Before Hearing Commissioners

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under: the Resource Management Act 1991

in the matter of: notices of requirement and resource consent applications by the NZ Transport Agency and Hamilton City Council for the Southern Links Project

Rebuttal evidence of Shaun Lion-Cachet (*transport planning, traffic modelling*) on behalf of the **NZ Transport Agency and Hamilton City Council**

Dated: 8 July 2014

Hearing date: 21 July 2014

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REBUTTAL EVIDENCE OF SHAUN LION-CACHET ON BEHALF OF THE NZ TRANSPORT AGENCY AND HAMILTON CITY COUNCIL

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INTRODUCTION

1 My full name is Shaun Lion-Cachet.

2 I have the qualifications and experience set out in paragraphs 2 to 5 of my statement of evidence-in-chief (EIC) dated 12 June 2014.

3 My rebuttal evidence is given in support of notices of requirement (*NORs*) and applications for resource consents lodged by the NZ Transport Agency (*the Transport Agency*) and Hamilton City Council (*HCC*) on 9 August 2013 in relation to the construction, operation and maintenance of the Southern Links Project (*Project*).

4 I repeat the confirmation given in my EIC that I have read and agree to comply with the 'Code of Conduct for Expert Witnesses' contained in the Environment Court Practice Note 2011.

5 In this statement of rebuttal evidence, I respond to the relevant sections of evidence of the following:

5.1 Rex Hannam (planning) (61);

5.2 Kathryn Drew (planning), on behalf of Titoki Sands Ltd (39);

5.3 Peter Skilton (planning), on behalf of Shona and Grant Mackintosh (27);

5.4 Cameron Inder (traffic engineering), on behalf of Titanium Park Joint Venture (38);

5.5 Ida Dowling (civil engineering), on behalf of Adare Company Ltd (52); and

5.6 James Lunday (urban design), on behalf of Adare Company Ltd (52).

6 The fact that this rebuttal statement does not respond to every matter raised in the evidence of submitter witnesses within my area of expertise should not be taken as acceptance of the matters raised. Rather, I rely on my earlier technical report (Transport Modelling Report[1]*),* my EIC and this rebuttal statement to set out my opinion on what I consider to be the key transport planning and modelling matters for this hearing.

[1] Appendix O of the Hamilton Southern Links Notices of Requirement: Assessment of Environmental Effects and Supporting Information

FURTHER COMMENT ON EVIDENCE IN CHIEF

Traffic flows on Tamahere Drive

7 In paragraph 77 of my EIC, I discussed the decrease in traffic flows on Tamahere Drive due to the Project without the south facing ramps of the Tamahere Interchange.

8 Paragraphs 78 and 79 of my EIC discuss the impacts of the proposed alterations to the Southern Interchange of the Hamilton Section of the Expressway. It is estimated that approximately 500 vehicles per day (vpd) from Tamahere east have a southerly destination.

9 If the south facing ramps on the Tamahere Interchange were closed in the future, I expect that a maximum of 500 additional vpd will be expected to travel on Tamahere Drive to access the Expressway via the Tamahere Drive roundabout.

10 To clarify the changes in traffic flows in the vicinity of the Waikato Expressway, Airport Road and Tamahere Drive[2], a diagram explaining the differences has been produced and is shown in **Annexure A**.

11 This diagram compares the all-day 2041 flows in the Tamahere area, showing the forecast Do Minimum flows, the Project flows *without* the south facing Tamahere Interchange ramps, and the Project flows *with* the south facing Tamahere Interchange ramps.

12 It is important to note that:

12.1 Traffic flows on Airport Road will reduce by almost 6,400 vpd due to the Project, with or without south facing ramps.

12.2 Traffic flows on Tamahere Drive will reduce due to the Project. With the Tamahere Interchange ramps remaining open, the reduction is estimated to be in the order of 200 vpd (approximately 1,000 vpd in total). If the south facing ramps are closed, this reduction is in the order of 400 vpd (approximately 800 vpd in total). This takes into account the updated layout of the Waikato Expressway Hamilton Section Southern Interchange.

12.3 The Waikato Expressway will attract some traffic south of the Project. This traffic will make use of the Project to connect from the south of the Project area to the west of Hamilton and the Airport.

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[2] Jeff Myles (18), Larry and Adrienne Martinus (57), Martin and Deborah Swann (50), Philip and Rosemary Dexter (70), and St Stephen's Church (86) have all submitted that the Project would increase traffic flows on Tamahere Drive.

12.4 North of the Tamahere Interchange (with or without south facing ramps), there is forecast to be a reduction in traffic flows on the Waikato Expressway by about 3,500 vpd. This is seen as a positive impact as the Waikato Expressway is very busy in this vicinity, and improved level of service can therefore be expected.

12.5 Between the Project interchange and the Tamahere Interchange there is also forecast to be a reduction in traffic flows. With the south facing ramps at Tamahere in place, this reduction will be in the order of 6,400 vpd. If the ramps are removed, the reduction will be in the order of 6,900 vpd.

RESPONSE TO EXPERT EVIDENCE OF SUBMITTERS

Rex Hannam

13 Mr Hannam's main concern is the alleged lack of assessment to the options through the Weston Lea area. Mr Hannam suggests using the old motorway alignment as it is less expensive (para 28), and he provides four options for the east-west connection in the north of Peacockes (para 29).

14 I have responded to Mr Hannam's suggested use of the old motorway alignment in my EIC[3]. Further to the EIC statement, the alignment proposed by Mr Hannam is expected to attract traffic away from the main north-south Major Arterial through Peacocke, leading to undesirable commuter traffic through the Peacocke town centre, and increasing flows on Peacockes Road.

15 The four options suggested by Mr Hannam are shown in Mr Hannam's map "Weston Lea Map D", and are shown in **Annexure B**.

