widths for Turning Roadways at Rural Intersections

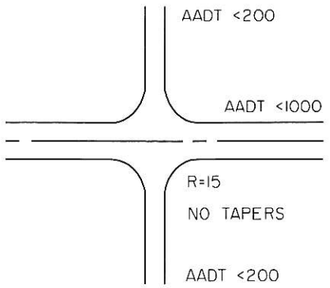
Minimum Pavement Width (m)										
R radius on inner edge of pavement (m)	Case I one-lane, one-way operation no provision for passing				Case II one-lane, one-way operation with provision for passing a stalled vehicle			Case III two-lane operation either one-way or two-way		
design traffic condition vehicle accommodation type	A (P)	B (SU)	C (WB-12)	D (WB-21)	A (P-P)	B (P-SU)	C (SU-SU)	A (P-SU)	B (SU-SU)	C (WB-12-WB-12)
15	5.4	5.4	7.0	9.1	7.0	7.6	8.8	9.4	11.0	13.1
25	4.8	5.2	5.8	7.8	6.4	6.8	8.1	8.7	9.8	11.4
35	4.5	5.0	5.4	7.1	6.0	6.6	7.5	8.4	9.4	10.4
45	4.2	4.8	5.2	6.6	5.8	6.4	7.3	8.2	9.0	10.0
60	4.2	4.8	5.0	6.0	5.8	6.4	7.2	8.2	8.8	9.4
80	4.0	4.8	5.0	5.7	5.8	6.2	7.0	8.0	8.6	9.4
100	4.0	4.8	5.0	5.4	5.5	6.2	6.8	8.0	8.5	9.0
125	4.0	4.6	4.8	5.2	5.5	6.0	6.8	8.0	8.4	8.8
150	3.7	4.6	4.6	5.1	5.5	6.0	6.7	7.8	8.4	8.8
tangent	3.7	4.6	4.6	5.1	5.2	5.8	6.4	7.6	8.2	8.2
	Width Adjustment for Edge of Pavement Treatment									
mountable curb	none				none			none		
barrier curb one side two sides	add 0.25m add 0.5m				none add 0.25m			add 0.25m add 0.5m		

Note:
1. The combination of vehicle accommodation type letters, such as P-SU for Case II, means the pavement width allows a P design vehicle to slowly pass by a stalled SU design truck or vice versa.
2. Case II C is generally used in Alberta.

TYPE I's

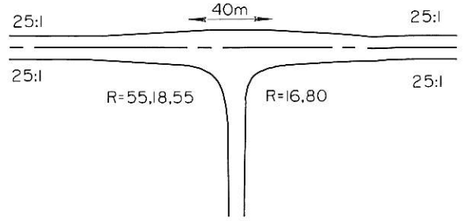


TYPE Ia

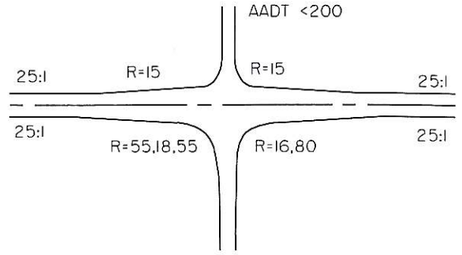


TYPE Ib

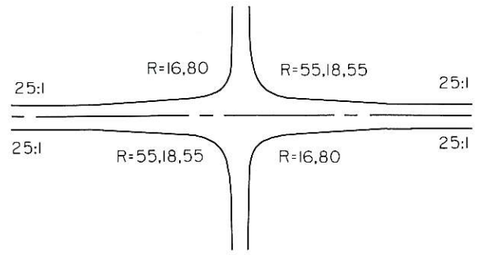
TYPE II's



TYPE IIa

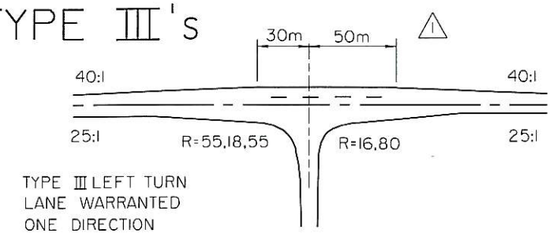


TYPE IIb

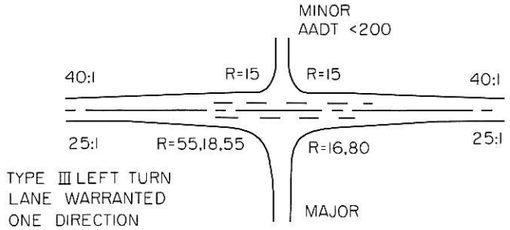


TYPE IIc

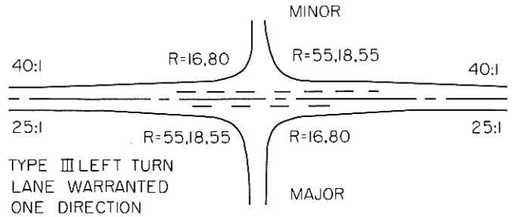
TYPE III's



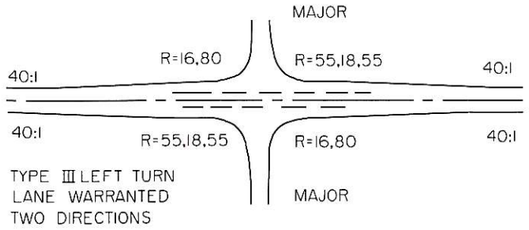
TYPE IIIa



TYPE IIIb

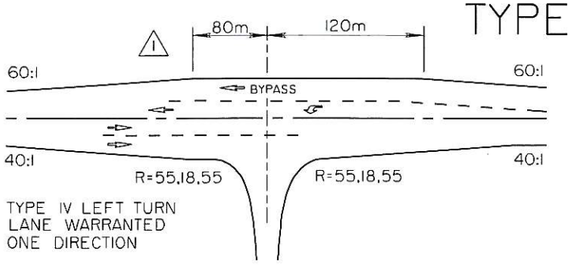


TYPE IIIc

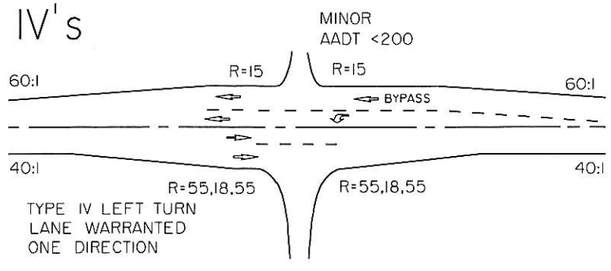


TYPE IIId

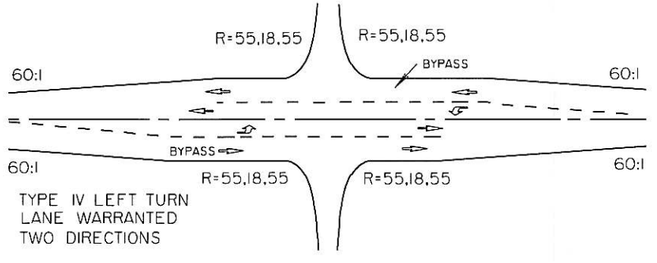
TYPE IV's



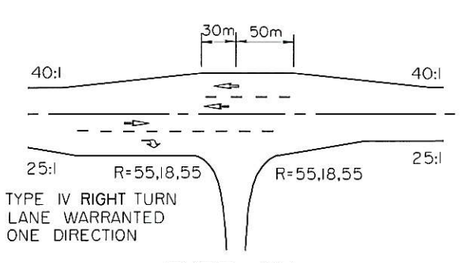
TYPE IVa



TYPE IVb



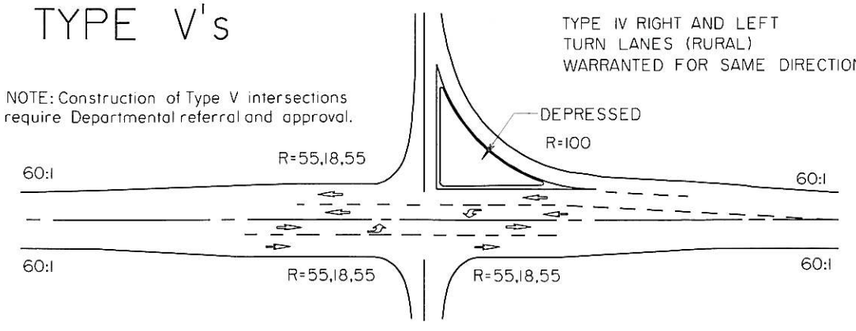
TYPE IVc



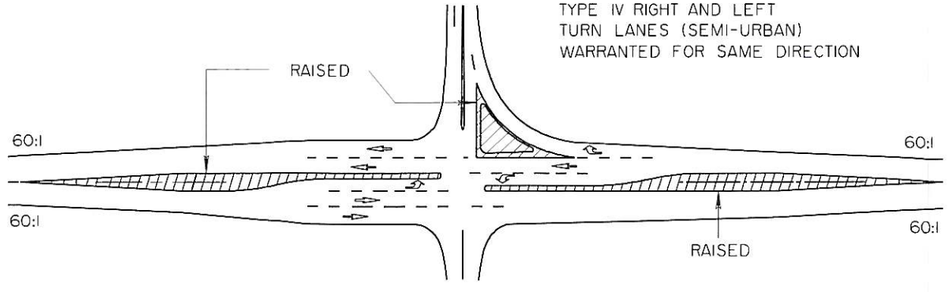
TYPE IVd

TYPE V's

NOTE: Construction of Type V intersections require Departmental referral and approval.



TYPE Vb



TYPE Vc

NOTES:
1. This is not a pavement marking drawing.
2. This figure depicts the typical layouts used for at-grade intersections. Detailed design considerations may dictate some minor alterations for particular intersections. The tapers shown here are typical for a 110 km/h design speed on the main highway.

No.	REVISIONS	BY	DATE
2			
1	REVISED LANE DIMENSIONS	TDN	06/98

Alberta INFRASTRUCTURE

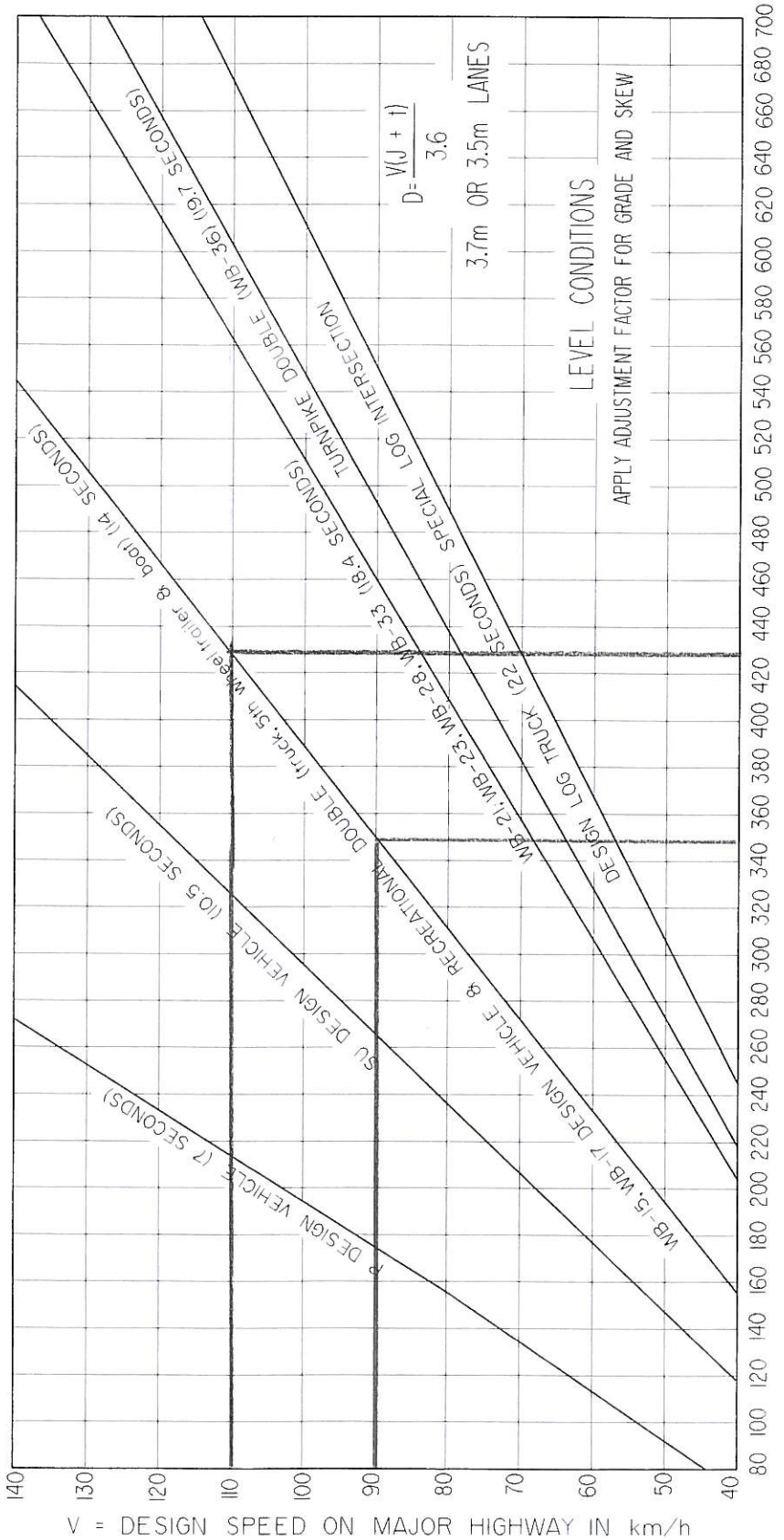
FIGURE D-7.5

Date: APRIL 1995

STANDARD AT-GRADE INTERSECTION LAYOUTS FOR TWO-LANE HIGHWAYS

Prepared By: LT	Checked By: B.K.	Scale: N.T.S.	PAGE D-III

FIGURE D-4.2.2.2 SIGHT DISTANCES FOR LEFT TURN ONTO HIGHWAY*



NOTES:

1. To determine the sight distance requirements at an intersection, the designer should select the longest vehicle or vehicle with the greatest I.S.D. need, that uses the intersection on a regular basis, i.e., daily. Because of the various eye heights, the I.S.D. available for several design vehicles may have to be checked.
2. The usefulness of intersection sight distances in excess of 500m has been debated and will be the subject of future research into gap acceptance by large trucks on rural highways in Alberta. Changes to this table may be made based on that research.

