Appendix D

Traffic Impact Study (Draft)

Vivian Manitoba
Traffic Impact Study

115424000.500
Draft Report

March 6, 2024

Prepared for:

Sio Silica

Prepared by:

Stantec Consulting Ltd.
500-311 Portage Ave
Winnipeg, MB R3B 2B9

Sign-off Sheet

This document entitled Vivian Manitoba Traffic Impact Study was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Sio Silica (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by [redacted]

(signature)

Caleb Schultz, Engineering Intern

Reviewed by [redacted]

(signature)

Mark Hearson, P.Eng.

Approved by [redacted]

(signature)

Bob Kurylko, P.Eng.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 STUDY PURPOSE AND OBJECTIVES

Stantec has been retained by Sio Silica to complete a Traffic Impact Study (TIS) for construction of a sand processing facility and loop track proposed at a site just east of PR 302 and south of PTH 15 in the Rural Municipality of Springfield, MB. Proposed site access will be located on PR 302. A TIS is required for approval by Manitoba Transportation and Infrastructure (MTI). According to the MTI's *General Guidelines for the Preparation of Traffic Impact Studies* document, the purposes of a traffic impact study (TIS) are to:

a) Determine what the impacts will be from a proposed development or redevelopment upon the adjacent highway network.

b) Determine what measures may be required to mitigate adverse impacts and allow the highway network to provide a satisfactory level of service.

The objectives of the TIS are:

- Document the characteristics of the development and select an appropriate study area and scenarios for analysis.
    - Location
    - Proposed land use
    - Site plan
    - Adjacent sites and highway conditions
    - Study area
    - Horizon years
- Estimate traffic volumes for all analysis scenarios.
    - Existing traffic conditions
    - Traffic growth rates
    - Site-generated traffic
    - Total future traffic and anticipated time expectations
    - Trip distribution
- Complete transportation analyses for the analysis scenarios.
    - Site access
    - Intersection capacity and level of service
    - Traffic safety
    - Site circulation and on-site queueing requirements
    - Pedestrian and other road user requirements
- Identify required infrastructure modifications and create corresponding conceptual designs.
    - Intersection treatment warrant analysis
    - Conceptual design sketches
    - Preliminary opinion of probable costs
- Record conclusions and make recommendations based on the results of the analyses.

The following sections describe the procedures used to complete these objectives.

2.0 CONTEXT

2.1 LOCATION

The proposed development site is located in the Rural Municipality of Springfield, east of PR 302, south of PTH 15, and west of the Town of Vivian. The site is approximately 1 km to the west of the Town of Vivian and 12 km to the east of the Town of Anola. The site is approximately 35 km to the east of the City of Winnipeg's Perimeter Highway. Figure 1 shows the proposed development site in the regional context. Figure 2 shows the proposed development site in the local context. The town of Anola (pictured) and the villages of Ostenfeld and Ross fall (not pictured) within the regional project area.

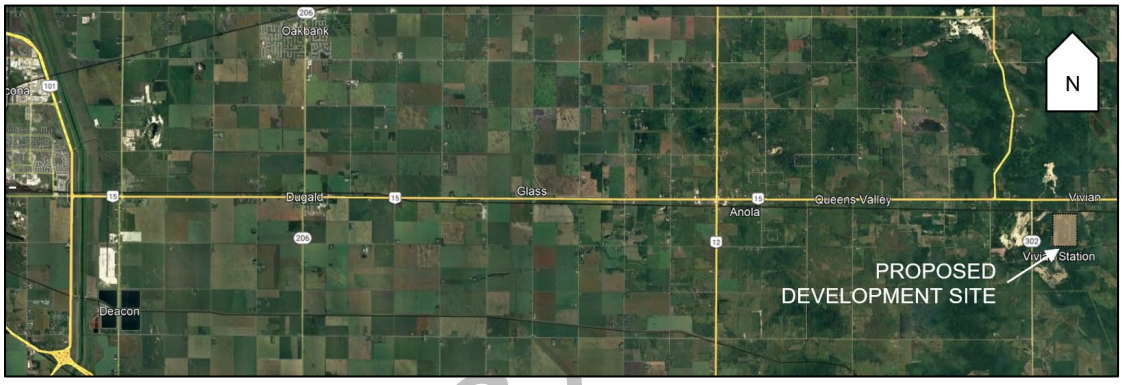

Figure 1: Regional Context

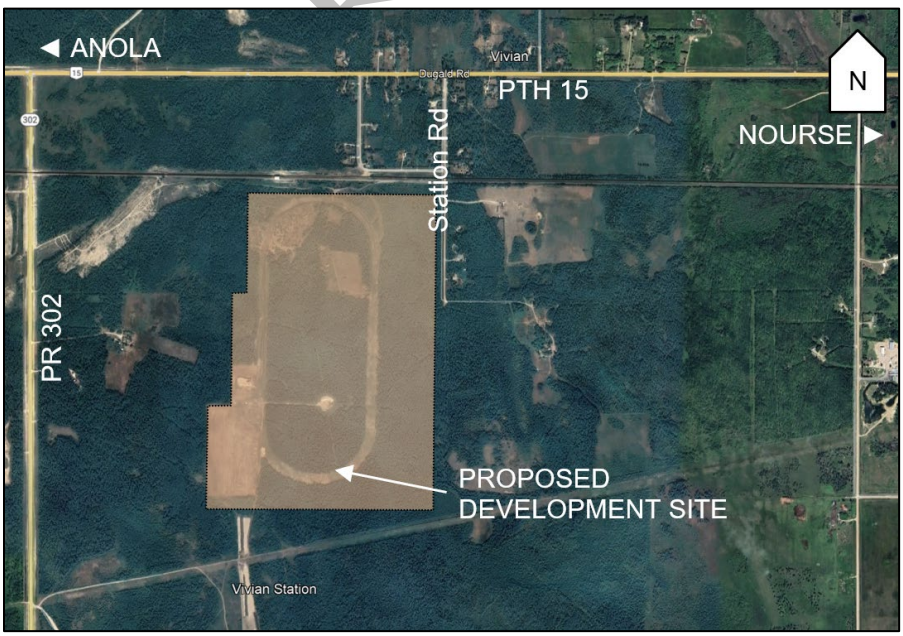

Figure 2: Local Context

The proposed site provides access to the Canadian National Railway, which is located at the north boundary of the site. The site has frontage along PR 302 to the west and Station Road to the east. Both PR 302 and Station Road connect to PTH 15 to the north; connectivity to Dugald, Anola, Winnipeg, and other communities is largely provided by PTH 15. Surrounding land use consists of mining and agriculture, with quarries located to the north, south and west. There are several rural homesteads in close proximity to the site and clusters of residential land use in nearby towns. Sio Silica plans to drill wells in the area over an extended number of years on private land south and west of the Sand Processing Facility Site Area.

2.2 PROPOSED LAND USE

The proposed site is approximately 300 acres of greenfield. Proposed land use for the area includes:

- 3.5 km rail loop
- 1.5 km access road
- office and maintenance building(s)
- screener building(s)
- silos
- wash plant building(s)
- crusher building(s)
- clarifier
- bucket elevators
- tripper conveyors
- water storage tanks
- propane tanks
- rail loadout buildings
- water storage tank(s)
- slurry line
- stockpiles
- parking

Trip generation for the proposed land use was provided by the client, as there are no standardized trip generation models for similar land uses included in the ITE *Trip Generation Manual – 11th Edition*.

2.3 SITE PLAN

Access to the development is proposed via an access road connecting to PR 302, shown in the site plan in Figure 3. The development is proposed for the north parcel of the two private land parcels encircled in red on Figure 3. The site access road will be roughly 1.5 km long and will be constructed on private land on the south parcel, however it will cross a government right-of-way at the south boundary of the development site. Note that the proposed site plan is conceptual.