15.1 **Option 1:** This option will require cutting into the terrace to rise to the new level, and is unlikely to be as attractive for traffic compared to the Project option. I expect that traffic from the south destined for the eastern side of Hamilton will prefer to use the more southern East-West Arterial, through the Peacocke town centre, and up Peacockes Road. This is undesirable for the town centre to have the through traffic, and it is undesirable to place this longer distance traffic on Peacockes Road which is already forecast to carry high flows from Peacocke residents heading to Hamilton CBD and other destinations north of Peacocke. I therefore consider option 1 to be not as good as the Project option and does not displace the Requiring Authority's preferred option.

[3] Refer to paragraphs 66 to 68 of EIC.

15.2 **Option 2:** This option follows the existing Peacockes Road alignment along its northern alignment. This option was dismissed by the Project team due to the impacts on properties along Peacockes Road – the urban upgrade of Peacockes Road to a Minor Arterial standard would require widening as well as horizontal and vertical alignment changes. These upgrades along this section of Peacockes Road would require property purchase and driveway amendments to a greater number of properties. In addition there is a significant power substation near the corner of Waiora Terrace that would be impacted. The alignment of the Project option allows this portion of Peacockes Road to continue to have direct road access without these impacts. I therefore consider option 2 to be not as good as the Project option and does not displace the Requiring Authority's preferred option.

15.3 **Option 3:** This option appears very close to the first part of the Project alignment at the Major Arterial end. Mr Hannam then suggests that the option follows the property boundaries of the historical motorway alignment, crossing Peacockes Road and Weston Lea Drive, then connecting to the north-south historical motorway alignment. This is not an attractive east-west link for traffic. Similar to option 1, I expect that traffic from the south destined for the eastern side of Hamilton will prefer to use the more southern East-West Arterial, through the Peacocke town centre, and up Peacockes Road. This is undesirable for the town centre to have the through traffic, and it is undesirable to place this longer distance traffic on Peacockes Road which is already forecast to carry high flows from Peacocke residents heading to Hamilton CBD and other destinations north of Peacocke. I therefore consider option 3 to be not as good as the Project option and does not displace the Requiring Authority's preferred option.

15.4 **Option 4:** Similar to option 1, this option will require cutting into the terrace to rise to the new level, and is unlikely to be as attractive for traffic compared to the Project option. In addition this option may impact on the southern portion of the proposed community sports fields on the terrace. The traffic impacts on the Peacocke town centre and Peacockes Road are expected to be similar to option 1. I therefore consider option 4 to be not as good as the Project option and does not displace the Requiring Authority's preferred option.

16 In my opinion the options suggested by Mr Hannam do not achieve the Project objectives as successfully as the preferred Project option, in particular: improving amenity and safety through reduced conflict and crash potential; improving residential environment;

minimise social effects; and protect the long term function of the road networks.

Kathryn Drew (Titoki Sands Ltd)

17 Ms Drew suggests that if the Tamahere Interchange south facing ramps are removed then Titoki Sands quarry traffic must travel on Tamahere Drive until such time that the quarry sand runs out. Ms Drew expects up to 300 quarry vpd (para 23) to be added to the Tamahere Drive traffic flows.

18 As discussed previously, the total traffic on Tamahere Drive in 2041, with the south facing ramps closed, is estimated to be about 800 vpd.

19 If the Titoki Sands quarry is still producing sand by this time, the 300 vpd of redirected quarry traffic would raise the total traffic on Tamahere Drive to about 1,100 vpd. At its peak, these traffic flows may equate to about 110 vehicles her hour, or about 2 vehicles per minute. Of this peak flow, the quarry traffic may equate to about only one vehicle every two minutes.

20 In reality, it is unlikely that the quarry traffic peak time would coincide with the commuter traffic peak time. In my opinion this is not a serious matter and I consider the effects would be no more than minor.

Peter Skilton (Shona and Grant Mackintosh)

21 In support of rebuttal evidence provided by Mr Eccles and Mr Dravitzki, I have estimated the traffic flows expected on Weston Lea Drive. This is in response to the uncertainties listed by Mr Skilton in para 6.1.9 of his evidence.

22 The transport model did not specifically forecast Weston Lea Drive traffic flows. Rather it forecast traffic flows for the large area to the east of Peacockes Road, which includes Weston Lea Drive. In the absence of any development planning for this area, I have made an estimate based on the approximate area that could be served by Weston Lea Drive, the likely number of houses in that area, and trips per house per day. Based on this, I have assumed between 650 and 700 houses, generating 8 trips per day, resulting in 5,200 vpd to 5,600 vpd. These traffic flows are approximately one quarter of the flows expected on Peacockes Road in 2041.

Cameron Inder (Titanium Park Joint Venture)

23 Mr Inder outlines the history behind the agreement in principle between the Transport Agency and Titanium Park Joint Venture (TPJV) that an interim roundabout would replace the current SH3/21

intersection (paras 2.4 and 2.5), although no agreement was made by the Transport Agency on timing (para 2.6).

24 In para 2.9 Mr Inder discusses the two rounds of traffic modelling mentioned in my EIC. Traffic modelling by the Project team investigating the roundabout initially proposed a single lane roundabout, and then modified this to a single lane roundabout with partial two laning.

25 Mr Inder points out[4] that the latest traffic modelling alternatives investigated as part of the Transport Agency/TPJV discussions at the SH3/21 intersection have not been included in the Transport Modelling Report[5]. The first draft of the modelling report was completed in June 2012, with subsequent revisions for client review (July 2012) and peer review (September 2012), all with a focus on the ultimate network rather than interim staging. The modelling carried out in support of the Transport Agency/TPJV discussions occurred from August 2012 to January 2013.

26 The final revision of the Transport Modelling Report was carried out in November 2013 with travel time updates. At this point the results of the interim SH3/21 intersection upgrade could have been included but were erroneously overlooked.

27 The second round of modelling was carried out in preparation of my EIC, which stated that these roundabouts had a lifespan that was limited, and was subject to the rate of growth within the TPJV Western Precinct.

