Before a Commissioner appointed by
Selwyn District Council

Under	The Resource Management Act 1991 (**the Act**)
In the matter of	Private Plan Change 61, being the rezoning of approximately 30ha of Rural Outer Plans to Business 2 & Living 1 Zones, east of Darfield

---

Statement of Evidence of Andrew David Carr

30 March 2021

Qualifications and experience

1 My full name is Andrew ("Andy") David Carr.

2 I am a Chartered Professional Engineer and an International Professional Engineer (New Zealand section of the register). I hold a Masters degree in Transport Engineering and Operations and also a Masters degree in Business Administration.

3 I served on the national committee of the Resource Management Law Association between 2013-14 and 2015-17, and I am a past Chair of the Canterbury branch of the organisation. I am also a Chartered Member of Engineering New Zealand (formerly the Institution of Professional Engineers New Zealand), and an Associate Member of the New Zealand Planning Institute.

4 I have more than 31 years' experience in traffic engineering, over which time I have been responsible for investigating and evaluating the traffic and transportation impacts of a wide range of land use developments, both in New Zealand and the United Kingdom.

5 I am presently a director of Carriageway Consulting Ltd, a specialist traffic engineering and transport planning consultancy which I founded seven years ago. My role primarily involves undertaking and reviewing traffic analyses for both resource consent applications and proposed plan changes for a variety of different development types, for both local authorities and private organisations. I have also been a Hearings Commissioner and acted in that role for Greater Wellington Regional Council, Ashburton District Council, Waimakariri District Council and Christchurch City Council.

6 Prior to forming Carriageway Consulting Ltd I was employed by traffic engineering consultancies where I had senior roles in developing the business, undertaking technical work and supervising project teams primarily within the South Island.

7 I have been involved in a number of proposals which have involved assessing the traffic generation and effects of residential and mixed-use plan change requests. Within Selwyn, this has included Plan Changes 77 (West Melton), 64 and 70 (Faringdon), 62 (Leeston), 60 (Kirwee), 34 (Southbridge), 25 (Porter Heights Ski Area), and 24 (Silverstream). I have also previously provided advice to the Council for incoming plan change requests, including Plan Changes 36 and 41.

8 In respect of resource consents, my experience includes Levi Park (470 residences on the eastern side of Rolleston), Faringdon (in excess of 1,200

residences in Rolleston), Stonebrook (460 residences on the western side of Rolleston). I have also advised the Council regarding the transportation aspects of large resource consent applications (most recently for a new supermarket in Lincoln, and a gravel extraction facility near Templeton).

9 Elsewhere, in Christchurch I have provided transportation advice for Plan Changes 68 (600 residences in Halswell), 30 (Prestons, for more than 2,000 residences towards the north of the city), and Plan Changes 11, 12, 17, 18, 20, 22 and 23 in Waimakariri.

10 I have carried out commissions in Selwyn District for more than 15 years. As a result of my experience, I consider that I am fully familiar with the particular traffic-related issues in the region and also the transportation characteristics of mixed-use plan change requests and resource consent applications.

Code of Conduct for Expert Witnesses

11 While this is not a hearing before the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2014 and that I have complied with it when preparing my evidence. Other than when I state I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of Evidence

12 In this matter, I have been asked by the plan change proponents, Rupert and Catherine Wright, to:

a. Review my previous assessments to ensure that they remain current;
b. Assess the submissions received on the plan change and identify whether the matters raised are relevant to the transportation considerations of the plan change and any actions arising; and
c. Comment on the Council Officers' reports.

13 I have been involved in this project since mid-2017, and this has included the production of a Transportation Assessment (Appendix 9 to the Plan Change Request). I have visited the site on numerous occasions, mostly recently in February 2021.

14 I have also prepared two Technical Notes in response to initial comments from Mr Smith, the Council's peer reviewer. These are attached as Annexures A and B, and relate to an assessment of the State Highway 73 / Horndon Street

intersection, and the cumulative effects arising from other plan changes in the area.

Review of Transportation Assessment

15 The Transportation Assessment was produced in February 2019. I have therefore taken the opportunity to review the information provided to ensure it remains current.

16 The roading network remains the same as described in the report, but as might be expected, traffic flows have changed since the volumes set out[1]. The two Waka Kotahi NZTA traffic counters used were within Darfield and west of Aylesbury, and the Transportation Assessment identified that both would record higher volumes that those past the site (in the case of the Darfield counter this was because it records local trips within the town, and in the case of the Aylesbury counter, this was because the settlement of Kirwee lies between the counter and the site). However the use of these counters provides a robust approach.

17 The volumes used in the earlier assessment are set out below.

Location	Weekday		Saturday		Sunday	
	Daily	Peak Hours	Daily	Peak Hour	Daily	Peak Hour
Darfield	5,225	420 (AM) 500 (PM)	4,550	425	3,850	375
Aylesbury	5,125	505 (AM) 550 (PM)	4,675	400	4,175	375

Table 1: Traffic Flows on Adjacent Road Network Used in Transportation Assessment (Recorded in 2018)

18 The most recent information shows the following.

Location	Weekday		Saturday		Sunday	
	Daily	Peak Hours	Daily	Peak Hour	Daily	Peak Hour
Darfield	4,780	340 (AM) 425 (PM)	3,925	380	3,510	380
Aylesbury	5,700	530 (AM) 540 (PM)	4,690	400	4,145	400

Table 2: Updated Traffic Flows on Adjacent Road Network (Recorded in 2020)

[1] Section 4.1 of the Transportation Assessment

19 To some extent, these figures will have been affected by restrictions on travel associated with COVID-19, in addition to the elimination of travel by overseas tourists. With that in mind, it can be seen that traffic flow recorded within Darfield have reduced. Although the daily flow at Aylesbury has increased, the peak hour flows remain almost the same.

20 As part of responding to submissions (discussed in more detail later in this evidence), I carried out a traffic survey at the State Highway 73 / Horndon Street intersection during February 2021. West of the intersection (that is, as close as possible to the NZTA Darfield counter), this showed a weekday morning peak hour of 358 vehicles (two-way) with an evening peak hour volume of 465 vehicles (two-way). These values are very similar to those recorded within Darfield by the Waka Kotahi traffic counter (to within 40 vehicles in the peak hour).

21 As I set out subsequently, the traffic flows I recorded on Horndon Street are the same as would be expected. This gives me confidence that the traffic counter was not carried out at an anomalous time.

22 Based on this result, in my view, the traffic volume past the site is closer to the traffic volume recorded in Darfield than the one recorded in Aylesbury. As such, I am of the view that the assessment carried out in the Transportation Assessment reflects traffic volumes that are greater than are presently occurring.

23 It is also evident that traffic growth on the highway in the peak hours is lower than allowed for in the Transportation Assessment (3.6% per annum)[2].

24 However, even allowing for the higher traffic flows and higher growth in the Transportation Assessment, I set out that with full development of the plan change area, queues and delays at the State Highway 73 / Creyke Road intersection would remain modest (Level of Service C or better)[3]. I consider that this is a 'worst case' scenario, and the queues and delays at the intersection will likely be lower than shown.