* INTERSECTION SIGHT DISTANCE (I.S.D.)

- THE I.S.D.'s SHOWN IN THIS FIGURE ARE BASED ON THE DISTANCE TRAVELLED AT DESIGN SPEED DURING A CRITICAL TIME (SHOWN ON THE FIGURE IN SECONDS). THE CRITICAL TIME INCLUDES THE TIME TAKEN FOR THE MANOEUVRE (LEFT TURN FROM THE MINOR ROAD) PLUS 2 SECONDS FOR PERCEPTION/REACTION TIME.
- THE INTERSECTION SIGHT DISTANCE AVAILABLE IS TO BE DETERMINED USING AN EYE HEIGHT (BASED ON THE DESIGN VEHICLE) LOCATED AT THE JUNCTION AND AN OBJECT HEIGHT OF 1.3m (REPRESENTING THE ROOF OF A PASSENGER VEHICLE) ON THE THROUGH ALIGNMENT. THE EYE HEIGHTS TO BE USED ARE SHOWN IN FIGURE D-5a.

Correction Factor:
L3 incline: 1.2
L3 decline: 0.9

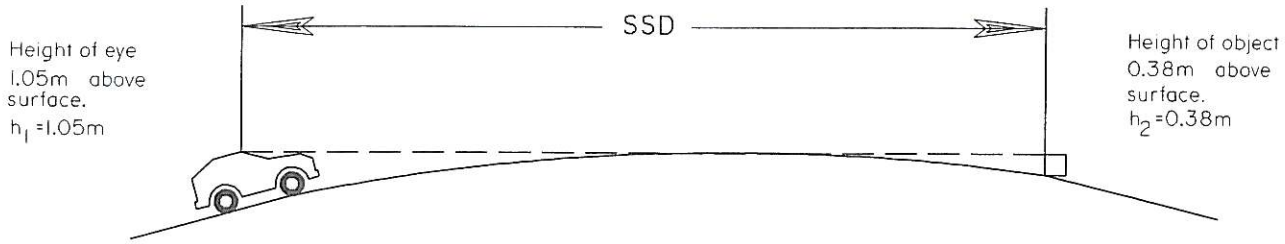
* THIS CHART IS BASED ON CRITERIA USED BY AASHTO FOR "SIGHT DISTANCE" AT STOP LOCATIONS. THE SET OF CRITERIA IS DESCRIBED AS CASE IIIB IN THE AASHTO PUBLICATION "A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS, 1994"

REVISIONS	No. 2	BY		DATE
	No. 1	BY BK	ADDED NOTE	DATE AUG / 99

FIGURE B-4.4.2a MINIMUM STOPPING SIGHT DISTANCE ON CREST VERTICAL CURVES

STOPPING SIGHT DISTANCE ON CREST VERTICAL CURVES

(i) For use in design of two-lane highways as an absolute minimum only.
(ii) For use in design of all divided highways and interchanges.



L = Minimum length of vertical curve in metres
A = Algebraic difference in grades, percent
SSD = Minimum stopping sight distance in metres
K = Rate of Vertical Curvature, Length in Metres Per Percent change of A.

$$K = \frac{L}{A}$$

When SSD < L

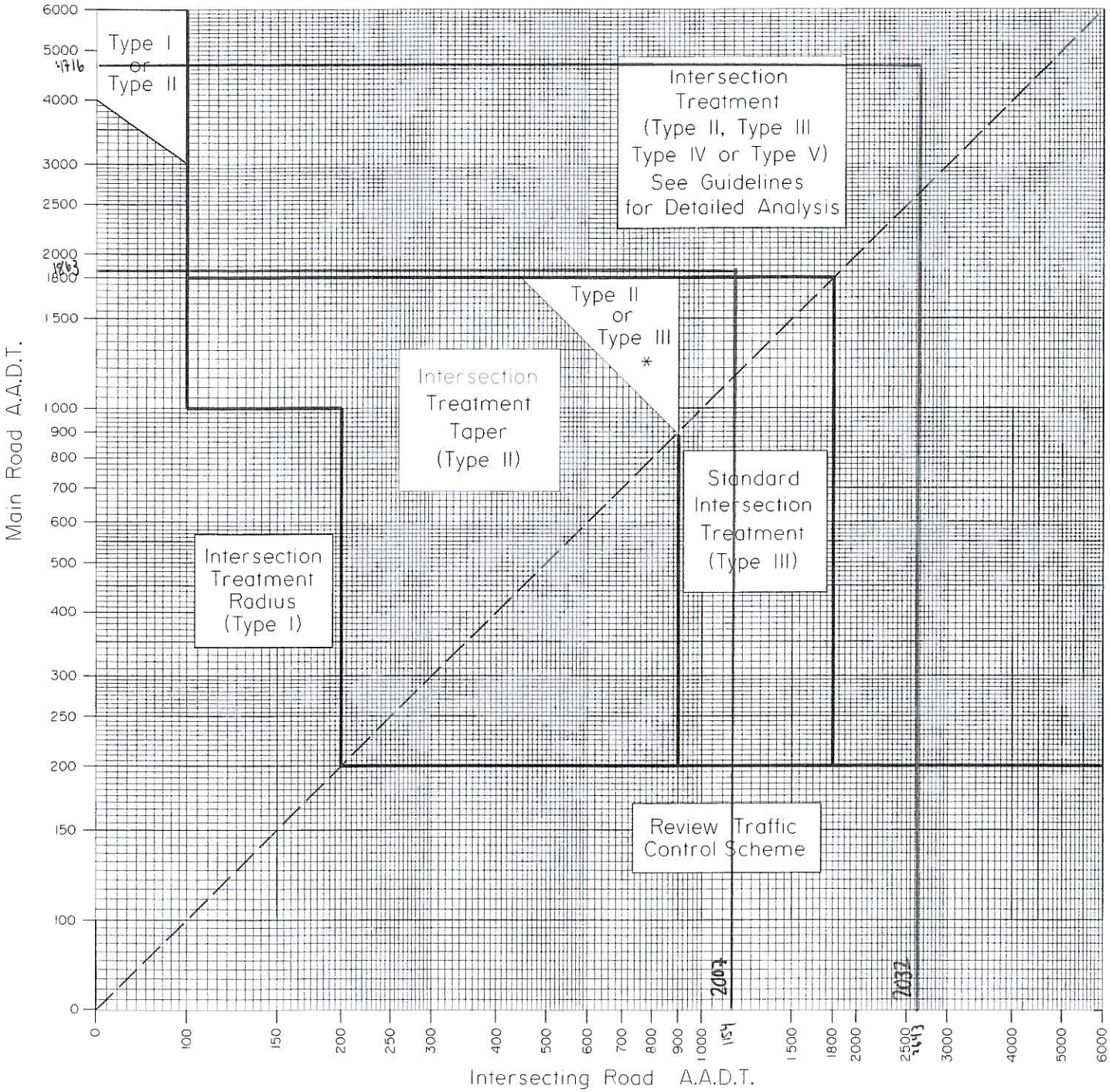
$$K = \frac{SSD^2}{200\ (\sqrt{h_1} + \sqrt{h_2})^2} = \frac{SSD^2}{538.67}$$

When SSD > L

$$K = \frac{2\ SSD}{A} - \frac{200\ (\sqrt{h_1} + \sqrt{h_2})^2}{A^2} = \frac{2\ SSD}{A} - \frac{538.67}{A^2}$$

Design Speed (km/h)	Assumed Running Speed (km/h)	Minimum Stopping Sight Distance (m)	Minimum K Values Vertical Crest Curves
40	40	45	5
50	50	65	10
60	60	85	15
70	70	110	25
80	80	140	35
90	90	170	55
100	100	200	75
110	108	235	100
120	115	270	130
130	115	275	140

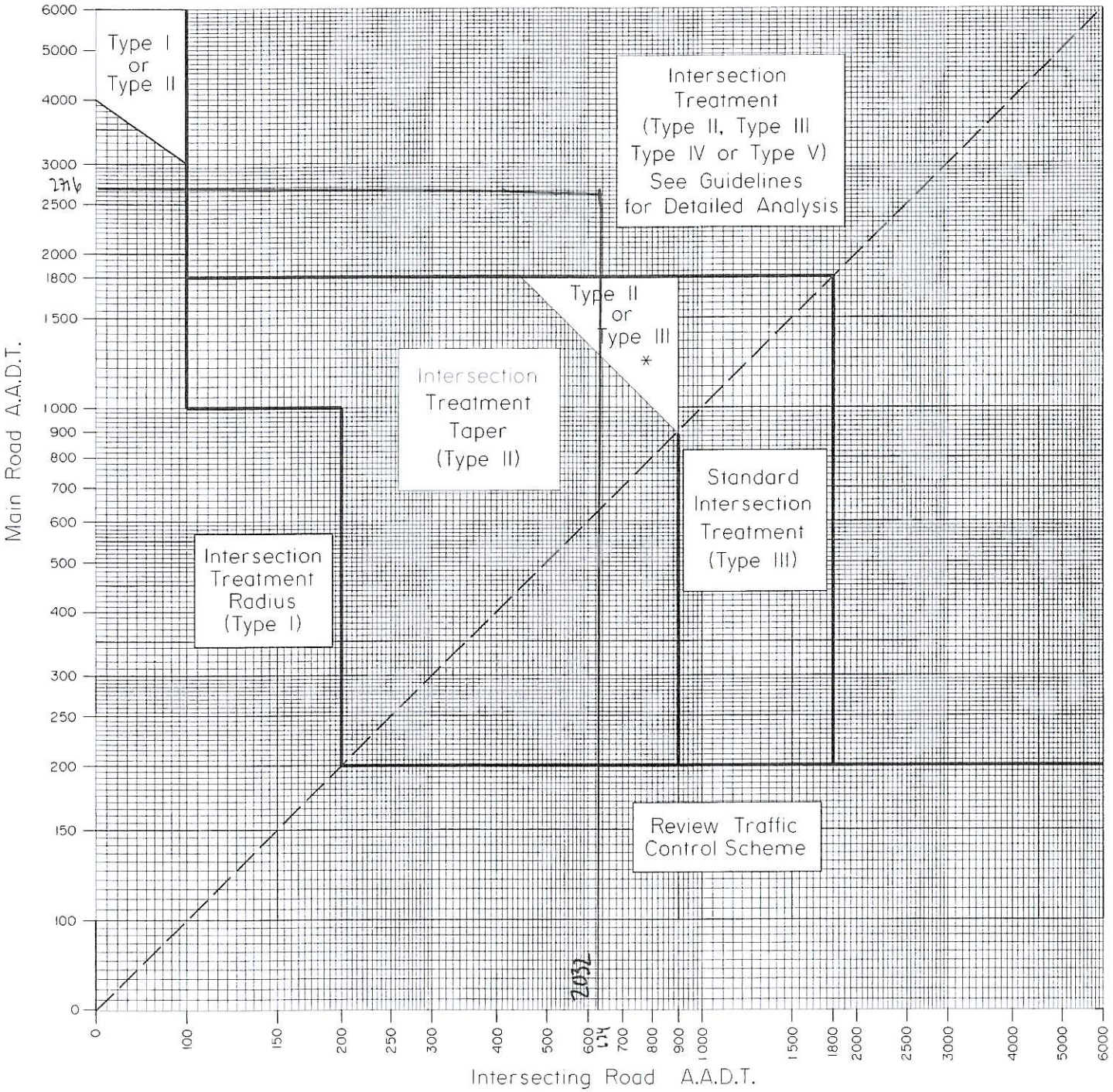
FIGURE D-7.4 TRAFFIC VOLUME WARRANT CHART FOR AT-GRADE INTERSECTION TREATMENT ON TWO-LANE RURAL HIGHWAYS (DESIGN SPEEDS 100, 110, 120 km/h)



Notes:

