BEFORE THE HEARING PANEL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of Proposed Plan Change 37 - Nukuhau (private) by AN Rajasingham LPT Trustees No 124 Limited anors to the Taupo District Council to rezone c.78ha of land in the Nukuhau area from Rural Environment to a mix of General Residential and Mixed Density Residential with a Neighbourhood Shopping Centre overlay.

STATEMENT OF EVIDENCE OF ROBERT SWEARS (TRAFFIC)

Dated 20 OCTOBER 2021

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1 Qualifications and Experience

1.1 Credentials

1 My full name is Robert Clive Swears. I am employed as a Technical Principal - Road Safety and Traffic Engineering in the Hamilton Office of WSP. I have been in this role for approximately six and a half years.

2 My qualifications include a New Zealand Certificate in Engineering, a Bachelor of Engineering degree with Honours from the University of Canterbury, and a Master of Engineering Science degree (Transport) from the University of New South Wales. I am a Chartered Member of Engineering New Zealand (CMEngNZ), and a Member of the Engineering New Zealand (EngNZ) Transportation Group.

3 I have been carrying out professional engineering tasks related to the investigation, design, and construction of roading and highway projects for 31 years. I have worked on a variety of transportation projects throughout my career for various clients including public agencies (such as Waka Kotahi and local authorities) and, to a lesser extent, private individuals and / or organisations.

4 I have provided various advice to my clients in relation to their applications and submissions on district plans and in the application of district plan provisions to land use activities having the potential to affect the road transport network.

1.2 Background

5 My evidence is given on behalf of AN Rajasingham LPT Trustees No 124 Limited anors ("the Applicant") in relation to the transport engineering implications of Proposed Plan Change 37 - Nukuhau (private) to the Taupo District Plan to rezone approximately 78 ha of land in the Nukuhau area from Rural

Environment to a mix of General Residential and Mixed Density Residential with a Neighbourhood Shopping Centre overlay ("the Project").

6 I am familiar with the location of the parcels of land ("the Site") that are the subject of the Project. I am also familiar with the road network in the vicinity of the Site and have provided extensive advice to Waka Kotahi (NZ Transport Agency) in relation to projects that had the potential to adversely affect Wairakei Drive (at the time when Wairakei Drive was also SH1).

7 In 2008 I prepared evidence for Waka Kotahi (known then as Transit New Zealand) in relation to the Board of Enquiry that considered the Te Mihi Geothermal Power Station Proposal; as a result, I am familiar with the road safety history for the Wairakei Drive / Poihipi Road intersection. I am also familiar with the basis on which the northbound left turn slip lane from Wairakei Drive onto Poihipi Road was established.

8 I was not involved with preparation of the 12 October 2020 Traffic Impact Assessment (TIA) titled "Nukuhau Private Plan Change, Taupo", which was prepared by my colleagues (Emma Cui and Tobie Ueckermann).

9 I was involved with preparation of the 22 September 2021 memorandum provided to Hamish Crawford (WSP, 2021a) that describes the results of additional transport modelling carried out by Ms Cui and reviewed by Mr Liu. For this statement of evidence I am reliant on the results of the modelling provided by Ms Cui that are described in the September 2021 memorandum and the subsequent October 2021 memorandum ((WSP, 2021a) and (WSP, 2021b)).

2 Code of Conduct

10 I have read and am familiar with the Code of Conduct for Expert Witnesses in the current Environment Court Practice Note (2014). I have complied with it in the preparation of this statement. I also confirm that the matters addressed in this statement are within my area of expertise, except where I rely on the opinion or evidence of other witnesses. I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

3 Scope of Evidence

11 In this statement I have not included a comprehensive description of the Site or the Project because these details are adequately defined in the Appendix E - Traffic Impact Assessment and elsewhere.

12 Primarily, my evidence addresses the following matters:

(i) Commentary regarding the TIA, which includes reference to the Waikato Regional Transport Model (WRTM).

(ii) Commentary regarding the 22 September 2021 (WSP, 2021a) memorandum prepared by Ms Cui, with my assistance and the subsequent 12 October 2021 memorandum (WSP, 2021b).

(iii) Overview of transport modes and, in particular, typical journey distances for walking and cycling.

(iv) Commentary regarding key constraints associated with the Project and the implications of a second crossing of the Waikato River.

(v) Response to matters raised in the Taupo District Council ("the Council") Section 42A Report.

(vi) Response to matters raised by submitters in relation to transport engineering.

4 Summary of Evidence

13 My statement broadly considers the transport network in the vicinity of the Site and discusses the transport engineering implications of traffic generated by the Project.

14 The traffic modelling results described by Ms Cui in her statement indicate significant increases in travel time as a result of development of existing residential zoned land on the northern side of the Waikato River.

15 Trip generation associated with the Project will further increase travel time if that traffic is added to future trip generation that might also occur.

16 However, if the Project proceeds and offsets residential development that might otherwise occur within existing residential zoned land, the Project presents the opportunity for a reduction in motor vehicle trip generation through some trips being transferred to active modes (walking and cycling). In my opinion, this is the fundamental component of the Site that means the Project is less likely to result in adverse transport engineering effects than might otherwise occur.

17 Subject to my preceding point, I have not identified anything associated with the Project that I consider presents an insurmountable or unrealistic hurdle to developing the Site in the manner described by the Plan Change.

5 Commentary regarding the Traffic Impact Assessment (TIA)

5.1 Commentary regarding the Traffic Impact Assessment

18 The key recommendation of the TIA ((WSP, 2020) is (Section 9.4) that "[…] this Private Plan Change application [the Project] be supported by the Taupō District Council, as the likely traffic and transportation impacts can be suitably mitigated by local intersection and other improvements […]".

19 There are matters in the TIA with which I have questions or concerns. While these matters do not affect the fundamental conclusion of the TIA, I consider it worth highlighting them for clarity:

(i) Road hierarchy.

(ii) Waikato Regional Transport Model (WRTM).

(iii) Control Gates Bridge traffic volumes.

(iv) Crash history.

(v) Safe system intersection form.

5.2 Road Hierarchy

20 In Table 2-2 the TIA (WSP, 2020, p. 5) describes the hierarchy of various roads on the Taupo District transport network. While I do not consider the matter has a material effect on the conclusions of the TIA, I note that Huka Falls Road is identified as an arterial, however, (TDC, 2021) indicates it is a Collector Road. In my opinion, the Taupo District Council (TDC) hierarchy is more plausible than the one identified by WSP, which is sourced from Waka Kotahi (2021).

21 The Waka Kotahi (2021) source does not describe the hierarchy of roads in the vicinity of the Site, therefore, I consider greater weight should be given to the Taupo District Council hierarchy. In any case, both Taupo District Council and Waka Kotahi identify the relative importance of Poihipi Road, Acacia Bay Road, and Norman Smith Street on the northern side of the Waikato River ("the River").

5.3 Waikato Regional Transport Model (WRTM)

5.3.1 Accuracy of WRTM

22 While it is not unusual for transport engineers to defend the transport models from which conclusions are drawn, I consider it important to put the Waikato Regional Transport Model (WRTM) in perspective.

23 As I have similarly noted elsewhere in relation to different matters, being considered by other consent authorities, I consider that the use of the WRTM to identify traffic volumes to be used for modelling purposes for the Project is generally appropriate and there is no better tool available.

24 However, just because the WRTM is the best tool available, it does not mean that the WRTM will provide absolutely reliable results. It is not unusual for results from the WRTM not to match reality.

25 While I consider the approach adopted by my colleagues is reasonable, I also consider that caution should be applied in relation to determining whether specific mitigation is required (or not required) based solely on the results of modelling derived from WRTM traffic volumes. The model provides a reasonable approximation of what may occur in terms of future traffic movements based on the range of assumptions. However, transport models should not be static and need

ongoing validation and refinement, as more information comes to hand, to inform amendments that will improve the reliability of the model.

26 Although the modelling results presented by Ms Cui are based on the best information presently available, I would be surprised if traffic growth and land use development proceed in exactly the manner described in the model. Similarly, I would be surprised if road users do not amend their behaviour as a result of constraints and / or congestion on the transport network. Therefore, I consider that modelling results should be regarded as a reasonable indicator, but they do not provide a perfect prediction of the future.

27 Alfred North Whitehead[1] succinctly defines this in his statement that "There is no more common error than to assume that, because prolonged and accurate mathematical calculations have been made, the application of the result to some fact of nature is absolutely certain." (source: (Akcelik, 2020)).

5.3.2 Levels of Service and Peak Spreading

28 In her statement, Ms Cui describes various levels of service at intersections and at the Bridge. While the results may appear to describe clearly defined parameters and performance measures, it needs to be kept in mind that levels of service are described on a continuum. For example (as illustrated in Figure 1 below), the level of service (LoS) for an approach to a roundabout is defined as LoS B if the delay is in the range from greater than 10 seconds to 20 seconds and LoS C if the delay is in the range from greater than 20 seconds to 35 seconds. However, there is not a transformational change in the

[1] Alfred North Whitehead (1861-1947) was a British mathematician and philosopher.

behaviour of traffic when average delay increases from (for example) 20.0 seconds (which is LoS B) to 20.1 seconds (which is LoS C).

Delay (SIDRA) method for Level of Service definitions based on delay only (for vehicles)

Level of Service	Control delay per vehicle in seconds (d)		
	Signals	"SIDRA Roundabout LOS" method (1)	Sign Control
A	d ≤ 10	d ≤ 10	d ≤ 10
B	10 < d ≤ 20	10 < d ≤ 20	10 < d ≤ 15
C	20 < d ≤ 35	20 < d ≤ 35	15 < d ≤ 25
D	35 < d ≤ **55**	35 < d ≤ **50**	25 < d ≤ **35**
E	**55** < d ≤ 80	**50** < d ≤ 70	**35** < d ≤ 50
F	80 < d	70 < d	50 < d

For Standard Left, Standard Right and New Zealand setups in SIDRA INTERSECTION, this is the default LOS Method for vehicles. Level of Service Target = LOS D is indicated by the table.

(1) The default *Roundabout LOS Method* is the ***SIDRA Roundabout LOS*** method for roundabouts which is unique to SIDRA INTERSECTION. It has been recommended by AUSTROADS - AGTM03-20, Guide to Traffic Management Part 3: Transport Study and Analysis Methods (2020), Table 7.3.

Figure 1: Levels of service based on control delay per vehicle (source: (Akcelik, 2020))

29 The other matter to keep in mind regarding levels of service is that LoS F is an open-ended scale. Therefore, modelling results described as LoS F are not necessarily equivalent with each other. For example, at a signalised intersection, if the control delay per vehicle is 81 seconds, the level of service is F, however; if the delay per vehicle is 8000 seconds the level of service is still F. Clearly, there is a significant difference in the delay per vehicle between the first example and the second example.

30 When delays are high (and levels of service are low) relatively small increments in traffic can result in relatively significant changes in delay. For example, if all else is equal, a 10% increase in traffic volumes may result in delay increases greater than 10%.

31 As traffic volumes and delay increase, road user behaviour may change in order to avoid the delays. For example, if a road user will experience a five-minute delay if they start their journey from Nukuhau to Taupō at 8:00 am, but they will experience a

one-minute delay if they start their journey at 7:50 am, the road user may change the time at which they start their journey in order to reduce the delay they experience on that journey.

32 When peak hour periods are clearly defined and road users identify that, by adjusting the time at which they travel, they can reduce their overall journey time, this tends to occur. Essentially, road users determine that, by extending the peak period, they can flatten and spread the peak which means the delay per road user is reduced at the time delay increases previously occurred.

