950 & 1260 PHOENIX WAY DEVELOPMENT

Transportation Impact Assessment

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1.0 INTRODUCTION

Watt Consulting Group was retained by *Nanaimo Forest Products* to conduct a Traffic Impact Assessment (TIA) for a proposed zoning bylaw amendment at the 950 & 1260 Phoenix Way properties in the City of Nanaimo. This study assesses the traffic impacts of the proposed land uses, reviews traffic conditions at key intersections, and assesses the need for any mitigation measures. The study reviews the existing traffic operations, the 10-year horizon background and post development conditions for all modes of transportation.

1.1 Study Area

The site is located to the east of the Nanaimo Forest Products pulp mill, 86 hectares in area (213 acres). See **Figure 1** for the study area and location. All key intersections within the study area are unsignalized. The study area includes the following five intersections:

- Maughan Road / Phoenix Way
- Maughan Road / Duke Point Highway NB off Ramp
- Maughan Road / Gordon Road
- Maughan Road / Duke Point Highway (Ferry only)
- Maughan Road / Maughan Road (Duke Point Highway access)

Assessment of the internal road network will also be included in the study.

1.2 Traffic Analysis Scenarios and Time Periods

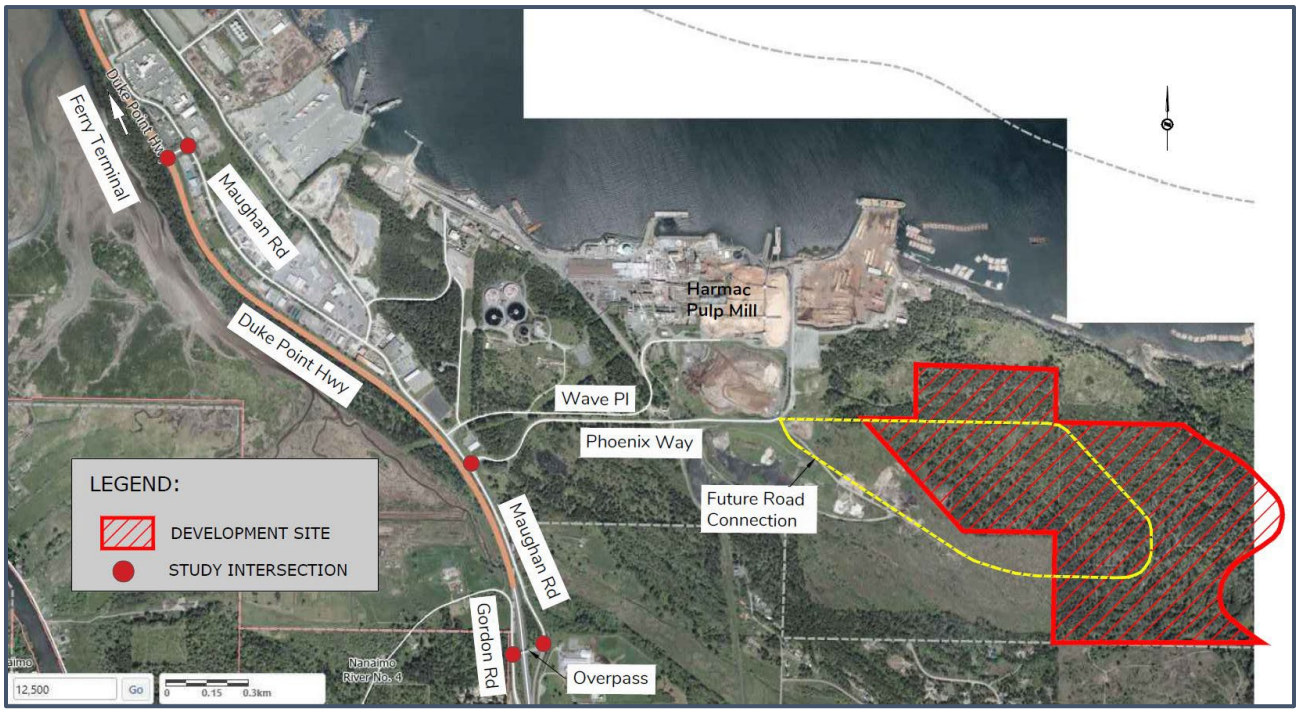
The following scenarios will be analyzed:

- 2023 Existing
- Background (2033)
- Post Development (2033)

The following scenarios will be analyzed:

- Weekday AM
- Weekday PM

Figure 1 – Study Area and Site Location



2.0 EXISTING CONDITIONS

2.1 Land Use

The site is composed of two large undeveloped lots zoned to AR1 (Rural Resource). There is an existing pulp mill (Harmac) to the west from the proposed site. To the south and east, the surrounding area is undeveloped. The property line on the south side of the proposed development is the city's boundary with the Regional District of Nanaimo.

2.2 Road Network

The existing road network, lane configuration, and intersection control are as follows:

Duke Point Highway (Highway 19) is a provincial highway under the jurisdiction of the BC MoTI which provides a connection between Island Highway S (Highway 1) and Duke Point Ferry Terminal. Duke Point Highway has a four lane cross section within the majority of the study area, except at the north end where the northbound direction is one lane only.

Maughan Road is an industrial road under the jurisdiction of the City of Nanaimo (southern part by RDN) which runs in parallel to Duke Point Highway and provides a connection between the highway and the industrial park in the Duke Point area.

Gordon Road is a local road under the jurisdiction of RDN which provides connections to Maughan Road (overpass) and Duke Point Highway (southbound on ramp).

Phoenix Way is a local road under the jurisdiction of the City of Nanaimo which provides connections to the development site from Maughan Road.

The statutory speed limit is 50 km/h on all study area roads except Duke Point Highway (90 km/h).

There are five key intersections (all 3-legged) within the study area as follows:

- **Maughan Road / Phoenix Way** is a key access point to the development and stop-controlled intersection with channelized islands for the northbound and westbound right turns. There is no separate left turn lane on Maughan Road southbound. The intersection is 100m spaced from the Wave Place (access road to the existing Harmac mill).
- **Maughan Road / Duke Point Highway NB Off Ramp** is a partially stop / yield controlled intersection. There is a yield control for right turn from Maughan Road SB to the overpass. The highway northbound off ramp is a free movement to Maughan Road NB while stop controlled for left movement to the Maughan Road overpass.
- **Maughan Road Overpass / Gordon Road** is all-way stop controlled on three approaches. However, the southbound movement from Gordon Road has extremely low volumes. It was observed that the northbound right / westbound left movements (98% of all entering PM volumes of the intersection) operate well with almost no stopping (like yield) although stop signs are installed.

  Duke Point Highway / Maughan Road access is an unsignalized intersection with channelized islands for the northbound and westbound right turns. No left turn is allowed from Maughan Road access onto the highway (southbound) while there is a southbound left turn lane with protected raised medians from the highway onto Maughan Road access.
- **Maughan Road / Maughan Road (highway access)** is stop controlled with a channelized island for the eastbound right turns. The intersection is just 60m spaced from the Duke Point Highway intersection.

2.3 Data Collection

Traffic counts were undertaken at the five key intersections during the AM and PM peak hours on May 24 and 25, 2023. The PM peak hour was found to be 4:30 to 5:30 PM at the Maughan Road / Phoenix Way intersection while 5:00 to 6:00 PM at Duke Point Highway / Maughan Road access. It was observed that the Maughan Road / Phoenix Way intersection PM peak volumes were concentrated for the 5:00 – 5:30 PM time period due to the commuter traffic of the existing Harmac mill, while the Duke Point Highway peak volumes concentrated for the only 5:45 – 6:00 PM time period after a delayed ferry arrival (Vancouver – Duke Point). The PM peak hour analysis reflects a worst-case scenario condition with the recurring commuter and ferry traffic. The AM peak hour was found to be 7:00 to 8:00 AM and has much lower volumes than PM overall. Therefore, the PM peak hour is considered the critical time period for the traffic impact analysis.

2.4 Traffic Modelling – Background Information

Analysis of the traffic conditions at the study intersections was undertaken using Synchro Studio 11. Synchro / SimTraffic is a two-part traffic modelling software that provides analysis of the traffic conditions based on the *Highway Capacity Manual (2010)* evaluation methodology. A detailed description is provided in **Appendix A**.

Heavy vehicle percentages at each intersection were taken based off the turning movement count data. The existing heavy vehicle percentage ranges from 6% to 20%.

Traffic operations will be analyzed, and any mitigation measures will be determined for the study area intersections. The following measures of effectiveness and their thresholds will be used to evaluate the traffic conditions:

- Overall v/c ratios greater than or equal to 0.85
- Individual movement v/c ratios greater than or equal to 0.90
- Individual movement Level of Service (LOS) “E” or “F”
- Maintenance of existing performance (i.e. same LOS) if existing LOS is “E” or “F”
- 95$_{th}$ Percentile Queue Length within existing queueing capacity

Trigger points for improvements will be identified if needed.

2.5 2023 Existing Conditions

Existing conditions were analyzed based on the collected 2023 volumes and existing roadway network. At all five study intersections, all movements operate well with acceptable delays (maximum PM peak delay: 18.6 seconds). The maximum v/c ratio for any individual lane is 0.74 for the westbound left movement at Maughan Road Overpass / Gordon Road intersection. At Maughan Road / Phoenix Way, the maximum delay is 15.7 seconds for the westbound left movement during the PM peak hour. No queuing issues were found at all turn lanes of all study intersections.

