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## Traffic Impact Assessment Benchlands Nkwûkwma Development

 Skénkenam Development group, Pemberton, BC DRAFT REPORTHowes Technical Advantage Ltd.

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## 1. Introduction

Bethel Land Corporation (Bethel) together with the Lil'wat Nation (Skénkenam Development Group) are planning to develop 267 residential units on the 31.23-hectare parcel in the Benchlands neighbourhood, north of the Village of Pemberton in BC. The land is part of a larger 62-hectare parcel and is referred to as the "Benchlands Nkwûkwma" development. As part of the rezoning approval process, the Village of Pemberton (the Village) requires a traffic impact assessment (TIA) for the project.

Howes Technical Advantage Ltd. (HTA) has been commissioned by Skénkenam Development group undertake the TIA. This study is based on information provided by Skénkenam and the Village as of end of January 2021.

### 1.1. Context

The Village adopted an Official Community Plan in 2014. The Benchlands Neighbourhood Concept Plan (NCP) was adopted as part of the OCP at that time. A traffic study was undertaken by InterCAD in 2005 and formed part of the Neighbourhood Plan (the InterCAD Report). The OCP Transportation Map is shown in Appendix A.

The terms of reference for the TIA have been developed based on the BC Ministry of Transportation and Infrastructure (BC MoTI) standard Terms of Reference. The Village has provided input to and approval of the scope and approach. The main arterial road system through the Village is owned and managed by BC MoTI. BC MoTI has been advised of the planned development and the Village will be liaising directly with BC MoTI for commentary.

The Village provided a copy of a report called Pemberton Crabapple and Downtown Traffic Impact Study, undertaken by ISL Engineering and Land Services, June 2018 (ISL Report). This report reviewed all current and future development proposed until the year 2027.

For this TIA, the proposed development is planned to be built out by 2025. The project location in relation to the Village is shown in Figure 1.

### 1.2. Project Description, Study Area

The proposed development consists of 267 units. The development is planned in two stages - Phase 1 and Phase 2. This is the main focus of this analysis and assessment. The site plan with the phases is illustrated in Figure 2.

There is a future phase of the development, Phase 3 with 187 units, with a possible build out timeline of 25 to 30 years in the future. Phase 3 is not included as part of this assessment at this stage.

For this assessment, it has been assumed that Phase 1 and 2 will be built by 2025. This is a more conservative approach for the analysis as it is likely that the units will be built over a longer period of 10 to 15 years.

The breakdown of the units is as follows:

- Single family: 71 units (smaller single-family homes)
- Multi-family:

132 units (townhouses and apartments)

- Single family + suite:

64 units (medium and large single-family homes)
The study area is shown in Figure 3. There are five study area intersections indicated which include:

- Highway 99/Portage Rd.
- Portage Rd./Birch St. (roundabout)
- Birch St./Prospect St.
- Dogwood St./Aster St.
- Eagle Dr./Pemberton Meadows Rd.


Figure 1: Benchlands Nkwûkwma Development Location

| Lecend |  | NUARY 20 |
| :---: | :---: | :---: |
|  | Site Boundary 31.23 ha / 77.17 ac |  |
|  | Legal Property Lines |  |
|  | 5 m Contour |  |
|  | ALR Boundary |  |
| $\cdots$ | Surveyed + Realigned Streams |  |
|  | Phase Boundary |  |
| \# | Phase Name |  |
|  | Phase 1 |  |
|  | Phase 2 |  |
| PRoposed Land use - draft v2. 0 |  |  |
| 28\% | Single Family Development Areas 8.63 hal 12.33 ac |  |
| 6\% | Strata Townhome Development Areas 2.03 hal 5.02 ac |  |
| 1\% | Apartment Development Areas 0.22 ha 10.54 ac |  |
| 1\% | Civic Infrastructure 0.37 ha 0.91 ac |  |
| 3\% | Neighbourhood Park 1.06 ha \| 2.62 ac |  |
| 34\% | Nature Park 10.75 ha / 26.56 ac |  |
| 10\% | Natural Area |  |
| 11\% | Public Road ROW 3.34 ha / 8.25 ac |  |
| 6\% | Development Reserve 1.84 ha / 4.55 ac |  |
| 100\% | 31.23 hal 77.7 rac |  |
| draft Yield |  |  |
|  | Large Single Family 118 m | 24 9\% |
|  | Medium Single Family 175 m | 40 15\% |
| \|11|| | Small Single Family 112 m | $47 \mathrm{l} \%$ |
| - | Duplex Single Family 111 m | 24 9\% |
| - | Townhome 16 m | $9234 \%$ |
|  | Apartment | 40 15\% |

FIGURE 2

## 1



### 1.3. Assumptions

The following assumptions have been made for this report:

- Development: The layout details and future land use were supplied by Ekistics.
- Milestone dates:
- The proposed Opening Day is 2025.
- The future projected traffic has been assumed as Opening Day +5 years in 2030.
- Background Traffic: Background traffic assumptions are based on counts undertaken and reference to the ISL Report.
- Other growth related to future development in the study area was used as represented in the ISL Report. The Village had provided ISL with the future and potential developments to the horizon year 2027. It is assumed the extent of this new development would also apply for the year 2030. In other words, no additional growth is assumed for 2030 beyond that contained in the ISL report
- It is assumed that there will be little other growth besides these developments in the next 10 years. As such no other background growth will be added to the local Village network.
- A $2 \%$ annual growth rate was applied to the existing through traffic on Highway 99. This will account for developments east of the Village and general growth in traffic on Highway 99.
- Road network:
- It is assumed that the majority of site traffic will use Eagle Drive (collector road) as it provides the most direct route to and from the development site.
- It is anticipated that some site traffic may use Dogwood St (collector road).
- A future road connection to the north of the site is not contemplated as part of this development.


### 1.4. Existing Transportation Network

## Road System:

The existing road network and traffic control is shown in Figure 3.
There are two existing road accesses to the proposed development. These are Eagle Drive and Dogwood Street. The main access for the development will be Eagle Drive which is a two-lane collector road. As noted previously, this is a more direct route and this route will carry the majority of the traffic which is destined for Highway 99. It is also anticipated that some development traffic will use Dogwood Street.

Therefore, the main roads servicing this project will be the route using Pemberton Meadows Rd, Birch Street and Portage Road connecting to Highway 99. All three of these
roads are collector standard with one lane in each direction. There are some turn lanes at intersections.

A future connection is proposed connecting to Pemberton Meadows Road north of Eagle Drive. This land is not owned by the developer and it is understood that development of these lands together with this access point is unlikely in the short to medium term.

A future connection between Eagle Drive and Walnut Street is shown in the OCP. However, the Village has advised that this link is unlikely to proceed.

The InterCAD report, in 2005, noted that access to the Village Centre relies on Portage Road as the only access from Highway 99. The report recommended the need to establish a secondary route as good transportation planning for the Village. There is ongoing development in and around the Village Centre. Two development areas west and south of the Centre, Harmony Reach and Tiyata, have been rezoned and eliminate the possibility of an additional link to Highway 99 on the east side of Pemberton Creek. Consequently, for the purposes of this traffic study, additional future accesses have not been assumed at this time.

## Pedestrian and Cycling:

There are numerous existing mountain bike trail and hiking trails in this area. The proposed development will include linkages to existing trails and provided improved networks to the Village. However, it is anticipated that walking and cycling modes will not provide significant reductions in vehicle trips in the peak hours given the location and topography of the site.

Transit: There are no existing or planned transit routes in the vicinity.

## 2. Existing Scenario

Traffic counts were undertaken in September 2019, prior to the current COVID-19 pandemic. The five study area intersection locations were counted. These data are summarized in Figure 4. The traffic count data are attached in Appendix B.

The AM peak hour is from 7:45 to 8:45 AM and the PM peak hour is from 4:30 to 5:30 PM. Based on a review of the September 2019 traffic count volumes at the key intersections, the AM peak hour traffic volumes are $75 \%$ of the PM peak hour volumes. The highest volumes are at the intersection of Highway 99 and Portage Road.

A comparison with the 2005 traffic data in the InterCAD report shows both increases and decreases in traffic in the Village area. Traffic volumes on Highway 99 have increased considerably in the last 14 years. The 2018 ISL Report was also reviewed and the recent 2019 traffic count data compared well.

The PM peak hour has the highest traffic volume and is the worst-case scenario. Therefore, the PM peak hour was the only scenario used for the future analysis in this traffic study.

## 3. Background Traffic

The proposed future development in the study area was used as represented in the ISL Report. The Village had provided ISL with the future and potential developments to the horizon year 2027. It is assumed that this would apply for this assessment to the milestone year of 2030. The total development includes 515 dwelling units (DU) and 16,000 $\mathrm{ft}^{2}$ of commercial. This includes 24 future single-family units in the Benchlands Phase 1 development.

The development location and associated trip generation is shown in Figure 5 (Reference ISL Report, Figure 3.1). The total generated traffic from these developments as applied to the key intersections is shown in Figure 6 (Reference ISL Report, Figure 3.2).

The total two-way trips from these developments are 249 trips in the AM peak hour and 360 trips in the PM peak hour.

It is assumed that there will be little other growth besides these developments in the next 10 years and therefore no other background growth was added to the local Village network. The only other future growth is the Nkwûkwma development which is captured in the Site Trips.

The Background growth for 2030 was calculated by using the existing traffic counts as a base and adding the future development. A $2 \%$ annual growth rate was applied to the existing through traffic on Highway 99 to account for developments east of the Village and general growth on Highway 99. The 2030 Background traffic plus the other development is shown in Figure 5.



FIGURE 5



## 4. Project Traffic

### 4.1. Trip Generation

This section describes the method used to establish the trip generation rates to be used for estimating the traffic that would to be generated by the development. The types of units are single family units, multi-family units and single-family dwellings with suites.