25 I have taken the opportunity to update my earlier assessment of road safety, and assessed the NZTA Crash Analysis System for reported crashes over the same area set out in paragraph 4.3.1 of the Transportation Assessment[4]. Between 2019 to the current time, there have been no additional crashes

---

[2] Section 4.1 of the Transportation Assessment

[3] Section 7.1 of the Transportation Assessment

[4] Creyke Road from 250m north of State Highway 73 to 200m south of the site southern boundary; and State Highway 73 for 250m either side of Creyke Road.

recorded to those set out in the Transportation Assessment. I remain of the view that the proposed plan change will not give rise to adverse road safety effects on the adjacent roading network.

26 With regard to the potential to upgrade the State Highway 73 / Creyke Road intersection[5], I remain of the view that for reasons of road safety, the southern approach to the intersection should be realigned and 'straighten up' the angle at which Creyke Road meets the highway. However in the Transportation Assessment, I evaluated the point at which the intersection requires a left-turn and a right-turn lane. Subsequent to this, I am aware that the Council has identified that permitted development in the immediate area should be included within any assessment of the intersection. I therefore discuss this further later in my evidence.

27 Overall, and subject to the matters relating to the upgrading of the State Highway 73 / Creyke Road intersection, I consider that the conclusions of the Transportation Assessment remain valid; that the proposed plan change can be supported from a traffic and transportation perspective.

Response to Submissions

28 I have reviewed the submissions received on the plan change request, and address the matters raised by submitters below. Where the same issue has been raised by different submitters, I have only responded to the issue once. For clarity, the issues are not set out in any particular order.

29 I have been advised that submissions 7 and 8 have been withdrawn insofar as they relate to transportation matters., I have therefore not considered these further.

Submitter Concern: The plan changes requires the upgrading of the State Highway 73 / Creyke Road intersection

30 I confirm that I have recommended that the intersection is upgraded, and I discuss this further below.

Submitter Concern: The access to the new residential zone is in close proximity to State Highway 73 and could present a safety hazard

31 The access is located more than 350m from State Highway 73. I therefore do not consider that there would be any intersection between the highway and the site access.

---

[5] Section 7.2 of the Transportation Assessment

Submitter Concern: Speed limits on State Highway 73 should be reconsidered

32 The matter of speed limits on a highway is not within the control of any plan change proponent (or resource consent applicant). In my view there is a case for reducing the speed limit, but this would be considered at the appropriate time by Waka Kotahi NZTA. My assessment is based on the speed limit remaining at 100km/h,

Submitter Concern: The safety and/or efficiency of Horndon Street may be adversely affected by the proposal

33 I have produced a Technical Note that deals specifically with the issue of efficiency, and it is attached as Annexure A to my evidence. This shows that the traffic generated by development of the plan change area would not adversely affect the State Highway 73 / Horndon Street intersection.

34 I do not consider that significant volumes of traffic associated with the plan change area would use Horndon Street, but even if there was to be a slight increase, the road is easily capable of accommodating additional traffic flows.

35 In respect of road safety, the NZTA Crash Analysis System shows that over the past 10 years, there has been just one crash recorded within 100m of the State Highway 73 / Horndon Street intersection. This occurred when a vehicle turning right into Horndon Street from the highway was hit from behind by a westbound vehicle, It did not result in any injuries, and the police report indicates that the 'at-fault' driver was potentially distracted.

36 Given the excellent safety record at the intersection, I do not consider that development of the plan change area would lead to adverse road safety effects at the intersection or on Horndon Street itself.

Response to Council Officers

37 I have read the reports of Mr Trewin, Council's Strategy and Policy Planner, who in turn relies on a report by Mr Smith of Abley, Council's consulting engineers. Given that Mr Smith's reporting forms the basis of Mr Trewin's conclusions, I have focussed my comments on Mr Smith's report. I also draw on the minutes of the meeting held between Mr Trewin, Mr Smith, myself and Ms Bensemann (for the plan change proponents) and Messrs Pearson and Long for Waka Kotaki NZ Transport Agency.

38 Notwithstanding that Mr Smith is ultimately unable to support the plan change request, there are a number of areas on which we agree:

(a) The cumulative effects of all developments in the area have been appropriately considered

(b) There is no adverse transportation-related effect at the SH73 / Horndon Creyke intersection

(c) State Highway 73 will continue to operate within its capacity

(d) The SH73 / Creyke Road intersection will continue to operate within its capacity

(e) The potential for non-residential traffic travelling through adjacent residential areas can be appropriately managed through design features on the road linkages.

39 Given that we agree on these matters, I have not considered them further. Rather, I focus on the areas of disagreement. As identified by Mr Smith however, this falls largely into just a couple of discrete areas, the safety of the state highway, and walking/cycling connectivity.

40 In respect of the matter of safety of the highway, there are two issues. Mr Smith requests that an assessment is carried out of the safety of the highway between Creyke Road and the urban boundary towards the west. The second matter is that of the proposed upgrading of the State Highway 73 / Creyke Road intersection

41 With regard to the safety of the highway between Creyke Road and the urban boundary, Mr Smith highlights that there have been four crashes recorded over the past ten years. Having reviewed the records (2011 to 2021), I note that the locations and circumstances of reported crashes were:

(a) A westbound driver lost control on their vehicle and drifted off the highway. The police report notes the driver reported being tired. The crash did not result in any injuries.

(b) A westbound driver failed to slow down to a temporary 30km/h speed limit due to roadworks, hit a patch of gravel, and struck a vehicle travelling in the opposite direction. The crash resulted in serious injuries.

(c) A westbound driver lost control on their vehicle and drifted off the highway. The police report notes the driver reported being suddenly unwell, with possible food poisoning. The crash resulted in minor injuries.

(d) A westbound driver lost control on their vehicle and drifted off the highway. The police report notes the driver fell asleep. The crash did not result in any injuries.

(e) A driver lost control on black ice and slid off the highway. It resulted in minor injuries (thus crash was reported in the Transportation Assessment)

42 As set out above, traffic flows on the highway are 4,780 vehicles per day with peak hour flows of between 340 and 425 vehicles per hour.

43 If the highway is assessed using the NZTA approach to forecasting crashes, then for the length of highway under consideration, a typical straight section of highway would have around 0.4 injury crashes per year, that is 4 injury crashes over a ten-year period. State Highway 73 has had five such crashes, only slightly more than this. Further one of these crashes (at the roadworks) was not directly due to the highway, but to temporary circumstances and where there may have been other circumstances involved (such as the traffic management having been incorrectly placed).

44 On this basis, I do not consider that the crash record indicates that there is a significant road safety concern on this section of highway.

45 It is also relevant to the safety of the highway that an intersection upgrade is proposed. The plan change provisions as lodged attempted to link the extent of traffic increase to the trigger for the upgrading of the intersection – in essence, the intent was to upgrade the intersection at the point when sufficient income had been received from the sale of lots within the site. Ultimately however, this proved difficult to refine.