28 The greatest uncertainty for the capacity and life of a single lane roundabout relates to the speed at which the TPJV Western Precinct is developed. The modelling is based on TPJV's forecasts that the Western Precinct will be fully developed by 2025.

29 Mr Inder acknowledges that the TPJV growth rates are deliberately conservative (para 3.5) and represent a development scenario at the upper end of the land use range in the Airport Business Zone. It is Mr Inder's opinion that the maximum potential traffic flow generated by the TPJV developments at completion has a low likelihood (para 3.6).

30 In my opinion, it cannot be guaranteed that the modelled queues and delays will occur at the dates stated. A fast rate of development will place strain on the single lane roundabout (reaching capacity earlier), whilst a slower rate of development provides a greater lifespan due to the slower build-up of traffic volumes.

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[4] Paras 5.1, 6.3 and 6.13.

[5] Refer to the AEE, Appendix O Transport Modelling Report.

31 Mr Inder states that TPJV is not satisfied that the single lane roundabout is suitable due to the limited lifespan (paras 2.12, 2.14 and 6.10). Mr Inder advises that TPJV would be satisfied with a dual lane roundabout which would have suitable capacity prior to the Project being constructed (paras 2.15, 2.16 and 2.18), similar to that assessed by Mr Inder and discussed with the Project team in late 2012/early 2013 (para 6.13).

32 I agree with Mr Inder that the dual lane roundabout does provide a longer design life than the single lane roundabout proposed in my EIC. I have tested the dual lane roundabout at 2025 (Western Precinct fully developed), and 2041 (with continued growth on the State highway but no more growth in the Western Precinct). Results of this testing are tabulated in **Annexure C** of my rebuttal evidence and shows that the performance of the dual circulating lane roundabout is good, even at 2041. **Table 2** shows that average intersection delay are less than 10 seconds, with a very good LOS of A, and 95 percentile queues on the State highway are about 60m in the morning peak and about 30m in the evening peak. Delays on the TPJV leg are 10 seconds in the morning and 14 seconds in the evening, with queues of about 40m in the evening.

33 My analysis concurs with that provided by Mr Inder (paras 2.15 and 2.16) in that the dual circulating roundabout performs well from a traffic perspective.

34 I agree with Mr Inder's view (para 2.17) that the dual lane roundabout provides greater certainty for the Transport Agency and for TPJV with regards to intersection capacity prior to the full Project being constructed (i.e. the full SH3/21 Interchange).

35 Mr Inder suggests that a full dual circulating lane or partial dual circulating lane roundabout is an appropriate solution (para 2.18). The safety of any roundabout that is to be constructed needs to be considered in relation to the number of entry/exit legs and the number of circulating lanes. In my opinion, a large diameter dual circulating lane roundabout with four entry/exit legs would provide a suitable interim access solution, and if designed to the appropriate standards will also provide good levels of safety. This is preferred from a safety perspective to a partial dual circulating lane roundabout. This layout is shown in **Annexure C** of my rebuttal evidence.

36 Once the full Project interchange is constructed at the SH3/21 intersection, the dual lane roundabout could be modified by removing the inside circulating lane, reconfiguring the southern exit-only leg to SH3, and adding the western leg for the ultimate interchange. This then provides an ultimate solution which complies with the Project design. This layout removes the safety concerns associated with a dual lane five leg roundabout. The layout is shown in **Annexure D** of my rebuttal evidence.

37 From a traffic engineering point of view, I could support this course of action.

Ida Dowling (Adare Company Ltd)

38 Ms Dowling considers that the requirement for the Garden Bridge to be constructed first has not been adequately tested (para 22).

39 Ms Dowling goes further by referring to Mr Lunday's evidence by suggesting that development of the area between the River and Peacockes Road would be the most attractive (para 30). The construction of the Peacocke minor arterial is therefore the most sensible first stage of development for Ms Dowling, with access to the wider network through the existing road infrastructure (para 30).

40 I will address these two issues together. **Annexure E** shows the all-day traffic flows in 2041, with Peacocke Structure Plan (PSP) area fully developed. It shows the routes taken into and out of Peacockes for the Project and for the Do Minimum network (which excluded the Garden Bridge in the north and the State highway connection in the south). Whilst not being the precise staging scenario suggested by Ms Dowling, it does show the likely route choice and the impact on those routes without the Project infrastructure in place. It can be concluded from this flow pattern that:

40.1 The full development of the PSP area relies on the provision of new transport infrastructure to cater for the traffic generated by the fully developed PSP area[6]. Ms Dowling appears to appreciate this, although her comments refer to partial development of the PSP area.

40.2 The new infrastructure attracts the bulk of the flows, as they are intended to do. In particular it can be seen that without the Garden Bridge, the Peacocke Major Arterial link towards the CBD is highly trafficked, almost at capacity for a four lane road. The level of service on this route is very poor (LOS E in the AM peak[7]). The route also has to cater for all destinations, whether those are east or west of the CBD. Destinations to the east are required to turn right onto Cobham Bridge to access the Hamilton Ring Road.

40.3 The (existing) local routes through Bader and Fitzroy carry flows in excess of 10,000vpd in the Do Minimum scenario, but have relatively low flows in the Project scenario.

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6 Refer to the AEE, Appendix O Transport Modelling Report, Section 5.3 The Preferred Network.

7 Refer to the AEE, Appendix O Transport Modelling Report, Section 5.3 The Preferred Network.

40.4 These higher flows are undesirable on neighbourhood roads with more of a residential and community function. The increase in traffic has the potential to degrade the amenity of the neighbourhood streets, as well as potentially worsening the road safety due to increased flows and potential conflict. Pedestrian and cyclist safety would be a particular concern.

40.5 The traffic increases on the local roads indicate the impact of not providing the higher order infrastructure. In Ms Dowling's example of isolated development without the associated infrastructure, I expect that the local roads through Bader and Fitzroy will have to carry the burden of the additional traffic. For the reasons discussed above this is undesirable.