In the InterCAD study, 2005, the PM peak hour was used for the analyses and trip rates were based on the ITE trip rate manual of the day ${ }^{1}$. This is summarized as follows:

- For single family units a rate of 1.02 vehicle trips/unit was used with a directional split of $63 \%$ inbound and $37 \%$ outbound.
- For multi-family and the suites in single family units, a blended rate was developed based on the premise that a location such as this would have higher trip rates compared to the typical suburban locations for the ITE data. This blended rate of 0.78 veh. trips/unit was the average of the single family rate (1.02) and the multifamily rate (0.56). The same directional split was assumed as per the single family split.

Trip generation rates were reviewed and the latest version (10th Edition) of the Institute of Transportation Engineers (ITE) Trip Generation Manual was referenced. This is shown in Table 1.

No reductions have been made for alternative mode use although there may be some residents who will cycle or walk to and from destinations outside the development site. Therefore, the estimate of peak hour motor vehicle trips is likely higher than actual trips and represents a conservative estimate to ensure that any impacts associated with the additional traffic are not underestimated.

Table 1: ITE Trip Rates

|  |  |  |  |  | AM PEAK HOUR |  |  | PM PEAK HOUR |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DESCRIPTION | ITE REF \# | ITE Description |  |  | RATE IN | RATE OUT | TOTAL RATE | RATE IN | RATE OUT | TOTAL RATE |
| Single family | 10th 210 | Gen Urban Suburban | Detached |  | 0.19 | 0.56 | 0.74 | 0.62 | 0.37 | 0.99 |
|  |  |  |  | Directional dist. | 25\% | 75\% |  | 63\% | 37\% |  |
| Multifamily Housing (Low Rise) | 10th 220 | Gen Urban Suburban | 1-2 levels |  | 0.11 | 0.35 | 0.46 | 0.35 | 0.21 | 0.56 |
|  |  |  |  | Directional dist. | 23\% | 77\% |  | 63\% | 37\% |  |
| Multifamily Housing (Mid Rise) | 10th 221 | Gen Urban Suburban | 3-10 levels |  | 0.09 | 0.27 | 0.36 | 0.27 | 0.17 | 0.44 |
|  |  |  |  | Directional dist. | 26\% | 74\% |  | 61\% | 39\% |  |
| Multifamily Housing (High Rise) | 10th 222 | Gen Urban Suburban | 10 plus levels |  | 0.07 | 0.24 | 0.31 | 0.22 | 0.14 | 0.36 |
|  |  |  |  | Directional dist. | 24\% | 76\% |  | 61\% | 39\% |  |

For this development, there are two land use types that can apply - single family (ITE ref \# 210) and multifamily low rise (ITE ref \# 220), 1-2 levels. The ITE Trip Generation Manual establishes two areas for residential trip rates - general urban/suburban and dense multiuse urban. Both of these areas are typical of a large metropolitan area with dense innercity development and lower density suburbs as opposed to more rural development. Accordingly, because of the project location, the ITE rates have been increased by

[^0]approximately 5 to $10 \%$ to reflect the more rural nature of the development (limited potential for non-vehicle trips). Suites in single family homes are assumed to have trip characteristics similar to multi-family units as the occupants are more likely to be renters.

The rates were adjusted as follows:

- Single Family ITE 210 rate increased by 5\%
- Multi-family ITE 220 rate increased by $10 \%$
- Single Family with Suite - sum of the adjusted Single Family Rate and Multi-family rate

Table 2 summarizes the trip generation rates used for the analysis.
Table 2: Adjusted Trip Generation Rates

|  |  |  | AM PEAK HOUR |  |  | PM PEAK HOUR |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DESCRIPTION | ITE REF \# |  | RATE IN | RATE OUT | TOTAL RATE R | RATE IN | RATE OUT | TOTAL RATE |
|  |  |  |  |  |  |  |  |  |
| Single family | Adj |  | 0.19 | 0.58 | 0.78 | 0.65 | 0.38 | 1.04 |
|  |  | Directional dist. | 25\% | 75\% | $\square$ | 63\% | 37\% |  |
| Multifamily Housing (Low Rise) | Adj |  | 0.12 | 0.39 | 0.51 | 0.39 | 0.23 | 0.62 |
|  |  | Directional dist. | 23\% | 77\% |  | 63\% | 37\% |  |
| Single family with Suite | Adj |  | 0.32 | 0.96 | 1.28 | 1.04 | 0.61 | 1.66 |
|  |  | Directional dist. | 25\% | 75\% |  | 63\% | 37\% |  |

### 4.2. $\quad$ Site Traffic

Based on these rates, the resultant project traffic is estimated using the adjusted trip rates and the build out unit numbers. Table 3 below shows the calculation of the Site traffic per land use.

Table 3: Total project Traffic - AM and PM peak hours

|  |  | AM PEAK HOUR |  |  | PM PEAK HOUR |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DESCRIPTION | UNITS | TRIPS IN | TRIPS OUT | TRIPS | TRIPS IN | TRIPS OUT | TRIPS |
| , |  |  |  |  |  |  |  |
| Single family | 71 | 14 | 41 | 55 | 46 | 27 | 74 |
|  |  |  |  |  |  |  |  |
| Multifamily Housing (Low Rise) | 132 | 15 | 51 | 67 | 51 | 30 | 81 |
|  |  |  |  |  |  |  |  |
| Single family with Suite | 64 | 21 | 62 | 82 | 67 | 39 | 106 |
|  |  |  |  |  |  |  |  |
|  | 267 | 50 | 154 | 204 | 164 | 97 | 261 |

No trip reductions in the peak hour were considered. The main reasons are that the location and topography of the development are not likely to result in significant use of alternative modes of transportation such as cycling and walking, and future transit service close to the development is not planned.
The total two-way Opening Day project traffic in the AM peak hour is 204 trips and in the PM peak hour is 261 trips.

### 4.3. Site Traffic Distribution

The trip distribution as noted in the ISL Report was reviewed and is shown in Table 4 below.

Table 4: ISL Report - Site Trip Distribution

| TO and FROM | ISL Report |  |
| :--- | :---: | :---: |
|  | AM | PM |
| Village | $25 \%$ | $25 \%$ |
| Northwest - Pemberton Meadows Rd | $15 \%$ | $15 \%$ |
| Southwest - Highway 99 | $25 \%$ | $25 \%$ |
| East - Highway 99 | $35 \%$ | $35 \%$ |

The InterCAD report distributed traffic at the intersection of Highway 99 and Portage Road in proportion to the traffic count.

The 2019 traffic count at Highway 99/Portage was reviewed for the splits east and west. These splits reflect existing traffic movements, but it is anticipated that employment and trips attractions will be located both in the East and the Southwest. This appears to be a consistent trend from the work undertaken in 2005 as well. The 2019 traffic count data reflect the following characteristics:

- Outbound on Portage Road at Highway 99:
- In the AM, $47 \%$ to Southwest and $37 \%$ to East
- In the PM, 24\% to Southwest and 64\% to East
- Inbound on Portage Road at Highway 99:
- In the AM, 25\% from Southwest and 58\% from East
- In the PM, 43\% from Southwest and $46 \%$ from East

The recommendation for the Project trip distribution is shown in Table 5 below with commentary to follow.

Table 5: Project Trip Distribution

|  | AM |  | PM |  |
| :--- | :---: | :---: | :---: | :---: |
|  | IN | OUT | IN | OUT |
| Village | $5 \%$ | $15 \%$ | $20 \%$ | $20 \%$ |
| Northwest - Pemberton Meadows Rd | $5 \%$ | $5 \%$ | $5 \%$ | $5 \%$ |
| Southwest - Highway 99 | $25 \%$ | $45 \%$ | $35 \%$ | $25 \%$ |
| East - Highway 99 | $65 \%$ | $35 \%$ | $40 \%$ | $50 \%$ |

The following discussion provides some commentary on the trip distribution:

- Northwest - there is not much of an attraction for Benchlands residents in the peak hours.
- The majority of the trips generated from and attracted to the site will be distributed south along Eagle Drive onto Pemberton Meadows Road.
- Half of the trips destined to and from the Village will be distributed along Dogwood Street (this equates to $10 \%$ of the total trips).
- The majority of trips in the peak hour are to and from employment.
- AM Peak distribution:
- Inbound: Nominal trips from Village and Northwest; trips from Highway 99 reflect current count splits.
- Outbound: Nominal trips to Northwest; trips to Village but less than ISL; trips to Highway 99 reflect current count splits.
- PM Peak distribution:
- Inbound: Nominal trips from Northwest; trips from Village higher than AM peak but less than ISL report; trips from Highway 99 reflect current count splits.
- Outbound: Nominal trips to Northwest; trips to Village higher than AM peak but less than the ISL report; trips to Highway 99 reflect ratio of current count splits and balanced with other percentages.

The resulting Total Project Trips assigned to the network are shown in Figure 8.

## 5. Future Traffic Volumes

The total trips for year 2030 were developed by adding the Total Background Trips to the Project Trips for 2030. This is shown in Figure 9.



## 6. Analysis

### 6.1. Analysis Assumptions

The Synchro software ${ }^{2}$ suite was used for the traffic analysis for the existing and the future horizon. This analysis is based on the procedure and methods of the Highway Capacity Manual (HCM) for signalized and unsignalized intersections. SIDRA ${ }^{3}$ as used to analyze the roundabout.

Operations of roadway facilities are described in terms of Level of Service (LOS). LOS is a qualitative description of traffic flow based on factors such as speed, travel time, delay, and freedom to manoeuvre. Six service levels are defined ranging from LOS A, the best operating conditions, to LOS F, the worst operating conditions. LOS E corresponds to "at or near capacity" operations. When volumes exceed capacity, stop-and-go conditions result and operations are designated LOS F. The delay thresholds and corresponding LOS are presented in Table 6. The calculated 95th percentile queue length has also been reported in terms of length $(\mathrm{m})$ where the average space for a car is approximately 7 m .

