Scoping Study
SH1 & SH62 Spring Creek Intersection

Report prepared for

NZTA

ViaStrada Ltd

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Executive Summary

This report examines options for the SH1 / SH62 intersection in Spring Creek north of Blenheim that will address an existing high crash rate.

The cross intersection has various challenges, including a very high percentage of heavy commercial vehicles, a compromised layout, and land use that generates pedestrian demand that is not supported by crossing facilities. A rail line parallel to SH1 with insufficient offset to the state highway and a mix of give way and stop control add to the complexity.

Various data sources were analysed for this assessment, including traffic growth, turning movement data, and rail schedules. A significant constraint is the rail loop just north of this intersection, which results in periods where the level crossing is closed to traffic and visibility is compromised.

Five main options for a modified intersection have been developed and compared using a multi-criteria analysis. Only the standard roundabout option is to be investigated further in the next project stage, as all other options had significant weaknesses. An economic analysis was carried out for a full pavement reconstruction and a pavement overlay, with the latter construction option achieving a higher BCR of 5.6 based on 1.9% traffic growth.

The standard roundabout option will now be taken forward to the next project stage.

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1 Project Brief

NZTA has engaged ViaStrada to prepare a scoping study report that identifies the best option to progress to the design and construction phase that will reduce the potential of fatal and serious injuries at the intersection while maintaining a suitable level of service for traffic on the national strategic SH1S. It is intended that this scoping report will form part of the scheme assessment report for the project. Following the scheme assessment report and subject to NZTA funding approval, the project will progress to the design and construction phases.

There have been several previous reports for this intersection including

- TPC Road Safety Review January 2011,
- OPUS Project Feasibility Report September 2010,
- MDC statement of proposal report Marlborough Growth & Development report pages 69 to 75.

These reports have been referenced to give historical information and previous options development context to the project.

2 Site description

Figure 1: Site layout

The site is located approximately 5 km north of Blenheim at the intersection of Rapaura Road (SH62) and Ferry Road with SH1. SH1 runs almost directly north-south at this location. The surrounding land use is a mix of residential, agricultural and commercial. North east of the intersection is an area of light industrial businesses including Kiwirail's Blenheim Freight Centre. SH1 is a two lane highway with 3.5 m traffic lanes north and south of the intersection. The main south railway line runs on the eastern side of the State Highway, with the centre of the track approximately 10.5 m from the southbound lane edge line.

SH1 has a 70 km/h speed limit through the intersection reduced from 80 km/h in March 2011. The speed limit of 70 km/h is physically identified with standard rural to residential speed thresholds located 300 m south (see Figure 2) and north (see Figure 3) of Spring Creek, respectively.

Figure 2: South speed threshold looking north

Figure 3: North speed threshold looking south

Approaching the intersection from the south, the SH features a 150 m long left turn lane leading into a uncontrolled left turn slip lane, a through lane, and a right turn bay with a 40 m storage length. North of Rapaura Road, there is a wide shoulder lane marked with chevrons, this lane is used as an acceleration and merge lane for slower vehicles (see Figure 4) however, under MOTSAM this is not permitted. It was also noted on site that several vehicles, including HCVs use this as a parking lane too.

Figure 4: left turn acceleration lane northbound

Approaching the intersection from the south, the SH features a 70 m long left turn bay leading to a give way controlled left turn slip lane, a through lane and a right turn bay with a 55 m storage length. South of Ferry Road, a 130 m acceleration and merge lane is provided for vehicles turning left from Ferry Road, with markings generally in compliance with MOTSAM.

Rapaura Road (SH62) is a two lane rural road that intersects from the west at an angle of 60 degrees to SH1 and features a narrow median island at the intersection. A stop control is placed against Rapaura Road at the intersection.

Ferry Road is a long straight two lane residential road and intersects from the east at an angle of 54 degrees to SH1. There is an exit slip lane provided for left turning vehicles. A give way control is placed against Ferry Road at the intersection with SH1. The main south rail line crosses Ferry Road 10.5 m from its intersection with SH1 and the level crossing features bells and lights but not barrier arms. The raised islands that protect the rail hardware are considered too small for the heavy commercial vehicle use in this location and they provide no pedestrian amenity.

A dairy, a service station and a two storey hotel are located in the south west corner of the intersection with some parking available in a service lane beside the SH. A Four Square supermarket and associated car parking is located on the northwest corner of the intersection. The north east and south east corners comprise the rail corridor and as such are free of buildings, however, there is a backpackers hostel located on the southern side of Ferry Road next to the rail corridor.

3 Problem description

This state highway intersection at Spring Creek (State Highway SH1 and SH62 Rapaura Road and Ferry Road; refer Figure 1) has a complex mix of different road users. There is a high percentage of heavy commercial vehicles (HCVs) associated with the Kiwirail operation at the Blenheim freight centre, many visitors and tourists in larger camper vehicles use this intersection to access the coast roads of Port Underwood, Rarangi and Whites Bay and there is seasonal use associated with forestry and the vineyards, which can also involve slow moving agricultural vehicles. Combined with these users are the commuters that routinely use the intersection during the AM, noon and PM peak hours. There is also some commercial activity at the intersection, which creates a pedestrian crossing desire, but there are no crossing facilities provided.

There have been 18 crashes recorded in the Crash Analysis System (CAS) within 50 m of the intersection in the 5 year period between 2008 and 2012. Of these crashes, 13 have involved vehicles undertaking a turning manoeuvre, one was a rear end collision and the remaining 4 have been loss of control crashes involving a single vehicle. Further details of the crashes are included in Section 5.3. A brief look at the ten year crashes is also included in Section 5.3.4 to explore longer term trends and any changes in crash occurrence.

Rapaura Road and Ferry Road intersect with SH1 at angles of 60 degrees and 54 degrees respectively, which restricts the visibility to approaching drivers. Austroads Guide to Road Design Part 4A Un-signalised and Signalised intersections Figure 6.3 shows the minimum recommended entry angle as 70 degrees. Therefore any re-design of the existing at-grade intersection should have an approach angle of not less than 70 degrees.

Visibility issues are compounded for vehicles exiting Ferry Road by the proximity of the rail line to the State Highway and the limited stacking space between the rail line and the limit line. Several drivers of large trucks were observed making their decision to enter the intersection from the eastern side of the rail line, some 20 m back from the limit line.

To the south of the intersection, SH1 makes a 7 degree deviation towards the east; this can be seen in Figure 1. As a result of this deviation, vehicles waiting in the northbound right turn bay obscure the inter-visibility between northbound through vehicles and vehicles in the southbound right turn bay waiting to turn into Rapaura Road (SH62).

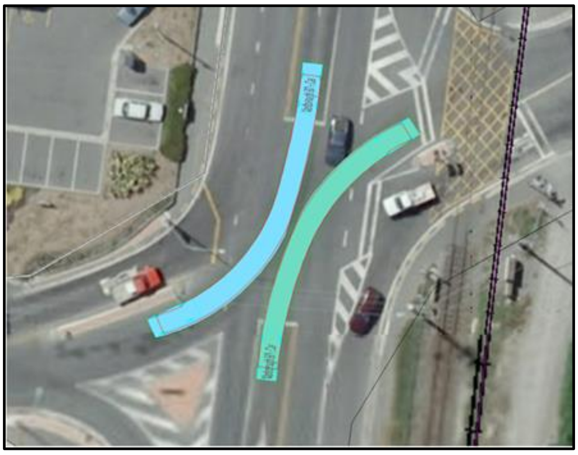


Figure 5: Right turning car swept paths

Figure 6: Right turning HCV & car swept paths

Another safety issue that results from the angled approaches of Rapaura Road and Ferry Road is the location of the limit lines of both SH right turn bays. As can be seen in Figure 5 and Figure 6, to allow the through movement of vehicles across the intersection, the right turn bay limit lines are set over 10 m back from the side road. This results in turning vehicles, particularly larger trucks, having to travel a considerable distance and time to clear the intersection. The setback right turn bays also allow an approaching SH1 vehicle to enter the bay and wait at the limit line while a side road vehicle is completing a right turn exit manoeuvre.

In the event of vehicles turning from the northbound and southbound right turn bays at the same time, then one or both vehicles are required to travel in a contra-flow direction in the traffic lane to complete the manoeuvre. As shown in Figure 6 this is exacerbated if one of the turning vehicles is a large truck such as a semi-trailer.

The layout has Ferry Road under a Give Way control and Rapaura Road is under a Stop control. This can lead to crashes with some drivers being aware that Ferry Road traffic has priority over Rapaura Road, as visitors and infrequent users of the intersection are unlikely to be aware of this.

The Spring Creek intersection has a low presence on the state highway network. It is not a small rural town and drivers may not expect pedestrians here. It is understood that the police regularly enforce the stop sign on Rapaura Road based on their observation that pedestrians crossing the north approach are vulnerable to left turn drivers looking to their right while making this turn, without stopping.

4 Concept plan development

The concept plans have been developed on aerial photographs with Terralink boundary information overlaid. ViaStrada has endeavoured to make sound concept design decisions on what will work safely and efficiently, based on site knowledge from two site visits and referencing crash records.

4.1 Disclaimer

The scheme plans are developed to a stage where we are confident they can fit physically into the available space as shown. There will still be a detailed design component required to confirm the final lengths of acceleration, merge and diverge tapers. All of the scheme proposals are based on Austroads minimum design requirements, and it is acknowledged that the concept designs may be 'tweaked' to minimise land required and to achieve possible cost savings. However, ViaStrada would suggest that NZTA insist on the minimum design standard and involve ViaStrada in any concept changes.

5 Collected traffic data

This project requires the collection of road traffic data and rail traffic data. This has been done to identify trends, peak hour times and possible conflict days and times between peak road and rail users.

5.1 Road traffic

5.1.1 Growth

The traffic growth on SH1 at the Opawa River Bridge (NZTA Site 18 RP 8.871) Figure 7 shows a fairly flat ten year period of traffic growth between 1992 and 2001. There is a sharp rise between 2001 and 2003 followed by slow increase up to 2007 with a general decline in volumes to 2012.

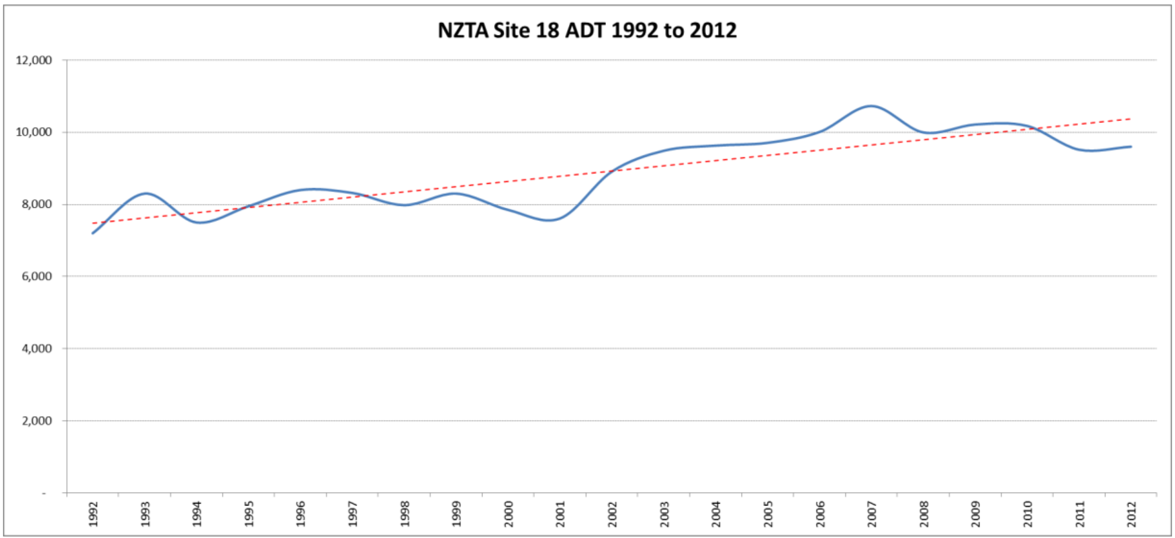


Figure 7: Traffic growth on SH1 Blenheim

The red dotted trend line in Figure 7 indicates an annual average linear growth rate of 1.93% over the twenty year period. It is noted that the traffic volumes since 2006 have been more or less static.

5.1.2 Daily volumes

The traffic volumes have been analysed from the NZTA traffic count Site [01S00026 Opawa] for March 2013. This is a 24 hour count site and volumes have been averaged over the month to give mid-week and weekend traffic flow profiles. The traffic flow profile in Figure 8 provides information to identify the mid-week peak hours and the weekend peak hour.

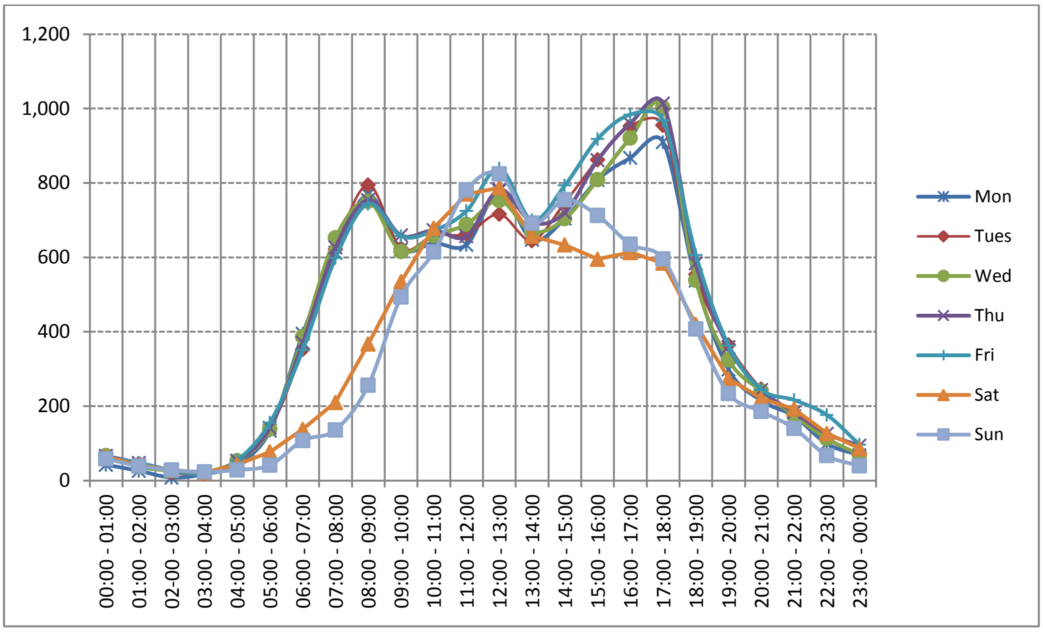


Figure 8: Daily traffic flow profile March 2013

5.1.3 Peak hour

The survey period and peak hour traffic flow times identified are shown in Table 1. The two hour survey period was used to allow the actual peak hour to be identified.

Table 1: Survey times

Survey	Survey period	Peak hour
Mid-week AM	07:30 to 09:30	7:45 to 8:45
Mid-week noon	11:30 to 13:30	11:30 to 12:30
Mid-week PM	16:00 to 18:00	16:30 to 17:30
Saturday	11:15 to 13:15	11:45 to 12:45
Sunday	11:15 to 13:15	11:30 to 12:30

5.1.4 Turning counts

To allow an effective design analysis for this intersection, detailed turning and classification counts are required. The LowDown traffic counting company has provided AM, noon and PM peak hour traffic counts to inform geometric and lane decisions. Because this is also a recognised tourist node and there is a significant amount of commercial traffic operating 24/7, a turning count during the weekend mid-day peak hours has also been undertaken and included in the analysis.

The location of the camera and orientation of the road labels used in the turning count surveys are shown in Figure 9.

