Memorial Avenue Investments Limited

Memorial Business Park
Memorial Avenue, Christchurch

Transportation Assessment

CARRIAGEWAY
CONSULTING
traffic engineering | transport planning

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1. Introduction

1.1. Memorial Avenue Investments Limited (MAIL) is seeking the rezoning of 24.5ha of land towards the southwest of the State Highway 1 (Russley Road) / Memorial Avenue intersection from Rural 5 to Industrial Park (Memorial Avenue) to facilitate commercial development known as the Memorial Business Park (MBP). The area of land involved is included within the Land Use Recovery Plan (LURP) as a '*Greenfield Priority Area – Business'*.

1.2. This Transportation Assessment sets out a detailed analysis of the transportation issues associated with development of the site, and addresses changes in travel patterns that are likely to arise. Where potential adverse effects are identified, ways in which these can be addressed are set out. The report is cognisant of the guidance specified in the New Zealand Transport Agency's 'Integrated Transport Assessment Guidelines' and although travel by private motor vehicle is addressed within this report, in accordance with best practice the importance of other transport modes is also recognised. Consequently, travel by walking, cycling and public transport is also considered.

2. Site Overview

2.1. Location

2.1.1. The site is situated approximately 8km northwest of Christchurch central city. The site is bounded by Memorial Avenue to the northeast, State Highway 1 (which in this location is known as Russley Road) to the northwest and Avonhead Road to the southwest. The location of the site in the context of the local area is shown in Figure 1 and in more detail in Figure 2. It is zoned as "Rural 5" in the Christchurch City District Plan ('City Plan").

Figure 1: General Location of Development Site within Northwest of Christchurch

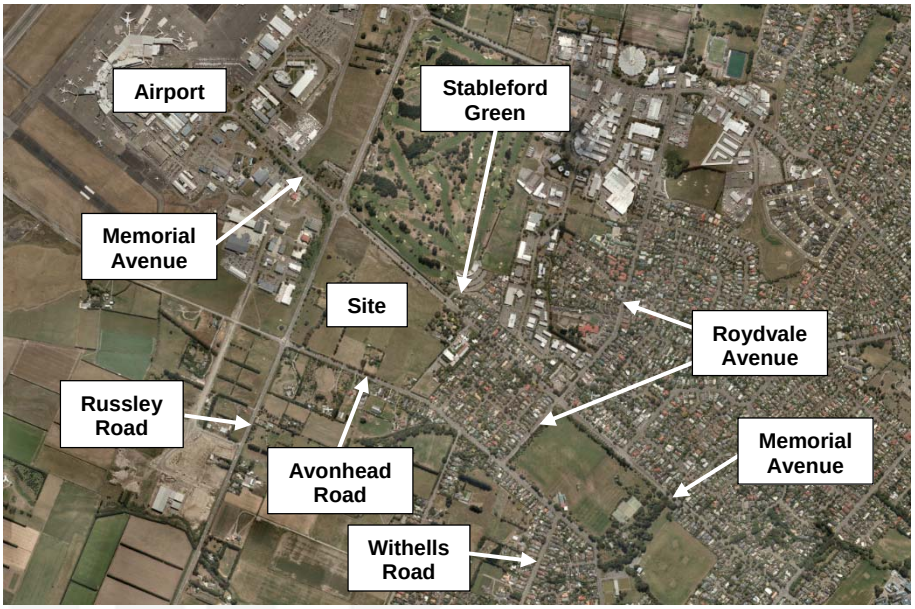


Figure 2: Aerial Photograph of Development Site and Environs

2.2. Road Hierarchy

2.2.1. The City Plan classifies Russley Road as a Major Arterial Road (Limited Access) with Memorial Avenue being Major Arterial Road. These are noted as "*dominant elements of the roading network connecting the major localities of the region, both within and beyond the main urban area, and link to the most important external localities*." They "*cater especially for longer trips and … will be constructed and managed to minimise their local access function*" (City Plan, Policy 2.7.2.1).

2.2.2. Avonhead Road, Roydvale Avenue and Withells Road are all Collector Roads. These are "*roads of little or no regional significance … (that) … distribute and collect local traffic within and between neighbourhoods and link rural communities. Their traffic movement function must be balanced against the significant property access function which they provide*" (City Plan, Policy 2.7.2.1).

2.2.3. Stableford Green to the north of the site is a Local Road, a category of road that is expected to "*function almost entirely as accessways and are not intended to act as through routes for motor vehicles*" (City Plan, Policy 2.7.2.1).

2.2.4. None of the roads in the immediate vicinity of the site are a designated cycle route (as set out on the City Council's Cycle Map).

3. Current Transportation Networks

3.1. Roading Network

3.1.1. To the immediate northwest of the site, Russley Road runs with a northeast-southwest alignment and is flat and straight. Towards the north of the site, the carriageway has four traffic lanes (two in each direction) due to the geometry required to accommodate a roundabout with Memorial Avenue. Further south however, Russley Road has only one lane in each direction. The speed limit is 80km/h.

Photograph 1: Russley Road, Adjacent to Site (Development Site on Right)

3.1.2. Memorial Avenue runs along the northeastern site boundary, and has a flat and straight alignment. It provides two traffic lanes in each direction of 3.5m width, as well as a parking lane that is 2m wide. There is a raised, grassed median between the two carriageways, and the road is subject to a 60km/h speed limit.

Photograph 2: Memorial Avenue Looking South (Development Site on Right)

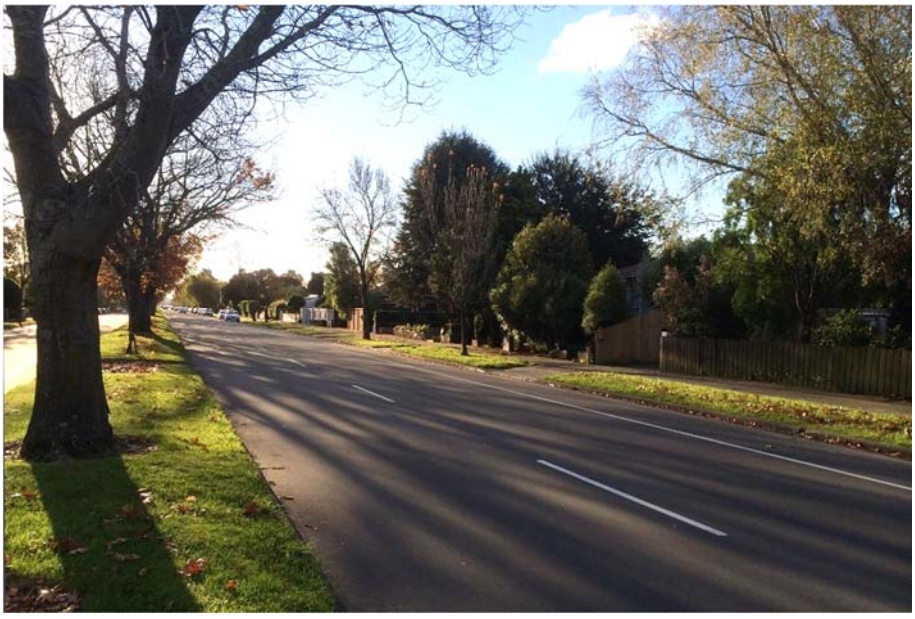
3.1.3. Memorial Avenue meets Russley Road at a roundabout at the site's northernmost boundary. The roundabout has four approaches, Russley Road to the northeast and southwest and Memorial Avenue towards the southeast and northwest, with the latter providing the primary entrance to Christchurch International Airport. The roundabout has two circulating lanes, with each entry and exit also having two lanes, and the diameter of the central island is 35m.

Photograph 3: Russley Road / Memorial Avenue Roundabout Looking South (Development Site at Rear Left)

3.1.4. Opposite the site, on the northern side of Memorial Avenue is Stableford Green, a local road serving a small number of residential properties and the Russley Golf Course. This has a 7m carriageway over much of its length, although this widens to 9m between Memorial Avenue and he entrance to the golf club. Stableford Green meets Memorial Avenue at a priority intersection which has a right-turn lane for vehicles moving from Memorial Avenue, although right-turns are prohibited from Stableford Green itself.

Photograph 4: Memorial Avenue / Stableford Green Intersection, Looking Towards Memorial Avenue (Development Site at Rear Right)

3.1.5. South of Stableford Green, the character of the land fronting onto Memorial Avenue changes to one of residential uses, and as a result there are numerous private driveways. The general configuration of the carriageway remains the same however, with two traffic lanes and a parking lane in each direction.



Photograph 5: Memorial Avenue South of Stableford Green

3.1.6. Approximately 1.1km southeast of the Russley Road / Memorial Avenue roundabout, Memorial Avenue meets Roydvale Avenue at a signalised intersection. Each of the approaches on Memorial Avenue has four traffic lanes (two for straight-ahead movements and one auxiliary lane each for left and right turns), meaning it has high capacity, whereas Roydvale Avenue (north) has three traffic lanes with Roydvale Avenue (south) having just two lanes. The raised median on Memorial Avenue continues on both sides of the intersection.

Photograph 6: Memorial Avenue / Roydvale Avenue Intersection, Looking Southeast Along Memorial Avenue

3.1.7. Roydvale Avenue has a flat and straight alignment. South of Memorial Avenue, it has a carriageway of 11m width with 90-degree parking provided along the majority of its eastern side (adjacent to Burnside Park).

Photograph 7: Roydvale Avenue Looking South

3.1.8. Roydvale Avenue meets Avonhead Road at a priority ('give-way') controlled intersection where traffic on the former must yield to vehicles on the latter. There is a short (23m) right turn lane on Avonhead Road for vehicles turning into Roydvale Avenue from the east, and a second traffic lane is marked for vehicles approaching the intersection from the northwest, although this does not have any arrows marked on the carriageway.

Photograph 8: Roydvale Avenue / Avonhead Road Intersection

3.1.9. Avonhead Road itself runs along the southwestern boundary of the site, and has a flat and straight alignment. Immediately adjacent to the site, the carriageway has a rural formation and is 9m wide marked with a centreline but no kerbs or edgeline markings. The speed limit on this section of the road is 80km/h.

Photograph 9: Avonhead Road Adjacent to Site (Site on Left)

3.1.10. Approximately 330m southeast of Russley Road, Avonhead Road becomes more urbanised with the carriageway widening to 12m and with kerb and channel on the southern side of the road, plus several private driveways. The speed limit at this point reduces to 50km/h. Some 170m east of this, kerb and channel commences on the northern side of the road together with private driveways to serve the adjacent residential properties. The carriageway widens further to 14m, some 250m west of Roydvale Avenue.

Photograph 10: Avonhead Road Southeast of Site

3.1.11. On the southwestern corner of the site, Avonhead Road meets Russley Road at a priority ('stop') controlled intersection. A median barrier is constructed on Russley Road such that the intersection operates as 'left-in / left-out' only, and this is reinforced by signage and carriageway markings.

Photograph 11: Russley Road / Avonhead Road Intersection, Looking from Avonhead Road

3.2. Non-Car Modes of Travel

3.2.1. There is no formal provision of footpaths on Russley Road, or on the westernmost (rural) part of Avonhead Road (including immediately adjacent to the site). However the bulk of roads in the area including Memorial Avenue have footpaths on both sides of the road.

Photograph 12: Footpath on Memorial Avenue Adjacent to Site (Site on Right)

3.2.2. There is a pedestrian crossing provided on Memorial Avenue around 125 north of the Memorial Avenue / Roydvale Avenue intersection, where the grassed median is sealed and an at-grade route is provided. There are also pedestrian crossing phases on each of the approach at the Memorial Avenue / Roydvale Avenue intersection

3.2.3. None of the roads in the vicinity of the site have marked cycle lanes. However there are cycle lanes on each approach to the Memorial Avenue / Roydvale Avenue intersection.

Photograph 13: Cycle Lanes and Pedestrian Crossing Provision at the Memorial Avenue / Roydvale Avenue Intersection

3.2.4. There are several bus stops on Memorial Avenue that are proximate to the site, two towards the north and two towards the south. Towards the north, the bus stop for northbound services is located around 75m south of the Memorial Avenue / Russley Road roundabout with the bus stop for the southbound services located on the southbound carriageway directly opposite. Neither have seating or a shelter provided.

Photograph 14: Memorial Avenue Bus Stops Towards North of Site (Development Site in Rear)

3.2.5. Further bus stops are located on Memorial Avenue around 100m south of Stableford Green. The bus stop on the southbound carriageway has a shelter as well as seating, a timetable and a rubbish bin but the stop on the northbound carriageway has only a timetable.

Photograph 15: Memorial Avenue Bus Stop Towards South of Site, Southbound Carriageway

Photograph 16: Memorial Avenue Bus Stop Towards South of Site, Northbound Carriageway

3.3. Future Changes

3.3.1. A number of changes are expected to take place in the vicinity of the site in the short-term, of which three are particularly significant.

3.3.2. The New Zealand Transport Agency has a comprehensive package of measures to improve the Christchurch Western Corridor, defined as that section of State Highway 1 which runs between the Northern Motorway in Belfast and Main South Road in Hornby (8.5km and 5.9km north and south of the site respectively). In order to accommodate increasing traffic volumes, the highway will be four-laned with a central median barrier being installed. This will necessitate changes at a number of intersections, including at Russley Road / Wairakei Road (800m north of the site) which will become left-in/left-out, and thus can no longer be used for access to the airport.

3.3.3. As part of the Western Corridor improvements, the existing Russley Road / Memorial Avenue roundabout will be replaced by a larger, grade-separated interchange where Russley Road will pass over Memorial Avenue, and a large signalised intersection will be constructed below the interchange. In order to ensure that the new interchange operates safely, the Russley Road / Avonhead Road intersection will be closed, with Avonhead Road effectively becoming a cul-de-sac.

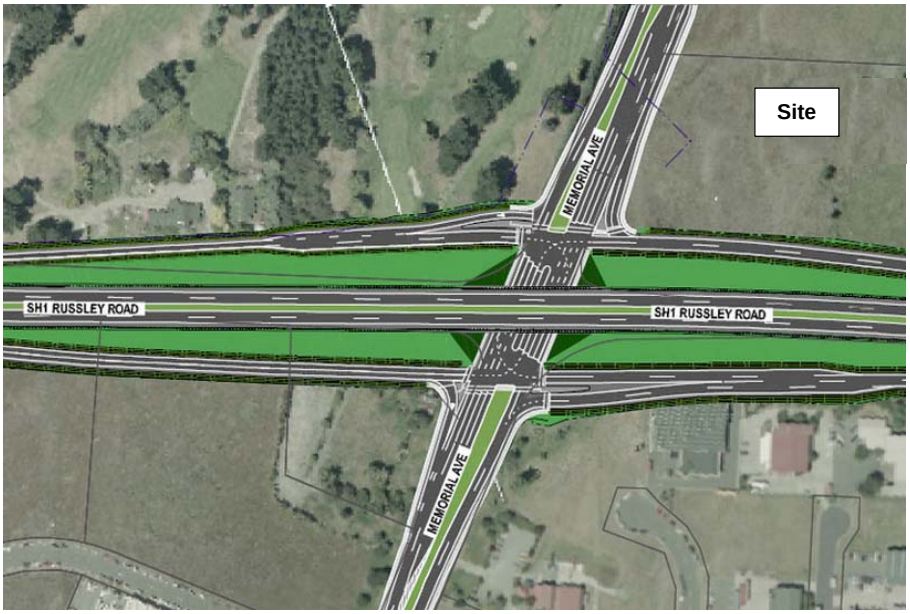


Figure 3: Proposed Grade-Separated Interchange, Russley Road / Memorial Avenue

3.3.4. Although the timing of this scheme cannot be confirmed, it is understood that subject to land purchase, construction may start in the 2014/15 financial year and it is likely to be completed within a 3 year period once work starts.

3.3.5. A second major change relates to a proposed change to the Christchurch City District Plan which is currently underway (Plan Change 84, PC84). If approved, this plan change means that various land use provisions at the airport would be revised such that a greater amount of development could take place, some of which would be unrelated to the primary purpose of the airport as a transportation hub. The plan change is presently being considered but if approved, the outcome would be that traffic flows in the area could increase to a greater extent than under current land zonings.

3.3.6. In late 2013, the Christchurch Land Use Recovery Plan (LURP) took effect. This puts in place various policies and rules to assist in the recovery of Greater Christchurch from the 2010 and 2011 seismic events, by providing direction for residential and business land use development over the next 10 to 15 years. The LURP also directs revisions to several other statutory planning documents (including the City Plan) to implement these land use changes.

3.3.7. The MBP site was identified within this document as being a '*greenfield priority area – business*', but a number of other locations were also identified for this purpose including a number in the vicinity of the MBP site. These sites were previously known as Plan Change 83 (PC83) and for convenience are referred to in this way throughout this report, although it is now understood that these will be progressed as part of the City Plan Review (Phase 2).

3.3.8. Additionally, several sites were also noted as being a '*greenfield priority area – residential*'. All of these changes in land use will have effects on the traffic flows in the immediate area of the

sites, but will also potentially result in the re-routing of vehicles on a more significant scale as drivers select routes to minimise their travel times.