Table 6: Level of Service Criteria

| Level of <br> service <br> (LOS) | Average delay: <br> Unsignalized intersection <br> movements (sec/vehicle) | Average delay for <br> Signalized intersection <br> movements (sec/vehicle) | v / c Ratio |
| :---: | :---: | :---: | :---: |
| A | $0-10$ | $0-10$ | $<0.60$ |
| B | $10-15$ | $10-20$ | $>0.60$ to 0.69 |
| C | $15-25$ | $20-35$ | $>0.70$ to 0.79 |
| D | $25-35$ | $35-55$ | $>0.80$ to 0.89 |
| E | $35-50$ | $55-80$ | $>0.90$ to 0.99 |
| F | $>50$ | $>80$ | $>1.00$ |

The following assumptions were used for this study:

- PM Peak Hour only (worst case scenario)
- Heavy vehicles - $2 \%$
- Grade - 0\%, except at Eagle Drive
- Speed - $50 \mathrm{~km} / \mathrm{h}$ for side streets, $60 \mathrm{~km} / \mathrm{h}$ for Highway 99
- Lane widths - 3.6 m
- The BC MoTl signal timings were used for Highway 99/Portage St.

[^1]
### 6.2. Analysis Results

The Synchro and SIDRA results are summarized in the tables below. The results shown are the approach leg Level of Service (LoS), the volume-capacity ratio (v/c) and the 95\% queue expressed in metres (m). The Synchro output is attached in Appendix C.

## Existing Traffic - Year 2019

The existing traffic volumes for August 2019 were analyzed with the existing laning, traffic controls and signal timing. The results are shown in Table 7.

Table 7: PM Peak Hour - 2019 - Existing Volumes, Existing Laning and Control

| Intersection | Movement | LOS | $95 \%$ Q (m) | v/c |
| :--- | :--- | :--- | :--- | :--- |
| Eagle Dr / Pemb. Meadows Rd | EB L+R | B | 3 | 0.10 |
| T-junction Stop for Eagle Dr | NB L | A | 1 | 0.01 |
|  | NB T |  |  | 0.12 |
|  | SB R |  |  | 0.01 |
|  | SB T |  | 0.09 |  |
| Aster St / Dogwood St | WB L+R | A | 3 | 0.08 |
| 3-way stop | SB T+L | A | 1 | 0.02 |
|  | NB T+R |  |  | 0.01 |
| Birch St / Prospect St | WB L+R | B | 3 | 0.44 |
| 3-way stop | SB T+L | B | 2 | 0.40 |
|  | NB T+R | A | 1 | 0.21 |
| Birch St / Portage Rd | NB | A | 18 | 0.37 |
| Roundabout | SB | A | 3 | 0.08 |
|  | EB | A | 16 | 0.32 |
| Portage Rd / Hwy 99 | EB L | B | 40 | 0.58 |
| Signal | EB T | B | 24 | 0.27 |
|  | EB R | A | 6 | 0.09 |
|  | WB L | B | 8 | 0.09 |
|  | WB T | B | 24 | 0.26 |
|  | WB R | A | 12 | 0.36 |
|  | NB L | B | 8 | 0.07 |
|  | NB T | B | 10 | 0.09 |
|  | NB R | A | 6 | 0.09 |
|  | SB L | C | 52 | 0.67 |
|  | SB T | B | 11 | 0.09 |
|  | SB R | A | 8 | 0.18 |

The network operates well with all movements at LoS C or better.
At the intersection at Highway 99 and Portage, the southbound left turn lane on Portage Rd has a short storage length of 25 m . As indicated in Table 7, the left turn queue exceeds this storage with an estimated 95th percentile queue length of 52 m . The current laning does not reflect existing traffic movements as the southbound left turn volumes are five times higher than the southbound through volumes. Despite this, the intersection operates acceptably as southbound through volume and low northbound conflicting volumes are low.

## Total Background Traffic - Year 2030

The total background traffic was analyzed with the existing laning, traffic controls and signal timing. The results are shown in Table 8.

Table 8: PM Peak Hour - 2030 - Total Background Traffic

| Intersection | Movement | LOS | 95\% Q (m) | v/c |
| :---: | :---: | :---: | :---: | :---: |
| Eagle Dr / Pemb. Meadows Rd | EB L+R | B | 5 | 0.15 |
| T-junction Stop for Eagle Dr | NB L | A | 1 | 0.03 |
|  | NB T |  |  | 0.13 |
|  | SB R |  |  | 0.01 |
|  | SB T |  |  | 0.12 |
| Aster St / Dogwood St | WB L+R | A | 3 | 0.08 |
| 3-way stop | SB T+L | A | 1 | 0.02 |
|  | NB T+R |  |  | 0.01 |
| Birch St / Prospect St | WB L+R | B | 2 | 0.42 |
| 3-way stop | SB T+L | B | 2 | 0.40 |
|  | NB T+R | A | 1 | 0.19 |
| Birch St / Portage Rd | NB | A | 23 | 0.42 |
| Roundabout | SB | A | 4 | 0.09 |
|  | EB | A | 21 | 0.38 |
| Portage Rd / Hwy 99 | EB L | C | 51 | 0.70 |
| Signal | EB T | B | 29 | 0.31 |
|  | EB R | A | 6 | 0.09 |
|  | WB L | B | 8 | 0.10 |
|  | WB T | B | 28 | 0.31 |
|  | WB R | A | 13 | 0.43 |
|  | NB L | B | 10 | 0.10 |
|  | NB T | B | 12 | 0.09 |
|  | NB R | A | 6 | 0.09 |
|  | SB L | C | 77 | 0.76 |
|  | SB T | B | 12 | 0.10 |
|  | SB R | A | 10 | 0.23 |

The future network continues to operate well with additional traffic as all movements operate at LoS C or better.

At Highway 99 and Portage the southbound left turn and eastbound left turn operate at LoS C. As noted previously, the southbound left turn queue extends beyond the turn bay storage length. For the eastbound left turn on Highway 99, the storage length is 70 m and the 95 percentile queue length is 51 m .

## Total Traffic - Year 2030

The total traffic was analyzed with the existing laning, traffic controls and signal timing. The results are shown in Table 9.

Table 9: PM Peak Hour - 2030 - Total Traffic

| Intersection | Movement | LOS | 95\% Q (m) | v/c |
| :--- | :--- | :--- | :--- | :--- |
| Eagle Dr / Pemb. Meadows Rd | EB L+R | B | 7 | 0.22 |
| T-junction Stop for Eagle Dr | NB L | A | 5 | 0.17 |
|  | NB T |  |  | 0.13 |
|  | SB R |  |  | 0.01 |
|  | SB T |  |  | 0.12 |
| Aster St / Dogwood St | WB L+R | A | 3 | 0.10 |
| 3-way stop | SB T+L | A | 1 | 0.03 |
|  | NB T+R |  |  | 0.01 |
| Birch St / Prospect St | WB L+R | C | 5 | 0.64 |
| 3-way stop | SB T+L | C | 4 | 0.58 |
|  | NB T+R | B | 1 | 0.23 |
| Birch St / Portage Rd | NB | A | 31 | 0.51 |
| Roundabout | SB | A | 4 | 0.09 |
|  | EB | A | 27 | 0.44 |
| Portage Rd / Hwy 99 | EB L | C | 77 | 0.81 |
| Signal | EB T | B | 29 | 0.30 |
|  | EB R | A | 6 | 0.08 |
|  | WB L | B | 8 | 0.09 |
|  | WB T | B | 28 | 0.29 |
|  | WB R | A | 14 | 0.48 |
|  | NB L | B | 10 | 0.09 |
|  | NB T | B | 12 | 0.09 |
|  | NB R | A | 6 | 0.09 |
|  | SB L | D | 94 | 0.84 |
|  | SB T | B | 12 | 0.09 |
|  | SB R | A | 11 | 0.25 |

With the addition of the project traffic, the network continues to operate well with all approaches at LoS C or better, with the exception of the southbound left turn at the intersection of Highway 99 and Portage Road, which operates at LoS D. This is an acceptable level of service, especially for a left turn. The estimated 95 percentile queue length for the southbound turn is 94 m which extends beyond the storage length of the left turn lane. For the eastbound left turn, the 95 -percentile queue length is estimated as 77 m which extends slightly beyond the storage length of the turn bay.

## Commentary for total traffic at 2030:

Intersection of Eagle Drive and Pemberton Meadows Road: This intersection operates well in the future with all movements of LoS B or better. Although there is an increase in traffic on Eagle Drive, this additional traffic is well within the capacity of the intersection.

Intersection of Aster Street and Dogwood Street: This intersection has been analyzed as a T -junction. As the volumes are low at this intersection, it operates well in the future with all movements of LoS A, the best possible level of service.

Intersection of Birch Street and Prospect Street: The traffic at this intersection will increase for the northbound right turn and the westbound left turn. Despite the increased traffic, the 3-way stop operates well with all movements at LoS C or better. In the future, there may be some increase in delays due to increased numbers of pedestrians as a result of the improvements made by the Village to improved walkability.

Intersection of Birch Street and Prospect Street: This roundabout operates well in the future with LoS of A for all approaches, the best possible level of service. The railway crossing operation does have an impact on the roundabout. This is an existing circumstance based on the current transportation network.

Intersection of Highway 99 and Portage Road: The signal timing was reviewed to see if there are opportunities to improve the operation. The signal timing setting was last updated in 2016. With the growth in Pemberton, as well as changes in the operation on Highway 99 based on new development to the east of the Village, it is suggested that a signal timing review is undertaken to better balance the traffic delays on all approaches and to minimize queue lengths, particularly for the left turns. In addition, there is also no specific PM peak time of day signal timing plan to account for PM peak traffic volumes.

## 7. Summary

The background traffic includes all proposed development in the study area as provided by the Village.