46 The plan change proponents therefore now propose a rule whereby:

(a) No development of the business use within the site is a permitted activity until the intersection is upgraded. In my view there is no need to specify exactly what upgrade is required because any upgrade could only be carried out with the approval of NZTA under a Corridor Access Request, meaning that if the upgrade was unsuitable or not to an appropriate standard, then the request would not be granted. However as a 'proof of concept', a layout with auxiliary right and left-turning lanes has been devised, to demonstrate that such a design is feasible.

(b) No development of the residential area is a permitted activity until such time as the southern approach of Creyke Road is 'straightened up' so that the carriageways meet at 90 degrees (plus or minus 20 degrees) Creyke Road presently meets the highway at an angle of around 40 degrees. To my knowledge, all guides and standards seek an angle of at least 70 degrees, in order to ensure that drivers are easily able to see

vehicles approaching without excessively turning their head[6]. Notwithstanding this existing safety-related deficiency, it was not raised by either the Council or NZTA when considering Plan Changes 24 or 48, both of which increased traffic flows through the intersection. Nevertheless, given that this proposed plan change will increase traffic at this intersection, the rule is proposed to promote a safer environment. The straightening up would solely involve a minor realignment of the carriageway rather than the provision of auxiliary turning lanes or any other treatment.

47 I note that Mr Smith supports this arrangement in principle, but recommends that all intersection improvements (seemingly including the auxiliary turning lanes) are carried out in one stage in order to minimise disruption to traffic on the highway. I do not agree with this, firstly the majority of works associated with the initial upgrading will not affect the main carriageway of the highway, and secondly, the provision of the full intersection upgrade in order to simply accommodate the traffic generation associated with 35 residences is not, in my view, reasonable to address the effects of this.

48 Finally in regard to road safety, Mr Smith considers that the speed environment around the site should be addressed, and speed limits reduced, and spends some time discussing this. While I personally agree with his assessment, my analysis is not based on such a reduction because the plan change proponents cannot implement such a change. Mr Smith also recognises that it is a matter solely for the Council and for NZTA.

49 In passing, the plan change proponents have offered to undertake an assessment of vehicle speeds and to provide this to both the Council and to NZTA in order to expedite the process of considering the traffic speeds.

50 The second issue of concern to Mr Smith is that of connectivity. As I understand it, his concerns do not relate to the intended long-term development pattern in the area, whereby the plan change site is connected to the sites to the immediate west and south, but to the short-term scenario in the case that

---

[6] Having observed the operation of the intersection, I note that the majority of truck drivers approaching from the south to either turn right or drive straight ahead do not do so in the correct manner. Instead, they position their vehicle in the short left-turn lane of Creyke Road so that they are better able to see approaching vehicles on the highway, before then making their turn onto the highway. This indicates to me that drivers with local knowledge are changing their behaviours to mitigate the safety-related deficiency.

the plan change site develops without development to the west and south. This is because the plan change area relies on links through the western and southern sites to provide for walking and cycling. Mr Smith highlights that without those links, pedestrians and cyclists would potentially need to travel along the highway (which he and NZTA consider to be unsafe) or would alternatively need to undertake a circuitous route via Creyke Road to the south and then Telegraph Road.

51 Mr Smith goes on to say that on this basis, he considers that the plan change request is inconsistent with District Plan Objective B2.1.3 and Policy B.2.1.5, and inconsistent with Canterbury Regional Policy Statement Objective 5.2.3 and Policy 5.3.8. These are:

(a) District Plan Objective B2.1.3: "*Future road networks and transport corridors are designed, located and protected, to promote transport choice and provide for: a range of sustainable transport modes; and alternatives to road movement of freight such as rail*"

(b) District Plan Policy B.2.1.5: "*Promote the strategic planning of transport networks to achieve a high level of connectivity and provision for sustainable transport including public transport, cycling and walking*."

(c) Canterbury Regional Policy Statement Objective 5.2.3: "*A safe, efficient and effective transport system to meet local regional, inter-regional and national needs for transport, which: 1. supports a consolidated and sustainable urban form; 2. avoids, remedies or mitigates the adverse effects of transport use and its provision; 3. provides an acceptable level of accessibility; and 4. is consistent with the regional roading hierarchy identified in the Regional Land Transport Strategy*."

(d) Canterbury Regional Policy Statement Policy 5.3.8: "*Integrate land use and transport planning in a way: 1. that promotes: a. the use of transport modes which have low adverse effects; b. the safe, efficient and effective use of transport infrastructure, and reduces where appropriate the demand for transport; 2. that avoids or mitigates conflicts with incompatible activities; and 3. where the adverse effects from the development, operation and expansion of the transport system: a. on significant natural and physical resources and cultural values are avoided, or where this is not practicable, remedied or mitigated; and b. are otherwise appropriately controlled*"

52 In my view, the core matter for Mr. Smith is one of timing. It does not seem to be a matter of contention that when the plan change area and the areas to the south and west are developed there will be appropriate connectivity for walking and cycling. Indeed, he specifically supports the proposed connections to these

areas. Rather, it is a matter of the outcome in the case when the plan change area is developed but the areas to the south and west are not.

53 I defer to the planning expertise of Ms Bensemann to consider the matter of compliance with the Objectives and Policies referred to by Mr Smith. However I highlight that Plan Changes 24 and 48 set out that volumes of walking and cycling in the immediate area were low, and did not address walking/cycling connectivity external to their respective areas.

54 Mr Smith notes (correctly) that NZTA did not wish to see any direct connection onto the highway from the northwestern corner of the site, meaning that this was removed from the ODP. He notes though that such a connection is proposed for Darfield Development Area 5 (Mr Smith's Figure 2). I anticipate that this provision is acceptable because the 50km/h speed limit commences just west of the proposed connection, meaning that concerns regarding the safety of people walking/cycling along the highway are reduced. Notwithstanding this, Mr Smith raises concerns with the absence of a footpath further towards the west for the proposed plan change (but not commenting that the same issue is present for Darfield Development Area 5).

55 However, I am cognisant that this is a plan change request. As such, to my mind, the typical approach applied is whether there is any fundamental impediment to the request being approved. In my view, there are two particularly relevant matters in this regard.

56 The first is that there is a separation of 7m between the southern edge of the state highway carriageway and the legal road reserve. This is easily sufficient to construct a shared walking and cycling route (which would typically be a maximum of 4m wide). As such, there is a design solution to the concerns that have been raised. This arrangement would potentially be the same as the off-road route between Lincoln and Rolleston, or the Little River Rail Trail between Lincoln and Christchurch, both of which run alongside roads with a speed limits of 80-100km/h but are separated from the road carriageway by a landscaping strip / verge.

Photograph 1: Example of Cycle Lane Adjacent to High Speed Road, Selwyn

57 If necessary, this could be addressed by a specific rule in the plan change provisions that resulted in residential activity being a Restricted Discretionary Activity until such time as a walking/cycling link was provided towards Darfield (with Council's discretion limited to the effects on walking and cycling). However, for the reason set out below, I do not consider that this is necessary.