1. If main road, or intersecting road, is <100 AADT provide Type I Intersection Treatment (15m radius), except as shown for the higher volume main roads on this chart (Type I or II zone) where engineering judgement may be used to select the appropriate treatment.
2. If main road is >4000 AADT Review Access Management
   - — — If Intersecting Road AADT is > Main Road AADT: Review Traffic Control Scheme
3. Use projected traffic volumes for design
   Sloping line is defined by Main Road AADT x Intersecting Road AADT = 800,000

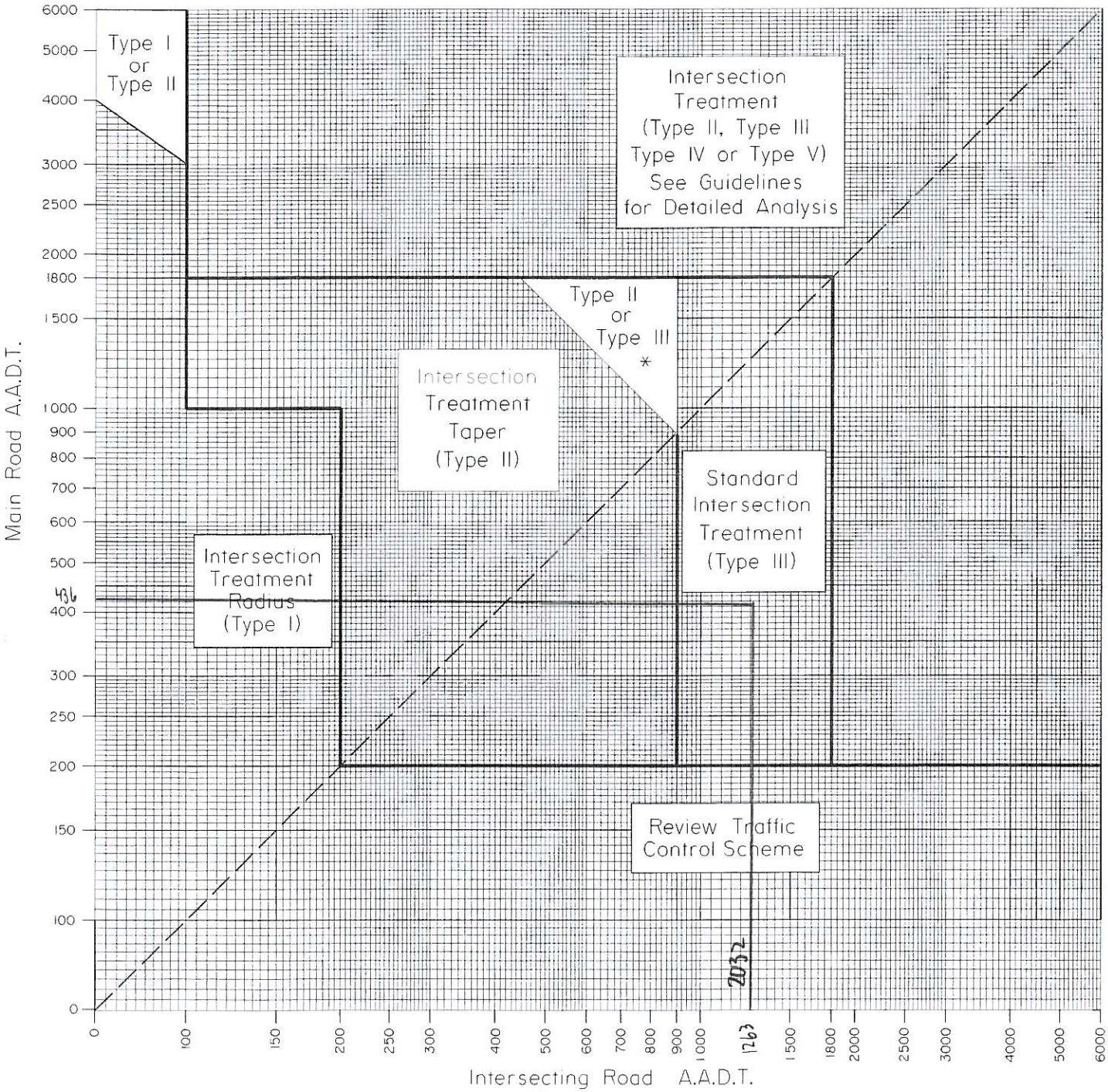
FIGURE D-7.4 TRAFFIC VOLUME WARRANT CHART FOR AT-GRADE INTERSECTION TREATMENT ON TWO-LANE RURAL HIGHWAYS (DESIGN SPEEDS 100, 110, 120 km/h)



Notes:

1. If main road, or intersecting road, is <100 AADT provide Type I Intersection Treatment (15m radius), except as shown for the higher volume main roads on this chart (Type I or II zone) where engineering judgement may be used to select the appropriate treatment.
2. If main road is >4000 AADT Review Access Management
   - — — If Intersecting Road AADT is > Main Road AADT: Review Traffic Control Scheme
3. Use projected traffic volumes for design
   Sloping line is defined by Main Road AADT x Intersecting Road AADT = 800,000

FIGURE D-7.4 TRAFFIC VOLUME WARRANT CHART FOR AT-GRADE INTERSECTION TREATMENT ON TWO-LANE RURAL HIGHWAYS (DESIGN SPEEDS 100, 110, 120 km/h)

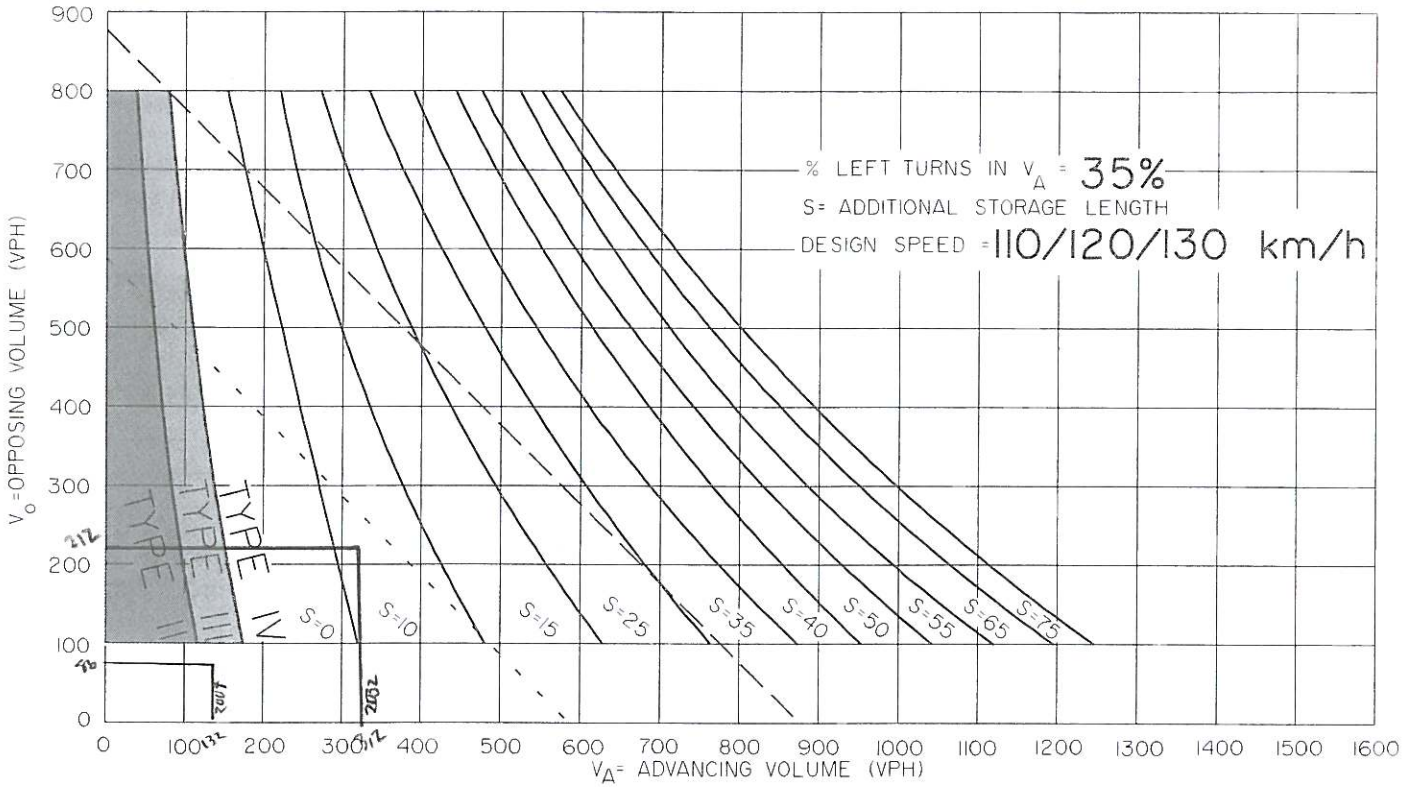


Notes:

1. If main road, or intersecting road, is <100 AADT provide Type I Intersection Treatment (15m radius), except as shown for the higher volume main roads on this chart (Type I or II zone) where engineering judgement may be used to select the appropriate treatment.
2. If main road is >4000 AADT Review Access Management
   - — — If Intersecting Road AADT is > Main Road AADT: Review Traffic Control Scheme
3. Use projected traffic volumes for design
   Sloping line is defined by Main Road AADT x Intersecting Road AADT = 800,000

Rainy Creek Road & Sunbreaker Cove Road (East Leg)

FIGURE D-7.6-7d WARRANTS FOR LEFT TURN LANES AND STORAGE REQUIREMENTS FOR TWO-LANE HIGHWAYS DESIGN SPEED 110/120/130 KM/H, LEFT TURN 35%, 40%



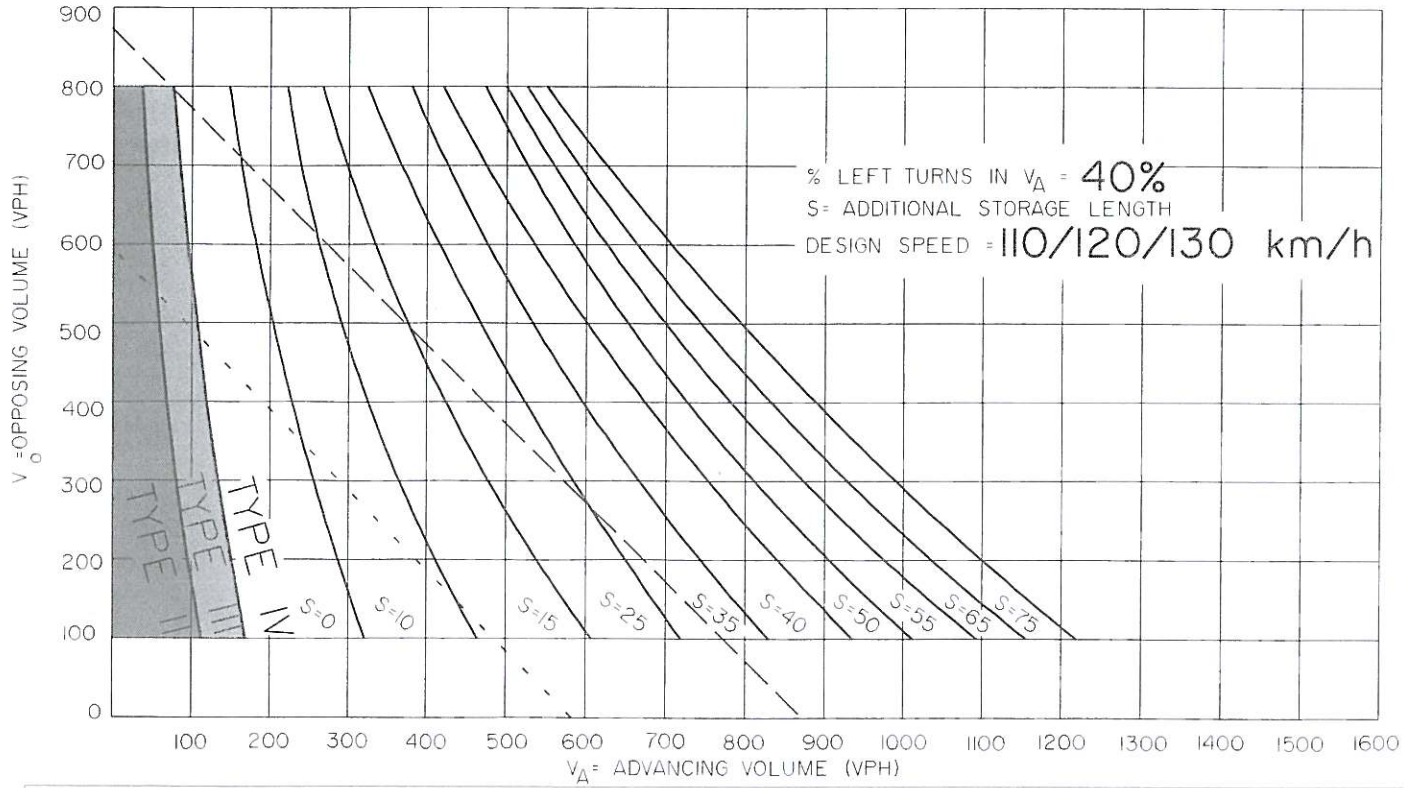
S = Additional storage length required, that is, in addition to what is shown on the appropriate Type IV standard drawing. Designers should check additional storage requirements for trucks, also see Table D.7.6a.