At Maughan Road / Duke Point Highway NB ramp, the northbound exit lane (one-way) would be atypical traffic control which is stop-controlled for the left turn and free for the through movement. The Synchro analysis for the northbound through movement could not reflect reality appropriately (no delay observed) due to the software's functional limitation.

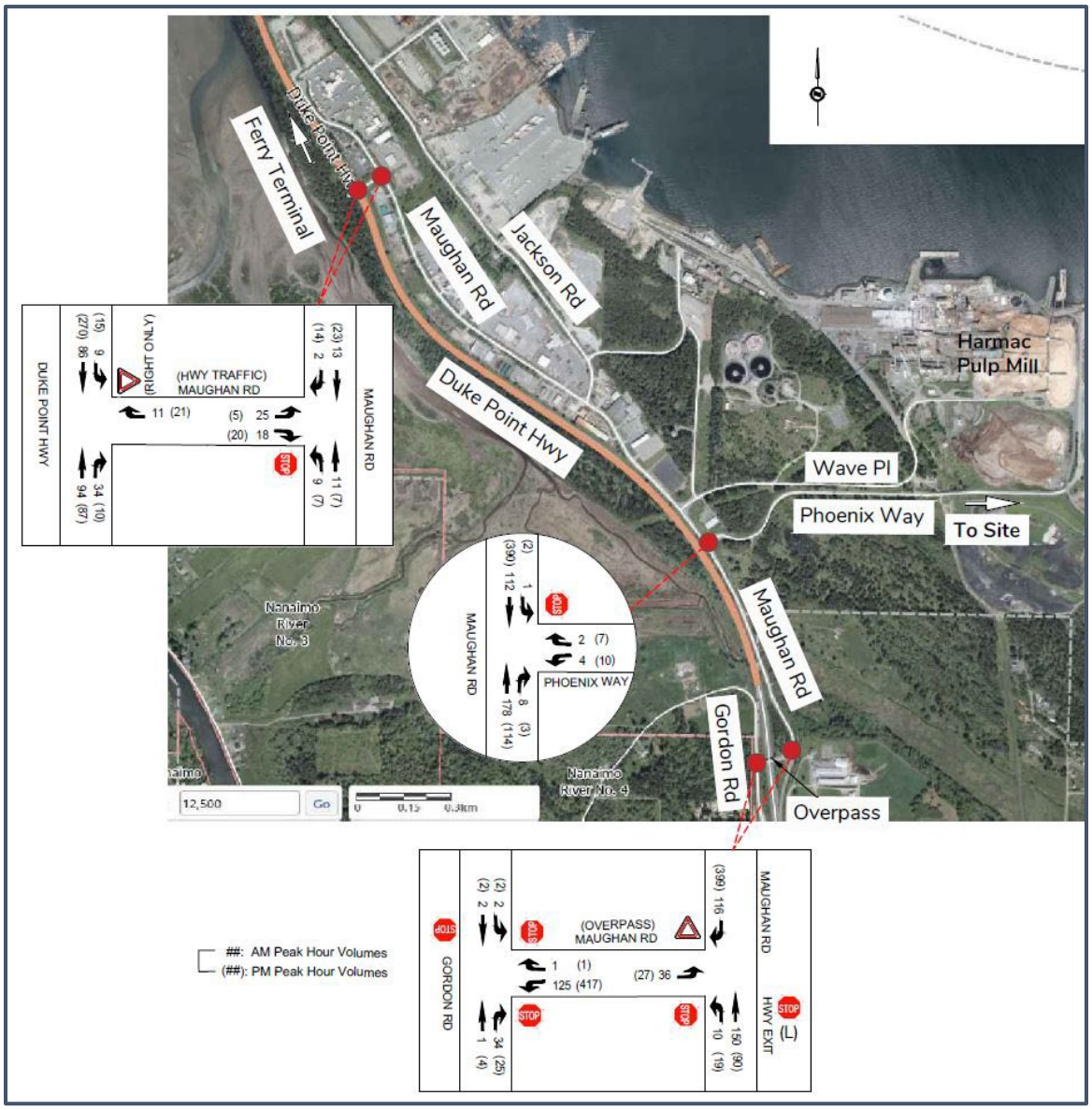
See **Table 1** for the 2023 existing v/c ratios, delays and queues. See **Figure 2** for the 2023 existing AM / PM peak hour traffic volumes.

Table 1 – 2023 Existing Conditions

INTERSECTION	MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
		v/c Ratio	Delay (s)	Queues (m)* 50th/95th	v/c Ratio	Delay (s)	Queue (m)* 50th/95th
MAUGHAN RD / PHOENIX WAY (WBL=Stop)	NBT	-	0	-	-	0	-
	NBR	-	0	-	-	0	-
	SBLT	0.01	7.7	-	0.01	8.6	-
	WBL	0.02	12.2	1.6/8.9	0.11	15.7	2.8/10.4
	WBR	0.01	9.4	-	0.02	9.5	-
MAUGHAN RD / DUKE POINT HWY NB OFF RAMP (NBL&EBL=Stop)	NBL	0.03	8.3	2.7/10.1(35)	0.04	8.8	4.5/13.5(35)
	NBT	0.27	10.2	16.7/26.7	0.15	9	12.5/21.5
	SBR	0.18	9	-	0.68	14.3	
	EBL	0.08	8.5	6.2/13.2	0.07	9.4	6.1/16.4
MAUGHAN OVERPASS / GORDON RD (All-Way Stop)	NBTR	0.06	7	6.0/12.8	0.07	8.7	6.3/16.3
	SBLT	0.01	7.5	0.7/4.6	0.02	8.6	0.9/5.4
	WBLR	0.23	8.5	9.5/15.7	0.74	18.6	19.4/29.8
MAUGHAN RD / DUKE POINT HWY	NBT	-	0	0	-	0	0
	NBR	-	0	0	-	0	0
	SBL	0.03	7.9	-	0.02	7.7	0.4/3.4(30)
	SBT	-	0	0	-	0	0
	WBR	0.05	10.4	-	0.06	9.9	-
MAUGHAN RD / HWY ACCESS (EB = Stop)	NBLT	0.02	7.4	-	0.01	7.6	-
	SBTR	-	0	0	-	0	0
	EBL	0.05	7.4	5.3/13.6	0.04	7.7	2.4/11.7
	EBR	-	0	0	-	0	0

*Note: 50th (or average) and 95th Queues based on SimTraffic for stop-controlled intersections (averaged from five simulation runs); (##) = Existing Storage Length

Figure 2 – 2023 Existing Volumes

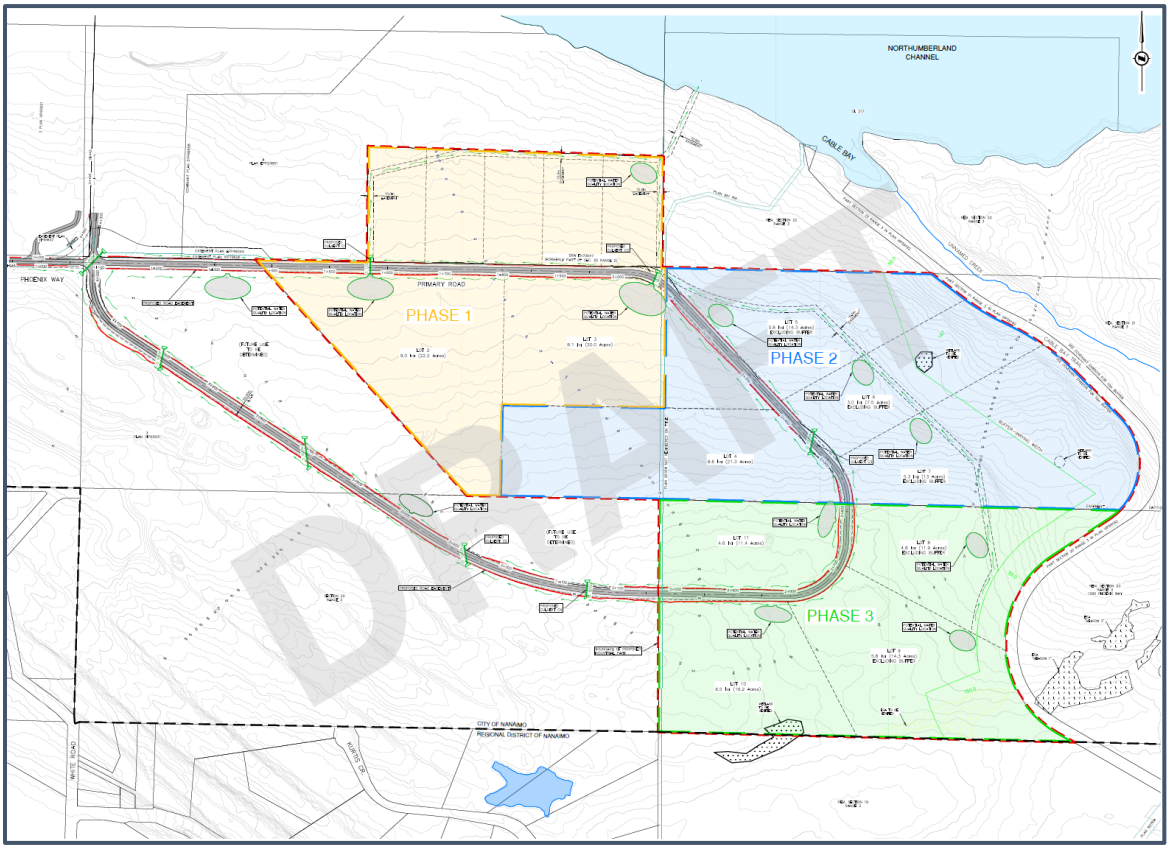


3.0 PROPOSED DEVELOPMENT

3.1 Proposed Land Use

The site (86 ha) will be split into 11 lots, with buildout currently to occur over three phases. According to the site plan, Phase 1 will be a 35% coverage of the total development area and Phase 2 will be a 70% and Phase 3 will be full buildout. The estimated gross floor area of the overall development is estimated to be in the order of 130,000 m^2 across all 11 lots. The proposed land uses for the site include heavy industrial, industrial park, manufacturing, warehousing, and sawmill. As the distribution of each land use across the site is currently unknown, it is assumed each land use of five land use types be evenly distributed with the same GFA area (GFA for each is a 20% of 130,000 m^2) for the analysis. See **Figure 3** for the site plan.