33 In heavily congested locations (such as Auckland) the peak period spreads more widely as road users endeavour to minimise their overall journey time. I consider it likely that if road users travelling across Control Gates Bridge, or using the intersections affected by the Project, identify they can reduce their journey time by travelling at a different time, then this peak spreading will occur. Therefore, the modelling results presented by Ms Cui are likely to provide a pessimistic representation of road user behaviour and the potential exists that the delay per road user will be less than the values described in the modelling results.

34 Noting that the example involves very high traffic volumes, and I am not suggesting peak spreading to the extent illustrated will occur on Control Gates Bridge, the graphs below show the change in the daily flow profile of northbound traffic on the Auckland motorway between Otahuhu and Penrose in the vicinity of the Panama Road overbridge.

35 The first graph (Figure 2) is the flow profile in 2000 and the second graph (Figure 3) is the flow profile in 2019.

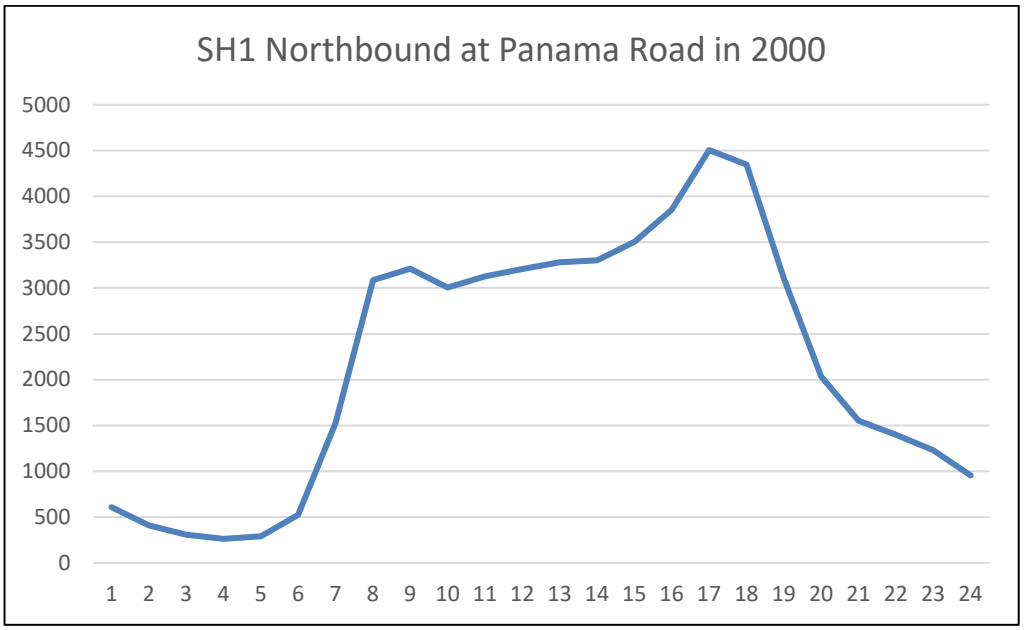

Figure 2: Average hourly traffic volumes on Auckland motorway SH1 northbound at Panama Road in 2000 (source: (Waka Kotahi, 2021))

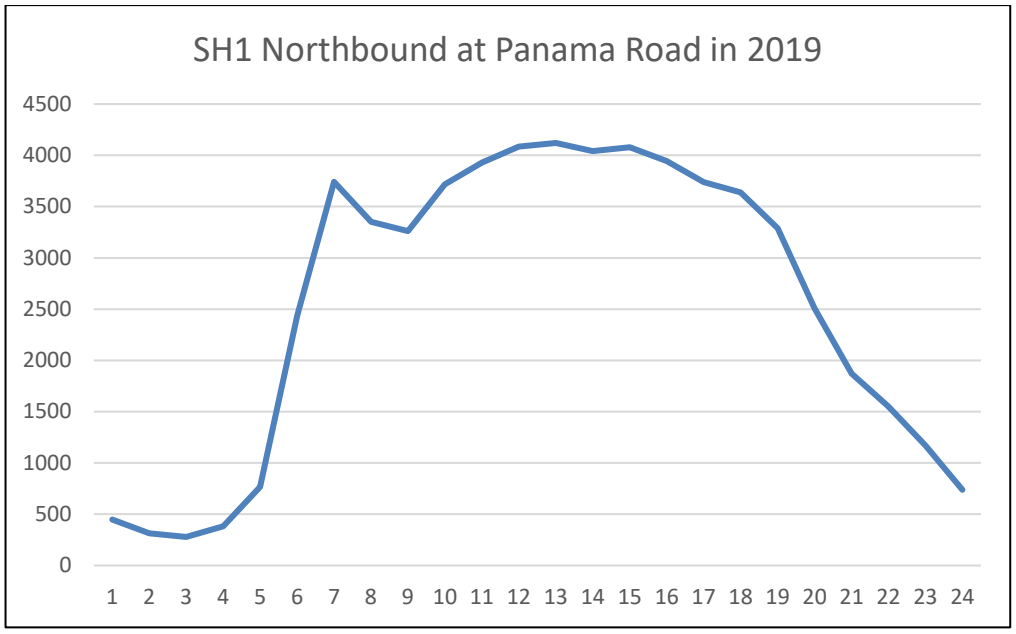

Figure 3: Average hourly traffic volumes on Auckland motorway SH1 northbound at Panama Road in 2019 (source: (Waka Kotahi, 2021))

36 The Annual Average Daily Traffic (AADT) volume in 2000 was 52,639 vehicles per day (vpd) and in 2019[2] it was 61,392 vpd. However, hourly traffic volumes had reduced from a peak of 4506 vehicles per hour (vph) in 2000 to 4078 vph in 2019. Road users changed their travel patterns to spread the peak; this resulted in hourly traffic volumes reducing.

37 Emphasising that there is a significant difference between the Auckland motorway and Control Gates Bridge, as peak hour traffic volumes on Control Gates Bridge increase, I expect there will be peak spreading which may result in a reduction in the peak hour traffic volumes identified from the WRTM and modelled by Ms Cui.

38 The other behaviour change that may occur, which is different to peak spreading but results in a similar outcome, is that road users may choose to complete the journey by a travel mode that involves less delay. For example, if a particular journey can be completed via active modes (walking and cycling), in a similar or shorter time than the same journey by motor vehicle, road users may elect to complete the journey by an active mode. This matter is discussed further in Section 7 of this statement.

5.4 Control Gates Bridge Traffic Volumes

39 In Appendix B of this statement I have described my analysis of historic traffic volumes on control Gates Bridge from traffic data

[2] I initially considered data from 2020 , however, the AADT of 55,141 vpd and peak hour traffic volume of 3702 vph indicated that traffic volumes were abnormally low. I concluded this may be due to changes in travel patterns as a result of Covid lockdowns.

measured in 2007 and 2009 when Tongariro Street was also SH1.

40 Waka Kotahi ((2013) and (2008)) data indicates that when Tongariro Street was SH1 the AADT volumes immediately north of the Bridge reached 29,255 vpd in 2007.

41 While the modelling described by Ms Cui shows that the Project will increase the volume of traffic using the Bridge, it is important to recognise that despite its capacity limitations, the Bridge is able to carry significant volumes of traffic.

42 For comparison purposes, Ms Cui (WSP, 2021a) has described various modelled traffic volumes. In the table below I have compared the 2030 all permitted and 2030 all permitted plus 80% of Nukuhau traffic volumes on Control Gates Bridge with the highest measured hourly traffic from 2007 (full details of the calculations are included in Appendix B).

Table 1: Modelled Traffic Volumes Compared with Measured Traffic Volumes

Scenario	Traffic Volume (vph)		
	Southbound	Northbound	Total
Measured AM peak 60-minute equivalent (2007)	1380[3]	868	2248
2030 AM all permitted	2336	717	3053
2030 AM all permitted plus 80% Nukuhau	2638	717	3355
Measured PM peak 60-minute equivalent (2007)	1004	1624	2628
2030 PM all permitted	1098	2272	3370
2030 PM all permitted plus 80% Nukuhau	1098	2571	3669

[3] 4 x 345 vph 15-minute southbound flow in Table 14.

43 The table illustrates that 2030 modelled traffic volumes are higher than the historically measured traffic volumes. However, as noted in the evidence of Ms Cui, the Bridge itself is not necessarily the capacity constraint.

5.5 Crash history

5.5.1 Crash history strategic context

44 Section 2.5.1 in the TIA notes that "The NZ Transport Agency [(Waka Kotahi, 2013)] assessed all vehicle crashes within the 10-year period between 2003-2012 and listed the Top 100 High Risk Interesections within New Zealand. The Poihipi Road and Wairakei Drive Intersection was identified as the second most dangerous intersection in NZ. The crash history shows that 16 crashes were reported at the Poihipi Road and Wairakei Drive Intersection, of which 12 of them were associated with cross and turning crashes including 4 minor crashes."

45 While the basis on which the Wairakei Drive / Poihipi Road intersection was identified as the second worst is not entirely clear to me, it is important to recognise that the period over which the analysis was completed was largely during the time when Wairakei Drive was also SH1. The table below describes the crash history[4] for the Wairakei Drive / Poihipi Road intersection from 2003 to 2020 inclusive. The search radius used is 50 m; we back analysed to determine this radius by adjusting the search radius until we identified a crash history that matched the information from the Waka Kotahi (2013) analysis.

[4] Search of the Waka Kotahi Crash Analysis System (CAS) database was completed by my colleague (Renata Gomez) on 30 September 2021.

Table 2: Crashes at the Wairakei Drive / Poihipi Road Intersection

Year	Crashes				Total	Total High Severity
	Fat	Ser	Min	Non-inj		
2003	0	0	0	3	3	0
2004	0	0	1	4	5	0
2005	0	0	1	2	3	0
2006	0	1	2	2	5	1
2007	0	1	4	5	10	1
2008	0	0	6	3	9	0
2009	0	1	2	3	6	1
2010	0	0	3	3	6	0
2011	0	0	1	1	2	0
2012	0	2	0	1	3	2
Subtotal 2003 to 2012	0	5	20	27	52	5
Subtotal from high-risk intersections report[5]	0	5	20	-	-	5
2013	0	0	0	1	1	0
2014	0	0	1	1	2	0
2015	0	0	1	4	5	0
2016	0	0	1	2	3	0
2017	0	0	1	2	3	0
2018	0	0	0	2	2	0
2019	0	1	0	1	2	1
2020	0	0	1	1	2	0
Subtotal 2013 - 2020	0	1	5	14	20	1

[5] The high-risk intersections report did not include information related to non-injury crashes.

46 The table shows that while the Wairakei Drive / Poihipi Road intersection has been the site of high severity crashes in the past, the crash history has improved since SH1 traffic was moved on to the East Taupo Arterial.

47 Included below is a table in which I have compared the annual average number of crashes within a 50 m radius of the intersection for three time periods. The reason for including the 2016 – 2020 period is because crash analysis is ordinarily conducted for a five-year period.

Table 3: Average Number of Crashes per Year at the Wairakei Drive / Poihipi Road Intersection

Period	Crashes / year				Total	Total High Severity
	Fat	Ser	Min	Non-inj		
2003 - 2012	0.0	0.5	2.0	2.7	5.2	0.5
2013 – 2020	0.0	0.1	0.6	1.8	2.5	0.1
2016 - 2020	0.0	0.2	1.0	2.8	4.0	0.2

48 The values in Table 3 need to be considered in context. For example, it could be interpreted that there has been a doubling of high severity crashes between the 2013 - 2020 and 2016 - 2020 crash periods. However, there was a single high severity crash in 2019, which results in a rounded value of 0.1 high severity crashes per year in the 2013 – 2020 period and 0.2 high severity crashes in the 2016 - 2020. The number of crashes has not increased, it is just that the number of years in the denominator of the equation has reduced.