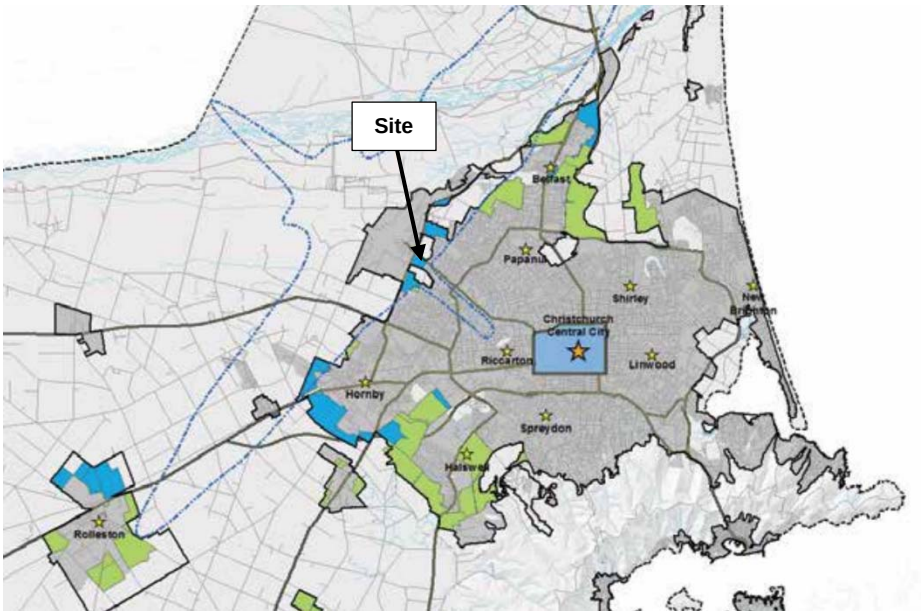


Figure 4: Extract from the Land Use Recovery Plan (Figure 4, Map A) Showing Priority Areas

3.3.9. As part of the evaluation of PC84, extensive transportation modelling of the potential effects on the road network was carried out using the Christchurch Assignment and Simulation Traffic (CAST) model which not only included the possible land uses changes associated with that plan change, but also made allowance for infrastructure upgrades including the NZTA schemes set out above, and the land uses changes arising from the LURP. As a result, these traffic flows have been adopted as the basis for the analysis of the rezoning of the MBP site.

4. Current Transportation Patterns

4.1. Traffic Flows

4.1.1. Both Christchurch City Council and NZTA carry out a regular programme of traffic counts on the roading network, and details have been obtained of the most recent data gathered on the road network close to the site.

Location	Survey Date	Average Daily Traffic Volume
Russley Road south of Memorial Avenue	2013	30,550
Russley Road north of Memorial Avenue	2013	26,800
Memorial Avenue east of Russley Road	2011	16,050
Avonhead Road east of Russley Road	2011	2,100
Roydvale Avenue south of Memorial Avenue	2012	7,950

Table 1: Daily Traffic Volumes near to Site

4.1.2. It can be seen that as part of State Highway 1, traffic volumes on Russley Road are significantly higher than those on the district roads. Memorial Avenue is also busy, with Avonhead Road and Roydvale Avenue being considerably less so. Of note however is that traffic flows collected in 2011 are likely to be distorted due to temporary patterns of land use arising from the earthquake events of that year, and therefore should be interpreted cautiously.

4.1.3. Based on previous surveys collected at these locations, traffic growth has been variable. Volumes on Russley Road have grown by more than 3% per annum over the past five years, with flows on Avonhead Road increasing by 2.1% per annum over the same period. However traffic on Roydvale Avenue has grown by just 1.0% per annum and there has been no growth on Memorial Avenue itself.

4.1.4. Turning volumes have also been obtained from the Council for both the Russley Road / Memorial Avenue and Memorial Avenue / Roydvale Avenue intersections, and the peak hour flows observed are set out below.

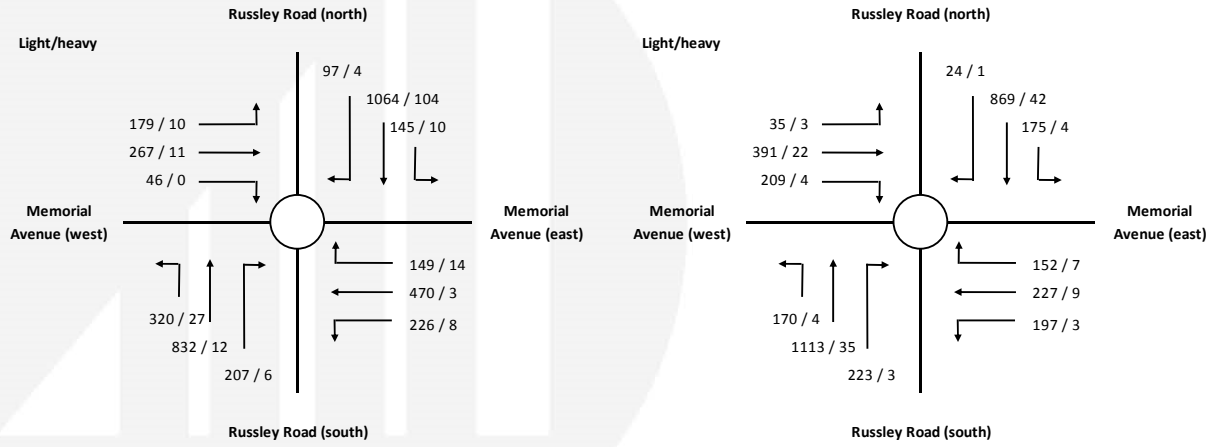


Figure 5: 2011 Morning and Evening Peak Hours Traffic Flows at the Russley Road / Memorial Avenue Roundabout

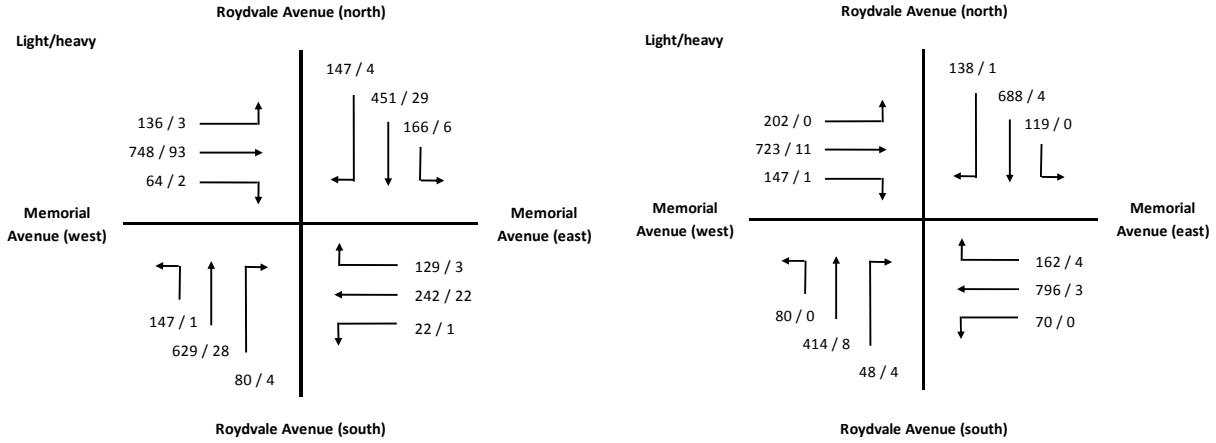


Figure 6: 2011 Morning and Evening Peak Hours Traffic Flows at the Memorial Avenue / Roydvale Avenue Intersection

4.1.5. Again it can be seen that the greatest traffic volumes occur on the state highway, and of note is that more than 50% of the flows at the Russley Road / Memorial Avenue roundabout relate to the north-south (or vice versa) movement. Conversely, while the flows are lower at the Memorial Avenue / Roydvale Avenue intersection, the 'straight ahead' movement on both Memorial Avenue and Roydvale Avenue are broadly similar at certain times.

4.1.6. To a large extent however, although these traffic volumes provide useful background, the changes in land use and new roading schemes that are due to occur mean that the current patterns cannot be assumed to continue into the future. As a result, there has been a greater reliance on traffic modelling rather than historic volumes for the analysis of the MBP site, and providing an assessment of existing levels of service on the roading network is somewhat irrelevant.

4.2. Non-Car Modes of Travel

4.2.1. There are no formal counts of walking or cycling movements in the area, but informal on-site observations suggest that volumes are commensurate with the residential development which fronts the surrounding district roads. No pedestrians or cyclists were observed during site visits that walked along the state highway. It is considered that the level of infrastructure provision is appropriate and adequate for the current volumes.

4.2.2. Two bus services use Memorial Avenue adjacent to the site. Service C ('The Comet') passes through Avonhead and the airport, via Avonhead Road, Roydvale Avenue and Memorial Avenue. This service operates with a 15-minute frequency at weekday peak times and a 30-minute frequency during weekday off-peaks and at weekends. Service 29 ('City to Airport') uses Fendalton Road and Memorial Avenue, operating with a 30-minute frequency both during the weekday peak times and also during weekday off-peaks and at weekends. These services provide a high level of service (in terms of the frequency of buses).

4.3. Road Safety

4.3.1. The NZTA Crash Analysis System has been used to identify the location and nature of the recorded traffic accidents in the vicinity of the site. All reported accidents between 2009 and 2013 were identified plus the partial record for 2014 within the area including Memorial Avenue, Russley Road, Avonhead Road and Roydvale Avenue, their intersections, and for a distance of 100m from each intersection.

4.3.2. This showed that there has been a total of 108 accidents, shown below by their respective locations.

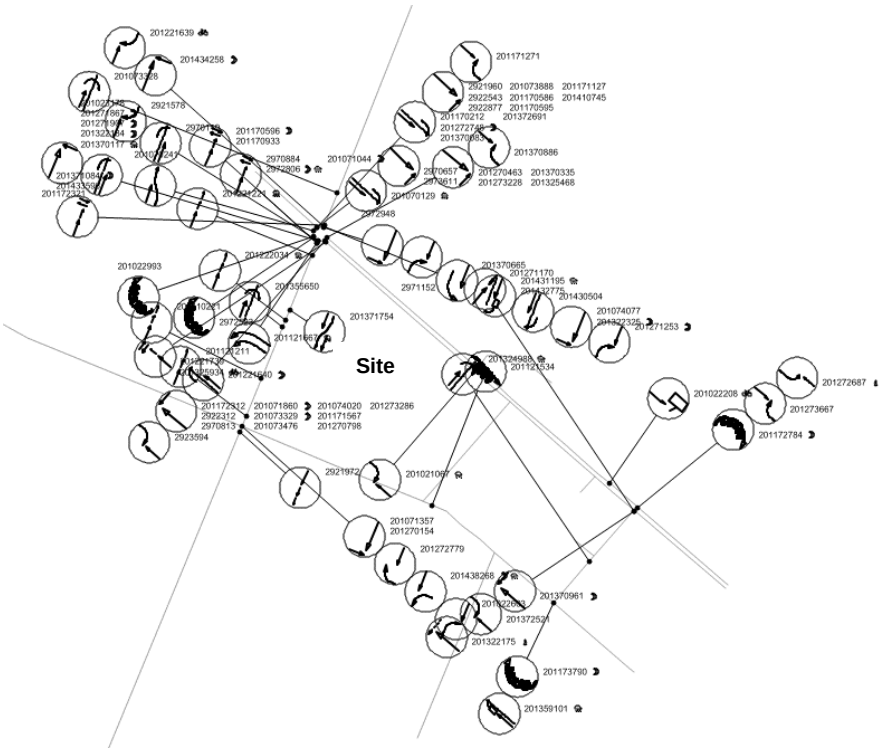


Figure 7: Location of Reported Accidents

Location	Fatal Injury	Serious Injury	Minor Injury	Non-Injury	Total
Russley Road / Memorial Avenue	0	1	28	60	**89**
Russley Road / Avonhead Road	0	0	1	4	**5**
Memorial Avenue / Stableford Green	0	0	1	0	**1**
Memorial Avenue / Roydvale Avenue	0	0	1	6	**7**
Roydvale Avenue / Avonhead Road	0	0	0	2	**2**
Total	**0**	**1**	**31**	**72**	**104**

Table 2: Number of Accidents and Injuries at Intersections

4.3.3. Some 89 of the total of 108 accidents (82%) were recorded at the Russley Road / Memorial Avenue intersection, of which the majority resulted in no injuries. The most common circumstances of the accidents related to failing to give way (41 accidents, 46% of the total), turning from an incorrect lane (18 accidents, 20% of the total) and a vehicle being struck from behind by another (15 accidents, 17% of the total).

4.3.4. Seven accidents occurred at the Memorial Avenue / Roydvale Avenue, but only two of these were due a driver turning at the intersection failing to give way to an oncoming vehicle. The remainder involved a vehicle striking a pole due to the driver being unable to see through a frosted windscreen, a vehicle failing to stop at the red traffic signal, a driver reversing into a another vehicle, and two accidents involved skateboarders one of whom was struck by a car while crossing the road correctly, and the other was struck while crossing against the red pedestrian signal.

4.3.5. Of the recorded accidents at the Russley Road / Avonhead Road intersection, three occurred when vehicles attempted to turn right onto the highway from the minor approach. Since this movement is now prohibited, this type of accident cannot now occur.

4.3.6. Two accidents occurred at the Roydvale Avenue / Avonhead Road, one when a turning vehicle was struck from behind and the other when a driver lost control when turning due to excessive speed.

4.3.7. Only four accidents were recorded at mid-block locations. These involved either vehicles that were reversing or car doors being opened in front of an oncoming vehicles, and all took place at different locations on the road network.

4.3.8. Other than at the Russley Road / Memorial Avenue roundabout, it is not considered that the records highlight any particular safety deficiencies on the roading network.

5. Proposal

5.1. MAIL is seeking that the site is rezoned from Rural 5 to Industrial Park (Memorial Avenue), which will enable a range of industrial, commercial, office, retail, and travellers' accommodation activities.

5.2. As previously noted, extensive transportation modelling was carried out for PC84 and this report seeks to build on that work. This modelling used the following land use scenario for the MBP site:

- Retail supermarket: 4,200sqm GFA;
- Bulk retail: 23,800sqm GFA;
- Other retail: 7,000sqm GFA
- Offices: 50,000sqm GFA; and
- Visitor Accommodation: 200 rooms.

5.3. The scenario used in PC84 has also been used for the purposes of this report, although it represents a greater level of development than would be enabled by this plan change. However, assessing a larger scale of development provides a robust analysis of outcomes/effects and necessarily means that where this higher level of development does not result in adverse outcomes, smaller-scale developments can also be accommodated.

5.4. Ancillary car parking will be provided for these land uses through both on-street parking and off-street provision.

5.5. A masterplan for the site has been developed, and is shown below together with separate layers for different types of road user.

5.6. With regard to the roading network, two routes through the site are proposed that will link Avonhead Road with Memorial Avenue, and both of these will be Primary Roads. No direct link is proposed onto Russley Road or the future on-ramp closest to the site. The easternmost access onto Memorial Avenue will be a signalised intersection where full turning movements are permitted. However the western access will be an unsignalised, left-in/left-out intersection and both accesses on Avonhead Road will also be priority ('give-way') controlled.

5.7. The provision of the signalised intersection coupled with the wide central median of Memorial Avenue means that it is possible to install a pedestrian crossing phase on its western side to facilitate walking movements between the site and the residential areas towards the north without imposing any additional delays on through traffic on Memorial Avenue. Provision is made internally for pedestrians by way of a network of footpaths on the proposed roads, with cyclists being accommodated through on-road cycle lanes on the Primary Roads.

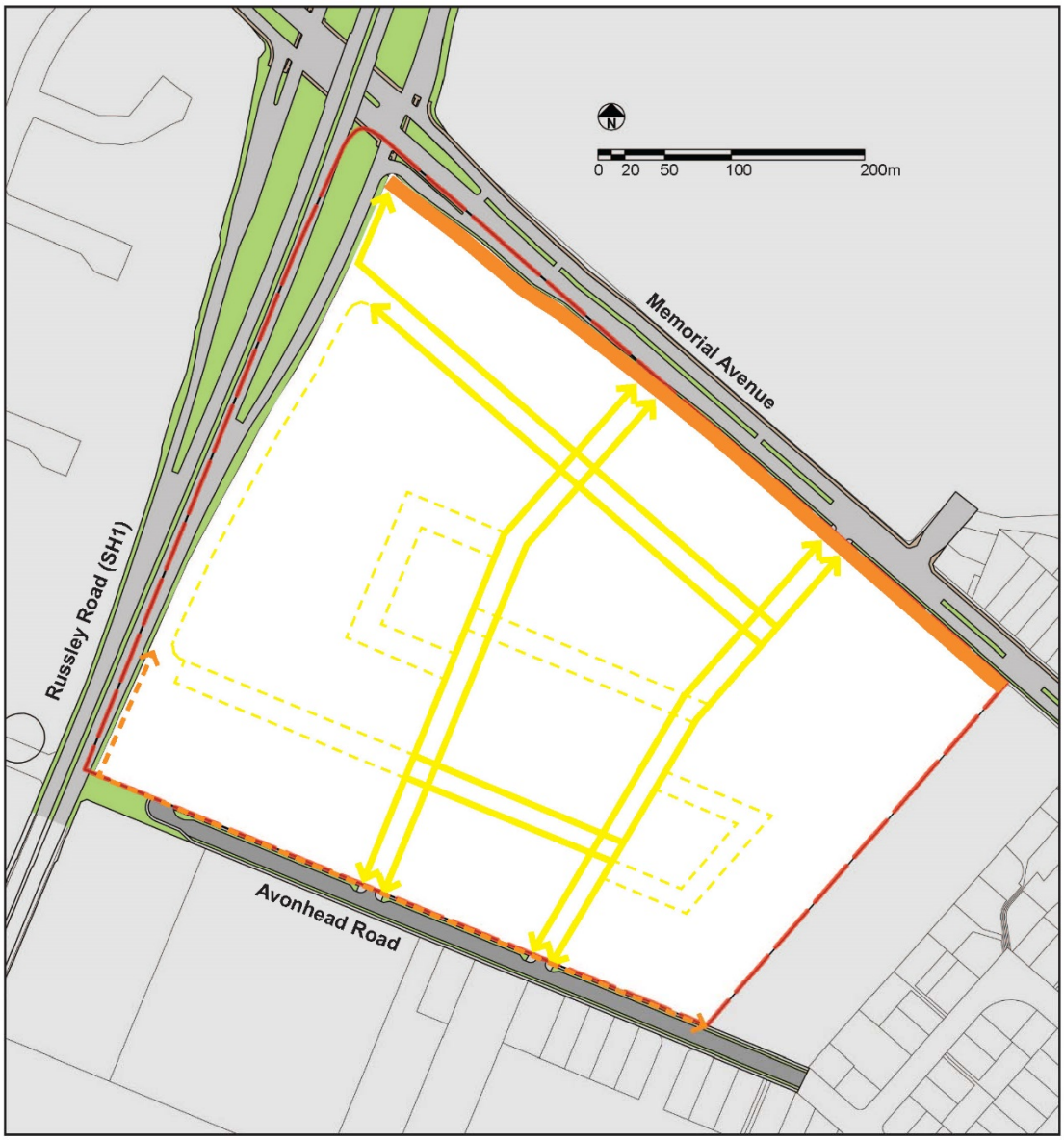
5.8. There are three off-road routes for pedestrians and cyclists within the site. One is through a linear park running along the southern side of Memorial Avenue with two other routes provided at the northwestern and southwestern corners of the site.