Figure 3 – Site Plan



3.2 Site Access

The site can be accessed from Phoenix Way via Maughan Road. A future road connection (site internal road) is proposed with a circulation layout through the site from Phoenix Way. The site would be also accessed from the existing Harmac mill site (Wave Pl) for emergency. See **Figure 3** for the proposed site plan and internal roadway network.

3.3 Trip Generation

There are five industrial land use types proposed on the site. For the three land use types, trip generation rates were estimated using the *ITE Trip Generation Manual, 11th Edition*. The proposed the heavy industrial and sawmill land uses do not have ITE rates provided. A local rate for the heavy industrial / sawmill uses was generated based on an estimate from the existing Harmac mill site. **Table 2** through **Table 6** show the ITE / local trip rates and estimated trips generated by proposed land uses. The estimated site trips are 462 trips for the AM peak hour and 569 trips for the PM peak.

Table 2 – Peak Hour Trip Generation Rates

ITE Land Use		Weekday AM			Weekday PM		
Code	Description	Rate	In	Out	Rate	In	Out
130	Industrial Park	0.34	81%	19%	0.34	22%	78%
140	Manufacturing	0.68	76%	24%	0.74	31%	69%
150	Warehousing	0.17	77%	23%	0.18	28%	72%
	Weighted Average (3 land uses)	0.40	78%	22%	0.42	27%	73%
Local*	Heavy Industrial / Sawmill	0.36	61%	39%	0.62	23%	77%

*Heavy Industrial / Sawmill rates were estimated from the existing trips based on a unit area (1,000 m^2) of the Harmac mill land size (650,000 m^2) while ITE rates based on 1,000 ft^2 of GFA.

Table 3 – Estimate of Existing Trips (Harmac Mill Site)

Existing Land Use	Peak Hour	Inbound	Outbound	Total
Pulp Mill Factory (Land size: 650,000 m^2)	AM	142	90	232
	PM	91	312	403

Table 4 - Trip Generation 1 (Industrial / Manufacturing / Warehousing)

Proposed Land Use	Peak Hour	Inbound	Outbound	Total
GFA: 60% of 130,000 m^2 = 78,000 m^2 (839,585 ft^2)	AM	262	74	336
	PM	95	258	353

Table 5 - Trip Generation 2 (Heavy Industrial / Sawmill)

Proposed Land Use	Peak Hour	Inbound	Outbound	Total
Land size: 40% of 86 Ha (344,000 m^2)*	AM	75	48	123
	PM	48	165	213

*The potential land size (40% of the proposed development area) was estimated at 344,000 m^2 which is a 53% of the existing Harmac pulp mill site.

Table 6 – Trip Generation (Site Total)

Proposed Land Use	Peak Hour	Inbound	Outbound	Total
Industrial 86 Ha	AM	339	123	462
	PM	145	424	569

Buildout of the site is anticipated to occur over three phases. **Table 7** summarizes the trip generation by phase.

Table 7 – Trip Generation (By Phase)

Proposed Land Use	Peak Hour	Inbound	Outbound	Total
Phase 1 (Lots 1-3) (27.1 ha, 67 acres)	AM	119	43	162
	PM	50	144	199
Phase 2 (Lots 1-7) (49.8 ha, 123.1 acres)	AM	235	85	320
	PM	100	294	394
Phase 3 (Lots 1-11) (71.5 ha, 176.9 acres)	AM	339	123	462
	PM	145	424	569

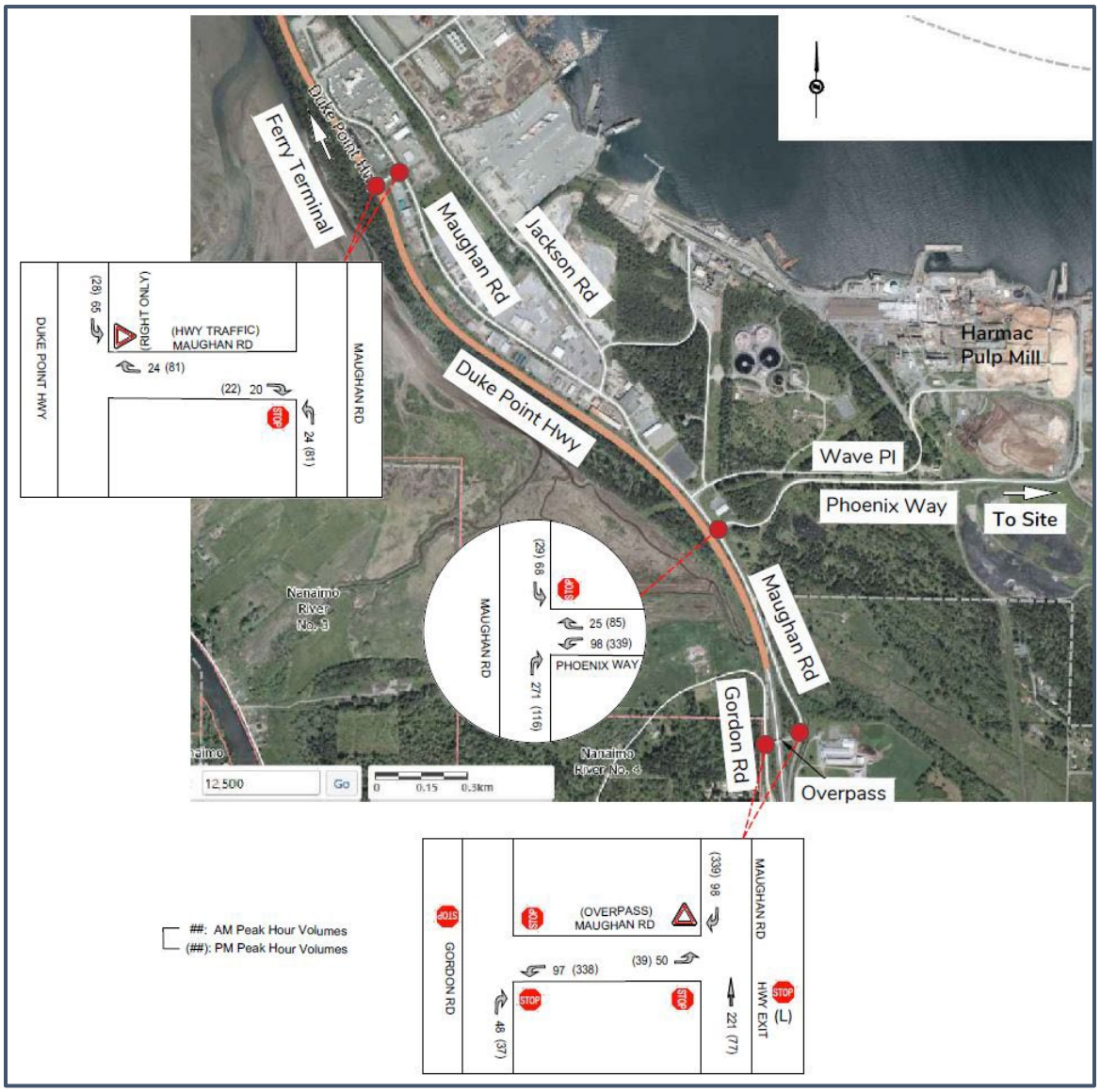
3.4 Trip Assignment

The trip assignment was based on the existing traffic patterns and key destinations / origins for traffic in the area. Based on the directional split percentages, the resultant trip assignments for full buildout for AM and PM peak hours are shown in **Figure 4**. The trip assignments for Phase 1 & 2 are 35% & 70% of full buildout (Phase 3).

AM / PM Peak Hour

- 80% of Trips-In/Out are from/to Maughan Road South
- 20% of Trips-In/Out are from/to Maughan Road North and Duke Point

Figure 4 – Trip Assignment (Full Buildout)



3.5 Opening Day (2033) Background Conditions

3.5.1 Corridor Growth

Opening day (full build-out) is projected to be in 2033. Background vehicle traffic will be forecasted using a 1.0% annual growth rate.