41 Ms Dowling suggests that development staging should be permitted through a condition requiring assessment through an Integrated Transport Assessment supporting a master plan (para 31).

42 In my opinion, this could lead to an incremental but potentially inconsistent approach to the provision of the arterial road network. For example, different developers may not assess the impacts on the arterial network in the same way, and may also have differing visions for that network. It is my opinion therefore that HCC should control the design and implementation of the arterial road network, and that the master planning needs to be consistent with HCC's arterial design once determined.

43 Ms Dowling raises concerns that the design details provided in the NOR have narrowed the scope of the road form, not allowing any flexibility to be changed in detailed design (para 34), and that the ultimate form of the roads and intersections within the designation boundaries should be catered for in the conditions (para 42).

44 This is not correct. The design details provided indicate one example of a road design, which is still at a scheme design level of detail, and which indicates what could be achieved within the designation. To determine a designation boundary, a scheme design was produced. There is scope and flexibility to alter this design within that boundary. This is also true of the development connections/intersections. As discussed above, HCC should control the design and implementation of the arterial road network, and that the master planning needs to be consistent with HCC's arterial design once determined.

James Lunday (Adare Company Ltd)

45 Mr Lunday considers that the Garden Bridge should only be built once the CBD is revitalised (para 19), that a review of the transport model would demonstrate that the Adare land can proceed without the bridge (para 20, bullet #3), and that the land between Peacockes Road and the River could be developed with Peacockes

Minor Arterial and without the Garden Bridge or the Peacocke Major Arterial (para 26).

46 The traffic modelling has been based on accepted regional land use, as discussed in my EIC. The modelling has graphically illustrated that the principal travel destinations for Peacocke residents are the Hamilton CBD, the Hospital, and the University, as shown in **Annexure F**. Lesser destinations include areas to the south, Hamilton west, Te Rapa and Rototuna.

47 The Garden Bridge is the link between Peacocke and the eastern and northern destinations, and as discussed above, without the Garden Bridge link the traffic with an eastern or northern destination are required to use alternate routes causing significant congestion.

48 Crucially, the Garden Bridge is required for connecting bulk infrastructure services, as discussed in the evidence of Mr Tony Denton, and without which the PSP area cannot develop. This would include the land belonging to the Adare Group which would require significant infrastructure servicing which needs to cross the River.

49 The Garden Bridge is therefore an essential strategic link for the PSP area.

50 Mr Lunday is concerned that the design speeds used for the minor arterials are too high (para 20, bullets #4 and #5).

51 The design speeds used are consistent with the District Plan[8]. Design speeds are not the same as the posted speed limits, which is normal design practice. For example, a 60km/h design speed is used on Peacockes Road and the East-West Minor Arterial, with posted speeds of 50km/h expected.

52 Mr Lunday makes various comments relating to the design of the road corridors (para 20 bullet #8, para 31, para 32) and the limiting effect that may arise due to the level of detail provided.

53 As discussed above, the design details provided indicate one example of a scheme design in order to determine a designation boundary. There is sufficient scope and flexibility to alter this design within that boundary. However, Mr Eccles addresses this further in his rebuttal evidence.

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[8] Refer to HCC Infrastructure Technical Specifications, Appendix A, Table 15.14-7a Criteria for the Form of Transportation Corridors (extract from Proposed District Plan, Volume 2)

CONCLUSIONS

54 I have read the statements of expert evidence provided by submitters relevant to my area of expertise, and that this evidence has not caused me to depart from the opinions expressed in your EIC, except for the matter of the interim SH3/21 intersection treatment. I have discussed this change in my evidence, and for all other matters I reconfirm the conclusions reached in my EIC.

55 It is important to note that traffic flows in the Tamahere area are expected to reduce as a result of the Project, especially on Airport Road and the very busy portion of the Waikato Expressway immediately north of the Tamahere Interchange. Traffic flows on Tamahere Drive are expected to be low, and are expected to reduce because of the Project.

56 I have concluded that Mr Hannam's route alignment options in the Weston Lea area of north Peacocke are not as good as the Project option and do not displace the Requiring Authority's preferred option.

57 Ms Drew suggests that if the Tamahere Interchange south facing ramps are removed then Titoki Sands quarry traffic must travel on Tamahere Drive until such time that the quarry sand runs out. The total traffic on Tamahere Drive in 2041, with the south facing ramps closed, is estimated to be about 800 vpd. If the Titoki Sands quarry is still producing sand by this time, the additional 300 vpd of redirected quarry traffic equates to about one vehicle every two minutes. In my opinion this is not a serious matter and I consider the effects would be no more than minor.

58 Mr Inder has stated that TPJV are concerned that the interim single lane roundabout at the SH3/21 intersection has a limited lifespan prior to implementation of the full SH3/21 Interchange. An option suggested by Mr Inder has been assessed and I agree that a dual lane roundabout provides greater capacity, with greater certainty for the Transport Agency and TPJV.

59 Once the full Project interchange is constructed at the SH3/21 intersection, the dual lane roundabout could be modified by removing the inside circulating lane, reconfiguring the southern exit-only leg to SH3, and adding the western leg for the ultimate interchange.

60 Ms Dowling and Mr Lunday have suggested that the Garden Bridge is not required to be constructed first for the PSP area. I have discussed that the traffic and safety impacts on the existing local/neighbourhood roads are undesirable and that the Garden Bridge is an essential part of the infrastructure.

61 Ms Dowling and Mr Lunday are also concerned that the detail provided in the NOR could reduce flexibility in the detailed design phase. I have dismissed these views, as the details provided are consistent with the District Plan, and that the scheme design was used to determine the designation boundary. There is sufficient scope and flexibility to alter this design within that boundary.

