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<b>Date:</b>	<i>February 2016</i>
<b>Project:</b>	<i>Queenstown Hanley Downs</i>
<b>Subject:</b>	<i>Northern (Woolshed) Access: Traffic Capacity Assessment</i>

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## 1 Context

Evidence presented to the Plan Change 44 (PC44) hearing in July 2015<sup>1</sup> noted that:

- the expected pattern of land-use resulting from PC44 would include more residential and educational activity, and less office and retail activity when compared to the situation under the operative District Plan;
- in particular, the number of dwellings enabled by PC44 ranged between 1,316 and 2,228;
- a new priority intersection with State Highway 6 (SH6) was proposed a short distance to the south of the existing Woolshed Road intersection;
- this would include an additional merge lane to accommodate the large volume of traffic expected to turn left from Woolshed Road towards Queenstown;
- while traffic demands are sensitive to a range of parameters (especially the rate and type of development), the intersection could be scaled to accommodate any level of development;
- the construction of the intersection to the highest standard at the outset would be likely to result in unnecessary over-provision, certainly in the short-term and possibly permanently if the scale of development of associated traffic activity did not eventuate; and
- there was agreement with the NZ Transport Agency (NZTA) that the intersection should at all times operate safely and provide an acceptable level of service.

At and immediately following the hearing, agreement was reached with the NZTA that the intersection would be upgraded to a standard rural priority intersection to accommodate the additional traffic demands and that more detailed design work would be undertaken to identify the relevant geometric parameters for the intersection.

In July 2015 a file note<sup>2</sup> identified the geometric design parameters, based on SIDRA analyses and traffic demands associated with a development including 1,800 dwellings. Key parameters were:

- a 55m long right turn bay from the north;
- a merge length for the left-turn towards the north of 275-300m;
- a deceleration lane of 140m for the left-turn movements from the south.

More detailed design work on the intersection was undertaken by Opus in November 2015. This has resulted in a new intersection location approximately 1km to the south of the original location, with a design which reverts to a tighter turn for the left-turn movement to the south without a merge lane (the NZTA advised that it saw no need for the provision of a merge lane when there was only a possibility that this would be required in the longer term).

This file note reports a capacity assessment of the revised proposed, taking account both of the change in geometric details but also the location, which can be expected to affect the pattern of turning movements.

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<sup>1</sup> Evidence of Tim Kelly for RCL, Proposed Plan Change 44, 26 June 2015.

<sup>2</sup> Queenstown PC44: Hanley Downs: Woolshed Road Intersection: Design Parameters (July 2015)

## 2 Geometric Detail

The current intersection proposal is detailed on Opus plan 6-XZ246.00/C02/RC (undated but received 15 February 2016). Key details include:

- a right turn from the north 55m in length and 3.5m wide;
- a 150m deceleration length for the left-turn from the south;
- a 15m radius and give-way control for the left turn towards the south; and
- through northbound and southbound lanes 3.5m wide.

## 3 Traffic Generation

All non-residential land-uses are unchanged from those reported in evidence to the PC44 hearing in July 2015.

For this assessment, the number of dwellings has been varied to assess the ability of the intersection to accommodate the traffic associated with differing development sizes.

The scenarios tested are:

- 1,500 dwellings;
- 1,650 dwellings;
- 1,800 dwellings; and
- 2,100 dwellings.

## 4 Traffic Distribution & Routes

The original assessments assumed that development-related traffic movements would distribute 20%/80% between SH6 South and SH6 North. These proportions have been retained.

The change in location of the northern access intersection is likely to affect the routes taken by some traffic movements. **Table 1** shows the assumed changes, based broadly on the distribution of development relative to the available access routes and the times / distances involved. The northern access is likely to become more attractive for trips to/from the south and slightly less attractive for trips to/from the north (particularly as area DP7 within Hanley Downs adjoins Jacks Point and Maori Jack Road).