3.5.2 2033 Opening Day Background Conditions

Opening day background conditions were analyzed based on the estimated 2033 background volumes. At all five study intersections, all movements will operate well with acceptable delays (maximum PM peak delay: 21.2 s). The maximum v/c ratio for any individual lane is 0.79 for the westbound left movement at Maughan Road / Overpass with all-way stop. At Maughan Road / Phoenix Way, the maximum delay is 16.6 seconds for the westbound left movement during the PM peak hour. At the Maughan Road / Duke Point Highway intersection, the westbound right movement will operate with 10 seconds of delay during the peak hours. No queuing issues were found at all turn lanes of all study intersections.

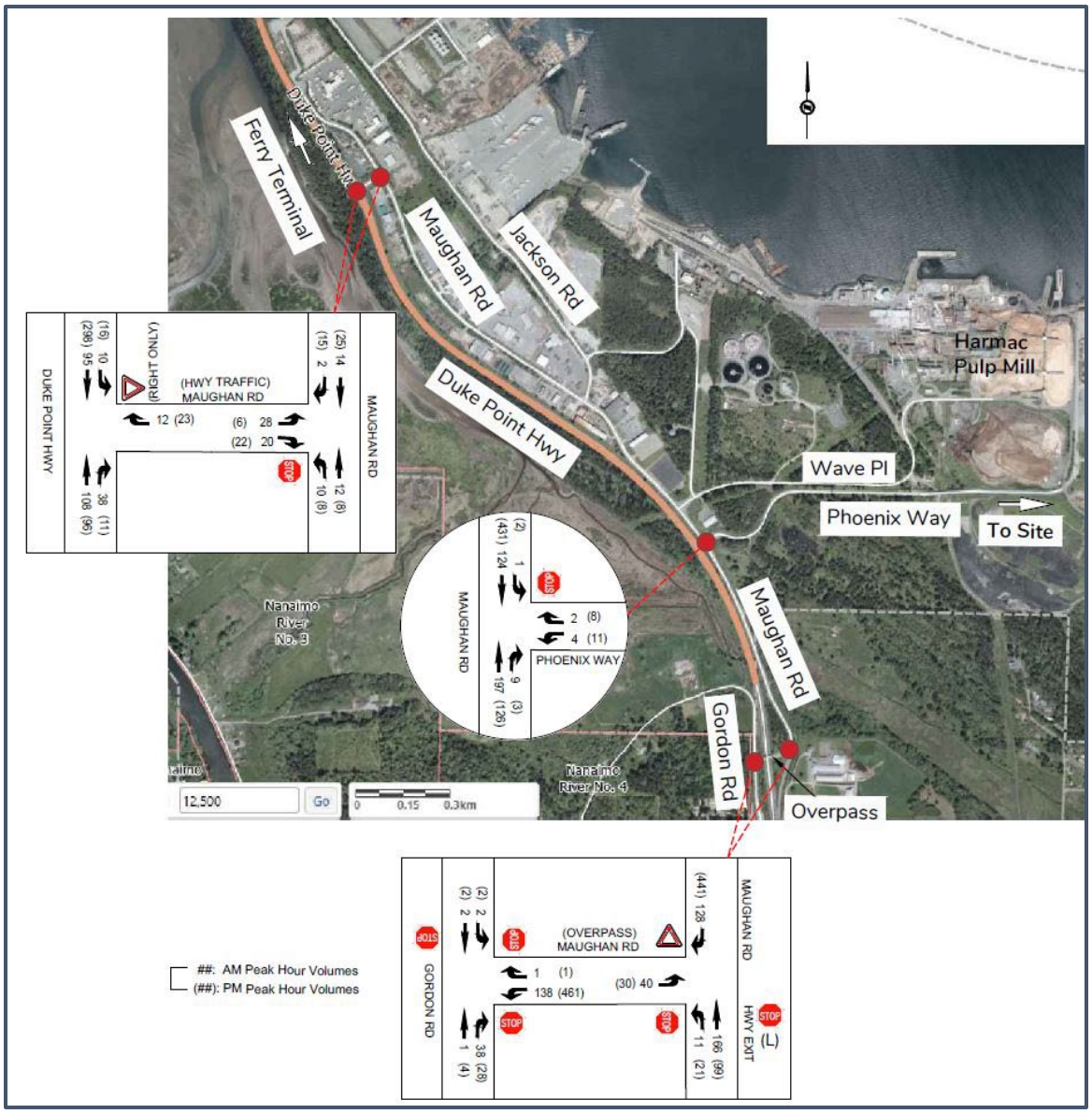
See **Table 8** for the 2033 background v/c ratios, delays and queues. See **Figure 5** for the 2033 background AM / PM peak hour traffic volumes.

Table 8 – 2033 Opening Day Background Conditions

INTERSECTION	MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
		v/c Ratio	Delay (s)	Queues (m)* 50th/95th	v/c Ratio	Delay (s)	Queue (m)* 50th/95th
MAUGHAN RD / PHOENIX WAY (WBL=Stop)	NBT	-	0	-	-	0	-
	NBR	-	0	-	-	0	-
	SBLT	0.01	7.7	-	0.01	8.6	-
	WBL	0.02	12.6	1.8/10.1	0.12	16.6	2.7/10.0
	WBR	0.01	9.6	-	0.02	9.6	-
MAUGHAN RD / DUKE POINT HWY NB OFF RAMP (NBL&EBL=Stop)	NBL	0.03	8.4	1.1/5.9 (35)	0.05	8.9	4.4/13.4(35)
	NBT	0.3	10.5	17.6/25.8	0.16	9.1	13.6/21.8
	SBR	0.2	9.2	-	0.72	15.9	
	EBL	0.09	8.7	8.3/15.3	0.08	9.6	7.9/18.3
MAUGHAN OVERPASS / GORDON RD (All-Way Stop)	NBTR	0.06	7	8.1/14.8	0.07	8.8	7.7/17.5
	SBLT	0.01	7.6	0.3/3.1	0.02	8.7	1.5/7.1
	WBLR	0.25	8.7	11.3/18.8	0.79	21.2	20.3/32.6
MAUGHAN RD / DUKE POINT HWY	NBT	-	0	0	-	0	0
	NBR	-	0	0	-	0	0
	SBL	0.03	8	0.6/4.0 (30)	0.02	7.7	0.3/2.7(30)
	SBT	-	0	0	-	0	0
	WBR	0.05	10.5	-	0.06	10	-
MAUGHAN RD / HWY ACCESS (EB = Stop)	NBLT	0.02	7.4	-	0.02	7.6	-
	SBTR	-	0	0	-	0	0
	EBL	0.05	7.3	6.8/16.0	0.04	7.7	1.6/9.1
	EBR	-	0	0	-	0	0

*Note: 50th (or average) and 95th Queues based on SimTraffic for stop-controlled intersections (averaged from five simulation runs); (##) = Existing Storage Length

Figure 5 – 2033 Background Volumes



3.6 Opening Day (2033) Post-Development Conditions

2033 opening day post development conditions were analyzed with 3 phases based on the background volumes plus the site trips added. For the future site trips, a truck percentage reflects existing truck percentages on adjacent roads, and modelling input data ranges from 6% to 25%.

3.6.1 Phase 1 Post Development Analysis Result

Based on the Synchro analysis results, Phase 1 of the development will not have significant impact on traffic operations at all five study intersections, including Maughan Road / Duke Point Highway and Maughan Road / Phoenix Way.

At Maughan Road / Phoenix Way, the westbound left movement will operate with an acceptable delay (28 seconds) during 2033 post development PM peak hour with Phase 1. At Maughan Road Overpass / Gordon Road, a major movement (westbound left) will operate with an acceptable delay of 32 seconds during the PM peak hour with Phase1. At all five study intersections, estimated all v/c ratios for individual lane remain at under 0.9 which is acceptable. At all five study intersections, the estimated 95th percentile queues were acceptable and the longest queue length was estimated at 46m for the westbound left movement at Maughan Road Overpass / Gordon Road.

Based on the analysis result, no capacity and safety issues were found at all study intersections with Phase 1 (35% of full buildout). Therefore, no mitigation measures are required at all five study intersections with Phase 1.