Estimates of site traffic are conservative as no reductions have been applied to reflect alternative mode use. The result is that the estimate of peak hour motor vehicle trips is intentionally higher than the actual trips would be, to ensure that any impacts of the additional development are not underestimated.
The PM Peak Hour was analyzed as the worst-case scenario for a regular weekday operation.
The traffic generated from the development will increase traffic volumes on some roads in the Village area but this is within the capacity of the intersections and roadways. The development is not expected to significantly impact the overall operation of the road network in the vicinity on the Village centre.

The five study intersections are estimated to operate below capacity after Opening Day and to year 2030.

The project traffic makes up 10\% of the total PM peak hour intersection traffic at Highway 99/Portage Road in 2030.

The intersection of Highway 99/Portage Road does experience some operational impacts based on the current geometry and signal timing plan. There is a high southbound left turn volume combined with a high eastbound left turn volume. This is a background operating condition.

These impacts could likely be mitigated through changes to the signal timing plan of the intersection of Highway 99/ Portage Road to optimize the eastbound and southbound left turn operations.

## 8. Conclusions and Recommendations

1. The traffic generated from the development for Phase 1 and 2 is within the capacity of the intersections and roadways.
2. In 2030, the number of trips generated by the development amount to only $10 \%$ of the total traffic volume at the intersection of Highway 99 and Portage Road.
3. No further mitigation improvements are required on the existing road network, over and above the improvements already included in the development.
4. It is recommended that a signal timing review be undertaken for the intersection of Highway 99/Portage Road, to mitigate the eastbound and southbound left turn operational impacts. This could be considered as part of the current Highway 99 corridor review by the Village and BC MOTI.

## Appendix A:

Village of Pemberton OCP Transportation Plan

Official
Community Plan
Map N
Regional Context Statement

## Legend

Regional Context
$\square$ Statement Areas

- Village Boundary
-Provincial Park
Transportation
_ Highway
—Arterial Road
- Local Road
. Resource Road
- Proposed Road
- Railway

Hydrography
Lake/River
$\square$ Wetland
Sand/Gravel Bar
-River/Stream - Definite
River/Stream - Indefinite
Elevation Contour
Index Contour ( 100 m ) Intermediate Contour (20m)

UTM Zone 10 N - NAD83
This map was produced for the December 2014


## Appendix B:

## Traffic Counts

Pemberton Meadows Rd \& Eagle Ridge Dr
Thursday, September 19, 2019

Project: \#7122: Howes - Whistler TMC's
Morning Peak Period
Municipality: Pemberton
Weather: Sunny
Vehicle Class: All Motorized Vehicles

Peak Hour Traffic by Movement


| Time | NORTH Approach |  |  | SOUTH Approach |  |  | WEST Approach |  |  | EAST Approach |  |  | PEDESTRIANS |  |  |  | Total Volumes |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | left | thru | right | left | thru | right | left | thru | right | left | thru | right | N | S | W | E |  |
| Peak Hour |  | 127 | 3 | 6 | 90 |  | 0 |  | 4 |  |  |  | 0 | 0 | 4 | 0 | 230 |
| PHF |  | 0.72 | 0.75 | 0.50 | 0.75 |  | 0.00 |  | 0.25 |  |  |  | 0.00 | 0.00 | 0.50 | 0.00 | 0.88 |
| Peak 15 X 4 |  | 176 | 4 | 12 | 120 |  | 0 |  | 16 |  |  |  | 0 | 0 | 8 | 0 | 260 |
| Average Hour |  | 111 | 5 | 9 | 70 |  | 1 |  | 4 |  |  |  | 0 | 0 | 2 | 0 | 200 |
| Survey Total |  | 222 | 9 | 18 | 140 |  | 2 |  | 7 |  |  |  | 0 | 0 | 4 | 0 | 398 |
| 7:00 |  | 16 | 1 | 0 | 9 |  | 0 |  | 1 |  |  |  | 0 | 0 | 0 | 0 | 27 |
| 7:15 |  | 27 | 0 | 1 | 8 |  | 0 |  | 0 |  |  |  | 0 | 0 | 0 | 0 | 36 |
| 7:30 |  | 22 | 1 | 2 | 20 |  | 1 |  | 2 |  |  |  | 0 | 0 | 0 | 0 | 48 |
| 7:45 |  | 30 | 4 | 9 | 13 |  | 1 |  | 0 |  |  |  | 0 | 0 | 0 | 0 | 57 |
| 8:00 |  | 25 | 1 | 3 | 25 |  | 0 |  | 0 |  |  |  | 0 | 0 | 0 | 0 | 54 |
| 8:15 |  | 26 | 1 | 1 | 24 |  | 0 |  | 0 |  |  |  | 0 | 0 | 2 | 0 | 52 |
| 8:30 |  | 44 | 0 | 0 | 11 |  | 0 |  | 4 |  |  |  | 0 | 0 | 0 | 0 | 59 |
| 8:45 |  | 32 | 1 | 2 | 30 |  | 0 |  | 0 |  |  |  | 0 | 0 | 2 | 0 | 65 |

4:30 PM to 5:30 PM



| Time | NORTH Approach |  |  | SOUTH Approach |  |  | WEST Approach |  |  | EAST Approach |  |  | PEDESTRIANS |  |  |  | Total Volumes |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | left | thru | right | left | thru | right | left | thru | right | left | thru | right | N | S | W | E |  |
| Peak Hour | 45 | 0 |  |  | 0 | 12 |  |  |  | 20 |  | 22 | 5 | 2 | 0 | 1 | 99 |
| PHF | 0.70 | 0.00 |  |  | 0.00 | 0.60 |  |  |  | 0.71 |  | 0.69 | 0.42 | 0.25 | 0.00 | 0.25 | 0.80 |
| Peak 15 X 4 | 64 | 0 |  |  | 0 | 20 |  |  |  | 28 |  | 32 | 12 | 8 | 0 | 4 | 124 |
| Average Hour | 38 | 0 |  |  | 0 | 7 |  |  |  | 17 |  | 17 | 4 | 2 | 0 | 2 | 79 |
| Survey Total | 76 | 0 |  |  | 0 | 14 |  |  |  | 34 |  | 34 | 7 | 3 | 0 | 3 | 158 |
| 7:00 | 7 | 0 |  |  | 0 | 0 |  |  |  | 1 |  | 2 | 0 | 0 | 0 | 1 | 10 |
| 7:15 | 7 | 0 |  |  | 0 | 0 |  |  |  | 5 |  | 3 | 1 | 1 | 0 | 1 | 15 |
| 7:30 | 10 | 0 |  |  | 0 | 0 |  |  |  | 2 |  | 4 | 0 | 0 | 0 | 0 | 16 |
| 7:45 | 16 | 0 |  |  | 0 | 0 |  |  |  | 4 |  | 2 | 0 | 0 | 0 | 1 | 22 |
| 8:00 | 9 | 0 |  |  | 0 | 3 |  |  |  | 7 |  | 6 | 0 | 2 | 0 | 0 | 25 |
| 8:15 | 12 | 0 |  |  | 0 | 5 |  |  |  | 6 |  | 8 | 2 | 0 | 0 | 0 | 31 |
| 8:30 | 8 | 0 |  |  | 0 | 4 |  |  |  | 3 |  | 6 | 3 | 0 | 0 | 0 | 21 |
| 8:45 | 7 | 0 |  |  | 0 | 2 |  |  |  | 6 |  | 3 | 1 | 0 | 0 | 0 | 18 |

4:45 PM to 5:45 PM


Pemberton Portage Rd \& Birch Rd - Aspen Blvd
Thursday, September 19, 2019

Project: \#7122: Howes - Whistler TMC's
Municipality: Pemberton
Weather: Cloudy
Vehicle Class: All Motorized Vehicles


Pemberton Portage Rd \& Birch Rd - Aspen Blvd
Thursday, September 19, 2019

Project: \#7122: Howes - Whistler TMC's
Afternoon Peak Period
Municipality: Pemberton
Weather: Cloudy
Vehicle Class: All Motorized Vehicles


Pemberton Portage Rd \& Birch Rd - Aspen Blvd
Thursday, September 19, 2019

Project: \#7122: Howes - Whistler TMC's
Municipality: Pemberton
Weather: Cloudy
Vehicle Class: All Motorized Vehicles


Pemberton Portage Rd \& Birch Rd - Aspen Blvd
Thursday, September 19, 2019

Project: \#7122: Howes - Whistler TMC's
Afternoon Peak Period
Municipality: Pemberton
Weather: Cloudy
Vehicle Class: All Motorized Vehicles


Project: \#7122: Howes - Whistler TMC's
Municipality: Pemberton
Weather: Cloudy
Vehicle Class: All Motorized Vehicles