49 While I have not completed a crash exposure analysis, it needs to be kept in mind that when the ETA was opened there was a reduction in traffic on Wairakei Drive (as illustrated in Appendix B). That reduction in traffic would have contributed to the reduction in crashes, however, that is only part of the reason.

Improvements made at the Wairakei Drive / Poihipi Road intersection would also have contributed to the reduction in crashes.

50 The key point of Table 3 is that there has been a significant reduction (from 0.5 to 0.2) in high severity crashes since the Waka Kotahi (2013) analysis was completed.

5.5.2 Crash history general context

51 The TIA (Section 2.5) includes a diagram (Figure 2-5) illustrating the locations of 71 reported crashes within a five-year period. One of these crashes resulted in serious injury (which will be the same crash to which I have referred in Section 5.5.1 of this statement).

52 While the collision diagram (Figure 2-6) in the TIA illustrates there have been numerous crashes on roads in the vicinity of the Site over the five-year period, it needs to be kept in mind that 56 of the 71 crashes did not involve injury and the remaining 14 involved minor injury. As noted in Section 5.6 of this statement; we expect crashes to occur.

53 As traffic volumes on the road network increase, we expect the number of crashes to increase simply because there is greater exposure to conflict for the vehicles using the network. However, there is nothing inherent in the Project which means the road network will be less safe than we would expect it to be for the increased volume of traffic that will be using the network.

54 I consider it appropriate and reasonable for the conditions associated with the Plan Change to require road safety audit of the design of the road network changes associated with the Project. The process provides an opportunity for the designs developed by the Applicant to be independently reviewed from

a road safety perspective and for the designs to be amended as necessary to ensure that the additions to the road network proposed by the Applicant will be safe and appropriate. I also consider the conditions should require the road safety auditors to have a specific focus on provisions made for active transport modes.

5.6 Safe system intersection form

55 The Waka Kotahi (2013) High-Risk Intersections Guide provides an overview of the Safe System approach to road safety and refers to the following cornerstones of the System[6]:

(i) Human beings make mistakes and crashes are inevitable.

(ii) The human body has a limited ability to withstand crash forces.

(iii) System designers and users share responsibility for managing forces so that crashes do not result in death or serious injury.

(iv) It will take an all of system approach to implement the Safe System in New Zealand.

56 Notwithstanding my previous comments regarding the crash history at the Wairakei Drive / Poihipi Road intersection, the key factors that will improve safety at any intersection include, but are not limited to, the following:

(i) Reducing impact speeds.

(ii) Reducing impact angles.

[6] The four points listed are partially paraphrased from the Guide.

(iii) Eliminating conflict points.

(iv) Providing greater certainty for road users regarding the intentions of other road users.

57 Taking the Wairakei Drive / Poihipi Road intersection as an example, changes have been made to (and at) the intersection that address some of the factors listed above. For example:

(i) The speed limit at the intersection was 80 km/h, it is now 50 km/h (impact speeds have been reduced).

(ii) There used to be two northbound lanes going up the Wairakei Drive hill towards Poihipi Road. Large slow vehicles travelling in the left-hand lane obstructed visibility from road users on Poihipi Road, waiting to select a gap in the northbound traffic stream, to faster vehicles travelling in the right-hand lane. As a result, a turning road user may consider they had identified a suitable gap, however, the faster vehicle in the right-hand lane "appeared" from behind the slow vehicle at the point where the Poihipi Road driver thought they had a gap. There is now a single lane uphill, which means the visual shielding does not occur (some conflict points have been removed).

(iii) Notwithstanding the point above, northbound traffic turning left into Poihipi Road turned from the left-hand lane close to Poihipi Road, therefore, turning traffic could obstruct visibility from Poihipi Road to traffic travelling uphill on Wairakei Drive. A physically separated left turn lane has been constructed, which makes the intentions of left turning road users clear and significantly reduces the potential for left turning vehicles to obstruct visibility from Poihipi Road to northbound through traffic (greater certainty regarding intentions of road users).

58 However, the potential for side impact crashes has not been eliminated. In addition, there is still uncertainty for road users regarding the intentions of other road users.

59 The "best" intersection form for any location will vary depending on a range of factors including available land, approach speeds, topography, volume of active mode users, and sight distance constraints.

60 Waka Kotahi (2013, p. 47) notes that:

(i) "Roundabouts have consistently good safety performance and are inherently Safe System compliant, so they are generally the preferred option considered for transformation treatments, subject to space considerations. Despite their often higher non-injury crash rates, their superior Safe System performance is achieved by controlling crash forces to occupants of motor vehicles to below Safe System thresholds. However, the outcome for motorcyclists and cyclists is not as favourable, as conflicts are still frequent, and impact speeds for them are still above their lower Safe System thresholds. […]"

(ii) "Traffic signal controlled crossroads do not perform as well under Safe System criteria and their performance varies widely. In urban areas they overall perform worse than priority controls, despite substantially reducing crossing movement crashes, they perform much worse for right turn against and pedestrian crashes. So they should not be automatically considered as a Safe System transformation, and where they are needed for other reasons, their shortcomings should be carefully addressed in the design."

61 However, there are likely to be advantages with a signalised intersection at a reconfigured single intersection point between

Wairakei Drive, Poihipi Road, and Huka Falls Road because of the following factors:

(i) There can be linking with signals at other locations (such as Norman Smith Street), which increases the potential for "green waves", which means delay for through traffic movements can be minimised.

(ii) Crossing distances for active mode users may be shorter than at a roundabout and there is clarity as to when the signals are accommodating the movement of active mode users.

(iii) The signal controller can accommodate variability in demand for the use of the intersection and minimise the overall delay to road users. Whereas roundabouts delay all road users due to the need to slow down to traverse the roundabout.

62 There is not a "crash free" and / or "delay free" intersection solution. Therefore, consideration needs to be given to competing demands to allow the most suitable intersection control form to be identified for the proposed Wairakei Drive / Poihipi Road / Huka Falls Road intersection.

63 In my opinion, regardless of the intersection form identified as most appropriate, the design should be subject to road safety audit so that safety for road users is optimised.

6 Commentary regarding the 22 September 2021 memorandum prepared by Ms Cui, with my assistance.

6.1 Extent and magnitude of development

64 I do not have any expertise in property economics or the rates at which subdivided land is purchased and dwellings constructed. However, once those dwellings are constructed and are used for

their intended purpose, I have a good understanding of the magnitude of trips generated by those dwellings.

65 In the memoranda ((WSP, 2021a) and (WSP, 2021b)) reference is made to the proportion of development that may occur within the different areas within which there is residential supply. Figure 4 below provides a breakdown of residential supply within the Taupo District.

Northern End of the Lake		Southern End of the Lake	
EUL	1,900	Kuratau/Omori	180
WEL	496	Mohi	50
Brentwood	120	Turang	400
Lakeside Brentwood	350	Whareroa	160
Vineyard on Huka falls	36	Undeveloped half charges	275
Acacia Bay	150	**Total Southern End**	**1,065**
Kinloch	334	**Unzoned**	
7 Oaks	162	Five Mile Bay site A and C	440
Undeveloped half charges	742	Nukuhau Private Plan Change	780
Total Northern End	**4,290**	**Total Unzoned**	**1,220**

Figure 4: District Residential Supply Breakdown (source: (Property Economics, 2021))

66 With respect to the Project, we have considered residential supply on the northern side of the River, which encompasses those areas highlighted by the red rectangle in Figure 4.

67 Assumptions have then been made in the modelling undertaken by Ms Cui regarding the proportions of those different areas that might be established for the various modelling scenarios. No account has been taken of the availability of residential supply on the southern side of the River.

68 Emphasising that I do not have expertise in property economics, the amount of residential supply that is sourced from land on the northern side of the River will influence the effects of that

residential development on the components of the transport network that are also affected by traffic generated by the Project. However, if residential supply is sourced from land on the southern side of the River, the effects of vehicle movements associated with the Project will be somewhat less than those identified by Ms Cui.

69 For example, if 100% of the Project is developed and none of the other residential supply on the northern side of the river is developed, the increase in travel time (including delay) associated with the Project will be less than if 100% of the Project is developed and some or all of the other residential supply on the northern side of the River is also developed.

70 From a transport engineering perspective, unless we have certainty regarding the rate of uptake of residential land in different locations, we need to make assumptions regarding the various proportions of uptake; which is what has been done to inform the modelling.

7 Walking and Cycling

7.1 Overview of transport modes; particularly typical journey distances for walking and cycling

71 Transport modelling does not typically provide us with a robust means to identify the impact of active modes (walking, cycling, and personal mobility devices (PMDs) such as scooters); therefore, transport modelling is typically motor vehicle focused. However, if journeys can be transferred from motor vehicles to active modes (and / or public transport) there will be a reduction in the volume of motor vehicle traffic using the transport network.

72 The attraction of active modes is dependent on a number of factors including, but not limited to:

(i) Journey distance

(ii) Attractiveness of route

(iii) Weather

73 It does not require much consideration of a long cycling journey on a potentially unsafe route in wet weather to identify that, given the choice, the journey is likely to be more attractive if taken in a motor vehicle than on a bicycle.

74 While we do not have control over the weather, when considering land use development and the appropriateness of development at one location compared with another location, we need to consider journey distances and the attractiveness of various routes via a range of transport modes.

75 I do not have any expertise in climate change, carbon emissions, greenhouse gases, and so on; however, it is known that there are fewer emissions associated with journeys via active modes than journeys by motor vehicle. Therefore, reducing the number of motor vehicle journeys or motor vehicles used for journeys (as occurs with public transport) should result in a reduction in emissions.

76 Statistics NZ (2021) describes that for a total of 6306 journeys from home to work by employed people age 16 and over, 746 (11.8%) of those journeys did not involve use of a private motor vehicle. That is, they were completed by walking, cycling, and / or public transport only.

77 In their reporting Statistics New Zealand (2021) states that:

(i) The average walk to work journey is 1.2 km, with the average time taken being 15.9 minutes.

(ii) The average cycle to work journey is 5.1 km, with the average time taken being 20.1 minutes.

78 An Otago University study (Mandic S., 2015) of active transport (walking and cycling) to school identified that the average journey distance for secondary school students is 1.4 km. However, the study did not clarify mode choice.

79 Ministry of Transport (2015) data indicates that 11 minutes is the average time spent walking per trip leg for education purposes for people aged 5 to 17 years. If we assume a walking speed of 5 km/h (Cavagna, 1983) for a child, the walking trip length within an 11-minute average period is 0.92 km.

80 Table 4 below provides a summary of the various active mode journey distances described above.

Table 4: Summary of Active Mode Journey Distances

Journey Type	Dist. (km)
Average walk to work	1.2
Average cycle to work	5.1
Average secondary student journey to school	1.4
Child walking to school	0.9

81 To provide context for these various active mode journey lengths I have considered distances from locations associated with the Site and permitted developments on the northern side of the River to the Spa Road / Tongariro Street roundabout. Table 5 describes the distance to the roundabout from various origins.