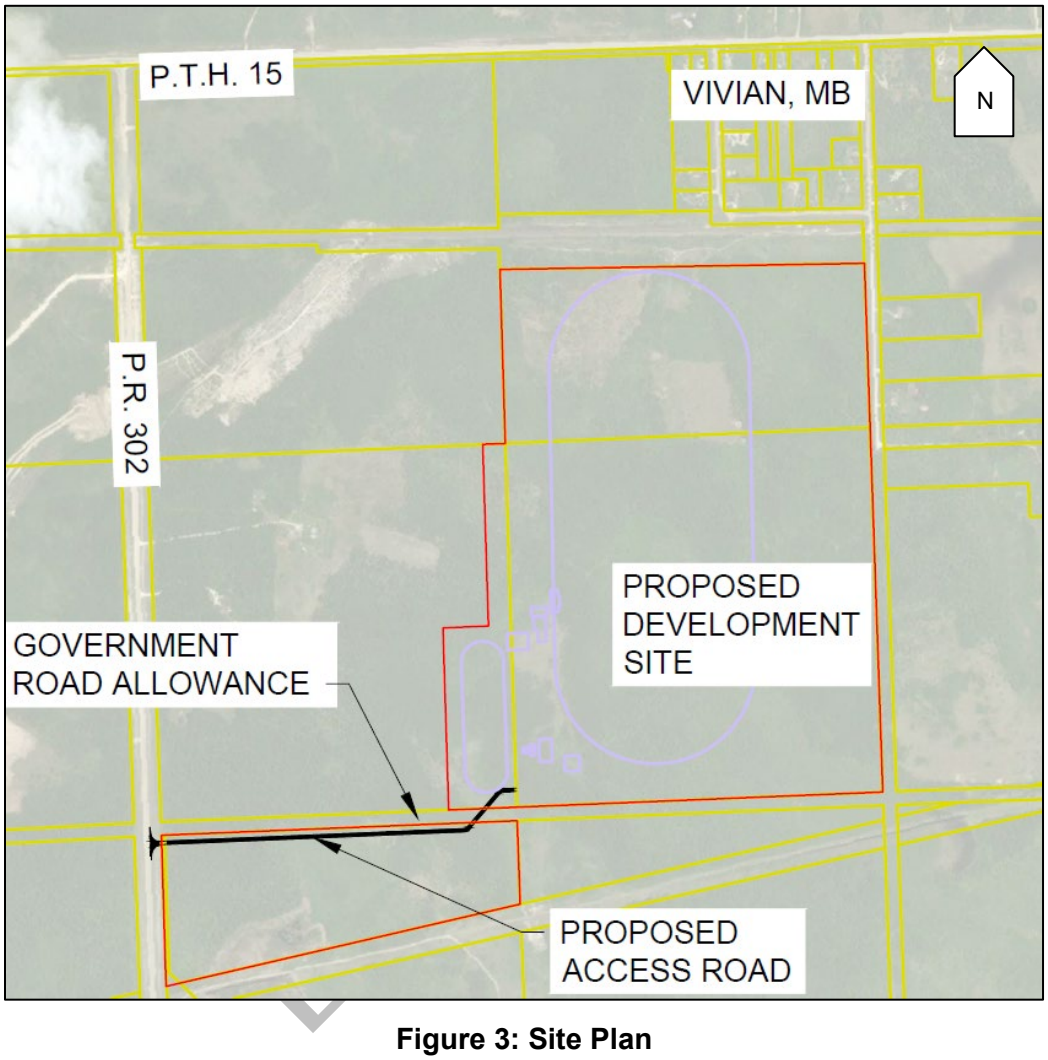

Figure 3: Site Plan

2.4 ADJACENT SITES / HIGHWAY CONDITIONS

2.4.1 Land Use

Surrounding land use is primarily agricultural, with several rural homesteads nearby and a denser pocket of residential in Vivian and other nearby towns. There is a proposed aggregate mine of unknown schedule and scale just south of the processing facility site and on the west side of PR 302. There is no traffic impact information currently available. As such, no nearby planned developments are explicitly considered in this TIS. There are a few quarry sites in the immediate area and one to the north on Oakwood Road. As quarry activity is seasonal, typically peaking in the summer months, traffic counts collected may not capture the full traffic impact of quarry operations in the area.

2.4.2 Transportation

Table 1 shows characteristics of the major highways near the proposed development. The adjacent segment of PTH 15 connects the Town of Vivan and the Town of Anola. PTH 15 provides connectivity to the City of Winnipeg's Perimeter Highway and other adjacent communities and municipalities. PR 302 runs north-south, connecting to the Town of Richer and the Trans-Canada highway to the south and the Town of Beausejour and PTH 44 to the north. The south leg of PR 302 is approximately one mile east of the north leg. Site access is proposed to connect to PR 302, south of PTH 15.

Table 1: Highway Characteristics

Road	Functional Classification	Basic Cross Section	Posted Speed Limit	Physical Characteristics
PTH 15	Rural Arterial	Two-Lane Undivided	100 km/h	Paved Surface Gravel Shoulders
PR 302	Rural Collector	Two-Lane Undivided	Unposted, default 90km/h	Gravel Surface Gravel Shoulders

PR 302 is a gravel two-lane undivided road with no pavement markings or posted speed limit, therefore a 90 km/h default speed limit is assumed.

The proposed access to the development is located along PR 302, approximately 1700 m south of the PR 302 and PTH 15 intersection. The CN railway crosses PR 302 approximately 400 m south of PTH 15. There is also an access to a quarry on the west side of PR 302 in close proximity to the CN railway crossing. There are no significant topographical features in the area of the proposed site. The property's east boundary along PR 302 is well forested and tree clearing will be required to construct the planned access road.

2.5 STUDY AREA

Based on the description of the proposed development, the study area includes two study intersections:

- PR 302 and PTH 15 (East Junction)
- Access road and PR 302

2.6 HORIZON YEARS AND TIME PERIODS FOR ANALYSIS

The proposed construction period for the development is estimated from spring of 2024 to quarter two of 2025. Based on the construction period, the study team elected to use the following analysis scenarios:

- 2023 Existing Traffic Conditions
- 2025 Future Combined Traffic Conditions at Full Buildout
- 2035 Future Combined Traffic Conditions

The traffic analysis for all scenarios pertain to typical weekday conditions in the AM and PM peak periods.

3.0 TRAFFIC VOLUMES

3.1 EXISTING TRAFFIC VOLUMES

The following traffic counts are available for the site from the Manitoba Highway Traffic Information System (MHTIS) for the study area:

- **Location: PR 302, south of PTH 15**
  Count type: CCS-TUBE
  Station Number: 873
  Directionality: combined traffic
  Availability: 2011 to 2017
- **Location: PTH 15, east of PTH 12**
  Count type: CCS-TUBE
  Station Number: 141
  Directionality: combined traffic
  Availability: 2011 to 2017

The following intersection turning movement count was obtained for the purpose of this study:

- **Location: PTH 15 at PR 302 (East Junction)**
  Count type: Miovision turning movement counts
  Directionality: total and truck traffic by movement for all approaches
  Availability: 24-hour count for November 30, 2023, 24-hour count for December 1, 2023

The availability of raw data corresponding to turning counts obtained for this report enabled the determination of peak periods for the intersection of PTH 15 and PR 302. The peak periods are as follows:

- AM Peak Hour: 7:30 AM to 8:30 AM
- PM Peak Hour: 5:30 PM to 6:30 PM

Average daily traffic (ADT) volumes near the intersections of PTH 15 at PR 302 were obtained for the purpose of this study. These volumes, presented in Table 2, present an incomplete picture of traffic volumes near the development site as they lack directionality, classification, and temporal detail. Therefore, two 24-hour counts were conducted on November 30 and December 1, 2023.

Table 2: Existing Counts for PTH 15 and PR 302

Location	AADT (Year)	Count Type
872 – PTH 15, 2.4 km east of PR 302	910 (2017)	Coverage Count Station (tube)
873 – PR 302, south of PTH 15	240 (2017)	Coverage Count Station (tube)

Turning movement count data for PTH 15 and PR 302 provides a better level of detail for directionality and temporality, while also providing the percentage of trucks for each turning movement. Background traffic data for PR 302 near the proposed site access road is presented in Table 4. Background traffic data for PTH 15 and PR 302 is presented in Table 5. The Transportation Research Board Highway Capacity Manual provides passenger car equivalents (PCE) for heavy vehicles based on terrain, as shown in Table 3. Using a desktop-level analysis of the vertical curvature present at the study site, a PCE of 1.5 was selected to generate PCE peak volumes.

Table 3: Passenger Car Equivalent Values for Traffic Adjustments

	PCE by type of terrain [passenger cars per vehicle]		
Vehicle	**Level**	**Rolling**	**Mountainous**
Trucks and buses, E_T	1.5	2.5	4.5

Table 4: Background Traffic Data for PR 302 and PTH 15 (2023)

Approach	West		East		South	
AADT	741		569		143	
Movement	**EBT**	**EBR**	**WBL**	**WBT**	**NBL**	**NBR**
AM peak-hour volume	32	4	1	57	17	2
AM truck percentage	9.4%	0%	0%	5.3%	5.9%	50%
AM PCE peak-hour volume	34	4	1	59	17	3
PM peak-hour volume	78	13	0	48	12	2
PM truck percentage	5.1%	15.4%	0%	6.3%	8.3%	0%
PM PCE peak-hour volume	80	14	0	50	13	2

3.1.1 Peak Hour Factors and Heavy Vehicles

The peak hour factor (PHF) represents the fluctuation of traffic flow within the peak hour. PHF is defined as:

$$PHF = \frac{Peak\ Hour\ Volume}{Peak\ 15\ Minute\ Volume\ \times 4}$$

Notice that lower PHFs indicate that more of the peak hour volume occurs within the peak 15 minutes, while higher PHFs indicate a more consistent flow within the peak hour. Volume fluctuation within the peak hour depends on many

factors, and thus is difficult to predict into the future. As such, observed PHFs are typically used for analysis of existing traffic conditions and PHFs for future values are set to a standard value of 0.92. The peak hour factors for the intersection of PTH 15 and PR 302 are as follows:

- AM Peak Hour = PHF = 0.883
- PM Peak Hour = PHF = 0.75

There is little variation in the truck traffic percentages between AM and PM peaks. Truck traffic percentages for eastbound and westbound through traffic vary between 5% and 9%, whereas there was no truck traffic observed turning in the peak periods of the turning movement counts in 2023.