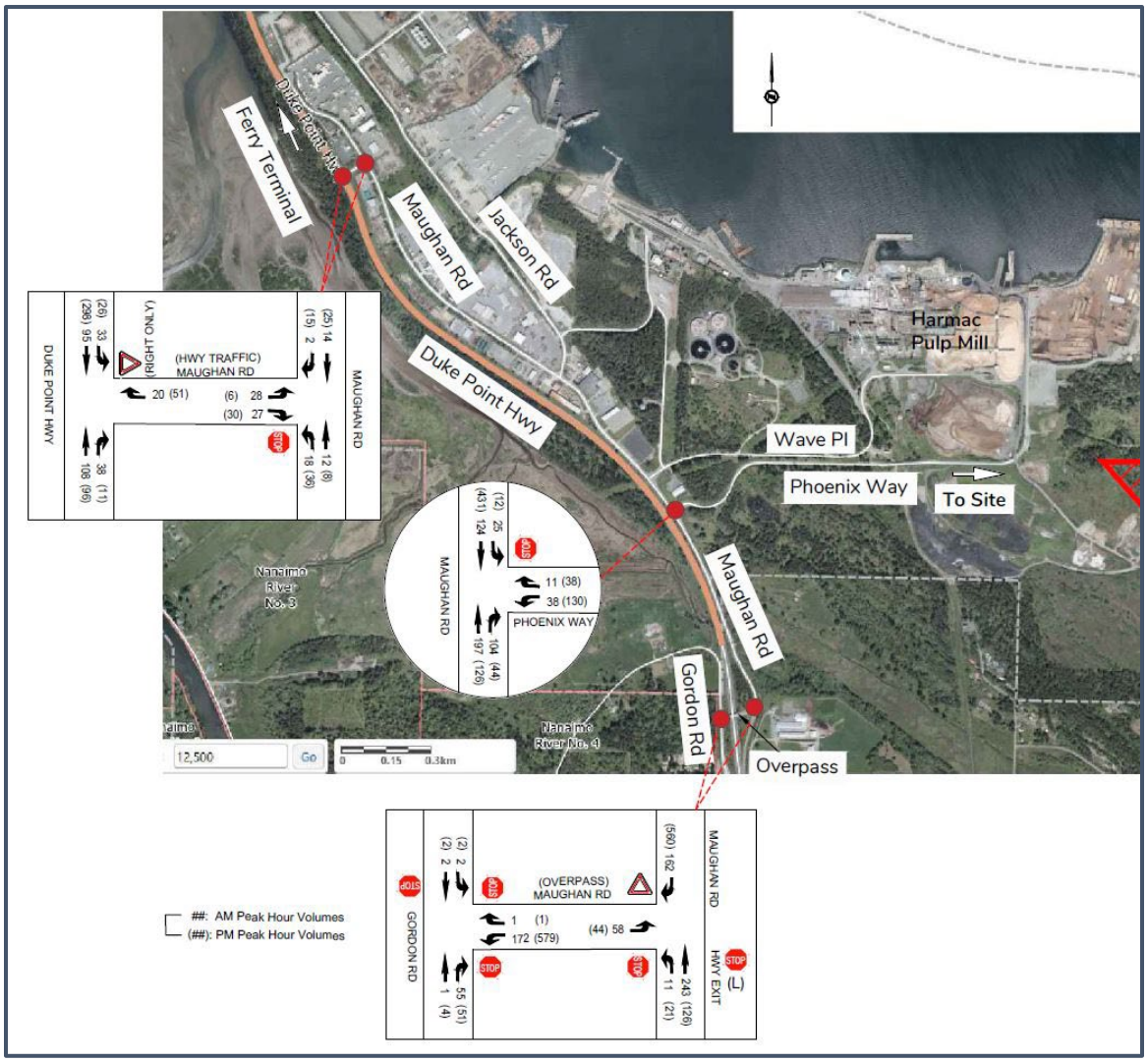
See **Table 9** for the 2033 post development (Phase 1) v/c ratios, delays and queues. See **Figure 6** for the 2033 Phase 1 post development AM / PM peak hour traffic volumes with Phase 1.

Table 9 – 2033 Post Development Conditions with Phase 1

INTERSECTION	MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
		v/c Ratio	Delay (s)	Queues (m)* 50th/95th	v/c Ratio	Delay (s)	Queue (m)* 50th/95th
MAUGHAN RD / PHOENIX WAY (WBL=Stop)	NBT	-	0	-	-	0	0.2/2.7
	NBR	-	0	-	-	0	-
	SBLT	0.04	8.1	1.2/6.8	0.02	7.7	0.6/5.3
	WBL	0.13	13.4	8.6/18.3	0.56	28.3	15.1/27.3
	WBR	0.03	10.0	-	0.08	9.5	0.3/6.8
MAUGHAN RD / DUKE POINT HWY NB OFF RAMP (NBL&EBL=Stop)	NBL	0.04	8.4	2.3/8.9(35)	0.05	9.1	3.6/12.1(35)
	NBT	0.40	11.3	18.0/27.9	0.21	9.8	14.2/23.7
	SBR	0.23	8.9	-	0.86	25.6	1.6/20.0
	EBL	0.12	9.1	8.5/14.7	0.11	10.2	8.0/17.3
MAUGHAN OVERPASS / GORDON RD (All-Way Stop)	NBTR	0.09	7.2	8.2/15.2	0.13	9.3	8.9/18.5
	SBLT	0.01	7.7	1.1/6.0	0.02	9.0	1.1/6.0
	WBLR	0.29	9.1	12.1/19.0	0.89	32.4	26.2/45.7
MAUGHAN RD / DUKE POINT HWY	NBT	-	0	0	-	0	0
	NBR	-	0	0	-	0	0
	SBL	0.06	8.0	1.3/7.2(30)	0.03	7.7	0.8/4.6(30)
	SBT	-	0	0	-	0	0
	WBR	0.06	10.5	-	0.10	10.1	-
MAUGHAN RD / HWY ACCESS (EB = Stop)	NBLT	0.03	7.4	0.1/1.3	0.04	7.6	0.1/1.9
	SBTR	-	0	0	-	0	0
	EBL	0.06	7.4	6.9/16.7	0.05	7.8	2.8/12.5
	EBR	-	0	0	-	0	0

*Note: 50th (or average) and 95th Queues based on SimTraffic for stop-controlled intersections (averaged from five simulation runs); (##) = Existing Storage Length

Figure 6 – 2033 Post Development Volumes with Phase 1



3.6.2 Phase 2 Post Development Analysis Result

Based on the Synchro analysis results, Phase 2 of the development will have significant impact on traffic operations at two study intersections at the south side of the study area, including Maughan Road / Phoenix Way. The intersection of Maughan Road / Duke Point Highway NB Off Ramp will continue to operate well for all movements. The development will not impact traffic operations at the other two study intersections on the north side of the study area, including the Maughan Road / Duke Point Highway intersection.

At Maughan Road / Phoenix Way, the westbound left movement will operate with a long delay (63 seconds) during 2033 post development (Phase 2) PM peak hour. At the intersection of Maughan Road Overpass / Gordon Road, the westbound left movement will operate with a long delay (56 seconds) during the PM peak hour with the development (Phase 2). At the two failing intersections, estimated maximum v/c ratios for individual lane exceeded 0.9, which is unacceptable. At Maughan Road Overpass / Gordon Road (all-way stop), the westbound left 95th percentile queue was estimated at 75m, but it will not be extended to the adjacent Maughan Road intersection (intersection spacing 100m).

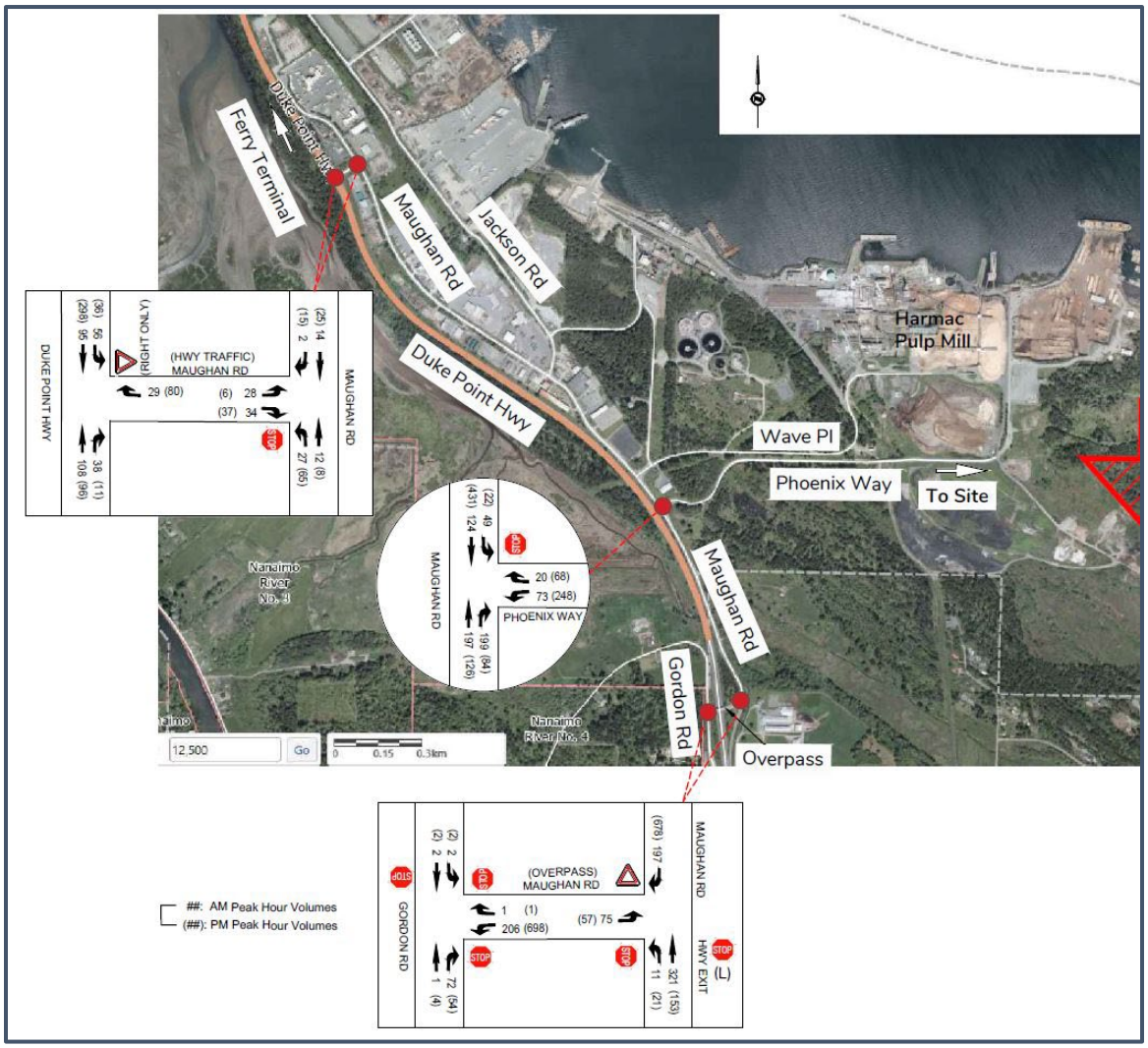
See **Table 10** for the 2033 post development (Phase 2) v/c ratios, delays and queues. See **Figure 7** for the 2033 Phase 2 post development AM / PM peak hour traffic volumes.