Shaun Lion-Cachet

8 July 2014

Annexures

Annexure A – Tamahere area all-day traffic flows in 2041

Annexure B – Weston Lea alignment options suggested by Mr Hannam

Annexure C – SH3/21 intersection – Interim arrangement

Annexure D – SH3/21 intersection – Ultimate arrangement

Annexure E – Peacocke Structure Plan traffic

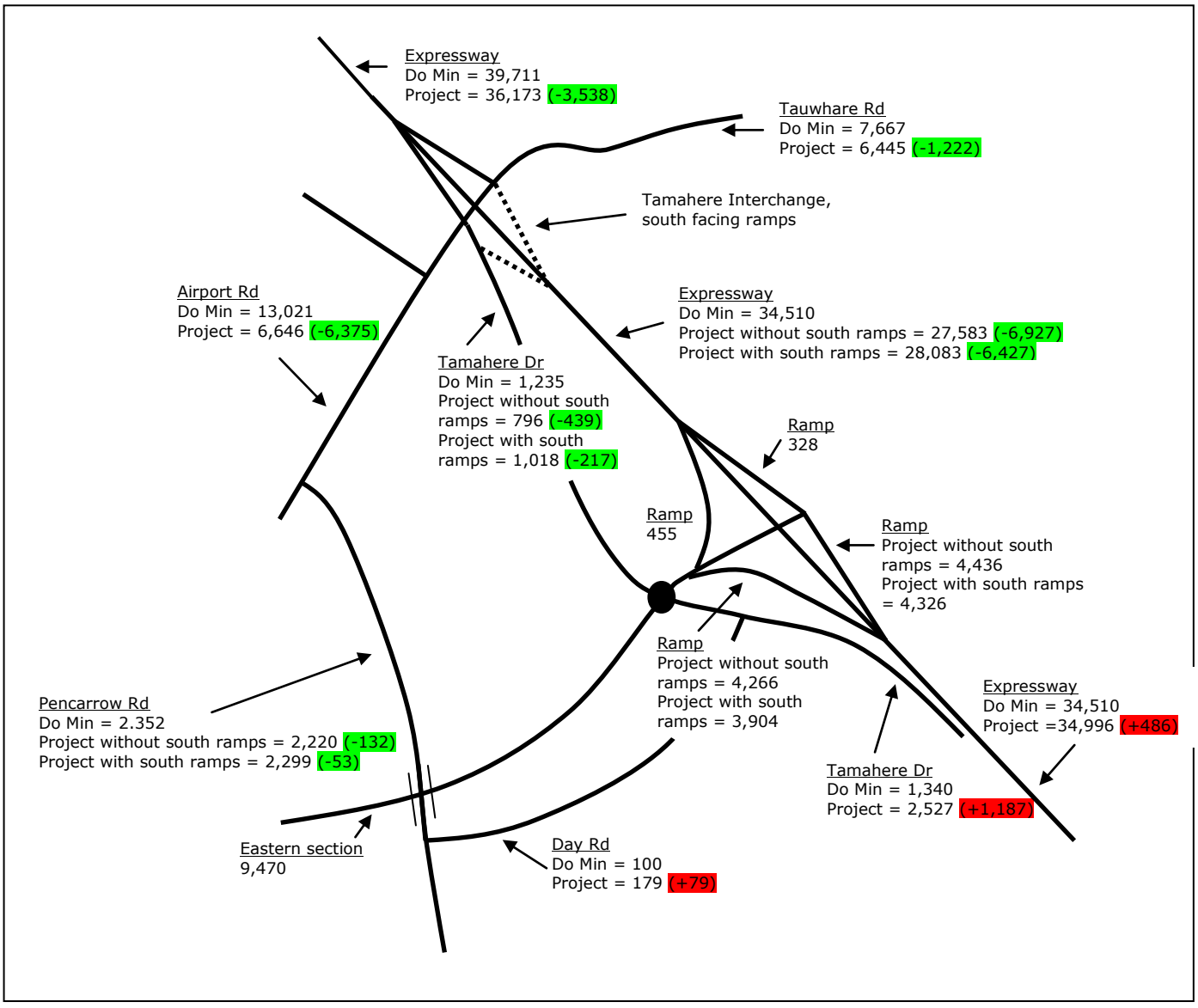
Annexure F – Peacocke origin/destination map

Annexure A – Tamahere area all-day traffic flows in 2041

The diagram displays the all-day traffic flows in 2041 in the vicinity of Tamahere:

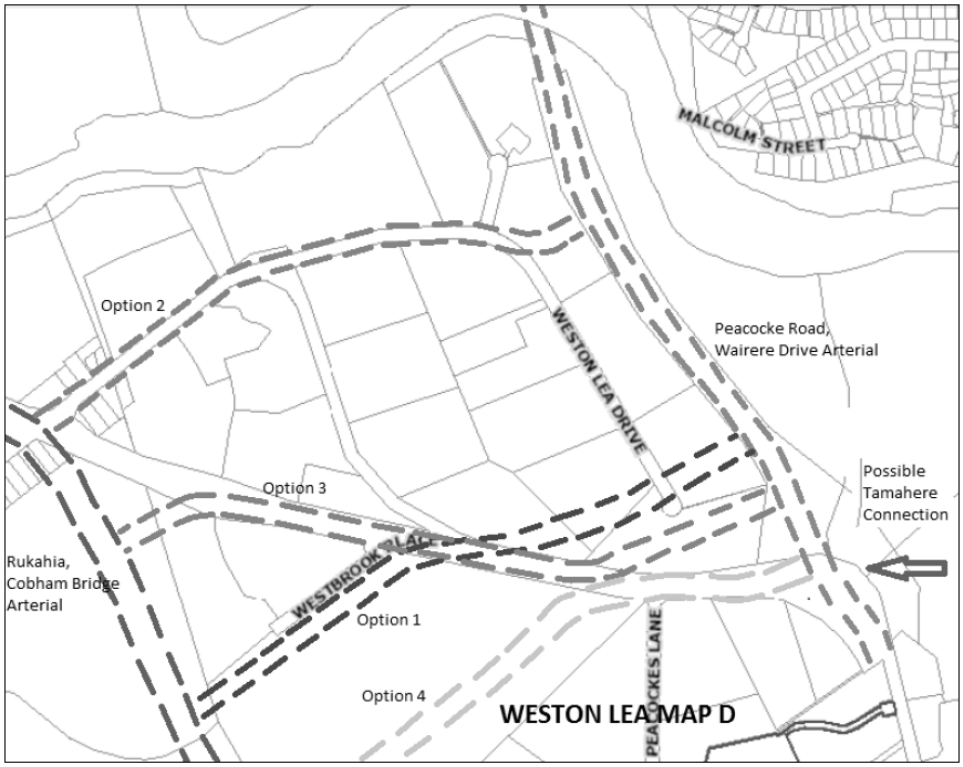
- Do Minimum traffic flows are shown for all infrastructure, except the new Project network.
- Project *without* south facing ramps on the Tamahere Interchange, including approx. 500vpd from Tamahere east due to limited movements at the Hamilton Southern Interchange.
- Project *with* south facing ramps on the Tamahere Interchange. Where there is no difference between ramps being open or closed, then only the Project flows are shown.
- Where a reduction in flows is expected compared to the Do Minimum, this is highlighted green. Where an increase in flows is expected compared to the Do Minimum, this is highlighted red.