Legend

- Site boundary
- Proposed developable land
- Proposed developable land Special Amenity Area
- Proposed development setback
- Proposed road network
- Proposed footpath
- Area with no additional building
- Proposed REPA extension

Figure 8: Proposed Masterplan

Figure 9: Proposed Vehicular Movement Network



Legend

- Site boundary
- Urban linear park along Memorial Avenue (including shared pedestrian and cycle connection)
- Pedestrian and cycle connection along Avonhead Road
- Major pedestrian and cycle connections
- Secondary pedestrian and cycle connections

Figure 10: Proposed Non-Car Movement Network

6. Traffic Generation and Distribution

6.1. Traffic Generation

6.1.1. The proposed plan change at the airport (PC84) included for several land uses that are comparable to those proposed at this site, and accordingly, the same traffic generation rates have been adopted for assessing the MBP site, as set out below:

Land Use	Quantity / Area	Trip Rates (per room or 100sqm GFA)		Number of Vehicle Movements	
		Daily	Peak Hour	Daily	Peak Hour
Visitor Accommodation	200 rooms	8.0	0.5	1,600	100
Retail supermarket	4,200sqm GFA	129.0	17.9	5,418	752
Retail (bulk retail)	23,800sqm GFA	45.0	5.6	10,710	1,333
Retail (Mall rate)	7,000sqm GFA	87.0	10.0	6,090	700
Offices	50,000sqm GFA	10.0	2.0	5,000	1,000
Total	**-**	**-**	**-**	**28,818**	**3,885**

Table 3: Traffic Generation of Full Extent of Proposed Development

6.1.2. These rates have been reviewed by consultants on behalf of Christchurch City Council and accepted as being appropriate for the site.

6.2. Internal Trips and Pass-by Traffic

6.2.1. The figures above take no account of the potential for trips to be made between the different land uses within the site, which would be wholly internal to the site, and therefore would not use the external road network. To take this into account a conservative allowance has been made for 10% of the office-based trips to visit retail land uses, and the number of trips associated with retail has been reduced accordingly.

Land Use	Quantity / Area	Trip Rates (per room or 100sqm GFA)		Number of Vehicle Movements	
		Daily	Peak Hour	Daily	Peak Hour
Visitor Accommodation	200 rooms	-	-	0	0
Retail supermarket	4,200sqm GFA	-	-	-122	-27
Retail (bulk retail)	23,800sqm GFA	-	-	-241	-28
Retail (Mall rate)	7,000sqm GFA	-	-	-137	-25
Offices	50,000sqm GFA	-	-	0	0
Total	**-**	**-**	**-**	**-500**	**-100**

Table 4: Allowance Made for Internal Trips at the Development

6.2.2. Under the Council's Development Contributions Policy (set out in the Long Term Plan), it is noted that 20% of vehicle movements to and from retail and office land uses are made by drivers that are already on the roading network and which divert into the site as part of their journey. Accordingly, this figures has been adopted in this instance also.

Land Use	Quantity / Area	Trip Rates (per room or 100sqm GFA)		Number of Vehicle Movements	
		Daily	Peak Hour	Daily	Peak Hour
Visitor Accommodation	200 rooms	-	-	0	0
Retail supermarket	4,200sqm GFA	-	-	-1,084	-150
Retail (bulk retail)	23,800sqm GFA	-	-	-2,142	-267
Retail (Mall rate)	7,000sqm GFA	-	-	-1,218	-140
Offices	50,000sqm GFA	-	-	-1,000	-200
Total	**-**	**-**	**-**	**-5,444**	**-757**

Table 5: Allowance Made for Pass-by Trips at the Development

6.2.3. Combining these various tables means that the number of wholly new trips on the network generated by development of the site can be found.

Land Use	Quantity / Area	Trip Rates (per room or 100sqm GFA)		Number of Vehicle Movements	
		Daily	Peak Hour	Daily	Peak Hour
Visitor Accommodation	200 rooms	-	-	1,600	100
Retail supermarket	4,200sqm GFA	-	-	4,212	574
Retail (bulk retail)	23,800sqm GFA	-	-	8,327	1,018
Retail (Mall rate)	7,000sqm GFA	-	-	4,735	535
Offices	50,000sqm GFA	-	-	4,000	800
Total	**-**	**-**	**-**	**22,874**	**3,048**

Table 6: New Trips Generated by the Development

6.2.4. These figures have been reviewed by consultants on behalf of Christchurch City Council and accepted as being appropriate.

6.3. Trip Distribution

6.3.1. As noted earlier, a plan change has been advanced for the airport (PC84) with modelling for this being carried out using the CAST model. As part of this, an allowance was made for a proportion of development within the MBP site, but this was less than the full extent of traffic movements that could be generated as of right if the land was to be rezoned. It has been agreed with Christchurch City Council that the distribution of vehicles used for this partial development of the site as calculated by the model can be extended and applied to the traffic generated at full development of the site. This is set out below.

Direction	Morning Peak Hour		Number of Vehicle Movements	
	Into Site	Out of Site	Into Site	Out of Site
Russley Road (south)	8.6%	23.3%	8.5%	21.2%
Memorial Avenue (west of Russley Road)	1.7%	9.4%	4.3%	5.7%
Russley Road (south)	15.5%	12.5%	13.2%	10.3%
Wairakei Road (southbound link)	1.1%	0.0%	0.4%	0.0%
Memorial Avenue (east of Roydvale Avenue)	36.1%	23.1%	38.4%	30.4%
Roydvale Avenue (north)	0.0%	3.6%	2.7%	3.7%
Avonhead Road	37.0%	28.1%	32.5%	28.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 7: Trip Distribution of the Development (Calculated by CAST)

7. Transportation Modelling

7.1. Overview

7.1.1. Two models have been used in order to evaluate the effects of the proposed rezoning. Initially the traffic flows in the area were found through the CAST modelling carried out for PC84. These were then input into a microsimulation model for the Memorial Avenue corridor, to provide a more refined assessment of the likely outcomes for that section of the road network. Finally, CAST was again used to assess whether there would be any transport-related effects at locations more remote from the site. This approach was discussed and agreed with the City Council, and Meeting Notes are attached as Appendices A and B.

7.2. Initial CAST Modelling

7.2.1. The CAST modelling for PC84 took into account that not all land use with a particular zoning would be fully developed due to limited demand for that land. Accordingly, while the development of the site was included within the modelling, not all traffic that could be generated by the site as of right under the proposed zoning was allowed for.

7.2.2. Through discussions, it was agreed that CAST was the optimum tool in this instance for providing the likely future traffic flows on the network, taking into account the various changes in land use and infrastructure. However it was also agreed that the CAST outputs for PC84 could not be used 'as was' due to the limitation on the amount of traffic generation to and from the MBP site. The approach agreed with the City Council was therefore that four origin/destination matrices would be provided:

- A matrix for a 'baseline' scenario, which included only for changes in infrastructure and also land use changes elsewhere in the city;
- A matrix solely for MBP site traffic, as calculated by the model;
- A matrix solely for PC83 traffic, as calculated using typical trip rates and allowing for the full development of the area; and
- A matrix solely for PC84 traffic, as calculated using typical trip rates and allowing for the full development of the area.

7.2.3. The MBP matrix would then be factored to ensure that full development of the site was allowed for, and the matrices then combined to produce an overall matrix for the Memorial Avenue corridor.

7.2.4. In all cases a 'design' year of 2026 was adopted. The results are shown below.

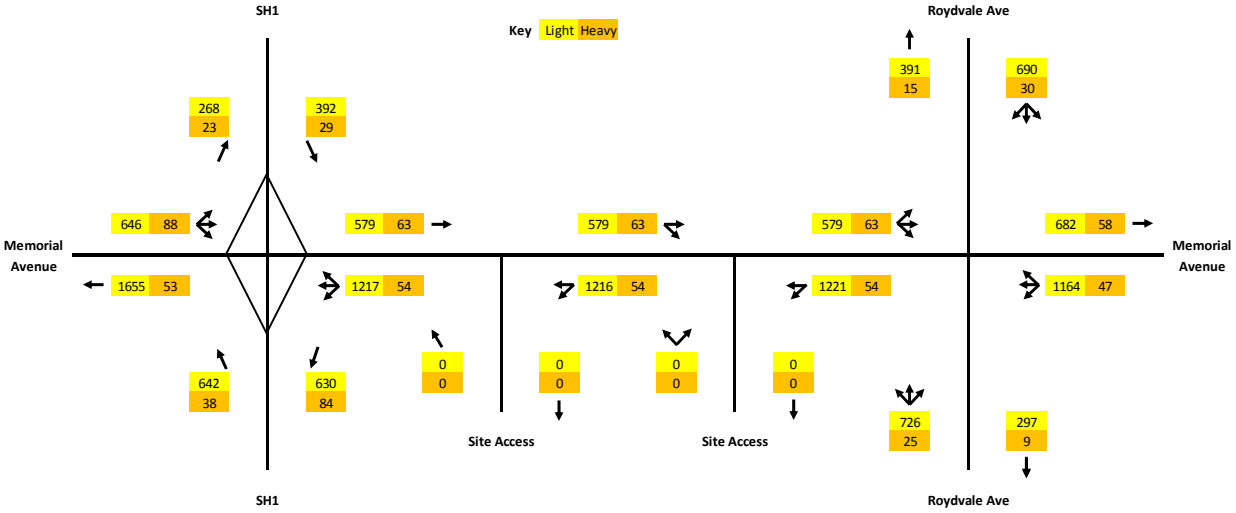


Figure 11: Memorial Avenue Corridor, Morning Peak Hour, No MBP Traffic

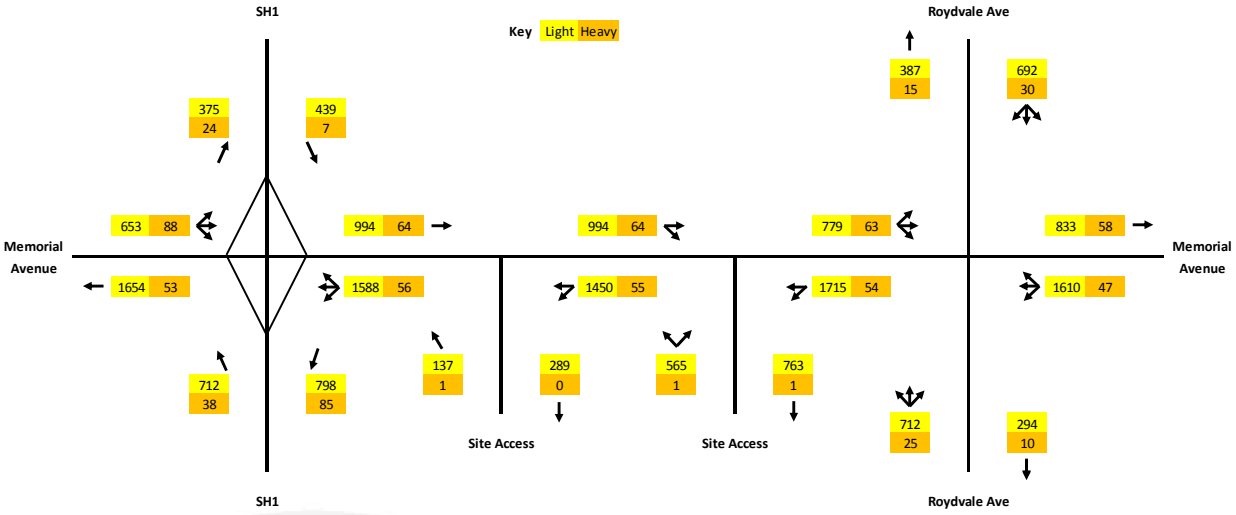


Figure 12: Memorial Avenue Corridor, Morning Peak Hour, With MBP Traffic

Figure 13: Memorial Avenue Corridor, Evening Peak Hour, No MBP Traffic

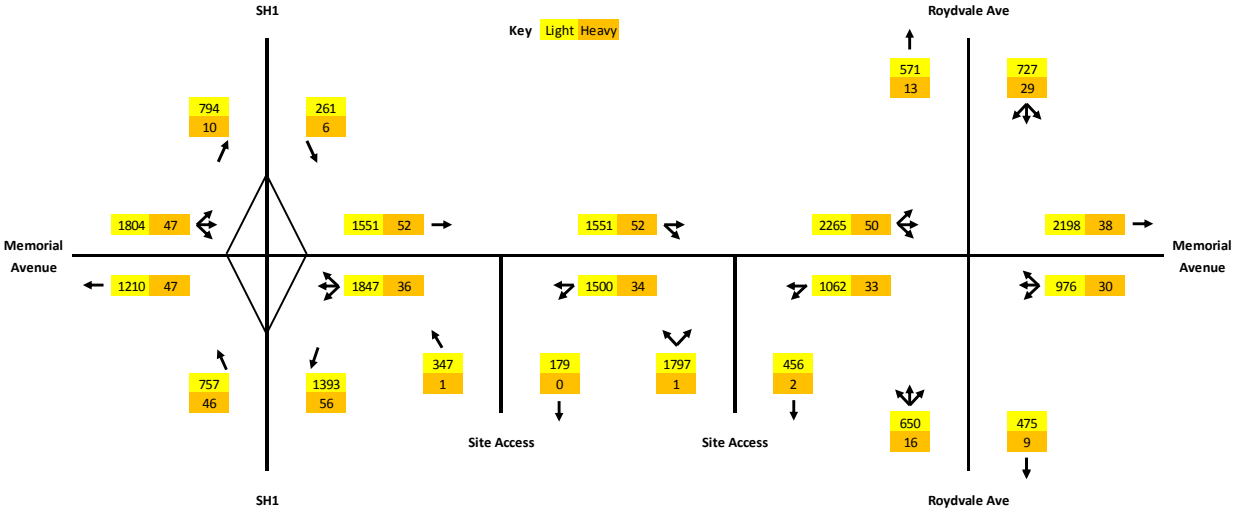


Figure 14: Memorial Avenue Corridor, Evening Peak Hour, With MBP Traffic

7.3. Microsimulation Modelling

7.3.1. The results of the manipulated matrices were then used within a microsimulation model in order to provide a more refined assessment of how the critical Memorial Avenue corridor would be affected by the site development. The microsimulation models were developed with reference to the S-Paramics 'The Microsimulation Consultancy Good Practice Guide' produced by SIAS.