3.2 TRAFFIC GROWTH RATE

Coverage count station data was used as the primary source of data for the determination of traffic growth rates. Growth rates of 0% and 4.8% correspond to best-fit exponential trendlines for historical data at stations 872 and 873, respectively. This is shown in Figure 4. The growth rate calculated from data collected at station 872, located on PTH 15 and east of PR 302 is applied to traffic on PTH 15. The growth rate at station 873, located along PR 302 is applied to traffic on PR 302 south of PTH 15. These rates are used to forecast existing traffic from the background traffic data collected, in addition to future traffic forecasts.

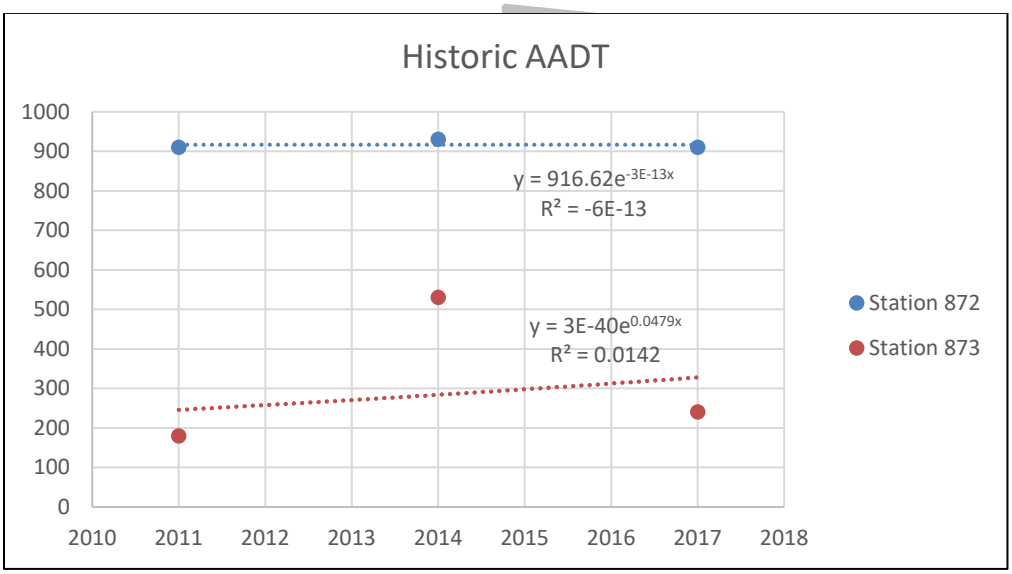

Figure 4: Historical AADT at Coverage Count Stations 872 and 873

3.3 SITE-GENERATED TRAFFIC

Site-generated traffic was estimated using a four-step transportation forecasting process. The four steps are:

- **Trip Generation**
  How much travel demand will be created during the time periods considered?
- **Directional Distribution**
  Where will people and goods be going to and coming from?
- **Mode Split**
  What modes of travel will people and goods use?
- **Route Assignment**
  What paths will trips take through the transportation network?

Trips were estimated for three analysis periods:

- Weekday AM peak hour of PTH 15
- Weekday PM peak hour of PTH 15
- Weekday Average Daily Traffic (ADT)

It is standard practice to estimate development traffic based on the peak hour of adjacent street traffic, which may not coincide with the peak hour of generation from the development. The rationale for this practice is that in most cases the total adjacent street traffic volume is greater than the traffic generated by the development, and thus the critical hour coincides with the peak hour on the adjacent street, whether or not that hour coincides with the peak hour of generation from the proposed development.

3.3.1 Trip Generation

There are no relevant trip generation surveys from the ITE *Trip Generation Manual – 11th Edition* that may be applied to the proposed development. The determination of site-generated traffic therefore relies upon client estimates of trip generation based on expected activity levels at the site and past experience. MTI is concerned with the impact of overall traffic volume increases on highways adjacent to the proposed processing facility therefore traffic generated by the potential adjacent sand extraction project is also included in traffic projections. The client estimate of site-generated traffic is based on the following activity:

Sand Processing Facility

- 25 employees per shift during construction and operation
- Equipment deliveries and waste removal will cause periodic truck traffic, typically during off-peak periods

Sand Extraction Project

- 20 employees per shift during construction and operation
- Additional trips will be generated for mechanic services and fuel delivery, typically during off-peak periods

The sand processing facility is expected to be in operation 24 hours a day, 7 days per week. Peak hour generation is expected at shift changes, which occur at 7:00 AM and 7:00 PM. The combination of trip ends based on the various types of trips, vehicle types, and temporal distribution assumptions results in traffic volumes presented in Table 5.

Table 5: Site-Generated Traffic

Period	AM Peak Period [one hour]		PM Peak Period [one hour]		ADT [24 hours]
Directionality	**Entering**	**Exiting**	**Entering**	**Exiting**	**Entering and Exiting**
Total traffic during period	45	45	45	45	180
Truck percentage	2%*	2%*	2%*	2%*	5%*
PCE volume during period	46	46	46	46	185

*According to the client, no truck traffic is expected during peak periods but a conservative 2% is used. 5% of the ADT is conservatively assumed to be truck traffic likely due to the occasional maintenance vehicle during off peak hours.

3.3.2 Directional Distribution

Traffic generated from the development site is assumed to primarily approach PTH 15 and PR 302 from the west. Approximately 80% of the workforce will commute from Winnipeg, Steinbach, Ste Anne, Anola, and Beausejour. Roughly ten percent is expected to come from Richer on PR 302 and won't enter the PR 302 at PTH 15 intersection. The remaining 10% is expected to originate in the town of Vivian or from farther east and will approach PR 302 from the east on PTH 15.

3.3.3 Mode Split

The development site is located rurally, so there are few complimentary land use origins or destinations in close proximity to suggest any trip ends correspond with active transportation. As such, the trip generation estimates were not reduced to account for travel by active modes. While the volume of trip ends may minorly vary from those estimated by the client, the determination of trip mode or vehicle classification is reliable based on trip function.

3.3.4 Route Assignment

The assignment of trips to the surrounding road network is straightforward based on the small size of the study area and lack of alternate routes. Traffic is assumed to primarily approach the intersection of PTH 15 and PR 302 from the west. No sensitivity analysis was performed as there are no viable alternate routes to consider.

3.4 TOTAL FUTURE TRAFFIC

Future traffic volumes for 2025 and 2035 scenarios are separated by projected background traffic and projected combined traffic generated by the proposed development. Volumes are presented in the peak hour volume and the PCE volume. Average daily traffic volumes are presented in vehicles per day (vpd). Peak hours of the proposed facility were assumed to coincide with peak hours of background traffic.

Table 6: Future Background Traffic Data for PR 302 and PTH 15 (2025)

Approach	West		East		South	
AADT	741		569		157	
Movement	EBT	EBR	WBL	WBT	NBL	NBR
AM peak-hour volume	32	4	1	57	19	2
AM truck percentage	9.4%	0%	0%	5.3%	6%	50%
AM PCE peak-hour volume	34	4	1	59	20	3
PM peak-hour volume	78	13	0	48	13	2
PM truck percentage	5.1%	15.4%	0%	6.3%	8%	0%
PM PCE peak-hour volume	80	14	0	50	14	6

Table 7: Future Combined Traffic Data for PR 302 and PTH 15 (2025)

Approach	West		East		South	
AADT	869		585		193	
Movement	**EBT**	**EBR**	**WBL**	**WBT**	**NBL**	**NBR**
AM peak-hour volume	32	36	5	57	51	6
AM truck percentage	9%	0%	0%	5%	6%	50%
AM PCE peak-hour volume	34	36	5	59	20	8
PM peak-hour volume	78	45	4	48	45	6
PM truck percentage	5%	4%	0%	6%	8%	0%
PM PCE peak-hour volume	80	46	4	49	47	6

Table 8: Future Background Traffic Data for PR 302 and PTH 15 (2035)

Approach	West		East		South	
AADT	741		569		250	
Movement	**EBT**	**EBR**	**WBL**	**WBT**	**NBL**	**NBR**
AM peak-hour volume	32	4	1	57	30	4
AM truck percentage	9.4%	0%	0%	5.3%	6%	50%
AM PCE peak-hour volume	34	4	1	59	20	4
PM peak-hour volume	78	13	0	48	21	4
PM truck percentage	5.1%	15.4%	0%	6.3%	8%	0%
PM PCE peak-hour volume	80	14	0	50	22	6