58 The second matter is whether it is reasonable to anticipate that development of the plan change area would proceed when development to the south and west was not progressing.

59 Plan Change 61 allows for both residential and business uses. The provisions for land to the south and west allow for residential uses only. If demand is sufficiently high such that the residential aspects of the proposed plan change progresses, I would expect that this same demand would also mean that the areas to the south and west were also being developed. This then creates the ability to form the linkages shown in the ODP for the proposed plan change.

60 Conversely, if there is little demand for residential development in areas to the south and west, I would not expect that there would be significant demand for residential development in the proposed plan change area. The need for any walking/cycling links is therefore minimised.

61 I acknowledge that this same argument cannot be made for the non-residential activities, because demand for business use and residential use are not the same. However the plan change provisions already set out that no business development can proceed until the State Highway 73 / Creyke Road intersection is upgraded. It would be straightforward to slightly amend this to also include that business activities cannot develop until the intersection is

upgraded and a suitable walking/cycling link is provided towards Darfield. I recommend that this revision is made.

Conclusions

62 On the basis of my assessment, I consider that the conclusions of the Transportation Assessment remain valid.

63 However I have considered the matter of the upgrading of the State Highway 73 / Creyke Road intersection further. In my view, the 'trigger' for the upgrading of the highway can be simplified, such that:

(a) No residential development can occur until the southern approach to the intersection is 'squared up' (that is, the existing acute angle that the road meets the highway is eliminated and Creyke Road (south) meets at 70 to 110 degrees.

(b) No non-residential development can occur until such time as auxiliary left-turn and right-turn lanes are provided for vehicles turning to/from the highway.

(c) No non-residential development can occur until such time as a suitable walking/cycling link is provided between the plan change area and the existing urban area of Darfield.

64 Having considered the safety record of the highway as requested by Mr Smith, I do not consider that there are any inherent safety-related issues that are evident.

65 While I support Mr Smith's views on reducing the speed limit, this is not a matter over which the plan change proponents have any ability to change.

66 I do not share Mr Smith's concerns regarding connectivity because the plan change area will in due course be well-connected to the adjacent areas. There are also no impediments to achieving appropriate technical solutions for walking/cycling connectivity. It is unlikely in my view that the residential aspects of the plan change area would develop while the residential activities to the south and west did not.

67 Overall I remain of the view that the proposed plan change can be supported from a traffic and transportation perspective

ANDREW DAVID CARR

30 March 2021

Annexure A

TECHNICAL NOTE

CARRIAGEWAY CONSULTING
A. PO Box 29623, Christchurch, 8540
P. 03 377 7010
E. office@carriageway.co.nz

project	**Darfield Plan Change**
to	Anna Bensemann / Gerard Cleary
from	Andy Carr, Carriageway Consulting Ltd
copies to	-
date	16 February 2021
subject	Performance of State Highway 73 / Horndon Street intersection

Introduction

One matter highlighted by the Council's transportation peer reviewer is that the presence of traffic generated by development of the plan change area could affect the queues and delays at the State Highway 73 / Horndon Street intersection some 550m west of Creyke Road. This Technical Note sets out an assessment of the operation of the intersection to address this concern.

Intersection Geometry and Characteristics

The State Highway 83 / Horndon Street intersection is priority ('give-way') controlled. For traffic approaching the highway on Horndon Street, a single traffic lane is provided which flares to provide two lanes on the immediate approach. This means that two vehicles can queue side-by-side, although the flaring is only sufficient for one vehicle length.

There are no formal auxiliary traffic lanes on the highway, but there is a wide sealed shoulder on the southern side of the highway which can be used by westbound vehicles passing any other vehicle turning right. While on site, we observed this to occur on numerous occasions, and westbound drivers were observed to slow down in order to pass.

Sightlines for vehicle turning to and from Horndon Street are excellent, due to the flat and straight alignment of the highway. The speed limit on the highway is 100km/h.

Figure 1: Aerial Photograph of State Highway 73 / Horndon Street Intersection

Traffic Flows

Traffic volumes recorded on the highway at the nearby NZTA traffic counters were reported in the Transportation Assessment as being:

- 420 to 505 vehicles in the morning peak hour (two-way); and
- 500 to 550 vehicles in the evening peak hour (two-way)

The MobileRoad website sets out that the daily traffic flows on Horndon Street are 410 vehicles (two-way). This indicates a peak hour volume of around 41 to 62 vehicle movements (two-way), assuming that the road carries 10% to 15% of the daily flow in the peak hours.

We carried out peak hour traffic surveys at the intersection on Monday 15 February 2021, and recorded the following:

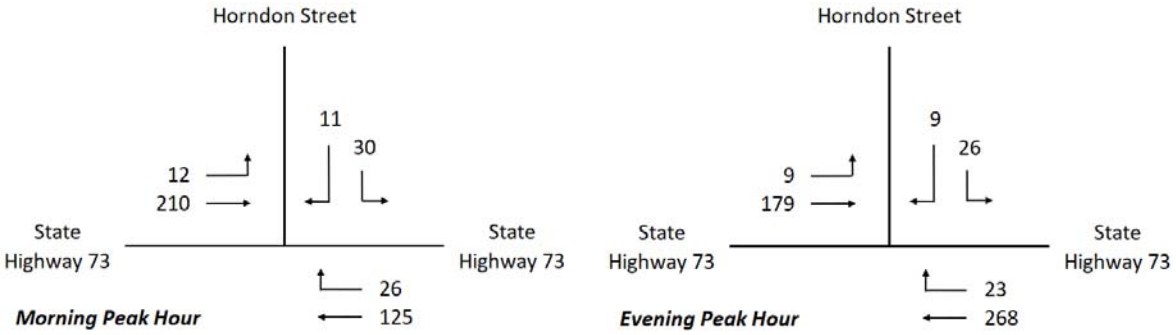

Figure 1: February 2021 Peak Hour Traffic Flows

Informal observations were made of the queue lengths and delays during the traffic count. Queue lengths at no time exceeded more than one vehicle, and delays at the stop-line were typically observed to be short, with many vehicles emerging onto the highway without stopping.

We highlight that the traffic flows on the highway in the morning are in the order of 358-391 vehicles (two-way) and in the evening are 465-496 vehicles (two-way). These compare to the traffic volumes at the NZTA counters of 420-505 vehicles and 500-550 vehicles respectively. The volumes on the highway are therefore around 20% lower than would otherwise be expected in the morning and 10% lower than expected in the evening.

The previously-reported traffic volumes were from 2018. It is plausible that the effects of COVID-19 have decreased traffic flows in the area. It is also plausible that because the other two counters are located towards the east and west of the site, that they record vehicles that are not present immediately east of Darfield. For the purposes of this analysis, and to present a robust assessment, the observed traffic volumes have been factored up by 20% and 10% respectively.