7.3.2. The geographic extent of the models is illustrated below.

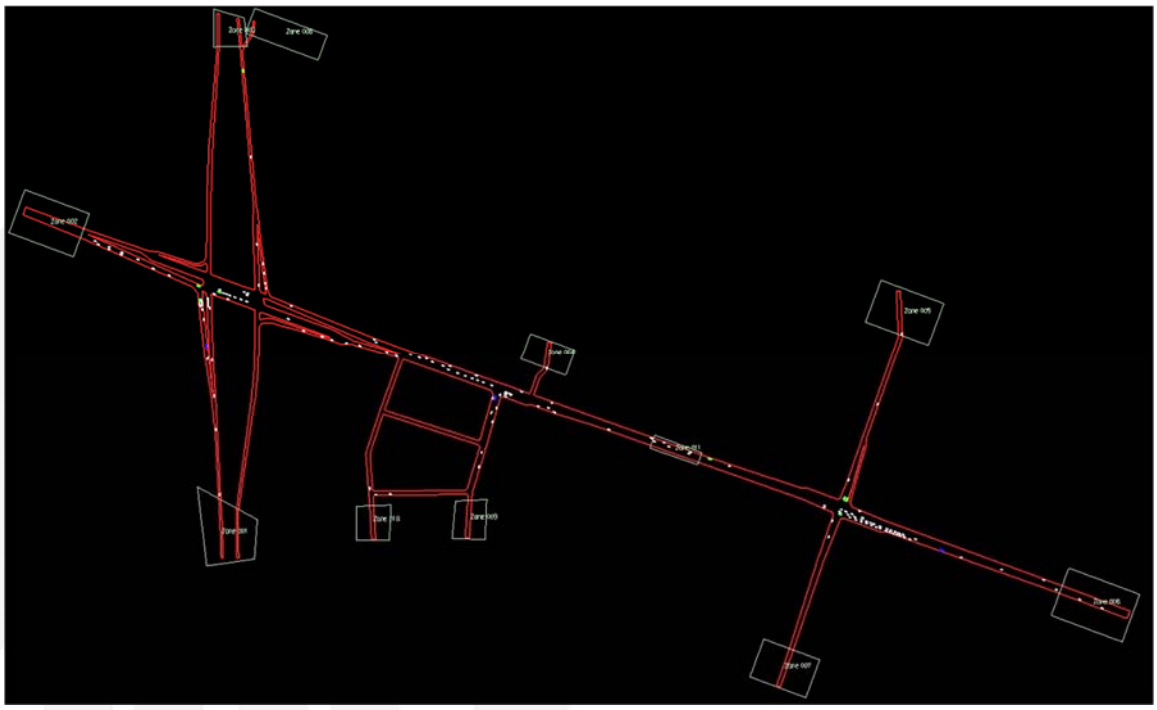


Figure 15: Extents of Microsimulation Model of Memorial Avenue Corridor

7.3.3. The results of this modelling exercise are set out below.

INTERSECTION	APPROACH	MOVEMENT	NUMBER OF JOURNEYS	AVERAGE DELAY					
				Movement		Approach		Intersection	
				s/veh	LOS	s/veh	LOS	s/veh	LOS
Memorial Ave / Roydvale Ave	Memorial Ave SE	Left	48	19	B	22	C	25	C
	Memorial Ave SE	Thru	1408	19	B				
	Memorial Ave SE	Right	213	45	D				
	Roydvale Ave SW	Left	293	49	D	46	D		
	Roydvale Ave SW	Thru	356	44	D				
	Roydvale Ave SW	Right	79	47	D				
	Memorial Ave NW	Left	152	10	A	13	B		
	Memorial Ave NW	Thru	674	10	B				
	Memorial Ave NW	Right	68	50	D				
	Roydvale Ave NE	Left	129	26	C	26	C		
	Roydvale Ave NE	Thru	186	21	C				
	Roydvale Ave NE	Right	82	36	D				
Eastern Site Access (Signals)	Memorial Ave SE	Left	575	20	C	21	C	20	C
	Memorial Ave SE	Thru	1197	22	C				
	Memorial Ave NW	Thru	600	3	A	14	B		
	Memorial Ave NW	Right	504	27	C				
	Eastern Site Access	Left	316	21	C	30	C		
	Eastern Site Access	Right	245	41	D				
Western Site Access (LILO)	Memorial Ave SE	Left in	10	8	A	15	B	15	B
	Western Site Access	Left out	136	15	B				
Memorial Ave east set of signals	Memorial Ave SE	Left	394	30	C	16	B	20	B
	Memorial Ave SE	Thru	1239	12	B				
	Memorial Ave NW	Thru from Airport	417	0	A	12	B		
	Memorial Ave NW	Thru from SH1 South	293	18	B				
	Memorial Ave NW	Right	211	28	C				
	SH1 North Off Ramp	Left	389	37	D	37	D		
	SH1 North Off Ramp	Right	302	37	D				
Memorial Ave west set of signals	Memorial Ave SE	Thru from Mem SE	943	0	A	10	B	19	B
	Memorial Ave SE	Thru from SH1 North	302	15	B				
	Memorial Ave SE	Right	296	39	D				
	Memorial Ave NW	Left	106	11	B	22	C		
	Memorial Ave NW	Thru	628	23	C				
	SH1 South Off Ramp	Left	456	35	D	35	D		
	SH1 South Off Ramp	Right	293	35	D				

Table 8: Results of Microsimulation Modelling, With Development, 2026 Morning Peak Hour

INTERSECTION	APPROACH	MOVEMENT	NUMBER OF JOURNEYS	AVERAGE DELAY					
				Movement		Approach		Intersection	
				s/veh	LOS	s/veh	LOS	s/veh	LOS
Memorial Ave / Roydvale Ave	Memorial Ave SE	Left	69	17	B	21	C	24	C
	Memorial Ave SE	Thru	857	17	B				
	Memorial Ave SE	Right	69	68	E				
	Roydvale Ave SW	Left	157	37	D	37	D		
	Roydvale Ave SW	Thru	383	32	C				
	Roydvale Ave SW	Right	124	52	D				
	Memorial Ave NW	Left	297	22	C	20	B		
	Memorial Ave NW	Thru	1872	17	B				
	Memorial Ave NW	Right	144	46	D				
	Roydvale Ave NE	Left	213	30	C	32	C		
	Roydvale Ave NE	Thru	261	27	C				
	Roydvale Ave NE	Right	103	49	D				
Eastern Site Access (Signals)	Memorial Ave SE	Left	355	17	B	20	C	26	C
	Memorial Ave SE	Thru	715	22	C				
	Memorial Ave NW	Thru	1319	2	A	7	A		
	Memorial Ave NW	Right	290	31	C				
	Eastern Site Access	Left	805	42	D	46	D		
	Eastern Site Access	Right	986	49	D				
Western Site Access (LILO)	Memorial Ave SE	Left in	5	6	A	31	D	31	D
	Western Site Access	Left out	343	31	D				
Memorial Ave east set of signals	Memorial Ave SE	Left	689	55	D	46	D	29	C
	Memorial Ave SE	Thru	1158	40	D				
	Memorial Ave NW	Thru from Airport	970	0	A	10	B		
	Memorial Ave NW	Thru from SH1 South	449	21	C				
	Memorial Ave NW	Right	506	21	C				
	SH1 North Off Ramp	Left	199	40	D	40	D		
	SH1 North Off Ramp	Right	166	40	D				
Memorial Ave west set of signals	Memorial Ave SE	Thru from Mem SE	721	0	A	10	A	27	C
	Memorial Ave SE	Thru from SH1 North	166	17	B				
	Memorial Ave SE	Right	437	24	C				
	Memorial Ave NW	Left	358	14	B	34	C		
	Memorial Ave NW	Thru	1477	38	D				
	SH1 South Off Ramp	Left	353	39	D	39	D		
	SH1 South Off Ramp	Right	449	39	D				

Table 9: Results of Microsimulation Modelling, With Development, 2026 Evening Peak Hour

7.3.4. Given that the traffic flows are considerably lower in the morning peak hour than in the evening, the performance of the road network is correspondingly better during that period than during the latter. However even in the evening peak hour, the road network performs well with all movements and all intersections operating with Level of Service D or better, other than for one movement. Level of Service D represents an acceptable level of service.

7.3.5. In respect of the single movement where Level of Service E is recorded, the queuing statistics from the model shows an average length of 2.3 pcu[1], a 95th percentile queue of 3.6 pcu and a maximum queue of 4.0 pcu. The length of the right-turn lane currently provided for this movement is some 32m and thus the expected queue can be accommodated without blocking any through traffic. However there is sufficient width available within the central (raised)

[1] Passenger Car Units: a way to homogenise reporting of traffic volumes, where cars are assigned a value of 1 and trucks assigned a value of 2.

median for the lane length to be extended in the unlikely event that the vehicle queue extended into the adjacent through traffic lane.

7.3.6. Regardless, for signalised intersections, it is the overall level of service that is the determinant of performance rather than a single movement. Consequently, it can be concluded that the traffic associated with full development of the site can be accommodated on the network in 2026.

7.3.7. The coding of the models has been subject to an audit by consultants on behalf of Christchurch City Council, which found that they were fit for purpose. The results of the models were also reviewed at the same time, and were accepted.

7.3.8. A detailed Technical Note setting out further information regarding the modelling is included as Appendix C.

7.4. Further CAST Modelling

7.4.1. As set out previously, changes to land use and infrastructure mean that drivers may divert onto alternative routes some distance from a site. Consequently, an assessment was carried out of intersections outside the Memorial Avenue corridor, again making use of the CAST model. In essence, the approach adopted was to firstly evaluate the delays under a 'baseline' scenario (that is, with no development of the MBP site, PC83 or PC84), with those expected with development of the MBP site. The delays were then converted into levels of service and results compared. A detailed Technical Note setting out the process followed and the results is included as Appendix D.

7.4.2. The analysis showed that several intersections were expected to have a poor level of service (mostly right turns) in the 'baseline' scenario, which were then exacerbated by small increases in traffic resulting from the development of the site. For practical purposes, the results were filtered to identify only locations where the increase in turning volumes was more than 50 vehicle movements per hour and the intersection location was within 3.5km of the site. The results are shown below.

Intersection			Peak Period	BASE (No MBP, PC83 or PC84)				BASE + MBP				Change	
Name	Type	Dist from Site (km)		Actual (PCU/hr)	V/C	Delay (sec/veh)	LOS	Actual (PCU/hr)	V/C	Delay (sec/veh)	LOS	Flow (PCU/hr)	Delay (sec/veh)
Kendal/Memorial	Priority (T)	0.9	AM	81	78	78	F	58	95	159	F	-24	81
Grahams/Memorial	Signals	1.7	AM	30	34	44	D	133	103	117	F	104	73
Grahams/Memorial	Signals	1.7	PM	103	65	65	E	104	74	83	F	1	18
Wairakei/Kendal	Priority (T)	2.1	PM	145	67	34	D	159	85	57	F	14	23
Crofton/Harewood	Priority	2.6	AM	106	82	73	F	65	84	112	F	-41	39
Yaldhurst/Cutts	Priority (T)	2.7	PM	32	72	147	F	57	96	173	F	26	26
Harewood/Gardiners/Breens	Priority	2.8	AM	86	83	82	F	53	81	108	F	-33	26
Harewood/Gardiners/Breens	Priority	2.8	PM	102	91	100	F	100	96	130	F	-2	30
Yaldhurst/Russley	Signals	2.8	AM	1480	100	73	E	1480	101	89	F	0	16
Yaldhurst/Russley	Signals	2.8	AM	331	99	120	F	331	100	135	F	0	15
Yaldhurst/Russley	Signals	2.8	PM	1364	100	83	F	1364	103	127	F	0	44
Yaldhurst/Russley	Signals	2.8	PM	378	93	73	E	390	96	87	F	12	14
Yaldhurst/Withells	Priority (T)	2.8	AM	151	84	58	F	163	92	76	F	12	17
Yaldhurst/Racecourse	Priority (T)	3.0	PM	248	100	95	F	221	103	159	F	-26	64
Avonhead/Yaldhurst	Signals (T)	3.2	PM	376	93	78	E	401	99	114	F	24	36
Yaldhurst/Middlepark	Signals (T)	3.2	PM	159	85	78	E	160	94	125	F	1	47

Table 10: Results of Additional CAST Modelling, With Development

7.4.3. Initially it had been expected that following identification of the affected intersections, further analyses would be carried out to refine the outcomes and then if appropriate devise schemes to ensure that an improved higher level of service was provided at those locations. In practice however, after carrying out the modelling, it became apparent that further analysis would not necessarily be of assistance. This is because analyses showed that some intersections experienced a degraded level of service due to committed land uses associated with implementation of the Land Use Recovery Plan, irrespective of development of the MBP site. Further, a number of the intersections identified were also affected by traffic generated by PC84. Consequently, delays at these locations will arise due to a combination of the existing 'base' levels, traffic associated with the Land Use Recovery Plan, PC84 and development of the MBP site, where the contribution of MBP may be relatively insignificant.

7.4.4. Additionally, the CAST model works by assigning traffic to the most efficient routes. Consequently, if just one congested intersection is improved, the model reassigns vehicles accordingly and this therefore changes the traffic flows passing through other intersections. The outcome of this reassignment is that delays could be alleviated, remain the same, or be exacerbated at other locations, including at locations which currently operate with acceptable levels of service. The practical outcome of this is that it may not be necessary to improve all intersections identified as having low levels of service.

7.4.5. Given these factors, no further modelling has been undertaken at this stage. Rather, an assessment is required of the likely intersection upgrades that arise due to just the Land Use Recovery Plan, plus those that are required for the traffic associated with PC84. Once this analysis is completed, the relative contributions of the traffic sources can be determined and the appropriate solutions identified.

7.5. Site Accesses

7.5.1. It can be seen from the tables above that both site accesses on Memorial Avenue operate with a good level of service, although the level of service at the western access in the evening peak hour is expected to be slightly lower than at the eastern access.

7.5.2. The western access will operate as a priority intersection, but the eastern access will be signalised. After a series of preliminary assessments, it was apparent that it was insufficient for this access to have only two lanes for vehicles emerging from the site, and thus the modelling carried out was based on a nominal layout with three traffic lanes provided for vehicles exiting, as shown below.

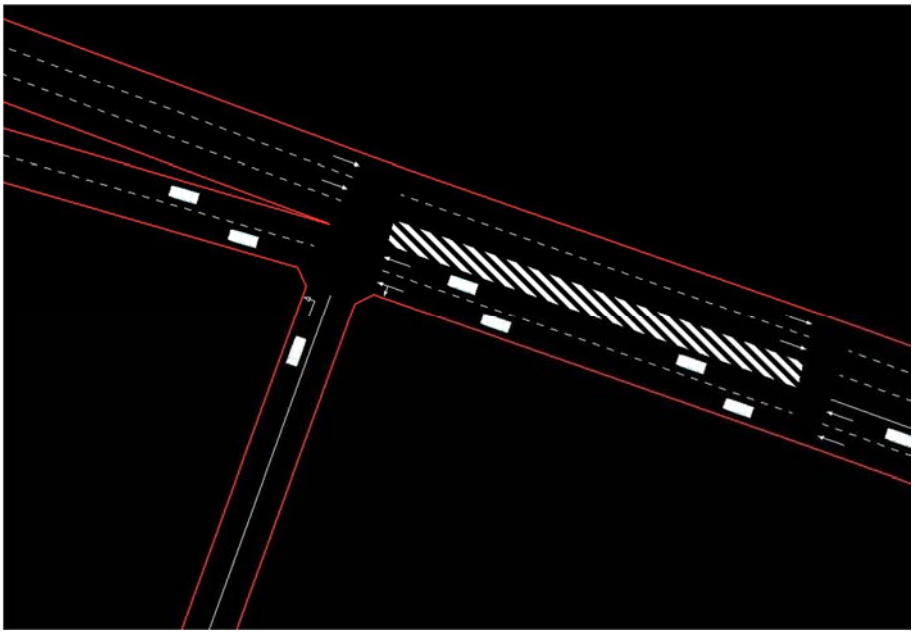


Figure 16: Indicative Layout of Western Site Access

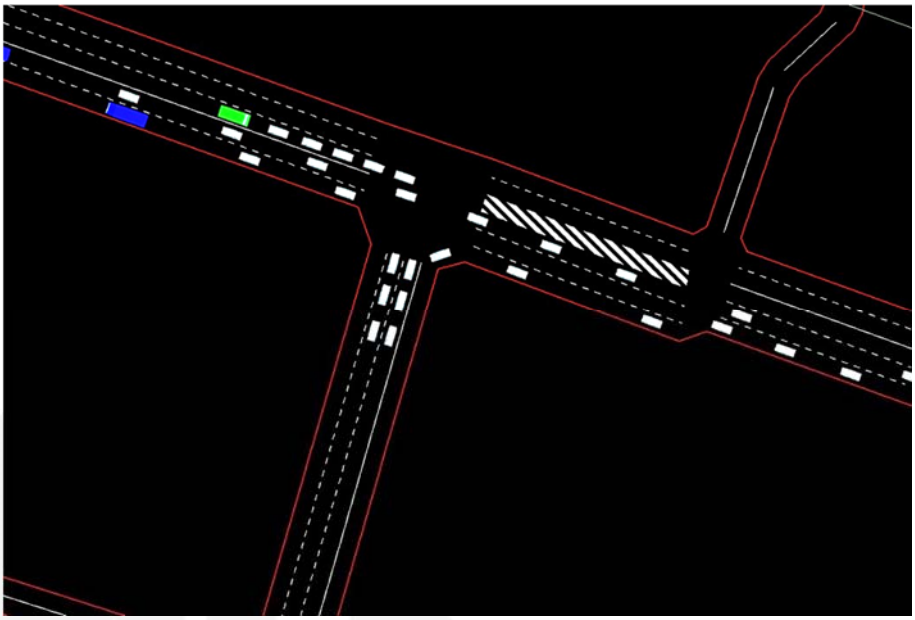


Figure 17: Indicative Layout of Eastern Site Access

7.5.3. The detailed layouts for these intersections will be determined at the time that land use and subdivision consents are sought. However the analysis undertaken to date shows that suitable forms of intersection can be accommodated at these location, and both only require land within the road reserve or within the site itself.

7.5.4. The site accesses onto Avonhead Road will carry far fewer vehicles than those onto Memorial Avenue and even at full development of the site, the volumes will be modest. Further, the closure of the western end of Avonhead Road will result in traffic flows on the road reducing considerably. Accordingly, priority-controlled intersections are proposed for both locations and are expected to operate satisfactorily.

7.6. Non-Car Modes of Travel

7.6.1. Since each of the roads within the site has footpaths and will be designed in a manner to meet (or exceed) current Council standards, it is expected that walking movements that are undertaken wholly within the site will be able to be made efficiently and safely. The relatively high permeability of the road network means that the pedestrians will not be required to use circuitous routes, and the off-road links to the northwest and southwest of the site coupled with the route through the linear park will ensure a high level of amenity for walking trips.

7.6.2. The internal network has also been produced with a view to ensuring that cycling will also be a safe and convenient travel mode. The north-south road which is expected to have the highest traffic flows will also have cycle lanes, and each intersection within the site will be appropriately treated to ensure that drivers are aware of the possible presence of cyclists. Cyclists will also be able to use the off-road links outlined above. In addition, Built Form Standard 16.4.5.2.11 requires that a cycleway is constructed between Avonhead Road and Memorial Avenue (note that the location of this has not yet been determined and so this is not shown on the masterplan).

7.6.3. The presence of Memorial Avenue creates severance for pedestrians attempting to access the site from the residential areas towards the northeast. However, it is possible to install a pedestrian crossing phase towards the immediate west of the eastern site access which will enable pedestrians to safely cross the road. This phase can be installed without any additional delays to through traffic.

7.6.4. The extent of development within the site is such that it is likely that there will be an increase in demand for public transport services. Since Memorial Avenue is already used by two services, it is plausible that this will be accomplished through the diversion of one (or both) of these into the site and consequently specific provision for public transport will be made (as shown on Figure 10). This will include ensuring that the geometry of the intersections through which the bus will pass is appropriate, and that on-street parking is restricted in locations where buses are expected to turn.