Table 5: Journey Distances to Spa Road / Tongariro Street Roundabout from Nukuhau and Permitted Development Locations

From Spa Road / Tongariro Street Roundabout to:	Dist. (km)	Relates to Development at
Wairakei Drive / Tongariro Street / Norman Smith Street intersection	0.55	None
Wairakei Drive / Poihipi Road intersection (existing)	1.3	Nukuhau
Poihipi Road / Acacia Bay Road intersection	1.6	Nukuhau
163 Lakewood Drive	2.2	Nukuhau (near eastern boundary of Parcel 6)
111 Jarden Mile	3.4	Brentwood
179 Acacia Bay Road	1.7	Lakeside Brentwood
2 The Boulevard	2.2	Vineyard on Huka Falls
100 Loch Views Road	8.1	Acacia Bay
18 Kahikatea Drive	21.2	Kinloch
44 Okaia Drive	21.7	7 Oaks Kinloch

82 However, the Spa Road roundabout is not itself a destination; I have simply used it for comparison purposes. Table 6: describes distances from the roundabout to some schools in Taupō.

Table 6: Journey Distances to Schools from Spa Road / Tongariro Street Roundabout

School	Dist. (km)
Taupō-nui-a-Tia College	0.8
Taupo Primary School	0.5
Mountview School	2.3
Tauhara College	4.1

83 Essentially, the distances from the Site and from permitted development areas are such that children are unlikely to walk to school and adults are unlikely to walk to work. However, from a cycle to work perspective the Plan Change site is well within reach of numerous locations around the Taupo central business district (CBD) and beyond when compared with the average cycle to work journey distance (5.1 km).

84 The distances from Lakeside Brentwood and Vineyard on Huka Falls are commensurate with those from various locations around the Site. Therefore, considering transport efficiency (whether by active modes or by motor vehicle) I consider that the most appropriate locations to be developed for residential use are (in no particular order):

(i) Nukuhau

(ii) Lakeside Brentwood

(iii) Vineyard on Huka Falls

85 Although Brentwood is also likely to be within reach of the average cycle to work journey, there are numerous other residential development opportunities within the three locations listed above that provide more attractive active mode journey distances.

86 Road users presented with the option of congested travel by private motor vehicle or free-flowing travel by active mode, may choose to travel by active modes if the journey distance is practicable (and other factors such as route attractiveness are achieved). Given that there are locations on the transport network where congestion is expected (regardless of whether the Project is established), I consider that options should be identified and pursued that will allow for that congestion to be reduced.

87 The Project is within a reasonable active mode range of the Taupo CBD while Kinloch (for example) is beyond the average range of active mode journeys. Therefore, from a congestion reduction perspective, it is reasonable to conclude that residential development at the Site has significantly greater potential to reduce congestion than residential development further away from the CBD.

7.2 Infrastructure for Walking and Cycling

88 The shared path along the eastern side of Wairakei Drive provides an attractive route for active mode users to travel to and from the Taupo CBD. However, the Nukuhau site (and other development sites such as Lakeside Brentwood) are located on the western side of Wairakei Drive. If signals are established at the Wairakei Drive / Poihipi Road / Huka Falls Road intersection, the signal controller can be set to provide for active mode user movements across Wairakei Drive to and from the shared path.

89 Given that there are not suitable places at which active mode users can cross Wairakei Drive to the north of Norman Smith Street, consideration needs to be given to the routes that would be used by active mode users to travel into Taupō. In my opinion, given the traffic volumes using Wairakei Drive, it is undesirable for less confident active mode users to cross Wairakei Drive except at locations where crossing movements are controlled (such as at the Norman Smith Street signalised intersections) or where there are refuges or grade separated crossing places.

90 The Applicant is not proposing to construct additional crossing places (except in conjunction with the new Poihipi Road / Wairakei Drive / Huka Falls Road intersection), however, even if there is a suitable crossing place in the vicinity of the new

intersection, active mode users whose destination is the Taupo CBD would have to travel in the opposite direction to use the crossing place, before travelling down the eastern side of Wairakei Drive on the shared path. Therefore, consideration needs to be given to how active mode users from the Site will be able to travel to and from Taupō.

91 One option could be to construct a shared path along the western side of Wairakei Drive, similar to the one along the eastern side, however, I would be concerned that this could encourage movements across Wairakei Drive where the only separation between opposing motor vehicle movements is the flush median. Therefore, vulnerable road users would not be protected.

92 Acknowledging that it is something of a simplification and that some works would be required to improve the corridors, there are three primary nodes for active mode users to travel from the Site into Taupō; these are as follows:

(i) In the vicinity of the existing Wairakei Drive / Poihipi Road intersection (green route on Figure 5).

(ii) Acacia Bay Road in the vicinity of the Herapeka Street intersection (purple route).

(iii) Lakewood Drive (brown route).

93 While there is relative flexibility for active mode users travelling from the Site to the CBD, I consider some of the routes that can be followed, based on existing or slightly modified infrastructure, will be safe and appropriate. However, the key exception to this is access from Lakewood Drive.

94 Figure 5 below illustrates the three indicative routes for travelling from the Site to the Wairakei Drive / Tongariro Street / Norman Smith Street intersection.

Figure 5: Indicative active mode routes from the Site to the Wairakei Drive / Tongariro Street / Norman Smith Street intersection. Green route is from Poihipi Road, purple route is from Herapeka Street, and brown route is from Lakewood Drive (refer to Appendix A for the original diagram)

95 Notwithstanding the issues for active mode routes from the Site into the Taupo CBD, the constraints along Norman Smith Street, particularly to the east of Noble Street are such that I consider additional provisions for cyclists are desirable before cyclist numbers are increased.

96 While I have not completed a design, it appears the least complicated solution would be to widen the footpath along the southern side of Norman Smith Street to provide a shared path and for a pedestrian refuge or similar to be established in the vicinity of the Norman Smith Street / Noble Street intersection.

97 In addition to the works along Norman Smith Street, I consider it would be necessary to provide a suitable connection from the

existing Poihipi Road through to the northern end of Woodward Street. Work should also be undertaken along the path (illustrated in Figure 6 below) from Woodward Street to the Wairakei Drive / Tongariro Street / Norman Smith Street intersection to increase the width and improve route security from a CPTED (Crime Prevention through Environmental Design) perspective.

Figure 6: Existing path from Woodward Street to Norman Smith Street intersection; looking towards Norman Smith Street.

98 It may be appropriate for some of the development contributions associated with the Project to be directed towards improvements to the walking and cycling network between the Site and Taupo CBD.

8 Key Constraints Including Implications of Second Crossing of Waikato River

99 Reference is made in the TIA (Section 8) regarding a second bridge across the Waikato River to increase traffic flow capacity across the River. While I have not conducted any analysis in relation to the suitability of the second crossing being immediately adjacent to the existing crossing, I question

whether it could be better for the second crossing to be located elsewhere so that traffic flows are not concentrated at the Spa Road / Tongariro Street intersection.

100 Emphasising that I have not undertaken any analysis, the traffic effects associated with a second crossing may be reduced if the crossing is in a location away from the existing Control Gates Bridge. For example, if the crossing was in the vicinity of Opepe Street there would be distribution of traffic movements along Spa Road so that road users not needing to travel along Tongariro Street to Lake Terrace could instead travel along Spa Road to their destinations in Taupō.

101 The reason for raising this matter is that the modelling to which Ms Cui refers is based on the assumption the second crossing will be immediately adjacent to control Gates Bridge. However, until there is certainty regarding the location of a second crossing, I consider any conclusions that are drawn based on an assumed location for the second crossing should be regarded as indicative only.

102 Notwithstanding that a second river crossing will increase the capacity for vehicle movements across the River, it needs to be kept in mind that the existing bridge is not necessarily the primary constraint for traffic flows across the River. As noted in the evidence of Ms Cui, the intersections on either side of the Bridge control the rate at which traffic can reach the Bridge.

9 Joint Witness Statement and Response to matters in the Taupo District Council Section 42A Report

103 I attended the Traffic Expert Conferencing conducted via a Teams meeting on 12 October 2021, and subsequent meetings with the traffic experts on 15 and 18 October, during which we

developed the Joint Witness Statement (JWS) dated 18 October 2021.

104 I have reviewed the statement of evidence prepared by Mr Smith, which forms part of the Section 42A (s42A) report.

105 As illustrated through the JWS, I agree with many of the points raised by Mr Smith in the s42A report. However, there appears to be a key point of difference between the opinion expressed by Mr Smith and my opinion.

106 Based on the content of his statement and the JWS I understand that Mr Smith considers PC37 should not proceed until such time as there is a second bridge crossing the Waikato River to provide relatively direct access to the Taupo town centre from areas of residential development on the northern side of the River.

107 My opinion is that if traffic associated with PC37 is added to the volumes of traffic that could be generated by development of land north of the bridge, that presently has a residential zoning, the queuing and delay at key locations on the local road network will increase. However, if residential development on the PC37 site replaces some of the residential development at other locations on the northern side of the Bridge, and the resultant total traffic volume at any given point on the transport network is the same for both cases, then the effects of PC37 on the transport network will be no worse than neutral.

108 While I do not have expertise in relation to residential development, I note that from a transport engineering perspective, if a given vehicle completes a movement (or series of movements) on the transport network, the effects associated with that movement will be the same if the given vehicle is replaced by an identical vehicle.

109 That is, at critical locations on the network (such as Control Gates Bridge), if everything else is equal (such as vehicle type, route followed, et cetera), then from an effects perspective it does not matter whether the vehicle movement has been generated by a dwelling on the PC37 site or a dwelling somewhere else (such as Kinloch).

110 However, because the Site is relatively close to the Taupo town centre, it presents the best opportunity for private motor vehicle movements to be replaced by journeys undertaken using active modes or public transport. And, because the other development locations do not have the same proximity to the town centre, they have reduced potential for private motor vehicle movements to be replaced by other modes.

111 Table 7 below is taken from below paragraph 6.9 the JWS.

Scenario		Range (minutes)	PM Travel time	
No	Percentage Devel'		Increase compared with other scenario	
			Compare	Increase
0	(0/0/0)	2.6 - 3.5	N/A	N/A
1	(100/60/0)	4.8 - 14.9	#0	2.2 - 11.4
2	(100/60/30)	6.0 - 16.0	#1	1.1 - 1.2
2	(100/60/30)	6.0 - 16.0	#0	3.4 - 12.5
3	(100/60/80)	7.0 - 18.1	#1	2.1 - 3.3
3	(100/60/80)	7.0 - 18.1	#0	4.3 - 14.7

Table 7: PM northbound travel times between (and including) Spa Road roundabout and Norman Smith Street intersection

112 As noted by Mr Smith (in the JWS), other development (excluding the Project) has the potential to increase by 2.2 – 11.4 minutes the travel time (including queuing on approaches) between (and including) the Spa Road roundabout and Norman Smith Street. Mr Smith also accurately observes that with 30% and 80% of the Project the worst-case travel times

increase by 12.5 and 14.7 minutes respectively (when compared with the base case). However, PC37 traffic results in journey time increases (in the worst case) of 1.2 and 3.3 minutes respectively.

113 Development excluding the Project increases the worst-case PM travel time by 425% (from 3.5 to 14.9 minutes). The addition of traffic associated with development of 30% of the Project results in a 457% travel time increase (from 3.5 to 16 minutes). If 80% of the Project is developed the increase is 517% (from 3.5 to 18.1 minutes).

114 The JWS includes a table (similar to Table 7 above) that describes travel times in the morning peak hour. However, in this statement, I have only referred to the evening peak period because the travel times are greater than those in the morning period.

115 If Project traffic is added to traffic generated by full development of the other areas north of the Bridge, the Project could result in travel times that in my view would be unacceptable. If the Project is permitted to develop, and the total amount of increased traffic is no greater than could occur without the Project, the resultant effects will be neutral. However, because of its proximity to the town centre, the Project presents the opportunity for traffic volumes (and therefore travel time) to decrease if motor vehicle trips are replaced by active mode trips.