Direction Labels

Direction	Leg Name	One-Way
N	SH1 Southbound	No
E	Ferry Rd	No
S	SH1 Northbound	No
W	Rapaura Rd	No

Figure 9: Traffic survey camera setup

5.1.5 AM peak hour

The mid-week 7:45 to 8:45 AM peak hour traffic survey volumes are shown in Figure 10. There is an exceptionally high percentage of HCVs recorded on Rapaura Road and northbound on the state highway heading towards Picton. The mid-week AM two hour traffic survey recorded 13 pedestrians and 3 cyclists outside of the peak hour.

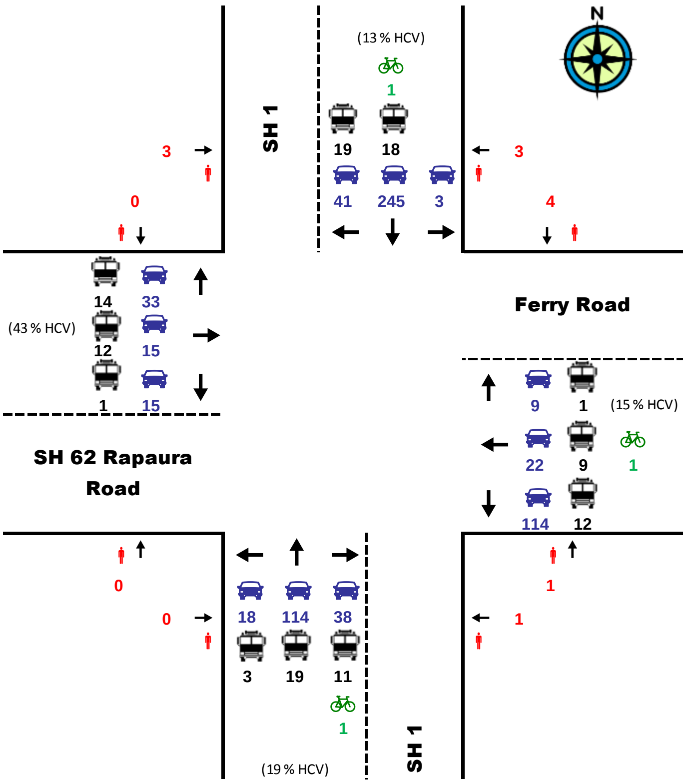


Figure 10: AM peak hour turning count

5.1.6 Noon Peak hour

The mid-week 11:30 to 12:30 noon peak hour traffic survey volumes are shown in Figure 11. Again, there is an exceptionally high percentage of HCVs recorded on Rapaura Road, Ferry Road and southbound on the state highway. No cyclists were recorded during the full two hour survey and no pedestrians were recorded outside of the peak hour.

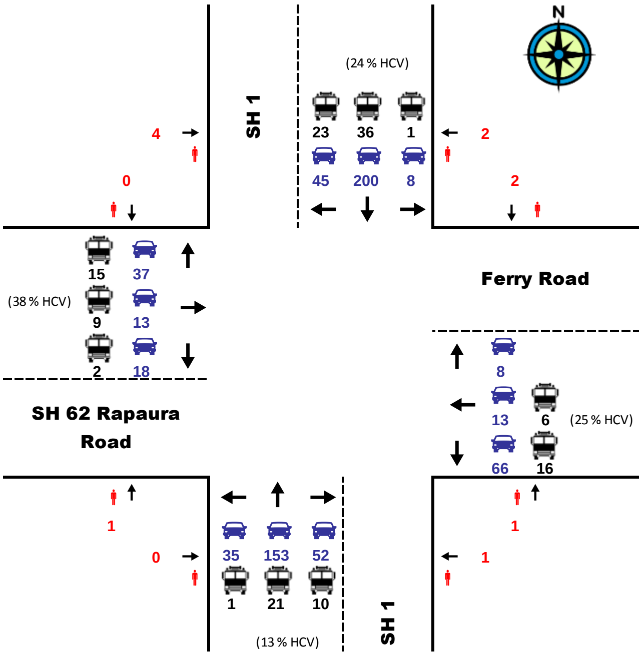


Figure 11: Noon turning count

5.1.7 PM peak hour

The mid-week 16:30 to 17:30 PM peak hour traffic survey volumes are shown in Figure 12. There is a high percentage of HCVs recorded on Ferry Road. Only one cyclist and no pedestrians were recorded during the full two hour survey.

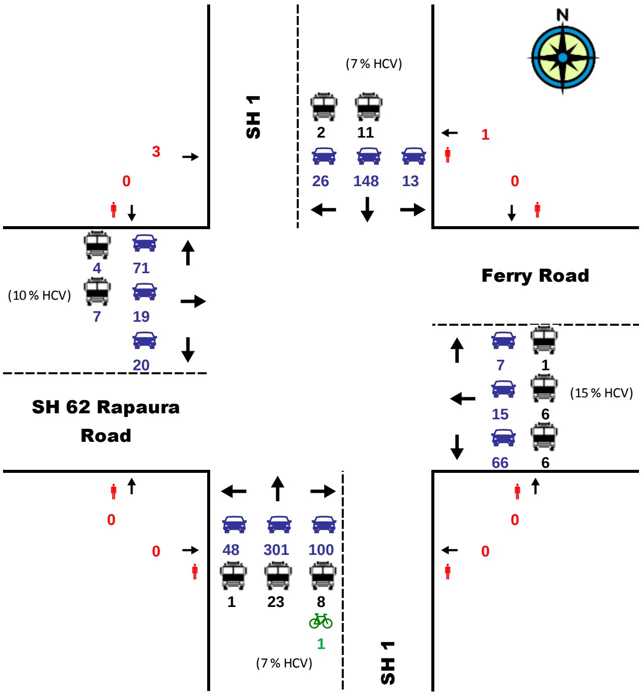


Figure 12: PM peak hour turning count

5.1.8 Saturday peak hour

The Saturday 11:45 to 12:45 peak hour traffic survey volumes are shown in Figure 13. The percent of HCVs on Saturday remains high particularly on Rapaura Road and southbound on the state highway. Three pedestrians and two cyclists were recorded outside of the peak hour. The percentage of HCVs remains high on Rapaura Road and southbound on the state highway.

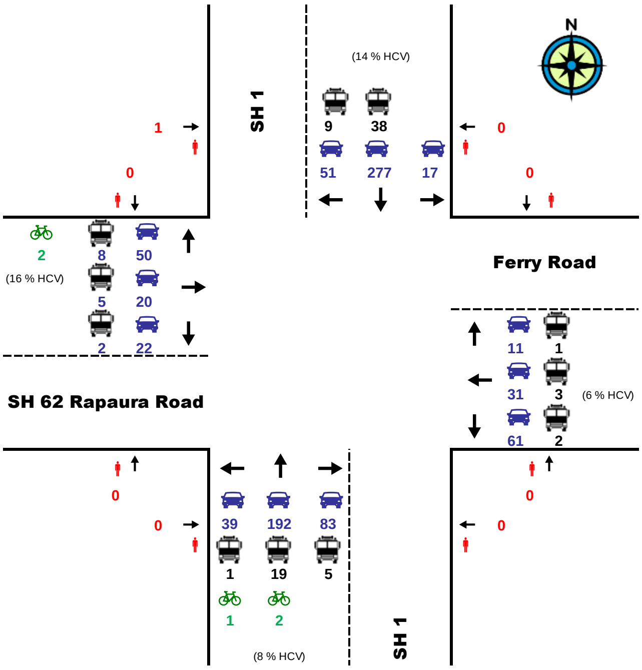


Figure 13: Saturday peak hour turning count

5.1.9 Sunday peak hour

The Sunday peak 11:30 to 12:30 hour volumes are shown in Figure 14. The southbound percent of HCVs remains high.

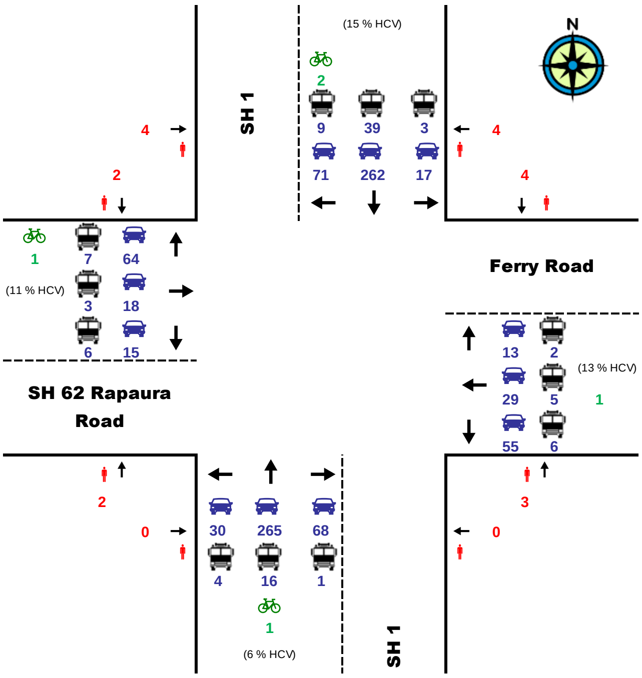


Figure 14: Sunday peak hour turning count

There are cyclists recorded on all approaches but there are low pedestrian volumes during the peak hour. There were fifteen pedestrians and three cyclists recorded outside of the peak hour survey.

5.1.10 Summary of turning counts

It is noted that Spring Creek has weekend volumes that are slightly higher than mid-week volumes as shown in Table 2. The higher weekend traffic flow is reflective of a tourist location, but there is also very high commercial activity associated with the rail freight centre, the seasonal agricultural and horticultural activity and the intersecting state highways.

Table 2: Summary of peak hour totals

Day	Peak	Light Vehicles	HCVs	Percent	Peak hour totals
Mid-week	**AM**	667	119	18%	786
	Noon	648	140	22%	788
	PM	834	69	8%	903
Saturday		854	93	11%	947
Sunday		907	101	11%	1,008

5.2 Kiwirail traffic

The Blenheim Freight Centre at Spring Creek is a transport interchange between road and rail. The rail operations include a 900 m loop track or double rail line that allow trains to shunt off the main line and be loaded or unloaded or access the various sidings. This operation introduces periods of trains slowing and shunting across the Ferry Road intersection.

5.2.1 Weekly rail schedules

Kiwirail has provided its rail schedules for a week for the rail link between Wellington and Christchurch. The schedule shows the freight and passenger trains, their direction, and times they are scheduled to pass through Spring Creek. The schedules do not show ‘specials’ which are non-routine maintenance and / or inspection rail vehicles and like all things are subject to change over time.

5.2.2 Tuesday rail schedule

The rail schedule for Tuesday is shown in Figure 15. Time is shown on the horizontal axis, and distance is shown on the vertical axis, respectively. The location of Spring Creek is shown as a green horizontal dashed line. The rail schedules are shown as angled lines with the dark blue lines being passenger trains and the light blue lines representing freight trains. The lines indicate direction of travel and route times. The times when trains stop at Spring Creek are shown with a short horizontal line at Spring Creek. The periods of trains stopping at Spring Creek are identified with a red ellipse.

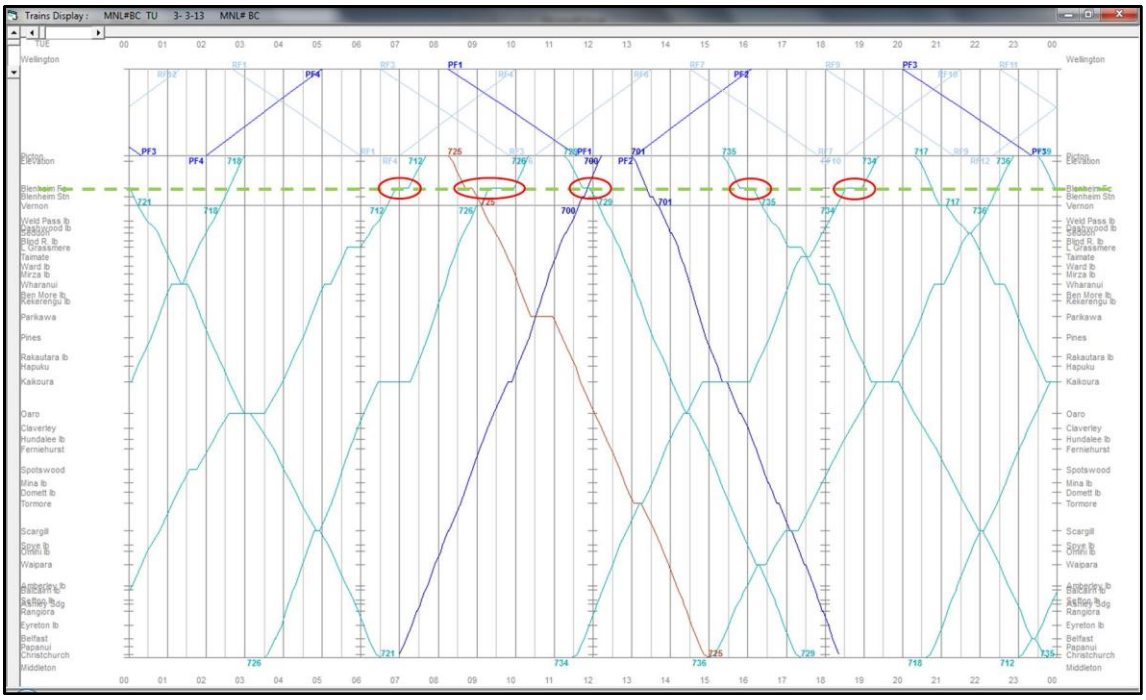


Figure 15: Tuesday rail schedule

The mid-week peak hour road traffic flows are shown as red rectangles in Figure 16. This is overlaid with the times that trains are expected to slow down or stop (shown as red ellipses) at Spring Creek from the rail schedules. This allows the identification of conflict times where peak road traffic volumes coincide with rail delays, causing additional stress at this intersection.

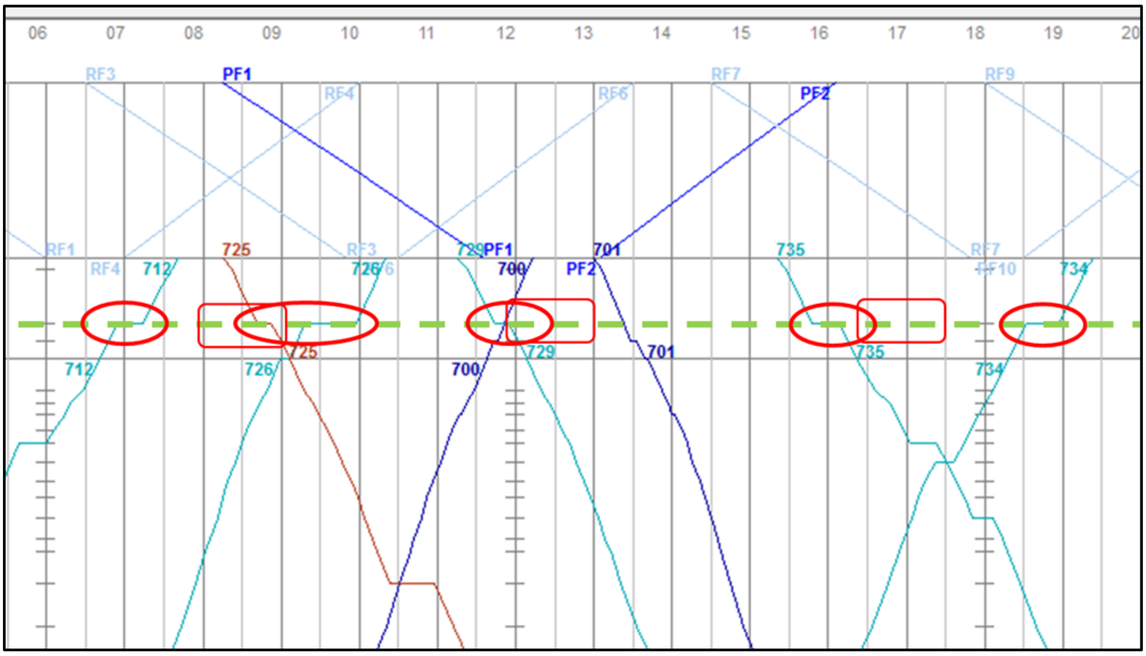


Figure 16: Tuesday rail & traffic conflict times

The Figure 15 rail schedule graph for Tuesday has been enlarged in Figure 16 to show the time period 5:30AM to 8:00PM. There is overlap in the morning peak hour for road traffic and train 725. Note that the horizontal train line 726 between 9:15AM and 10:00AM at Spring Creek (shown with the dashed green line) shows a 45 minute period of parking or shunting associated with the Blenheim freight Centre at Spring Creek (location shown as green dashed line on graph).