7.6.5. Providing for buses within the site also means that the distance a passenger has to walk between the bus stop and their final destination is reduced, which will further enhance the attractiveness of this mode of transport.

7.6.6. Taking these features of the site into account, it is considered that high levels of provision will be made for those using non-car travel modes.

7.7. Road Safety

7.7.1. The current accident records do not indicate any particular features or factors that would affect, or be affected by, the proposed development. The cluster of accidents at the Russley Road / Memorial Avenue roundabout can be expected to be addressed through the proposed grade-separation scheme and the consequential closure of Avonhead Road at Russley Road will also address the small number of accidents that have occurred at this location.

7.7.2. The site accesses will introduce turning traffic at locations where presently traffic does not turn, and therefore potentially will increase accident risk at those locations. However the intersections will be designed to appropriate standards, and the flat and straight alignment of both Memorial Avenue and Avonhead Road mean that excellent sight distances will be achieved. Moreover a proportion of the vehicles using the accesses will be ‘diverted’ trips that are already on the network and consequently, will already be undertaking turning movements

at other locations. Consequently their diversion into the site will potentially reduce accident risk elsewhere, thereby offsetting any increase in risk. As a result, it is not considered that the proposed new accesses will have any noticeable effect on road safety.

7.8. Summary and Conclusions

7.8.1. Overall, the modelling undertaken shows that the traffic associated with the development of the site can be accommodated on the roading network without any adverse efficiency issues arising. Levels of service on the Memorial Avenue corridor to the immediate north of the MBP site remain good, with all intersections operating with Level of Service D or better (other than for one movement). Level of Service D represents an acceptable level of service.

7.8.2. Both site accesses on Memorial Avenue will operate with acceptable levels of service, although the level of service at the western access (left-in/left-out) in the evening peak hour is expected to be slightly lower than at the eastern (signalised) access.

7.8.3. Non-car modes of travel are suitably accommodated within the site through a permeable site layout, a network of footpaths and cycling infrastructure, including three off-road routes. Pedestrian severance due to Memorial Avenue will be addressed through a pedestrian crossing phase at the proposed traffic signals, which can be implemented without reducing vehicular capacity. A route will be provided within the site for bus services, which could be implemented easily through diverting one or both of the existing services that currently use Memorial Avenue.

7.8.4. The current accident records do not indicate any particular features or factors that would affect, or be affected by, the proposed development, and the proposed site accesses will be designed to appropriate standards.

8. Strategic Planning Documents

8.1. Introduction

8.1.1. There are a number of strategic planning documents with which any land rezoning is expected comply. An assessment of the proposed development of the site against these documents has been undertaken and the results are summarised below.

8.2. Canterbury Regional Policy Statement

8.2.1. The Canterbury Regional Policy Statement 2013 (RPS) sets out an overview of the significant resource management issues in the region, and sets out ways to resolve those issues and achieve the integrated management of the natural and physical resources. Chapter 5 of the RPS ('Land Use and Infrastructure') highlights a number of polices relating to the transportation networks:

Policy 5.3.7 *– In relation to strategic land transport network and arterial roads, the avoidance of development which:*

(1) adversely affects the safe efficient and effective functioning of this network and these roads, including the ability of this infrastructure to support freight and passenger transport services; and

(2) in relation to the strategic land transport network and arterial roads, to avoid development which forecloses the opportunity for the development of this network and these roads to meet future strategic transport requirements.

Policy 5.3.8 *– Integrate land use and transport planning in a way:*

(1) that promotes:

(a) the use of transport modes which have low adverse effects;

(b) the safe, efficient and effective use of transport infrastructure, and reduces where appropriate the demand for transport;

(2) that avoids or mitigates conflicts with incompatible activities; and

(3) where the adverse effects from the development, operation and expansion of the transport system:

(a) on significant natural and physical resources and cultural values are avoided, or where this is not practicable, remedied or mitigated; and

(b) are otherwise appropriately controlled.

Policy 5.3.9 *– In relation to regionally significant infrastructure (including transport hubs):*

(1) avoid development which constrains the ability of this infrastructure to be developed and used without time or other operational constraints that may arise from adverse effects relating to reverse sensitivity or safety;

Policy 6.3.2 *– Business development, residential development (including rural residential development) and the establishment of public space is to give effect to the principles of good urban design below, and those of the NZ Urban Design Protocol 2005, to the extent appropriate to the context:*

(2) Integration – recognition of the need for well-integrated places, infrastructure, movement routes and networks, spaces, land uses and the natural and built environment. These elements should be overlaid to provide an appropriate form and pattern of use and development.

(3) Connectivity – the provision of efficient and safe high quality, barrier free, multimodal connections within a development, to surrounding areas, and to local facilities and services, with emphasis at a local level placed on walking, cycling and public transport as more sustainable forms of transport

***Policy 6.3.4** – Ensure that an efficient and effective transport network that supports business and residential recovery is restored, protected and enhanced so that it maintains and improves movement of people and goods around Greater Christchurch by:*

(1) avoiding development that will overload strategic freight routes;

(2) providing patterns of development that optimise use of existing network capacity and ensuring that, where possible, new building projects support increased uptake of active and public transport, and provide opportunities for modal choice;

3) providing opportunities for travel demand management;

(4) requiring integrated transport assessment for substantial developments; and

(5) improving road user safety.

8.2.2. To a large extent, the identification of the site within the Land Use Recovery Plan and also within the RPS as an area that is suitable for development means that it can be anticipated that the regional council considers that the general location is suitable for a more intensive land use. However as the extent and intensity of any development is not confirmed, there is still a requirement to ensure that the proposed level of development achieves the relevant policies and objectives.

8.2.3. The analysis carried out shows that the traffic generated by the proposed development does not adversely affect the effective or safe functioning of the arterial roads in the immediate area, and the resultant levels of service do not mean that the arterial networks could not be developed further in future. In regard to the latter, the rezoning makes allowance for the proposed Russley Road / Memorial Avenue grade-separation scheme. No adverse transport-related effects are anticipated to occur at the nearby airport as a result of the development of the site, and the proposed rezoning takes into account the expected growth at the airport as assessed through PC84.

8.2.4. The site specifically provides for non-car modes of travel, with provision made for walking, cycling and public transport, including enhancing connectivity to areas towards the north by providing for walking journeys across Memorial Avenue through a pedestrian phase at the proposed signalised intersection. An off-road route is provided for pedestrians and cyclists that runs the full length of the site northern boundary, and there are also off-road routes for these users to ensure connectivity towards the northwest and southwest. There is considerable scope to ensure that the different transport networks are well integrated within the site to support both efficiency and safety.

8.3. Canterbury Regional Land Transport Strategy

8.3.1. The Canterbury Regional Land Transport Strategy (2012-2042) (RLTS) identifies the region's transport needs and the roles of all land transport modes and has a vision of the region having "an accessible, affordable, integrated, safe, resilient and sustainable transport

system". This is supported by five objectives, of ensuring a resilient, environmentally sustainable and integrated transport system, increasing transport safety for all users, protecting and promoting public health, assisting economic development and improving levels of accessibility for all.

8.3.2. The strategy also sets out 16 outcomes that are expected to be achieved. These are set out below, together with the ways in which the proposed rezoning contributes to them.

a. *Reduced greenhouse gas emissions from use of the domestic transport system:* The mix of land uses means that one journey can be made to the site, with internal journeys between the range of different land uses being made by non-car modes. The site is also accessible by public transport and thus there is no requirement to use a private motor vehicle to travel to or from the site.

b. *Improved resilience of the transport network to infrastructure damage or emergencies:* The site is adjacent to a state highway, which can be expected to be constructed to the highest standards and thus be highly resilient. Four points of access are proposed to the site to ensure that access can be maintained even if any are unexpectedly closed.

c. *Improved resilience of the transport system to external changes:* The site is accessible by non-car modes of travel, and only requires the diversion of an existing bus routes rather than the provision of a wholly new service.

d. *Improved land use and transport integration:* As set out elsewhere in this report, the site is considered to be well-integrated with the transportation networks, and has been identified in the Land Use Recovery Plan as being suitable for development.

e. *Reduction in fatal and serious injuries for all modes:* The accident records do not indicate that there are any safety-related deficiencies on the road network, and new infrastructure will be designed to meet current standards.

f. *Improved personal safety and reduced security risks to all transport users:* (See (e) above).

g. *Improved health from increase in time spent travelling by active means:* The site provides for walking and cycling, and connectivity to areas towards the north is assisted through the provision of a pedestrian crossing phase at the proposed signalised intersection on Memorial Avenue.

h. *Increased proportion of the population travelling by active means:* (See (g) above)

i. *Reduced community exposure to vehicle pollutants, noise and vibration:* The majority of vehicles travelling to the site will use Memorial Avenue, which is an Arterial Road and therefore expected to carry significant volumes of traffic.

j. *Improved journey time reliability on the strategic transport network:* The modelling exercise carried out shows that the capacity of the road network would not be exceeded, even at full development of the site.

k. *Increased energy efficiency per trip:* The mix of land uses means that one journey can be made to the site, with internal journeys between the range of different land uses being made by non-car modes. The site is also accessible by public transport and thus there is no requirement to use a private motor vehicle to travel to or from the site.

l. *Regional and inter-regional journey time reliability on key freight routes is maintained:* The modelling exercise carried out shows that the capacity of the road network would not be exceeded, even at full development of the site.

m. *Freight hubs are protected and maintained:* The closest freight hub is the airport, and the analysis undertaken identifies that development-related traffic generated by the site would not unduly affect the airport's activities.

n. *Connectedness is enhanced:* The proposal provides for reducing the severance created by Memorial Avenue by way of a pedestrian phase at the proposed traffic signals. This crossing point will also be available for those not travelling to the site.

o. *Increased travel choices for households to access urban and suburban centres:* The site is located such that it can be accessible by walking and public transport as well as private car. There is limited ability to encourage external cycle travel, but once within the site, a high level of provision is made for cyclists.

p. *Improved mobility for the transport disadvantaged:* Provision is made for non-car travel to and within the site.

8.3.3. Overall, the proposed site rezoning is not considered to be contrary to the RLTS.

8.4. Christchurch Transport Strategic Plan (2012-2042)

8.4.1. The document was published as part of the city's response to earthquake recovery and sets out a vision of "keeping Christchurch moving forward by providing transport choices to connect people". Four goals are set out to achieve this, improving access and choice, creating safe, healthy, and liveable communities, supporting economic vitality, and creating opportunities for environmental enhancements.

8.4.2. The modelling undertaken shows that the proposed rezoning does not give rise to unacceptable levels of congestion on the arterial road network (Action 1.1.1) and therefore does not compromise its ability to provide reliable and efficient journeys. Cycle facilities are provided within the site, including both on-road and of-road routes and the linear park will assist cyclists that pass the site on their way to other destinations and would be suitable to form part of a designated cycleway. The individual developments within the site are anticipated to comply with the City Plan with regard to provision for cycle parking (Action 1.1.3). The site will facilitate public transport (Action 1.1.4) without the need for wholly new services, but rather, will build on existing services that already pass on Memorial Avenue which is designated as part of the Core Public Transport Network. A high level of provision will be made for pedestrians within the site (Action 1.1.5), and footpaths will be connected to existing external routes. Additionally, the provision of a pedestrian crossing phase at the proposed signalised intersection on Memorial Avenue will reduce severance for those walking to and from the site.

8.4.3. There will also be a mix of facilities within the site, which will encourage trip-chaining (the visit to more than one destination within a site) and these will all be short-distance journeys that will not necessitate the use of a car to travel between them (Action 1.3.1). Supporting this, the site is identified within the Land Use Recovery Plan (Action 2.1.3) as being a suitable growth area, and provides a mix of land uses on a core public transport route (Action 2.2.2).

8.4.4. The current road safety records do not indicate that the development-related traffic would give rise to, or would exacerbate, any road safety issues (Action 2.3.1) and the new roads and intersection can be designed to meet current standards. No off-site parking is required, meaning there would be no impediment to the Council removing the parking lanes on Memorial Avenue if desired (Action 3.1.3).

8.4.5. Overall, it is considered that the proposed rezoning is aligned with the Christchurch Transport Strategic Plan.

8.5. Canterbury Regional Public Transport Plan

8.5.1. The Canterbury Regional Passenger Transport Plan (2012) sets out Environment Canterbury's objectives and policies for delivering public transport in the region. These fall within five areas of the network of services, vehicle quality and service performance standards, fares and ticketing, branding/marketing/information, and infrastructure.

8.5.2. One aspect of the strategy is to ensure that bus stops are located no more than 400m from potential patrons, and are spaced no more than 300m to 400m apart. The size of the site however means that this cannot be achieved unless buses travel into the site, because the bus stops on Memorial Avenue are more than of 400m from the southern site boundary. Consequently, provision has been made for buses to enter the site and travel in a loop before re-emerging onto Memorial Avenue. This provision means that if desired, existing services that pass the site could be easily diverted, and all of the site would be brought within 220m of a bus route. The identified route will be designed in a manner to specifically accommodate buses.

8.6. Canterbury Regional Travel Demand Management Strategy

8.6.1. The Canterbury Regional Travel Demand Management Strategy (2008) describes methods that affect whether, how, when and where travel occurs, with a view to maximising the efficiency of the land transport system. Integrating land use planning and transportation is noted by the strategy as being an important influence in managing travel demand.

8.6.2. The Travel Demand Management Strategy is a high-level strategy which focuses upon providing a background to travel demand management, but nevertheless it is considered that the proposed rezoning is not inconsistent with the strategy in that the site is accessible by public transport, walking and cycling. Further, the proposed mix of land uses within the site together with its size means that there will be increased likelihood of trip linking (that is, visits to multiple destinations within the site), with such trips not being dependent upon car travel.

8.7. Christchurch City Plan

8.7.1. At this stage, it is considered that the site will be developed according to the existing traffic and transportation Rules within the City Plan and no new transportation-related Objectives, Policies or Rules are proposed. If there are any deviations from those Rules (such as the provision of different standards of road widths), these will be identified when land use and/or subdivision consents are sought and the acceptability of these non-compliances determined at that time.

8.8. Christchurch City Council Infrastructure Design Standard

8.8.1. The Infrastructure Design Standard sets out design requirements for infrastructure, including the road network. Generally, the proposed masterplan is in accord with the Design Standard although it sets out that all approaches to 'T'-intersections should be at 90 or 180 degrees, whereas the masterplan shows that in some instances, the angle is 70 degrees. However the latter is within the requirements of the overarching Standard NZS4404:2010 ('Land Development and Subdivision Infrastructure').

8.8.2. The roading hierarchy within the site cannot yet be confirmed but assuming that the two north-south routes become Collector Roads and the remainder become Local Roads, then Table 2 of the Infrastructure Design Standard shows that the required intersection spacings

will not be met (as a separation of 150m is required between intersections on a Collector Road). The site has been designed however to facilitate a high degree of permeability for pedestrians and cyclists, and to be a low-speed environment, and consequently it is not considered that the reduced spacing will result in any adverse effects.

9. Conclusions

9.1. This report has identified, evaluated and assessed the various transport and access elements of the proposed rezoning of 24.5ha of land to the east of Russley Road and south of Memorial Avenue for mixed commercial use.

9.2. In view of a number of changes that are likely to take place in respect of land use and infrastructure that will change the traffic volumes on the frontage road network, a transport model has been used to assess the effects of developing the site. This shows that even will full development, each intersection in the immediate area will operate with Level of Service D or better. Each turning movement at each intersection also operates at Level of Service D or better, other than for one exit movement from the site. Any increased queues or delays at this location will be internal to the site and will not affect the operation of the frontage road.

9.3. The current safety record in the area of the site is very good, and there is no evidence to suggest there are any deficiencies on the roading network, other than at the Russley Road / Memorial Avenue intersection which is shortly due to be grade-separated. Accordingly, it is not considered that the presence of development-related traffic will result in any road safety matters arising, or exacerbate an existing issue.

9.4. No adverse effects on non-car modes of travel are anticipated as a result of the development of the site. Rather, it is considered that the provision for these road users will be enhanced through a new pedestrian crossing on Memorial Avenue, off-road routes for pedestrians and cyclists including a route running along the full length of the site northern boundary, facilitating the diversion of existing bus services into the site and other initiatives.

9.5. An evaluation of the proposed rezoning has been carried out against regional and local transportation strategies and policies, and it is considered that overall the proposal is consistent with these.

9.6. Overall, and subject to the preceding comments, the proposed development can be supported from a traffic and transportation perspective.

Carriageway Consulting Limited
August 2014

Appendix A

Agreed Approach for Initial Modelling

MEETING NOTE

CARRIAGEWAY CONSULTING
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project	**Memorial Avenue Plan Change (PC35)**
meeting date	26 March 2014
attending	Andy Milne (AM): Christchurch City Council Anita Hansbury (AH): Christchurch City Council John Falconer (JF): QTP Ltd Sarah Eveleigh (SJE): Anderson Lloyd Lawyers Andy Carr (ADC): Carriageway Consulting Ltd
apologies	-
distribution	All attendees

SJE opened the meeting by explaining the intended purpose, of reaching an understanding as to the modelling work that has been carried out with regard to PC83/84, how PC35 (MAIL) had been taken into account, and how MAIL could move forwards utilising the modelling that has already been carried out.

ADC added his understanding that the QTP reports for PC83/84 had referred to MAIL being modelled "*to the full extent that the developer aspires*" as part of the receiving environment for PC83/84, but noted that this was a little ambiguous. It could relate to the full quantum of land use being included within to the model, or could refer to the full amount of expected traffic generation of MAIL being taken into account. In regard to the matter of land use vs traffic generation, ADC referred back to previous conversations where it was noted that the traffic generation of MAIL within QTP's modelling equated to only 60% of the traffic generation set out in the MAIL Transportation Assessment.