Traffic flows on Horndon Street are 67-79 vehicles (two-way) which is slightly higher than estimated above. These volumes have therefore not been factored.

Intersection Modelling

The intersection has been modelled using the computer software package Sidra Intersection and the results are summarised below (using the factored flows).

Road and Movement		Morning Peak Hour			Evening Peak Hour		
		Avg Delay (secs)	95 %ile Queue (veh)	Level of Service	Avg Delay (secs)	95 %ile Queue (veh)	Level of Service
State Highway 73 (east)	L	8.8	0	A	8.7	0	A
Horndon Street	L	2.9	0	A	2.6	0	A
	R	4.2	0	A	4.8	0	A
State Highway 73 (east)	L	8.0	0	A	8.0	0	A

Table 1: Peak Hour Levels of Service at the State Highway 73 / Horndon Street Intersection, Factored 2021 Volumes

It can be seen that the intersection has negligible queuing and delays, as observed during the surveys.

In the Transportation Assessment, ambient traffic growth of 36% was applied (representing 10 years of growth at 3.6% per annum). Applying this factor to the volumes noted above, yields the following results.

Road and Movement		Morning Peak Hour			Evening Peak Hour		
		Avg Delay (secs)	95 %ile Queue (veh)	Level of Service	Avg Delay (secs)	95 %ile Queue (veh)	Level of Service
State Highway 73 (east)	L	9.4	0	A	9.2	0	A
Horndon Street	L	3.3	0	A	2.9	0	A
	R	5.4	0	A	6.4	0	A
State Highway 73 (east)	L	8.0	0	A	8.0	0	A

Table 2: Peak Hour Levels of Service at the State Highway 73 / Horndon Street Intersection, Factored 2021 Volumes Plus 36% Ambient Traffic Growth

It can be seen that the intersection performance continues to be excellent with ten years of growth added.

Traffic Generation of Proposed Plan Change Area

As set out in the Transportation Assessment, development of the plan change area would give rise to the following additional traffic volumes on the highway past Horndon Street:

- Morning peak hour
  - Eastbound (towards site): 120
  - Westbound (away from site): 35
- Evening peak hour
  - Eastbound (towards site): 56
  - Westbound (away from site): 113

Modelling of Intersection with Plan Change

The intersection has been modelled using the expected future traffic flows of both ten years of growth plus full development of the plan change area, and the results are shown below.

Road and Movement		Morning Peak Hour			Evening Peak Hour		
		Avg Delay (secs)	95 %ile Queue (veh)	Level of Service	Avg Delay (secs)	95 %ile Queue (veh)	Level of Service
State Highway 73 (east)	L	10.3	0	A	9.7	0	A
Horndon Street	L	4.0	0	B	3.2	0	A
	R	6.8	0	A	8.4	0	A
State Highway 73 (east)	L	8.0	0	A	8.0	0	A

Table 3: Peak Hour Levels of Service at the State Highway 73 / Horndon Street Intersection, Factored 2021 Volumes Plus 36% Ambient Traffic Growth Plus Plan Change

The modelling shows that the intersection continues to perform well.

Summary

Based on our assessment we consider that the intersection will continue to operate with good levels of service and low queues and delays even when ambient traffic growth plus full development of the plan change area is considered.

Annexure B

TECHNICAL NOTE

CARRIAGEWAY CONSULTING
A. PO Box 29623, Christchurch, 8540
P. 03 377 7010
E. office@carriageway.co.nz

project	**Darfield Plan Change**
to	Anna Bensemann / Gerard Cleary
from	Andy Carr, Carriageway Consulting Ltd
copies to	-
date	9 March 2021
subject	Performance of State Highway 73 / Creyke Road intersection

Introduction

The issue of the performance and potential upgrading of the SH73 / Creyke Road intersection is now on the critical path, with keen interest in progressing a fairly detailed design being expressed by both road controlling authorities (NZTA and SDC). The SDC peer reviewer also identified that the intersection needed to be reassessed taking into account permitted developments through other plan changes / resource consents in the area. This Technical Note sets out an assessment of the operation of the intersection to address this concern.

Intersection Geometry and Characteristics

The SH73 / Creyke Road intersection geometry was described in the Transportation Assessment, and remains the same as in that report:

- four-arm priority ('stop') controlled intersection, with Creyke Road forming the fourth approach towards the north across the railway.
- an auxiliary turning lane for the movement from south to west but no right-turn or left-turn lanes on the highway for drivers turning into Creyke Road.
- minor approaches at 40 degrees to the highway, so drivers turning right have to look over their left shoulder through the rear passenger-side window rather than the front window.
- sight distances affected by an overgrown shelter belt towards the west.

Figure 1: Aerial Photograph of State Highway 73 / Creyke Road Intersection

Of interest, while on site we observed that in order to offset the 40 degree angle, drivers of heavy vehicles turning right or going straight ahead from Creyke Road (south) initially used the left-turn lane (presumably to get a better view of the traffic on the highway) before then turning towards their right and their intended exit. This meant that in effect, the drivers turned left before turning right.

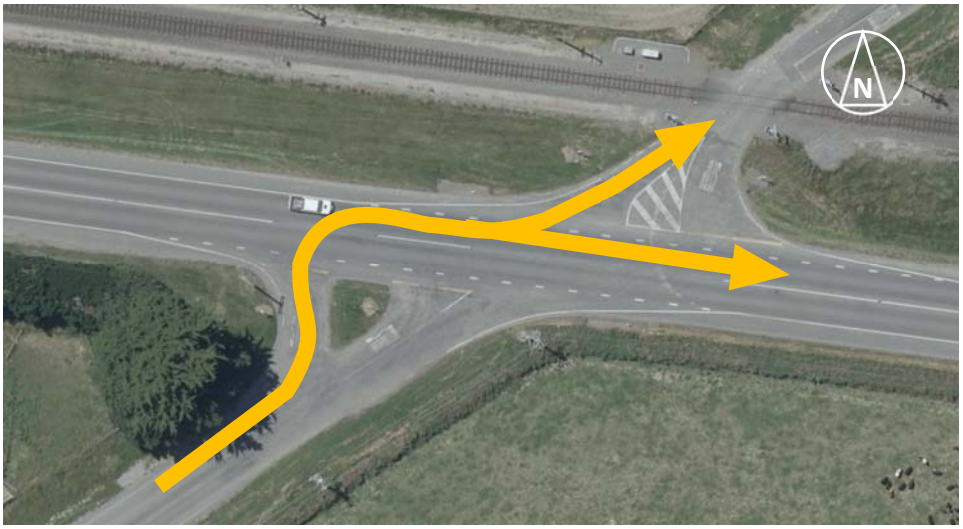

Figure 2: Observed Path of Heavy Vehicles

Traffic Flows

Traffic volumes recorded on the highway at the nearby NZTA traffic counters were reported in the Transportation Assessment as being:

- 420 to 505 vehicles in the morning peak hour (two-way); and
- 500 to 550 vehicles in the evening peak hour (two-way)

The MobileRoad website sets out that the daily traffic flows on Creyke Road are 125 vehicles (two-way). This indicates a peak hour volume of around 15-20 vehicle movements (two-way), assuming that the road carries 10% to 15% of the daily flow in the peak hours.