Table 9: Future Combined Traffic Data for PR 302 and PTH 15 (2035)

Approach	West		East		South	
AADT	869		585		287	
Movement	**EBT**	**EBR**	**WBL**	**WBT**	**NBL**	**NBR**
AM peak-hour volume	32	36	5	57	62	8
AM truck percentage	9%	0%	0%	5%	6%	25%
AM PCE peak-hour volume	34	4	5	59	63	9
PM peak-hour volume	78	45	4	48	53	8
PM truck percentage	5%	4%	0%	6%	8%	0%
PM PCE peak-hour volume	80.0	46	4	50	55	8

Table 10: Background Traffic for PR 302 and the Site Access Road (2023)

Approach	East		South		North	
ADT	0		137		136	
Movement	**WBL**	**WBR**	**NBT**	**NBR**	**SBL**	**SBT**
AM peak-hour volume			19			5
AM truck percentage			11%			0%
AM PCE peak-hour volume			20			5
PM peak-hour volume			14			13
PM truck percentage			7%			15%
PM PCE peak-hour volume			14			14

Table 11: Future Combined Traffic for PR 302 and the Site Access Road (2025)

Approach	East		South		North	
ADT	180		160		229	
Movement	**WBL**	**WBR**	**NBT**	**NBR**	**SBL**	**SBT**
AM peak-hour volume	5	40	21	5	40	5
AM truck percentage	2%	2%	11%	2%	2%	0%
AM PCE peak-hour volume	5	40	22	5	40	5
PM peak-hour volume	5	40	15	5	40	14
PM truck percentage	2%	2%	7%	2%	2%	15%
PM PCE peak-hour volume	5	40	16	5	40	15

Table 12: Future Combined Traffic for PR 302 and the Site Access Road (2035)

Approach	East		South		North	
ADT	180		245		319	
Movement	**WBL**	**WBR**	**NBT**	**NBR**	**SBL**	**SBT**
AM peak-hour volume	5	40	33	5	40	9
AM truck percentage	2%	2%	11%	2%	2%	0%
AM PCE peak-hour volume	5	40	35	5	40	9
PM peak-hour volume	5	40	25	5	40	23
PM truck percentage	2%	2%	7%	2%	2%	15%
PM PCE peak-hour volume	5	40	25	5	40	25

3.5 TRAFFIC VOLUME SUMMARY

Figure 5 provides a visual summary of the existing and future traffic conditions.

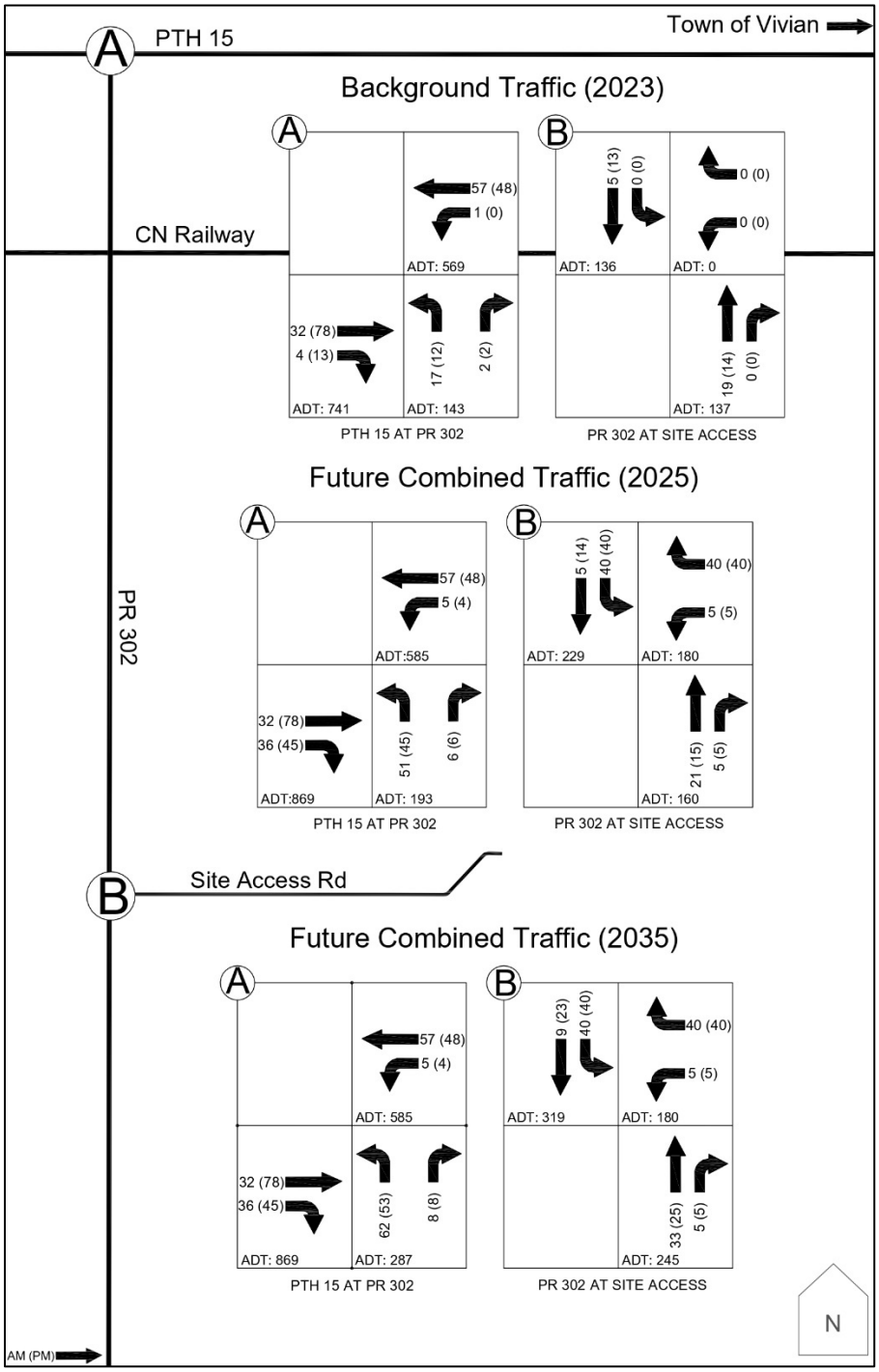

Figure 5: Traffic Volume Summary

4.0 TRAFFIC ANALYSIS

The traffic analysis included several components:

- Peak hour traffic operations analysis
- Traffic signal warrant analysis
- Average daily traffic analysis

Each of these components offers different insight into traffic and transportation issues at the location analyzed. The peak hour traffic operations analysis investigates delay, volume-to-capacity, and queueing at intersections. The traffic signal warrant analysis determines if traffic volumes warrant signalization. Analysis of average daily traffic provides insight into the number of basic lanes appropriate for a given road.

Analyses were conducted for the two study intersections:

- PR 302 and the development site access road
- PR 302 and PTH 15

Analyses were conducted for the three analysis scenarios:

- 2023 Existing Traffic Conditions
- 2025 Combined Traffic Conditions
- 2035 Future Combined Traffic Conditions

The following sections describe the configurations of the study intersections and the results of the analyses.

4.1 SITE ACCESS

The proposed road access is shown in the site access plan provided as Figure 3. The base configurations used for Synchro at the site access is shown in Figure 6. The access approach is a two-way road that is stop controlled. Neither the south nor north approaches are stop controlled. The base configuration does not include any geometric modifications to the north and south approaches. Further discussion on safety considerations at the access road intersection is presented in Section 4.3.

The base configuration used for Synchro at the intersection of PR 302 at PTH 15 is also provided, as shown in Figure 7.