JF clarified that the modelling carried out for PC83/84 assumed landuse inputs consistent with the MAIL site being zoned as per the developer's aspirations. Because demand for this type of land use is finite for a given population base, and because demand is less than supply due to every potential growth area in the UDS/LURP being included in the model, the number of trips allocated to each site by the model can be significantly less than the true potential. It is unlikely that all areas identified in the UDS/LURP would be developed simultaneously, but because each area could potentially be developed within the planning horizon, they are all included in the baseline scenario ("no picking winners"). Other spatial factors, introduced during model calibration, can also affect future trip generation in some areas. Furthermore, the model does not distinguish between specific types of retail (or brands etc.), where a wide range of variation is possible from the generic values assumed in the model. In the case of MAIL, the combination of these factors results in the amount of allocated model trips being approximately 60% of what might be expected at full site development if typical trip rates[1] had been applied. While this approach provides a suitably generic receiving environment across the full network, it does however mean that trip generation at specific (yet to be built) sites may be lower than what might be expected at full development of each site.

JF said that in order to address this issue for the assessment of PC83/84, the traffic generation of PC83/84 had been based on first principles (ie using a standard traffic engineering approach of trip rates and floor areas) and included both 'mid-range' and 'high' scenarios for SPAZ, as well as

[1] For the purposes of this Note, "typical trip rates" means trip rates commonly used within Transportation Assessments that are based on vehicle movement surveys collected from comparable developments and national database sources.

varying levels of development in Areas 1-3. Similarly, several context-specific baseline scenarios were produced with varying levels of development in SPAZ and Areas 1-3. In each case, the estimated trip generation was implemented in the model by adopting related employment inputs that achieved a level of trip generation consistent with that calculated from first principles. He noted that this was in accord with best practice, where trip generation for the Plan Change area is effectively 'locked' for each scenario and therefore is unable to change due to other influences within the model.

There was then a discussion about whether the modelling methodologies for PC83/84 and MAIL were consistent, and of how the various sites could/should be prioritised within the modelling. It was agreed by all that it was important to have an approach to addressing both the PC83/84 and MAIL sites that reflected they were both at an early stage in the consenting process and to ensure that both were treated identically in terms of how they are assessed. To that end, ADC and JF agreed that in theory, the consistent approach for assessing MAIL would be for the modelling to be carried out with the PC83/84 zoning in place (with no MAIL development) and allow the model to calculate the likely extent of uptake of the PC83/84 land. This would then form a receiving environment onto which the traffic generation of MAIL could be added.

However, it was thought that rather than undertake further modelling, the same outcomes could be achieved by a different approach. JF said that it was straightforward to extract origin-destination (OD) matrices from the existing models and agreed to provide the following matrices:

- An OD matrix for a 'baseline' scenario, which excluded PC83, PC84 and MAIL traffic but allowed for other land use development in the city;
- An OD matrix just for MAIL traffic, as calculated by the model and allowing for the full rezoning of the site as sought by PC35;
- An OD matrix for PC83 traffic, as calculated using typical trip rates and allowing for the full rezoning as sought; and
- An OD matrix for PC84 traffic, as calculated using typical trip rates and allowing for the full rezoning as sought.

For clarity, the matrices would cover only the Memorial Avenue corridor between (and including) Roydvale Avenue and Russley Road.

These could then be used by ADC in the microsimulation model that had already been built for MAIL, as follows:

- Initially the 'baseline', PC83, PC84 and MAIL OD matrices would be combined and included within the microsimulation model to evaluate the performance of the Memorial Avenue corridor;
- The MAIL OD matrix would then be factored to the traffic generation levels set out in the PC35 Transportation Assessment (noting that this reflects full development of the MAIL site based on typical trip rates) and the model re-run;
- If the model showed that the Memorial Avenue corridor was still operating satisfactorily, then it could be concluded that the traffic generated by the full development of MAIL and calculated using typical trip rates could be accommodated on the road network;
- If the model did not show that the Memorial Avenue corridor was operating satisfactorily, then the traffic flows associated with PC83 and PC84 would be reduced until the total traffic could be accommodated on the road network. A discussion would then be required to address whether the 'scaling down' of PC83 and PC84 traffic was a reasonable representation of a potential reduced take-up of land in those areas.

JF confirmed that he was happy with this approach (but also noting the potential need for second stage as discussed below). He also confirmed that in the interest of a pragmatic assessment, there was no need to adjust the OD matrices other than factoring up and down (i.e. trip distribution patterns associated with PC35, 83 & 84 should be maintained).

AM highlighted that he had concerns regarding the performance of the Yaldhurst/Avonhead intersection to the south, and of the potential for this to be used by MAIL traffic. AH similarly highlighted that she was aware that residents had concerns about the Roydvale/Avonhead intersection.

It was agreed that assessment of these (and possibly other) intersections should form a second stage in the analysis, but that for the immediate future, the focus should be on the microsimulation modelling of the Memorial Avenue corridor.

Appendix B

Agreed Approach for Further Modelling

MEETING NOTE

CARRIAGEWAY CONSULTING
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project	**Memorial Business Park**
topic	Second tranche of modelling work
meeting date	11 June 2014
attending	Andy Milne (AM): Christchurch City Council Mark Stevenson (MS): Christchurch City Council John Falconer (JF): QTP Ltd Sarah Eveleigh (SJE): Anderson Lloyd Lawyers Andy Carr (ADC): Carriageway Consulting Ltd
apologies	-
distribution	All attendees

ADC opened the meeting by outlining the background of the modelling work to date, noting that it had been agreed to undertake this in two tranches of firstly the Memorial Avenue corridor and secondly, other intersections of concern to the Council (assuming that the Memorial Avenue corridor had been agreed to operate satisfactorily). Since the first of these tasks had been carried out without significantly adverse queues and delays arising, the purpose of the meeting was to commence the second matter and to reach agreement on all of the locations to be modelled. He provided two trip matrices showing the directions from which traffic would travel to and from Memorial Business Park (MBP), based upon the matrices produced for the modelling to date.

MS noted that he and AM had provided some initial thoughts on locations via e-mail. JF noted that he had looked further at the model runs carried out and had produced a more detailed assessment of vehicle origins and destinations at MBP, in a graphical form. He distributed copies of 'bandwidth diagrams', where the width of the line is proportional to the increase in traffic volume on each road due to MBP traffic.

Initially, the parties started to review the bandwidth diagrams with a view to identifying intersections and routes that appeared to have the highest increase in traffic, and listing these as requiring further analysis. However it rapidly became apparent that this ad hoc approach could lead to locations being assessed which were not required and/or locations being omitted where further analysis was justified. Consequently there was a discussion as to how the existing model runs could be used to devise a more structured approach to identifying locations for additional analysis. JF noted that it was straightforward to compare the outputs of two model runs and thought that a process based on this would be plausible. He also said that the CAST model was able to identify the levels of service provided for each turning movement at the intersections.

All agreed that it was important to ensure that the process identified effects arising from MBP traffic *only*, since there would be likely to be changes to the network arising from other developments that could affect levels of service.

It was therefore agreed that:

- JF will compare the model runs for the 'baseline' (ie no PC83, PC84 or MBP) to the model runs for 'baseline+PC83+PC84' and to 'baseline+PC83+PC84+MBP'. The turning movements at each intersection will be assessed to identify whether the levels of service had changed (indicating an effect due to development-related traffic), or whether levels of

service were at E or F (indicating a situation that could be exacerbated by additional traffic loadings).

- JF will then rank these intersections (and movements) according to the significance of the change.
- The parties will then carry out a 'commonsense' check on the identified intersections to ensure that no locations have been omitted that local knowledge suggests should have been included, and vice versa.
- Following agreement of these intersections, ADC will carry out a more detailed analysis of each location using the Sidra Intersection modelling software. This software facilitates a higher level of refinement than can be produced using CAST.

AM highlighted the issue of increased traffic flows giving rise to changes in amenity for residents, such as through reduced opportunities to cross the road. ADC noted that these could be quantified though using the process set out in the NZTA 'Pedestrian Planning and Design Guide'. Both MS and JF queried whether there was any benefit in testing locations where there was already formal provision for crossing pedestrians. However both Avonhead Road and Kendall Avenue were identified as not having any formal crossing provision and where the traffic increase associated with MBP appeared to be relatively high.

It was therefore agreed that traffic flows on these roads would be provided to ADC by JF, and ADC will then quantify the levels of service for crossing pedestrians. This analysis will start geographically closer to the MBP site, where any effects are likely to be more pronounced, and progress outwards, ceasing when the results show a good level of service is provided.

Appendix C

Results of Microsimulation Modelling

TECHNICAL NOTE

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project	**Memorial Business Park**
To	John Falconer, QTP Ltd
From	Andy Carr, Carriageway Consulting Ltd
copies to	Mark Christensen / Sarah Eveleigh, Anderson Lloyd Lawyers Andrew Mason, Memorial Avenue Investments Ltd
Date	8 May 2014
Subject	Microsimulation model outputs

Introduction

This Technical Note summarises the process undertaken to model the traffic effects of the Memorial Business Park ('MBP', 'MAIL').

Overarching Methodology Adopted

The methodology for undertaking the modelling was discussed and agreed at a meeting held on 26 March 2014 and attended by John Falconer (QTP, as consultants to Christchurch City Council), Andy Milne and Anita Hansbury (Christchurch City Council), Sarah Eveleigh (Anderson Lloyd Lawyers) and Andy Carr (Carriageway Consulting Ltd). It was formalised in a subsequent Meeting Note as follows:

> *…ADC and JF agreed that in theory, the consistent approach for assessing MAIL would be for the modelling to be carried out with the PC83/84 zoning in place (with no MAIL development) and allow the model to calculate the likely extent of uptake of the PC83/84 land… However, it was thought that rather than undertake further modelling, the same outcomes could be achieved by a different approach. JF said that it was straightforward to extract origin-destination (OD) matrices from the existing models and agreed to provide the following matrices:*
>
> - *An OD matrix for a 'baseline' scenario, which excluded PC83, PC84 and MAIL traffic but allowed for other land use development in the city;*
> - *An OD matrix just for MAIL traffic, as calculated by the model and allowing for the full rezoning of the site as sought by PC35;*
> - *An OD matrix for PC83 traffic, as calculated using typical trip rates and allowing for the full rezoning as sought; and*
> - *An OD matrix for PC84 traffic, as calculated using typical trip rates and allowing for the full rezoning as sought.*
>
> *These could then be used in the microsimulation model that had already been built for MAIL, as follows:*
>
> - *Initially the 'baseline', PC83, PC84 and MAIL OD matrices would be combined and included within the microsimulation model to evaluate the performance of the Memorial Avenue corridor;*

- *The MAIL OD matrix would then be factored to the traffic generation levels set out in the PC35 Transportation Assessment (noting that this reflects full development of the MAIL site based on typical trip rates) and the model re-run;*
- *If the model showed that the Memorial Avenue corridor was still operating satisfactorily, then it could be concluded that the traffic generated by the full development of MAIL and calculated using typical trip rates could be accommodated on the road network;*
- *If the model did not show that the Memorial Avenue corridor was operating satisfactorily, then the traffic flows associated with PC83 and PC84 would be reduced until the total traffic could be accommodated on the road network. A discussion would then be required to address whether the 'scaling down' of PC83 and PC84 traffic was a reasonable representation of a potential reduced take-up of land in those areas.*

JF said that in the interest of a pragmatic assessment, there was no need to adjust the OD matrices other than factoring up and down (i.e. trip distribution patterns associated with MAIL, 83 & 84 should be maintained).

Subsequent to this this, the various matrices have been provided by QTP for the years 2026 and 2041. It is understood from correspondence with QTP that in the 2026 scenario there is only partial development of the PC83 and PC84 sites but that the 2041 matrices allow for full development of these sites.

Detailed Methodology Used for 2026 Model Runs

The details of the manipulation of the QTP matrices are set out below, which follows the agreed methodology albeit with some minor revisions. Additional notes are also included within the spreadsheets of the matrices.

Traffic Generation of MBP

In order to ensure that there is consistency between the various analyses, the rates that were used for earlier assessments of the MBP site were updated according to the rates that have been promulgated by QTP within their analyses for PC83 and PC84. The areas proposed for MBP have also been revised since earlier analyses and therefore it was important to also take these into account. No changes to the trip rates used by QTP have been made.

An allowance of 20% was made for passby trips (that is, trips already on the road network that would visit the site as part of their current journey), with 10% of the office workers assumed to visit the retail component of the site (meaning that these trips take place wholly within the site).

QTP's MBP matrices show that in the morning, the site can be expected to generate 30% less traffic than in the evening. Consequently, a simple pro-rata exercise has been carried out and the trip rates for all land uses reduced by 30% for calculation of the morning peak hour traffic volumes.

Amendments to the QTP 2026 Baseline Traffic Flows

Some minor changes were required to the 'baseline' matrices since they showed trips being made to the MBP site associated with the current land use and these would cease if the land is developed for a different purpose. These trips were therefore removed from the matrices.

The traffic movements for Stableford Green were also removed from the matrix, as these appeared to be very low for the extent of development served and in addition a number of right-turn

movements emerging from Stableford Green were shown whereas this movement is prohibited in practice. However, a higher number of trips associated with Stableford Green were manually added to the matrices, as noted below.

Stableford Green Traffic Generation

A nominal 50 vehicle movements (two-way) was allowed for (five times greater than the number of vehicles in the QTP baseline matrix) to represent movements associated with the 17 residences served by the road plus additional movements associated with the golf club. These trips were generally allocated according to the distribution shown in the QTP baseline matrix. In a small number of cases however, this would have resulted in vehicles attempting to turn right from Stableford Green, a movement which is prohibited and consequently these trips were assumed to turn left instead. In practice, the low volume of vehicles reassigned (at most, 6 in the peak hour) means that the model performance is extremely unlikely to be affected by this.

Factoring of the QTP MBP Matrix

The matrix provided by QTP for MBP was factored up, according to the expected traffic generation calculated previously. This was carried out by way of a simply pro-rata of each cell of the matrix.

The QTP matrix assumed full turning movements at each access, whereas the western access is left-in/left-out only. For this spreadsheet however no manual redistribution of trips has been carried out to account for turning movements that cannot be made – rather there has been reliance on the model to undertake this itself through reallocating vehicles using the two internal link roads that have been coded.

MBP Passby Trips

The number of passby trips was calculated earlier as part of the MBP traffic generation. These are trips already on the network which will visit to the MBP site before continuing on to their original destination. As such, the matrix is zero sum (that is, there is no 'new' traffic created, merely a reallocation of existing traffic on the network).

Initially the revised baseline matrix was factored down such that the total number of trips equated to the total number of passby trips (keeping all cells in proportion). A reassignment of these trips to MBP was then carried out as if all of these trips were entering the site followed by a second reassignment as if all of the trips were exiting the site. The two matrices were then weighted according to the proportion of incoming and outgoing trips (found from the QTP MAIL matrices) and then added together.

In undertaking this exercise, a reassignment was also carried out to reflect the fact that the western site access is left-in/left-out only, and thus some passby trips will need to emerge from a different access to which they entered the site.

Preliminary Total Matrices

The preliminary matrices were then found through adding the revised baseline matrices, Stableford Green traffic, factored MBP traffic and passby MBP traffic, to the QTP matrices for PC83 and PC84.

Preliminary Adjusted Matrices

A number of movements within the preliminary matrices were then adjusted in view of the model coding. In particular, some movements that were not coded in the model (such as the north-south movements across the Russley overbridge and movements between the north and Wairakei Road)

were deleted, as they have no effect on the model performance. Other very minor reassignments were also carried out.

Initial Modelling Outcomes for 2026 Traffic Flows

The preliminary adjusted matrices were input to the microsimulation models, and the models run. The results showed that significant queues and delays arose for vehicles emerging from the western (left-in/left-out) access intersection whereas at the same time there was significant spare capacity at the eastern access.

These results highlight that at this stage, it is difficult to be prescriptive about the relative attractiveness of the two site accesses to drivers exiting the site. It is intuitive that a driver visiting a destination close to the eastern access would enter and exit the site using that access. However the situation is less clear for destinations within the site that are equidistant from both accesses, and is further complicated by the restricted turning movements at the western access that mean certain movements must take place at the eastern access regardless of from where in the site they originate (for example, all trips made from the site towards the city centre). Finally, given that the internal layout has not yet been determined it is possible that the development density will vary across the site meaning that more trips would naturally take place via one access than the other.

In view of this, a further adjustment was made of manually reallocating trips emerging from the site such that the delays for these vehicles were comparable at both accesses. Through an iterative process, this was found to occur with 70% of all trips heading towards the state highway using the eastern (signalised) access and the remaining 30% of these trips using the western (left-in/left-out) access.

Final Modelling Outcomes for 2026 Traffic Flows

A summary of the model outputs for the 2026 traffic flows is shown below.