Figure 1: Tamahere area all day traffic flows in 2041



Annexure B – Weston Lea alignment options suggested by Mr Hannam

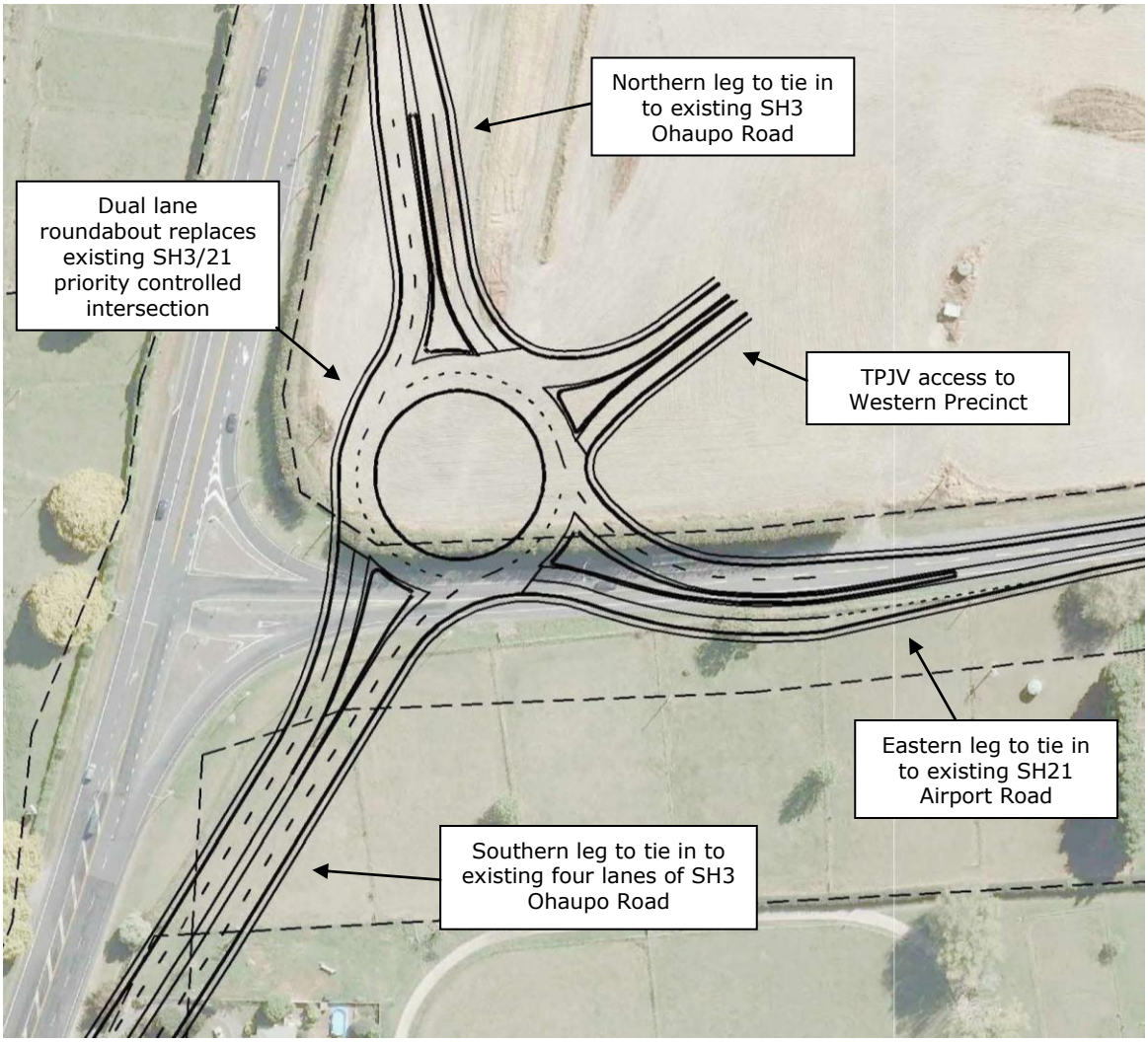
Figure 2: Weston Lea alignment options suggested by Mr Hannam



Annexure C – SH3/21 intersection – Interim arrangement

The following diagram displays the interim intersection layout for a SH3/21 roundabout. The diagram shows a dual circulating lane roundabout with 4 legs. In the interim arrangement, SH3 traffic is required to flow through the roundabout.

Figure 3: SH3/21 intersection – Interim arrangement layout



The following tables display the performance of the dual circulating lane, 4 leg roundabout in the AM and PM peak periods in 2025 and 2041.