5.3 Crash analysis

5.3.1 Five year crash history

For crash analysis, NZTA requires an assessment of crashes over the last five years to identify trends, patterns, commonality and changes over this period. This timeframe also eliminates 'one off' events that can skew data over a shorter time period. The crashes over a longer 'ten year' period are investigated in section 5.3.5 to look at longer term trends, costs and consequences from changes to the built environment.

There have been 23 crashes (see Figure 17) recorded in the Crash Analysis System (CAS) within 50 m of the intersection in the 5 year period between 2008 and 2012. Of these crashes, 16 are considered to be associated with the intersection and of those, 13 (81%) have involved vehicles making a turning manoeuvre. Of the remaining three crashes, one was a rear end collision caused by not slowing adequately for a turning vehicle and two have been loss of control crashes involving a single vehicle.

There is a total of 1 fatal crash, 2 serious crashes, 7 minor injury crashes and 6 non-injury crashes at the intersection.

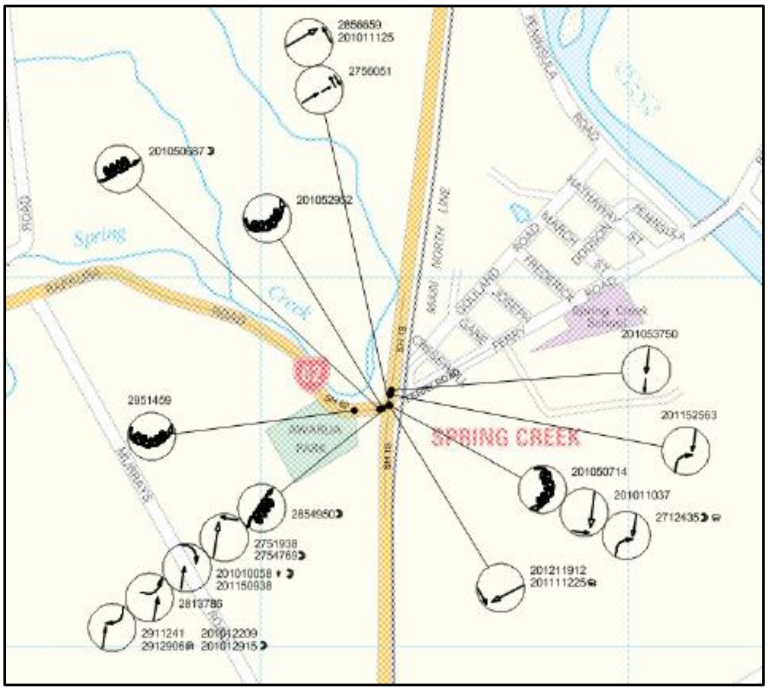


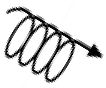
Figure 17: Spring Creek crash diagram

As can be seen in Figure 17 the south approach to the intersection has the highest number of crashes and this approach also has the most severe crashes.

5.3.2 Five year crash summary

The sixteen crashes have been grouped into their crash types and their numbers against crash severity. This identifies crash commonality which isolates problems at the intersection which informs mitigation measures.

Table 3: Crash summary

				Crash severity			
Symbol	Crash Type	Description	No	Fatal	Serious	Minor	Non-injury
	LB	Crossing / Turning making turn	5		1	3	1
	HA	Crossing / Turning right angle	5			4	1
	JA	Crossing / Turning right turn right side	2	1			1
	KA	Crossing / Turning left turn in	1		1		
	FA	Rear end obstruction slow vehicle	1				1
	C & D	Loss of control various	2				2
Crash totals by severity			**16**	**1**	**2**	**7**	**6**

The five LB crashes (1 serious, 3 minor and 1 non-injury) are failure to give way that can be a consequence of right turning drivers not being able to see approaching through traffic due to opposed queued vehicles and curved SH alignment plus being exposed for a long period of time to cover the right turn distance.

The five HA crashes (4 minor and 1 non-injury) are failure to give way that can be a consequence of approach angle, poor intervisibility plus being exposed for a long period of time to cover the crossing distance.

5.3.3 Five year crash information

The following Table 4 shows the crash types and descriptions from the CAS database for the five year period 2008 to 2012 used in this analysis.

Table 4: CAS data

Crash ID	Description	Causes
201012209 Minor LB	CAR2 turning right hit by oncoming CAR1 NBD on SH 1S	CAR1 failed to give way when turning to non-turning traffic, attention diverted by scenery or persons outside vehicle CAR2 failed to give way when turning to non-turning traffic, attention diverted by scenery or persons outside vehicle
201152563 Non-injury LB	CAR2 turning right hit by oncoming VAN1 SBD on SH 1S	CAR2 failed to give way when turning to non-turning traffic, inattentive, didn't see/look when required to give way to traffic from another direction ENV: entering or leaving other commercial
2911241 Minor LB	BUS2 turning right hit by oncoming CAR1 NBD on SH 1S	BUS2 failed to give way when turning to non-turning traffic, attention diverted by scenery or persons outside vehicle, didn't see/look when required to give way to traffic from another direction
2912906 Minor LB	CAR2 turning right hit by oncoming CAR1 NBD on SH 1S	CAR2 failed to give way when turning to non-turning traffic
201012915 Serious LB	SUV2 turning right hit by oncoming CAR1 NBD on SH 1S	SUV2 failed to give way when turning to non-turning traffic, misjudged speed etc… of vehicle coming from another direction with right of way
2856659 Non-injury HA	CAR1 EBD on SH 62 hit CAR2 crossing at right angle from right	CAR1 failed to give way at stop sign, didn't see/look when required to give way to traffic from another direction
201211912 Minor HA	CAR1 SBD on FERRY ROAD hit CAR2 crossing at right angle from right	CAR1 failed to give way at give way sign, attention diverted by other traffic
201111225 Minor HA	CAR1 WBD on FERRY ROAD hit SUV2 crossing at right angle from right, CAR1 hit House Or Bldg	CAR1 failed to give way to traffic approaching/crossing from the right, overseas/migrant driver failed to adjust to NZ road rules and road conditions
201011125 Minor HA	CAR1 EBD on SH 62 RAPAURA ROAD hit SUV2 crossing at right angle from right	CAR1 alcohol test above limit or test refused, failed to give way at stop sign SUV2 alcohol test above limit or test refused
201011037 Minor HA	CAR1 SBD on SH 1S hit VAN2 crossing at right angle from right	VAN2 did not stop at stop sign, misjudged speed etc… of vehicle coming from another direction with right of way, new driver showed inexperience
201010058 Fatal JA	TRUCK1 NBD on SH 1S hit TRUCK2 turning right onto SH 1S from the left, TRUCK1 hit Guard Rail, TRUCK2 hit Post or Pole	TRUCK2 alcohol test above limit or test refused, did not stop at stop sign, attention diverted by cell phone, fatigue (drowsy, tired, fell asleep), casualty thrown from vehicle
201150938 Non-injury	SUV1 NBD on SH 1S hit VAN2 turning right onto SH	VAN2 failed to give way at stop sign, didn't see/look when required to give way to traffic from another direction, overseas/migrant driver failed to

Crash ID	Description	Causes
JA	1S from the left	adjust to NZ road rules and road conditions
2813786 Serious KA	SUV1 NBD on SH 1S hit CAR2 merging from the left	CAR2 failed to give way at stop sign, overseas/migrant driver failed to adjust to NZ road rules and road conditions
201053750 Non-injury FA	CAR1 SBD on SH 1S hit rear end of SUV2 stopped/moving slowly	CAR1 failed to notice car slowing, attention diverted by other traffic
2854950 Non-injury CC	SUV1 NBD on SH 1S lost control; went off road to right, SUV1 hit Traffic Sign	SUV1 alcohol test above limit or test refused, fatigue (drowsy, tired, fell asleep)
201050714 Non-injury DA	VAN1 SBD on SH 1S lost control turning right, VAN1 hit Fence, Post Or Pole on right hand bend	VAN1 load not well secured or moved

5.3.4 Crash changes since speed limit change

NZTA have advised that the 80 km/h (rural to urban) speed threshold located approximately 300 m south and 300 m north of the Spring Creek intersection was installed in March 2011. The crash occurrences have been plotted for the five year period with the installation of the speed threshold overlaid, see Figure 18. The threshold is considered relatively recent for crash analysis, but early indications show fewer crashes as a consequence of the lower speeds through the Spring Creek. Prior to the change, a crash was reported every 2.8 months; since the change, there have been two crashes reported, which equals one crash every 10.5 months. Due to the low number of crashes since, and the short observation period, the change is not expected to be statistically relevant yet.

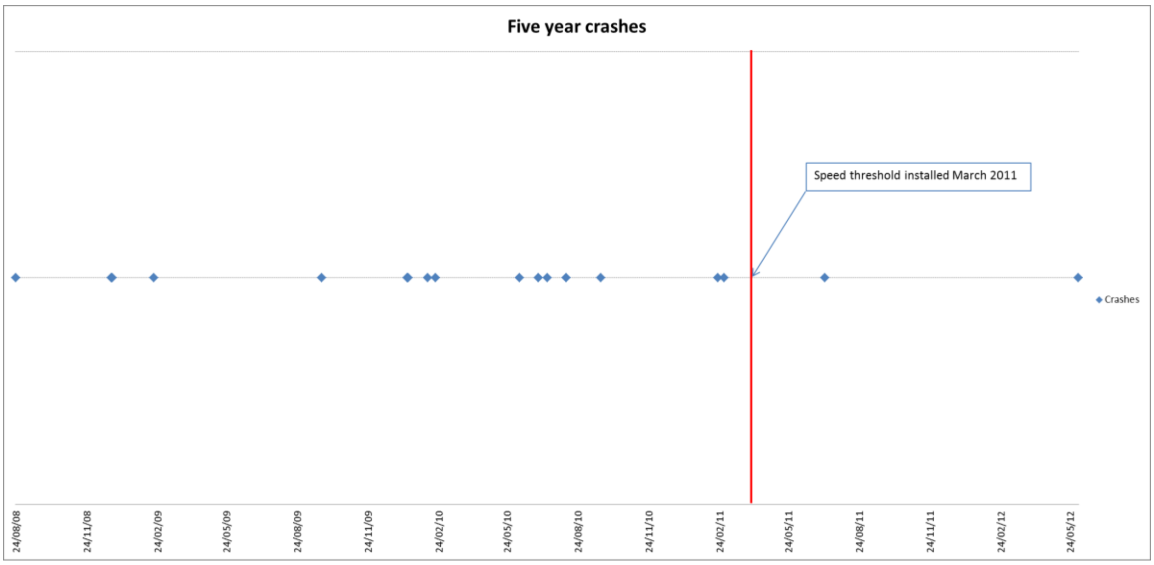


Figure 18: Crash occurrence with speed threshold

5.3.5 Ten year crash history

There have been 31 crashes recorded in the Crash Analysis System (CAS) at the intersection in the 10 year period between 2003 and 2012. Of these crashes, 20 (65%) have involved vehicles making a turning manoeuvre. This is a similar ratio to the five year crashes which suggests that the intersection has had the turning manoeuvre crash problems for some time.

The ten year crash history shows 1 fatal crash, 2 serious crashes, 11 minor injury and 17 non-injury crashes.

6 Stakeholder relationship management & consultation

It was decided that, other than Kiwirail, no other engagement was appropriate until the scoping report was completed and a greater understanding of the options and their appropriateness was understood. Engagement with the directly affected stakeholders (listed below) will be undertaken as part of the Scheme Assessment Report and their comments on the preferred options included there.

6.1 Management

6.1.1 NZTA

The local stakeholders will be contacted directly by NZTA or their representative to discuss the options developed to get their feedback.

6.2 Consultation

6.2.1 Kiwirail

[redacted]

ViaStrada had a telephone conversation with Kiwirail on 10 April. Following this discussion a list of questions was sent by email on 11 April, with Appendix G containing the responses.

6.2.2 Midland Distributors

[redacted]

6.2.3 Junction Hotel

[redacted]

6.2.4 Spring Creek Motels

[redacted]

6.2.5 4 Square

[redacted]

6.2.6 Spring Creek Service Station

[redacted]

6.2.7 Spring Creek Dairy

[redacted]

6.2.8 Swampys Backpackers

[redacted]

6.2.9 Other

[redacted]

7 Options considered

This section presents various options that have been explored and put forward for further assessment. The various site constraints are also presented that apply to the different options. This will become part of the evaluation used to reduce the number of options taken forward to the next stage.

It should be noted that several options were discounted at a very early stage due to the anticipated risks, site constraints and limited betterment associated with the options.

Relocating Ferry Road to the south is not easily achieved due to the current residential and commercial development of this area, requiring the acquisition of several properties and an area of vineyard. Therefore this option has not been explored further.

7.1 The five options

Five options have been developed for consideration in the scoping study stage.

7.1.1 Square up the intersection [Do minimum]

This option improves the Rapaura Road and Ferry Road approach angles to improve sight lines from the side roads and better define priority controls. Large median and splitter islands are used to channel traffic and help to define the intersection. These islands can also provide pedestrian protection to cross the state highway.

7.1.2 Roundabout

The roundabout is Austroads compliant with a 15 m diameter central island with an 8 m circulating lane. This optimises the size of the central island within the boundaries and provides sufficient deflection to slow all vehicles approaching and travelling through the roundabout. The median islands on the state highway are very long to slow through traffic and reduce random property access. However these can be shortened to meet specific access requirements. The roundabout removes the need for the auxiliary acceleration and deceleration lanes as drivers are more accustomed to being held up by HCVs as they exit roundabouts. The deceleration left turn lane for southbound drivers turning into Ferry Road is retained to provide adequate swing in and queuing storage if a train is on the crossing. All HCV movements have been checked with Autotrack swept path software.

7.1.3 Gane Street extension

The Gane Street extension creates a staggered Tee intersection with Ferry Road closing at the rail crossing and Rapaura Road being realigned to improve approach geometry. The intersections are 200 m apart which allows two end-on-end right turn bays to be marked along the centre of the state highway. This allows right turning vehicles to have an unobstructed view of approaching vehicles before they make their right turn as there are no opposing right turning vehicles with this layout.

7.1.4 Rapaura Road extension

The Rapaura Road extension is also a staggered Tee intersection with Rapaura Road closing at the current rail crossing and Ferry Road being realigned to improve approach geometry. These intersections are 140 m apart which means the right turn bays are separated along the centre of the state highway with double yellow no passing lines. This layout also allows right turning vehicles to have an unobstructed view of approaching vehicles before they make their right turn as there are no opposing right turning vehicles with this layout.

7.1.5 Traffic signals

The option of traffic signals has been explored as this intersection control offers protection for the railway crossing over Ferry Road. Three different phase sequences were modelled in SIDRA to determine if the intersection can operate efficiently with the expected traffic composition and volumes.

The outputs for the split phase, diamond overlap and a two phase sequence can be seen in Table 5.