- - - - Traffic signals may be warranted in rural areas, or urban areas, with restricted flow.

—— —— —— Traffic signals may be warranted in "free flow" urban areas.

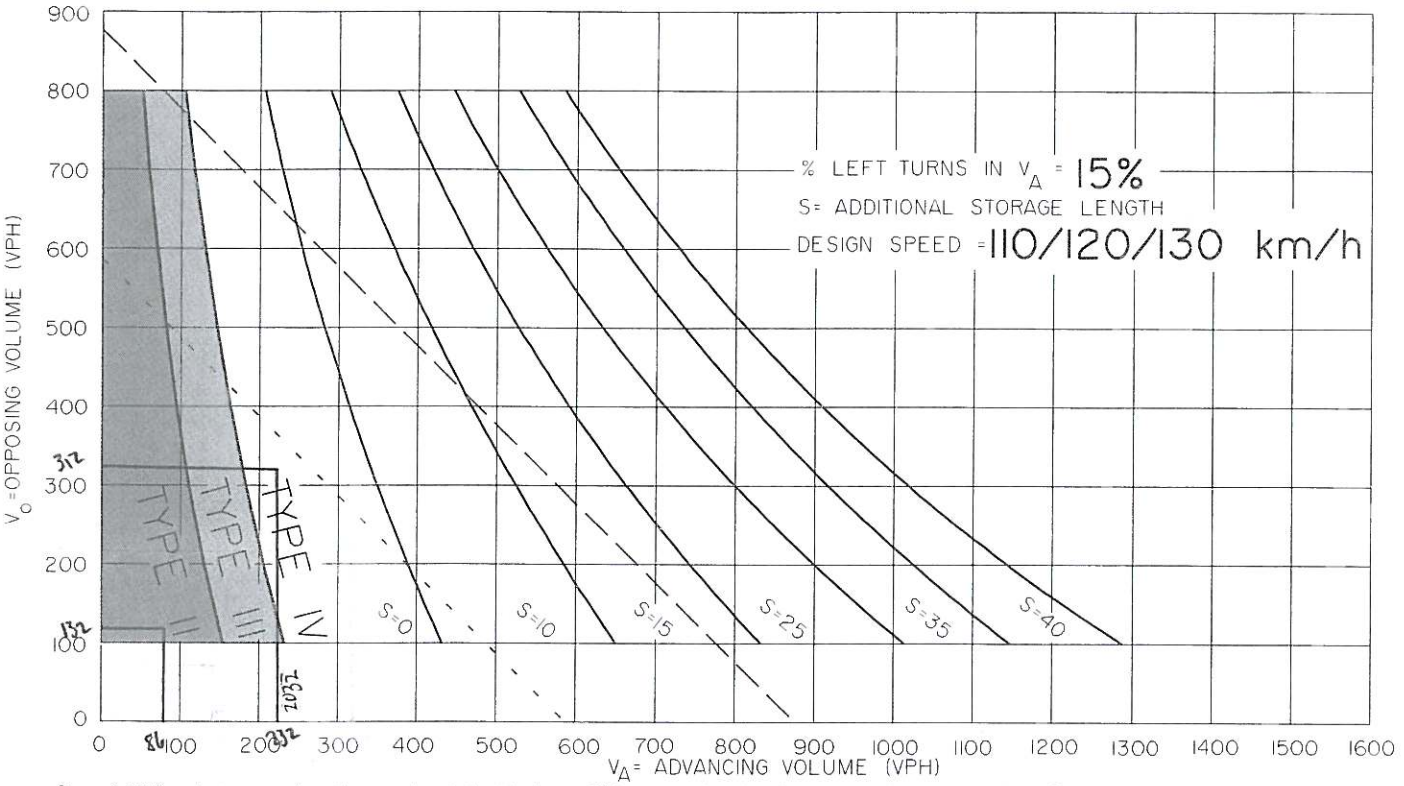
Notes:

1. The traffic signal warrant lines are provided for reference only. For detailed analysis of the requirements for signals, contact Roadway Engineering Branch.
2. Warrant for Type I treatment is shown in Figure D-7.4.



Sunbrenker Cove Road & Rainy Creek Road (west leg)

FIGURE D-7.6-7b WARRANTS FOR LEFT TURN LANES AND STORAGE REQUIREMENTS FOR TWO-LANE HIGHWAYS DESIGN SPEED 110/120/130 KM/H, LEFT TURN 15%, 20%



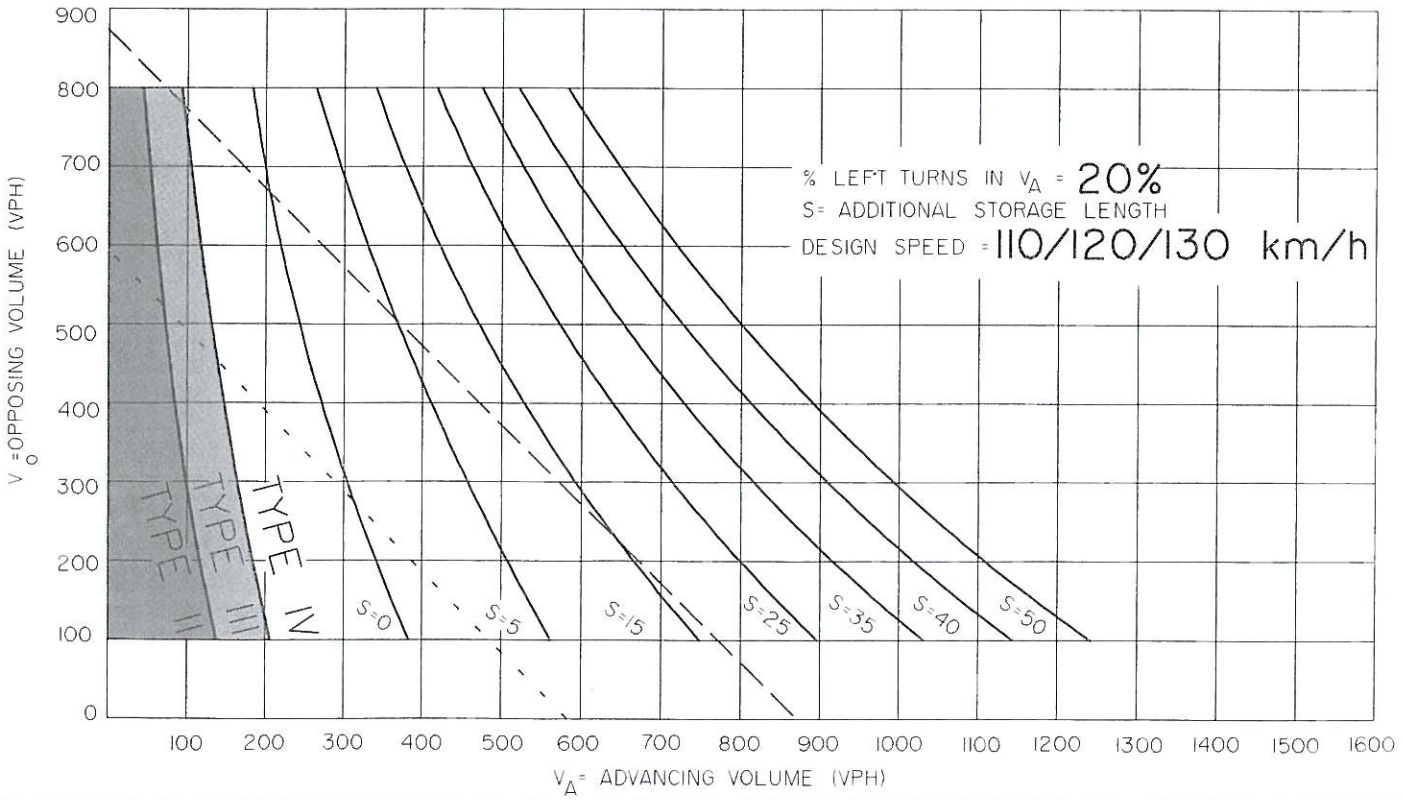
S = Additional storage length required, that is, in addition to what is shown on the appropriate Type IV standard drawing. Designers should check additional storage requirements for trucks, also see Table D.7.6a.

- - - - Traffic signals may be warranted in rural areas, or urban areas, with restricted flow.

—— —— Traffic signals may be warranted in "free flow" urban areas.

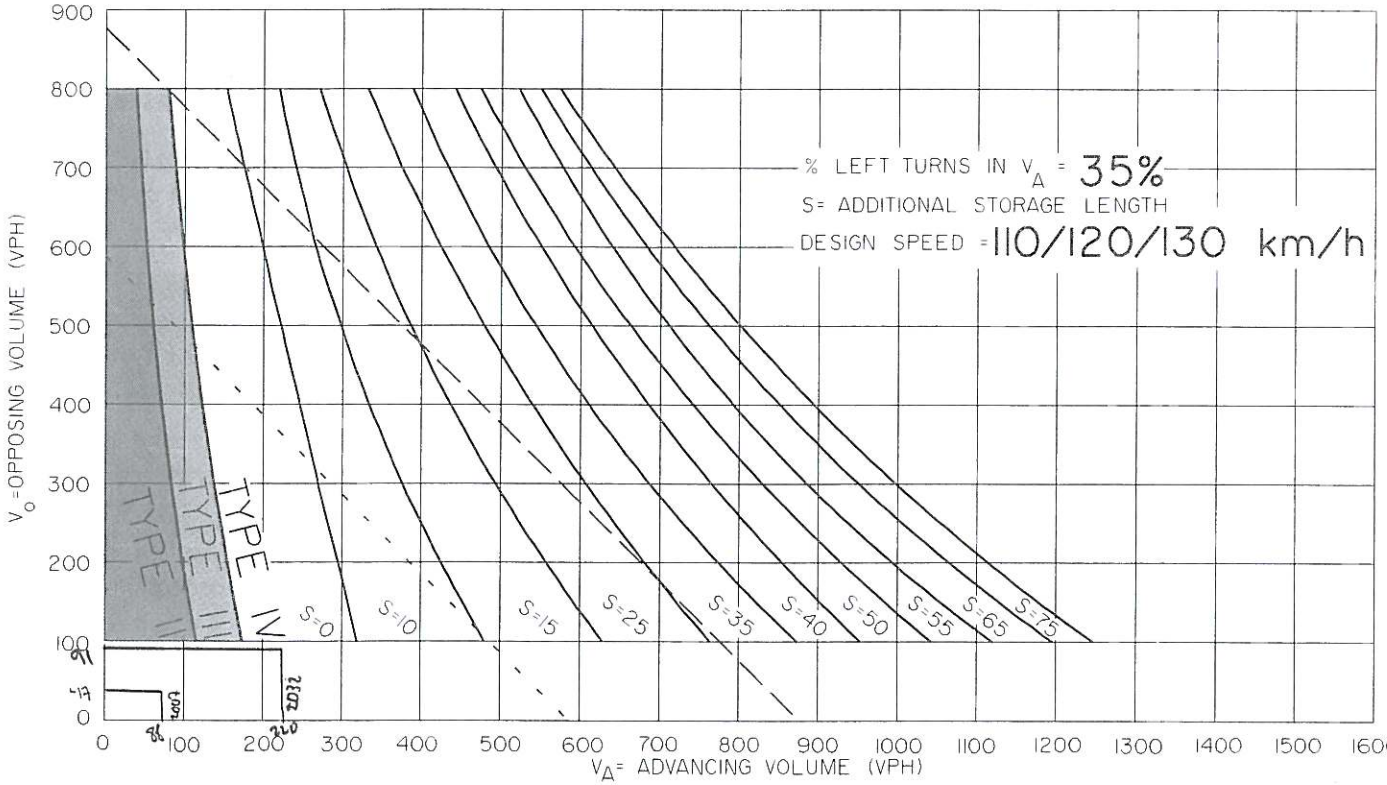
Notes:

1. The traffic signal warrant lines are provided for reference only. For detailed analysis of the requirements for signals, contact Roadway Engineering Branch.
2. Warrant for Type I treatment is shown in Figure D-7.4.