Peak Hour Traffic by Movement
7:45 AM to 8:45 AM


| Time | NORTH Approach |  |  | SOUTH Approach |  |  | WEST Approach |  |  | EAST Approach |  |  | PEDESTRIANS |  |  |  | Total Volumes |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | left | thru | right | left | thru | right | left | thru | right | left | thru | right | N | S | W | E |  |
| Peak Hour | 120 | 53 | 153 | 48 | 57 | 49 | 83 | 82 | 25 | 58 | 114 | 197 | 3 | 6 | 20 | 12 | 1,039 |
| PHF | 0.77 | 0.63 | 0.85 | 0.63 | 0.89 | 0.64 | 0.77 | 0.82 | 0.78 | 0.69 | 0.84 | 0.68 | 0.25 | 0.50 | 0.63 | 0.50 | 0.95 |
| Peak 15 X 4 | 156 | 84 | 180 | 76 | 64 | 76 | 108 | 100 | 32 | 84 | 136 | 288 | 12 | 12 | 32 | 24 | 1,096 |
| Average Hour | 105 | 54 | 157 | 50 | 42 | 41 | 65 | 71 | 21 | 45 | 114 | 150 | 4 | 5 | 17 | 7 | 915 |
| Survey Total | 209 | 108 | 314 | 99 | 84 | 81 | 130 | 142 | 42 | 89 | 228 | 300 | 7 | 9 | 33 | 14 | 1,826 |
| 7:00 | 13 | 13 | 26 | 14 | 5 | 4 | 3 | 11 | 4 | 4 | 21 | 13 | 1 | 0 | 3 | 0 | 131 |
| 7:15 | 14 | 11 | 43 | 15 | 5 | 9 | 13 | 9 | 5 | 11 | 37 | 21 | 0 | 0 | 0 | 1 | 193 |
| 7:30 | 20 | 10 | 59 | 15 | 7 | 9 | 16 | 15 | 6 | 9 | 37 | 29 | 0 | 1 | 1 | 0 | 232 |
| 7:45 | 27 | 11 | 42 | 12 | 16 | 11 | 16 | 18 | 7 | 21 | 34 | 35 | 3 | 2 | 2 | 2 | 250 |
| 8:00 | 24 | 7 | 37 | 19 | 12 | 19 | 22 | 16 | 8 | 14 | 34 | 30 | 0 | 0 | 2 | 2 | 242 |
| 8:15 | 30 | 14 | 45 | 8 | 14 | 9 | 18 | 25 | 8 | 16 | 27 | 60 | 0 | 3 | 8 | 6 | 274 |
| 8:30 | 39 | 21 | 29 | 9 | 15 | 10 | 27 | 23 | 2 | 7 | 19 | 72 | 0 | 1 | 8 | 2 | 273 |
| 8:45 | 42 | 21 | 33 | 7 | 10 | 10 | 15 | 25 | 2 | 7 | 19 | 40 | 3 | 2 | 9 | 1 | 231 |



## Appendix C:

## Synchro/SIDRA Analysis Sheets




| Intersection |  |
| :--- | :---: |
| Intersection Delay, s/veh | 11 |
| Intersection LOS | B |



| Lane | NBLn1 | WBLn1 | SBLn1 |
| :--- | ---: | ---: | ---: |
| Vol Left, \% | $0 \%$ | $32 \%$ | $79 \%$ |
| Vol Thru, \% | $52 \%$ | $0 \%$ | $21 \%$ |
| Vol Right, \% | $48 \%$ | $68 \%$ | $0 \%$ |
| Sign Control | Stop | Stop | Stop |
| Traffic Vol by Lane | 126 | 254 | 216 |
| LT Vol | 06 | 81 | 170 |
| Through Vol | 60 | 0 | 46 |
| RT Vol | 154 | 173 | 0 |
| Lane Flow Rate | 1 | 343 | 281 |
| Geometry Grp | 0.205 | 0.441 | 0.396 |
| Degree of Util (X) | 4.814 | 4.626 | 5.077 |
| Departure Headway (Hd) | Yes | Yes | Yes |
| Convergence, Y/N | 736 | 772 | 701 |
| Cap | 2.902 | 2.687 | 3.155 |
| Service Time | 0.209 | 0.444 | 0.401 |
| HCM Lane V/C Ratio | 9.2 | 11.3 | 11.5 |
| HCM Control Delay | A | B | B |
| HCM Lane LOS | 0.8 | 2.3 | 1.9 |


|  | $\rangle$ |  |  | 7 |  |  | 4 | $\dagger$ | $p$ |  | $\dagger$ | $\downarrow$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | \％ | $\uparrow$ | 「 | ${ }^{4}$ | $\uparrow$ | 「 | ${ }^{7}$ | $\uparrow$ | 「 | \％ | 4 | F |
| Traffic Volume（vph） | 213 | 152 | 43 | 32 | 149 | 227 | 30 | 51 | 46 | 270 | 52 | 99 |
| Future Volume（vph） | 213 | 152 | 43 | 32 | 149 | 227 | 30 | 51 | 46 | 270 | 52 | 99 |
| Ideal Flow（vphpl） | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width（m） | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.5 | 3.6 | 3.6 |
| Storage Length（ m ） | 70.0 |  | 35.0 | 70.0 |  | 70.0 | 25.0 |  | 15.0 | 25.0 |  | 65.0 |
| Storage Lanes | 1 |  | 1 | 1 |  | 1 | 1 |  | 1 | ． |  | 1 |
| Taper Length（m） | 30.0 |  |  | 30.0 |  |  | 20.0 |  |  | 30.0 |  |  |
| Lane Utill．Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt |  |  | 0.850 |  |  | 0.850 |  |  | 0.850 |  |  | 0.850 |
| Flt Protected | 0.950 |  |  | 0.950 |  |  | 0.950 |  |  | 0.950 |  |  |
| Satd．Flow（prot） | 1593 | 1676 | 1425 | 1593 | 1676 | 1425 | 1593 | 1676 | 1425 | 1575 | 1676 | 1425 |
| Flt Permitted | 0.654 |  |  | 0.653 |  |  | 0.720 |  |  | 0.721 |  |  |
| Satd．Flow（perm） | 1096 | 1676 | 1425 | 1095 | 1676 | 1425 | 1207 | 1676 | 1425 | 1195 | 1676 | 1425 |
| Right Turn on Red |  |  | Yes |  |  | Yes |  |  | Yes |  |  | Yes |
| Satd．Flow（RTOR） |  |  | 47 |  |  | 247 |  |  | 50 |  |  | 108 |
| Link Speed（k／h） |  | 60 |  |  | 60 |  |  | 50 |  |  | 50 |  |
| Link Distance（m） |  | 426.0 |  |  | 251.0 |  |  | 552.0 |  |  | 279.6 |  |
| Travel Time（s） |  | 25.6 |  |  | 15.1 |  |  | 39.7 |  |  | 20.1 |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj．Flow（vph） | 232 | 165 | 47 | 35 | 162 | 247 | 33 | 55 | 50 | 293 | 57 | 108 |
| Shared Lane Traffic（\％） |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Group Flow（vph） | 232 | 165 | 47 | 35 | 162 | 247 | 33 | 55 | 50 | 293 | 57 | 108 |
| Turn Type | Perm | NA | Perm | Perm | NA | Perm | Perm | NA | Perm | Perm | NA | Perm |
| Protected Phases |  | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |
| Permitted Phases | 4 |  | 4 | 8 |  | 8 | 2 |  | 2 | 6 |  | 6 |
| Detector Phase | 4 | 4 | 4 | 8 | 8 | 8 | 2 | 2 | 2 | 6 | 6 | 6 |
| Switch Phase |  |  |  |  |  |  |  |  |  |  |  |  |
| Minimum Initial（s） | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Minimum Split（s） | 28.5 | 28.5 | 28.5 | 28.5 | 28.5 | 28.5 | 23.1 | 23.1 | 23.1 | 23.1 | 23.1 | 23.1 |
| Total Split（s） | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 31.0 | 31.0 | 31.0 | 31.0 | 31.0 | 31.0 |
| Total Split（\％） | 52．3\％ | 52．3\％ | 52．3\％ | 52．3\％ | 52．3\％ | 52．3\％ | 47．7\％ | 47．7\％ | 47．7\％ | 47．7\％ | 47．7\％ | 47．7\％ |
| Maximum Green（s） | 28.5 | 28.5 | 28.5 | 28.5 | 28.5 | 28.5 | 25.9 | 25.9 | 25.9 | 25.9 | 25.9 | 25.9 |
| Yellow Time（s） | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 |
| All－Red Time（s） | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Lost Time Adjust（s） | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time（s） | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 |
| Lead／Lag |  |  |  |  |  |  |  |  |  |  |  |  |
| Lead－Lag Optimize？ |  |  |  |  |  |  |  |  |  |  |  |  |
| Vehicle Extension（s） | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | None | None | None | None | Min | Min | Min | Min | Min | Min |
| Walk Time（s） | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk（s） | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 |
| Pedestrian Calls（\＃／hr） | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ， | ． | 1 | 1 |
| Act Effct Green（s） | 15.7 | 15.7 | 15.7 | 15.7 | 15.7 | 15.7 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 |
| Actuated g／C Ratio | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 |
| v／c Ratio | 0.58 | 0.27 | 0.09 | 0.09 | 0.26 | 0.36 | 0.07 | 0.09 | 0.09 | 0.67 | 0.09 | 0.18 |
| Control Delay | 18.5 | 11.8 | 4.4 | 10.7 | 11.7 | 3.6 | 10.6 | 10.4 | 4.4 | 21.1 | 10.4 | 3.8 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |


|  | 4 | $\rightarrow$ | \% | 7 |  | 4 | 4 | $\dagger$ | $>$ | - | $\downarrow$ | $\downarrow$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Total Delay | 18.5 | 11.8 | 4.4 | 10.7 | 11.7 | 3.6 | 10.6 | 10.4 | 4.4 | 21.1 | 10.4 | 3.8 |
| LOS | B | B | A | B | B | A | B | B | A | C | B | A |
| Approach Delay |  | 14.5 |  |  | 7.1 |  |  | 8.2 |  |  | 15.7 |  |
| Approach LOS |  | B |  |  | A |  |  | A |  |  | B |  |
| Queue Length 50th (m) | 12.8 | 7.9 | 0.0 | 1.6 | 7.8 | 0.0 | 1.4 | 2.4 | 0.0 | 16.2 | 2.4 | 0.0 |
| Queue Length 95th (m) | 39.3 | 24.0 | 5.1 | 7.2 | 23.6 | 11.5 | 7.1 | 10.0 | 5.5 | 51.5 | 10.4 | 8.0 |
| Internal Link Dist (m) |  | 402.0 |  |  | 227.0 |  |  | 528.0 |  |  | 255.6 |  |
| Turn Bay Length (m) | 70.0 |  | 35.0 | 70.0 |  | 70.0 | 25.0 |  | 15.0 | 25.0 |  | 65.0 |
| Base Capacity (vph) | 790 | 1209 | 1041 | 790 | 1209 | 1096 | 791 | 1099 | 951 | 783 | 1099 | 971 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.29 | 0.14 | 0.05 | 0.04 | 0.13 | 0.23 | 0.04 | 0.05 | 0.05 | 0.37 | 0.05 | 0.11 |

Intersection Summary
Area Type: CBD

Cycle Length: 65
Actuated Cycle Length: 42.7
Natural Cycle: 55
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.67
Intersection Signal Delay: 12.1
Intersection Capacity Utilization 58.5\% ICU Level of Service B
Analysis Period (min) 15
Splits and Phases: $\quad 3:$ Vine Rd/Portage Rd \& Highway 99


## INPUT VOLUMES

Vehicles and pedestrians per 60 minutes
® Site: 101 [Pemberton - 2019 Existing (Site Folder: General)]
Pemberton Roundabout
Site Category: (None)
Roundabout

## Volume Display Method: Total and \%



|  | All MCs | Light Vehicles (LV) | Heavy Vehicles (HV) |
| :--- | :---: | :---: | :---: |
| S: Portage Rd | 477 | 467 | 10 |
| N: Aspen Bv | 61 | 60 | 1 |
| W: Birch Rd | 392 | 384 | 8 |
| Total | 930 | 911 | 19 |



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Geometric Delay is included).