Table 5: Traffic signal phase comparison

Split phase Sunday Noon				
11:30am to 12:30pm Signals - Fixed Time Cycle Time = 100 seconds (Practical Cycle Time) Output Sequence: A, B, C, D				
Phase	A	B	C	D
Green Time (sec)	21	14	23	18
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	27	20	29	24
Phase Split	27%	20%	29%	24%
Diamond overlap Sunday Noon				
11:30am to 12:30pm Signals - Fixed Time Cycle Time = 90 seconds (Practical Cycle Time) Output Sequence: A, B, C, D				
Phase	A	B	C	D
Green Time (sec)	8	26	14	18
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	14	32	20	24
Phase Split	16%	36%	22%	27%
Two phase Sunday Noon				
11:30 - 12:30 Noon Signals - Fixed Time Cycle Time = 50 seconds (Practical Cycle Time) Output Sequence: A, B				
Phase	A		B	
Green Time (sec)	20		18	
Yellow Time (sec)	4		4	
All-Red Time (sec)	2		2	
Phase Time (sec)	26		24	
Phase Split	52%		48%	

Table 6 shows different traffic signal performance measures.

Table 6: Traffic signal performance comparison

		Split phase	Diamond Over Lap	Two phase
		Control Delay (Average) s		
Weekday	AM	33.4	30.8	13.9
	Noon	35.8	32.5	14.5
	PM	36.5	34.0	14.3
Saturday	Noon	40.3	35.8	15.0
Sunday	Noon	45.5	34.7	15.4
		LOS		
Weekday	AM	C	C	B
	Noon	D	C	B
	PM	D	C	B
Saturday	Noon	D	D	B
Sunday	Noon	D	C	B
		Longest Queue (m)		
Weekday	AM	83.7	76.5	36.5
	Noon	90.0	80.2	38.0
	PM	113.1	100.7	45.3
Saturday	Noon	125.7	117.7	50.3
Sunday	Noon	160.9	117.2	54.7
		Practical spare capacity (%)		
Weekday	AM	41.6	36.5	142.7
	Noon	27.9	30.6	137.9
	PM	12.8	11.3	103.0
Saturday	Noon	3.2	5.7	87.9
Sunday	Noon	1.2	27.1	76.0

Ideally the split phase approach will be used to minimise any further crashes, however there is considerable inefficiency with this sequence. The diamond overlap provides a lessor level of safety but does address the right turn against crashes, however there is insufficient room for this to operate. The two phase is the most efficient operation but is has little safety benefits for the intersection. The comparison of the three different phase sequences can be seen in Table 6. A comparison between the existing layout, the roundabout and traffic signals can be seen in

7.2 Site constraints

There are several physical constraints at this site that will influence the ability to relocate either SH62 Rapaura Road or Ferry Road. Part of relocating roads is the need to secure adequate land for road from the various land holders.

7.2.1 Truck depot and the Kiwirail operations

Relocating Ferry Road to the north has been explored for the Gane Street extension. This option separates the offset at a minimum desirable length to accommodate two end on end right turn bays. However the constraints for this location relate to the truck depot and the Kiwirail operations. The feasibility of this option will be determined by the practicality and cost to achieve the Gane Street extension by relocating the railway loop line.

Advice received from Kiwirail included the observation that, “one of the major problems at Ferry Road Level Crossing is caused by trucks turning right onto SH1 to Picton. There is virtually no headroom between the State Highway and Level Crossing and so a truck and trailer unit will foul the tracks while waiting to turn right. Moving the level crossing further north will not alleviate this problem”.

The peak road traffic times that conflict with ‘train’ times at Spring Creek are shown in Table 7. The train number is shown in [square brackets] and when the conflict times are close, 15 to 30 minutes, these have also been included in case of rail delays. This information is based on the measured peak hours for road traffic against the extended time spent by trains at Spring Creek. It is also noted that the trains are usually on schedule, but it is acknowledged that delays can occur from time to time.

Table 7: identified peak hour conflicts

Day	Time	Kiwirail operations & peak hour traffic flow
Monday	Noon	If [700] delayed 15 minutes
	PM	If [735] delayed 15 minutes
Tuesday	AM	[725]
	Noon	[700]
	PM	If [735] delayed 30 minutes
Wednesday	Noon	If [700 and/or 729] delayed 15 minutes
	PM	If [735] delayed 15 minutes
Thursday	Noon	If [700 and/or 729] delayed 15 minutes

Day	Time	Kiwirail operations & peak hour traffic flow
	PM	If [735] delayed 15 minutes
Friday	Noon	If [700 and/or 729] delayed 15 minutes
	PM	If [735] delayed 15 minutes
Saturday	Noon	[700 and 729]
Sunday	Noon	[700]

The table shows that if there are direct conflicts between peak hour traffic flows and scheduled train movements. However, even minor rail delays, increase potential risks of peak hour road traffic volumes coinciding with Kiwirail shunting operations at Spring Creek on every day of the week. It was noted during the short video survey of the intersection that scheduled trains were late.

There are direct conflicts occurring on Tuesdays during the AM and noon peak hours plus the Saturday and Sunday peak hours are likely to continue, unless Kiwirail decide to reschedule the trains. The conflict times would also be addressed by the development of Clifford bay should the port relocation project be progressed, see section 9.4.

It is expected that there will continue to be conflict between the scheduled train arrival times at Spring Creek and the traffic peak hour times. The scheduled conflict times could be explored by Kiwirail and NZTA to determine any mitigation measures are available.

7.2.2 Spring Creek waterway and stop banks

Relocating (SH62) Rapaura Road to the north is unlikely as it will require significant waterway and stop bank works plus the construction of two new bridges. Therefore relocating (SH62) Rapaura Road to the north option has not been explored further.

7.2.3 Land acquisition

The requirement to purchase land brings uncertainty associated with the time and cost to acquire land. This becomes more complex as the number of land holders increases, however, even one property purchase can become time and cost consuming. For this reason, preference is given to options that do not require land purchase or have absolute minimal land purchase required.

7.2.4 Commercial & residential development

There is a Four Square supermarket and associated car parking located on the northwest quadrant of the intersection. This site has two driveways with direct access onto SH1S and SH62. The site is subject to consent decision in Appendix J (attached) that should define where and how their accesses operate. This issue is raised as the SH1S access permits southbound state highway drivers to enter some 50 m north of the intersection and the SH62 access is located just 20 m from the intersection. Both accesses are considered too close for the current intersection volumes, layout and mix of traffic.

The Blenheim Freight Centre and other transport businesses are located on the northeast Quadrant of Spring Creek which is a major HCV generator and rail interface. Any road options that impact in this location will have significant cost and delay constraints as noted in section 7.2.1.

There is residential and commercial development in the southeast quadrant of the intersection. Any relocation or redevelopment of Ferry Road to the south is not easily achieved due to requiring the acquisition of several commercial properties and an area of vineyard.

The south west quadrant also has mixed development use with the hotel, petrol station and dairy, with adjacent motels and a sports club.

7.3 Options evaluation

To present the four options in a comparable way, we have developed a format that shows a list of the design features, pros and cons for each option.

Table 8: Options comparison

Option	Design features	Pros	Cons
Square up intersection [Do min]	Realign Rapaura Road approach to 70 degrees Large 'rural' size raised islands to channel vehicles Pedestrian crossing facilities provided on raised islands Opposed right turn bays with offset islands on left side of drivers to provide better visibility to traffic approaching on the state highway SH through lanes are 3.5 m wide SH right turn bays are 3.0 m wide Acceleration and deceleration lanes	Improved alignment of intersecting side roads Improved intervisibility between through traffic and right turners with the offset islands Provides pedestrian crossing facilities	Requires land purchase Required land may not be available Provides the least crash benefit to the intersection. Drivers may not be familiar or comfortable with the right turn bay islands on their left
Roundabout	15 m diameter roundabout Northbound left turn slip lane removed Pedestrian crossing facilities	Intersection speed controlled Provides pedestrian crossing facilities The long state highway island restrict turns into and out of businesses	Requires land purchase Required land may not be available Local businesses may object to the long state highway islands as their access configurations will alter Additional delay highway traffic and vehicles turning right across railway line have limited storage space and will require accommodation.

Option	Design features	Pros	Cons
Gane Street extension	Gane Street extended to intersect with SH1 Ferry Road closed at railway Rapaura Road realigned. Section of rail passing loop relocated.	Angled crossroad intersection replaced by staggered T Improved visibility at Rapaura Road	Requires land purchase Required land may not be available Requires 300 m extension of the railway passing loop to the north There is limited space between the Gane Street limit lines and rail line, but in a location where there is less traffic to give way to The right turn out of Gane St acceleration and merge lane will lead directly into the northbound road overtaking lane Moving the loop track and connection further north will have a major impact on the freight centre layout and capacity It is understood Kiwirail would not consent to this relocation due to stopped train on the loop blocking visibility to a moving train
Rapaura Road extension	Rapaura Road diverted to the south Ferry Road slightly realigned to increase approach angle to state highway	Provides pedestrian crossing facility Angled crossroad intersection replaced by staggered T Improved visibility at Ferry Road	Requires land and building purchase Required land may not be available The road goes through the sports clubrooms and creates severance to the sports fields Relocation of level crossing equipment

Option	Design features	Pros	Cons
Traffic signals	Large overhead mast arms on the state highway approaches. Large 'rural' size median islands to channel vehicles & protect signal hardware. Pedestrian cross walks and cycle lane facilities can be provided	The main north-south State highway 1s can remain operational when a train is crossing Ferry Road	Traffic signals are out of context in a rural area Considerable [warning sign] interventions are required to ensure driver speed/behaviour is appropriate. Signals will require land purchase and the land may not be available. Rapaura Road traffic has to wait on a red signal every cycle and not just when a train is crossing Ferry Road. Drivers may cut through the 4 Square to bypass the signals on any red phase. The Limit lines for Ferry Road are located east of the railway crossing creating a very wide intersection. The poor approach angles of Ferry and Rapaura mean these legs should run in their own phase. The cost of travel time is likely to negate crash savings. The cross walk lengths will be very long. The traffic signal poles are road side hazards. Right angle crashes [with increased crash severity] can still occur. Drivers will not be aware of the signal displays other drivers are facing.

All of the options require land purchase and this can have significant cost and time implications. However the Gane Street extension and the Rapaura Road extension require considerable more land than the do-minimum or roundabout options.

7.4 Option performance

A full intersection performance analysis can be undertaken during the next design stage of the Spring Creek project.

The intersection volumes have been assessed and there are very high through and turning volumes during most traffic peak hours. An initial SIDRA run of the existing situation indicates that the current intersection layout does have performance issues. This indicates that a roundabout on the state highway may perform well for the state highway and side road traffic.

7.5 Crash reduction with each option

7.5.1 Five year crashes

Table 9 shows the crash types that will be reduced by the various treatment options against the crashes recorded.

Table 9: Predicted crash reduction

Severity	Fatal	Serious	Minor	Non-injury
Codes	JA	LB	LB HA KA	LB JA HA FA CB CC DA DB
Number of crashes	1	1	8	6
Square up [Do minimum]				
Improve sight lines	-30 %	-30 %	-30 %	-30%
Traffic islands on approach	-20 %	-20 %	-20 %	-20 %
Reinforce priority	-30 %		-30 %	-30 %
Roundabout				
Geometry	-70 %	-70 %	-70 %	-70 %
Gane Street extension				
Improve sight lines	-30 %	-30 %	-20 %	-20 %
Stagger cross intersection	-30 %	-50 %	-30 %	-30 %
Reinforce priority	-30 %		-30 %	-30 %
Traffic islands on approach	-20 %	-20 %	-20 %	-20 %
Rapaura Road extension				
Improve sight lines	-30 %	-30 %	-20 %	-20 %
Stagger cross intersection	-30 %	-50 %	-30 %	-30 %
Reinforce priority	-30 %		-30 %	-30 %
Traffic islands on approach	-20 %	-20 %	-20 %	-20 %

The crash reductions shown in Table 9 are a combination of crash reduction information from Austroads Part 4 table 9.5 and the Transit accident countermeasure literature review research report No 10 (1992) along with engineering judgement the author has gained from previous crash reduction studies. The table does not consider crash increases associated with each treatment.

The crash reductions shown in Table 9 indicate that the roundabout offers the best crash reduction. From this crash reduction assessment, the do minimum option provides the least improvement, but it will have a much lower cost. The higher costing offset Tee intersection options will provide a safety improvement over the do minimum.

7.5.2 Ten year crashes

The ten year crash data allows the fatal and serious crashes to be converted to death or serious injury (DSI) crashes, which reflects the human injury costs associated with the crashes and not the single crash occurrence. The DSI figure is multiplied by the crash reduction proportion to give the crashes saved in ten years. This value is multiplied by $100,000,000 and then divided by the option cost in dollars to give a broader look at the crash history. Appendix F shows the DSI conversion calculations.

7.6 Option elimination

There are considerable project risks associated with the two offset Tee intersections. The risks are mainly the additional costs of building new road and the uncertainty associated with time and cost to acquire land to achieve the new alignments. Both offset Tee options require Kiwirail approvals and infrastructure changes which also have uncertainty associated with time and costs to achieve.

The do minimum option has the risk of not providing sufficient crash reductions to achieve the crash saving benefits required.

The option of traffic signals was explored and discussed with the client for this intersection. The pros and cons for traffic signals are described in section 7.3.

The roundabout option will be subject to an intersection performance assessment as roundabouts can result in a negative benefit from the additional time delay to the state highway traffic.

7.6.1 Square up the intersection [Do minimum]

To square up the intersection to achieve the Austroads minimum approach angle of 70 degrees requires the Rapaura Road approach being shifted north into the Four Square property. This does facilitate the construction of a large left turn slip lane island on the south west corner outside the hotel and provides a large area for possible landscape enhancement. However, this will introduce uncertainty associated with time and cost to secure the Four Square land. This option also has the lowest expected crash reductions.

7.6.2 The Gane Street extension

The Gane Street extension, being a new road, has the inherent design flaw of crossing a railway line that is located within 10 m from the state highway. This creates a storage problem for Ferry Road traffic and a conflict for trains. Compounding this issue is the Blenheim Freight Centre has a double loop railway line for parking and shunting access to sidings. Kiwirail would not permit a new road to cross the double line. The double loop is 900 m long and would need to be relocated north some 250 m of its current location, and this is expected to have a considerable cost and time delay component. Although the approach to the state highway is squared up and the crossroads offset, the problems associated with vehicles not clearing the railway line as they are waiting at the state highway limit lines remain. This option also shows the Rapaura Road approach and intersection being reconfigured to make it safer and more efficient. The Rapaura Road realignment work does not necessarily have to happen, but many crashes would not be addressed if left as existing.

7.6.3 The Rapaura Road extension

The Rapaura Road extension option provides a relatively simple route to connect to the state highway some 150 m south of its current location that does not go through too many properties. This option also provides a physical boundary to a potential commercial zone with the closure of the old Rapaura Road intersection opposite Ferry Road. However, this alignment does go through the clubrooms and severs the sports field from the clubrooms. This option also shows the Ferry Road approach and intersection being reconfigured to make the approach alignment safer with respect to approach angle and it removes the long straight approach to the intersection. The Ferry Road realignment work does not necessarily have to happen as part of the do minimum, but many crashes would not be addressed if the current layout remains.

7.6.4 Traffic Signals

Traffic signals in this location will require large overhead mast arms on the state highway approaches. Large 'rural' size median islands would be used to channel vehicles and protect signal hardware. Pedestrian cross walks and cycle lane facilities can be provided.

The main positive aspect of traffic signals at Spring Creek is that the main north-south State highway 1s can remain operational when a train is crossing Ferry Road.