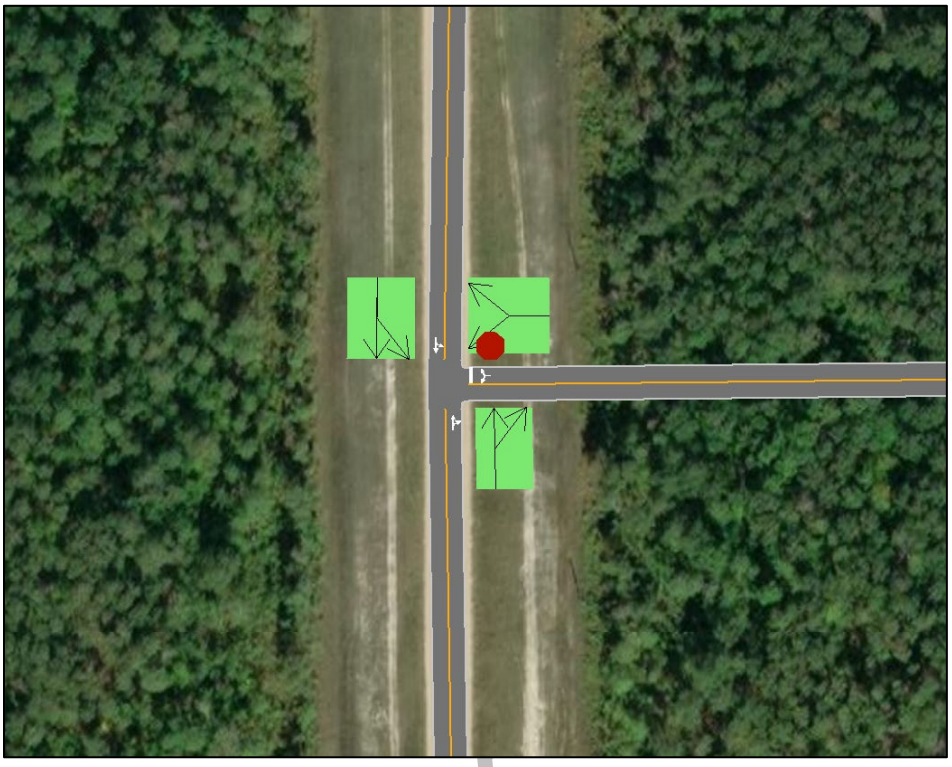

Figure 6: Base Synchro Model including Site Access Road

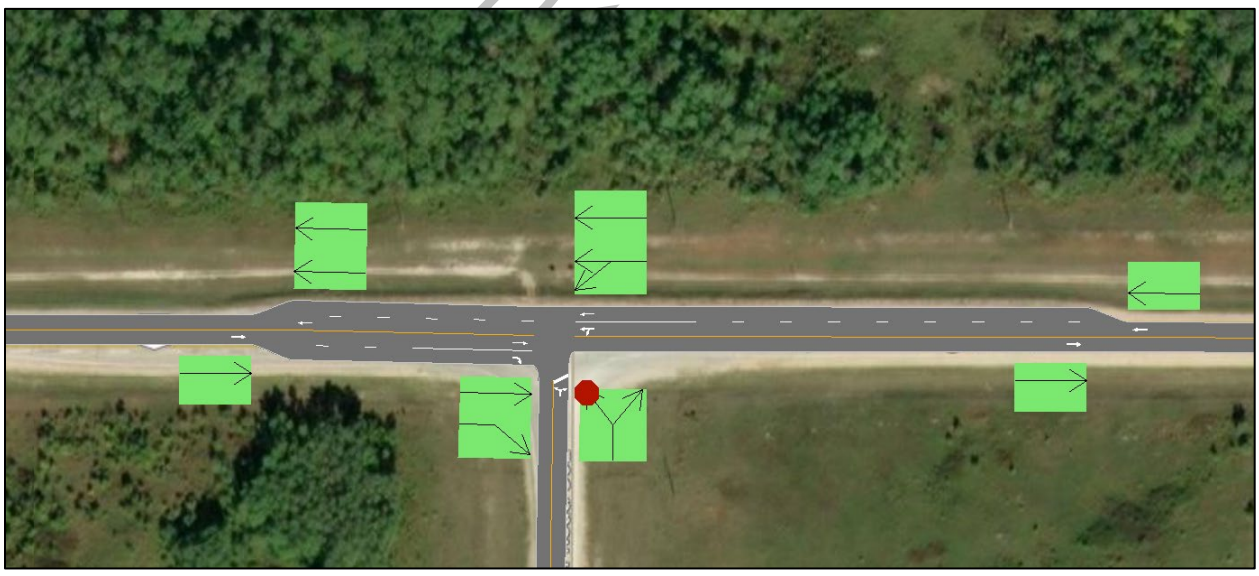

Figure 7: Base Synchro Model at PR 302 and PTH 15

4.2 PEAK HOUR TRAFFIC OPERATIONS ANALYSIS

The peak hour traffic operations analysis was completed using *Synchro Studio 10* (Synchro) software. Synchro allows users to model traffic operations for street networks including signalized and unsignalized intersections. Traffic

operations performance is returned in the form of volume to capacity (v/c) ratios, intersection capacity utilization (ICU), delays, level of service (LOS), and queue lengths.

In each of the analyses, reported performance includes delay, LOS, and ICU at the overall intersection level, and performance for critical movements. A critical movement is a movement that meets at least one these criteria:

- Operating at LOS D or worse
- Volume to capacity (v/c) ratio of 0.85 or greater
- Ninety-fifth percentile queue lengths exceed available queue storage lengths

Appendix B provides background information on these measures. Synchro traffic analysis reports are included in Appendix A.

4.2.1 Assumptions

The peak hour traffic operations analysis was based on the following assumptions:

- Operating speed was assumed to be equal to the posted speed limit.
- Ideal saturated flow rate for the HCM analysis was 1,900 veh/hr (equivalent to 1,800 pcu/hr in the Canadian Capacity Guide).
- PHFs for all scenarios were set to a default value of 0.92.
- The number of pedestrian crossings per hour was assumed to be zero for all approaches.

The following sections give the analysis results from each of the analysis scenarios.

4.2.2 Existing 2023 Traffic Conditions

The peak hour traffic operations analysis began with the 2023 existing traffic scenario, to establish baseline performance of PR 302 at the proposed access road location and at the intersection of PR 302 and PTH 15.

Table 13: Traffic Analysis Results for Existing Traffic Conditions (2023)

Intersection	Overall Intersection LOS / Delay [s] / ICU AM (PM)	Critical Movements Movement / LOS / Delay [s] / v/c AM (PM)
PR 302 and PTH 15	A / 1.5 / 13% (A / .8 / 14%)	None (None)
PR 302 and site access road	N/A	N/A

4.2.3 Combined 2025 Traffic Conditions

The peak hour traffic operations analysis included a scenario of combined site-generated traffic and existing traffic in 2023, to establish baseline effect of site-generated traffic at the intersection of PR 302 and the proposed access road, and the intersection of PR 302 and PTH 15.

Table 14: Traffic Analysis Results for Future Traffic Conditions (2025)

Intersection	Overall Intersection LOS / Delay [s] / ICU AM (PM)	Critical Movements Movement / LOS / Delay [s] / v/c AM (PM)
PR 302 and PTH 15	A / 3 / 15% (A / 2.3 / 14%)	None (None)
PR 302 and site access road	A / 5.9 / 19% (A / 5.9 / 19%)	None (None)

4.2.4 Future Combined 2035 Traffic Conditions

The peak hour traffic operations analysis included a scenario of future combined site-generated traffic and existing traffic projected to 2029, to establish long-term effects of site-generated traffic at the intersection of PR 302 and the proposed access road, and the intersection of PR 302 and PTH 15.

Table 15: Traffic Analysis Results for Future Traffic Conditions (2035)

Intersection	Overall Intersection LOS / Delay [s] / ICU AM (PM)	Critical Movements Movement / LOS / Delay [s] / v/c AM (PM)
PR 302 and PTH 15	A / 3.4 / 16% (A / 2.6 / 14%)	None (None)
PR 302 and site access road	A / 5.2 / 19% (A / 5.2 / 19%)	None (None)

4.2.5 Peak Hour Analysis Conclusion

In all of the three scenarios included in peak hour analysis, the existing intersections provide acceptable traffic operations performance and no changes to the existing intersections are warranted from this analysis.

4.3 TRAFFIC SIGNAL WARRANT ANALYSES

The traffic signal warrant analysis (TSWA) procedure considers traffic volumes averaged over the peak six hours of a typical weekday and returns a number of "warrant points". Based on MTI's current policy, traffic signals are warranted for rural intersections with more than 50 points. The peak six hours usually include a two-hour peak period in the morning, a two-hour peak period at mid-day, and a two-hour peak period in the afternoon.

The signal warrant can be overturned if the traffic volume on both minor roads averages less than 75 vehicles per hour (vph) over the peak six hours. In those cases, the minor road traffic is considered too light for traffic signals to be warranted, regardless of the warrant points returned by the analysis. In the case of both the intersections of PTH 15 at PR 302 and PR 302 at the site access, the access volumes are sufficiently low (<75 vph) that signalization is not recommended, and the warrants do not need to be applied.

4.4 AVERAGE DAILY TRAFFIC

Average daily traffic (ADT) volumes can be used to give some insight into the number of lanes appropriate for a given road. MTI sometimes considers widening from two lanes to four lanes when ADT volumes exceed 6,000 vpd on an arterial road or 7,000 vpd on a collector road. Consideration for widening also depends on the intended roadway mobility function, economic conditions, and the surrounding land use context. No ADT traffic volumes on any of the approaches to the study site intersections warrant the addition of lanes based on daily traffic capacity and PTH 15 is already channelized at PR 302.