Rainy Creek Road & Sunbreaker Cove Road (South Leg)

FIGURE D-7.6-7d WARRANTS FOR LEFT TURN LANES AND STORAGE REQUIREMENTS FOR TWO-LANE HIGHWAYS DESIGN SPEED 110/120/130 KM/H, LEFT TURN 35%, 40%



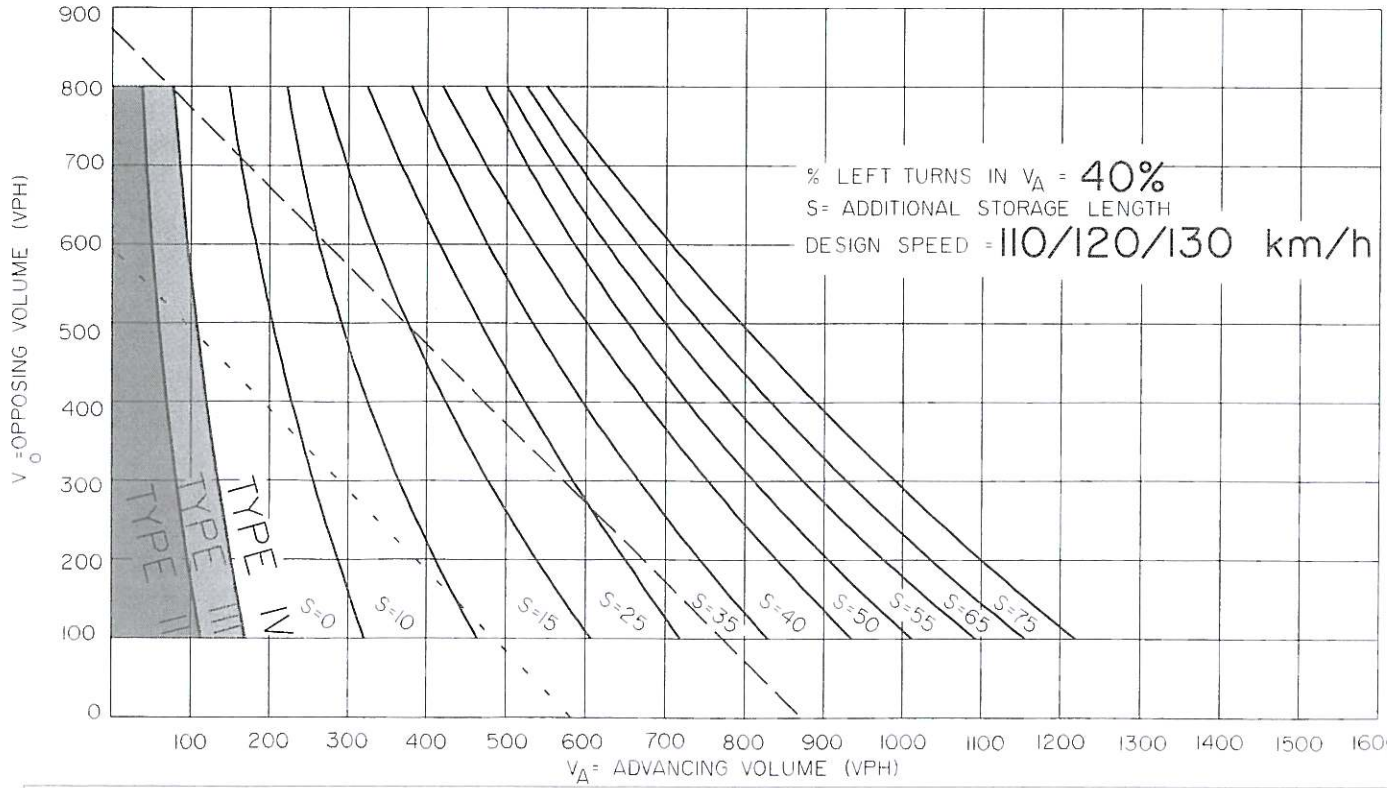
S = Additional storage length required, that is, in addition to what is shown on the appropriate Type IV standard drawing. Designers should check additional storage requirements for trucks, also see Table D.7.6a.

- - - - Traffic signals may be warranted in rural areas, or urban areas, with restricted flow.

—— —— —— Traffic signals may be warranted in "free flow" urban areas.

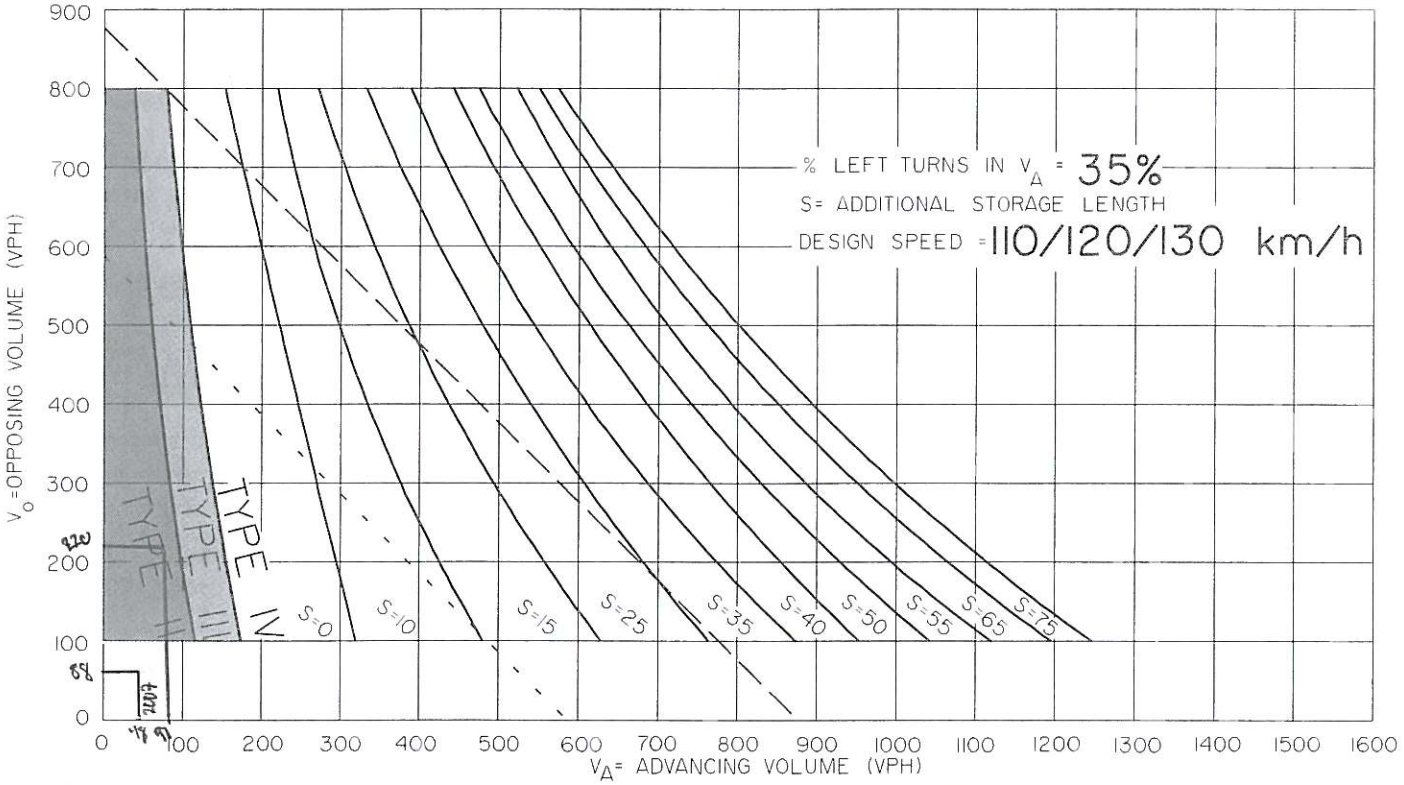
Notes:

1. The traffic signal warrant lines are provided for reference only. For detailed analysis of the requirements for signals, contact Roadway Engineering Branch.
2. Warrant for Type I treatment is shown in Figure D-7.4.



Rainy Creek Road & Sunbreaker Cove Road (North leg)

FIGURE D-7.6-7d WARRANTS FOR LEFT TURN LANES AND STORAGE REQUIREMENTS FOR TWO-LANE HIGHWAYS DESIGN SPEED 110/120/130 KM/H, LEFT TURN 35%, 40%



S = Additional storage length required, that is, in addition to what is shown on the appropriate Type IV standard drawing. Designers should check additional storage requirements for trucks, also see Table D.7.6a.

- - - - Traffic signals may be warranted in rural areas, or urban areas, with restricted flow.

—— —— —— Traffic signals may be warranted in "free flow" urban areas.

Notes:

1. The traffic signal warrant lines are provided for reference only. For detailed analysis of the requirements for signals, contact Roadway Engineering Branch.
2. Warrant for Type I treatment is shown in Figure D-7.4.

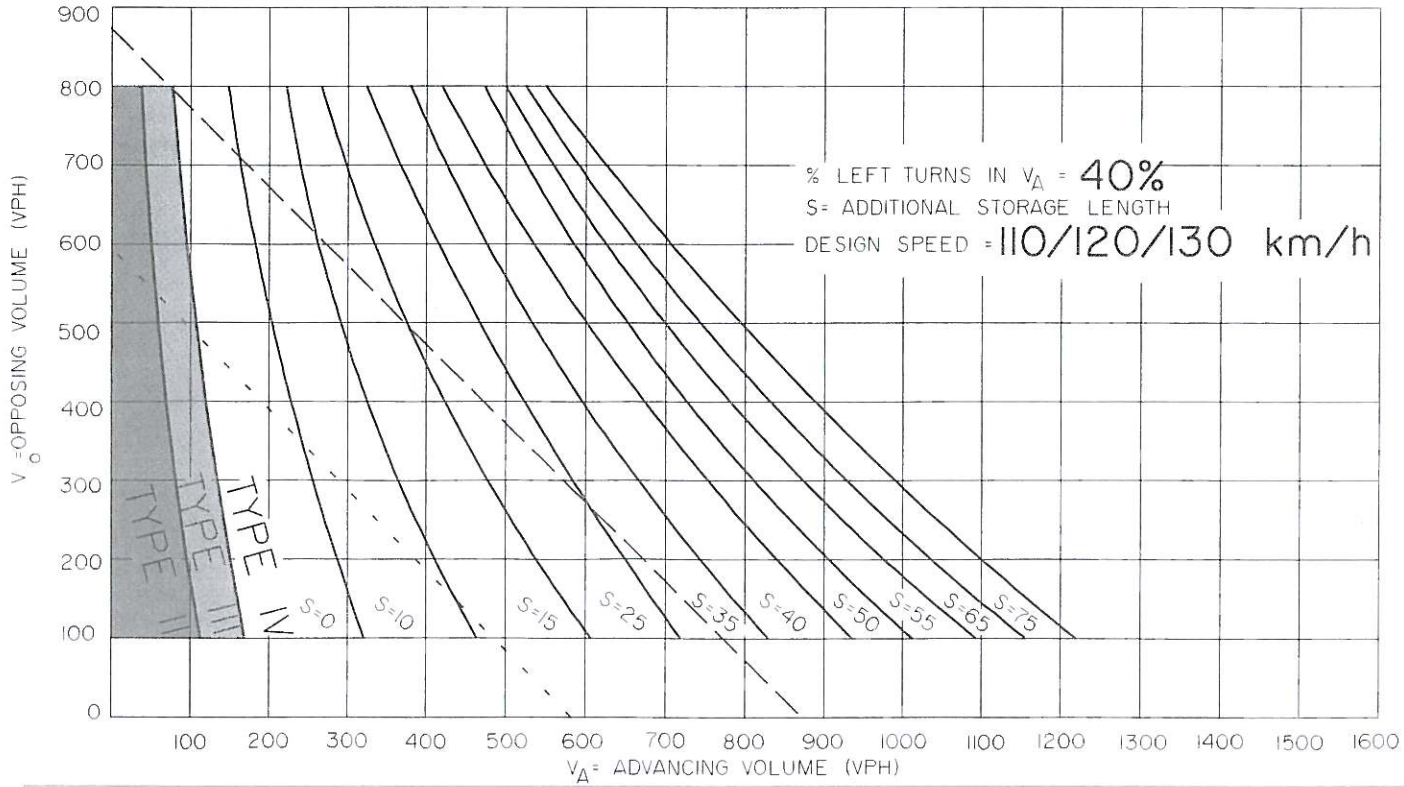
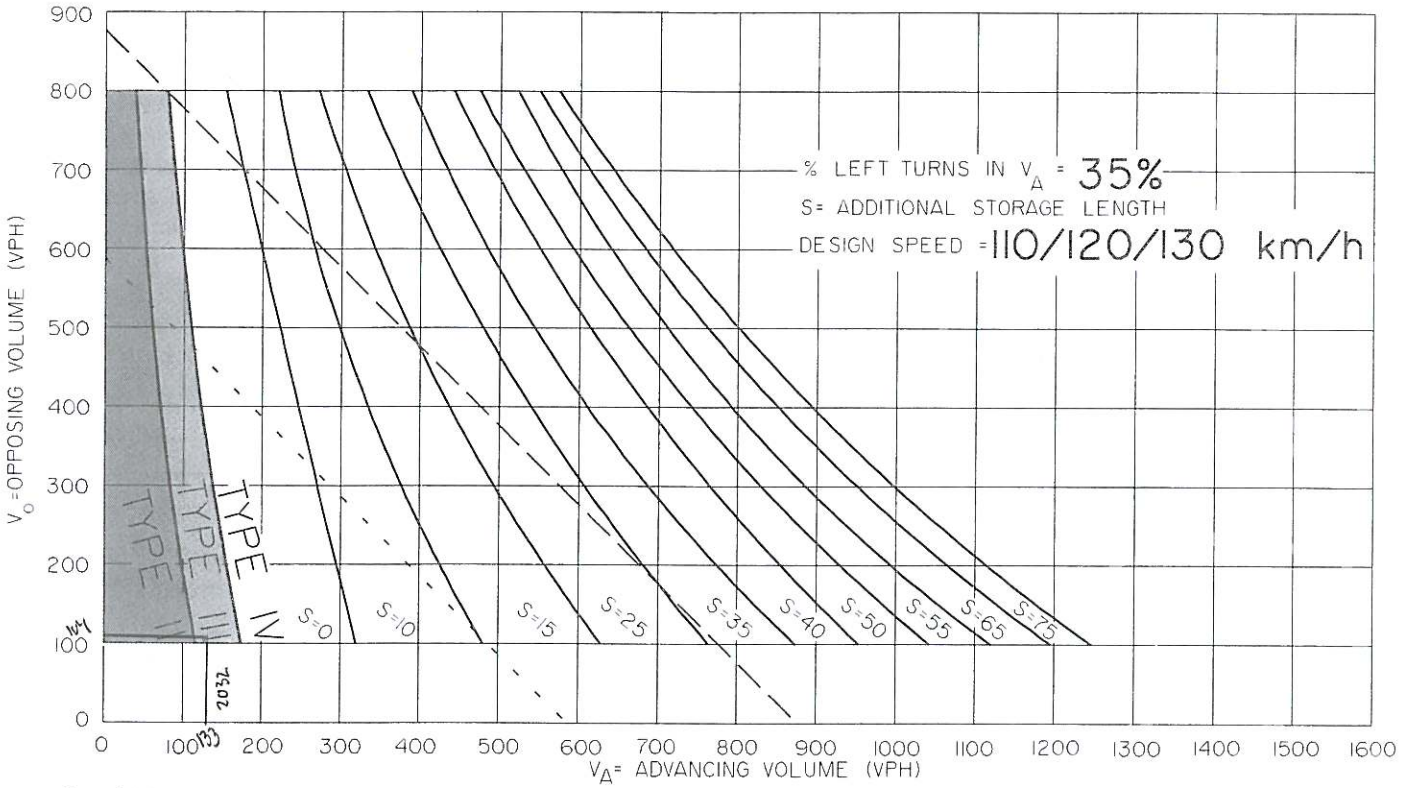