We carried out peak hour traffic surveys at the intersection on Tuesday 2 March 2021, and recorded the following:

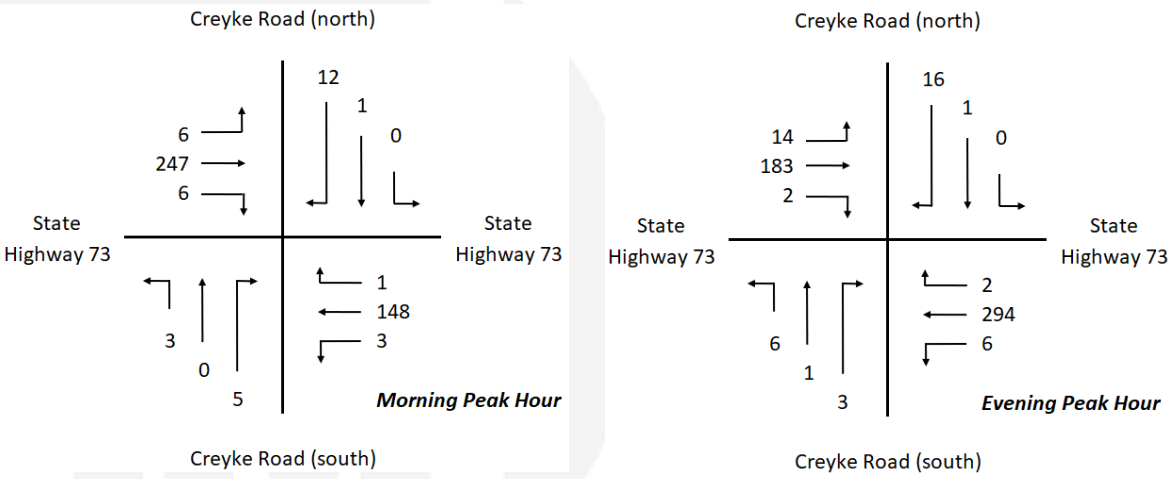

Figure 1: March 2021 Peak Hour Traffic Flows

Informal observations were made of the queue lengths and delays during the traffic count, but none were seen, other than:

- Occasionally, a right-turning vehicle (SH73 to Creyke Road) had to wait for a gap in the oncoming traffic;
- Most turning trucks from Creyke Road (both north and south) had to wait for a gap in the traffic.

By way of a cross-comparison, traffic counts were carried out during February 2021 at the SH73 / Horndon Street intersection, which lies just to the west. Crucially, there are no accesses or intersections between Horndon Street and Creyke Road, meaning that the two traffic counts can act as checks on one another to ensure that the observed traffic characteristics were not abnormal

- Morning peak hour
    - Occurred at the same time at both intersections, 7:10am to 8:10am
    - On SH73 east of Horndon Street, 240 vehicles were seen heading eastbound. At SH73 west of Creyke Road, 259 vehicles were seen heading eastbound (19 vehicles difference)
    - On SH73 east of Horndon Street, 136 vehicles were seen heading westbound. At SH73 west of Creyke Road, 163 vehicles were seen heading westbound (27 vehicles difference)
- Evening peak hour
    - Occurred at the same time at both intersections, 4:45pm to 5:45pm
    - On SH73 east of Horndon Street, 205 vehicles were seen heading eastbound. At SH73 west of Creyke Road, 199 vehicles were seen heading eastbound (6 vehicles difference)
    - On SH73 east of Horndon Street, 291 vehicles were seen heading westbound. At SH73 west of Creyke Road, 316 vehicles were seen heading westbound (25 vehicles difference)

On this basis, we consider that the two traffic counts generally align with one another. Since they occurred on different days of the week and in different months, in our view this indicates that the volumes seen are representative of the prevailing volumes.

As with our assessment of the SH73 / Horndon Road intersection, the traffic flows on the highway differ from those used in our previous analysis. In the morning, the volumes observed were 404-422 vehicles (two-way) and in the evening were 488-515 vehicles (two-way). These compare to the traffic volumes at the NZTA counters of 420-505 vehicles and 500-550 vehicles respectively. The volumes on the highway are therefore around 10% lower than would otherwise be expected in the morning and 5% lower than expected in the evening.

The previously-reported traffic volumes were from 2018. It is plausible that the effects of COVID-19 have decreased traffic flows in the area. It is also plausible that because the other two counters are located towards the east and west of the site, that they record vehicles that are not present immediately east of Darfield.

For the purposes of this analysis, and to present a robust assessment, the observed through traffic volumes have been factored up by 10% in the morning and 5% in the evening so that they more closely align with those reported for the highway.

Traffic flows on Creyke Road are 18-19 vehicles (two-way) against an estimated value of 15-20 vehicles. These volumes have therefore not been factored.

Intersection Modelling

The intersection has been modelled using the computer software package Sidra Intersection and the observed values (factored as above), and the results are summarised below.

Road and Movement		Morning Peak Hour			Evening Peak Hour		
		Avg Delay (secs)	95 %ile Queue (veh)	Level of Service	Avg Delay (secs)	95 %ile Queue (veh)	Level of Service
State Highway 73 (east)	L	7.4	0	A	7.7	0	A
	R	9.0	0	A	8.8	0	A
Creyke Road (north)	L	12.2	0	B	11.6	0	B
	T	19.6	0	C	12.5	0	B
	R	12.6	0	B	16.0	0	C
State Highway 73 (west)	L	7.7	0	A	8.4	0	A
	R	9.5	0	A	11.8	0	A
Creyke Road (north)	L	13.4	0	B	13.5	0	B
	T	11.8	0	B	21.1	0	C
	R	12.2	0	B	12.6	0	B

Table 1: Peak Hour Levels of Service at the State Highway 73 / Creyke Road Intersection, Factored 2021 Volumes

It can be seen that the intersection has negligible queuing and delays, as observed during the surveys.

Traffic Generation of Permitted Development

As part of the peer review process, the Council has identified changes in the immediate area that may result in increased traffic flows through the intersection. Within the area that was subject to PC24 and PC48, we understand that the following subdivision consents have been approved:

- 185169 – 4 lots;
- 195776 – 38 lots;
- 205731 – 9 lots;
- 175229 – 2 lots; and
- 175060 – 171 lots (Ascot Park).

Figure 3: PC24 and PC48 Areas

Given that these two plan changes appear to be the main concern, we have reviewed the transportation assessments that supported them, on the basis that these should reveal the expected extent of traffic increase through the SH73 / Creyke Road intersection.

Plan Change 24 was progressed in 2013 and the area rezoned contains both residential and business activities. The documentation notes that "*Creyke Road will provide a link between the L2A zone and SH73 east of Darfield. It is expected therefore that this road would be used for travel between the L2A zone and Christchurch. Even in the unlikely event that all trips between the Christchurch and the L1 and L2A zones used Creyke Road (about 100vph in the evening peak), it is considered that the road will have sufficient capacity to accommodate the additional traffic*."