4.5 TRAFFIC SAFETY

The proposed location of the access road is well spaced from PTH 15. Generally, there is little roadside vegetation that may reduce sightlines in the area of the proposed access road.

5.0 INTERSECTION MODIFICATIONS

Stantec applied MTI's *Warrants and Standards for Intersection Treatments of Rural Two-Lane Highways* to both intersections in the study area. The application of the warrants applies to both the AM and PM peak periods for both the intersection of PR 302 and the site access road, and the intersection of PTH 15 and PR 302. For the intersection of PTH 15 and PR 302, the westbound and eastbound AADTs result in the warrant of a widened intersection including widening of the minor road, in this case PR 302. However, the intersection is already built to the higher standard of a bypass intersection. Based on aerial imagery, the existing EB right turn lane and taper is 130 m and WB bypass lane is 140 m in length, exceeding the taper lengths of a typical widened intersection. The turn radii of PR 302 both exceed 10 m and the taper is approximately 15:1. PR 302 and its shoulders are paved for 20 m immediately south of PTH 15, but shoulders are not paved other than on the PR 302 approach. The warranted EB taper length east of PR 302 is not met. The right turn conflict warrant is met in the future combined scenario for the eastbound PTH 15 approach at PR 302, however a right turn lane is already provided and therefore no specific modification is required here.

6.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.1 SUMMARY

The following points provide a summary of the traffic impact study (TIS) assumptions and analysis results:

- The proposed development is to have access to PR 302 between the Town of Vivian and the Town of Ostenfeld. The study intersections are located at the site access road/PR 302 and PTH 15/PR 302.
- Projections and analyses were completed for the following scenarios:
    - 2023 existing traffic conditions
    - 2025 combined traffic conditions
    - 2035 future combined traffic conditions
- At full build out, the proposed development is estimated to generate 45 AM peak hour trips, 45 PM peak hour trips, and 180 average daily traffic (ADT) trips.
- Peak hour traffic operations analysis found that the study intersections provide acceptable performance across all scenarios.
- The traffic signal warrant analysis found that no traffic signals are warranted for the study intersections.
- The average daily traffic analysis found that no existing road segments at the study intersections had projected average daily traffic that would warrant consideration for widening to four-lanes in any scenario (PTH 15 is already channelized at PR 302).

6.2 CONCLUSIONS AND RECOMMENDATIONS

The study team made the following conclusions based on the TIS findings:

- The widening warrant was met for EB and WB PTH 15 at PR 302 in all scenarios per the Manitoba Infrastructure *Warrants and Standards for Intersection Treatments of Rural Two-Lane Highways* (1998). The widening warrant was met for all scenarios analyzed therefore it is not triggered by increased traffic from the proposed development. The intersection configuration is similar to a bypass intersection design from the MTI *Warrants*, and may provide acceptable accommodation of vehicular traffic in its current configuration given that this is higher warrant..

APPENDIX A
SYNCHRO TRAFFIC ANALYSIS REPORTS

Appendix A SYNCHRO TRAFFIC ANALYSIS REPORTS

Figure A.1 through Figure A.6 present the peak hour traffic analysis for the intersection of PR 302 and PTH 15 for the three analysis scenarios for the AM peak period.

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	EBT	EBR	WBL	WBT	NBL	NBR
Node #	2	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	32	4	1	57	17	2
X East (m):	-229786.6	Future Volume (vph)	32	4	1	57	17	2
Y North (m):	568582.4	Sign Control	Free	—	—	Free	Stop	—
Z Elevation (m):	0.0	Median Width (m)	0.0	—	—	0.0	3.7	—
Description		TWLTL Median	☐	—	—	☐	☐	—
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.02	Critical Gap, tC (s)	—	—	4.1	—	6.9	7.9
Intersection Delay (s):	1.5	Follow Up Time, tF (s)	—	—	2.2	—	3.6	3.8
Intersection LOS:	A	Volume to Capacity Ratio	0.02	0.00	0.00	0.02	0.02	0.02
ICU:	0.13	Control Delay (s)	0.0	0.0	0.0	0.1	9.0	9.0
ICU LOS:	A	Level of Service	A	A	A	A	A	A
		Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.5	0.5
		Approach Delay (s)	0.0	—	—	0.1	9.0	—

Figure A.1: AM Peak Period Synchro Results for PR 302 and PTH 15 for Existing Traffic Conditions (2023)

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	EBT	EBR	WBL	WBT	NBL	NBR
Node #	2	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	32	36	5	57	51	6
X East (m):	-229786.6	Future Volume (vph)	32	36	5	57	51	6
Y North (m):	568582.4	Sign Control	Free	—	—	Free	Stop	—
Z Elevation (m):	0.0	Median Width (m)	0.0	—	—	0.0	3.7	—
Description		TWLTL Median	☐	—	—	☐	☐	—
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.07	Critical Gap, tC (s)	—	—	4.1	—	6.9	7.9
Intersection Delay (s):	3.0	Follow Up Time, tF (s)	—	—	2.2	—	3.6	3.8
Intersection LOS:	A	Volume to Capacity Ratio	0.02	0.02	0.00	0.02	0.07	0.07
ICU:	0.15	Control Delay (s)	0.0	0.0	0.0	0.5	9.3	9.3
ICU LOS:	A	Level of Service	A	A	A	A	A	A
		Queue Length 95th (m)	0.0	0.0	0.1	0.1	1.7	1.7
		Approach Delay (s)	0.0	—	—	0.6	9.3	—

Figure A.2: AM Peak Period Synchro Results for PR 302 and PTH 15 for Future Combined Traffic Conditions (2025)

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	EBT	EBR	WBL	WBT	NBL	NBR
Node #	2	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	32	36	5	57	62	8
X East (m):	-229786.6	Future Volume (vph)	32	36	5	57	62	8
Y North (m):	568582.4	Sign Control	Free	—	—	Free	Stop	—
Z Elevation (m):	0.0	Median Width (m)	0.0	—	—	0.0	3.7	—
Description		TWLTL Median	☐	—	—	☐	☐	—
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.08	Critical Gap, tC (s)	—	—	4.1	—	6.9	7.4
Intersection Delay (s):	3.4	Follow Up Time, tF (s)	—	—	2.2	—	3.6	3.5
Intersection LOS:	A	Volume to Capacity Ratio	0.02	0.02	0.00	0.02	0.08	0.08
ICU:	0.16	Control Delay (s)	0.0	0.0	0.0	0.5	9.3	9.3
ICU LOS:	A	Level of Service	A	A	A	A	A	A
		Queue Length 95th (m)	0.0	0.0	0.1	0.1	2.1	2.1
		Approach Delay (s)	0.0	—	—	0.6	9.3	—

Figure A.3: AM Peak Period Synchro Results for PR 302 and PTH 15 for Future Combined Traffic Conditions (2035)

Figure A.4 through Figure A.6 present the peak hour traffic analysis for the intersection of PR 302 and PTH 15 for the three analysis scenarios for the PM peak period.

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	EBT	EBR	WBL	WBT	NBL	NBR
Node #	2	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	78	13	0	48	12	2
X East (m):	-229786.6	Future Volume (vph)	78	13	0	48	12	2
Y North (m):	568582.4	Sign Control	Free	—	—	Free	Stop	—
Z Elevation (m):	0.0	Median Width (m)	0.0	—	—	0.0	3.7	—
Description		TWLTL Median	☐	—	—	☐	☐	—
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.05	Critical Gap, tC (s)	—	—	—	—	7.0	6.9
Intersection Delay (s):	0.8	Follow Up Time, tF (s)	—	—	—	—	3.6	3.3
Intersection LOS:	A	Volume to Capacity Ratio	0.05	0.01	—	0.02	0.02	0.02
ICU:	0.14	Control Delay (s)	0.0	0.0	—	0.0	9.2	9.2
ICU LOS:	A	Level of Service	A	A	—	A	A	A
		Queue Length 95th (m)	0.0	0.0	—	0.0	0.4	0.4
		Approach Delay (s)	0.0	—	—	0.0	9.2	—

Figure A.4: PM Peak Period Synchro Results for PR 302 and PTH 15 for Existing Traffic Conditions (2023)

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	EBT	EBR	WBL	WBT	NBL	NBR
Node #	2	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	78	45	4	48	45	6
X East (m):	-229786.6	Future Volume (vph)	78	45	4	48	45	6
Y North (m):	568582.4	Sign Control	Free	—	—	Free	Stop	—
Z Elevation (m):	0.0	Median Width (m)	0.0	—	—	0.0	3.7	—
Description		TWLTL Median	☐	—	—	☐	☐	—
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.07	Critical Gap, tC (s)	—	—	4.1	—	7.0	6.9
Intersection Delay (s):	2.3	Follow Up Time, tF (s)	—	—	2.2	—	3.6	3.3
Intersection LOS:	A	Volume to Capacity Ratio	0.05	0.03	0.00	0.02	0.07	0.07
ICU:	0.14	Control Delay (s)	0.0	0.0	0.0	0.5	9.5	9.5
ICU LOS:	A	Level of Service	A	A	A	A	A	A
		Queue Length 95th (m)	0.0	0.0	0.1	0.1	1.6	1.6
		Approach Delay (s)	0.0	—	—	0.5	9.5	—