FIGURE D-7.6-7d WARRANTS FOR LEFT TURN LANES AND STORAGE REQUIREMENTS FOR TWO-LANE HIGHWAYS DESIGN SPEED 110/120/130 KM/H, LEFT TURN 35%, 40%



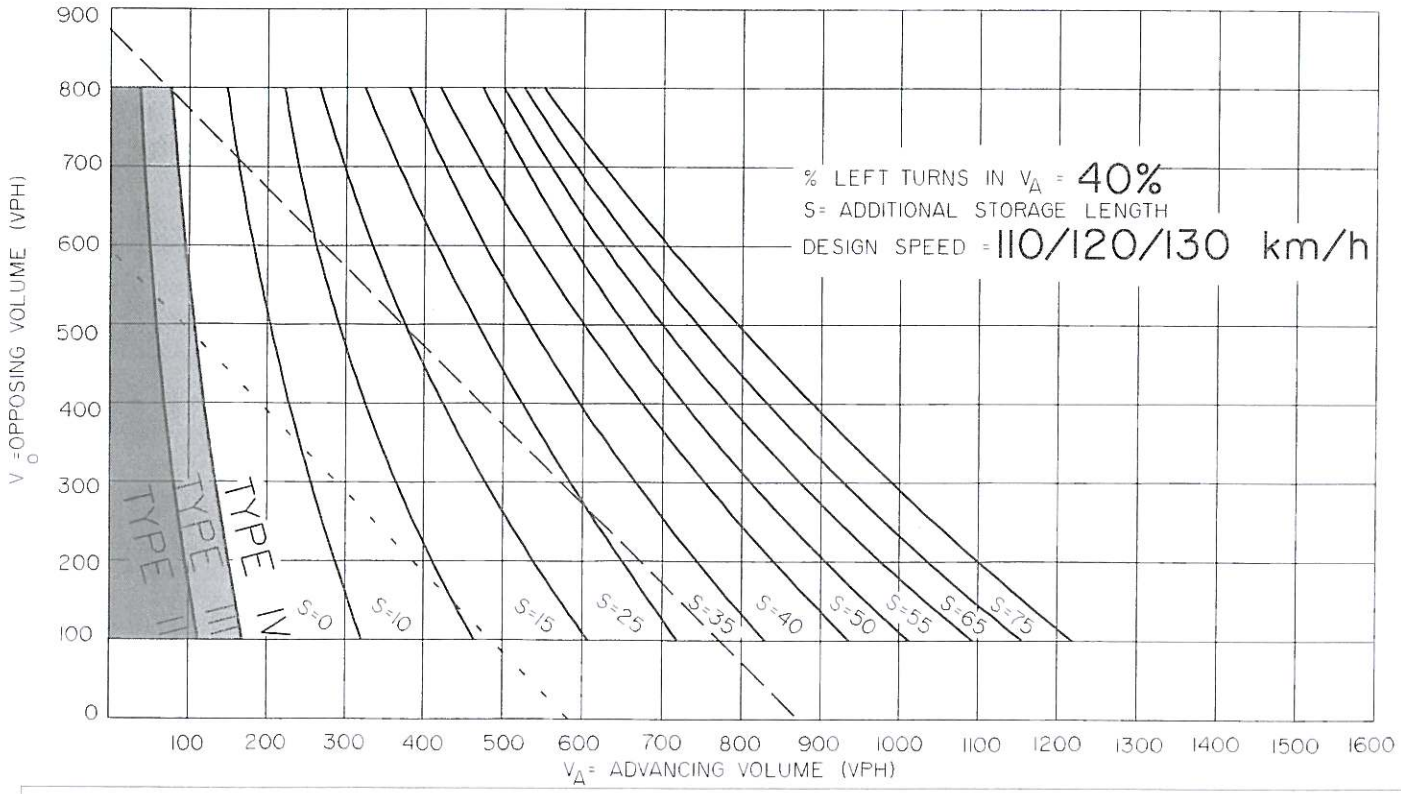
S = Additional storage length required, that is, in addition to what is shown on the appropriate Type IV standard drawing. Designers should check additional storage requirements for trucks, also see Table D.7.6a.

- - - - Traffic signals may be warranted in rural areas, or urban areas, with restricted flow.

—— —— —— Traffic signals may be warranted in "free flow" urban areas.

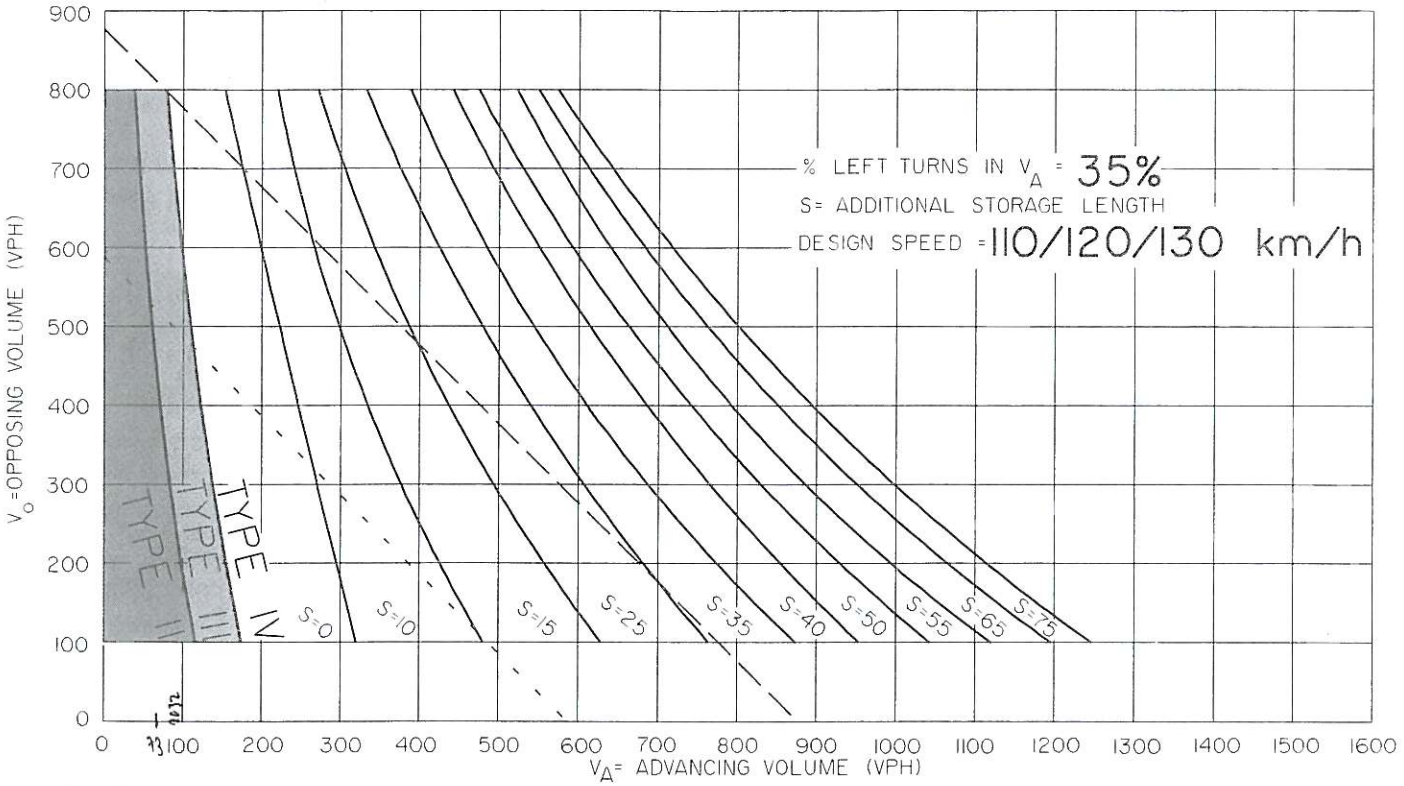
Notes:

1. The traffic signal warrant lines are provided for reference only. For detailed analysis of the requirements for signals, contact Roadway Engineering Branch.
2. Warrant for Type I treatment is shown in Figure D-7.4.



 Rainy Creek Road & North Access Road (south leg)

FIGURE D-7.6-7d WARRANTS FOR LEFT TURN LANES AND STORAGE REQUIREMENTS FOR TWO-LANE HIGHWAYS DESIGN SPEED 110/120/130 KM/H, LEFT TURN 35%, 40%



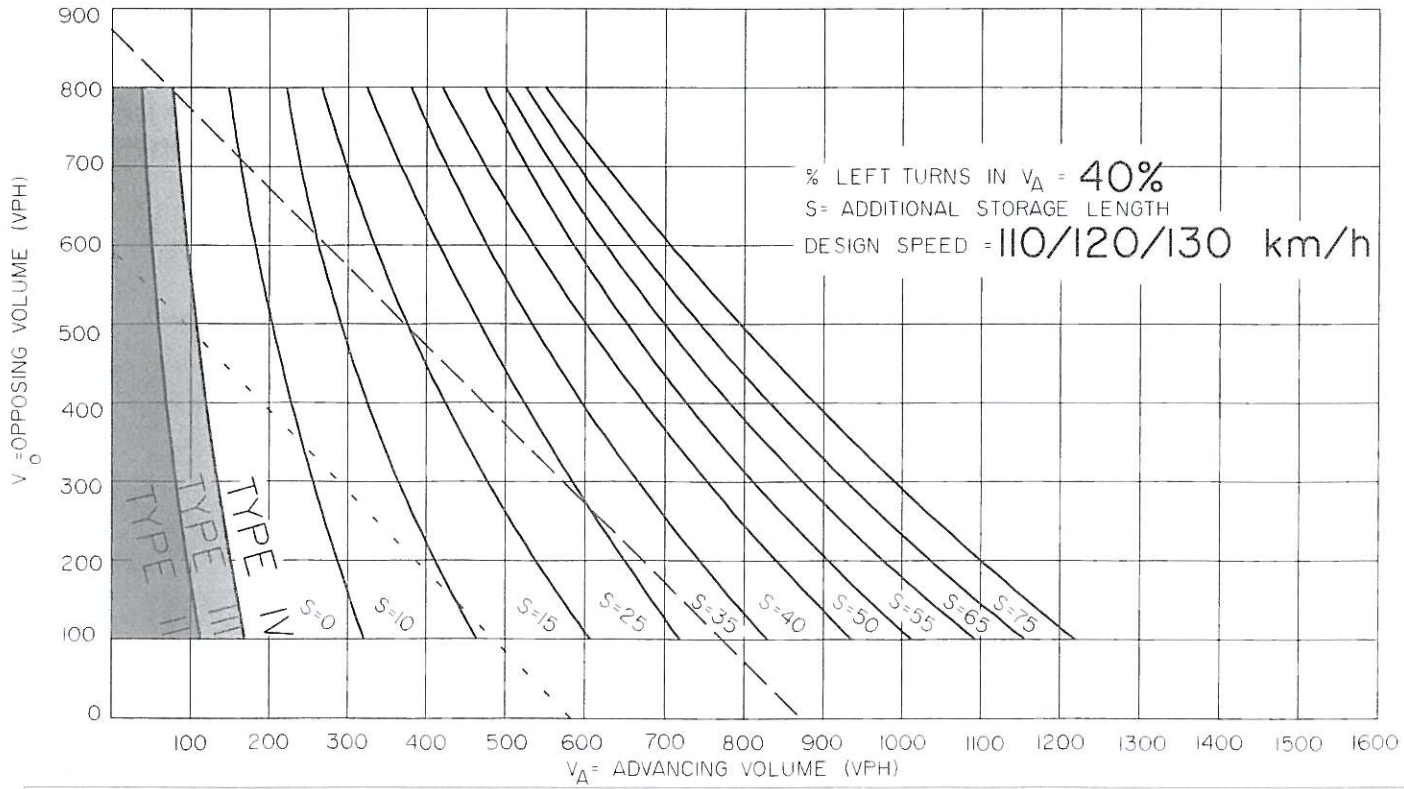
S = Additional storage length required, that is, in addition to what is shown on the appropriate Type IV standard drawing. Designers should check additional storage requirements for trucks, also see Table D.7.6a.