SIDRA INTERSECTION 9.0 | Copyright © 2000-2020 Akcelik and Associates Pty Ltd | sidrasolutions.com
Organisation: ASSOCIATED ENGINEERING GROUP LTD. | Licence: PLUS / 1PC | Processed: Sunday, February 28, 2021 11:04:11 AM
Project: C:IUsersljacksonblOneDrive - Associated Engineering Group LTD\_Work\Projects\For_Donnal20200210_Pemberton
ISIDRA_Analysis_20210204\Roundabout_Analysis-20210204.sip9

## LANE SUMMARY

## Site: 101 [Pemberton - 2019 Existing (Site Folder: General)]

## Pemberton Roundabout

Site Category: (None)
Roundabout

| Lane Use and Performance |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | DEMAND FLOWS |  | Cap. <br> veh/h | Deg. Satn <br> v/c | Lane Util. $\qquad$ \% | Aver. Delay <br> sec | Level of Service | 95\% BACK OF QUEUE <br> [ Veh Dist] <br> m |  | Lane Config | Lane Length <br> m | Cap. Prob. <br> Adj. Block. \% \% |  |
| South: Portage Rd |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane $1^{\text {d }}$ | 530 | 2.0 | 1442 | 0.368 | 100 | 6.8 | LOS A | 2.5 | 17.9 | Full | 85 | 0.0 | 0.0 |
| Approach | 530 | 2.0 |  | 0.368 |  | 6.8 | LOS A | 2.5 | 17.9 |  |  |  |  |
| North: Aspen Bv |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane $1^{\text {d }}$ | 68 | 2.0 | 849 | 0.080 | 100 | 4.6 | LOS A | 0.4 | 2.9 | Full | 40 | 0.0 | 0.0 |
| Approach | 68 | 2.0 |  | 0.080 |  | 4.6 | LOS A | 0.4 | 2.9 |  |  |  |  |
| West: Birch Rd |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane $1^{\text {d }}$ | 436 | 2.0 | 1382 | 0.315 | 100 | 2.3 | LOS A | 2.2 | 15.8 | Full | 35 | 0.0 | 0.0 |
| Approach | 436 | 2.0 |  | 0.315 |  | 2.3 | LOS A | 2.2 | 15.8 |  |  |  |  |
| Intersectio <br> n | 1033 | 2.0 |  | 0.368 |  | 4.8 | LOS A | 2.5 | 17.9 |  |  |  |  |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
d Dominant lane on roundabout approach

| Approach Lane Flows (veh/h) |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| South: Portage Rd |  |  |  |  |  |  |  |  |
| Mov. <br> From S To Exit: | L2 W | T1 N | Total | \%HV | Cap. veh/h | Deg. Satn v/c | Lane Prob. Util. SL Ov. \% \% |  |
| Lane 1 | 461 | 69 | 530 | 2.0 | 1442 | 0.368 | 100 NA | NA |
| Approach | 461 | 69 | 530 | 2.0 |  | 0.368 |  |  |
| North: Aspen Bv |  |  |  |  |  |  |  |  |
| Mov. <br> From N To Exit: | T1 S | R2 W | Total | \%HV | Cap. veh/h | Deg. Satn v/c | Lane Prob. Util. SL Ov. \% \% |  |
| Lane 1 | 44 | 23 | 68 | 2.0 | 849 | 0.080 | 100 NA | NA |
| Approach | 44 | 23 | 68 | 2.0 |  | 0.080 |  |  |
| West: Birch Rd |  |  |  |  |  |  |  |  |
| Mov. <br> From W To Exit: | L2 N | R2 S | Total | \%HV | Cap. veh/h | Deg. Satn v/c | $\begin{array}{cr} \text { Lane } & \text { Prob. } \\ \text { Util. SL Ov. } \\ \% & \% \end{array}$ |  |
| Lane 1 | 34 | 401 | 436 | 2.0 | 1382 | 0.315 | 100 NA | NA |
| Approach | 34 | 401 | 436 | 2.0 |  | 0.315 |  |  |




| Intersection |  |
| :--- | ---: | :--- |
| Intersection Delay, s/veh | 10.7 |
| Intersection LOS | B |


| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Configurations | \$ |  | $\uparrow$ |  |  | $\uparrow$ |
| Traffic Vol, veh/h | 90 | 208 | 68 | 62 | 209 | 49 |
| Future Vol, veh/h | 90 | 208 | 68 | 62 | 209 | 49 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles, \% | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 98 | 226 | 74 | 67 | 227 | 53 |
| Number of Lanes | 1 | 0 | 1 | 0 | 0 | 1 |
| Approach | WB |  | NB |  | SB |  |
| Opposing Approach |  |  | SB |  | NB |  |
| Opposing Lanes | 0 |  | 1 |  | 1 |  |
| Conflicting Approach Left | NB |  |  |  | WB |  |
| Conflicting Lanes Left | 1 |  | 0 |  | 1 |  |
| Conflicting Approach Right | SB |  | WB |  |  |  |
| Conflicting Lanes Right | 1 |  | 1 |  | 0 |  |
| HCM Control Delay | 10.9 |  | 9 |  | 11.4 |  |
| HCM LOS | B |  | A |  | B |  |


| Lane | NBLn1 | WBLn1 | SBLn1 |
| :--- | ---: | ---: | ---: |
| Vol Left, \% | $0 \%$ | $30 \%$ | $81 \%$ |
| Vol Thru, \% | $52 \%$ | $0 \%$ | $19 \%$ |
| Vol Right, \% | $48 \%$ | $70 \%$ | $0 \%$ |
| Sign Control | Stop | Stop | Stop |
| Traffic Vol by Lane | 130 | 298 | 258 |
| LT Vol | 0 | 90 | 209 |
| Through Vol | 68 | 0 | 49 |
| RT Vol | 62 | 208 | 0 |
| Lane Flow Rate | 141 | 324 | 280 |
| Geometry Grp | 1 | 1 | 1 |
| Degree of Util (X) | 0.188 | 0.414 | 0.392 |
| Departure Headway (Hd) | 4.778 | 4.599 | 5.034 |
| Convergence, Y/N | Yes | Yes | Yes |
| Cap | 743 | 777 | 710 |
| Service Time | 2.857 | 2.655 | 3.104 |
| HCM Lane V/C Ratio | 0.19 | 0.417 | 0.394 |
| HCM Control Delay | 9 | 10.9 | 11.4 |
| HCM Lane LOS | A | B | B |
| HCM 95th-tile Q | 0.7 | 2 | 1.9 |


|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |


|  | $\Rightarrow$ | $\rightarrow$ |  | 7 |  | 4 | 4 | 4 | 7 |  | $\dagger$ | $\downarrow$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Minimum Gap (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Time Before Reduce (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Time To Reduce (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Recall Mode | None | None | None | None | None | None | Min | Min | Min | Min | Min | Min |
| Walk Time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 |
| Pedestrian Calls (\#/hr) | 1 | 1 | , | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Act Effct Green (s) | 18.6 | 18.6 | 18.6 | 18.6 | 18.6 | 18.6 | 19.1 | 19.1 | 19.1 | 19.1 | 19.1 | 19.1 |
| Actuated g/C Ratio | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 |
| v/c Ratio | 0.70 | 0.31 | 0.09 | 0.10 | 0.31 | 0.43 | 0.10 | 0.09 | 0.09 | 0.76 | 0.10 | 0.23 |
| Control Delay | 24.4 | 13.0 | 4.3 | 11.5 | 12.9 | 3.7 | 11.7 | 11.3 | 4.5 | 26.9 | 11.4 | 3.7 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 24.4 | 13.0 | 4.3 | 11.5 | 12.9 | 3.7 | 11.7 | 11.3 | 4.5 | 26.9 | 11.4 | 3.7 |
| LOS | C | B | A | B | B | A | B | B | A | C | B | A |
| Approach Delay |  | 18.3 |  |  | 7.6 |  |  | 9.1 |  |  | 19.1 |  |
| Approach LOS |  | B |  |  | A |  |  | A |  |  | B |  |
| Queue Length 50th (m) | 21.1 | 12.3 | 0.0 | 2.3 | 12.1 | 0.0 | 2.4 | 3.3 | 0.0 | 25.7 | 3.4 | 0.0 |
| Queue Length 95th (m) | 50.8 | 28.2 | 5.2 | 7.9 | 27.7 | 12.6 | 9.3 | 11.3 | 5.9 | \#76.8 | 11.6 | 9.5 |
| Internal Link Dist ( m ) |  | 402.0 |  |  | 227.0 |  |  | 528.0 |  |  | 255.6 |  |
| Turn Bay Length (m) | 70.0 |  | 35.0 | 70.0 |  | 70.0 | 25.0 |  | 15.0 | 25.0 |  | 65.0 |
| Base Capacity (vph) | 666 | 1049 | 910 | 664 | 1049 | 1009 | 682 | 953 | 834 | 677 | 953 | 873 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.42 | 0.19 | 0.05 | 0.06 | 0.19 | 0.31 | 0.07 | 0.06 | 0.06 | 0.52 | 0.07 | 0.17 |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Area Type: CBD |  |  |  |  |  |  |  |  |  |  |  |  |
| Cycle Length: 65 |  |  |  |  |  |  |  |  |  |  |  |  |
| Actuated Cycle Length: 49.1 |  |  |  |  |  |  |  |  |  |  |  |  |
| Natural Cycle: 55 |  |  |  |  |  |  |  |  |  |  |  |  |
| Control Type: Actuated-Uncoordinated |  |  |  |  |  |  |  |  |  |  |  |  |
| Maximum v/c Ratio: 0.76 |  |  |  |  |  |  |  |  |  |  |  |  |
| Intersection Signal Delay: 14.4 |  |  |  |  | Intersection LOS: B |  |  |  |  |  |  |  |
| Intersection Capacity Utilization 66.3\% <br> ICU Level of Service C Analysis Period (min) 15 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| \# 95th percentile volume exceeds capacity, queue may be longer. |  |  |  |  |  |  |  |  |  |  |  |  |
| Queue shown is maximum after two cycles. |  |  |  |  |  |  |  |  |  |  |  |  |