Figure A.5: PM Peak Period Synchro Results for PR 302 and PTH 15 for Future Combined Traffic Conditions (2025)

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	EBT	EBR	WBL	WBT	NBL	NBR
Node #	2	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	78	45	4	48	53	8
X East (m):	-229786.6	Future Volume (vph)	78	45	4	48	53	8
Y North (m):	568582.4	Sign Control	Free	—	—	Free	Stop	—
Z Elevation (m):	0.0	Median Width (m)	0.0	—	—	0.0	3.7	—
Description		TWLTL Median	☐	—	—	☐	☐	—
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.08	Critical Gap, tC (s)	—	—	4.1	—	7.0	6.9
Intersection Delay (s):	2.6	Follow Up Time, tF (s)	—	—	2.2	—	3.6	3.3
Intersection LOS:	A	Volume to Capacity Ratio	0.05	0.03	0.00	0.02	0.08	0.08
ICU:	0.14	Control Delay (s)	0.0	0.0	0.0	0.5	9.5	9.5
ICU LOS:	A	Level of Service	A	A	A	A	A	A
		Queue Length 95th (m)	0.0	0.0	0.1	0.1	1.9	1.9
		Approach Delay (s)	0.0	—	—	0.5	9.5	—

Figure A.6: PM Peak Period Synchro Results for PR 302 and PTH 15 for Future Combined Traffic Conditions (2035)

Figure A.7 through Figure A.9 present the peak hour traffic analysis for the intersection of PR 302 and the Site Access Road for the three analysis scenarios for the AM peak period.

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	WBL	WBR	NBT	NBR	SBL	SBT
Node #	5	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	0	0	19	0	0	5
X East (m):	-229859.5	Future Volume (vph)	0	0	19	0	0	5
Y North (m):	566812.1	Sign Control	Stop	—	Free	—	—	Free
Z Elevation (m):	0.0	Median Width (m)	3.7	—	0.0	—	—	0.0
Description		TWLTL Median	☐	—	☐	—	—	☐
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.05	Critical Gap, tC (s)	—	—	—	—	—	—
Intersection Delay (s):	0.0	Follow Up Time, tF (s)	—	—	—	—	—	—
Intersection LOS:	A	Volume to Capacity Ratio	—	—	0.01	—	—	0.00
ICU:	0.07	Control Delay (s)	—	—	0.0	—	—	0.0
ICU LOS:	A	Level of Service	—	—	A	—	—	A
		Queue Length 95th (m)	—	—	0.0	—	—	0.0
		Approach Delay (s)	0.0	—	0.0	—	—	0.0

Figure A.7: AM Peak Period Synchro Results for PR 302/Site Access Road for Existing Traffic Conditions (2023)

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	WBL	WBR	NBT	NBR	SBL	SBT
Node #	5	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	5	40	21	5	40	5
X East (m):	-229859.5	Future Volume (vph)	5	40	21	5	40	5
Y North (m):	566812.1	Sign Control	Stop	—	Free	—	—	Free
Z Elevation (m):	0.0	Median Width (m)	3.7	—	0.0	—	—	0.0
Description		TWLTL Median	☐	—	☐	—	—	☐
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.05	Critical Gap, tC (s)	6.4	6.2	—	—	4.1	—
Intersection Delay (s):	5.9	Follow Up Time, tF (s)	3.5	3.3	—	—	2.2	—
Intersection LOS:	A	Volume to Capacity Ratio	0.05	0.05	0.02	0.02	0.03	0.03
ICU:	0.19	Control Delay (s)	8.7	8.7	0.0	0.0	0.2	6.6
ICU LOS:	A	Level of Service	A	A	A	A	A	A
		Queue Length 95th (m)	1.1	1.1	0.0	0.0	0.6	0.6
		Approach Delay (s)	8.7	—	0.0	—	—	6.6

Figure A.8: AM Peak Period Synchro Results for PR 302/Site Access Road for Combined Traffic Conditions (2025)

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	WBL	WBR	NBT	NBR	SBL	SBT
Node #	5	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	5	40	33	5	40	9
X East (m):	-229859.5	Future Volume (vph)	5	40	33	5	40	9
Y North (m):	566812.1	Sign Control	Stop	—	Free	—	—	Free
Z Elevation (m):	0.0	Median Width (m)	3.7	—	0.0	—	—	0.0
Description		TWLTL Median	☐	—	☐	—	—	☐
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.05	Critical Gap, tC (s)	6.4	6.2	—	—	4.1	—
Intersection Delay (s):	5.2	Follow Up Time, tF (s)	3.5	3.3	—	—	2.2	—
Intersection LOS:	A	Volume to Capacity Ratio	0.05	0.05	0.02	0.02	0.03	0.03
ICU:	0.19	Control Delay (s)	8.7	8.7	0.0	0.0	0.2	6.0
ICU LOS:	A	Level of Service	A	A	A	A	A	A
		Queue Length 95th (m)	1.1	1.1	0.0	0.0	0.6	0.6
		Approach Delay (s)	8.7	—	0.0	—	—	6.0

Figure A.9: AM Peak Period Synchro Results for PR 302/ Site Access Road for Future Combined Traffic Conditions (2035)

Figure A.10 through Figure A.12 present the peak hour traffic analysis for the intersection of PR 302 and the Site Access Road for the three analysis scenarios for the PM peak period.

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	WBL	WBR	NBT	NBR	SBL	SBT
Node #	5	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	0	0	19	0	0	13
X East (m):	-229859.5	Future Volume (vph)	0	0	19	0	0	13
Y North (m):	566812.1	Sign Control	Stop	—	Free	—	—	Free
Z Elevation (m):	0.0	Median Width (m)	3.7	—	0.0	—	—	0.0
Description		TWLTL Median	☐	—	☐	—	—	☐
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.01	Critical Gap, tC (s)	—	—	—	—	—	—
Intersection Delay (s):	0.0	Follow Up Time, tF (s)	—	—	—	—	—	—
Intersection LOS:	A	Volume to Capacity Ratio	—	—	0.01	—	—	0.00
ICU:	0.07	Control Delay (s)	—	—	0.0	—	—	0.0
ICU LOS:	A	Level of Service	—	—	A	—	—	A
		Queue Length 95th (m)	—	—	0.0	—	—	0.0
		Approach Delay (s)	0.0	—	0.0	—	—	0.0

Figure A.10: PM Peak Period Synchro Results for PR 302/Site Access Road for Existing Traffic Conditions (2023)

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	WBL	WBR	NBT	NBR	SBL	SBT
Node #	5	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	5	40	21	5	40	5
X East (m):	-229859.5	Future Volume (vph)	5	40	21	5	40	5
Y North (m):	566812.1	Sign Control	Stop	—	Free	—	—	Free
Z Elevation (m):	0.0	Median Width (m)	3.7	—	0.0	—	—	0.0
Description		TWLTL Median	☐	—	☐	—	—	☐
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.05	Critical Gap, tC (s)	6.4	6.2	—	—	4.1	—
Intersection Delay (s):	5.9	Follow Up Time, tF (s)	3.5	3.3	—	—	2.2	—
Intersection LOS:	A	Volume to Capacity Ratio	0.05	0.05	0.02	0.02	0.03	0.03
ICU:	0.19	Control Delay (s)	8.7	8.7	0.0	0.0	0.2	6.6
ICU LOS:	A	Level of Service	A	A	A	A	A	A
		Queue Length 95th (m)	1.1	1.1	0.0	0.0	0.6	0.6
		Approach Delay (s)	8.7	—	0.0	—	—	6.6

Figure A.11: PM Peak Period Synchro Results for PR 302/Site Access Road for Combined Traffic Conditions (2025)

NODE SETTINGS		HCM 2000 SIGNING SETTINGS	WBL	WBR	NBT	NBR	SBL	SBT
Node #	5	Lanes and Sharing (#RL)						
Zone:		Traffic Volume (vph)	5	40	25	5	40	21
X East (m):	-229859.5	Future Volume (vph)	5	40	25	5	40	21
Y North (m):	566812.1	Sign Control	Stop	—	Free	—	—	Free
Z Elevation (m):	0.0	Median Width (m)	3.7	—	0.0	—	—	0.0
Description		TWLTL Median	☐	—	☐	—	—	☐
Control Type	Unsig	Right Turn Channelized	—	None	—	None	—	None
Max v/c Ratio:	0.05	Critical Gap, tC (s)	6.4	6.2	—	—	4.1	—
Intersection Delay (s):	5.1	Follow Up Time, tF (s)	3.5	3.3	—	—	2.2	—
Intersection LOS:	A	Volume to Capacity Ratio	0.05	0.05	0.02	0.02	0.03	0.03
ICU:	0.20	Control Delay (s)	8.7	8.7	0.0	0.0	0.2	4.9
ICU LOS:	A	Level of Service	A	A	A	A	A	A
		Queue Length 95th (m)	1.1	1.1	0.0	0.0	0.6	0.6
		Approach Delay (s)	8.7	—	0.0	—	—	4.9

Figure A.12: PM Peak Period Synchro Results PR 302/Site Access Road for Future Combined Traffic Conditions (2035)

APPENDIX B
TRANSPORTATION ENGINEERING BACKGROUND INFORMATION

Appendix B TRANSPORTATION ENGINEERING BACKGROUND INFORMATION

This appendix contains background information on transportation engineering concepts and performance measures.

