Memorandum

20 May 2020

To			
Copy to	Ian Robertson, Sean Neilson		
From	Shruti Gadgil	Tel	+64 27 616 2269
Subject	Wharf Street/Kitchener Street Intersection Modelling	Job no.	51/12513123

1 Introduction

Further to the 2016 report provided by TDG outlining the different options to increase efficiency at Wharf Street/ Kitchener Street intersection, Dunedin City Council have commissioned GHD in 2020 to review and conduct further modelling at this intersection to understand delays and queue length changes caused by signalising the intersection.

In order to understand the impacts of installing new signals at Wharf Street/ Kitchener Street intersection, traffic models of the existing intersection and the proposed option were developed in SIDRA. These models were then evaluated to determine quantitatively the operational difference between current layout and the proposed new layout.

2 Existing Network Modelling

2.1 Existing Intersection Layout

Wharf Street is a two lane each way regional road with a wide median with an average ADT of 16,900 (2019, Mobile Roads) vehicles per day. Kitchener Street is a one-lane two way urban road with a cycle and kerbside parking and an average ADT of 765 vehicles (2019, Mobile Roads)

The SIDRA intersection model of the existing intersection layout is shown in Figure 1 below.

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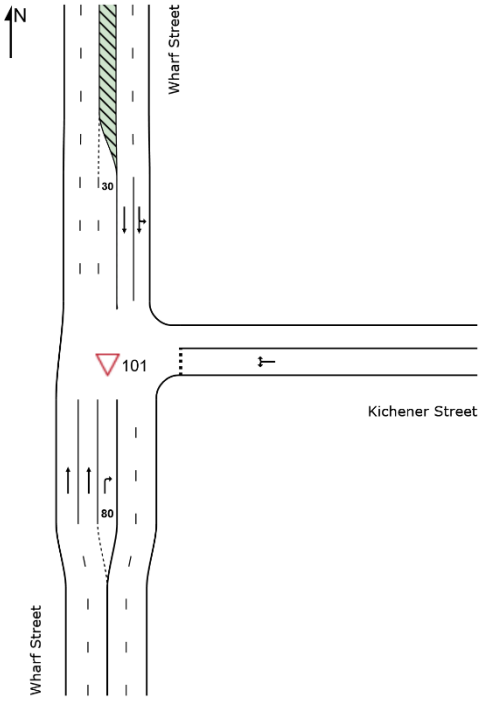

Figure 1 - Existing Intersection Layout

2.2 Assumptions and Exclusions

The following assumptions and exclusions have been made for this analysis:

- Have not allowed for network modelling or intersection with adjacent intersections.
- Have modelled existing lane configurations based on latest available aerials.
- Only intersections shown in Figure 1 are modelled in SIDRA.
- Only the peak periods were modelled. These numbers were extracted from the TDG report provided to GHD.
- No queue length data was available hence; gap acceptance values were modified to replicate on-site observations.
- Right turning vehicles from Kitchener Street were assumed to be using the central median on Wharf Street and hence a merging lane has been provided in the model as show in Figure 1.
- Excluded any cyclist count in the modelling.

2.3 Traffic Counts and Modelled Periods

Dunedin City Council provided GHD with traffic counts conducted on Wharf Street for the first week of April 2019 (Easter was at the end of the second week of April). However, the TDG report uses volumes that are higher than these traffic volumes. These flows have been increased by 5% on Kitchener Street and 30% increase on Wharf Street to allow for growth and uncertainty in turning volumes. For the modelling of this intersection, only peak periods have been considered.

2.4 Modelling Parameters

- Lane widths and short turn lane lengths have been configured to match aerials.

- SIDRA reduced gap acceptance parameters gave been used for the un-signalised intersection. A reduction of 30% to the default gap acceptance parameters has been used only for PM traffic flows to accurately replicate on-site conditions.
- SIDRA default gap acceptance parameters have been used for the signalised movements.
- 60 km/h entry and exit speeds for vehicles along Wharf Street and 50 km/hr entry and exit speeds for Kitchener Street.
- Yellow time of 4 seconds, and all red time of 1 second.
- Arrival type has been set as "4 - favourable" rather than "3-isolated" for the northbound approach to the traffic signals on Wharf Street due to the proximity of the traffic signals at Strathallan Street.

3 Proposed Signalised Intersection

3.1 Proposed Intersection Layout

Figure 2 below shows the proposed intersection layout once signalised.

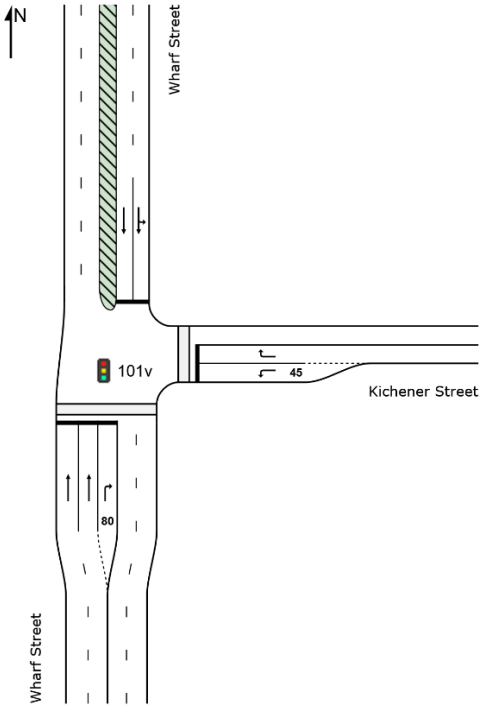

Figure 2: Proposed Signalised Intersection Layout

3.2 Proposed Intersection Phasing

SCATS phasing sequence have been adopted for the network models as illustrated in Figure 3.