Table 1: SH3/21 intersection – Interim arrangement performance in 2025

Approach	Movement	Ave delay	LOS	95%ile queue	Ave delay	LOS	95%ile queue
		2025 AM Peak			2025 PM Peak		
South: SH3 Ohaupo Rd	Through (Ohaupo Rd)	4	A	41	3	A	20
	Right (TPJV)	10	A	41	8	A	20
	Right (Airport Rd)	11	B	41	9	A	20
East: SH21 Airport Rd	Left (Ohaupo Rd)	4	A	6	6	A	9
	Right (Ohaupo Rd)	9	A	9	13	B	6
	Right (TPJV)	10	B	9	14	B	6
North east: TPJV	Left (Airport Rd)	4	A	5	9	A	37
	Left (Ohaupo Rd)	3	A	5	8	A	37
	Right (Ohaupo Rd)	10	B	5	14	B	14
North: SH3 Ohaupo Rd	Left (TPJV)	6	A	6	4	A	12
	Left (Airport Rd)	6	A	6	3	A	12
	Through (Ohaupo Rd)	5	A	12	2	A	25
All vehicles		7	A	41	6	A	37

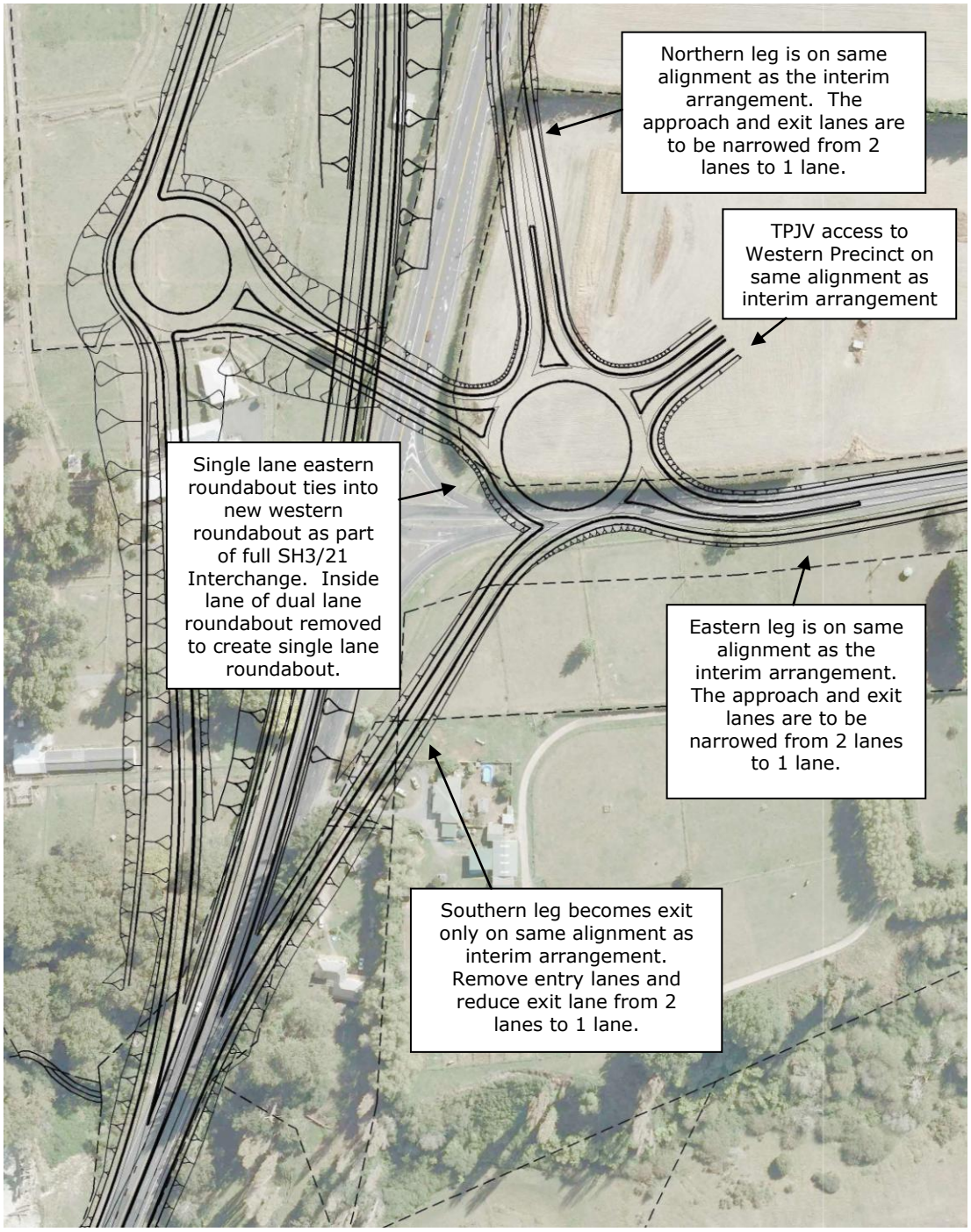
Table 2: SH3/21 intersection – Interim arrangement performance in 2041

Approach	Movement	Ave delay	LOS	95%ile queue	Ave delay	LOS	95%ile queue
		2041 AM Peak			2041 PM Peak		
South: SH3 Ohaupo Rd	Through (Ohaupo Rd)	5	A	62	3	A	26
	Right (TPJV)	11	B	62	8	A	26
	Right (Airport Rd)	13	B	62	9	A	26
East: SH21 Airport Rd	Left (Ohaupo Rd)	5	A	8	6	A	12
	Right (Ohaupo Rd)	10	A	11	13	B	7
	Right (TPJV)	11	B	11	14	B	7
North east: TPJV	Left (Airport Rd)	5	A	6	9	A	38
	Left (Ohaupo Rd)	4	A	6	8	A	38
	Right (Ohaupo Rd)	10	B	6	14	B	15
North: SH3 Ohaupo Rd	Left (TPJV)	6	A	10	3	A	13
	Left (Airport Rd)	6	A	10	3	A	13
	Through (Ohaupo Rd)	5	A	19	2	A	27
All vehicles		7	A	62	6	A	38

Annexure D – SH3/21 intersection – Ultimate arrangement

The following diagram displays the ultimate intersection layout for a SH3/21 roundabout. The diagram shows a single circulating lane roundabout with 5 legs. In this arrangement, the SH3 traffic is realigned through the SH3/21 interchange.