Table 10 – 2033 Post Development Conditions with Phase 2

INTERSECTION	MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
		v/c Ratio	Delay (s)	Queues (m)* 50th/95th	v/c Ratio	Delay (s)	Queue (m)* 50th/95th
MAUGHAN RD / PHOENIX WAY (WBL=Stop)	NBT	-	0	-	-	0	-
	NBR	-	0	-	-	0	-
	SBLT	0.07	8.2	3.2/12.8	0.02	7.8	1.3/7.9
	WBL	0.29	16.8	13.5/24.6	0.89	**62.5 (F)**	24.5/45.8
	WBR	0.05	10.0	-	0.10	9.6	2.3/19.3
MAUGHAN RD / DUKE POINT HWY NB OFF RAMP (NBL&EBL=Stop)	NBL	0.04	8.6	3.0/10.5(35)	0.05	9.2	4.4/13.6(35)
	NBT	0.55	14.5	21.7/34.3	0.26	10.3	16.2/25.5
	SBR	0.30	9.9	-	0.93	34.8	3.8/32.2
	EBL	0.16	9.8	9.5/15.5	0.13	10.6	10.3/21.3
MAUGHAN OVERPASS / GORDON RD (All-Way Stop)	NBTR	0.11	7.4	9.2/15.1	0.13	9.6	10.0/20.5
	SBLT	0.01	7.8	1.1/6.0	0.02	9.2	0.9/5.4
	WBLR	0.32	9.4	13.3/22.0	**1.0**	**55.9 (F)**	35.7/**74.9**
MAUGHAN RD / DUKE POINT HWY	NBT	-	0	0	-	0	0
	NBR	-	0	0	-	0	0
	SBL	0.09	8.2	1.7/7.4(30)	0.04	7.8	1.5/7.7(30)
	SBT	-	0	0	-	0	0
	WBR	0.09	10.6	-	0.15	10.5	-
MAUGHAN RD / HWY ACCESS (EB = Stop)	NBLT	0.04	7.4	0.1/1.2	0.07	7.7	0.8/6.1
	SBTR	-	0	0	-	0	0
	EBL	0.07	7.6	6.6/16.2	0.06	7.9	1.6/9.6
	EBR	-	0	0	-	0	0

*Note: 50th (or average) and 95th Queues based on SimTraffic for stop-controlled intersections (averaged from five simulation runs); (##) = Existing Storage Length

Figure 7 – 2033 Post Development Volumes with Phase 2



3.6.3 Considerations for Phase 2 Post Development Mitigation

At Maughan Road / Phoenix Way with the development traffic added, a traffic signal is not warranted (both TAC and BC MoTI's warrant requirements) based on the 2033 Phase 2 PM peak hour volumes and delays. A traffic signal is not required for the intersection treatment for Phase 2. Failing conditions would occur only for a short time period (Harmac shift change period: 5:00 - 5:30 PM) of a weekday. If the PM peak hour (dismissal time) for the new development (Phase 2) sets at a half hour earlier (4:00 – 5:00 PM) than the existing Harmac site, the southbound through volumes on Maughan Road significantly decrease (approximately by 40%) and failing conditions for the westbound left movement can be avoided. A dismissal time differentiation between the existing Harmac site and new development would be a key solution to an effective measure for the Maughan Road / Phoenix Way intersection conditions with Phase 2.

At Maughan Overpass / Gordon Road with all-way stop, the westbound movement would be failing with a long delay for the PM peak hour based on the Synchro result (HCM 2010). However, based on the SimTraffic analysis, an average delay for the westbound movement was measured at 18.4 seconds which is still acceptable. At the intersection, the southbound movement has extremely low volumes with two (2) vehicles for the PM peak hour. No capacity issues are anticipated (acceptable delays for all movements) at the two intersections on the south side of the study area with Phase 2. No mitigation measures would be required at these two intersections with Phase 2.

3.6.4 Phase 3 Post Development Analysis Result

The site trips were estimated based on a worst-case scenario due to undetermined land use types. It was identified that the development will little impact all five study intersections until Phase 2. However, based on the Synchro analysis results of Phase 3, the development will have significant impact on traffic operations at the three study intersections at the south end of the study area, including Maughan Road / Phoenix Way. The development will not noticeably impact traffic operations at the other two study intersections on the north side of the study area, including the Maughan Road / Duke Point Highway intersection.

At Maughan Road / Phoenix Way, the westbound left movement will operate with an unacceptably long delay (193 seconds) during 2033 post development (Phase 3) PM peak hour. At the two intersections of Maughan Road / Duke Point Highway NB Off Ramp and Maughan Road Overpass / Gordon Road, a major movement will operate with long delays (LOS F) during the PM peak hour with Phase 3. At the three failing intersections, estimated v/c ratios for all lanes with excessive delays exceed 1.0, which is unacceptable. At Maughan Road Overpass / Gordon Road (all-way stop), the westbound left 95th percentile queue was estimated at 109m which could be extended beyond the adjacent Maughan Road intersection (intersection spacing 100m).

The two study intersections on the north side of the study area continue to operate well with minor additional delays (maximum delay: 10.8 seconds). During the AM peak hour, all intersections will operate well with acceptable delays for all movements (LOS C or better).

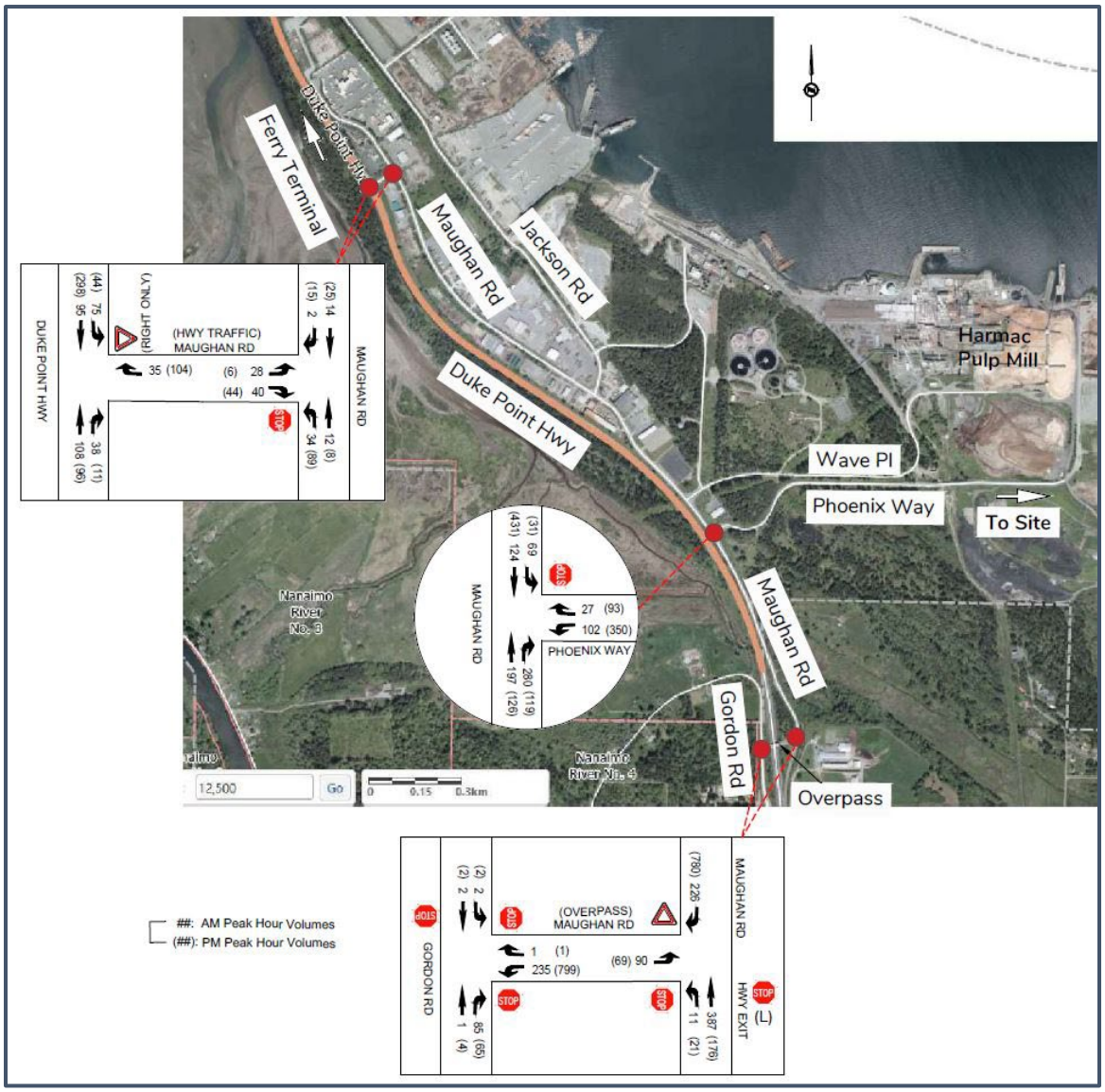
See **Table 11** for the 2033 post development (Phase 3) v/c ratios, delays and queues. See **Figure 8** for the 2033 Phase 3 post development AM / PM peak hour traffic volumes.