Movement	Original Assessment		Modified Assessment	
	Woolshed	MJR	Woolshed	MJR
Hanley Downs <-> SH6 South	20%	80%	30%	70%
Hanley Downs <-> SH6 North	95%	5%	85%	15%
Jacks Point <-> SH6 South	0%	100%	0%	100%
Jacks Point <-> SH6 North	25%	75%	30%	70%

**Table 1: Assume Routings of Development Vehicle Movements**

## 5 Intersection Performance Assessments

Intersection simulation software SIDRA has been used to forecast capacity conditions for weekday AM and PM peak periods in 2027. Background traffic volumes on SH6 in 2014 have been assumed to grow at 2% per annum to this year.

Detailed results are shown by **Figures 1-4**. The performance for each turning movement is discussed below.

*SH6 South: Left Turn to Woolshed Road*

The movement is very low in volume (most drivers from the south would access the development area

via Maori Jack Road) and operates at LOS A at all times. Delays are limited to the geometric delay associated with the manoeuvre.

#### *SH6 South: Northbound Through Movement*

This movement has priority and experiences no delays.

#### *Woolshed Road: Left Turn to North*

This movement is high in volume, especially in the AM peak when residents are expected to travel to work in the Queenstown / Frankton areas. With 1,650 dwellings and above, this movement is greater than the northbound through movement on SH6 during the AM peak.

A requirement for this movement to give-way to the northbound through movement introduces delays and some queuing. During the AM peak and with 1,500 dwellings, the average delay is 19s (LOS C), increasing to 27s (LOS D) with 1,650 dwellings. With 1,800 dwellings and above, delays and queues increase rapidly with LOS F for a development of 2,100 dwellings.

The much lower traffic demands on this movement during the PM peak means that this operates at LOS A for all development scenarios.

The proposed intersection includes little room to store left and right turning vehicles at the give-way line. While the right turning volume is low, any more than one vehicle waiting to turn right causes additional delay to the high volume left-turn movement. A test in which the length of the available right-turn lane was increased from 5m to 15m for the 2,100 dwelling development in the AM peak indicates that delays experienced by the left-turn movement would reduce from 154s to 106s (but still LOS F).

#### *Woolshed Road: Right Turn to South*

The movement is very low in volume (most drivers towards the south would leave the development area via Maori Jack Road).

In the AM peak, the need for this movement to give way to both through movements on SH6 plus right-turning traffic entering the development means that delays of 30-35s (LOS D) are experienced for a development of up to 1,800 dwellings, deteriorating to a delay of 40s (LOS E) for a 2,100 dwelling development.

In the PM peak, the much higher right-turn entry flows from SH6 (north) would result in high delays to this movement, which would experience a delay of 47s (LOS E) for a 1,500 dwelling development, increasing to a delay of 74s (LOS F) for a 2,100 dwelling development.

#### *SH6 North: Southbound Through Movement*

This movement has priority and experiences no delays (with the exception of the PM peak period for the 2,100 dwelling development, where a small delay arises as a result of the right turn movement extending beyond the available turn bay length – this is addressed below).

#### *SH6 North: Right Turn to Woolshed Road*

This movement is high in volume, especially in the PM peak when residents are expected to travel from work in the Queenstown / Frankton areas.

For the AM peak period, this movement operates with low levels of delay, only increasing to 17s (LOS C) for the 2,100 dwelling development.

For the PM peak period, this movement operates with acceptable levels of delay and a queue length of 43m for a development of up to 1,800 dwellings (the length of the right turn bay is 55m). For a 2,100 dwelling development, although operating with a modest delay of 17s (LOS C), the queue length extends to 60m, beyond the length of the right turn bay and causing some interference to through southbound movements.

## 6 Interpretation

The results described above indicate that for a development of up 1,650 dwellings, the intersection will operate satisfactorily, with the only significant delay experienced by a small volume of right-turn movements to SH6 (which would be likely to utilise Maori Jack Road to avoid such delays).