INTERSECTION	APPROACH	MOVEMENT	NUMBER OF JOURNEYS	AVERAGE DELAY					
				Movement		Approach		Intersection	
				s/veh	LOS	s/veh	LOS	s/veh	LOS
Memorial Ave / Roydvale Ave	Memorial Ave SE	Left	48	19	B	22	C	25	C
	Memorial Ave SE	Thru	1408	19	B				
	Memorial Ave SE	Right	213	45	D				
	Roydvale Ave SW	Left	293	49	D	46	D		
	Roydvale Ave SW	Thru	356	44	D				
	Roydvale Ave SW	Right	79	47	D				
	Memorial Ave NW	Left	152	10	A	13	B		
	Memorial Ave NW	Thru	674	10	B				
	Memorial Ave NW	Right	68	50	D				
	Roydvale Ave NE	Left	129	26	C	26	C		
	Roydvale Ave NE	Thru	186	21	C				
	Roydvale Ave NE	Right	82	36	D				
Eastern Site Access (Signals)	Memorial Ave SE	Left	575	20	C	21	C	20	C
	Memorial Ave SE	Thru	1197	22	C				
	Memorial Ave NW	Thru	600	3	A	14	B		
	Memorial Ave NW	Right	504	27	C				
	Eastern Site Access	Left	316	21	C	30	C		
	Eastern Site Access	Right	245	41	D				
Western Site Access (LILO)	Memorial Ave SE	Left in	10	8	A	15	B	15	B
	Western Site Access	Left out	136	15	B				
Memorial Ave east set of signals	Memorial Ave SE	Left	394	30	C	16	B	20	B
	Memorial Ave SE	Thru	1239	12	B				
	Memorial Ave NW	Thru from Airport	417	0	A	12	B		
	Memorial Ave NW	Thru from SH1 South	293	18	B				
	Memorial Ave NW	Right	211	28	C				
	SH1 North Off Ramp	Left	389	37	D	37	D		
	SH1 North Off Ramp	Right	302	37	D				
Memorial Ave west set of signals	Memorial Ave SE	Thru from Mem SE	943	0	A	10	B	19	B
	Memorial Ave SE	Thru from SH1 North	302	15	B				
	Memorial Ave SE	Right	296	39	D				
	Memorial Ave NW	Left	106	11	B	22	C		
	Memorial Ave NW	Thru	628	23	C				
	SH1 South Off Ramp	Left	456	35	D	35	D		
	SH1 South Off Ramp	Right	293	35	D				

Table 1: Model Results, 2026 Morning Peak Hour

INTERSECTION	APPROACH	MOVEMENT	NUMBER OF JOURNEYS	AVERAGE DELAY					
				Movement		Approach		Intersection	
				s/veh	LOS	s/veh	LOS	s/veh	LOS
Memorial Ave / Roydvale Ave	Memorial Ave SE	Left	69	17	B	21	C	24	C
	Memorial Ave SE	Thru	857	17	B				
	Memorial Ave SE	Right	69	68	E				
	Roydvale Ave SW	Left	157	37	D	37	D		
	Roydvale Ave SW	Thru	383	32	C				
	Roydvale Ave SW	Right	124	52	D				
	Memorial Ave NW	Left	297	22	C	20	B		
	Memorial Ave NW	Thru	1872	17	B				
	Memorial Ave NW	Right	144	46	D				
	Roydvale Ave NE	Left	213	30	C	32	C		
	Roydvale Ave NE	Thru	261	27	C				
	Roydvale Ave NE	Right	103	49	D				
Eastern Site Access (Signals)	Memorial Ave SE	Left	355	17	B	20	C	26	C
	Memorial Ave SE	Thru	715	22	C				
	Memorial Ave NW	Thru	1319	2	A	7	A		
	Memorial Ave NW	Right	290	31	C				
	Eastern Site Access	Left	805	42	D	46	D		
	Eastern Site Access	Right	986	49	D				
Western Site Access (LILO)	Memorial Ave SE	Left in	5	6	A	31	D	31	D
	Western Site Access	Left out	343	31	D				
Memorial Ave east set of signals	Memorial Ave SE	Left	689	55	D	46	D	29	C
	Memorial Ave SE	Thru	1158	40	D				
	Memorial Ave NW	Thru from Airport	970	0	A	10	B		
	Memorial Ave NW	Thru from SH1 South	449	21	C				
	Memorial Ave NW	Right	506	21	C				
	SH1 North Off Ramp	Left	199	40	D	40	D		
	SH1 North Off Ramp	Right	166	40	D				
Memorial Ave west set of signals	Memorial Ave SE	Thru from Mem SE	721	0	A	10	A	27	C
	Memorial Ave SE	Thru from SH1 North	166	17	B				
	Memorial Ave SE	Right	437	24	C				
	Memorial Ave NW	Left	358	14	B	34	C		
	Memorial Ave NW	Thru	1477	38	D				
	SH1 South Off Ramp	Left	353	39	D	39	D		
	SH1 South Off Ramp	Right	449	39	D				

Table 2: Model Results, 2026 Evening Peak Hour

Given that the traffic flows are considerably less in the morning peak hour, the performance of the road network is correspondingly better that in the evening peak hour. However even during the evening peak hour, the road network performs well with all movements and all intersections operating with Level of Service D or better, other than one movement. Level of Service D represents an acceptable level of service.

In respect of the single movement where Level of Service E is recorded, the queuing statistics from the model shows an average length of 2.3 pcu, a 95th percentile queue of 3.6 pcu and a maximum queue of 4 pcu. The length of the right-turn lane currently provided for this movement is some 32m and thus the queue can be accommodated without blocking any through traffic. However there is sufficient width available within the central median for the lane length to be extended if required.

Regardless, for signalised intersections, it is the overall level of service that is the determinant of performance rather than a single movement. Consequently, it can be concluded that the traffic associated with full development of the Memorial Business Park can be accommodated on the network in 2026.

Detailed Methodology Used for Additional Model Runs

It is unusual within the context of district plan change requests to look beyond a horizon of more than ten years, because as timescales increase, so does the level of uncertainty concerning the assumptions which underlie the analyses and in turn the margin of error in the results increases. In this instance however, it is understood that full development of PC83 and PC84 has only been allowed for in the 2041 matrices produced by QTP. Consequently, to take this into account a second model run was carried out. This followed the methodology set out above and used the same 2026 trip matrices, other than for PC83 and PC84 where those produced for 2041 were used instead.

In view of the earlier results which showed the roading network was under less stress in the morning than during the evening, only the evening peak was modelled. The results are summarised below.

INTERSECTION	APPROACH	MOVEMENT	NUMBER OF JOURNEYS	AVERAGE DELAY					
				Movement		Approach		Intersection	
				s/veh	LOS	s/veh	LOS	s/veh	LOS
Memorial Ave / Roydvale Ave	Memorial Ave SE	Left	74	17	B	19	B	22	C
	Memorial Ave SE	Thru	861	15	B				
	Memorial Ave SE	Right	71	74	E				
	Roydvale Ave SW	Left	169	41	D	40	D		
	Roydvale Ave SW	Thru	397	37	D				
	Roydvale Ave SW	Right	96	52	D				
	Memorial Ave NW	Left	344	18	B	15	B		
	Memorial Ave NW	Thru	1881	12	B				
	Memorial Ave NW	Right	162	41	D				
	Roydvale Ave NE	Left	223	33	C	34	C		
	Roydvale Ave NE	Thru	279	30	C				
	Roydvale Ave NE	Right	94	51	D				
Eastern Site Access (Signals)	Memorial Ave SE	Left	341	17	B	21	C	24	C
	Memorial Ave SE	Thru	747	23	C				
	Memorial Ave NW	Thru	1369	2	A	6	A		
	Memorial Ave NW	Right	283	24	C				
	Eastern Site Access	Left	743	36	D	42	D		
	Eastern Site Access	Right	1010	47	D				
Western Site Access (LILO)	Memorial Ave SE	Left in	6	7	A	24	C	24	C
	Western Site Access	Left out	317	24	C				
Memorial Ave east set of signals	Memorial Ave SE	Left	618	43	D	44	D	27	C
	Memorial Ave SE	Thru	1179	44	D				
	Memorial Ave NW	Thru from Airport	1042	0	A	9	A		
	Memorial Ave NW	Thru from SH1 South	422	17	B				
	Memorial Ave NW	Right	551	21	C				
	SH1 North Off Ramp	Left	198	40	D	40	D		
	SH1 North Off Ramp	Right	164	40	D				
Memorial Ave west set of signals	Memorial Ave SE	Thru from Mem SE	745	0	A	6	A	25	C
	Memorial Ave SE	Thru from SH1 North	164	18	B				
	Memorial Ave SE	Right	434	12	B				
	Memorial Ave NW	Left	313	13	B	33	C		
	Memorial Ave NW	Thru	1592	37	D				
	SH1 South Off Ramp	Left	353	39	D	39	D		
	SH1 South Off Ramp	Right	422	39	D				

Table 3: Model Results, 2026 Evening Peak Hour Plus 2041 PC83/84 Development

These results are very similar to those which were forecast to arise in the evening peak hour in 2026. Discussions with QTP have identified that in due course, the effects of PC83 and PC84 in the immediate vicinity of the MBP site are likely to diminish, due to additional roading links being constructed that mean vehicles associated with those sites use routes to the north or south of MBP and thus does not need to use Memorial Avenue.

Summary and Conclusions

This Technical Note describes the processes used to manipulate the trip matrices provided by QTP to better reflect the traffic generation and distribution of the Memorial Business Park, and to derive the expected traffic flows on the adjacent roading network. The traffic flows used were based upon data provided by QTP, which was then revised and amended to more fully reflect the expected traffic generation of the MBP site. The calculated flows were then input into a microsimulation model to evaluate the effects on the roading network.

The results show that the roading network is able to accommodate full development of the MBP site, together with full development of both the PC83 and PC84 plan change areas.

Appendix D

Results of Further Modelling

TECHNICAL NOTE

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project	**Memorial Business Park**
to	Mark Stevenson, Christchurch City Council Andy Milne, Christchurch City Council Sarah Eveleigh, Anderson Lloyd Lawyers Andrew Mason, Memorial Avenue Investments Ltd
from	John Falconer, QTP Ltd Andy Carr, Carriageway Consulting Ltd
copies to	-
date	21 July 2014
subject	Results of Second Tranche of Modelling

Introduction

This Technical Note has been jointly produced by John Falconer and Andy Carr to set out their agreed, shared view on the results of the second tranche of modelling that has been undertaken and the potential way forward.

Methodology Adopted

At a meeting held on 11 June 2014, an approach was discussed and agreed to assess the effects of the Memorial Business Park (MBP) at intersections outside the Memorial Avenue corridor. The methodology is set out in detail in an earlier Meeting Note but in essence it involves comparing the outputs of the CAST transportation model for a 'baseline' scenario (ie no PC83, PC84 or MBP) to the model outputs for 'baseline+MBP' to identify locations where the levels of service change or are already very poor.

This analysis was carried out on behalf of the City Council by QTP.

Results

The results are set out in full in Attachment 1 (morning peak hour) and Attachment 2 (evening peak hour).

Attachment 3 is a summary of Attachments 1 and 2, and sets out the locations where Memorial Business Park can be considered to have an effect on intersection efficiency.

Results for the Johns Road / Sawyers Arms Road and Johns Road / Harewood Road intersections are not shown in Attachment 3 because it is assumed that the known issues in the future baseline at these locations will be addressed via other processes.

A number of district roads are indicated to have a poor Level of Service (mostly right turns) in the baseline, which are exacerbated by small increases in traffic resulting from MBP. For practical purposes, results are only shown where the increase in turning volumes is more than 50 vehicle movements per hour and for intersections that are within 3.5km of the site.

Discussion

Initially it had been agreed that following identification of the affected intersections, further analyses would be carried out to refine the outcomes and then if appropriate devise schemes to ensure that an improved higher level of service is provided at those locations. In practice however, after carrying out the modelling, it became apparent that further analysis would not necessarily resolve any of the following key issues that arose:

- Some intersections experience a degraded level of service due to committed land uses associated with implementation of the Land Use Recovery Plan rather than MBP. As such, it can be expected that those intersections will be upgraded, or a reduction in LoS accepted, regardless of whether MBP proceeds. Details of any improvement schemes are not yet available, but once the intersections are upgraded, the effects of the MBP may be considerably lessened at those locations.
- A number of the intersections identified are also affected by traffic generated by PC83 and/or PC84. Consequently, any improvement scheme at those locations is triggered by a combination of the Land Use Recovery Plan and those other plan changes, as well as MBP. A scheme that is suited to accommodating solely MBP traffic may not be appropriate for the higher volumes that would arise from other sources. Therefore, there is limited value in developing schemes (at this stage) that only address the effects associated with MBP, given potential for additional (cumulative) effects from other sites.
- If an intersection is identified in the baseline scenario as having reduced efficiency, this then means that the model will assign some or all of the MBP-related vehicles onto different routes. In turn this puts pressure on other parts of the road network through which those vehicles pass. However it also means that if those congested baseline intersections are upgraded (which may happen regardless of MBP) then there will be a reassignment of MBP-related vehicles. In turn this will reduce queues and delays on other parts of the road network. Overall, this means that addressing deficiencies in the baseline scenario is therefore also likely to address some of the local network issues that have been identified due to MBP.
- At priority intersections, the most significant queues and delays arise for vehicles turning right from (or to) the minor approach, and the modelling shows that this occurs at several locations as a result of MBP traffic. Having already quantified the likely scale of effects at affected intersections during the intersection identification process, further modelling is unlikely to provide any additional value.

Given these factors, we do not consider that it is worthwhile undertaking more refined modelling of the identified intersections. Rather, the current modelling is considered to be sufficient for the purpose of indicating the locations where efficiency issues ***may*** arise as a result of MBP traffic, and many useful conclusions (including those outlined above) can be drawn from the results.

Further assessment to develop potential solutions to address identified adverse effects would (in our view) best be done in conjunction with addressing effects arising from the Land Use Recovery Plan, PC83 and PC84. We consider that the assessment of MBP is now sufficiently advanced for input to this process, however until such time as an up-to-date and coordinated assessment is complete, we are unable to draw any further conclusions regarding potential locations, extent and mitigation of traffic effects.

ATTACHMENT 1: MORNING PEAK PERIOD

Intersection		Dist from Site (km)	CAST MOVEMENT			MBP				BASE				Change		QTP Comment
Name	Type		A Node	B Node	C Node	Actual (PCU/hr)	V/C	Delay (sec/veh)	LOS	Actual (PCU/hr)	V/C	Delay (sec/veh)	LOS	Flow (PCU/hr)	Delay (sec/veh)	
Memorial/Roydvale	Signals	0.6	6539	**2110**	6542	210	80	52	D	270	78	39	D	-61	13	Addressed in Microsim
Kendal/Memorial	Priority (T)	0.9	1412	**1368**	6539	58	95	159	F	81	78	78	F	-24	81	Large change in delay
Grahams/Memorial	Signals	1.7	6538	**1345**	6537	133	103	117	F	30	34	44	D	104	73	Signficant change LoS D -> LoS F
Grahams/Memorial	Signals	1.7	6538	**1345**	6536	725	91	44	D	783	61	21	A-C	-58	23	Significant change, but no worse than LoS D
Grahams/Memorial	Signals	1.7	6536	**1345**	6535	113	101	70	E	166	98	52	D	-52	19	Significant change, but no worse than LoS E
Memorial/Greers	Signals	2.2	6532	**1343**	6531	92	71	88	F	102	62	68	E	-10	21	Right turn into Memorial eastbound. Boderline LoS for signals.
Memorial/Greers	Signals	2.2	6534	**1343**	6531	150	71	50	D	147	58	40	D	3	10	Not significant, LoS D
Memorial/Greers	Signals	2.2	6534	**1343**	6532	361	83	50	D	309	71	40	D	52	10	Not significant, LoS D
Memorial/Greers	Signals	2.2	6534	**1343**	6533	102	51	54	D	65	29	43	D	37	10	Not significant, LoS D
Harewood/Waimakariri	Priority (T)	2.3	6358	**6359**	8653	124	80	60	F	129	71	43	E	-5	17	Related to Johns/Harewood capacity issue
Harewood/Watsons	Priority (T)	2.4	6357	**3782**	6355	68	49	40	E	46	25	23	A-C	22	17	Significant change, but no worse than LoS E
Harewood/Wooldridge	Priority (T)	2.4	3782	**1903**	8943	107	58	35	E	85	34	19	A-C	22	16	Significant change, but no worse than LoS E
Harewood/Wooldridge	Priority (T)	2.4	8943	**1903**	1302	58	44	39	E	63	34	25	D	-5	14	Significant change, but no worse than LoS E
Harewood/Nunweek	Priority	2.6	6434	**1302**	1903	64	46	40	E	53	26	21	A-C	11	18	Significant change, but no worse than LoS E
Crofton/Harewood	Priority	2.6	6057	**1310**	1302	65	84	112	F	106	82	73	F	-41	39	Right turn from Crofton
Harewood/Gardiners/Breens	Priority	2.8	3586	**1309**	1856	53	81	108	F	86	83	82	F	-33	26	Through & Right southbound movement giving way to increased Harewood traffic flows
Yaldhurst/Russley	Signals	2.8	7963	**1348**	7079	1480	101	89	F	1480	100	73	E	0	16	Intersection capacity issues - exacerbated by MBP
Yaldhurst/Russley	Signals	2.8	7964	**1348**	7079	331	100	135	F	331	99	120	F	0	15	Intersection capacity issues - exacerbated by MBP
Yaldhurst/Russley	Signals	2.8	7963	**1348**	7964	263	69	36	D	178	46	25	A-C	85	11	Not significant, LoS D
Yaldhurst/Withells	Priority (T)	2.8	1101	**1350**	7118	163	92	76	F	151	84	58	F	12	17	Right turn from Withells Rd, exacerbated by MBP
Masham/Kintyre	Priority (T)	3.1	7012	**3771**	7008	85	77	76	F	101	75	61	F	-15	15	Right Turn Out (this is still assumed to be enabled with 4 laning?)
Johns (SH1)/Sawyers Arms	Roundabout (2L)	3.4	8657	**1265**	5271	324	108	174	F	309	105	120	F	15	54	Known future capacity issues at this intersection, but exacerbated by MBP
Johns (SH1)/Sawyers Arms	Roundabout (2L)	3.4	8657	**1265**	8656	1847	108	170	F	1895	105	116	F	-48	54	Known future capacity issues at this intersection, but exacerbated by MBP
Johns (SH1)/Sawyers Arms	Roundabout (2L)	3.4	6356	**1265**	8657	78	101	85	F	99	97	57	E	-20	28	Known future capacity issues at this intersection, but exacerbated by MBP
Johns (SH1)/Sawyers Arms	Roundabout (2L)	3.4	6356	**1265**	5271	217	101	81	F	213	99	53	D	4	28	Known future capacity issues at this intersection, but exacerbated by MBP
Johns (SH1)/Sawyers Arms	Roundabout (2L)	3.4	6356	**1265**	8656	488	101	76	E	448	99	48	D	40	28	Known future capacity issues at this intersection, but exacerbated by MBP
Wairakei/Aorangi	Priority	3.4	3597	**1316**	6014	102	77	65	F	107	70	49	E	-5	16	Aorangi Southbound Thru, intersection sensitive to small increases in MBP traffic. Remote from site.
Yaldhurst/Brodie	Priority (T)	3.6	7150	**7147**	7973	68	70	117	F	91	75	98	F	-23	19	Intersection sensitive to small increases in MBP traffic. Remote from site.
Blighs/Windermere	Priority (T)	4.3	6085	**6083**	1656	218	89	50	E	237	85	39	E	-18	11	Not significant, LoS E
Main South/Lowther	Priority (T)	4.5	1863	**1382**	1381	190	102	146	F	218	101	118	F	-28	28	Intersection at capacity and unstable (and remote from site), not relevant
Fendalton/Idris/Straven	Signals	4.5	6519	**1340**	6518	120	93	150	F	129	92	135	F	-8	15	Intersection sensitive to small increases in MBP traffic. Remote from site.
Fendalton/Idris/Straven	Signals	4.5	6516	**1340**	6518	945	100	77	E	932	99	67	E	12	11	Not significant, LoS E
Blenheim/Curletts	Signals	4.6	7782	**1378**	7292	1007	100	96	F	994	99	85	F	13	11	Intersection sensitive to small increases in MBP traffic. Remote from site.
Fendalton/Clifford Ave	Priority (T)	5.0	2002	**6123**	6706	72	89	116	F	75	86	102	F	-4	14	Intersection sensitive to small increases in MBP traffic. Remote from site.