However there are some safety and efficiency compromises with traffic signals including;

- Traffic signals are out of context in a rural area with the next closest traffic signals in Wellington, Nelson and Christchurch depending on your route to Spring Creek.
- Traffic signals in this rural environment will require considerable [warning and advisory] intervention and measures to ensure traffic speed and driver behaviour is appropriate in this location. This is not in line with the self-explaining roads.
- Signals will require land purchase and the land may not be available.
- Rapaura Road traffic will have to wait on a red signal every cycle and not just when a train is crossing Ferry Road.
- Drivers may cut through the 4 Square to bypass the signals on any red phase, between 36 to 72 bypass movements per hour.
- The Limit lines for Ferry Road are located east of the railway crossing as there is insufficient room for vehicles to queue between the railway line and the state highway. This will create a very wide intersection.
- To achieve safety the whole intersection may have to operate with [4] split phases which are very inefficient.
- If the split phase option is not acceptable, both the SH 1s approaches should have protected right turns as the approach alignment angle blocks intervisibility from the right turn bays.
- There is insufficient width for right turning vehicles tracking curve to run a diamond overlap.
- The poor approach angles of Ferry Road and Rapaura Road indicate these legs may have to run in their own phase to achieve improved safety.

- The negative cost of travel time is likely to cancel out any crash savings.
- The cross walk lengths for the few pedestrians are long and will require a lot of cycle time further delaying state highway traffic.
- The sixteen traffic signal poles are road side hazards in themselves.
- Rear end crashes are a consequence of traffic signals.
- Right angle crashes [with increased crash severity] can still occur at this cross road intersection with traffic signals.
- Depending on the phase sequence used, opposing drivers are not aware of what displays other drivers are facing and this will cause safety issues and delays. This uncertainty is similar to the current layout with Ferry Road traffic with a Give-Way control opposing Rapaura traffic with a stop control and only some drivers being aware of the situation or difference.

A summary table can be found in Appendix H of the traffic signal performance [split phase, diamond overlap and two-phase] is compared against the performance of a single lane roundabout and the existing intersection.

7.6.5 Elimination recommendations

- That the ‘do minimum’ square up the intersection option is not developed further based on the considerable land acquisition requirement, high construction cost and the expectation that it does not provide acceptable safety benefits.
- That the Gane Street extension option is not developed further because it only provides marginal safety benefits and requires significant land purchase and relocations of Kiwirail hardware and facilities.
- That the Rapaura Road extension option is not developed further for the same reason that it only provides marginal safety benefits and requires significant land purchase and relocation of Kiwirail hardware and facilities.
- That traffic signals are not suitable for the Spring Creek intersection as they are not considered ‘self-explaining’ in this environment plus there are safety and efficiency issues.

8 Option to be progressed

The standard Roundabout option has been discussed directly with NZTA and a modification is suggested to avoid or minimise the land purchase requirement and address a design concern where northbound right turning vehicles have no storage space to queue when a train is on the crossing. Appendix H outlines why the modified roundabout has been rejected on safety grounds.

8.1 Roundabout

The Austroads compliant roundabout is to be progressed for this site. This option addresses most crashes and removes the need for the auxiliary acceleration and deceleration lanes as drivers are more accustomed to being held up by HCVs as they exit roundabouts.

8.2 Cost estimates

Two cost estimates have been provided for comparison. The first is based on a full pavement reconstruction and the second estimate includes simple pavement overlay. Refer to 0and Appendix C for details and comments relating to assumptions made in the development of the estimates.

It was noted during the site visit that a Waka is located to the southeast of the intersection. An allowance of $50,000 has been included in the cost estimate to include this Waka or similar enhancement as part of the intersection upgrade.

There has also been an allowance made in the cost estimate for rail barriers arms to be included across Ferry Road. However, this may not be physically possible due to the close proximity of the railway line to the state highway and this will be explored fully with Kiwirail.

8.2.1 Full pavement reconstruction

The full pavement reconstruction option has an expected estimate of $1,763,500 with a 95th percentile estimate of $2,402,000

8.2.2 The pavement overlay option

The overlay option has an expected estimate of $1,490,200 with a 95th percentile estimate of $2,012,000.

8.3 Economic evaluation

Two Economic evaluations have been provided for each of the estimates above for comparison. The first economic evaluation is based on a full pavement reconstruction and the second economic evaluation reflects the costs of the simple pavement overlay. Refer to Appendix D and Appendix E for details of the economic evaluations and resultant Benefit Cost Ratios (BCRs).

8.3.1 Full pavement reconstruction

The full pavement reconstruction economic evaluation has a BCR of 4.7 based on safety, 1.9% traffic growth with the expected estimate of $1,763,500. To reflect that traffic growth has slowed since 2006 the BCR is checked with 0% traffic growth resulting in a BCR of 3.6.

8.3.2 The pavement overlay option

The pavement overlay economic evaluation has a BCR of 5.6 based on safety, 1.9% traffic growth with the expected estimate of $1,490,200. The BCR drops to 4.2 when 0% traffic growth is used.

8.4 Environmental and social

The environmental and social assessment commences with the consideration of all issues and potential effects associated with the options to be progressed.

As both options are geometrically similar, they are presented jointly here, with any differences noted in the commentary.

8.4.1 Noise

The change of priority at the Spring Creek intersection, with the implementation of a roundabout and state highway traffic now required to give way, will have an effect on noise in this location. There will be more noise associated with traffic slowing and accelerating at the intersection, however, this may be offset by a lower overall noise associated with the lower speed environment. Following the decision to progress either of the roundabout options, a full noise assessment will be required for this site.

8.4.2 Air Quality

The main issue for air quality is increased dust nuisance and air pollution associated with the construction of the roundabout. Following the decision to progress either of the roundabout options, an air quality assessment may be required for this site to determine changes to motorised vehicle pollutants in proximity to the adjacent land use.

8.4.3 Water resources

A water resource consideration for this project is the impact on Spring Creek that runs parallel to and on the north side of SH62 Rapaura Road and then parallel along the west side of SH1S. The main issue for this water resource is water pollution associated with the construction of the roundabout finding its way into this watercourse, however, this can be managed on site during construction. The watercourse is located some 30 m from the expected construction extents and determination of consent requirements will need to be explored with the Marlborough District Council.

8.4.4 Ecological resources

No vegetation or fauna will be effected by the construction works associated with the roundabout construction. However, earthworks will disturb topsoil which may make its way into water courses as discussed in section 8.4.3. This could have short term impacts on the fresh water ecology and can be managed on site during construction.

8.4.5 Culture and heritage

Spring Creek, or Awarua as it is known to local iwi, is a significant water course with a considerable catchment area. Cultural and heritage values at Spring Creek and any effects as a consequence of this proposal must be identified as part of the scheme assessment stage of the project.

No heritage buildings, sites, places or trees were shown at Spring Creek in the Marlborough District Council's Appendix A Register of Significant Heritage Resources dated 28 October 2010.

8.4.6 Visual quality

The intersection currently provides little profile for drivers passing through Spring Creek. There will be an opportunity to significantly enhance the visual amenity of this site with the establishment of a roundabout.

A landscape enhancement plan can be included in the detailed design that identifies this intersection as a location, or point of arrival, at Spring Creek. The residual area that is currently wide open chip seal can be returned to a more natural state providing opportunities for the community to add visual amenity.

8.4.7 Community

The Spring Creek community is mostly located on the east of SH1S with several commercial and sports clubs and fields located on the west of the state highway. The commercial area to the west is further bisected by Rapaura Road (SH62). Ferry Road is mostly residential on both sides, with the Kiwirail Blenheim freight centre and a commercial transport company located to the north. The commercial activity facilities employment, entertainment and convenience services for the community, however there are no safe pedestrian links across the roads between any of these activities.

The option to be progressed avoids some of the community severance issues associated with the Rapaura Road extension through the sports club.

It is expected that the community will benefit from the implementation of a roundabout in this location because of safety increased safety and increased accessibility for pedestrians. The second point is reliant on well-designed pedestrian facilities being required and included in the detail design.

8.4.8 Public health

The public health aspects of this proposal include safety for all road user and increased opportunities for pedestrians. The main public health benefit from this proposal is addressing the major crash types that have resulted in fatal, serious and minor injury crashes.

8.4.9 Summary of environmental and social effects

It is considered that the roundabout option, when considered in terms of environmental and social effects, provide solutions that avoid, remedy or mitigate these effects and the estimated costs are economically viable.

8.5 Integrated planning / travel demand management

Integrated planning and travel demand management is difficult to bring to an existing rural project in New Zealand. Typically small towns develop at transport junctions and often reflect little consideration of these values. Typically locals would use a car to make their short local trips to the shops and clubs as crossing the roads at Spring Creek on foot has considerable risk. However, both roundabout options can provide locals and visitors with increased opportunities to walk or cycle safely between the commercial and sports activities. This should see a reduction in locally generated traffic, as walking and or cycling may now be considered an acceptable mode of transport.

9 Risks

9.1 Site constraints

As previously discussed, there are several constraints at this site that will influence the ability to achieve the roundabout option, including:

- Kiwirail crossing requirements
- Spring Creek waterway, stop banks and consents
- Land acquisition with respect to availability, cost and delays
- Commercial interruption
- Fibre optic cables and service utility infrastructure

9.2 Funding

The number of serious crashes and the fatal crash indicate that this intersection is of high priority for safety improvement. Both of the roundabout options (full reconstruction and overlay) show good BCRs at 6.4 and 7.6, respectively.

9.3 Delays

The main delay risk to the project is the acquisition of the land associated with the Four Square store. The inclusion of landscape enhancements and a redesign of the store car park entrance and parking may help to resolve and hasten these issues for the Four Square and local community.

9.4 Clifford Bay

The project is compromised by the possible future relocation of the main South Island passenger and freight port from Picton to Clifford Bay south of Blenheim. If such relocation would occur, much of the traffic heading to and from Picton would no longer use this intersection. This will have a significant impact on the state highway volumes and whether SH62 remains a state highway, with a high percentage of HCVs using the intersection. NZTA has decided to proceed with the Spring Creek project until such time as plans for the port relocation become more definite.

Note: the client will put some more work into this section before the report is published, but it is sufficient for now.

10 Matters for further discussion

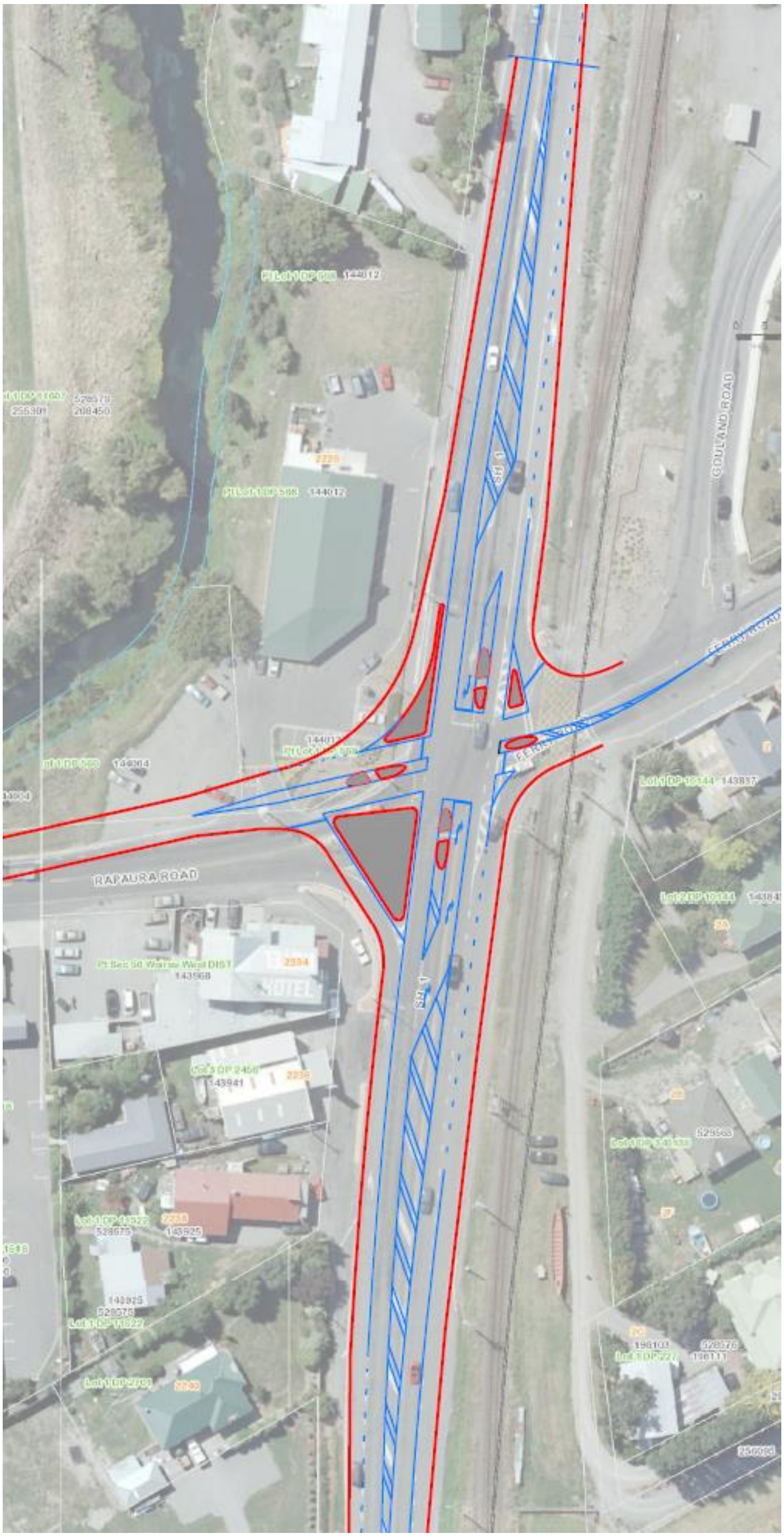
- The consultation management
- Inclusion of integrated planning / travel demand management
- Specific treatments for existing driveways
- Other

11 Ranking of options

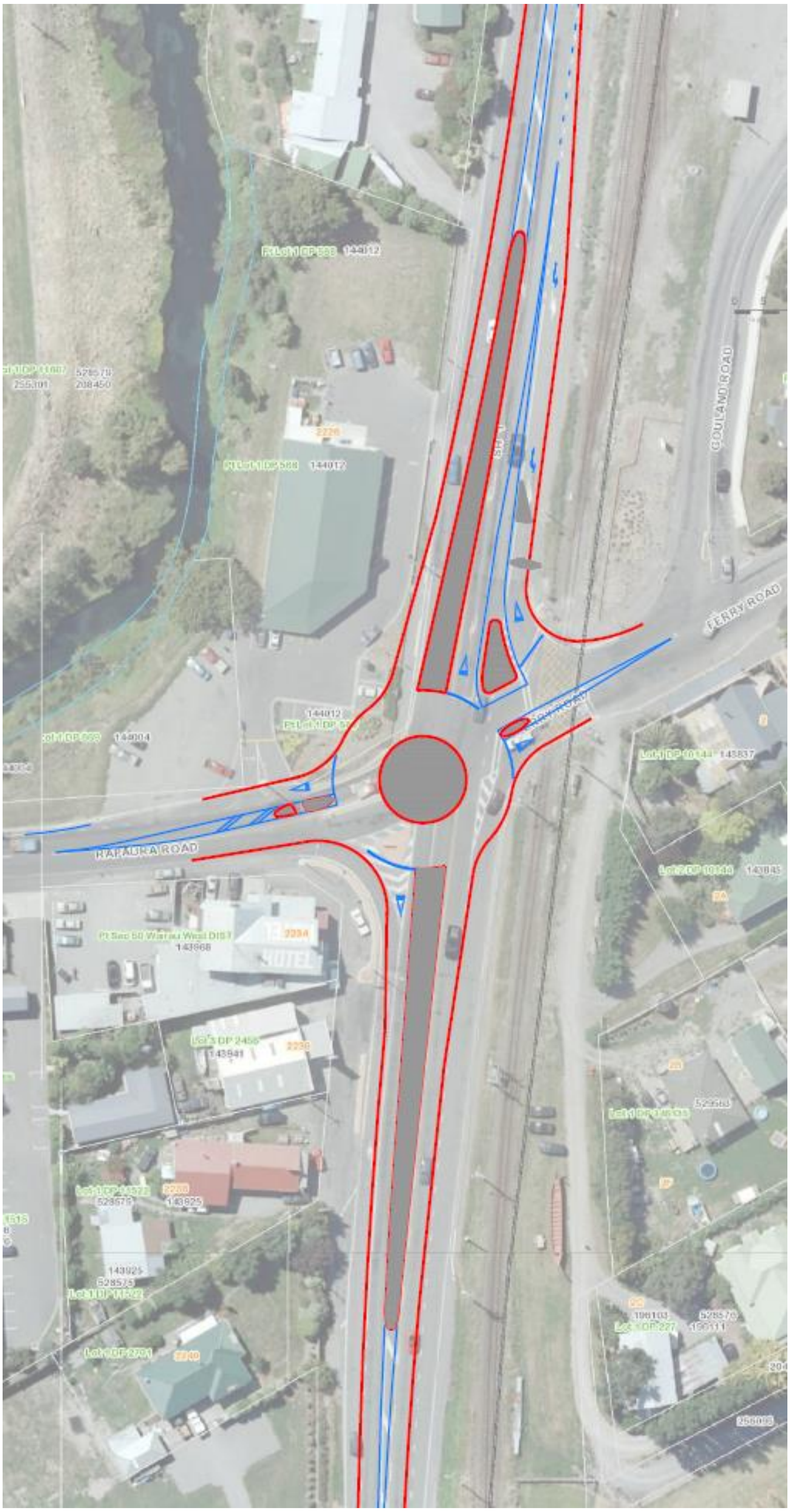
Not Applicable.