Figure 4: SH3/21 intersection – Ultimate arrangement layout



The following table displays the performance of the single circulating lane, 5 leg roundabout in the AM and PM peak periods in 2041.

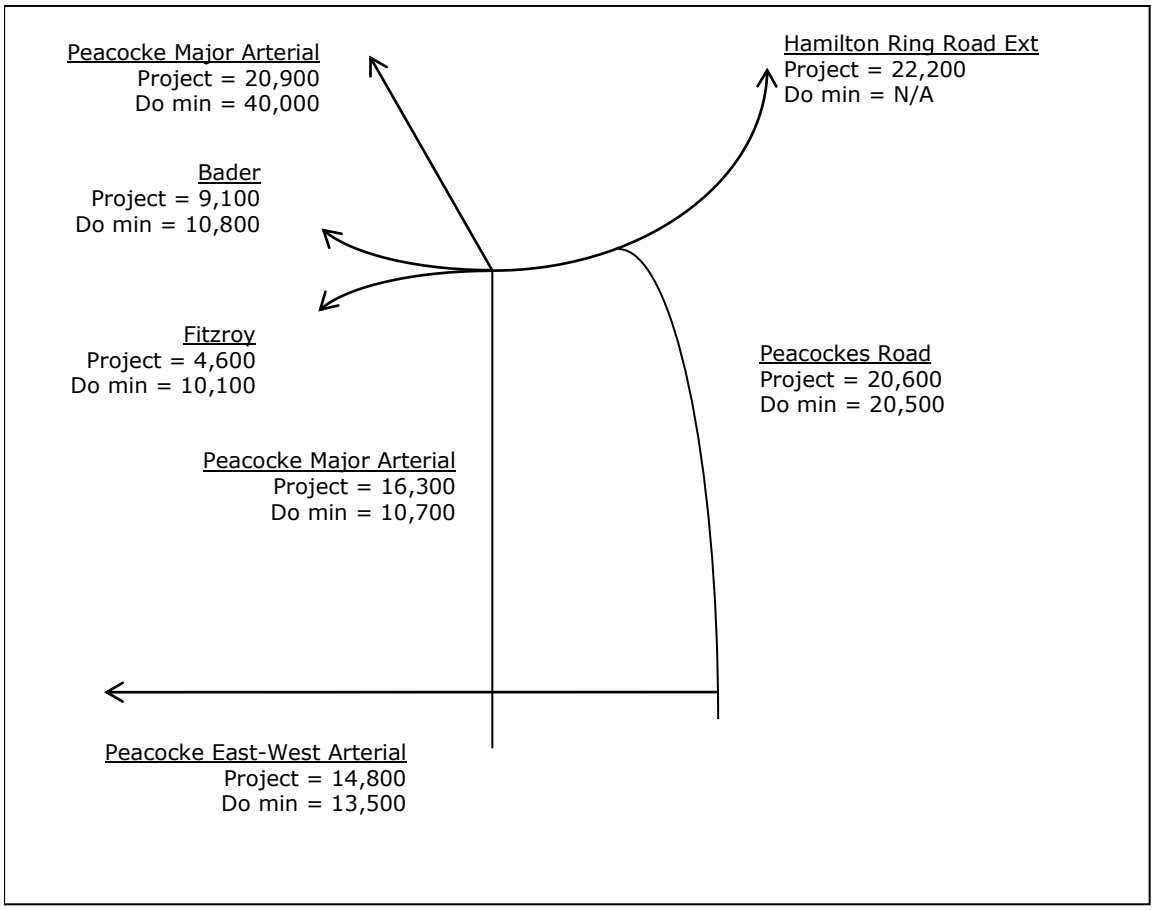
Table 3: SH3/21 intersection – Ultimate arrangement performance in 2041

Approach	Movement	Ave delay	LOS	95%ile queue	Ave delay	LOS	95%ile queue
		2041 AM Peak			2041 PM Peak		
East: SH21 Airport Rd	Left (SH3 ramp)	3	A	19	6	A	24
	Through (Interchange)	2	A	19	5	A	24
	Right (Ohaupo Rd)	9	A	19	12	B	24
	Right (TPJV)	10	B	19	13	B	24
North east: TPJV	Left (Airport Rd)	3	A	11	7	A	54
	Left (SH3 ramp)	2	A	11	5	A	54
	Right (Interchange)	8	A	11	11	B	54
	Right (Ohaupo Rd)	10	A	11	13	B	54
North: Ohaupo Rd	Left (TPJV)	5	A	6	3	A	10
	Left (Airport Rd)	5	A	6	2	A	10
	Through (SH3 ramp)	4	A	6	1	A	10
	Right (Interchange)	11	B	6	8	A	10
West: Interchange approach	Left (Ohaupo Rd)	3	A	22	2	A	9
	Left (TPJV)	2	A	22	1	A	9
	Through (Airport Rd)	2	A	22	1	A	9
	Right (SH3 ramp)	9	A	22	8	A	9
All vehicles		5	A	22	6	A	54

Annexure E – Peacocke Structure Plan traffic

The following diagram displays the 2041 all-day traffic between Hamilton and the Peacocke area without the Garden Bridge.

Figure 5: Peacocke Structure Plan traffic



Annexure F – Peacocke origin/destination map

The following diagram displays AM peak hour destinations for travel generated from Peacocke.

The diagram displays desire lines – the broader the line the greater the attraction.

Figure 6: Peacocke origin/destination map