116 The other matter to keep in mind in relation to the modelling results described in the JWS (and in the memoranda (WSP, 2021a) and (WSP, 2021b)) is that the traffic volumes modelled for 2030 are generally greater than the traffic volumes for 2041 described in the TIA. Ms Cui compares the traffic volume information in Appendix B of her statement. Those differences

highlight the effect of assumptions made regarding the extent of future residential development on the outcomes of the traffic modelling. If the extent of development on the northern side of the River is less than has been assumed for the 2030 modelling, then the 2030 travel times described in the JWS will be overstated and present a conservative perspective. While the potential exists for the modelling results described in the JWS to present a conservative view, I do not expect that less conservative residential development assumptions would result in the elimination of modelled delay. However, I expect that the delays (and travel times) described in the JWS (and in this statement) would be less pronounced than the figures indicate.

10 Response to matters raised by submitters in relation to transport engineering

117 In the following paragraphs I have included comments in response to submissions made that relate to the transport engineering effects of the Project on the transport network.

10.1 Structure Planning and Configuration of the Site

118 While I do not agree with the Rangatira E Trust (Submitter 49) that the Project is premature, I do agree that it is desirable for broad structure plans to be established for various locations (for example, the wider Taupo urban area) so that planning of the transport network can proceed based on a level of certainty regarding the likely nature and intensity of land use development.

119 However, as noted in this statement, I consider the Project presents benefits from a transport engineering perspective because the Site is closer to established trip attractors and generators than other parcels of land on the northern side of the Bridge. Therefore, from a whole of transport network

perspective, I consider the Project provides the opportunity for some residential related journey lengths to be minimised (when compared with those other parcels of land) and for active mode use to be maximised.

120 A revision to the Project is proposed by Submitter 47 "[…] so that Docherty Drive feeds into Watene Lane, or continues north to eventually join Poihipi Road." Figure 7 below illustrates the location of Docherty Drive and other roads to which the submitter refers.

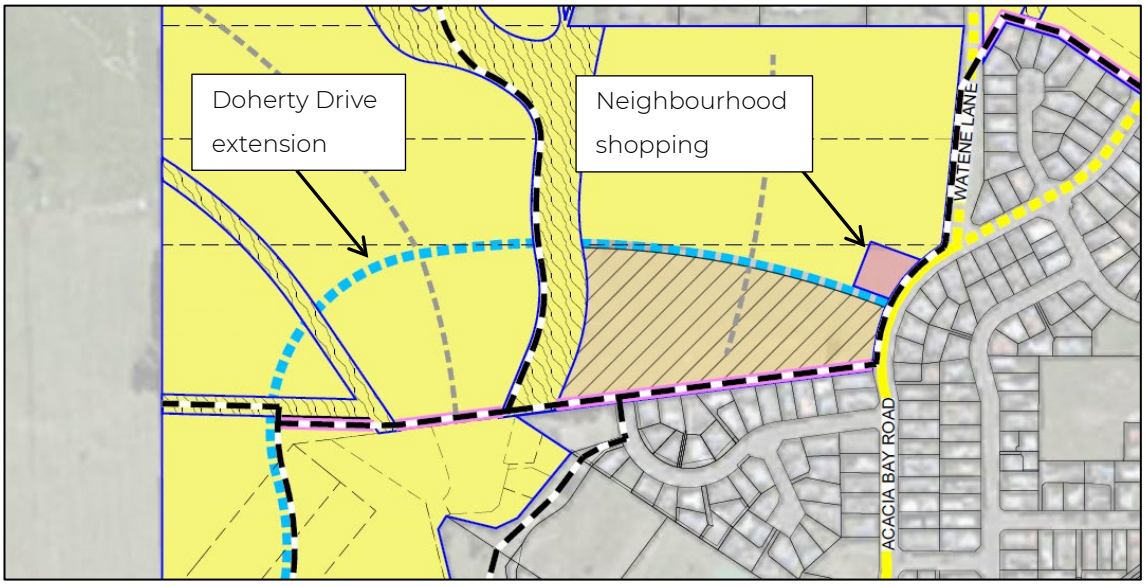

Figure 7: Alignment of Docherty Drive extension (dashed blue line) relative to Acacia Bay Road (refer to Appendix A for the full diagram)

121 The position of the connection of the Docherty Drive extension with Acacia Bay Road is approximately midway between the intersections of Watene Lane and Herapeka Street with Acacia Bay Road. The proposed neighbourhood shopping centre will be at the intersection of the Docherty Drive extension with Acacia Bay Road; this means the neighbourhood centre is readily accessible from three approaches. However, if the Docherty Drive extension continues north to Watene Lane or Poihipi Road this will reduce accessibility to the neighbourhood

centre and result in longer journeys than would otherwise be necessary.

122 In addition, the Docherty Drive extension is positioned on the outside of a curve on Acacia Bay Road, which means there will be good visibility in both directions to and from the intersection. However, I consider it important for the buildings, signage, and parking associated with the neighbourhood shopping centre to be designed to avoid obstruction of sightlines from the Docherty Drive extension intersection. It may be appropriate for a condition to be imposed on the Project in this regard.

123 From a public transport perspective, I consider it preferable for Docherty Drive extension to join Acacia Bay Road at the proposed intersection to optimise the catchment from which public transport passengers can be collected. In this regard, I consider it preferable that the area of the Site to the north-west of the Docherty Drive extension is developed after those areas of the Site close to Docherty Drive extension.

124 The closest boundary of the school (St Patrick's Catholic Primary and Intermediate School) to which the submitter refers is approximately 350 m south of the Docherty Drive extension intersection, which is not particularly close from an urban road network perspective.

125 Contact Energy (Submitter 48) raises concern regarding the potential for "[…] construction traffic associated with Stage 2 of the Te Mihi Power Station […] having to pass through the middle of a residential area […]".

126 The concerns the submitter raises are related to the original layout for the Site (refer to Figure 8 below), which included residential development on both sides of the realigned Poihipi Road. However, the alignment of Poihipi Road has since been amended (refer to Figure 9 below) so that the general

residential zone is to the south of the realigned Poihipi Road. In addition, the 10 m wide landscaping strip to the south of Poihipi Road provides total access control. I consider it preferable that there is no direct property access to the Poihipi Road arterial along the length where the arterial adjoins the Site.

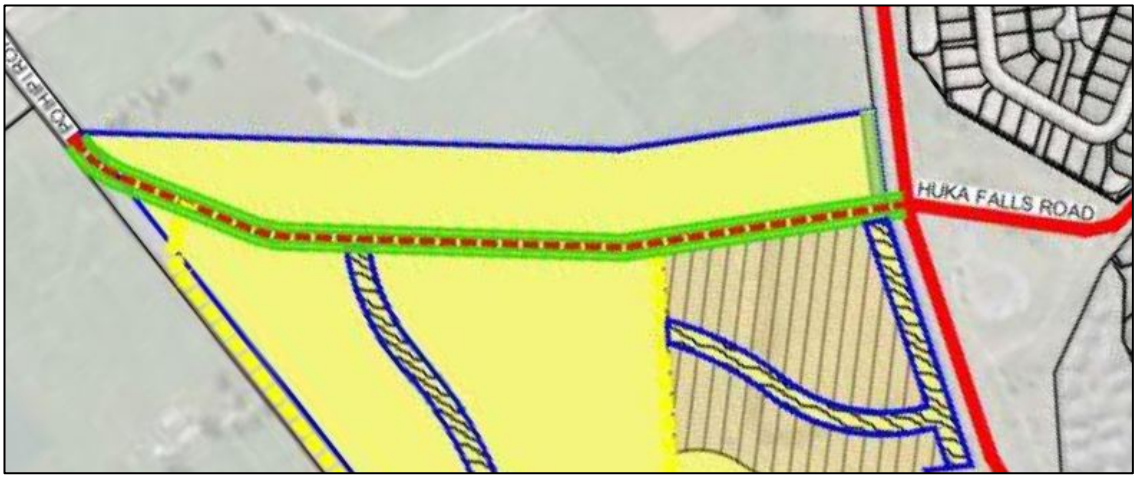

Figure 8: Originally proposed alignment of Poihipi Road, with residential development to the north

Figure 9: Amended alignment of Poihipi Road with no residential development to the north and full access control to the south

127 Amending the alignment of Poihipi Road and providing access control will address the concerns raised by Submitter 48 in relation to construction traffic passing through a residential area. However, I consider it important that the design of the

alignment of Poihipi Road, on the approaches to the signalised intersection, and the signalised intersection itself are safety audited to ensure that the amended alignment does not introduce adverse road safety effects.

10.2 Speed Management

128 I agree with the view presented by Submitters 13 and 18 in relation to speed control mechanisms for the roads developed in conjunction with the Project. While speed limits for the roads within the Site have not been determined, I consider it important those speed limits are safe and appropriate and there is relative compatibility between the PC 37 speed limits and those on the adjoining and wider Taupo urban transport network.

129 As noted in paragraph 56 of this statement, reducing crash impact speeds reduces injury severity; Waka Kotahi (2016, p. 13) refers to safe and appropriate speeds for different road classifications. High-volume national roads, such as urban motorways, have the highest safe and appropriate speeds, whereas low-volume access roads (some of which will be established within the Site) justify the slowest speeds. While speed limit reviews and establishment of safe and appropriate speed limits on New Zealand's road network is an ongoing process, I agree that in some locations it is necessary to have speed control mechanisms to encourage road users to comply with speed limits. However, the tools available to encourage road users to comply with speed limits are not limited to speed bumps (refer to (Waka Kotahi, 2016)). I consider it preferable for roads to be designed to encourage compliance with speed limits and, if necessary, for additional elements such as vertical deflection devices to be included if other speed management methods need reinforcement.

10.3 Second River Crossing

130 Brent Walker (Submitter 5) considers that until there is another crossing of the River, growth to the north of the River should be opposed. He also refers to the TDG report, which notes in several places (for example (TDG, 2018, p. 28)) that there are capacity constraints for Control Gates Bridge. TDG (2018, p. 23) observes that "[…] the capacity of the bridge is about 1450 vph in either direction as this is the maximum that goes over the bridge before queues develop." This flow rate is approximately mid-way between the AM and PM observed peak hour flows in 2007 (refer to Table 1 of this statement). The important point to note is that the bridge capacity value is not the value at which the Bridge collapses or at which traffic flow stops altogether, but rather it is the traffic volume at which queues develop.

131 TDG (2018, p. 28) also observes that "Increased development in the north increasing traffic on Control Gates Bridge will exacerbate […] delays." This is to be expected and has been highlighted by Ms Cui in her analysis. However, as noted in this statement, I consider that if there is to be any development to the north of the River it should be development that promotes active modes and the use of public transport. The further any given development area is from the Taupo CBD as a trip attractor / generator, the less likely active modes will be adopted by road users.

132 Acknowledging that it is a transport policy decision matter rather than a transport engineering one, if development to the north of the River is to be prohibited, I consider it should apply to all development. However, if development is to be permitted, I consider it should be development that maximises the potential for transport modes that will reduce the number of vehicles on the transport network. In this regard, the Project

presents an opportunity to reduce motor vehicle trips when compared with other development locations for which active mode transport is significantly less attractive.

133 Several submitters (Submitters 7, 8, 9, 10, 11, 15, 16, 17, 35, 36, 39, 40, 52, 57, and 58) have made reference to the timeframe for establishment of a second river crossing and the alignment of that with development of the Project. As demonstrated by Ms Cui, the Project is not the primary factor that results in low levels of service on the Bridge and at nearby intersections. Motor vehicle trip generation associated with the Project will exacerbate queuing and delay. However, as noted previously, because of its proximity to the CBD, the Site also presents an opportunity for reducing motor vehicle trip generation. However, the reduction is not solely attributable to mode shift from motor vehicles to active modes. As noted by Mr Smith (paragraph 4.20), the commercial development associated with the Project is likely to reduce the volume of motor vehicle traffic beyond the boundaries of the Nukuhau area.