B.1 CONCEPTS

B.1.1 AADT and ADT

Annual average daily traffic (AADT) and average daily traffic (ADT) are two common representations of daily traffic volumes. An AADT volume is a traffic volume averaged from an entire year of data. This data is either collected continuously for an entire year, or algorithms are used to account for small periods where data is unavailable due to equipment failure or maintenance. An ADT volume is a traffic volume averaged from some period less than an entire year. Because ADTs represent a less comprehensive time period, they can be reported for specific conditions, such as weekday ADT, weekend ADT, September ADT, etc.

Compared to ADT volumes, AADT volumes are theoretically more representative of actual average traffic conditions, because they account for traffic fluctuations through an entire year. ADT volumes are collected from a smaller sample, and thus are more vulnerable to effects from daily or weekly fluctuations in traffic volumes.

In this report AADT and ADT volumes are reported. MHTIS provides AADT volumes, so background traffic volumes are reported as AADT. For site generated traffic, daily traffic estimates are typically weekday ADT, rather than AADT. When site generated traffic is combined with background traffic—this occurs in the post-development scenarios—the result is ADT, because the site generated portion of the traffic is a weekday ADT measure, and thus the total figure does not account for traffic fluctuations over an entire year.

B.2 PERFORMANCE MEASURES

B.2.1 Highway Capacity Manual

The intersection capacity and level of service analysis was based in part on methodology from the *Highway Capacity Manual* (HCM). Several performance measures from the HCM methodology are detailed below:

- **Level of Service (LOS)** – Based on the average vehicle delay during a 15-minute analysis period. Levels of Service range from A (minimal delay) to F (unacceptable delay) and may be measured on an intersection, approach, or movement basis.

- **Degree of Saturation** – The ratio of demand flow rate (v) to maximum capacity (c). Where the v/c ratio is 1.0 or greater, the intersection is operating at full capacity and experiencing major congestion.

- **Vehicle Delay** – The average time that vehicles are delayed on an intersection, approach, or movement basis. Measured in seconds of delay per vehicle or total hours of delay during the peak hour being analyzed.

For design and planning purposes, LOS D or better under peak hour conditions is considered acceptable. Table A.1 and Table A.2 describe the characteristics of each LOS for signalized and unsignalized stop-controlled intersections, respectively, as listed in the HCM.

Table A.1: Signalized Intersections - HCM Level of Service Characteristics

HCM Level of Service	Average Signal Delay per Vehicle (sec/veh)	Characteristics
A	≤ 10	Free flow, low volumes and high speeds, most drivers can select own speed
B	> 10 and ≤ 20	Stable flow, speed restricted slightly by traffic
C	> 20 and ≤ 35	Stable flow, speed controlled by traffic
D	> 35 and ≤ 55	Approaching unstable flow, low speed
E	> 55 and ≤ 80	Unstable flow and speeds, volumes at/near capacity
F	> 80	Forced flow, low speed, volume above capacity

Table A.2: Stop Controlled Intersections - HCM Level of Service Characteristics

HCM Level of Service	Total Delay (sec/veh)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

B.2.2 Intersection Capacity Utilization

Intersection Capacity Utilization (ICU) is another measure used to evaluate intersection performance. It is expressed as a ratio or percentage of intersection capacity used by the demand volumes. ICU can be expressed using Level of Service (ICU LOS), which is not equivalent to the HCM LOS described earlier, although the two may agree in some situations.

Table A.3: ICU Level of Service

Level of Service	Intersection Capacity Utilization (%)	Characteristics
A	≤ 60%	The intersection has no congestion. A cycle length of 80 sec. or less will move traffic efficiently. All traffic should be served on the first cycle. Traffic fluctuations, accidents, and lane closures can be handled with minimal congestion. This intersection can accommodate up to 40% more traffic on all movements.
B	> 60% and ≤ 70%	The intersection has very little congestion. Almost all traffic will be served on the first cycle. A cycle length of 90 sec. or less will move traffic efficiently. Traffic fluctuations, accidents, and lane closures can be handled with minimal congestion. This intersection can accommodate up to 30% more traffic on all movements
C	> 70% and ≤ 80%	The intersection has no major congestion. Most traffic should be served on the first cycle. A cycle length of 100 sec. or less will move traffic efficiently. Traffic fluctuations, accidents, and lane closures may cause some congestion. This intersection can accommodate up to 20% more traffic on all movements.
D	> 80% and ≤ 90%	The intersection normally has no congestion. The majority of traffic should be served on the first cycle. A cycle length of 110 sec. or less will move traffic efficiently. Traffic fluctuations, accidents, lane closures and sub-optimal timing can cause congestion. This intersection can accommodate up to 10% more traffic on all movements.
E	>90% and ≤ 100%	The intersection is on the verge of congested conditions. Many vehicles are not served on the first cycle. A cycle length of 120 sec. is required to move all traffic. Minor traffic fluctuations, accidents, lane closures and sub-optimal timing can cause significant congestion. This intersection has less than 10% reserve capacity available.
F	> 100% and ≤ 110%	The intersection is over capacity and likely experiences congestion periods of 15 to 60 min. per day. Residual queues at the end of green are common. A cycle length over 120 sec. is required to move all traffic. Minor traffic fluctuations, accidents, and lane closures can cause increased congestion. Sub optimal signal timings can cause increased congestion.

G	> 110% and ≤ 120%	The intersection is 10% to 20% over capacity and likely experiences congestion periods of 60 to 120 min. per day. Long queues are common. A cycle length over 120 sec. is required to move all traffic. Motorists may be choosing alternate routes, if they exist, or making fewer trips during the peak hour. Signal timings can be used to "ration" capacity to the priority movements.
H	> 120%	The intersection is 20% over capacity and could experience congestion periods of over 120 min. per day. Long queues are common. A cycle length over 120 sec. is required to move all traffic. Motorists may be choosing alternate routes, if they exist, or make fewer trips during the peak hour. Signal timings can be used to "ration" capacity to the priority movements.

Highway Capacity Manual Level of Service (HCM LOS) and Intersection Capacity Utilization Level of Service (ICU LOS) are different performance measures and cannot be directly compared. HCM LOS is delay-based, while ICU LOS is capacity-based. At times the two measures will give very different evaluations of overall traffic operations. In these situations, the HCM LOS can be used to determine average delays experienced by traffic while the ICU LOS can be used to determine how much reserve capacity is available at each intersection and how frequently each intersection experiences congestion.

APPENDIX C
TRAFFIC DATA

Appendix C TRAFFIC DATA

The following traffic counts are supplied as raw data in Microsoft Excel format along with this study:

- 24-hour count from November 30, 2023 at 6:00 AM to December 1, 2023 at 5:59 AM, named *20231130_traffic_count_pth15_pr302e.xlsx*
- 24-hour count from December 1, 2023 at 6:00 AM to December 2, 2023 at 5:59 AM, named *20231201_traffic_count_pth15_pr302e.xlsx*

Traffic video was collected using a Miovision Scout camera. Automated traffic counting was performed by Miovision.

APPENDIX D
TRAFFIC SIGNAL WARRANT ANALYSIS

Appendix D TRAFFIC SIGNAL WARRANT ANALYSIS

Stantec performed checks on whether Traffic Signal Warrant Analysis should be applied, considering when the minor road traffic is too light for traffic signals to be warranted regardless of the warrant points returned by the analysis. This is based on traffic volumes on the minor road approach(es) averaging less than 75 vehicles per hour (vph) over the peak six hours.

In the case of both the intersections of PTH 15 at PR 302 and PR 302 at the site access, the minor road volumes are sufficiently low (<75 vph) that signalization is not recommended, and the warrants do not need to be applied. These calculations were performed for the future combined traffic scenario for 2035.

PTH 15 at PR 302

Average minor road (PR 302) approach volume over peak six hours = 60 vph

PR 302 at the site access

Average minor road (site access) approach volume over peak six hours = 40 vph