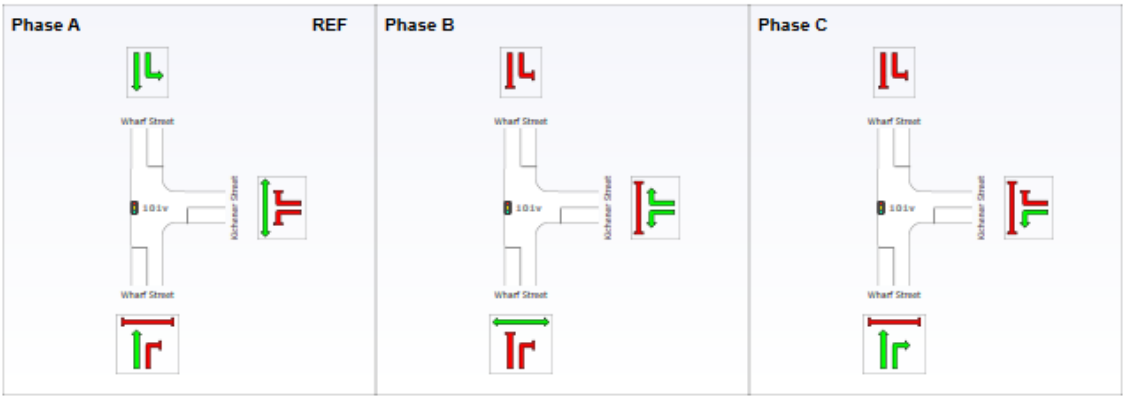

Figure 3: Option Network Phase Sequence

Optimum cycle time and phase splits determined by SIDRA for the option networks are illustrated in Appendix A.

SIDRA cycle time option was set to user given phase times. SCATS average cycle time and phase splits were adopted as a base and adjusted to achieve model validation.

3.3 Calibration

No calibration can be undertaken for this intersection due to lack of queue length survey data. Hence, default SIDRA values have been used for this analysis.

4 Network Performance comparison

For the signalised intersection, the following optimum cycle times have been used for the signalised option:

- **Morning Peak**: Optimum cycle time of 76 seconds
- **Evening Peak**: Optimum cycle time of 98 seconds

4.1 Morning Peak Comparison (Existing and Signalised Option)

Existing and proposed intersection performance is tabulated in Table 1 and Table 2 below.

Table 1: Network Performance - Morning Peak (Existing and Option)

Morning Peak							
Approach/Movement		Existing Network			Option 1		
		Average Delay (Seconds)	LOS	95% Back of Queue (veh)	Average Delay (Seconds)	LOS	95% Back of Queue (veh)
South: Wharf Street	Through	0	LOS A	0	1	LOS A	4
	Right	12	LOS B	***1***	38	LOS D	***4***
	Approach	***1***	***NA***	1	***3***	***LOS A***	4
East:Kitchener Street	Left	7	LOS A	1	25	LOS C	1
	Right	24	LOS C	1	43	LOS D	2
	Approach	***15***	***LOS C***	1	***33***	***LOS C***	2
North: Wharf Street	Left	6	LOS A	***0***	17	LOS B	***9***
	Through	***0***	LOS A	0	***12***	LOS B	9
	Approach	0	NA	0	12	LOS B	9
All Vehicles		***1***	***NA***	***1***	***5.6***	***LOS A***	***9***

The AM modelling illustrates that South Wharf Street right turn movement performs at LOS D with the signals incorporated. The highest delays for this intersection are seen at Kitchener Street right turning movements. There is an overall increase of 18 seconds delay to that movement.

Overall, at the AM peak period, the intersection performs at a LOS A with the signals options.

4.2 Evening peak comparison

Table 2: Option Network Performance - Evening Peak

Evening Peak							
Approach/Movement		Existing Network			Option 1		
		Average Delay (Seconds)	LOS	95% Back of Queue (veh)	Average Delay (Seconds)	LOS	95% Back of Queue (veh)
South: Wharf Street	Through	0	LOS A	0	0	LOS A	1
	Right	47	LOS E	***1***	56	LOS E	***1***
	Approach	***1***	***NA***	1	***2***	***LOS A***	5
East:Kitchener Street	Left	30	LOS D	5	43	LOS D	6
	Right	55	LOS F	5	60	LOS E	5
	Approach	***41***	***LOS E***	5	***51***	***LOS D***	5
North: Wharf Street	Left	6	LOS A	***0***	17	LOS B	***33***
	Through	***0***	LOS A	0	***11***	LOS B	33
	Approach	0	***NA***	0	11	***LOS B***	33
All Vehicles		***3***	***NA***	***4.8***	***10***	***LOS B***	***33.3***

The PM modelling illustrates that southbound Wharf Street vehicles will have an increase of 33 vehicles queued. Queueing and delays are expected for the intersections through movements as this movement is now signalised. However, at present there are traffic lights located at Strathallan Street already. Site observations show queuing from Strathallan Street past Kitchener Street at peak hours. Hence, the addition of signals at Kitchener Street intersection will not significantly impact the intersection.

Overall, at the PM peak period, the intersection performs at a LOS B with the signals options.

4.3 Summary

SIDRA model indicates that signalising Kitchener Street / Wharf Street intersection does not have significant delays and queue lengths for both the AM and PM peak. There are some delays experienced during PM peak southbound at Wharf Street but these queuing already occurs through this intersection during evening peak times.

Implementing signals at this intersection will not cause any significant impacts on the overall functionality of the intersection.

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The base model is not calibrated due to limitations of data availability, specifically without data on observed queue lengths or average delay. This is acknowledged as a limitation of the modelling in terms of the accuracy of the base model.

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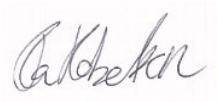

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