134 I agree that an additional bridge will reduce queuing and delay associated with the constraint presented by Control Gates Bridge. However, as noted in this statement, I do not consider it is as simple as constructing another bridge alongside the existing one. I consider it desirable for various options to be evaluated and (on the assumption it is demonstrated to be necessary) for a second river crossing to be established at a location that disperses motor vehicle movements rather than concentrating them at a single location (that is, the Spa Road roundabout).

135 Submitter 45 proposes that Taupo District Council advances the timeframe for constructing a second crossing of the River in order to address existing and future congestion.

136 From the perspective of the Project, I consider it would be beneficial for the second crossing to be constructed.

10.4 Intersection Form

137 Mr Bowater (Submitter 10) considers that roundabouts should be the intersection form associated with any connections for new major roads. From a Safe System perspective I agree to an extent with Mr Bowater in relation to motor vehicle movements. For a rural location, roundabouts reduce crash severity through promoting reduced operating speeds and impact angles. However, in urban areas where there are typically higher volumes of active mode road users, roundabouts present some disadvantages because of the difficulties for active mode users to travel through the intersection.

138 Grade separating motor vehicle and active mode users can address some of the road safety shortcomings that can occur at roundabouts (refer to Figure 10 as an example). However, the routes that active mode users need to follow to traverse the roundabout can involve gradients and longer journeys when compared with traversing the roundabout at grade.

Figure 10: Roundabout with Grade Separated Active Mode Routes (source: (Esri, n.d.)

139 Submitter 15 (Julie Jennings) also makes reference to the form of the Wairakei Drive / Poihipi Road / Huka Falls Road intersection and its importance for residents of Kinloch to be able to access Taupo. The proposed signalised intersection will not result in a significant change to the journey length from Taupo to Kinloch, however, the signal control will provide those road users with more certainty regarding the intentions of road users travelling along Wairakei Drive. That is, it will be significantly less necessary for road users turning to and from Poihipi Road to judge the intentions of other road users and the suitability of gaps in traffic streams before being able to turn at the intersection.

140 Submitter 15 also refers to "[…] no traffic management." in conjunction with the proposed Wairakei Drive / Poihipi Road / Huka Falls Road signalised intersection. The basis of the submitter's conclusion is unclear, however, I consider it important that the conditions for the Project require all significant road network changes (such as the establishment

and signalisation of the intersection) to be subject to road safety audit.

141 Submitter 17 (Geoff Rameka) raises concerns regarding the efficiency of the new signalised intersection and its effects on the intersecting roads. Because road users presently travelling north and south on Wairakei Drive are not required to stop to accommodate road users turning to and from Poihipi Road and Huka Falls Road there will be delays for the Wairakei Drive road users. However, there will be reduced delays for road users turning to and from Poihipi Road and Huka Falls Road. An advantage with a signalised intersection over a roundabout is that the signal controller can manage traffic flows to minimise the overall delay to road users at the intersection; whereas, if the intersection is controlled by a roundabout, all road users are affected regardless of whether there is other traffic using the intersection at the same time. Therefore, to an extent, I agree with the submitter that the signalised intersection will "[…] put added pressure […]" on some road user movements through the intersection, but it will also relieve pressure on some road user movements.

142 There is not a perfect solution that provides a safe and efficient intersection form which accommodates all road users. However, taken as a whole, I consider that the signalised intersection form proposed for the Wairakei Drive / Poihipi Road / Huka Falls Road intersection will be suitable to accommodate the traffic it is intended to serve.

143 Contact Energy (Submitter 48) documents the importance of Poihipi Road for providing access to land use associated with the Te Mihi Power Station. They also refer to the works undertaken by Contact Energy to establish a northbound left turn slip lane from Wairakei Drive into Poihipi Road. I provided

evidence to the Board of Enquiry hearing that considered the Te Mihi proposal, and I identified that it would be desirable for the left turn slip lane to be constructed at Poihipi Road.

144 While I do not consider that a left turn slip lane is necessarily a critical component of the design of a signalised intersection at the Wairakei Drive / Poihipi Road / Huka Falls Road intersection, I do consider it important for the intersection design to accommodate the vehicles associated with Te Mihi Power Station and the other vehicles that will travel along the Poihipi Road arterial.

145 While conventional transport engineering design should allow for the types of vehicles expected to be using any component of the transport system, I do not consider it unreasonable for the conditions applying to the Project to specifically require the design of the intersection to accommodate vehicles associated with the Te Mihi Power Station. However, at this stage, the design has not been completed, therefore, it may also be appropriate for the conditions for the Project to require that the precise location of the proposed stormwater reserve and cycling and walking route in the vicinity of the intersection is not confirmed until the intersection design has been completed (Figure 11 below illustrates the features to which I refer in this paragraph).

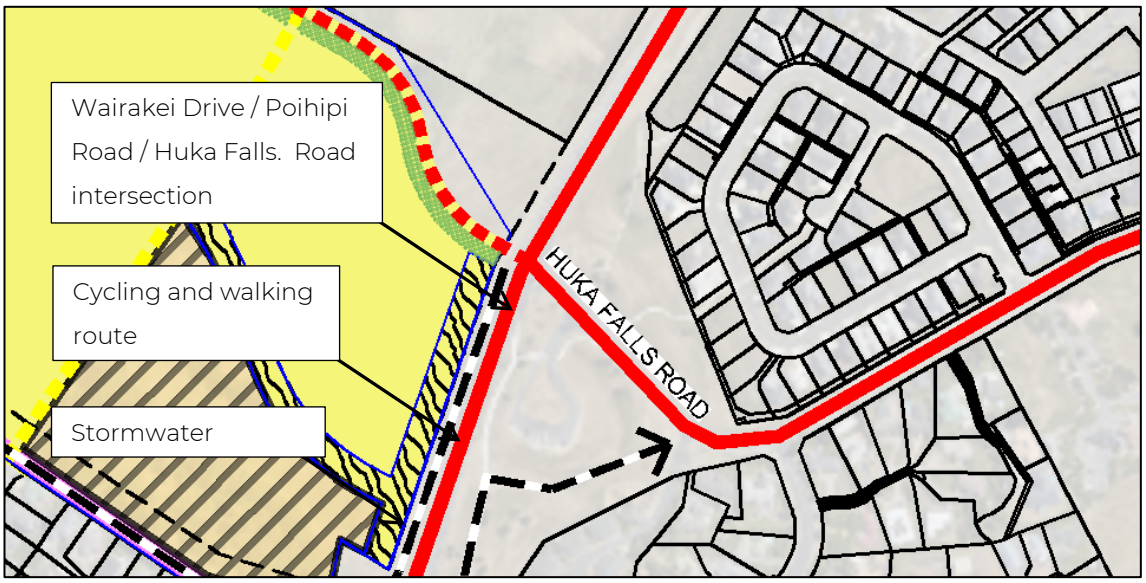

Figure 11: Wairakei Drive / Poihipi Road / Huka Falls Road intersection (refer to Appendix A for the full diagram)

146 Think Taupo (Submitter 54) also refers to intersection form and proposes that "[…] roundabouts be recommended for all new intersections." associated with the Project.

147 As noted in Section 5.6 of this statement, there are arguments for and against roundabouts as a form of intersection control. For example, Submitter 54 quotes from Waka Kotahi (2021) that "Roundabouts are the safest form of intersection control for motor vehicle occupants […] than at intersections controlled by traffic signals, stop, or give-way signs." However, the source to which the submitter refers goes on to state "[…] injury crash rates for cyclists at roundabouts are typically higher than at other intersection types. Furthermore, the safe system threshold impact speed for pedestrians, cyclists and motorcyclists is 30 km/h, which is easily exceeded at most roundabouts."

148 Measures can be added to signalised intersections (and to roundabouts) such as raised tables that reduce approach speeds and consequently reduce the severity of crashes when these occur. However, my understanding is that precise design

details are not usually established at the Plan Change stage of a development.

149 There is not a perfect intersection form that will result in elimination of crashes. I have not conducted a multi-criteria analysis to determine whether signals or a roundabout are the most appropriate form of intersection control for the Wairakei Drive / Poihipi Road / Huka Falls Road intersection. However, as noted in this statement (paragraphs 62 and 63):

(i) consideration needs to be given to competing demands to allow the most suitable intersection control form to be identified for the proposed Wairakei Drive / Poihipi Road / Huka Falls Road intersection, and

(ii) regardless of the intersection form identified as most appropriate, the design should be subject to road safety audit so that safety for road users is optimised.

150 Based on the information presently available, I consider that signalisation of the Wairakei Drive / Poihipi Road / Huka Falls Road intersection is appropriate.

10.5 Congestion, Queuing, and Delay

151 I agree with Submitter 12 that the Project will exacerbate congestion at Control Gates Bridge and at the Spa Road roundabout. The traffic modelling results presented by Ms Cui confirm that if the Project and other zoned developments proceed, the addition of Project traffic to that generated by the other developments will result in increases in queuing and delay. However, the modelling results and the behaviour of road users in response to queuing and delay needs to be considered in context.

152 As illustrated by Figure 2 and Figure 3 of this statement, road users will respond to delay by adjusting their travel patterns to

minimise the delay experienced. Therefore, as noted previously, I consider it unlikely that the queuing and delay increases described by (WSP, 2021a) will eventuate. If queuing and delay of the magnitude described began to develop, I expect that peak spreading would occur. The other matter to keep in mind is that active modes and public transport will be more attractive and efficient when associated with land use development relatively close (for example, Nukuhau compared with Kinloch) to the Taupo CBD. Therefore, because of the proximity of the Site to the Taupo CBD, I consider the Project presents the potential for active modes to reduce queuing and delay, however, the same reductions are less likely to be achieved for development locations at a greater distance from key trip attractors such as the Taupo CBD.

153 Submitter 19 raises concerns regarding the traffic volumes used in the analysis described in the TIA (WSP, 2020). As noted in this statement, traffic models are essentially mathematical models that consider possible scenarios based on known (or likely) trip generation rates and the assignment of vehicle movements to particular routes. Notwithstanding that a perfect traffic model does not exist, I consider that a conservative process has been followed for the traffic model modelling associated with the Project. The initial modelling completed by Ms Cui (WSP, 2020) has been supplemented by the additional modelling ((WSP, 2021a) and (WSP, 2021b)). The feedback provided by Mr Smith (through the s42A report) essentially provides the peer review sought by the submitter.

154 With reference to the concerns raised by the submitter, the other matter to consider in relation to modelled traffic volumes is that the 2030 volumes described in the memoranda and in the JWS are more conservative than those described in the TIA.

10.6 Walking and Cycling

155 Submitter 18 proposes that "[…] a pedestrian over-street bridge needs to be considered […] This would aid in maximizing the efficiency of the roadway, while allowing, with appropriate ramp, safe passage of bikes, pedestrians and wheelchairs alike."

156 The submitter has not indicated a location in which they consider the over bridge should be constructed, however, I question the need for the over bridge given the facilities available for pedestrians and cyclists to cross Wairakei Drive at the two signalised intersections.

157 One of the issues with over bridges is that unless the topography is such that active mode users do not have to follow significant route deviations and / or climb to use the bridge, they tend to be underutilised. The other factor that promotes the use of the over bridges by active mode users is if the road they are crossing has significant traffic volumes and the crossing cannot be conducted safely at grade. For Wairakei Drive between the Poihipi Road / Huka Falls Road intersection and the Norman Smith Street intersection, there is access control from the adjoining properties, which means there generally will not be demand for crossing the corridor between the two signalised intersections.