Appendix A Option plans

Do minimum

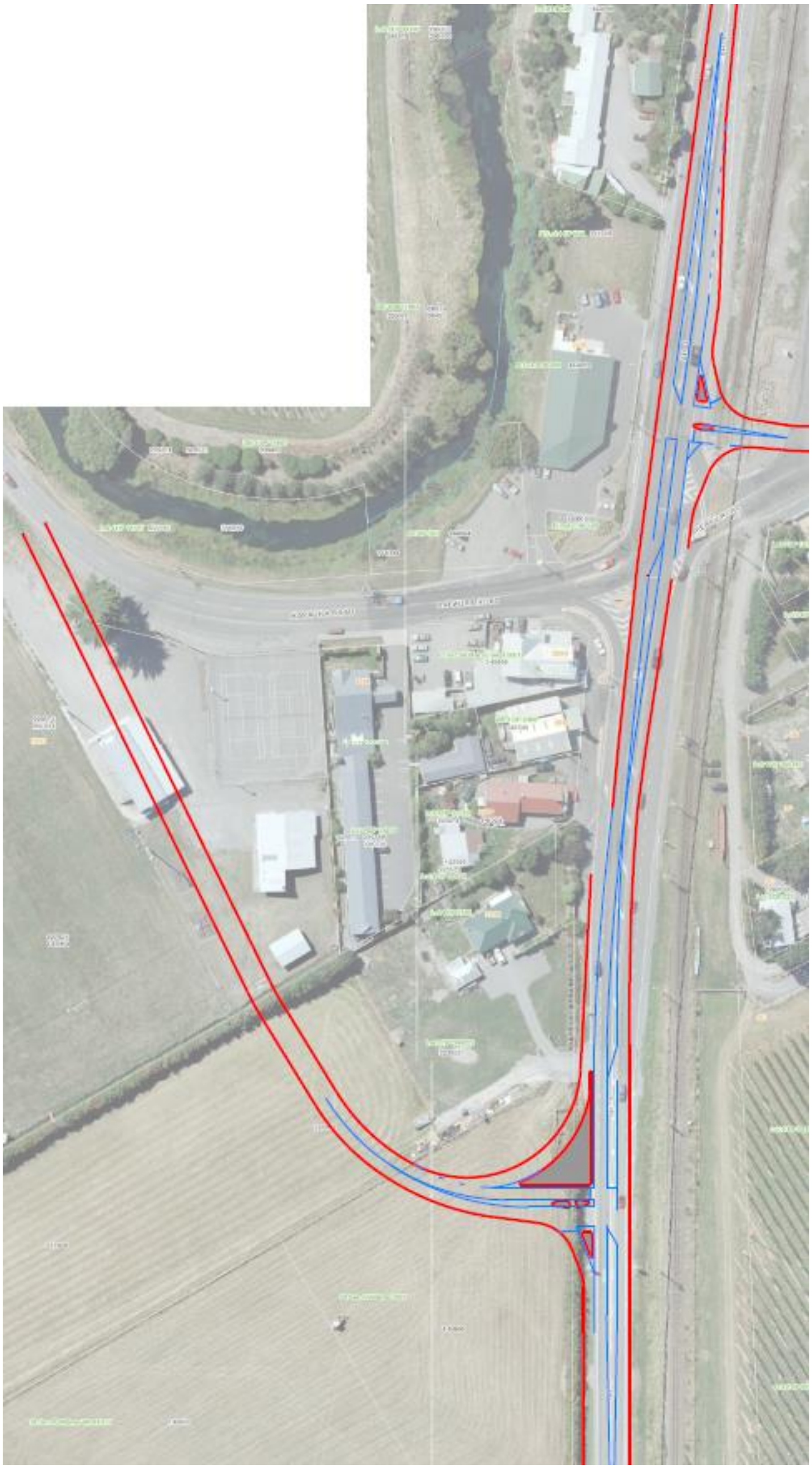


Four leg roundabout



Gane Street extension

SH62 Rapaura Road extension



Traffic Signals

No concept plan has been developed and assessment is based on SIDRA analysis and safety assessment of the intersection geometry

Appendix B Cost estimate full pavement reconstruction

Spring Creek - SH1/Ferry Road Intersection - Option 1 (Full Pavement Reconstruction) Roundabout

OE

Option Estimate

Item	Description	Base Estimate	Expected Estimate	95%ile Estimate
A	Project Property Cost	95,000	109,300	133,100
B	Investigation and Reporting	0	0	0
C	D&PD & NZTA Managed Costs	78,325	78,325	78,325
	If there are insufficient rows below to display all the Items from the Elemental Breakdown, then press here to generate additional rows.			
	MSQA, NZTA Managed Costs, & Consent Monitoring Fees	65,271		
	Physical Works ($1,305,416)			
D1	Preliminary And General	181,000		
D2	Site Clearance	93,575		
D3	Earthworks And Ground Improvement Works	86,045		
D4	Kerb And Channel	65,950		
D5	Stormwater Drainage	290,400		
D6	Pavement Layer Construction	209,216		
D7	Pavement Surfacing	129,730		
D8	Footpath, Cycleway, Roundabout Construction	15,450		
D9	Pavement Markings And Signs	50,000		
D10	Railway Crossing	50,000		
D11	Street Lighting, Power And Telecom Services	23,000		
D12	Reinstatement	61,050		
D13	Alterations To Services And Utilities	50,000		
D14	(blank)			
D15	(blank)			
D16	(blank)			
D17	(blank)			
D18	(blank)			
D19	(blank)			
D20	(blank)			
D21	(blank)			
D22	(blank)			
D	Total Construction & MSQA	1,370,687	1,575,875	2,190,575
	Total Base Estimate	1,544,012		
	Note: These estimates are exclusive of escalation and GST.			
E	Assessed / Analysed Contingency	219,488		
	Expected Estimate		1,763,500	
F	Assessed / Analysed Funding Risk		638,500	
	95th Percentile Estimate			2,402,000

Note: These estimates are exclusive of escalation and GST.

Base Date of Estimate	27 May 2013	Cost Index
Estimate prepared by:	GHD - Sloan Gunn	Signed
Estimate internal peer review by:		Signed
Estimate external peer review by:		Signed
Estimate approved by NZTA Project Mgr:		Signed

Notes: for full pavement reconstruction estimate

Ver	**Comments:** *(Basis on which this estimate has been prepared.)*
1	Estimate Quantities based and CAD outputs and scaling
2	Further calculation values available, majority of rates pro-rata from previous Roundabouts
3	Remove existing fence - Four Square Boundary = 74.8m length
4	Removal of existing kerb = 58.6m (dish channel) +100.7m+13.6m+14.6m
5	Remove existing bunds (next to Four Square) - assume $100/m2, for 3m2 each
6	Assume requirement for barrier arms as rail movements exceed 15km/h - NZTA TCD vol9 section 6
7	Removal of 3 lighting poles for intended relocation
8	Assume relocation of 1 possible survey markers
9	50m2 Traffic Island removal, rate taken as cut and removal of concrete
10	Area of footpath construction taken from prelim concept drawings, 210.6m2=1.5m*(26.3+30.5+5.5+5+20.9+46.2+6) =
11	12 Pram crossings to be installed, taken from concept drawings
12	Reinforced Mountable kerb for roundabout = 47.1m
13	Sawcut existing surface measured from concept drawings at tie-ins
14	Dishchannel assumed to be reinstated along northern boundary
15	Scarify existing paved surface all surfaces
16	Topsoiling = assume all large traffic Islands plus A4 and A6, ref quant est drawings
17	Grassing = assume same as topsoiling area, eg Topsoiling/0.1m
18	Assume the construction/relocation of 3 sumps within the construction works
19	Assumed stormwater requirement for settling pond for stormwater treatment before creek discharge
20	Allow 30m RCRRJ Culvert for discharge of stormwater to creek
21	Pavement marking removal taken as lump sum for all previous markings
22	Pavement marking taken as lump sum for all markings required within the scope of works
24	Installation of signs shall be taken as a lump sum (some shall be relocations)
25	Reinstatment/installation of kerb/kerb and channel is assumed to follow and tie in with pre-existing K&C
26	Assume the installation of 3 new lighting columns else the relocation of existing
27	Assume the relocation of 4 power poles for swale and road construction
28	Alterations to existing services, allow $40,000 lump sum (wastewater, fibre-optic, telecom services, water-mains, etc)
29	Swale construction = 625m2 taken from railway-side boundary.
30	Tie into exisiting seal = 58.5m=15.9+13.8+15.0+13.8, assume lump sum, ~$3500 per tie in (4 tie-ins)
31	Miscellanious feature items lump-sum = $50,000 as per client meetings discussion (Waka feature)
32	Assume large lump-sum for liasing with kiwi-rail
33	Assume 5m3 of recoverable topsoils
34	Assume no geotechnical monitoring (boreholes, piezometers, settlement)
35	Assume no significant subgrade improvement layer required
36	Strip to stock-pile from commercial side acquired land
37	Assume not requiring imported bulk-fill in scope of works
38	Undercut unsuitable material = Provisional quantity (10% of site)
39	Filtration fabric for 50% of site
40	Assume no additional pavement stabilisation other than what has been provided in eathworks/pavement construction
41	Assume all safety barrier requirements met
42	Assume all imported material used for pavement constructuion and finished level to match existing
43	SMA for roundabout and 30m approaches
44	Assume mountable kerb for pram crossings as part of pram-crossing rate
45	TTM based on 20 week construction period
46	Assume 6% D&PD
47	Assume 5% MSQA
48	

Appendix C Cost estimate pavement overlay

Spring Creek - SH1/Ferry Road Intersection - Option 2 (Pavement Overlay) Roundabout Reconstruction

OE

Option Estimate

Item	Description	Base Estimate	Expected Estimate	95%ile Estimate
A	**Project Property Cost**	**95,000**	**109,300**	**133,100**
B	**Investigation and Reporting**	**0**	**0**	**0**
C	**D&PD & NZTA Managed Costs**	**0**	**0**	**0**
	If there are insufficient rows below to display all the Items from the Elemental Breakdown, then press here to generate additional rows.			
	MSQA, NZTA Managed Costs, & Consent Monitoring Fees	0		
	Physical Works **($1,093,945)**			
D1	Preliminary And General	136,000		
D2	Site Clearance	93,575		
D3	Earthworks And Ground Improvement Works	16,245		
D4	Kerb And Channel	65,350		
D5	Stormwater Drainage	290,400		
D6	Pavement Layer Construction Roundabout	45,445		
D7	Pavement Construction Approach Rds	67,700		
D8	Pavement Surfacing	129,730		
D9	Footpath, Cycleway, Roundabout Construction	15,450		
D10	Pavement Markings And Signs	50,000		
D11	Railway Crossing	50,000		
D12	Street Lighting, Power And Telecom Services	23,000		
D13	Reinstatement	61,050		
D14	Alterations To Services And Utilities	50,000		
D15	(blank)			
D16	(blank)			
D17	(blank)			
D18	(blank)			
D19	(blank)			
D20	(blank)			
D21	(blank)			
D22	(blank)			
D	**Total Construction & MSQA**	**1,093,945**	**1,260,600**	**1,758,900**
	Total Base Estimate	**1,188,945**		
	Note: These estimates are exclusive of escalation and GST.			
E	Assessed / Analysed Contingency	180,955		
	Expected Estimate		**1,369,900**	
F	Assessed / Analysed Funding Risk		522,100	
	95th Percentile Estimate			**1,892,000**

Note: These estimates are exclusive of escalation and GST.

Base Date of Estimate	30 May 2013	**Cost Index**
Estimate prepared by:	**GHD - Sloan Gunn**	**Signed**
Estimate internal peer review by:	**GHD - Reilly Connor**	**Signed**
Estimate external peer review by:		**Signed**
Estimate approved by NZTA Project Mgr:		**Signed**

Notes: for the pavement overlay estimate

Ver	**Comments:** *(Basis on which this estimate has been prepared.)*
1	Estimate Quantities based and CAD outputs and scaling
2	Further calculation values available, majority of rates pro-rata from previous Roundabouts
3	Remove existing fence - Four Square Boundary = 74.8m length
4	Removal of existing kerb = 58.6m (dish channel) +100.7m+13.6m+14.6m
5	Remove existing bunds (next to Four Square) - assume $100/m2, for 3m2 each
6	Assume requirement for barrier arms as rail movements exceed 15km/h - NZTA TCD vol9 section 6
7	Removal of 3 lighting poles for intended relocation
8	Assume relocation of 1 possible survey markers
9	50m2 Traffic Island removal, rate taken as cut and removal of concrete
10	Area of footpath construction taken from prelim concept drawings, 210.6m2=1.5m*(26.3+30.5+5.5+5+20.9+46.2+6) =
11	12 Pram crossings to be installed, taken from concept drawings
12	Reinforced Mountable kerb for roundabout = 47.1m
13	Sawcut existing surface measured from concept drawings at tie-ins
14	Dish channel assumed to be reinstated along northern boundary
15	Scarify existing paved surface all surfaces
16	Top soiling = assume all large traffic Islands plus A4 and A6, ref quant est drawings
17	Grassing = assume same as top soiling area, eg Topsoiling/0.1m
18	Assume the construction/relocation of 3 sumps within the construction works
19	Assumed stormwater requirement for settling pond for stormwater treatment before creek discharge
20	Allow 30m RCRRJ Culvert for discharge of stormwater to creek
21	Pavement marking removal taken as lump sum for all previous markings
22	Pavement marking taken as lump sum for all markings required within the scope of works
24	Installation of signs shall be taken as a lump sum (some shall be relocations)
25	Reinstatment/installation of kerb/kerb and channel is assumed to follow and tie in with pre-existing K&C
26	Assume the installation of 3 new lighting columns else the relocation of existing
27	Assume the relocation of 4 power poles for swale and road construction
28	Alterations to existing services, allow $40,000 lump sum (wastewater, fibre-optic, telecom services, water-mains, etc)
29	Swale construction = 625m2 taken from railway-side boundary.
30	Tie into exisiting seal = 58.5m=15.9+13.8+15.0+13.8, assume lump sum, ~$3,500 per tie in (4 tie-ins)
31	Miscellanious feature items lump-sum = $50,000 as per client meetings discussion (Waka feature)
32	Assume large lump-sum for liasing with kiwi-rail
33	Assume 5m3 of recoverable topsoils
34	Assume no geotechnical monitoring (boreholes, piezometers, settlement)
35	Assume no significant subgrade improvement layer required
36	Strip to stock-pile from commercial side acquired land
37	Assume not requiring imported bulk-fill in scope of works
38	Undercut unsuitable material = Provisional quantity (10% of site)
39	Filtration fabric for 50% of site
40	Assume no additional pavement stabilisation other than what has been provided in eathworks/pavement construction
41	Assume all safety barrier requirements met
42	Assume all imported material used for pavement constructuion and finished level to match existing
43	SMA for roundabout and 30m approaches
44	Assume mountable kerb for pram crossings as part of pram-crossing rate
45	12 week construction period for TTM
46	Assume 6% D&PD
47	Assume 5% MSQA
48	