Splits and Phases: 3: Vine Rd/Portage Rd \& Highway 99


## LANE LEVEL OF SERVICE

Lane Level of Service
$\theta$ Site: 101 [Pemberton - 2030 Background]
Pemberton Roundabout
Roundabout

## All Movement Classes

|  | South | North | West | Intersection |
| :---: | :---: | :---: | :---: | :---: |
| LOS | A | A | A | A |



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.

## LANE SUMMARY

Site: 101 [Pemberton - 2030 Background]
Pemberton Roundabout
Roundabout

| Lane Use and Performance |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Demand Total veh/h | $\begin{aligned} & \text { lows } \\ & \text { HV } \\ & \% \end{aligned}$ | Cap. veh/h | Deg. Satn v/c | Lane Util. \% | Average Delay sec | Level of Service | $\begin{gathered} 95 \% \text { Ba } \\ \text { Veh } \end{gathered}$ | $\begin{gathered} \text { Queue } \\ \text { Dist } \\ \text { m } \end{gathered}$ | Lane Config | Lane Length m | Cap. Adj. \% | Prob. Block. \% |
| South: Portage Rd |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane $1^{\text {d }}$ | 612 | 2.0 | 1453 | 0.421 | 100 | 6.9 | LOS A | 3.1 | 22.2 | Full | 85 | 0.0 | 0.0 |
| Approach | 612 | 2.0 |  | 0.421 |  | 6.9 | LOS A | 3.1 | 22.2 |  |  |  |  |
| North: Aspen Bv |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane $1^{\text {d }}$ | 68 | 2.0 | 787 | 0.086 | 100 | 5.2 | LOS A | 0.4 | 3.2 | Full | 40 | 0.0 | 0.0 |
| Approach | 68 | 2.0 |  | 0.086 |  | 5.2 | LOS A | 0.4 | 3.2 |  |  |  |  |
| West: Birch Rd |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane $1^{\text {d }}$ | 532 | 2.0 | 1396 | 0.381 | 100 | 2.3 | LOS A | 2.9 | 21.0 | Full | 35 | 0.0 | 0.0 |
| Approach | 532 | 2.0 |  | 0.381 |  | 2.3 | LOS A | 2.9 | 21.0 |  |  |  |  |
| Intersection | 1212 | 2.0 |  | 0.421 |  | 4.8 | LOS A | 3.1 | 22.2 |  |  |  |  |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D),
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
d Dominant lane on roundabout approach

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Project: P:\20192623\00_HTA_Projects\PM\02.00_Project_Planning\20200210_Pemberton\SIDRA_Analysis\Roundabout_Analysis.sip7

## INPUT VOLUMES

Vehicles and pedestrians per 60 minutes
F Site: 101 [Pemberton-2030 Background]
Pemberton Roundabout
Roundabout

Volume Display Method: Total and \%


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| Intersection |  |
| :--- | ---: |
| Intersection Delay, s/veh | 15.3 |
| Intersection LOS | C |


| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Configurations | \$ |  | $\uparrow$ |  |  | $\uparrow$ |
| Traffic Vol, veh/h | 90 | 339 | 76 | 62 | 287 | 54 |
| Future Vol, veh/h | 90 | 339 | 76 | 62 | 287 | 54 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles, \% | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 98 | 368 | 83 | 67 | 312 | 59 |
| Number of Lanes | 1 | 0 | 1 | 0 | 0 | 1 |
| Approach | WB |  | NB |  | SB |  |
| Opposing Approach |  |  | SB |  | NB |  |
| Opposing Lanes | 0 |  | 1 |  | 1 |  |
| Conflicting Approach Left | NB |  |  |  | WB |  |
| Conflicting Lanes Left | 1 |  | 0 |  | 1 |  |
| Conflicting Approach Right | SB |  | WB |  |  |  |
| Conflicting Lanes Right | 1 |  | 1 |  | 0 |  |
| HCM Control Delay | 16.4 |  | 10.2 |  | 15.9 |  |
| HCM LOS | C |  | B |  | C |  |


| Lane | NBLn1 | WBLn1 | SBLn1 |
| :--- | ---: | ---: | ---: |
| Vol Left, \% | $0 \%$ | $21 \%$ | $84 \%$ |
| Vol Thru, \% | $55 \%$ | $0 \%$ | $16 \%$ |
| Vol Right, \% | $45 \%$ | $79 \%$ | $0 \%$ |
| Sign Control | Stop | Stop | Stop |
| Traffic Vol by Lane | 138 | 429 | 341 |
| LT Vol | 0 | 90 | 287 |
| Through Vol | 76 | 0 | 54 |
| RT Vol | 62 | 339 | 0 |
| Lane Flow Rate | 150 | 466 | 371 |
| Geometry Grp | 1 | 1 | 1 |
| Degree of Util (X) | 0.23 | 0.64 | 0.575 |
| Departure Headway (Hd) | 5.51 | 4.939 | 5.584 |
| Convergence, Y/N | Yes | Yes | Yes |
| Cap | 650 | 732 | 645 |
| Service Time | 3.558 | 2.979 | 3.622 |
| HCM Lane V/C Ratio | 0.231 | 0.637 | 0.575 |
| HCM Control Delay | 10.2 | 16.4 | 15.9 |
| HCM Lane LOS | B | C | C |
| HCM 95th-tile Q | 0.9 | 4.7 | 3.7 |


|  | $\rangle$ |  |  | 7 |  |  | 4 | $\uparrow$ |  |  | $\downarrow$ | $\downarrow$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | * | $\uparrow$ | 「 | \% | $\uparrow$ | 「 | ${ }^{7}$ | $\uparrow$ | F | ${ }_{1}$ | $\uparrow$ | F |
| Traffic Volume (vph) | 317 | 182 | 46 | 37 | 179 | 356 | 41 | 55 | 50 | 370 | 58 | 157 |
| Future Volume (vph) | 317 | 182 | 46 | 37 | 179 | 356 | 41 | 55 | 50 | 370 | 58 | 157 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (m) | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.5 | 3.6 | 3.6 |
| Storage Length ( m ) | 70.0 |  | 35.0 | 70.0 |  | 70.0 | 25.0 |  | 15.0 | 25.0 |  | 65.0 |
| Storage Lanes | 1 |  | 1 | 1 |  | 1 | 1 |  | 1 | 1 |  | 1 |
| Taper Length (m) | 30.0 |  |  | 30.0 |  |  | 20.0 |  |  | 30.0 |  |  |
| Lane Utill. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt |  |  | 0.850 |  |  | 0.850 |  |  | 0.850 |  |  | 0.850 |
| FIt Protected | 0.950 |  |  | 0.950 |  |  | 0.950 |  |  | 0.950 |  |  |
| Satd. Flow (prot) | 1593 | 1676 | 1425 | 1593 | 1676 | 1425 | 1593 | 1676 | 1425 | 1575 | 1676 | 1425 |
| Flt Permitted | 0.635 |  |  | 0.633 |  |  | 0.716 |  |  | 0.718 |  |  |
| Satd. Flow (perm) | 1065 | 1676 | 1425 | 1061 | 1676 | 1425 | 1200 | 1676 | 1425 | 1190 | 1676 | 1425 |
| Right Turn on Red |  |  | Yes |  |  | Yes |  |  | Yes |  |  | Yes |
| Satd. Flow (RTOR) |  |  | 50 |  |  | 387 |  |  | 54 |  |  | 171 |
| Link Speed (k/h) |  | 60 |  |  | 60 |  |  | 50 |  |  | 50 |  |
| Link Distance (m) |  | 426.0 |  |  | 251.0 |  |  | 552.0 |  |  | 279.6 |  |
| Travel Time (s) |  | 25.6 |  |  | 15.1 |  |  | 39.7 |  |  | 20.1 |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 345 | 198 | 50 | 40 | 195 | 387 | 45 | 60 | 54 | 402 | 63 | 171 |
| Shared Lane Traffic (\%) |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Group Flow (vph) | 345 | 198 | 50 | 40 | 195 | 387 | 45 | 60 | 54 | 402 | 63 | 171 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) |  | 3.6 |  |  | 3.6 |  |  | 3.6 |  |  | 3.6 |  |
| Link Offset(m) |  | 0.0 |  |  | 0.0 |  |  | 0.0 |  |  | 0.0 |  |
| Crosswalk Width(m) |  | 4.8 |  |  | 4.8 |  |  | 4.8 |  |  | 4.8 |  |
| Two way Left Turn Lane |  |  |  |  |  |  |  |  |  |  |  |  |
| Headway Factor | 1.14 | 1.14 | 1.14 | 1.14 | 1.14 | 1.14 | 1.14 | 1.14 | 1.14 | 1.16 | 1.14 | 1.14 |
| Turning Speed (k/h) | 25 |  | 15 | 25 |  | 15 | 25 |  | 15 | 25 |  | 15 |
| Turn Type | Perm | NA | Perm | Perm | NA | Perm | Perm | NA | Perm | Perm | NA | Perm |
| Protected Phases |  | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |
| Permitted Phases | 4 |  | 4 | 8 |  | 8 | 2 |  | 2 | 6 |  | 6 |
| Detector Phase | 4 | 4 | 4 | 8 | 8 | 8 | 2 | 2 | 2 | 6 | 6 | 6 |
| Switch Phase |  |  |  |  |  |  |  |  |  |  |  |  |
| Minimum Initial (s) | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Minimum Split (s) | 28.5 | 28.5 | 28.5 | 28.5 | 28.5 | 28.5 | 23.1 | 23.1 | 23.1 | 23.1 | 23.1 | 23.1 |
| Total Split (s) | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 31.0 | 31.0 | 31.0 | 31.0 | 31.0 | 31.0 |
| Total Split (\%) | 52.3\% | 52.3\% | 52.3\% | 52.3\% | 52.3\% | 52.3\% | 47.7\% | 47.7\% | 47.7\% | 47.7\% | 47.7\% | 47.7\% |
| Maximum Green (s) | 28.5 | 28.5 | 28.5 | 28.5 | 28.5 | 28.5 | 25.9 | 25.9 | 25.9 | 25.9 | 25.9 | 25.9 |
| Yellow Time (s) | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 |
| All-Red Time (s) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 |
| Lead/Lag |  |  |  |  |  |  |  |  |  |  |  |  |
| Lead-Lag Optimize? |  |  |  |  |  |  |  |  |  |  |  |  |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | None | None | None | None | Min | Min | Min | Min | Min | Min |