158 There is a pedestrian connection from the eastern end of Belvedere Crescent to the shared path along the eastern side of Wairakei Drive (refer to Figure 12), however, because there are not complementary connections from the western side of Wairakei Drive to adjoining land use I consider there would be little if any active mode user demand for crossing Wairakei Drive between the two signalised intersections. As a result, I do not consider that a walking and cycling over bridge is necessary.

Figure 12: Walkway (highlighted by red line) from Wairakei Drive to Belvedere Crescent (source: (Esri, n.d.))

159 Submitter 19 raises concerns regarding the "[...] lack of 'safe' pedestrian/cyclist routes between Nukuhau and Rangatira Park."

160 The proposed signalisation of the new intersection of Wairakei Drive / Poihipi Road / Huka Falls Road will address the concerns raised by the submitter.

161 Submitter 31 raises a question regarding the intended treatment for the berm on Watene Lane and notes that this area is used as a walkway.

162 As described on the diagram in Appendix A of this statement, the Applicant proposes that the question raised by Submitter 31 is addressed through the provision of a walking and cycling route along Watene Lane between Acacia Bay Road and the existing alignment of Poihipi Road, which itself will become a walking and cycling route. The alignment of this route is illustrated by the dashed black line in Figure 13 below.

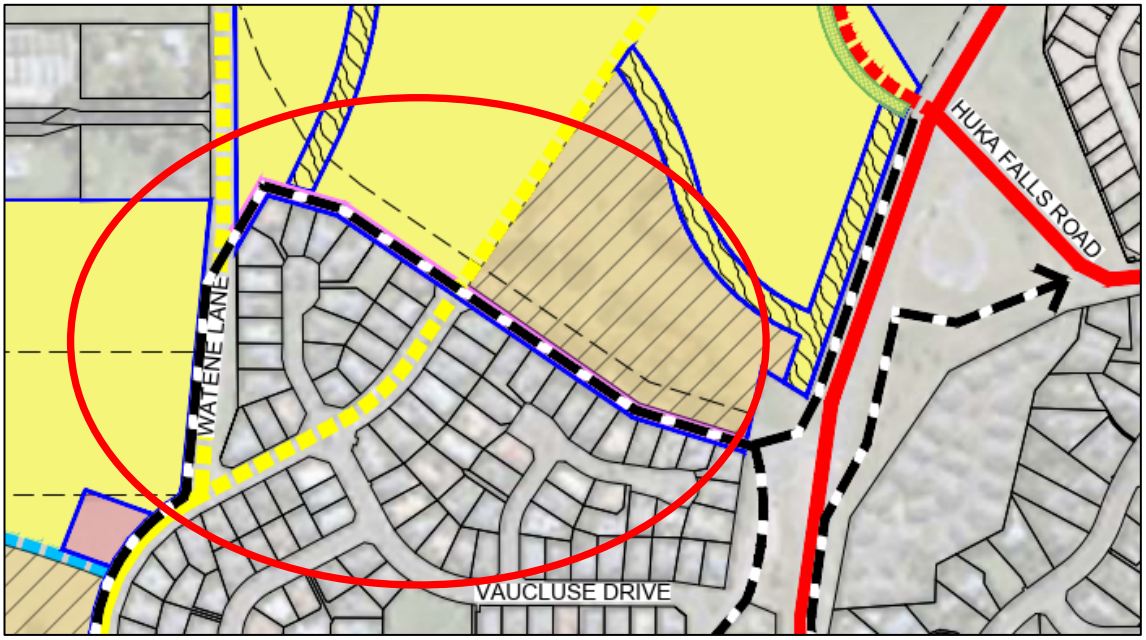

Figure 13: Alignment of cycling and walking route (dashed black line highlighted by red oval) along Watene Lane and existing Poihipi Road (refer to Appendix A for the full diagram)

163 Bike Taupo (Submitter 44) has raised concerns that "[…] there does not appear to be any consideration of the impact of the increased levels of traffic on cycle safety especially at the intersection of Norman Smith [Street] and Acacia Bay [… Road]. This is not a cycle friendly intersection and the increased traffic load will make it less safe for cyclists."

164 As noted in Section 7.2 of this statement I consider there is merit in providing a shared path along Norman Smith Street to the east of Noble Street. However, I acknowledge the concerns raised by Bike Taupo regarding the configuration of the Acacia Bay Road / Norman Smith Street intersection from a cycling perspective.

165 From a transport engineering perspective, I can understand the basis on which the unusual configuration of the Acacia Bay Road / Norman Smith Street intersection has been developed, however, I also recognise the lack of provision for cyclists at the intersection. For example, a northbound cyclist turning right

from Acacia Bay Road into Norman Smith Street must either "take the lane" and occupy the right turn lane or ride between the northbound through lane and the right turn lane. In my opinion, both scenarios requiring cyclists to mix with motor vehicle traffic resulted in an undesirable situation.

166 Clearly, consideration has been given to the movement of motor vehicles at the intersection and I agree with Bike Taupō that increased volumes of traffic associated with the Project and permitted land use development have the potential to adversely affect safety for cyclists. However, it needs to be kept in mind that this is an existing shortcoming with the road network and is not of the Applicant's making. I also recognise that for active mode travel to and from the Site to be encouraged, there needs to be good infrastructure for walking and cycling beyond the boundaries of the Site (as well as within the Site). Because there is benefit to all active mode users (not just those associated with the Project) I consider it desirable for the Applicant to work with Council to develop complementary solutions (within and beyond the Site respectively) that will encourage active mode use.

10.7 Public Transport

167 Waikato Regional Council (Submitter 43) notes that "Given the location and size of the development, any bus route diversion into the area will create a significant delay which will make existing services less desirable. WRC recommends considering a new bus route servicing the plan change area and nearby suburbs."

168 The TIA (WSP, 2020, p. 22) notes that "Although a bus service is not currently serving the Nukuhau Development area directly, there are two current scheduled bus routes in operation close

by. […] it can be expected that the public transport services and routes will be expanded and/or amended […]".

169 I consider there is merit in Waikato Regional Council's submission; particularly given that the Project will result in a large-scale concentration of residential development relatively close to the CBD. This presents the potential for a relatively high proportion of journeys to be undertaken by public transport rather than by private motor vehicle. The shortcomings with the "Taupo North" and "Taupo West" routes are that they are serving comparatively small trip generating locations for public transport.

170 It may be practicable for the existing Taupo West route to be extended to the north to provide a service for the southern areas of the Site and for the Taupo North route to be extended to the west to provide a service with the northern areas of the Site.

171 Acknowledging that the specific routes will need to be developed based on the configuration of the transport network within the Site, I consider it appropriate for there to be a condition on the Project requiring the road network to be established to accommodate efficient routing of public transport.

10.8 Climate Change

172 Concern is raised by Submitter 42 regarding the effects of traffic on climate change. While (as noted in paragraph 75 of this statement) I do not have expertise in climate change, I do have expertise in transport engineering and the distances motor vehicles must travel in order to follow certain routes. I also understand carbon emissions have been linked with climate change.

173 Right Car (n.d.) states that "Carbon Dioxide (CO_2) is the main greenhouse gas contributing to climate change [...] Combustion of fuel in your vehicle's engine emits CO_2 [...]". Therefore, the longer a vehicle is running[7] the greater the output of CO_2. Consequently, measures that will reduce the length of time vehicle engines are running will reduce the output of CO_2. On the assumption that there is demand for residential development on the northern side of the River, the lower the level of vehicle use required for that residential development the lower the output of CO_2. The Project presents that opportunity because it is located closer to the Taupo CBD than other residential development areas on the northern side of the River and it presents significant potential for some motor vehicle journeys to be replaced with active mode and / or public transport journeys. Therefore, from a transport engineering perspective, it appears the Project will provide positive effects in relation to climate change.

11 Conclusions

174 In my opinion, the Project presents the potential for a reduction in the number of motor vehicle movements across the Bridge between (and including) the Norman Smith Street intersection and the Spa Road roundabout. If Project traffic is added to traffic from other permitted development north of the Bridge, the resultant delays have the potential to be significant. However, if the Plan Change is granted and trip generation by the Site replaces trip generation that could occur from other locations, the effect will be neutral. From a transport engineering perspective, this does not provide any advantage.

[7] Assuming that the vehicles being compared are identical and are travelling at the same speed.

However, if some of the motor vehicle trips, that would otherwise be generated by the Site, can be replaced by active mode trips there would be a reduction in the overall travel time. In my opinion this is the key transport engineering advantage of the Project compared with other development.

175 The likelihood of overall trip generation being unchanged (when comparing the with and without Project scenarios) is a matter that would need to be determined by a specialist in residential property development (which I am not). If the overall trip generation is likely to otherwise increase as a result of the Project, then the Planners may be able to identify suitable development control mechanisms to ensure that the overall trip generation is kept to a level no greater than could occur based on existing permitted development.

176 Assumptions made in the memoranda ((WSP, 2021a) and (WSP, 2021b)) regarding the extent of residential development on the northern side of the Bridge have a significant influence on the modelled travel time and delay. Therefore, if the extent of residential development is a less than has been assumed, the effects will also be less than has been described. Notwithstanding that, reduced levels of assumed development will not result in delay being eliminated.

177 If the Site was a similar distance from the Taupo town centre as existing permitted development areas, I could not endorse the Project because there are unlikely to be mitigating measures such that the Project would generate less traffic than could be generated by the existing permitted development. However, because of its proximity to the town centre, I consider that the Project has significant potential to reduce the traffic loading on the transport network through some trips being shifted from motor vehicles to active modes. While I am not aware of a

robust methodology for determining the proportion of motor vehicle trips that could be shifted to active modes, I consider it reasonable to conclude that the number of shifted trips will be greater where the trip length is typical for active mode journeys (as occurs with the Site) than for those locations where the trip length is greater than typical.

178 With regard to points raised by submitters, I conclude that:

(i) The form of the various intersections associated with the Project does not need to be determined at the Plan Change stage. However, I have not identified anything associated with the Project that is likely to preclude suitable intersections being designed and constructed.

(ii) Measures should be incorporated into the design of the Site for speed limits to be set at safe and appropriate levels and for there to be speed management measures to promote compliance with those speed limits.

(iii) While construction of a second river crossing in advance of development of the Site is likely to reduce congestion on Control Gates Bridge, the location of the Site relative to the town centre also presents the potential to reduce congestion through some motor vehicle trips being transferred to active modes.

(iv) There should not be residential development to the north of the realigned Poihipi Road; this has been addressed through refinements to the schematic design of the Site. In this regard, I consider it important there is not direct access to residential properties along the realigned Poihipi Road.

(v) Notwithstanding that detailed design has not been completed, there does not appear to be anything associated with the Project that is likely to result in a disproportionate increase in crashes. However, I consider it important that detailed design of transport engineering elements of the Site is subject to road safety audit. That auditing should include a specific focus on walking and cycling.

(vi) Congestion and delay along Norman Smith Street, Wairakei Drive and Tongariro Street are likely to increase with or without the Project. However, the Project presents an opportunity for congestion and delay to be less than it might otherwise be without the Project.

(vii) Existing infrastructure for walking and cycling should be improved to accommodate additional active mode traffic generated by the Site. In addition, there needs to be good connectivity between the active modes infrastructure on the Site and associated infrastructure beyond the boundaries of the Site.

(viii) The road network of the Site should be designed to readily accommodate public transport with a view to existing routes that pass through Nukuhau being extended and / or reconfigured to promote public transport as a viable and attractive mode of transport between the Site and the town centre.