Appendix D Economic evaluation full pavement reconstruction

Spreadsheet v 1.03 (04-June-10)

SP5 Isolated intersection improvements continued

Worksheet 1 - Evaluation summary

1	Evaluator(s)	Mark Weeds, GHD Christchurch				
	Reviewer(s)	Warren Lloyd, Viastrada Christchurch				
2	Activity/package details					
	Approved organisation name	NZ Transport Agency				
	Activity/package name	Spring Creek Safety Improvements				
	Your reference					
	Activity description	SH1/ SH62/ Ferry Road Intersection Improvements, Spring Creek				
	Describe the issues to be addressed	High crash rate at existing priority control intersection				
3	Location					
	Brief description of location	Spring Creek is located on SH1, approximately 5km north of Blenheim. SH62 Rapaura Road provides a bypass of Blenheim urban area to SH6				
4	Alternatives and options					
	Describe the do-minimum	Maintain existing stop-controlled cross-roads				
	Summarise the options assessed	Construct new roundabout				
5	Timing					
	Time zero (assumed construction start date)	1 July	2015			
	Expected duration of construction (months)		6			
6	Economic efficiency					
	Date economic evaluation completed (mm/yyyy)		29/05/2013			
	Base date for costs and benefits	1 July	2012			
	AADT at time zero		10000			
	Traffic growth rate at time zero (%)		2.00%			
	Traffic volume entering the intersection	9600	in the year	2012/13		
	Posted speed limit	70	km/h			
7	PV cost of do-minimum			$	0	**A**
8	PV cost of the preferred option			$	1640055	**B**

9	Benefit values from worksheet 4, 5, 6							
	PV travel time cost savings	$	0	**C** x Update factor ^{TTC}	1.37	= $	0	**W**
	PV VOC and CO_2 savings	$	0	**D** x Update factor ^{VOC}	1.06	= $	0	**Y**
	PV accident cost savings	$	6467931	**E** x Update factor ^{AC}	1.20	= $	7761518	**Z**

10 $$BCR_N = \frac{\text{PV net benefits}}{\text{PV net costs}} = \frac{\mathbf{W+Y+Z}}{\mathbf{B-A}} = \frac{7761518}{1640055} = 4.73$$

11 $$FYRR = \frac{\text{PV 1st year benefits}}{\text{PV net costs}} = \frac{[(\mathbf{W}+\mathbf{Y})/DF^{VOC} + (\mathbf{Z}/DF^{AC})] \times 0.93}{\mathbf{B-A}} = 0.37\ \%$$

Economic evaluation full pavement reconstruction continued…

SP5 Isolated intersection improvements continued

Worksheet 3 - Cost of Option

1 PV of estimated cost of proposed work (as per attached estimate sheets)

$ 1763500 x 0.93 = $ 1640055 **(a)**

2 PV of maintenance cost in year 1 = $ **(b)**

3 PV of annual maintenance costs following completion of the work

(years 2 to 30 inclusive) $ x 10.74 = $ 0 **(c)**

4 PV of periodic maintenance costs

Time zero 1st July in the year

Year	Type of maintenance	Amount $	SPPWF	PV

Sum of PV of periodic maintenance = $ 0 **(d)**

5 PV cost of annual operating costs (separate to maintenance costs)

(years 2 to 30 inclusive) $ x 10.74 = $ 0 **(e)**

6 PV of total costs of the preferred option

PV total costs **(a)** + **(b)** + **(c)** + **(d)** + **(e)** = $ 1640055 **B**

Transfer the PV cost for the preferred option **B**, to **B** on worksheet 1

Economic evaluation full pavement reconstruction continued…

SP5 Isolated intersection improvements continued

Worksheet 6 - Accident cost savings

	Movement category	All movements	Vehicle involvement	All vehicles	
1	Do-minimum mean speed	70	Road category	Rural Strategic	
	Posted speed limit	70	Traffic growth rate	2.00%	%
2	Option mean speed	70			

	Do-minimum	Severity: Fatal	Serious	Minor	Non-injury
3	Number of years of typical accident rate records	5			
4	Number of reported accidents over period	1	2	7	6
5	Fatal/serious severity ratio (tables A6.19(a) to (c))	0.18	0.82	1.0	1.0
6	Number of reported accidents adjusted by severity **(4)** x **(5)**	0.54	2.46	7	6
7	Accidents per year = **(6)/(3)**	0.11	0.49	1.40	1.20
8	Adjustment factor for accident trend (table A6.1(a))	1.02			
9	Adjusted accidents per year = **(7)** x **(8)**	0.110	0.501	1.426	1.222
10	Under-reporting factors (tables A6.20(a) to (b))	1	1.5	2.75	7
11	Total estimated accidents per year = **(9)** x **(10)**	0.110	0.752	3.922	8.556
12	Accident cost, 100km/h limit (tables A6.21(e) to (h))	3,800,000	405,000	24,000	2,400
13	Accident cost, 50km/h limit (tables A6.21(a) to (d))	3,350,000	360,000	21,000	2,100
14	Mean speed adjustment = ((**1**) - 50)/50	0.4			
15	Cost per accident = **(13)** + **(14)** x [**(12)** - **(13)**]	3,530,000	378,000	22,200	2,220
16	Accident cost per year = **(11)** x **(15)**	388,332	284,153	87,060	18,995
17	Total cost of accidents per year (sum of columns in row **(16)** fatal + serious + minor + non-injury)	$778,539			
	Option				
18	Percentage accident reduction	70	70	70	70
19	Percentage of accidents 'remaining' [100 - **(18)**]	30	30	30	30
20	Predicted accidents per year **(11)** x **(19)**	0.033	0.226	1.176	2.567
21	Accident cost, 100km/h limit (tables A6.21(e) to (h))	3,800,000	405,000	24,000	2,400
22	Accident cost, 50km/h limit (tables A6.21(a) to (d))	3,350,000	360,000	21,000	2,100
23	Mean speed adjustment = ((**2**) - 50)/50	0.4			
24	Cost per accident = **(22)** + **(23)** x [**(21)** - **(22)**]	3,530,000	378,000	22,200	2,220
25	Accident cost per year = **(20)** x **(24)**	116,499	85,246	26,118	5,698
26	Total cost of accidents per year (sum of columns in row **(25)** fatal + serious + minor + non-injury	$233,562			
27	Annual accident cost savings = **(17)** - **(26)**	$544,978			
28	PV accident cost savings = **(27)** x DF^{AC}	$6,467,931			E

Transfer PV of accident cost savings, **E** for the preferred option to **E** on worksheet 1

Appendix E Economic evaluation pavement overlay

Spreadsheet v 1.03 (04-June-10)

SP5 Isolated intersection improvements continued

Worksheet 1 - Evaluation summary

1	Evaluator(s)	Mark Weeds, GHD Christchurch			
	Reviewer(s)	Warren Lloyd, Viastrada Christchurch			
2	Activity/package details				
	Approved organisation name	NZ Transport Agency			
	Activity/package name	Spring Creek Safety Improvements			
	Your reference				
	Activity description	SH1/ SH62/ Ferry Road Intersection Improvements, Spring Creek			
	Describe the issues to be addressed	High crash rate at existing priority control intersection			
3	Location				
	Brief description of location	Spring Creek is located on SH1, approximately 5km north of Blenheim. SH62 Rapaura Road provides a bypass of Blenheim urban area to SH6			
4	Alternatives and options				
	Describe the do-minimum	Maintain existing stop-controlled cross-roads			
	Summarise the options assessed	Construct new roundabout			
5	Timing				
	Time zero (assumed construction start date)	1 July	2015		
	Expected duration of construction (months)		6		
6	Economic efficiency				
	Date economic evaluation completed (mm/yyyy)		29/05/2013		
	Base date for costs and benefits	1 July	2012		
	AADT at time zero		10000		
	Traffic growth rate at time zero (%)		2.00%		
	Traffic volume entering the intersection	9600	in the year	2012/13	
	Posted speed limit	70	km/h		
7	PV cost of do-minimum			$ 0	A
8	PV cost of the preferred option			$ 1385886	B
9	Benefit values from worksheet 4, 5, 6				
	PV travel time cost savings	$ 0	**C** x Update factor ^{TTC} 1.37	= $ 0	W
	PV VOC and CO_2 savings	$ 0	**D** x Update factor ^{VOC} 1.06	= $ 0	Y
	PV accident cost savings	$ 6467931	**E** x Update factor ^{AC} 1.20	= $ 7761518	Z

10 $$BCR_N = \frac{\text{PV net benefits}}{\text{PV net costs}} = \frac{\mathbf{W+Y+Z}}{\mathbf{B-A}} = \frac{7761518}{1385886} = 5.60$$

11 $$FYRR = \frac{\text{PV 1st year benefits}}{\text{PV net costs}} = \frac{[(\mathbf{W+Y}) / DF^{VOC} + (\mathbf{Z} / DF^{AC})] \times 0.93}{\mathbf{B-A}} = 0.44\ \%$$

Economic evaluation pavement overlay continued…

SP5 Isolated intersection improvements continued

Worksheet 3 - Cost of Option

1 PV of estimated cost of proposed work (as per attached estimate sheets)

$ 1490200 x 0.93 = $ 1385886 **(a)**

2 PV of maintenance cost in year 1 = $ **(b)**

3 PV of annual maintenance costs following completion of the work

(years 2 to 30 inclusive) $ x 10.74 = $ 0 **(c)**

4 PV of periodic maintenance costs

Time zero 1st July in the year

Year	Type of maintenance	Amount $	SPPWF	PV

Sum of PV of periodic maintenance = $ 0 **(d)**

5 PV cost of annual operating costs (separate to maintenance costs)

(years 2 to 30 inclusive) $ x 10.74 = $ 0 **(e)**

6 PV of total costs of the preferred option

PV total costs **(a)** + **(b)** + **(c)** + **(d)** + **(e)** = $ 1385886 **B**

Transfer the PV cost for the preferred option **B**, to **B** on worksheet 1

Economic evaluation pavement overlay continued…

SP5 Isolated intersection improvements continued

Worksheet 6 - Accident cost savings

	Movement category	All movements	Vehicle involvement	All vehicles	
1	Do-minimum mean speed	70	Road category	Rural Strategic	
	Posted speed limit	70	Traffic growth rate	2.00%	%
2	Option mean speed	70			

	Do-minimum	Severity: Fatal	Serious	Minor	Non-injury
3	Number of years of typical accident rate records	5			
4	Number of reported accidents over period	1	2	7	6
5	Fatal/serious severity ratio (tables A6.19(a) to (c))	0.18	0.82	1.0	1.0
6	Number of reported accidents adjusted by severity **(4)** x **(5)**	0.54	2.46	7	6
7	Accidents per year = **(6)/(3)**	0.11	0.49	1.40	1.20
8	Adjustment factor for accident trend (table A6.1(a))	1.02			
9	Adjusted accidents per year = **(7)** x **(8)**	0.110	0.501	1.426	1.222
10	Under-reporting factors (tables A6.20(a) to (b))	1	1.5	2.75	7
11	Total estimated accidents per year = **(9)** x **(10)**	0.110	0.752	3.922	8.556
12	Accident cost, 100km/h limit (tables A6.21(e) to (h))	3,800,000	405,000	24,000	2,400
13	Accident cost, 50km/h limit (tables A6.21(a) to (d))	3,350,000	360,000	21,000	2,100
14	Mean speed adjustment = (**(1)** - 50)/50	0.4			
15	Cost per accident = **(13)** + **(14)** x [**(12)** - **(13)**]	3,530,000	378,000	22,200	2,220
16	Accident cost per year = **(11)** x **(15)**	388,332	284,153	87,060	18,995
17	Total cost of accidents per year (sum of columns in row **(16)** fatal + serious + minor + non-injury)	$778,539			
	Option				
18	Percentage accident reduction	70	70	70	70
19	Percentage of accidents 'remaining' [100 - **(18)**]	30	30	30	30
20	Predicted accidents per year **(11)** x **(19)**	0.033	0.226	1.176	2.567
21	Accident cost, 100km/h limit (tables A6.21(e) to (h))	3,800,000	405,000	24,000	2,400
22	Accident cost, 50km/h limit (tables A6.21(a) to (d))	3,350,000	360,000	21,000	2,100
23	Mean speed adjustment = (**(2)** - 50)/50	0.4			
24	Cost per accident = **(22)** + **(23)** x [**(21)** - **(22)**]	3,530,000	378,000	22,200	2,220
25	Accident cost per year = **(20)** x **(24)**	116,499	85,246	26,118	5,698
26	Total cost of accidents per year (sum of columns in row **(25)** fatal + serious + minor + non-injury	$233,562			
27	Annual accident cost savings = **(17)** - **(26)**	$544,978			
28	PV accident cost savings = **(27)** x DF^{AC}	$6,467,931			**E**

Transfer PV of accident cost savings, **E** for the preferred option to **E** on worksheet 1

Appendix F Ten year crash DSI conversion

DSI (Death Serious Injury)	**Values**
Step 1:	
Get the current Fatal and Serious crashes per ten years	
Fatal Crashes	1
Serious Crashes	2
Step 2:	
Convert the Fatal & Serious crashes to DSIs, multiply Fatal & Serious crashes by the factors below	
Rural intersections Priority X	1.33
DSI =	3.99
Step 3	
Multiply current DSIs by the Crash reduction proportion for Fatal & Serious crashes for the project	
Reduction is 70%	2.79
Step 4:	
To get DSIs per 100 Million. Multiply number of DSIs saved in ten year by 100,000,000	
	$279,300,000
Step 5:	
Divide by cost in dollars	
Roundabout (full pavement reconstruction)	
$1,619,000	173
Roundabout (pavement overlay)	
$1,369,000	204

DSI (Death Serious Injury)

Crash Type	No	Crash severity				Adjusted DSI's (HRIG Table A3.8)	DSI Equivalents
		Fatal	Serious	Minor	Non-injury		
LB	5		1	3	1	0.35	1.4
HA	5			4	1	0.5	2
JA	2	1			1	0.36	0.36
KA	1		1			0.25	0.25
FA	1				1	0.1	0
C & D	2				2	0.3	0
						Total	**4.01**

PoF = $(9602/2 \times 3000/2)^{0.4}$ = 553

From HRIG Fig 6.3: 5 year DSI at existing priority crossroads = 0.8
From HRIG Fig 6.3: 5 year DSI at a roundabout = 0.25

Potential 5 year DSI reduction = (4.01- 0.25) / 4.01 = 94%

Potential 5 year DSI saved by roundabout = 4.01 – 0.25 = 3.76

For estimated project cost of $1.7M
4.01 x $100m / $1.7m = 236

Appendix G KiwiRail dialogue – Spring Creek

[redacted]

Hello [redacted]

Thank you for taking the time to speak with me today. The following are the notes from our discussion. I have listed all my questions in black, with my notes of your answers noted below in *blue italics* also with the [redacted] prefix

I will contact [redacted] regarding the barrier arms programme for Ferry Road. And I will also ask about having a record of the 'lights on' times for the Ferry Road signals to see if we can get average and maximum closure times for the crossing. This will allow us to determine worst case state highway queue lengths.

The text in *red italics* are questions I would like a little more information on from you, including the actual maximum length required for the double line or loop crossing, graphs showing the train schedules at Spring Creek and a list or breakdown of train lengths that use this section of track.

