Supporting Waipapa Growth: Addendum to Detailed Business Case

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October 2017

VERSION – FINAL

Additional Option Assessment: Alternative Roundabout

NZ TRANSPORT AGENCY
WAKA KOTAHI

New Zealand Government

More information

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CONTENTS

FIGURES

TABLES

APPENDICES

Appendix A – Option Drawing
Appendix B – Environmental Social Responsibility Screen (ESR)
Appendix C – Multi Criteria Analysis
Appendix D – Traffic Modelling
Appendix E – Economics
Appendix F – Cost Estimates
Appendix G – Land Requirement Plan

Additional Option Assessment: Alternative Roundabout

1. INTRODUCTION

This document is an addendum to the Supporting Waipapa Growth: Detailed Business Case, October 2017[1] (DBC), which set out the Single Stage Business Case for the State Highway 10 (SH10) / Waipapa Road intersection.

This addendum assesses the additional option put forward by a local Waipapa resident Mr. Peter Williams and outlines the assessment results for the various criteria used to evaluate the short-listed options considered in the DBC[1].

1.1 Background Information

The DBC set out the strategic case that identified the problems and benefits, the context of the case, the refinement of the problems, and the subsequent option development and evaluation framework. The option identification and evaluation process was undertaken as follows:

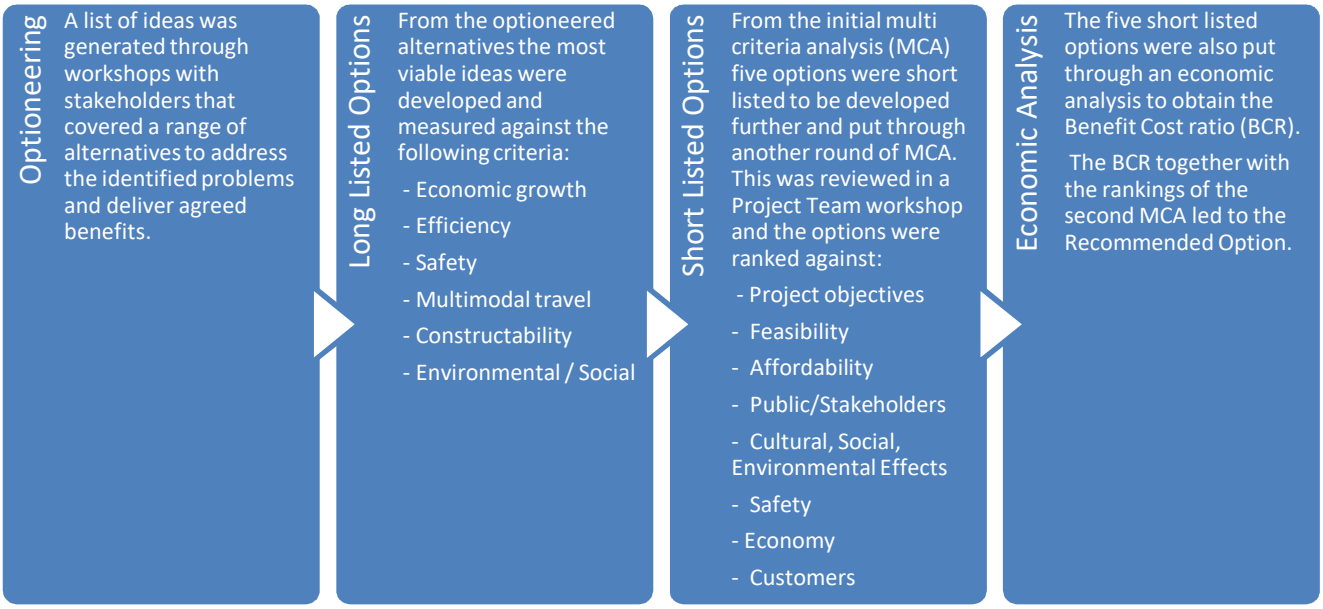

Figure 1: Option development process diagram

1.2 Problems and Benefits

The problem statements that were refined through the Strategic Case[2] capture the situation at Waipapa and are detailed in Table 1.