At a development of 1,800 dwellings and above, significant delays would be experienced by the left-turn movement from Woolshed Road towards the north during the AM peak – though these could be eased by the provision of separate left and right turning lanes. The corresponding return movement in the PM peak period would also experience delays approaching one minute. Importantly, no impacts would be experienced by through movements on SH6.

A development of 2,100 dwellings and above would result in unacceptable levels of delay and a need to extend the right-turn bay from the north if safety and capacity problems were to be avoided for SH6 movements.

It is stressed that the estimates of traffic activity associated with the development are based upon a number of assumptions and may be regarded as a ‘worst-case’, on the basis that:

- the unit trip rate of 8 vehicle trips / dwelling / day is likely to be high in the context of residential development more remote from the established urban area of Frankton / Queenstown;
- the development may attract a higher proportion of retirees who are less inclined to travel during weekday peak periods;
- unit trip rates for the ‘higher yield’ development scenarios are likely to be lower because average lot and dwelling sizes will be lower;
- existing SH6 counts already include an element of traffic associated with the existing Jacks Point development with some potential ‘double counting’ of vehicle movements;
- no allowance has been made for any reductions associated with the provision of public transport services, which could well be justified for the combined development; and
- growth in SH6 volumes may be suppressed if any of the proposals for the provision of a more direct transportation facility between Queenstown and Milford / Te Anau eventuate.

The intersection could be designed and constructed to a standard which would accommodate the largest development size without the capacity issues identified above. This would involve the provision of a merge lane for the left turn movement towards the north and a longer right-turn bay for movements from the north.

The larger footprint and land-take requirements for such an intersection, together with the forecasting uncertainties described above, suggests a more pragmatic response is for the construction of the intersection to a lower standard while not precluding additional capacity provision in the event that this is required in the longer term. This approach has been previously agreed with the NZTA.

## 7 Recommendations

It is recommended that the Opus intersection design be adopted, but with the provision of separate approach lanes for left and right turning movements from Woolshed Road.

As development progresses, traffic conditions should be monitored to assess the performance of the intersection and growth in background traffic volumes. This monitoring should be used to identify the need for any minor works to pre-empt capacity or safety issues before these arise.

Period	Approach	Movement	Movement					Approach					Intersection				
			Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS
AM Peak, 2027: 1500 Dwellings	SH6 S	Left	13	8.0	1%	0.0	LOS A	568	0.2	30%	0.0	NA	1,752	8.1	86%	73.8	NA
		Through	556	0.0	30%	0.0	LOS A										
	Woolshed	Left	538	19.2	86%	73.8	LOS C										
		Right	34	30.2	22%	5.3	LOS D										
	SH6 N	Through	398	0.0	22%	0.0	LOS A										
		Right	214	12.4	31%	10.3	LOS B										

Period	Approach	Movement	Movement					Approach					Intersection				
			Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS
PM Peak, 2027: 1500 Dwellings	SH6 S	Left	28	8.0	2%	0.0	LOS A	466	0.5	24%	0.0	NA	1,695	4.8	57%	31.8	NA
		Through	438	0.0	24%	0.0	LOS A										
	Woolshed	Left	174	7.4	22%	6.1	LOS A										
		Right	9	47.5	12%	2.4	LOS E										
	SH6 N	Through	585	0.0	32%	0.0	LOS A										
		Right	461	13.4	57%	31.8	LOS B										

Figure 1: Intersection Performance: Weekday AM & PM Peak 2027: 1500 Dwellings

Period	Approach	Movement	Movement					Approach					Intersection				
			Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS
AM Peak, 2027: 1650 Dwellings	SH6 S	Left	14	8.0	1%	0.0	LOS A	576	0.2	31%	0.0	NA	1,813	10.8	93%	110.7	NA
		Through	562	0.0	31%	0.0	LOS A										
	Woolshed	Left	574	26.7	93%	110.7	LOS D	611	27.1	93%	110.7	LOS D					
		Right	37	32.3	25%	6.2	LOS D										
	SH6 N	Through	400	0.0	22%	0.0	LOS A	626	4.6	33%	11.4	NA					
		Right	226	12.6	33%	11.4	LOS B										