1. Is Spring Creek a strategic component in the KIWIRAIL (KR) rail network?

   [redacted] *- yes this is a freight centre and shunting yard for trans shipping.*

2. How much longer will Spring Creek be a strategic component?

   [redacted] *- no change is known or expected but this is constantly under review as options arise from time to time.*

3. Is there any expansion planned for Spring Creek?

   [redacted] *– is not privy to any planed changes at Spring Creek.*

4. Any planned changes to the section of double rail or sidling's layout?

   [redacted] *– the double line is a crossing loop designed for the (KR) longest train of 900m. However, a train this length is unlikely to be able to negotiate the local steep gradients and the actual longest train length will be shorter than this (*[redacted] *to confirm lengths based on gradients and weight).*

5. Are there any plans to put barrier arms on the Ferry Road crossing?

   [redacted] *will know about this* [redacted]

6. Does (KR) have a view on what will happen to its operations at Spring Creek if the Clifford bay port proceeds?

   [redacted] *– The possibility of the Clifford Bay Port being constructed has been raised from time to time over the last two to three decades. It currently has some profile but he is not aware of any planning or infrastructure projects being worked on for this eventuality.*

7. Can you send me a typical day/week/month train schedule for Spring Creek?

   [redacted] *to send graphs of train time schedules at Spring Creek).*

8. How flexible is this schedule?

   [redacted] *- The schedule can run early or late but is generally on time. Changes to the schedule are a reflection of changes in the market and freight needs. Shunts and 'specials' are not scheduled.*

9. What is a typical train length, and maximum train length

   [redacted] *– This will vary according to freight requirement. ([redacted] to send a breakdown of train lengths on this section of the network).*

10. What speed do trains travel through Spring Creek?

    [redacted] *– Express passenger 90 Km/h and Express freight 80 Km/h.*

11. Can you tell me how often and how long the Ferry Road crossing bells/lights are activated

    [redacted] *may know about this* [redacted]

12. Would (KR) allow NZTA to relocate some sections of railway line?

    [redacted] *– yes, subject to 'others' funding, with (KR) planning, design and construction/supervision approvals as required.*

13. Would (KR) allow a new section of road to cross the double loop section of track?

    [redacted] *– No, because the double loop track can be used for parking trains and wagons for a prolonged period of time.*

14. Would (KR) allow the relocation of the double section of track 250m to the north?

    [redacted] *– (KR) would look at a proposal to ensure it would still allow (KR) to operate the crossing loop and points for connections into the trans shipping area.*

15. Would (KR) allow the realignment of the Ferry Road approach to the state highway, and shift the associated (KR) hardware?

    [redacted] *– yes, but subject to 'other's funding and (KR) planning, design and construction/supervision approvals as required.*

16. Can you provide $ROC for any/all of works above?

    [redacted] *– yes, but not for multiple options, only options that are seriously under consideration.*

17. Does (KR) have a view on the residential properties fronting the rail corridor using the rail reserve to access their property?

    [redacted] *– this is probably an existing use issue, and not aware of any action on this.*

18. Does (KR) have a view on road that is currently on rail land? We are concerned that this could be a game changer if the legal boundaries were 'enforced'. Is there a mechanism where (KR) permit use or provide an easement in these situations?

    [redacted] – This is a new question [redacted] but I think it could become the elephant in the room?

Kind regards

[redacted]

ViaStrada Ltd

[redacted]

Hi [redacted],

My answers to your [three] questions in your email below:

1. The present crossing loop is 900m long. We will need to retain this capacity.
2. Graphs attached.
3. Train lengths are a function of allowable maximum gross tonnage for a particular section. The length of trains will vary depending on the mix of loaded and unloaded wagons. A train of empty wagons 900m long would be well within the allowable maximum tonnage.

It appears there are three rail tracks in the vicinity of your proposed route. The third track is the connection into Spring Creek yard. Moving the loop track and this yard connection further north will have a major impact on the yard layout and its capacity.

I am told that one of the major problems at Ferry Road Level Crossing is caused by trucks turning right onto SH1 to Picton. There is virtually no headroom between the State Highway and Level Crossing and so a truck and trailer unit will foul the tracks while waiting to turn right. Moving the level crossing further north will not alleviate this problem.

Please give me a call if you require any clarification.

Kind regards,

[redacted]

Appendix H Intersection performance comparison

		Existing	Roundabout	Traffic Signals		
				Split phase	Diamond Over Lap	Two phase
		Control Delay (Average) s				
Weekday	AM	9.3	9.6	33.4	30.8	13.9
Weekday	Noon	8.8	9.9	35.8	32.5	14.5
Weekday	PM	7.7	9.5	36.5	34.0	14.3
Saturday	Noon	9.1	10.0	40.3	35.8	15.0
Sunday	Noon	13.7	10.3	45.5	34.7	15.4
		LOS				
Weekday	AM	NA	A	C	C	B
Weekday	Noon	NA	A	D	C	B
Weekday	PM	NA	A	D	C	B
Saturday	Noon	NA	A	D	D	B
Sunday	Noon	NA	B	D	C	B
		Longest Queue (m)				
Weekday	AM	28.1	12.3	83.7	76.5	36.5
Weekday	Noon	22.1	14.4	90.0	80.2	38.0
Weekday	PM	16.5	20.8	113.1	100.7	45.3
Saturday	Noon	22.4	17.0	125.7	117.7	50.3
Sunday	Noon	44.0	23.3	160.9	117.2	54.7
		Practical spare capacity (%)				
Weekday	AM	201.6	235.3	41.6	36.5	142.7
Weekday	Noon	183.6	205.9	27.9	30.6	137.9
Weekday	PM	192.2	127.2	12.8	11.3	103.0
Saturday	Noon	113.8	161.8	3.2	5.7	87.9
Sunday	Noon	24.2	101.5	1.2	27.1	76.0

The LOS is not calculated for two-way sign controlled intersections [stop sign or give way /yield sign]. This is because the uncontrolled major road movements experience little delay at two-way sign controlled intersections, and as a result, the average intersection delay does not reflect the delay levels of minor movements subject to the sign control.

Appendix I The modified three leg roundabout

Description

The standard roundabout is modified to have three legs which means it can be located slightly further south of the intersection to avoid or minimise the land purchase requirement. There is also a design concern that northbound right turning vehicles have no storage space to queue when a train is on the crossing, providing an offset Tee intersection away from the roundabout may provide sufficient space for storage.

The modified roundabout option would see the development of a three leg roundabout on Rapaura Road with the Ferry Road approach relocated slightly further north to improve the approach angle and form a Tee intersection with SH1S. The separation distance from the roundabout should provide northbound right turning vehicle queuing space. Ferry Road will be left turn out only, requiring northbound and SH62 bound vehicles to use the roundabout. Vehicles southbound on SH1S will be able to left turn into Ferry Road and vehicles northbound on SH1S and those coming from SH62 will be able to right turn into Ferry Road protected with a physical median island.

The modified roundabout option will require consideration of how to convey a warning message to northbound right turning drivers, turning into Ferry Road that a train is presently on the crossing and they should queue to the left of SH1S before the roundabout. This can be achieved with electronic signs and communications with the transport industry.

Assessment

Table 10: Three leg roundabout features

Option	Design features	Pros	Cons
Three leg Roundabout	15 m diameter roundabout Northbound left turn slip lane removed No right turn out of Ferry Road permitted Ferry Road is left turn out only Ferry Road is left and right turn in Pedestrian crossing facilities Storage space for right turning vehicles into Ferry Road	Intersection speed controlled Provides pedestrian crossing facilities The long state highway island restrict turns into and out of businesses No land required on the west side of the intersection Increased separation between the state highway and the railway line	Requires land purchase from Kiwirail Required land may not be available There is high cost associated with relocating rail hardware Additional delay highway traffic and vehicles turning right across railway line have limited storage space and will require accommodation. Kiwirail would not consent to having the Ferry Road approach being any closer to the loop track as a parking train can block visibility to a moving train.

Crash reduction

Table 11 shows the crash types that will be reduced with the three leg roundabout against the crashes recorded.

The crash reductions shown are a combination of crash reduction information from Austroads Part 4 table 9.5 and the Transit accident countermeasure literature review research report No 10 (1992) along with engineering judgement the author has gained from previous crash reduction studies. The table does not consider crash increases associated with each treatment.

The three leg roundabout has fewer approach legs and the offset Tee of Ferry Road has reduced turn movements with the right turn out ban, which will reduce crashes. However, the southbound through vehicles may not reduce their approach speed at the Tee intersection, which increases crash injury. It is anticipated that the serious and minor (LB, HA & KA) crossing crash reduction may not be as good for the Ferry Road approach with the Tee intersection.

Table 11: Predicted crash reduction

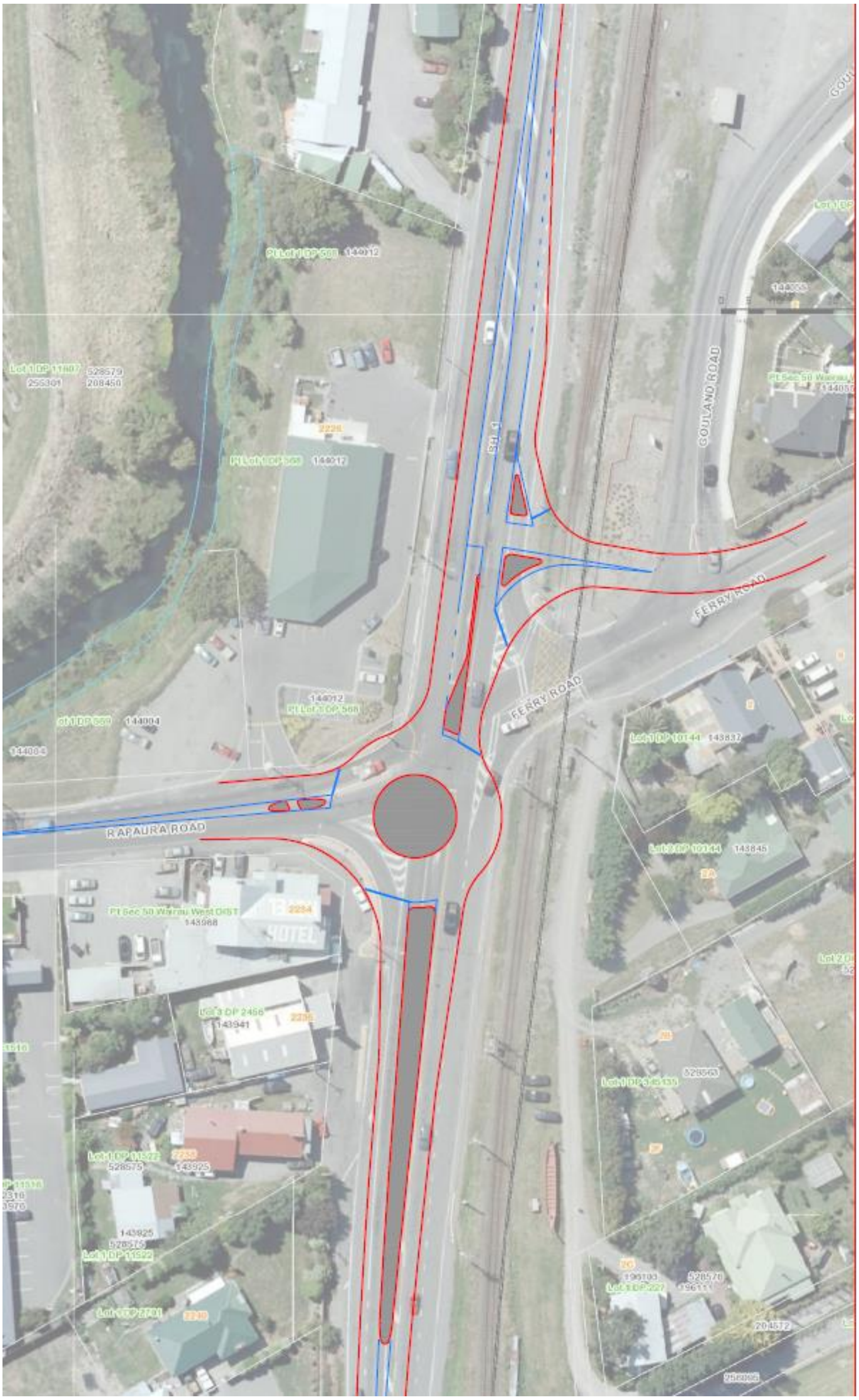
	Severity	Fatal	Serious	Minor	Non-injury
	Codes	JA	LB	LB HA KA	LB JA HA FA CB CC DA DB
	Number of crashes	1	1	8	6
Three leg roundabout Geometry		-70 %	-35 %	-35 %	-70 %

Summary

The modified roundabout option will require consideration of how to convey a warning message to northbound right turning drivers, turning into Ferry Road that a train is nearly or presently on the crossing and they should queue to the left of SH1S before the roundabout. This may be achieved with electronic signs and communications with the transport industry.

During a lengthy discussion with [redacted] Kiwirail it was discovered that relocating Ferry Road closer to the loop track creates a known crash risk to trains and traffic. There are records of crashes where drivers have seen the signals flashing and heard the bells ringing, but when they saw the train was parked, they continued across the railway line. This resulted in crashes when a moving train was obscured by the parked train. Subsequently neither Kiwirail nor NZTA would consent to this layout.

Plan of the three leg roundabout



Appendix J Resource consent decision No U 000978

MARLBOROUGH DISTRICT COUNCIL

Resource Management Act

Resource Consent No: U 000978

RC 28/1/2

Applicant	**Withers, Allan Morris**
Proposal:	To undertake earthworks in a hazard area. To build a structure within 8 metres of a stopbank. To have site access which does not meet the requirements of the General Rules of the Proposed Wairau/Awatere Resource Management Plan
Date of Site Visit	

RC No:U 000978

DECISION

Pursuant to the Resource Management Act 1991 consent is hereby granted to the application for a resource consent.

Land Use - Activity

Location: SH1, Spring Creek.

Grid Reference E 2590343 N 5971419

Subject to the following condition(s)

01 That the development proceed in accordance with the plans and application submitted to Council. Specific plan references are those drawn by Cameron Gibson & Wells Ltd, identified as job number 9820, sheets S1B, S2C, and S3B - S10B.

Land Use - Building

Location: SH 1, Spring Creek.

Grid Reference E 2590343 N 5971419

Subject to the following condition(s)

01 That the development proceed in accordance with the plans submitted to Council, drawn by Cameron Gibson & Wells Ltd, dated September 01, and identified as job number 9820, sheet S1B, sheet S2C, and sheets S3B - S10B, and held on Council file U000978.

Land Use - Land Disturbance

Location: SH 1, Spring Creek.

Grid Reference E 2590343 N 5971419

Subject to the following condition(s)

01 That the proposed earthworks and associated installation of the stormwater system be undertaken in accordance with the plans provided to Council, drawn by Cameron Gibson & Wells Ltd, dated 10/01/02, and identified as job number 9820, sheet D1 and D2, faxed to Council on 17/01/02.

F D M

RC No:U 000978

02 That Marlborough District Council be given at least 24 hours notice of the proposed earthworks through the stopbank.

03 That all excavation and re-instatement associated with the stopbank be supervised on site by a registered engineer.

Reasons

1 The proposal is deemed a non-complying activity in accordance with the most stringent criteria afforded one of the activities proposed. The applicant has obtained the approval of both Transit New Zealand and the adjoining landowner. No adverse effect on the environment, more than minor in nature, is anticipated by the proposal. Indeed given the redevelopment as a whole, it is anticipated that the effects on the environment, in respect to visual and traffic safety maters, will be quite positive.

Footnotes

1 This consent does not eliminate the need to obtain a building consent. No work may commence until a building consent is approved.

DELEGATION SCHEDULE ITEM NUMBER(S): 12 21(3)

DELEGATED COUNCIL COMMISSIONER/OFFICER(S)

APPROVED ☑ **DEFERRED FOR COMMITTEE DECISION** ☐

[signature] **Date:** 28-1-02.

Anna Straker

Resource Management Officer

Friday, 25 January 2002