Table 11 – 2033 Phase 3 Post Development Conditions with No Mitigation

INTERSECTION	MOVEMENT	AM PEAK HOUR			PM PEAK HOUR		
		v/c Ratio	Delay (s)	Queues (m)* 50th/95th	v/c Ratio	Delay (s)	Queue (m)* 50th/95th
MAUGHAN RD / PHOENIX WAY (WBL=Stop)	NBT	-	0	-	-	0	-
	NBR	-	0	-	-	0	-
	SBLT	0.10	8.3	2.0/9.0	0.03	7.8	1.4/7.8
	WBL	0.46	22.7	15.0/23.5	**1.31**	**193 (F)**	35.6/**70.0**
	WBR	0.06	10.2	-	0.13	9.8	5.3/30.5
MAUGHAN RD / DUKE POINT HWY NB OFF RAMP (NBL&EBL=Stop)	NBL	0.04	8.7	1.8/7.9(35)	0.05	9.4	3.9/12.4(35)
	NBT	0.67	18.9	24.8/38.5	0.30	11	16.3/26.0
	SBR	0.35	10.8	-	**1.02**	**58.1 (F)**	8.0/54.6
	EBL	0.20	10.5	10.2/15.7	0.17	11.2	10.5/18.3
MAUGHAN OVERPASS / GORDON RD (All-Way Stop)	NBTR	0.14	7.7	9.7/17.1	0.15	10.1	10.4/18.1
	SBLT	0.01	8	2.2/8.6	0.02	9.6	1.2/6.4
	WBLR	0.41	10.4	15.0/25.1	**1.15**	**107 (F)**	51.5/**109**
MAUGHAN RD / DUKE POINT HWY	NBT	-	0	0	-	0	0
	NBR	-	0	0	-	0	0
	SBL	0.12	8.3	2.2/7.9(30)	0.05	7.8	1.6/6.9(30)
	SBT	-	0	0	-	0	0
	WBR	0.10	10.8	-	0.19	10.8	-
MAUGHAN RD / HWY ACCESS (EB = Stop)	NBLT	0.05	7.5	0.4/3.3	0.09	7.8	0.7/5.4
	SBTR	-	0	0	-	0	0
	EBL	0.08	7.8	6.7/14.8	0.06	8.1	2.5/12.1
	EBR	-	0	0	-	0	0

*Note: 50th (or average) and 95th Queues based on SimTraffic for stop-controlled intersections (averaged from five simulation runs); (##) = Existing Storage Length

Figure 8 – 2033 Post Development Volumes with Phase 3



3.7 Considerations for Post-Development Mitigation

At Maughan Road / Phoenix Way with the development traffic added, a traffic signal is not warranted by the TAC manual, but it is warranted by BC MoTI's warrant requirements based on the 2033 post development (Phase 3) PM peak hour volumes and delays. A traffic signal would be required to treat failing conditions at the intersection. However, failing conditions will occur only for a short time period (Harmac shift change period: 5:00 – 5:30 PM) of a weekday. Except for the concentrated rush hour, a signal would be not required at the intersection. During the Harmac dismissal (shift change) period, on Maughan Road southbound traffic volumes are 2.34 times greater than non-dismissal.

Installing a roundabout would be challenging at this intersection due to geographical limitations; realignment of Maughan Road at the Phoenix Way intersection would be required to provide a roundabout due to the proximity and elevation difference of Duke Point Highway to the west. Furthermore, a roundabout would need to be sized to accommodate large trucks, as it would be primarily serving industrial traffic. This further exacerbates the geometric challenges of installing a roundabout at this location.

At Maughan Road / Phoenix Way, a southbound left turn lane is not warranted based on the 2033 post development AM / PM peak hour volumes.

At the other two failing intersections on the south side of the study area, a change in traffic control change would also be challenging. The current all-way stop and combined stop / yield / free control are uniquely set up with flow efficiency for the local traffic patterns. Signalization would be not allowed for these two intersections which are closely located each other. Conversion to roundabouts would also be challenging due to the steep grades and right-of-way limitations in the immediate vicinity of the intersections.

It is recommended that the impact analysis of Phase 3 be undertaken based on local site volumes after Phase 2 is complete. A further study for Phase 3 would be required for more accurate analysis based on actual traffic volumes by Phase 2.

3.8 Trigger Points Analysis

With the current traffic control maintained, trigger points for improvements were identified with two scenarios: (1) under the existing PM peak hour (worst case scenario) and (2) using a half hour shifted PM peak hour to avoid the Harmac dismissal period. The trigger point analysis is based on acceptable levels of service (LOS C / D or better) for individual movements at the three subject intersections. At Maughan Road / Phoenix Way, a trigger point is a LOS D maintained with an acceptable v/c ratio for the westbound left movement (stop controlled). At the other two intersections with the Maughan Road overpass, a trigger point for each scenario satisfies a LOS C or better with acceptable v/c ratios for all movements.

Under the worst-case scenario (1), a trigger point was identified as 58% of full build-out (i.e. partial build-out of Phase 2). Under the shifted peak hour scenario (2), a trigger point was identified as 77% of full build-out (i.e. Phase 3). For the scenario (2), the analysis peak hour (4:00 – 5:00 PM) is 30 min shifted from the scenario (1) peak hour (4:30 – 5:00 PM). The development site should use a different employee shift time (5:00 PM) to avoid the existing Harmac trips and include TDM (Transportation Demand Management) measures such as employee shift variance, car share and shuttle service. A 77% trigger point coincides 100,000 m^2 of GFA which is 77% of the currently proposed 130,000 m^2 of GFA total.

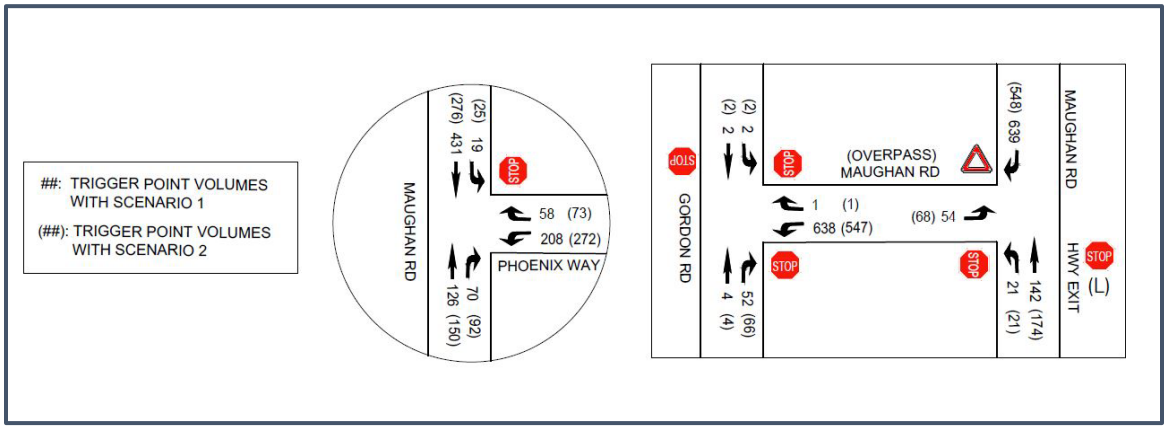
See **Table 12** for the 2033 trigger point PM peak hour v/c ratios, delays and queues. See **Figure 9** for the 2033 trigger point PM traffic volumes at three study intersections.

Table 12 – Trigger Point Analysis Results (PM Peak Hour)

INTERSECTION	MOVEMENT	SCENARIO 1 (4:30-5:30 PM)			SCENARIO 2 (4:00-5:00 PM)		
		v/c Ratio	Delay (s)	Queues (m)* 50th/95th	v/c Ratio	Delay (s)	Queue (m)* 50th/95th
MAUGHAN RD / PHOENIX WAY (WBL=Stop)	NBT	-	0	-	-	0	0.1/1.8
	NBR	-	0	-	-	0	-
	SBLT	0.02	7.7	0.7/5.9	0.03	7.8	1.4/7.3
	WBL	0.69	34.6 (D)	20.0/36.8	0.75	34.2 (D)	22.2/39.3
	WBR	0.08	9.5	1.0/12.3	0.11	9.8	0.7/10.0
MAUGHAN RD / DUKE POINT HWY NB OFF RAMP (NBL&EBL=Stop)	NBL	0.05	9	4.6/13.3(35)	0.05	9.1	4.5/13.5(35)
	NBT	0.23	9.8	15.2/23.8	0.29	10.5	16.0/24.8
	SBR	0.75	17.5 (C)	1.5/19.3	0.72	16.6 (C)	0.5/11.2
	EBL	0.11	10	10.6/19.8	0.15	10.4	11.3/20.6
MAUGHAN OVERPASS / GORDON RD (All-Way Stop)	NBTR	0.10	9	10.7/19.1	0.14	9.2	11.4/20.4
	SBLT	0.02	8.8	1.1/5.8	0.02	8.8	1.0/5.8
	WBLR	0.84	25 (C)	27.7/50.0	0.80	22.8 (C)	23.1/35.3

*Note: 50th (or average) and 95th Queues based on SimTraffic for stop-controlled intersections (averaged from five simulation runs); (##) = Existing Storage Length

Figure 9 – 2033 Trigger Point PM Peak Hour Volumes



4.0 TRANSPORTATION DEMAND MANAGEMENT

Transportation Demand Management (TDM) is the application of strategies and policies to influence the travel choice of an individual, most commonly to reduce single-occupant vehicle travel. TDM measures typically aim to encourage sustainable travel, enhance travel options, and decrease parking demand.