12 References

I have referred to the following sources while preparing my evidence:

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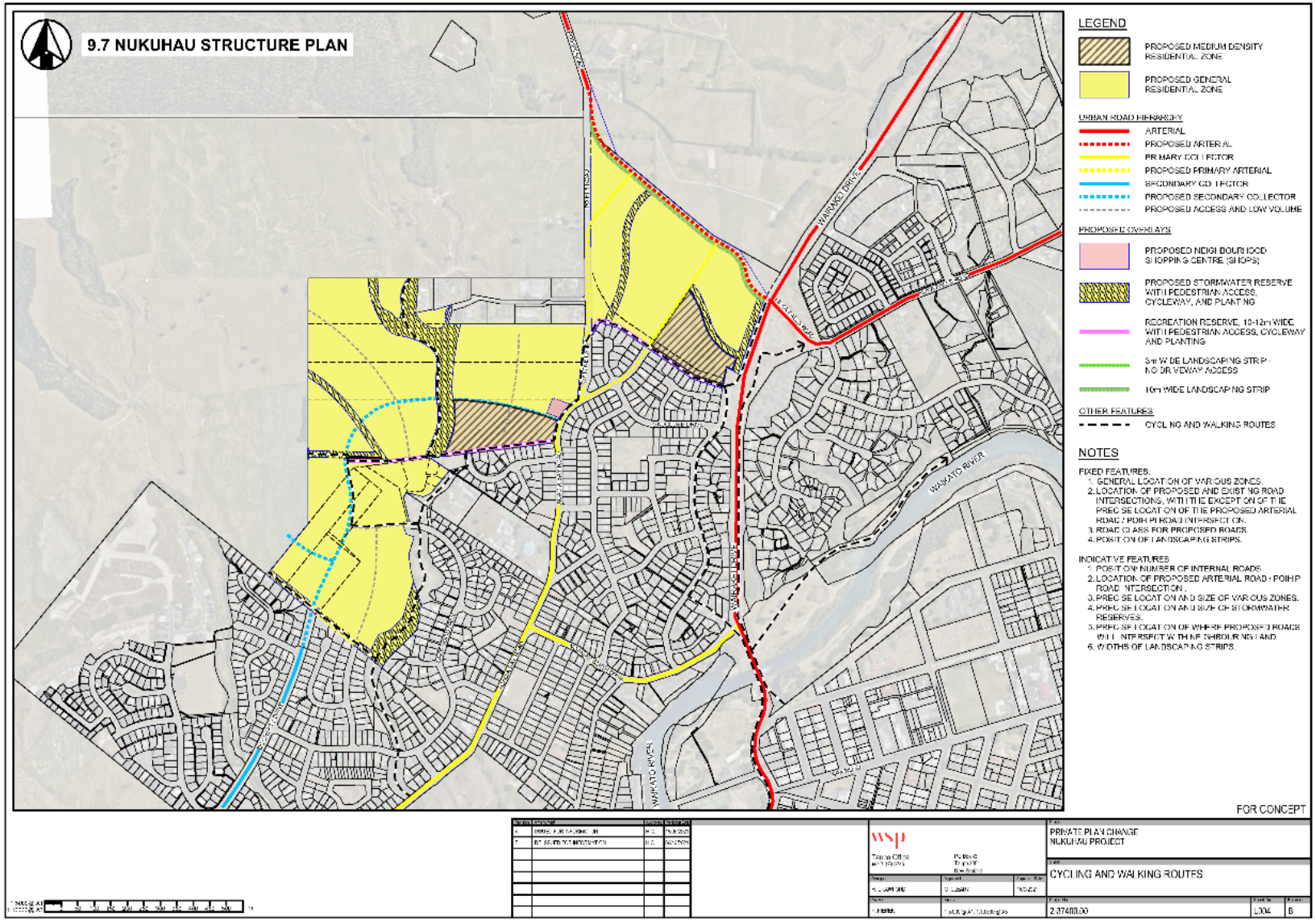
13 Appendix A: Cycling and Walking Routes



14 Appendix B: Control Gates Bridge Traffic Volumes

1 The TIA (WSP, 2020, p. 6) describes the September 2017 average weekday traffic flow on Control Gates Bridge ("**the Bridge**") as 26,150 vpd. The TIA identifies that the East Taupo Arterial (ETA) opened in 2010 and traffic volumes on Tongariro Street (which was previously also SH1) immediately north of the Bridge reduced "[…] from 29,000-30,000 vpd (measured in 2007 and 2009) respectively to just under 24,800 vpd."

2 Waka Kotahi ((2013) and (2008)) recorded the following information regarding AADT volumes immediately north of the Bridge.

Table 8: Traffic Volumes on Tongariro Street (SH1) 20 m north of Control Gates Bridge

Year	AADT (vpd)
2003	27617
2004	28575
2005	28195
2006	28879
2007	29255
2008	27829
2009	28465
2010	24881
2011	24021
2012	23695

3 Based on the values in Table 8, the source of the 2007 and 2009 traffic volumes to which reference is made in the TIA is unclear. However, the table illustrates that traffic volumes between the Bridge and Norman Smith Street had reduced to about 24,000 vehicles per day in 2012

4 Based on the averages of weekday (Monday to Friday) hourly raw traffic count data for the four seven-day periods (May, July,

November, and December), during which Waka Kotahi (2021) recorded data during the peak year for traffic volumes (2007), the weekday peak hour traffic volumes across the Bridge were as described in the following tables:

Table 9: 2007 AM Average Weekday Peak Hour Traffic Volumes on Tongariro Street 20 m north of Control Gates Bridge (data from May, July, November, and December)

Period	Southbound	Northbound	Total
0715 - 0815	816	833	1649
0730 – 0830	920	926	1846
0745 – 0845	1034	1035	2069
0800 – 0900	1077	1077	2154
0815 – 0915	1066	1080	2146
0830 – 0930	1003	1030	2033
08:45 - 09:45	920	948	1868
09:00 - 10:00	852	874	1726
09:15 - 10:15	833	840	1673
09:30 - 10:30	825	831	1656
09:45 - 10:45	819	833	1652
10:00 - 11:00	815	820	1635

Table 10: 2007 PM Average Weekday Peak Hour Traffic Volumes on Tongariro Street 20 m north of Control Gates Bridge (data from May, July, November, and December)

Period	Southbound	Northbound	Total
1615 - 1715	1191	1184	2375
1630 - 1730	1240	1232	2472
1645 - 1745	1230	1221	2452
1700 – 1800	1170	1153	2323
1715 – 1815	1014	1028	2042
1730 - 1830	868	877	1745

5 However, I noted some apparent irregularities in the traffic counts in November and December. While I have theories as to the basis behind those irregularities[8], I do not have sufficient information to be able to robustly determine the validity (or otherwise) of the traffic count data in those months. Therefore, I also considered peak hour traffic volumes with the November and December data removed from consideration. Those results are described in Table 11 and Table 12.

Table 11: 2007 AM Average Weekday Peak Hour Traffic Volumes on Tongariro Street 20 m north of Control Gates Bridge (data from May and July only)

Period	Southbound	Northbound	Total
0715 - 0815	515	581	1096
0730 – 0830	605	604	1209
0745 – 0845	684	668	1351
0800 – 0900	695	730	1424
0815 – 0915	667	759	1426
0830 – 0930	598	773	1370
08:45 - 09:45	1044	755	1799
09:00 - 10:00	935	722	1657
09:15 - 10:15	884	726	1610
09:30 - 10:30	846	736	1582
09:45 - 10:45	830	747	1577
10:00 - 11:00	816	748	1564

[8] One theory is that the data for the northbound and southbound flows was swapped. Another theory is that for the December count, the clock on the traffic counter was set to New Zealand standard time rather than to daylight saving time.

Table 12: 2007 PM Average Weekday Peak Hour Traffic Volumes on Tongariro Street 20 m north of Control Gates Bridge (data from May and July only)

Period	Southbound	Northbound	Total
1615 - 1715	1009	1319	2328
1630 - 1730	1004	1433	2436
1645 - 1745	972	1437	2409
1700 – 1800	919	1350	2269
1715 – 1815	819	1157	1975
1730 - 1830	713	944	1657

6 During the May and July morning peak and the afternoon weekday peak hour periods (0845 – O945 and 1630 - 1730 respectively) the 15-minute traffic flows based on data from the four periods were as described in Table 13 below.

Table 13: 15 Minute Flows within Weekday Peak Hour (based on data from May, July, November, and December)

Period	South-bound	North-bound	Total	60 minute equivalent
08:00 - 08:15	233	237	470	1878
08:15 - 08:30	270	265	536	2142
08:30 - 08:45	288	284	571	2285
08:45 - 09:00	287	291	578	2311
16:30 - 16:45	285	288	573	2290
16:45 - 17:00	289	295	584	2337
17:00 - 17:15	342	326	668	2670
17:15 - 18:30	324	324	648	2590

7 However, as before, because of the irregularities with the November and December data, I have also documented the 15-minute weekday peak hour flows based on the May and July data only; these are in Table 14 below.

Table 14: 15 Minute Flows within weekday Peak Hour (based on data from May and July only)

Period	South-bound	North-bound	Total	60 minute equivalent[9]
08:45 - 09:00	345	217	562	2248
09:00 - 09:15	254	185	439	1754
09:15 - 09:30	228	176	404	1614
09:30 - 09:45	218	178	395	1580
16:30 - 16:45	252	310	562	2246
16:45 - 17:00	249	329	577	2308
17:00 - 17:15	251	406	657	2628
17:15 - 18:30	252	389	641	2564

8 The tables illustrate that even within the peak hour there is variation in the volume of traffic within any 15-minute period. If we had data to further subdivide the 15-minute periods we could observe that there are minute by minute fluctuations in traffic volumes.

9 From a modelling perspective, (depending on the model used) it is not practicable to model the fluctuations in traffic volumes within a peak hour or within a peak 15-minute period within the peak hour. Therefore, for simplicity, models tend to adopt traffic volumes that represent the realistic worst case across the full peak hour. While there has been an increase in traffic volumes using the Bridge since the ETA opened, and the modelling described by Ms Cui shows that the Project will further increase

[9] The sum of the northbound and southbound volumes does not always equal the total shown in the table. Similarly, four times the total volume does not always equal the 60 minute equivalent. The reason for this is the rounding with some of the traffic volumes on which the averages are based.

the volume of traffic using the Bridge, it is important to recognise that despite its capacity limitations, the Bridge is able to carry significant volumes of traffic.

10 For comparison purposes, Ms Cui (WSP, 2021a) has described various modelled traffic volumes. In the table below I have compared the 2030 all permitted and 2030 all permitted plus 80% of Nukuhau traffic volumes on Control Gates Bridge with the highest measured traffic from 2007 (that is, from the May and July data only).

11 However, as noted by Ms Cui in Appendix B of her statement, the 2030 Scenario #3 (100/60/80) volumes recorded in Table 15 below are less than the 2041 traffic volumes described in the TIA.

Table 15: Modelled Traffic Volumes Compared with Measured Traffic Volumes

Scenario	Traffic Volume (vph)		
	Southbound	Northbound	Total
Measured AM peak 60-minute equivalent (2007)	1380[10]	868	2248
2030 AM all permitted	2336	717	3053
2030 AM all permitted plus 80% Nukuhau	2638	717	3355
Measured PM peak 60-minute equivalent (2007)	1004	1624	2628
2030 PM all permitted	1098	2272	3370
2030 PM all permitted plus 80% Nukuhau	1098	2571	3669

[10] 4 x 345 vph 15-minute southbound flow in Table 14.

12 The actual 2030 traffic volumes will be very much dependent on the extent of development on the northern side of the River. Therefore, the less development there is, the less traffic there will be.