Reviewing the traffic generation of the L1 and L2A zones, as assessed in the supporting Transportation Assessment, we note that:

- A rate of 1 vehicle movement per unit was allowed for in the peak hours
- The L1 zone is expected to have a maximum of 400 residences
- The L2A zone is expected to have a maximum of 45 residences
- 25% of the traffic generation of the residential zones would travel to/from the east and Christchurch
- In the morning peak hour, 85% of traffic would leave the development with 35% exiting in the evening peak hour (and 15% and 65% of traffic entering respectively).

We note that the L1 zoning lies towards the northwest of the plan change area and that a direct link is provided towards the north which connects to the highway. Taking this into account, we consider that while all of the L2A development might use Creyke Road, we agree with the plan change proponents that it would be unlikely that all of the development in the L1 area would use this route. Rather, in our view it would only be attractive for about 50% of the development within the L1 area. This then yields the following (drawn from the PC24 Transportation Assessment):

- There are 445 permitted residences at PC24 of which 245 would potentially find Creyke Road to the northeast a convenient route. The remaining 200 residences would access the highway closer to Darfield
- Each residence generates 1 vehicle movement in the peak hours.
- 25% of all vehicle movements at PC24 would be made to/from the east.

- Hence in the peak hours, 61 vehicles (two-way) would use Creyke Road to join the highway, and 50 vehicles would join the highway closer to Darfield and become 'straight ahead' traffic past Creyke Road
- Morning peak hour:
    - 52 vehicles exiting Creyke Road, turning right onto the highway
    - 9 vehicles turning left from the highway onto Creyke Road
    - 43 vehicles on the highway heading east
    - 7 vehicles on the highway heading west
- Evening peak hour
    - 21 vehicles exiting Creyke Road, turning right onto the highway
    - 40 vehicles turning left from the highway onto Creyke Road
    - 17 vehicles on the highway heading east
    - 33 vehicles on the highway heading west

For PC48, 26 residences were contemplated in the Transportation Assessment within the plan change documentation, but 3 were existing and hence the increase was 23 residences. Otherwise, the plan change adopted the same assumptions as for PC24. Following the same methodology as set out above, this then yields the following:

- There are 23 new permitted residences at PC48
- 25% of all vehicle movements at PC48 would be made to/from the east.
- Hence in the peak hours, 6 vehicles (two-way) would use Creyke Road to join the highway
- Morning peak hour:
    - 5 vehicles exiting Creyke Road, turning right onto the highway
    - 1 vehicle turning left from the highway onto Creyke Road
- Evening peak hour
    - 2 vehicles exiting Creyke Road, turning right onto the highway
    - 4 vehicles turning left from the highway onto Creyke Road

That is, the two plans changes together could be expected to generate the following traffic volumes:

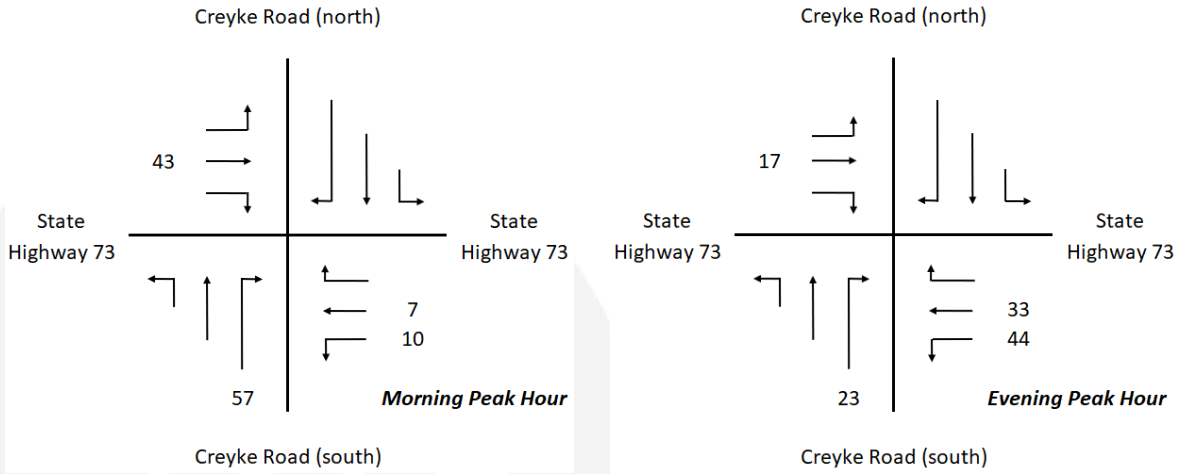

Figure 2: Peak Hour Traffic Generation, PC24 and PC48

Ambient Traffic Growth

In the Transportation Assessment, ambient traffic growth of 36% was applied (representing 10 years of growth at 3.6% per annum). We have retained the same factor, although it is likely that growth will be lower in the immediate future due to the effects of reduced activity arising from COVID-19.

Receiving Traffic Environment

Based on the assessment above, we consider that the design year for assessment of the proposed plan change is given by:

- The observed (2021) traffic volumes
- SH73 traffic flows factored by 10% and 5% in the morning and evening peak hours respectively
- Ambient traffic growth of 36% added to all movements
- Plus traffic generation associated with PC24 and PC48.

These volumes are shown below.

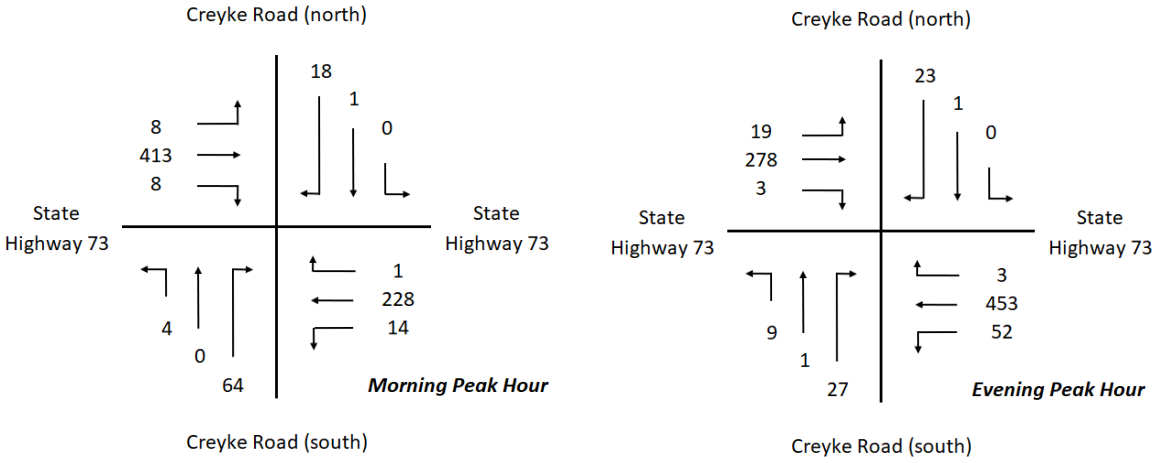

Figure 3: Peak Hour Traffic Generation, Full Development of Plan Change Areas Plus Ambient Traffic Growth for Ten Years

We have modelled the intersection using these traffic volumes and the results are summarised below.