In order to reduce the vehicular demand of the proposed development, the following TDM measures are being considered:

- Staggered shift starts to distribute the volume of traffic across a longer period of time, and reduce impact on the local road network
- An employee carpool program will be operated on the site to encourage a reduction in single occupancy vehicle trips
- An employee shuttle program will be explored that provides service to key transit-accessible locations in Nanaimo, such as the Downtown Nanaimo Exchange, the South Parkway Plaza exchange, or a planned stop along the future BC Transit Route 77. Transit access is discussed further in **Section 5.2**.

5.0 ACTIVE TRANSPORTATION

5.1 Pedestrian and Cycling Facilities

The study area is an isolated, rural, industrial area. There are no existing dedicated pedestrian facilities on any of the streets in the study area. No pedestrians were observed at any of the study area intersections during the data collection process.

Bike-accessible paved shoulders are generally available on all roads in the study area, however these facilities are not suitable for all ages and abilities, and are not designated cycling routes by the City of Nanaimo. Within the study area, the Duke Point Highway is a designated bike route. Only a few cyclists were observed on Maughan Road near Phoenix Way during the data collection process.

5.2 Transit

The nearest bus stop to the site is approximately 3 km away, at MacMillan Road / Duke Point (near Harmac Road). This is not a feasible distance for employees or visitors to the site to access transit service.

The Route 77 Duke Point Ferry Connector is highlighted as recommended improvement in the 2022 RDN Transit Redevelopment Strategy. In addition to providing service between the South Parkway Plaza and Duke Point Ferry Terminal by way of the Duke Point Highway, this route would also service industrial sites in the Maughan Road area, such as the proposed development. With forecasted service to operate every 2.5 hours (in alignment with Duke Point ferry service), it is unknown how much impact this route may have on the travel characteristics of the proposed development, and where the proposed stop locations would be.

6.0 INTERNAL ROAD NETWORK

According to the current site plan, a 20m wide easement is proposed for the site internal road. At the northwest corner of the development site, a new four-way intersection is proposed with a 90-degree alignment with Phoenix Way as a site entrance. The proposed road network circulates through the site and connects to Phoenix Way. The internal road will be built as a private road on the NFP (Nanaimo Forest Products) property and would be designed based on the current Phoenix Way specifications (i.e. 9.0m of pavement, 1.0m gravel shoulder). The site includes heavy industrial / sawmill factory and would be used by the largest truck type occurring with some frequency in the turning traffic stream. Therefore, WB-20 tractor semitrailers (WB-20) is considered as a design vehicle for the proposed internal road.

Due to the rural characteristics of the area, and the limited provisions of active transportation facilities in the surrounding area that would support sustainable travel for employees to the site, the current internal road design does not incorporate dedicated active transportation facilities. Pedestrians and cyclists may use gravel shoulders along the internal road.

7.0 CONCLUSIONS

The proposed land uses for the site includes heavy industrial, industrial park, manufacturing, warehousing, and sawmill in the area (86 hectares). The estimated gross floor area of the overall development is 130,000 m^2 across the site. It is assumed for the study that each land use across the site is evenly distributed with the same size. The development will be processed into 3 phases and each phase approximately covers one third of the total area.

The site trips were estimated as a worst-case scenario based on the ITE Trip Generation Manual and local trip rates. The estimated site trips are 462 trips for the AM peak hour and 569 trips for the PM peak hour with full buildout. The development traffic impact was analyzed by phase. Based on the analysis result of Phase 1, no capacity issues were found at all five study intersections with Phase 1. With Phase 2, significant long delays would happen at the two intersections for the PM peak hour only: the westbound left movement (delay 62.5 seconds) at Maughan Road / Phoenix Way and westbound movement (delay 55.9 seconds) at Maughan Overpass / Gordon Road. However, the failing conditions at these two intersections can be avoidable if a dismissal time is differently adjusted between the existing Harmac site and new development. All movements at all study intersections will operate with all acceptable delays if a staggered shift policy is supported to prevent a concentration of the commute traffic. No additional mitigation measures would be required with Phase 2.

The site trip generation of full buildout (Phase 3) is based on a worst-case scenario. Due to the significant amount of the site trips, the development (Phase 3) will impact traffic operations at three adjacent intersections within the study area, including Maughan Road / Phoenix Way. The failing conditions will be experienced for the PM peak hour. At the three key intersections, unacceptable delays will occur during the 2033 post development PM peak hour with the development. However, mitigation measures for the improvement would be challenging to be implemented at the two key intersections (Maughan Road / Duke Point Highway NB off Ramp and Maughan Road / Gordon Road).

Under the current traffic control maintained, trigger points for improvements were analyzed with two scenarios: (1) under the existing PM peak hour (worst case scenario) and (2) using a half hour shifted PM peak hour to avoid the Harmac dismissal period. A trigger point is 58% of the full build-out for the Scenario (1) (i.e. partial build-out of Phase 2) and 77% for the Scenario (2) (i.e. Phase 3). For the Scenario (2), TDM measures would be necessary including staggering shifts, car share, and shuttle service to reduce the development impact. Assuming Scenario (2), it is identified a reduced GFA size of the development (up to 100,000 m^2) will not require mitigation measures at all study intersections.

The proposed internal road will be built as a private road and designed similarly to existing Phoenix Way. A typical road cross section for the proposed internal road would be a 9.0m paved surface and a 1.0m gravel shoulder for both sides. No sidewalk or multi-use pathways are provided along the internal road due to the rural nature of the area.

No mitigation would be required at all study intersections except a small TDM strategy until Phase 2. After Phase 2 is complete, the actual site trips should be measured to determine the Phase 3 development size which identifies actual trigger points for mitigation. A further study would be required at a point of the Phase 2 completion.

8.0 RECOMMENDATIONS

The current traffic control and laning would remain at all study intersections. The following is recommended with the development:

For Phase 1 & 2:

- No impact identified with Phase 1; No mitigation required for Phase 1.
- A mild TDM program required for Phase 2 including a staggered shift policy to disperse the commute traffic. No additional mitigation measures required.
- Internal road be designed as per a typical cross section (9m wide pavement) of existing Phoenix Way.
- Design vehicle WB-20 for the proposed internal road.

For Phase 3:

- Consider a development size to be reduced with a 58% trigger point (75,400 m^2) of 130,000 m^2 (estimated GFA of the site) if TDM is not included.
- A trigger point be extended up to 77% (GFA 100,000 m^2) of 130,000 m^2 if TDM measures are appropriately supported.
- TDM measures to be explored include staggered shift starts, an employee carpool program, and an employee shuttle program.

After Phase 2 is complete, a further study would be required for the Phase 3 impact assessment.

APPENDIX A – SYNCHRO BACKGROUND

SYNCHRO MODELLING SOFTWARE DESCRIPTION

The traffic analysis was completed using Synchro and SimTraffic traffic modelling software. Results were measured in delay, level of service (LOS), 95th percentile queue length and volume to capacity ratio. Synchro is based on the Highway Capacity Manual (HCM) methodology. SimTraffic integrates established driver behaviours and characteristics to simulate actual conditions by randomly "seeding" or positioning vehicles travelling throughout the network. The simulation is run ten times (ten different random seedings of vehicle types, behaviours and arrivals) to obtain statistical significance of the results.

Levels of Service

Traffic operations are typically described in terms of levels of service, which rates the amount of delay per vehicle for each movement and the entire intersection. Levels of service range from LOS A (representing best operations) to LOS E/F (LOS E being poor operations and LOS F being unpredictable/disruptive operations). LOS E/F are generally unacceptable levels of service under normal everyday conditions. A LOS C or better is considered acceptable operations, while D is considered to be on the threshold between acceptable and unacceptable operations. Highway operations will typically need to operate at LOS C or better for through movements and LOS E or better for other traffic movements with lower order roads.

The hierarchy of criteria for grading an intersection or movement not only includes delay times, but also takes into account traffic control type (stop signs or traffic signal). For example, if a vehicle is delayed for 19 seconds at an unsignalized intersection, it is considered to have an average operation, and would therefore be graded as an LOS C. However, at a signalized intersection, a 19 second delay would be considered a good operation and therefore it would be given an LOS B. The table below indicates the range of delay for LOS for signalized and unsignalized intersections.

Table A1: LOS Criteria, by Intersection Traffic Control

Level of Service (LOS)	Unsignalized Intersection Average Vehicle Delay (sec/veh)	Signalized Intersection Average Vehicle Delay (sec/veh)
A	0 – 10	0 – 10
B	> 10 – 15	> 10 – 20
C	> 15 – 25	> 20 – 35
D	> 25 – 35	> 35 – 55
E	> 35 – 50	> 55 – 80
F	> 50	> 80