|  | $\stackrel{ }{*}$ | $\rightarrow$ | 7 | 1 | 4 | 4 | 4 | 4 | \% | ( | ¢ | $\checkmark$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Walk Time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Flash Dont Walk (s) | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 |
| Pedestrian Calls (\#/hr) | 1 | 1 | 1 | 1 | 1 | , | 1 | 1 | 1 | 1 | 1 | 1 |
| Act Effct Green (s) | 22.3 | 22.3 | 22.3 | 22.3 | 22.3 | 22.3 | 22.5 | 22.5 | 22.5 | 22.5 | 22.5 | 22.5 |
| Actuated g/C Ratio | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| v/c Ratio | 0.81 | 0.30 | 0.08 | 0.09 | 0.29 | 0.48 | 0.09 | 0.09 | 0.09 | 0.84 | 0.09 | 0.25 |
| Control Delay | 32.8 | 13.1 | 4.1 | 11.5 | 13.1 | 3.8 | 12.5 | 12.2 | 4.6 | 35.5 | 12.3 | 3.7 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 32.8 | 13.1 | 4.1 | 11.5 | 13.1 | 3.8 | 12.5 | 12.2 | 4.6 | 35.5 | 12.3 | 3.7 |
| LOS | C | B | A | B | B | A | B | B | A | D | B | A |
| Approach Delay |  | 23.8 |  |  | 7.2 |  |  | 9.7 |  |  | 24.6 |  |
| Approach LOS |  | C |  |  | A |  |  | A |  |  | C |  |
| Queue Length 50th (m) | 34.5 | 15.2 | 0.0 | 2.8 | 15.0 | 0.0 | 3.1 | 4.2 | 0.0 | 40.5 | 4.4 | 0.0 |
| Queue Length 95th (m) | \#76.4 | 28.2 | 5.2 | 7.9 | 27.7 | 13.8 | 9.3 | 11.3 | 5.9 | \#93.6 | 11.6 | 10.3 |
| Internal Link Dist (m) |  | 402.0 |  |  | 227.0 |  |  | 528.0 |  |  | 255.6 |  |
| Turn Bay Length ( m ) | 70.0 |  | 35.0 | 70.0 |  | 70.0 | 25.0 |  | 15.0 | 25.0 |  | 65.0 |
| Base Capacity (vph) | 569 | 895 | 784 | 567 | 895 | 942 | 583 | 814 | 720 | 578 | 814 | 779 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.61 | 0.22 | 0.06 | 0.07 | 0.22 | 0.41 | 0.08 | 0.07 | 0.07 | 0.70 | 0.08 | 0.22 |

## Intersection Summary

## Area Type: <br> CBD

Cycle Length: 65

## Actuated Cycle Length: 55.9

Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 17.8
Intersection Capacity Utilization 72.8\%
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
Splits and Phases: $\quad 3:$ Vine Rd/Portage Rd \& Highway 99


## INPUT VOLUMES

Vehicles and pedestrians per 60 minutes
© Site: 101 [Pemberton - 2030 Total (Site Folder: General)]
Pemberton Roundabout
Site Category: (None)
Roundabout

## Volume Display Method: Total and \%



|  | All MCs | Light Vehicles (LV) | Heavy Vehicles (HV) |
| :--- | :---: | :---: | :---: |
| S: Portage Rd | 674 | 661 | 13 |
| $\mathrm{~N}:$ Aspen Bv | 61 | 60 | 1 |
| W: Birch Rd | 552 | 541 | 11 |
| Total | 1287 | 1261 | 26 |



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Geometric Delay is included).

SIDRA INTERSECTION 9.0 | Copyright © 2000-2020 Akcelik and Associates Pty Ltd | sidrasolutions.com
Organisation: ASSOCIATED ENGINEERING GROUP LTD. | Licence: PLUS / 1PC | Processed: Thursday, February 4, 2021 10:01:28 AM
Project: Not Saved

## LANE SUMMARY

## Site: 101 [Pemberton - 2030 Total (Site Folder: General)]

## Pemberton Roundabout

Site Category: (None)
Roundabout

| Lane Use and Performance |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | DEMAND FLOWS |  | Cap. <br> veh/h | Deg. Satn <br> v/c | Lane Util. $\qquad$ \% | Aver. Delay <br> sec | Level of Service | 95\% BACK OF QUEUE <br> [ Veh Dist] <br> m |  | Lane Config | Lane Length <br> m | Cap. Prob. Adj. Block.$\qquad$ |  |
| South: Portage Rd |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane $1^{\text {d }}$ | 749 | 2.0 | 1471 | 0.509 | 100 | 7.1 | LOS A | 4.3 | 30.8 | Full | 85 | 0.0 | 0.0 |
| Approach | 749 | 2.0 |  | 0.509 |  | 7.1 | LOS A | 4.3 | 30.8 |  |  |  |  |
| North: Aspen Bv |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane $1^{\text {d }}$ | 68 | 2.0 | 700 | 0.097 | 100 | 6.4 | LOS A | 0.5 | 3.8 | Full | 40 | 0.0 | 0.0 |
| Approach | 68 | 2.0 |  | 0.097 |  | 6.4 | LOS A | 0.5 | 3.8 |  |  |  |  |
| West: Birch Rd |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane $1^{\text {d }}$ | 613 | 2.0 | 1409 | 0.435 | 100 | 2.3 | LOS A | 3.7 | 26.4 | Full | 35 | 0.0 | 0.0 |
| Approach | 613 | 2.0 |  | 0.435 |  | 2.3 | LOS A | 3.7 | 26.4 |  |  |  |  |
| Intersectio <br> n | 1430 | 2.0 |  | 0.509 |  | 5.0 | LOS A | 4.3 | 30.8 |  |  |  |  |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (\%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
d Dominant lane on roundabout approach

| Approach Lane Flows (veh/h) |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| South: Portage Rd |  |  |  |  |  |  |  |  |
| Mov. <br> From S <br> To Exit | L2 W | T1 N | Total | \%HV | Cap. veh/h | Deg. Satn v/c | Lane Prob. Util. SL Ov. $\% \quad \%$ | $\begin{aligned} & \text { Ov. } \\ & \text { Lane } \\ & \text { No. } \end{aligned}$ |
| Lane 1 | 680 | 69 | 749 | 2.0 | 1471 | 0.509 | 100 NA | NA |
| Approach | 680 | 69 | 749 | 2.0 |  | 0.509 |  |  |
| North: Aspen Bv |  |  |  |  |  |  |  |  |
| Mov. <br> From N To Exit: | $\begin{gathered} \mathrm{T} 1 \\ \mathrm{~S} \end{gathered}$ | R2 <br> W | Total | \%HV | Cap. veh/h | Deg. Satn v/c | Lane Prob. $\underset{\%}{\text { Util. SL Ov. }}$ | $\begin{aligned} & \text { Ov. } \\ & \text { Lane } \\ & \text { No. } \end{aligned}$ |
| Lane 1 | 44 | 23 | 68 | 2.0 | 700 | 0.097 | 100 NA | NA |
| Approach | 44 | 23 | 68 | 2.0 |  | 0.097 |  |  |
| West: Birch Rd |  |  |  |  |  |  |  |  |
| Mov. <br> From W To Exit | L2 N | R2 S | Total | \%HV | Cap. veh/h | Deg. Satn v/c | Lane Prob. Util. SL Ov. \% \% | $\begin{aligned} & \text { Ov. } \\ & \text { Lane } \\ & \text { No. } \end{aligned}$ |
| Lane 1 | 34 | 579 | 613 | 2.0 | 1409 | 0.435 | 100 NA | NA |
| Approach | 34 | 579 | 613 | 2.0 |  | 0.435 |  |  |


[^0]:    ${ }^{1}$ Trip Generation Manual, Institute of Transportation Engineers (ITE), 10 ${ }^{\text {th }}$ Edition

[^1]:    2 Synchro Software - Version 10
    ${ }^{3}$ Sidra Intersection - Version 7.0