Table 1: Refined Problem Statements

STRATEGIC BUSINESS CASE	DETAILED BUSINESS CASE	COMMENT/JUSTIFICATION
Lack of long term integrated planning and robust zoning controls has resulted in suboptimal land use patterns and a deficient transport system (20%)	**Lack of long term integrated planning and robust zoning controls has resulted in sub-optimal land use patterns and a deficient transport system (20%)**	*No change in wording. Weighting amended for relevance to the SH10 corridor*
Disjointed and outdated Waipapa corridor transport infrastructure is a major barrier to safe and efficient multi-modal passage and realising community outcomes (45%)	**Disjointed and insufficient transport infrastructure is a major barrier to safe, efficient and reliable multi-modal passage, including visitor journeys, and realising community outcomes in Waipapa (45%)**	*Minor changes to capture tourist trips*
Landuse and network changes have significantly altered vehicle mix, journey patterns and crash profile on the State Highway and adjoining intersections (35%)	**Land use development pressure and network changes have significantly altered vehicle mix and journey patterns on the State Highway and adjoining local roads. This has led to increased pressure at key points on the network and changes to crash patterns (35%)**	*Recognising recent growth within Waipapa*

The Strategic Business Case process also finalised the benefits as follows:

- **Benefit One:** Improved Economic Growth for Waipapa and Kerikeri (10%)
- **Benefit Two:** Improved Network Efficiency (45%)
- **Benefit Three:** Increased Safety (15%)
- **Benefit Four:** Increased multi-modal travel (30%)

1.3 Short-Listed Options

From the eleven long-list of options that were identified in a workshop on 17 November 2016, five options were shortlisted as meriting closer examination after the initial Multi Criteria Analysis (MCA). The short-listed options included:

- **Right Turn Bay (RTB)**
- **Roundabout**
- **Traffic Signals**
- **Head to Head RTBs**
- **Close Waipapa Loop Road South**

In addition to the short-listed option, the **Do Minimum Option: Klinac Lane Extension** was also considered in the MCA.

1.4 Option Assessment and Preferred Option

1.4.1 Methodology

The project team carried out a more detailed analysis of the short-listed options in a final MCA to determine the Preferred Option.

The following criteria were considered and ranked against, in the MCA:

1. **Project specific objectives**
2. **Feasibility / constructability** – Property risks, consenting risks, implementability, significant hazards' risk, Whole of Life operation / maintenance costs
3. **Affordability** – Funding risks, operating cost risks
4. **Public / Stakeholders** – public expectations
5. **Cultural, Social, Environmental Effects** – Community cohesion, connectivity
6. **Economy** – based on traffic modelling outputs
7. **Customers** – local users, freight users visiting users.

The five short-listed options were compared to the Do-Minimum option of Klinac Lane Extension. The team composed of a good range of skills, with both local and regional knowledge. They readily arrived at agreement on some scores, and for others reached consensus after a healthy debate.

The team was comfortable that the final ranking of options was arrived at through fair consideration, with the outcome of the process detailed in the DBC[1] for the Do-Minimum option of upgrading Klinac Lane and the five short-listed options. The additional option of Alternative Roundabout has been considered since and the outcome is presented below.

1.4.2 Key Findings: Previously Short-Listed Options

Table 2 presents the key findings from the short-listed options MCA.

Table 2: Waipapa DBC short-list options' MCA findings

SHORT LISTED OPTION	DESCRIPTION	COST	BCR	FUNDING PROFILE
Right Turn Bays (RTB)	Minor intersection improvements with the implementation of a right turn bay for vehicles turning from SH10 into Waipapa Road. Option also includes a splitter island on Waipapa Loop Road that restrict movements from this approach to a left out only. The northern access to Waipapa Road remains open and option design encourages vehicles to use this intersection for the right turn from SH10 to Waipapa Loop Road, right turn from Waipapa Loop Road to SH10 and movements from Waipapa Loop Road to Waipapa Road. Access between Skippers Lane and Waipapa Loop Road remains unchanged.	$5.7M	2.9	LLM
Roundabout	This option includes the conversion of the existing crossroads to a single lane roundabout. This option also includes intersection rationalisation with both the northern Waipapa Loop Road access to SH10 and Skipper Lane access onto Waipapa Loop Road being closed.	$7.1M	3.1	MHM