ATTACHMENT 2: EVENING PEAK PERIOD

Intersection		Dist from Site (km)	CAST MOVEMENT			MBP				BASE				Change		QTP Comment
Name	Type		A Node	B Node	C Node	Actual (PCU/hr)	V/C	Delay (sec/veh)	LOS	Actual (PCU/hr)	V/C	Delay (sec/veh)	LOS	Flow (PCU/hr)	Delay (sec/veh)	
MBP Eastern Access	Signals (T)	0.4	8647	**6364**	8944	274	85	59	E	53	16	23	A-C	221	36	Addressed in Microsimulation
Memorial/Roydvale	Signals	0.6	6539	**2110**	6542	85	87	147	F	135	81	83	F	-51	64	Addressed in Microsimulation
Memorial/Roydvale	Signals	0.6	6540	**2110**	6539	161	75	68	E	108	49	49	D	54	19	Addressed in Microsimulation
Memorial/Roydvale	Signals	0.6	6540	**2110**	6542	472	85	48	D	381	69	36	D	91	12	Not significant, LoS D
Grahams/Memorial	Signals	1.7	6538	**1345**	6537	105	101	77	E	64	57	47	D	41	29	Right turn from Grahams towards MPB. Bordeline LoS F for signals.
Grahams/Memorial	Signals	1.7	6537	**1345**	6536	104	74	83	F	103	65	65	E	1	18	Right turn into Grahams soutbound. Bordeline LoS F for signals.
Wairakei/Charlcott	Priority (T)	1.9	6041	**3601**	1904	143	73	41	E	139	57	25	A-C	5	16	Significant change, but no worse than LoS E
Wairakei/Farrington	Priority (T)	2.1	1905	**1904**	3593	391	95	44	E	273	61	15	A-C	118	30	Significant change, but no worse than LoS E
Wairakei/Kendal	Priority (T)	2.1	6042	**1905**	1608	159	85	57	F	145	67	34	D	14	23	Significant change LoS D -> LoS F
Memorial/Greers	Signals	2.2	6531	**1343**	6534	78	58	66	E	112	57	47	D	-33	19	Right turn into Greers Nortbound
Johns (SH1)/Harewood	Roundabout (2L)	2.3	8650	**1311**	8653	901	105	124	F	788	103	88	F	113	36	Known future capacity issues at this intersection, but exacerbated by MBP
Johns (SH1)/Harewood	Roundabout (2L)	2.3	8650	**1311**	8651	1321	105	119	F	1441	103	83	F	-120	36	Known future capacity issues at this intersection, but exacerbated by MBP
Johns (SH1)/Harewood	Roundabout (2L)	2.3	8654	**1311**	8650	104	100	53	D	96	49	33	A-C	8	20	Significant change, but no worse than LoS D
Johns (SH1)/Harewood	Roundabout (2L)	2.3	8654	**1311**	8653	640	100	47	D	494	83	27	A-C	147	20	Significant change, but no worse than LoS D
Johns (SH1)/Harewood	Roundabout (2L)	2.3	8654	**1311**	8651	488	100	42	D	549	85	21	A-C	-62	20	Significant change, but no worse than LoS D
Harewood/Waimakariri	Priority (T)	2.3	6355	**6359**	6358	67	85	115	F	81	58	46	E	-15	70	Directly related to Johns/Harewood capacity issue (secondary effect)
Harewood/Watsons	Priority (T)	2.4	1903	**3782**	6357	113	103	183	F	159	101	132	F	-46	51	Directly related to Johns/Harewood capacity issue (secondary effect)
Ryans/Grays	Priority (T)	2.5	7002	**7001**	2123	569	99	41	E	489	91	23	A-C	81	18	Significant change, but no worse than LoS E
Maidstone/Waimari	Signals	2.5	7067	**1354**	7967	157	73	48	D	80	31	30	A-C	77	18	Significant change, but no worse than LoS D
Maidstone/Waimari	Signals	2.5	7067	**1354**	7968	592	90	48	D	547	74	30	A-C	45	18	Significant change, but no worse than LoS D
Crofton/Harewood	Priority	2.6	5061	**1310**	6057	106	71	53	F	77	48	34	D	29	19	Significant change, but possible local stability issues
Grahams/Staines	Priority (T)	2.7	6046	**3591**	6513	93	60	41	E	154	56	22	A-C	-61	19	Significant change, but no worse than LoS E
Memorial/Ilam	Signals	2.7	6529	**1833**	6528	126	77	78	E	113	69	67	E	13	11	Not significant
Yaldhurst/Cutts	Priority (T)	2.7	7083	**1349**	1332	57	96	173	F	32	72	147	F	26	26	Right turn out of Cutts. Sensitive to small increase in MBP traffic.
Harewood/Gardiners/Breens	Priority	2.8	1856	**1309**	3586	100	96	130	F	102	91	100	F	-2	30	Through & Right northbound movement giving way to increased Harewood traffic flows
Yaldhurst/Russley	Signals	2.8	7079	**1348**	7963	1364	103	127	F	1364	100	83	F	0	44	Intersection capacity issues - exacerbated by MBP, borderline LoS F
Yaldhurst/Russley	Signals	2.8	7079	**1348**	7964	806	101	45	D	819	100	29	A-C	-13	15	Significant change, but LoS D
Yaldhurst/Russley	Signals	2.8	7963	**1348**	7964	390	96	87	F	378	93	73	E	12	14	Intersection capacity issues - exacerbated by MBP
Grahams/Greers	Signals	2.9	5042	**1596**	1560	215	97	84	F	331	97	66	E	-116	18	Right turn into Grahams exacerbated by MBP. LoS E
Yaldhurst/Racecourse	Priority (T)	3.0	1350	**1101**	2316	221	103	159	F	248	100	95	F	-26	64	Right Turn into Racecouse Rd giving way to increased traffic on Yaldhurst.
Yaldhurst/Racecourse	Priority (T)	3.0	2316	**1101**	1350	352	94	43	E	327	87	32	D	25	12	Significant change, but no worse than LoS E
Greers/Condell	Priority (T)	3.1	3596	**1560**	1855	58	56	58	F	55	46	44	E	3	13	Not significant
Avonhead/Yaldhurst	Signals (T)	3.2	3719	**1356**	7156	401	99	114	F	376	93	78	E	24	36	Right turn from Avonhead. Could be given more greentime (sufficient capacity exists)
Yaldhurst/Middlepark	Signals (T)	3.2	7977	**1809**	7165	160	94	125	F	159	85	78	E	1	47	Right turn into Middleton … more greentime could be given (sufficient capacity exists).
Ilam/University	Priority (T)	3.3	7184	**7180**	7181	117	84	44	E	111	62	22	A-C	6	22	Significant change, but no worse than LoS E
Johns (SH1)/Sawyers Arms	Roundabout (2L)	3.4	8656	**1265**	6356	182	108	172	F	333	105	123	F	-150	49	Known future capacity issues at this intersection, but exacerbated by MBP
Johns (SH1)/Sawyers Arms	Roundabout (2L)	3.4	8656	**1265**	8657	1688	108	168	F	1710	105	118	F	-22	49	Known future capacity issues at this intersection, but exacerbated by MBP
Johns (SH1)/Sawyers Arms	Roundabout (2L)	3.4	5271	**1265**	6356	296	104	126	F	270	101	89	F	26	37	Known future capacity issues at this intersection, but exacerbated by MBP
Johns (SH1)/Sawyers Arms	Roundabout (2L)	3.4	5271	**1265**	8657	252	104	122	F	223	101	85	F	29	37	Known future capacity issues at this intersection, but exacerbated by MBP
Johns (SH1)/Sawyers Arms	Roundabout (2L)	3.4	5271	**1265**	8656	62	104	131	F	73	101	94	F	-11	37	Known future capacity issues at this intersection, but exacerbated by MBP
Wairakei/Aorangi	Priority	3.4	3597	**1316**	6014	74	64	58	F	73	52	41	E	1	17	Not significant (and remote from site)
Wairakei/Aorangi	Priority	3.4	6014	**1316**	3597	68	72	73	F	81	72	62	F	-13	11	Not significant (and remote from site)
Yaldhurst/Curletts	Signals	3.7	7973	**1355**	7969	572	97	73	E	557	93	54	D	15	18	Not significant, LoS E
Yaldhurst/Curletts	Signals	3.7	7972	**1355**	7973	85	74	95	F	78	64	79	E	7	16	Intersection sensitive to small increases in MBP traffic. Remote from site.
Fendalton/Clyde	Signals	3.7	6523	**2098**	6526	92	78	105	F	111	75	84	F	-19	22	Right turn into Clyde northbound, must giveway to increased Memorial traffic
Fendalton/Clyde	Signals	3.7	6523	**2098**	6525	1065	100	84	F	1038	97	66	E	27	18	Right turn into Clyde northbound. Bordeline LoS F for signals.
Fendalton/Clyde	Signals	3.7	6526	**2098**	6525	95	51	55	D	66	30	43	D	29	12	Not significant, LoS D
Yaldhurst/Angela	Priority (T)	3.8	7154	**5093**	7971	53	56	62	F	61	53	50	F	-7	12	Not significant (and remote from site)
Riccarton/Curletts	Signals	3.9	7970	**1380**	7976	265	97	102	F	258	94	83	F	7	19	Right turn into Riccarton westbound. Remote from site.
Yaldhurst/Brake	Priority (T)	3.9	7152	**7151**	5093	64	59	57	F	82	60	46	E	-17	11	Not significant (and remote from site)
Wairakei/Ilam	Priority	3.9	3524	**1319**	6115	73	72	74	F	93	73	62	F	-20	12	Not significant (and remote from site)
Clyde/Creyke/Kotare	Signals	3.9	7985	**1359**	7984	163	77	66	E	213	72	48	D	-50	17	Intersection at capacity and unstable (and remote from site), not relevant
Clyde/Creyke/Kotare	Signals	3.9	7984	**1359**	7987	104	83	107	F	112	79	90	F	-8	17	Intersection at capacity and unstable (and remote from site), not relevant
Clyde/Creyke/Kotare	Signals	3.9	7986	**1359**	7984	691	94	52	D	658	90	41	D	33	11	Not significant (and remote from site)
Riccarton/Hansens Lane	Priority (T)	4.0	7980	**1057**	3762	281	81	44	E	242	67	31	D	39	13	Significant change, but no worse than LoS E, Remote from site

Fendalton/Glandovey	Signals (T)	4.0	6521	**1084**	6522	89	80	110	F	97	77	91	F	-8	19 Right turn into Glandovey opposed by increased eastbound traffic on Fendalton.
Clyde/University Drive	Priority (T)	4.1	7187	**3928**	7198	143	86	64	F	170	81	45	E	-27	19 Intersection sensitive to small increases in MBP traffic. Remote from site.
Riccarton/Watts	Priority (T)	4.1	1379	**1413**	1810	79	93	126	F	84	89	107	F	-5	19 Intersection sensitive to small increases in MBP traffic. Remote from site.
Kotare/Weka	Priority (T)	4.2	7196	**3750**	1185	202	92	62	F	251	92	51	F	-49	11 Not significant (and remote from site)
Clyde/Kirkwood	Priority (T)	4.2	7177	**1825**	1826	94	73	49	E	86	63	34	D	8	16 Significant change, but no worse than LoS E, Remote from site
Clyde/Kirkwood	Priority (T)	4.2	7177	**1825**	7198	57	37	41	E	91	40	27	D	-35	14 Significant change, but no worse than LoS E, Remote from site
Blenheim/Watts	Priority	4.5	7450	**1379**	1413	146	96	99	F	148	93	83	F	-3	16 Intersection at capacity and unstable (and remote from site), not relevant
Blenheim/Watts	Priority	4.5	1413	**1379**	7450	155	101	126	F	161	99	112	F	-6	14 Link capacity issue - model sensitive to small changes
Main South/Lowther	Priority (T)	4.5	1863	**1382**	1381	157	106	238	F	185	106	218	F	-28	20 Intersection at capacity and unstable (and remote from site), not relevant
Fendalton/Idris/Straven	Signals	4.5	6517	**1340**	6516	66	62	83	F	70	58	72	E	-4	11 Not significant (and remote from site)
Kotare/Kahu	Priority	4.5	7203	**1187**	2137	203	95	74	F	241	93	57	F	-38	18 Intersection sensitive to small increases in MBP traffic. Remote from site.
Blenheim/Curletts	Signals	4.6	7782	**1378**	7292	960	103	145	F	960	102	129	F	0	17 Intersection at capacity and unstable (and remote from site), not relevant
Blenheim/Curletts	Signals	4.6	7292	**1378**	7782	864	104	180	F	864	103	166	F	0	14 Intersection at capacity and unstable (and remote from site), not relevant
Blenheim/Curletts	Signals	4.6	7700	**1378**	7292	416	99	118	F	409	97	107	F	7	11 Intersection at capacity and unstable (and remote from site), not relevant
Blenheim/Hansens Lane	Signals	4.8	7266	**1377**	7700	323	91	95	F	306	86	81	F	17	13 Intersection at capacity and unstable (and remote from site), not relevant
Blenheim/Annex	Signals	4.8	7255	**1376**	1838	209	87	87	F	202	82	72	E	7	14 Not significant (and remote from site)
Straven/Boys High	Priority (T)	4.9	7210	**3749**	7209	81	86	101	F	85	82	85	F	-4	16 Not significant (and remote from site)

ATTACHMENT 3: SUMMARY OF ATTACHMENTS 1 AND 2 (LOCATIONS WHERE MBP MAY CREATE EFFICIENCY ISSUES)

Intersection		Dist from Site (km)	Peak Period	CAST MOVEMENT			MBP				BASE				Change	
Name	Type			A Node	B Node	C Node	Actual (PCU/hr)	V/C	Delay (sec/veh)	LOS	Actual (PCU/hr)	V/C	Delay (sec/veh)	LOS	Flow (PCU/hr)	Delay (sec/veh)
Kendal/Memorial	Priority (T)	0.9	AM	1412	**1368**	6539	58	95	159	F	81	78	78	F	-24	81
Grahams/Memorial	Signals	1.7	AM	6538	**1345**	6537	133	103	117	F	30	34	44	D	104	73
Grahams/Memorial	Signals	1.7	PM	6537	**1345**	6536	104	74	83	F	103	65	65	E	1	18
Wairakei/Kendal	Priority (T)	2.1	PM	6042	**1905**	1608	159	85	57	F	145	67	34	D	14	23
Crofton/Harewood	Priority	2.6	AM	6057	**1310**	1302	65	84	112	F	106	82	73	F	-41	39
Yaldhurst/Cutts	Priority (T)	2.7	PM	7083	**1349**	1332	57	96	173	F	32	72	147	F	26	26
Harewood/Gardiners/Breens	Priority	2.8	AM	3586	**1309**	1856	53	81	108	F	86	83	82	F	-33	26
Harewood/Gardiners/Breens	Priority	2.8	PM	1856	**1309**	3586	100	96	130	F	102	91	100	F	-2	30
Yaldhurst/Russley	Signals	2.8	AM	7963	**1348**	7079	1480	101	89	F	1480	100	73	E	0	16
Yaldhurst/Russley	Signals	2.8	AM	7964	**1348**	7079	331	100	135	F	331	99	120	F	0	15
Yaldhurst/Russley	Signals	2.8	PM	7079	**1348**	7963	1364	103	127	F	1364	100	83	F	0	44
Yaldhurst/Russley	Signals	2.8	PM	7963	**1348**	7964	390	96	87	F	378	93	73	E	12	14
Yaldhurst/Withells	Priority (T)	2.8	AM	1101	**1350**	7118	163	92	76	F	151	84	58	F	12	17
Yaldhurst/Racecourse	Priority (T)	3.0	PM	1350	**1101**	2316	221	103	159	F	248	100	95	F	-26	64
Avonhead/Yaldhurst	Signals (T)	3.2	PM	3719	**1356**	7156	401	99	114	F	376	93	78	E	24	36
Yaldhurst/Middlepark	Signals (T)	3.2	PM	7977	**1809**	7165	160	94	125	F	159	85	78	E	1	47

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