Road and Movement		Morning Peak Hour			Evening Peak Hour		
		Avg Delay (secs)	95 %ile Queue (veh)	Level of Service	Avg Delay (secs)	95 %ile Queue (veh)	Level of Service
State Highway 73 (east)	L	7.2	0	A	7.2	0	A
	R	9.9	0	A	9.5	0	A
Creyke Road (north)	L	13.4	0	B	12.2	0	B
	T	28.0	0	D	16.3	0	C
	R	14.9	0	B	19.6	0	C
State Highway 73 (west)	L	8.2	0	A	8.7	0	A
	R	9.9	0	A	13.0	0	B
Creyke Road (north)	L	13.4	1	B	14.5	0	B
	T	14.7	1	B	34.1	0	D
	R	15.0	1	B	16.0	0	C

Table 2: Peak Hour Levels of Service at the State Highway 73 / Creyke Road Intersection, Factored 2021 Volumes Plus 36% Ambient Traffic Growth Plus PC24 Plus PC48 (No PC61 Traffic)

It can be seen that the intersection performance continues to be acceptable with ten years of growth added. However the Creyke Road (north) through movement is extremely close to Level of Service E (which commences at 35 seconds, with 34.1 seconds forecast).

We have reviewed the need for auxiliary turning lanes:

- Morning peak hour:
  - Right-turn lane:
    - $Q_M = Q_{T1} + Q_{T2} + Q_L = 413 + 228 + 14 = 655$ vehicles
    - $Q_R = 8$ vehicles
    - Right-turn lane required
  - Left-turn lane
    - $Q_M = Q_{T2} = 228$ vehicles (westbound)
    - $Q_L = 14$ vehicles
    - Left-turn lane not required
- Evening peak hour:
  - Right-turn lane:
    - $Q_M = Q_{T1} + Q_{T2} + Q_L = 278 + 453 + 52 = 783$ vehicles
    - $Q_R = 3$ vehicles
    - Right-turn lane not required
  - Left-turn lane
    - $Q_M = Q_{T2} = 453$ vehicles (westbound)
    - $Q_L = 52$ vehicles
    - Left-turn lane required

On this basis an auxiliary right-turn lane and left-turn lane are both justified at full development of the PC24 and PC48 areas.

Accordingly, we consider that the need for an intersection improvement scheme is not wholly triggered by the proposed plan change. Rather, it is a latent aspect of the two plan changes that have already been approved.

Traffic Generation of Proposed Plan Change Area

Development of the plan change area would give rise to the additional traffic volumes on the highway at the intersection, as set out in Section 6 of the Transportation Assessment.

Modelling of Intersection with Plan Change

The intersection has been modelled using the expected future traffic flows of both ten years of growth plus full development of PC24 and PC48, plus full development of the proposed plan change area. The results are shown below. Note that for this assessment, no changes are assumed to have been made to the existing layout, in order to allow for a direct comparison against the previous modelling results.

For this, we have split the two types of development within PC61 such that one assessment is shown with the residential traffic only, and the other is shown with the residential traffic plus the business/industrial traffic.

Road and Movement		Morning Peak Hour			Evening Peak Hour		
		Avg Delay (secs)	95 %ile Queue (veh)	Level of Service	Avg Delay (secs)	95 %ile Queue (veh)	Level of Service
State Highway 73 (east)	L	7.2	0	A	7.2	0	A
	R	9.9	0	A	9.5	0	A
Creyke Road (north)	L	13.4	0	B	12.2	0	B
	T	28.2	0	D	16.7	0	C
	R	15.1	0	C	19.9	0	C
State Highway 73 (west)	L	8.2	0	A	9.5	0	A
	R	9.9	0	A	13.0	0	B
Creyke Road (north)	L	13.4	1	B	14.5	0	B
	T	14.9	1	B	34.1	0	D
	R	15.2	1	C	16.4	0	C

Table 4: Peak Hour Levels of Service at the State Highway 73 / Creyke Road Intersection, Factored 2021 Volumes Plus 36% Ambient Traffic Growth Plus PC24 Plus PC48 Plus PC61 (Residential Traffic Only)

It can be seen that with full residential development, queues remain the same and delays increase by at most 0.4 seconds per vehicle. On this basis, we consider that the residential aspect of PC61 will have only a negligible effect on the intersection efficiency.

Road and Movement		Morning Peak Hour			Evening Peak Hour		
		Avg Delay (secs)	95 %ile Queue (veh)	Level of Service	Avg Delay (secs)	95 %ile Queue (veh)	Level of Service
State Highway 73 (east)	L	7.3	0	A	7.3	0	A
	R	10.1	0	B	9.5	0	A
Creyke Road (north)	L	13.5	1	B	12.2	1	B
	T	28.2	1	D	20.2	1	C
	R	17.9	1	C	24.1	1	C
State Highway 73 (west)	L	9.8	2	A	11.3	1	B
	R	11.1	2	B	13.0	1	B
Creyke Road (north)	L	13.4	1	B	15.0	1	B
	T	20.0	1	C	34.1	3	D
	R	20.8	1	C	24.3	3	C

Table 4: Peak Hour Levels of Service at the State Highway 73 / Creyke Road Intersection, Factored 2021 Volumes Plus 36% Ambient Traffic Growth Plus PC24 Plus PC48 Plus PC61 (Residential and Business/Industrial Traffic)

It can be seen that when the business/industrial-related traffic is added, queue lengths remain largely unaffected but delays increase by up to 5 seconds per vehicle on some turning movements. However Levels of Service A, B, C or D are provided, which we consider still represents an appropriate level of efficiency.

Summary

Based on our assessment we consider that the capacity of the intersection is not a concern, as even when existing (approved) plan changes are taken into account, coupled with the traffic generation of the proposed plan change, queues and delays remain acceptable. On this basis, it is considered that a priority intersection has sufficient capacity for the expected traffic flows.

With regard to the form of the intersection, the analysis shows that when a design year of ten years is considered, plus full development of PC24 and PC48, both left-turn and right-turn auxiliary turning lanes are justified at the intersection. However neither plan change has made provision for any improvements at the intersection, despite the analysis presented as part of those plan changes showing that the traffic from up to 117[1] residences could be expected to pass through the intersection.

By way of reference, the proposed plan change would result in the traffic from 35 residential lots passing through the intersection. There would also be additional traffic arising from the proposed business/industrial activity within the site.

Carriageway Consulting
9 March 2021

[1] 111 residences in the PC24 area and 6 residences from the PC48 area

A.

P.

E.