- - - - Traffic signals may be warranted in rural areas, or urban areas, with restricted flow.

—— —— Traffic signals may be warranted in "free flow" urban areas.

Notes:

1. The traffic signal warrant lines are provided for reference only. For detailed analysis of the requirements for signals, contact Roadway Engineering Branch.
2. Warrant for Type I treatment is shown in Figure D-7.4.



A P P E N D I X F

SIGNALIZATION WARRANT WORKSHEET

FIGURE B2-6

TRAFFIC CONTROL SIGNAL INSTALLATION WARRANT AND PRIORITY RATING WORK SHEET

Location Sunbreaker Cove Rd & East Access Rd Year 2032 Date of Count April 17, 2018

I Collisions (Figure B2-1)

Priority points = P_a 8

II Crossing Gaps, Progression, Delay and Vehicular Stops

A. One-Way Street (Figure B2-2)

Priority points	=	P_1	x	V_{tew}	x	F_{eew}		
E-W Street - E. of int.	=	___	x	___	x	___	=	___
E-W Street - W. of int.	=	___	x	___	x	___	=	___
Priority points	=	P_1	x	V_{tns}	x	F_{ens}		
N-S street - N. of int.	=	___	x	___	x	___	=	___
N-S street - S. of int.	=	___	x	___	x	___	=	___

B. Two-Way Street (Figure B2-3)

Priority points =	=	P_2	x	V_{tew}	x	F_{eew}		
E-W Street - E. of int.	=	___	x	___	x	___	=	___
E-W Street - W. of int.	=	2.0	x	0.44	x	1.0	=	0.88
Priority points	=	P_2	x	V_{tns}	x	F_{ens}		
N-S street - N. of int.	=	2.0	x	1.33	x	1.0	=	2.66
N-S street - S. of int.	=	2.0	x	1.12	x	1.0	=	2.24 5.78

III Crossing Gaps, Intersecting Volumes, and Pedestrian Volumes

A. Through Street One-Way (Figures B2-4 and B2-5)

1). Priority points

= (V_{aew} + P_{ew}) x (V_{ans} + P_{ns}) x F_{ow} x F_r
= (___ + ___) x (___ + ___) x ___ x ___ = ___

2). Priority points

= P_3 x F_t = ___

B. Through Street Two-Way

Priority points

= (V_{aew} + P_{ew}) x (V_{ans} + P_{ns}) x F_{ow}
= (0.44 + 0.0) x (2.45 + 0.0) x 1.0 = 1.078 1.078

TOTAL PRIORITY POINTS 6.86

NOTE: Complete I; the appropriate equation for each intersection leg in Section II A and/or II B; and either Section IIIA or III B.

* **Maximum points for II = + 80**

FIGURE B2-6

FIGURE B2-6

TRAFFIC CONTROL SIGNAL INSTALLATION WARRANT AND PRIORITY RATING WORK SHEET

Location Rainy Creek Road & Sunbeam Court Road Year 2007 Date of Count Apr. 17, 2008

I Collisions (Figure B2-1)

Priority points = P_a 8

II Crossing Gaps, Progression, Delay and Vehicular Stops

A. One-Way Street (Figure B2-2)

Priority points	=	P_1	x	V_{tew}	x	F_{eew}		
E-W Street - E. of int.	=	___	x	___	x	___	=	___
E-W Street - W. of int.	=	___	x	___	x	___	=	___
Priority points	=	P_1	x	V_{tns}	x	F_{ens}		
N-S street - N. of int. =		___	x	___	x	___	=	___
N-S street - S. of int.	=	___	x	___	x	___	=	___

B. Two-Way Street (Figure B2-3)

Priority points =	=	P_2	x	V_{tew}	x	F_{eew}			
E-W Street - E. of int.	=	2.0	x	1.128	x	1.0	=	2.256	
E-W Street - W. of int.	=	2.0	x	0.735	x	1.0	=	1.47	
Priority points	=	P_2	x	V_{tns}	x	F_{ens}			
N-S street - N. of int.	=	2.0	x	0.402	x	1.0	=	0.804	
N-S street - S. of int.	=	2.0	x	0.752	x	1.0	=	1.504	6.034

III Crossing Gaps, Intersecting Volumes, and Pedestrian Volumes

A. Through Street One-Way (Figures B2-4 and B2-5)

1). Priority points

= (V_{aew} + P_{ew}) x (V_{ans} + P_{ns}) x F_{ow} x F_r
= (___ + ___) x (___ + ___) x ___ x ___ = ___

2). Priority points

= P_3 x F_t = ___

B. Through Street Two-Way

Priority points

= (V_{aew} + P_{ew}) x (V_{ans} + P_{ns}) x F_{ow}
= (1.863 + 0.0) x (1.154 + 0.0) x 1.0 = 2.15 2.15

TOTAL PRIORITY POINTS 8.18

NOTE: Complete I; the appropriate equation for each intersection leg in Section II A and/or II B; and either Section IIIA or III B.

* **Maximum points for II = + 80**

FIGURE B2-6

FIGURE B2-6

TRAFFIC CONTROL SIGNAL INSTALLATION WARRANT AND PRIORITY RATING WORK SHEET

Location Rainy Creek Road & Sunbreaker Cove Road Year 2032 Date of Count April 17, 2008

I Collisions (Figure B2-1)

Priority points = P_a 8

II Crossing Gaps, Progression, Delay and Vehicular Stops

A. One-Way Street (Figure B2-2)

Priority points	=	P_1	x	V_{tew}	x	F_{eew}		
E-W Street - E. of int.	=	___	x	___	x	___	=	___
E-W Street - W. of int.	=	___	x	___	x	___	=	___
Priority points	=	P_1	x	V_{tns}	x	F_{ens}		
N-S street - N. of int.	=	___	x	___	x	___	=	___
N-S street - S. of int.	=	___	x	___	x	___	=	___

B. Two-Way Street (Figure B2-3)

Priority points =	=	P_2	x	V_{tew}	x	F_{eew}			
E-W Street - E. of int.	=	2.0	x	2.67	x	1.0	=	5.34	
E-W Street - W. of int.	=	2.0	x	1.98	x	1.0	=	3.96	
Priority points	=	P_2	x	V_{tns}	x	F_{ens}			
N-S street - N. of int.	=	2.0	x	0.78	x	1.0	=	1.56	
N-S street - S. of int.	=	2.0	x	1.88	x	1.0	=	3.76	14.67

III Crossing Gaps, Intersecting Volumes, and Pedestrian Volumes

A. Through Street One-Way (Figures B2-4 and B2-5)

1). Priority points

= (V_{aew} + P_{ew}) x (V_{ans} + P_{ns}) x F_{ow} x F_r
= (___ + ___) x (___ + ___) x ___ x ___ = ___

2). Priority points

= P_3 x F_t = ___

B. Through Street Two-Way

Priority points

= (V_{aew} + P_{ew}) x (V_{ans} + P_{ns}) x F_{ow}
= (4.65 + 0.0) x (2.66 + 0.0) x 1.0 = 12.37 12.37

TOTAL PRIORITY POINTS 26.99

NOTE: Complete I; the appropriate equation for each intersection leg in Section II A and/or II B; and either Section IIIA or III B.

* **Maximum points for II = + 80**

FIGURE B2-6

FIGURE B2-6

TRAFFIC CONTROL SIGNAL INSTALLATION WARRANT AND PRIORITY RATING WORK SHEET

Location Rainy Creek Road & North Access Year 2032 Date of Count April 17, 2008

I Collisions (Figure B2-1)

Priority points = P_a 8

II Crossing Gaps, Progression, Delay and Vehicular Stops

A. One-Way Street (Figure B2-2)

Priority points	=	P_1	x	V_{tew}	x	F_{eew}		
E-W Street - E. of int.	=	___	x	___	x	___	=	___
E-W Street - W. of int.	=	___	x	___	x	___	=	___
Priority points	=	P_1	x	V_{tns}	x	F_{ens}		
N-S street - N. of int. =		___	x	___	x	___	=	___
N-S street - S. of int.	=	___	x	___	x	___	=	___

B. Two-Way Street (Figure B2-3)

Priority points =	=	P_2	x	V_{tew}	x	F_{eew}		
E-W Street - E. of int.	=	2.0	x	1.137	x	1.0	=	2.274
E-W Street - W. of int.	=	2.0	x	0.89	x	1.0	=	1.78
Priority points	=	P_2	x	V_{tns}	x	F_{ens}		
N-S street - N. of int.	=	~~2.0~~	x		x	~~1.0~~	=	
N-S street - S. of int.	=	2.0	x	0.624	x	1.0	=	1.248 5.302

III Crossing Gaps, Intersecting Volumes, and Pedestrian Volumes

A. Through Street One-Way (Figures B2-4 and B2-5)

1). Priority points

= (V_{aew} + P_{ew}) x (V_{ans} + P_{ns}) x F_{ow} x F_r
= (___ + ___) x (___ + ___) x ___ x ___ = ___

2). Priority points

= P_3 x F_t = ___

B. Through Street Two-Way

Priority points

= (V_{aew} + P_{ew}) x (V_{ans} + P_{ns}) x F_{ow}
= (2.027 + 0.0) x (0.624 + 0.0) x 1.0 = 1.26 1.26

TOTAL PRIORITY POINTS 6.56

NOTE: Complete I; the appropriate equation for each intersection leg in Section II A and/or II B; and either Section IIIA or III B.

* **Maximum points for II = + 80**

FIGURE B2-6

A P P E N D I X G

CAPACITY ANALYSIS

rainycreek&northaccess_2032
HCS+: Unsignalized Intersections Release 5.21

TWO-WAY STOP CONTROL SUMMARY

Analyst:	Kevin Paul, E.I.T.
Agency/Co.:	A. D. Williams Engineering Inc
Date Performed:	16/03/2008
Analysis Time Period:	Peak Hour
Intersection:	Rainy Creek & North Access
Jurisdiction:	Lacombe County
Units: U. S. Customary	
Analysis Year:	2032
Project ID: i15452.00	
East/West Street:	Rainy Creek Road
North/South Street:	North Access Road
Intersection Orientation: EW	Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		60	44	66	67	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		60	44	66	67	
Percent Heavy Vehicles		--	--	10	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			
Lanes		1	1	1	1	
Configuration		T	R	L	T	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	29		44			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	29		44			
Percent Heavy Vehicles	10		10			
Percent Grade (%)		0			2	
Flared Approach: Exists?/Storage			No /			/
Lanes	0		0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L		LR				
v (vph)		66		73				
C(m) (vph)		1439		835				
v/c		0.05		0.09				
95% queue length		0.14		0.29				
Control Delay		7.6		9.7				
LOS		A		A				
Approach Delay				9.7				
Approach LOS				A				

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: Kevin Paul, E.I.T.
Agency/Co.: A. D. Williams Engineering Inc
Date Performed: 16/03/2008
Analysis Time Period: Peak Hour
Intersection: Rainy Creek & North Access
Jurisdiction: Lacombe County
Units: U. S. Customary
Analysis Year: 2032
Project ID: i15452.00
East/West Street: Rainy Creek Road
North/South Street: North Access Road
Intersection Orientation: EW Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		60	44	66	67	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Peak-15 Minute Volume		15	11	16	17	
Hourly Flow Rate, HFR		60	44	66	67	
Percent Heavy Vehicles		--	--	10	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			
Lanes		1	1	1	1	
Configuration		T	R	L	T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	29		44			
Peak Hour Factor, PHF	1.00		1.00			
Peak-15 Minute Volume	7		11			
Hourly Flow Rate, HFR	29		44			
Percent Heavy Vehicles	10		10			
Percent Grade (%)		0			2	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		10	10		10			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.02	0.02	0.02
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		10	10		10			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		104	259		60			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	60	
Potential Capacity	983	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	983	
Probability of Queue free St.	0.96	1.00
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows	104	
Potential Capacity	1439	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1439	
Probability of Queue free St.	0.95	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows	259	
Potential Capacity	713	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.95
Maj. L, Min T Adj. Imp Factor.		0.96
Cap. Adj. factor due to Impeding mvmnt	0.95	0.92
Movement Capacity	680	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		

Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	259	
Potential Capacity	713	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.95
Maj. L, Min T Adj. Imp Factor.		0.96
Cap. Adj. factor due to Impeding mvmnt	0.95	0.92
Movement Capacity	680	
Results for Two-stage process:		
a		
y		
C t	680	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	29		44			
Movement Capacity (vph)	680		983			
Shared Lane Capacity (vph)		835				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	680		983			
Volume	29		44			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						

n max	
C sh	835
SUM C sep	
n	
C act	

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L		LR				
v (vph)		66		73				
C(m) (vph)		1439		835				
v/c		0.05		0.09				
95% queue length		0.14		0.29				
Control Delay		7.6		9.7				
LOS		A		A				
Approach Delay				9.7				
Approach LOS				A				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.95
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		7.6
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

rainycreek&sunbreaker_2007
HCS+: Unsignalized Intersections Release 5.21

TWO-WAY STOP CONTROL SUMMARY

Analyst: Kevin Paul, E.I.T.
Agency/Co.: A. D. Williams Engineering Inc
Date Performed: 16/03/2008
Analysis Time Period: Peak Hour
Intersection: Rainy Creek & Sunbreaker Cove
Jurisdiction: Lacombe County
Units: U. S. Customary
Analysis Year: 2007
Project ID: i15452.00
East/West Street: Rainy Creek Road
North/South Street: Sunbreaker Cove Road
Intersection Orientation: EW Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	52	53	27	15	39	32
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	52	53	27	15	39	32
Percent Heavy Vehicles	10	--	--	10	--	--
Median Type/Storage	Undivided /					
RT Channelized?			No			
Lanes	0	1	1	1	1	0
Configuration		LT	R		L	TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	30	6	52	51	238	92
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	30	6	52	51	238	92
Percent Heavy Vehicles	10	10	10	10	10	10
Percent Grade (%)		0			2	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT	L		LTR			LTR	
v (vph)	52	15		88			381	
C(m) (vph)	1480	1469		571			658	
v/c	0.04	0.01		0.15			0.58	
95% queue length	0.11	0.03		0.55			4.01	
Control Delay	7.5	7.5		12.5			17.9	
LOS	A	A		B			C	
Approach Delay				12.5			17.9	
Approach LOS				B			C	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: Kevin Paul, E.I.T.
Agency/Co.: A. D. Williams Engineering Inc
Date Performed: 16/03/2008
Analysis Time Period: Peak Hour
Intersection: Rainy Creek & Sunbreaker Cove
Jurisdiction: Lacombe County
Units: U. S. Customary
Analysis Year: 2007
Project ID: i15452.00
East/West Street: Rainy Creek Road
North/South Street: Sunbreaker Cove Road
Intersection Orientation: EW Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	52	53	27	15	39	32
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	13	13	7	4	10	8
Hourly Flow Rate, HFR	52	53	27	15	39	32
Percent Heavy Vehicles	10	--	--	10	--	--
Median Type/Storage	Undivided /					
RT Channelized?			No			
Lanes	0	1	1	1	1	0
Configuration	LT		R	L	TR	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	30	6	52	51	238	92
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	8	2	13	13	60	23
Hourly Flow Rate, HFR	30	6	52	51	238	92
Percent Heavy Vehicles	10	10	10	10	10	10
Percent Grade (%)		0			2	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	53	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	10	10	10	10	10	10	10	10
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.02	0.02	0.02
t(3,lt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.2	4.2	7.2	6.6	6.3	7.2	6.6	6.3
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	10	10	10	10	10	10	10	10
t(f)	2.3	2.3	3.6	4.1	3.4	3.6	4.1	3.4

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	71	80	407	258	53	285	269	55
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500		1500		1500		1500	
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	53	55
Potential Capacity	992	990
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	992	990
Probability of Queue free St.	0.95	0.91
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows	80	71
Potential Capacity	1469	1480
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1469	1480
Probability of Queue free St.	0.99	0.96
Maj L-Shared Prob Q free St.		0.96
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows	258	269
Potential Capacity	633	624
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	604	595
Probability of Queue free St.	0.99	0.60
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows	407	285
Potential Capacity	541	651
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.57	0.94
Maj. L, Min T Adj. Imp Factor.	0.67	0.96
Cap. Adj. factor due to Impeding mvmnt	0.60	0.91
Movement Capacity	327	591

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	258	269

Potential Capacity	633	624
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	604	595
Result for 2 stage process:		
a		
y		
C t	604	595
Probability of Queue free St.	0.99	0.60
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	407	285
Potential Capacity	541	651
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.57	0.94
Maj. L, Min T Adj. Imp Factor.	0.67	0.96
Cap. Adj. factor due to Impeding mvmnt	0.60	0.91
Movement Capacity	327	591
Results for Two-stage process:		
a		
y		
C t	327	591

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	30	6	52	51	238	92
Movement Capacity (vph)	327	604	992	591	595	990
Shared Lane Capacity (vph)		571			658	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	327	604	992	591	595	990
Volume	30	6	52	51	238	92
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						

n max		
C sh	571	658
SUM C sep		
n		
C act		

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT	L		LTR			LTR	
v (vph)	52	15		88			381	
C(m) (vph)	1480	1469		571			658	
v/c	0.04	0.01		0.15			0.58	
95% queue length	0.11	0.03		0.55			4.01	
Control Delay	7.5	7.5		12.5			17.9	
LOS	A	A		B			C	
Approach Delay				12.5			17.9	
Approach LOS				B			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.96	0.99
v(il), Volume for stream 2 or 5	53	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.96	
d(M,LT), Delay for stream 1 or 4	7.5	7.5
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.3	

rainycreek&sunbreaker_2032
HCS+: Unsignalized Intersections Release 5.21

TWO-WAY STOP CONTROL SUMMARY

Analyst: Kevin Paul, E.I.T.
Agency/Co.: A. D. Williams Engineering Inc
Date Performed: 16/03/2008
Analysis Time Period: Peak Hour
Intersection: Rainy Creek & Sunbreaker Cove
Jurisdiction: Lacombe County
Units: U. S. Customary
Analysis Year:
Project ID: i15452.00
East/West Street: Rainy Creek Road
North/South Street: Sunbreaker Cove Road
Intersection Orientation: EW Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	29	105	98	114	146	52
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	29	105	98	114	146	52
Percent Heavy Vehicles	10	--	--	10	--	--
Median Type/Storage	Undivided /					
RT Channelized?			No			No
Lanes	0	1	1	1	1	1
Configuration		LT	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	90	12	118	50	8	33
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	90	12	118	50	8	33
Percent Heavy Vehicles	10	10	10	10	10	10
Percent Grade (%)		0			2	
Flared Approach: Exists?/Storage			/			No /
Lanes	0	1	1	0	1	0
Configuration		LT	R		LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT	L	LT		R		LTR	
v (vph)	29	114	102		118		91	
C(m) (vph)	1328	1322	359		928		390	
v/c	0.02	0.09	0.28		0.13		0.23	
95% queue length	0.07	0.28	1.18		0.44		0.91	
Control Delay	7.8	8.0	19.0		9.4		17.0	
LOS	A	A	C		A		C	
Approach Delay			13.9				17.0	
Approach LOS			B				C	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: Kevin Paul, E.I.T.
Agency/Co.: A. D. Williams Engineering Inc
Date Performed: 16/03/2008
Analysis Time Period: Peak Hour
Intersection: Rainy Creek & Sunbreaker Cove
Jurisdiction: Lacombe County
Units: U. S. Customary
Analysis Year:
Project ID: i15452.00
East/West Street: Rainy Creek Road
North/South Street: Sunbreaker Cove Road
Intersection Orientation: EW Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	29	105	98	114	146	52
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	7	26	24	28	36	13
Hourly Flow Rate, HFR	29	105	98	114	146	52
Percent Heavy Vehicles	10	--	--	10	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			No
Lanes	0	1	1	1	1	1
Configuration	LT		R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	90	12	118	50	8	33
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	22	3	30	12	2	8
Hourly Flow Rate, HFR	90	12	118	50	8	33
Percent Heavy Vehicles	10	10	10	10	10	10
Percent Grade (%)		0			2	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?			No			
Lanes	0	1	1	0	1	0
Configuration	LT		R		LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	105	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	10	10	10	10	10	10	10	10
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.02	0.02	0.02
t(3,lt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.2	4.2	7.2	6.6	6.3	7.2	6.6	6.3
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	10	10	10	10	10	10	10	10
t(f)	2.3	2.3	3.6	4.1	3.4	3.6	4.1	3.4

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	198	203	583	589	105	651	635	146
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500		1500		1500		1500	
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	105	146
Potential Capacity	928	880
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	928	880
Probability of Queue free St.	0.87	0.96
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows	203	198
Potential Capacity	1322	1328
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1322	1328
Probability of Queue free St.	0.91	0.98
Maj L-Shared Prob Q free St.		0.98
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows	589	635
Potential Capacity	410	385
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.89
Movement Capacity	366	344
Probability of Queue free St.	0.97	0.98
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows	583	651
Potential Capacity	412	371
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.87	0.86
Maj. L, Min T Adj. Imp Factor.	0.90	0.90
Cap. Adj. factor due to Impeding mvmnt	0.87	0.78
Movement Capacity	358	290

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	589	635

Potential Capacity	410	385
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.89
Movement Capacity	366	344
Result for 2 stage process:		
a		
y		
C t	366	344
Probability of Queue free St.	0.97	0.98
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	583	651
Potential Capacity	412	371
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.87	0.86
Maj. L, Min T Adj. Imp Factor.	0.90	0.90
Cap. Adj. factor due to Impeding mvmnt	0.87	0.78
Movement Capacity	358	290
Results for Two-stage process:		
a		
y		
C t	358	290

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	90	12	118	50	8	33
Movement Capacity (vph)	358	366	928	290	344	880
Shared Lane Capacity (vph)	359				390	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	358	366	928	290	344	880
Volume	90	12	118	50	8	33
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						

n max								
C sh			359				390	
SUM C sep								
n								
C act								

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT	L	LT		R		LTR	
v (vph)	29	114	102		118		91	
C(m) (vph)	1328	1322	359		928		390	
v/c	0.02	0.09	0.28		0.13		0.23	
95% queue length	0.07	0.28	1.18		0.44		0.91	
Control Delay	7.8	8.0	19.0		9.4		17.0	
LOS	A	A	C		A		C	
Approach Delay				13.9			17.0	
Approach LOS				B			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	0.91
v(il), Volume for stream 2 or 5	105	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.98	
d(M,LT), Delay for stream 1 or 4	7.8	8.0
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.2	

sunbreakercove&eastaccess_2032
HCS+: Unsignalized Intersections Release 5.21

TWO-WAY STOP CONTROL SUMMARY

Analyst: Kevin Paul, E.I.T.
Agency/Co.: A. D. Williams Engineering Inc
Date Performed: 16/03/2008
Analysis Time Period: Peak Hour
Intersection: Sunbreaker Cove & East Access
Jurisdiction: Lacombe County
Units: U. S. Customary
Analysis Year: 2032
Project ID: i15452.00
East/West Street: East Access Road
North/South Street: Sunbreaker Cove Road
Intersection Orientation: NS Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	23	108			103	53
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	23	108			103	53
Percent Heavy Vehicles	10	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	1	1			1	0
Configuration	L	T				TR
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				36		15
Peak Hour Factor, PHF				1.00		1.00
Hourly Flow Rate, HFR				36		15
Percent Heavy Vehicles				10		10
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	23					36		15
C(m) (vph)	1377					678		899
v/c	0.02					0.05		0.02
95% queue length	0.05					0.17		0.05
Control Delay	7.7					10.6		9.1
LOS	A					B		A
Approach Delay							10.2	
Approach LOS							B	

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:	Kevin Paul, E.I.T.
Agency/Co.:	A. D. Williams Engineering Inc
Date Performed:	16/03/2008
Analysis Time Period:	Peak Hour
Intersection:	Sunbreaker Cove & East Access
Jurisdiction:	Lacombe County
Units: U. S. Customary	
Analysis Year:	2032
Project ID: i15452.00	
East/West Street:	East Access Road
North/South Street:	Sunbreaker Cove Road
Intersection Orientation: NS	Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	23	108			103	53
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	6	27			26	13
Hourly Flow Rate, HFR	23	108			103	53
Percent Heavy Vehicles	10	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	1			1	0
Configuration	L	T				TR
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				36		15
Peak Hour Factor, PHF				1.00		1.00
Peak-15 Minute Volume				9		4
Hourly Flow Rate, HFR				36		15
Percent Heavy Vehicles				10		10
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	10					10		10
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.2					6.5		6.3
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	10					10		10
t(f)	2.3					3.6		3.4

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	156					284		130
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		130
Potential Capacity		899
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		899
Probability of Queue free St.	1.00	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows		156
Potential Capacity		1377
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1377
Probability of Queue free St.	1.00	0.98
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		284
Potential Capacity		690
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.97	0.98
Movement Capacity		678

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		

Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		284
Potential Capacity		690
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.97	0.98
Movement Capacity		678
Results for Two-stage process:		
a		
y		
C t		678

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				36		15
Movement Capacity (vph)				678		899
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				678		899
Volume				36		15
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						

n max	
C sh	
SUM C sep	
n	
C act	

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	23					36		15
C(m) (vph)	1377					678		899
v/c	0.02					0.05		0.02
95% queue length	0.05					0.17		0.05
Control Delay	7.7					10.6		9.1
LOS	A					B		A
Approach Delay							10.2	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	7.7	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		