Period	Approach	Movement	Movement					Approach					Intersection				
			Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS
PM Peak, 2027: 1650 Dwellings	SH6 S	Left	32	8.0	2%	0.0	LOS A	472	0.6	24%	0.0	NA	1,750	5.2	61%	37.1	NA
		Through	440	0.0	24%	0.0	LOS A										
	Woolshed	Left	184	7.4	24%	6.5	LOS A	195	9.8	24%	6.5	LOS A					
		Right	11	51.6	14%	2.9	LOS F										
	SH6 N	Through	591	0.0	32%	0.0	LOS A	1,083	6.4	61%	37.1	NA					
		Right	493	14.0	61%	37.1	LOS B										

Figure 2: Intersection Performance: Weekday AM & PM Peak 2027: 1650 Dwellings

Period	Approach	Movement	Movement					Approach					Intersection				
			Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS
AM Peak, 2027: 1800 Dwellings	SH6 S	Left	16	8.0	1%	0.0	LOS A	585	0.3	31%	0.0	NA	1,876	18.6	100%	194.2	NA
		Through	569	0.0	31%	0.0	LOS A										
	Woolshed	Left	611	49.4	100%	194.2	LOS E	651	48.5	100%	194.2	LOS E					
		Right	40	34.7	29%	7.1	LOS D										
	SH6 N	Through	402	0.0	22%	0.0	LOS A	640	4.8	35%	12.5	NA					
		Right	238	12.9	35%	12.5	LOS B										

Period	Approach	Movement	Movement					Approach					Intersection				
			Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS
PM Peak, 2027: 1800 Dwellings	SH6 S	Left	34	8.0	2%	0.0	LOS A	476	0.6	24%	0.0	NA	1,803	5.6	65%	43.1	NA
		Through	442	0.0	24%	0.0	LOS A										
	Woolshed	Left	195	7.5	25%	7.0	LOS A	206	10.3	25%	7.0	LOS B					
		Right	12	57.9	17%	3.6	LOS F										
	SH6 N	Through	597	0.0	33%	0.0	LOS A	1,121	6.9	65%	43.1	NA					
		Right	524	14.7	65%	43.1	LOS B										

Figure 3: Intersection Performance: Weekday AM & PM Peak 2027: 1800 Dwellings

Period	Approach	Movement	Movement					Approach					Intersection				
			Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS
AM Peak, 2027: 2100 Dwellings	SH6 S	Left	18	8.0	1%	0.0	LOS A	600	0.3	32%	0.0	NA	1,997	55.3	115%	497.6	NA
		Through	582	0.0	32%	0.0	LOS A										
	Woolshed	Left	683	153.5	115%	497.6	LOS F	729	146.3	115%	497.6	LOS F					
		Right	46	40.0	36%	9.2	LOS E										
	SH6 N	Through	406	0.0	22%	0.0	LOS A	668	5.3	40%	15.0	NA					
		Right	262	13.5	40%	15.0	LOS B										

Period	Approach	Movement	Movement					Approach					Intersection				
			Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS	Veh/hr	Average Delay (secs)	RFC %	95% Queue (m)	LOS
PM Peak, 2027: 2100 Dwellings	SH6 S	Left	40	8.0	2%	0.0	LOS A	485	0.7	24%	0.0	NA	1,909	6.9	74%	59.5	NA
		Through	445	0.0	24%	0.0	LOS A										
	Woolshed	Left	216	7.7	28%	8.4	LOS A	229	11.6	28%	8.4	LOS B					
		Right	14	73.5	24%	5.1	LOS F										
	SH6 N	Through	607	0.8	47%	45.4	LOS A	1,195	8.6	74%	59.5	NA					
		Right	587	16.5	74%	59.5	LOS C										

Figure 4: Intersection Performance: Weekday AM & PM Peak 2027: 2100 Dwellings