SHORT LISTED OPTION	DESCRIPTION	COST	BCR	FUNDING PROFILE
Traffic Signals	SH 10, Waipapa Road and Waipapa Loop Road are all signalised with two lane approaches on each leg. This option also includes intersection rationalisation with both the northern Waipapa Loop Road access to SH10 and Skipper Lane access onto Waipapa Loop Road being closed. Pedestrian crossing facilities are incorporated into each leg.	$6.6M	N/A	LLL
Head to Head RTBs	This option involves shifting the Waipapa Road approach further south creating a staggered T-intersection arrangement with Waipapa Loop Road, with right turn bays into both. This option also includes intersection rationalisation with both the northern Waipapa Loop Road access to SH10 and Skipper Lane access onto Waipapa Loop Road being closed. Pedestrian links, including central refuges on the State Highway, would also be provided.	$6.2M	2.7	LLL
Close Waipapa Loop Road South	This option would completely close the intersection at the south intersection of Waipapa Loop Road, diverting all traffic through the north intersection and Skippers Lane. Access to Skippers Lane from the State Highway would only be from the south end. Pedestrian links, including central refuges on the State Highway, would also be provided.	$5.7M	2.8	LLL

1.4.3 Key Findings: Alternative Roundabout

OPTION 6: ALTERNATIVE ROUNDABOUT

Description:

This option includes the construction of a roundabout east of the existing intersection, such that the SH would be constructed offline to the existing carriageway. This option, unlike the other Roundabout option, does not include intersection rationalisation with both the northern Waipapa Loop Road access to SH10 and Skipper Lane access onto Waipapa Loop Road being closed.

KEY POINTS OF DIFFERENCE:

Alignment to investment objectives:

This option has the 2nd highest alignment to investment objectives of all considered options.

Risks:

The option is considered to pose significant risk for a number of reasons, namely, the largest footprint (both temporary and permanent), and safety concerns with the access to Skippers Lane (discussed in further detailed in Section 1.4.4 of this report). This layout would also increase traffic on Skippers Lane and therefore conflict between through-traffic and parked vehicles. It is important to note that the roundabout as drawn by the suggesting party would not be feasible and as such would have to be designed according to design standards.

Effects:

The overall effect of this option will be higher than the other options considered in terms of land take (including permanently taking rural land from the community), however the construction phase will have a lesser impact on the existing intersection and businesses as the roundabout would be able to be built offline. This option would significantly alter the general characteristic of the township, and as the roundabout will not provide a direct link to the industrial/commercial area west of SH10, it may lead to the businesses being bypassed more often. Also, the increase in impervious surfaces resulting from this option will necessitate increased drainage through a flood prone area.

Outcome:

Even though the Alternative Roundabout option has overall alignment to the investment objectives, it has a number of negative affects both in terms of safety and the environment. It is also the most expensive of all the other options considered. It meets the objectives but does produce conflict in traffic coming off/ going

on to the roundabout and the traffic from leaving the Waipapa Loop Road. As such it will not address the current issue of intersection delays for side road traffic at the same time as providing opportunity for more development within the Waipapa area.
Cost: $9.4M
BCR: 2.6
Funding Profile: MML

1.4.4 Safety

There are a few significant safety concerns related to this option. These are:

- Access to Skippers Lane, especially for larger vehicles, for example the frequent freight for the industrial / commercial properties on Skippers Lane and to the northwest of SH10.
- Lack of adequate stacking space for vehicles coming off the roundabout (SH10) queuing to turn right into Skippers Lane – this could be mitigated by changing the priority on Skippers Lane (as shown), but the separation between intersections is sub-standard.
- Lack of adequate stacking space for queuing vehicles to enter the roundabout.
- Increase in the traffic on Skippers Lane.
- Conflict between through traffic and parked vehicle/pedestrians on Skippers Lane.
- Inadequate intersection separation distances between proposed roundabout and local roads including Waipapa Loop Road and, to a lesser extent, Mawson Avenue. This leads to conflicts between people departing the roundabout and vehicles turning to and from these two local roads.

Assessment of Effects

Of the short-listed options assessed in the DBC, the Right Turn Bays option was deemed the most favourable, the Roundabout option being the second most favourable, and the remaining options being relatively equal in terms of avoiding environmental, health, heritage and social impact. As for the Alternative Roundabout, it scores as the worst option in comparison to all the other options considered, including the Do Minimum.

Appendix F presents the Environmental and Social Responsibility Screen (ESR) completed for this option.

1.4.5 Natural Environment

All short-listed options considered in the DBC[1] were relatively equal in this regard.

For this option, even though the road reserve will need to be extended, and would require a Notice of Requirement (NoR), the rural zoned land to be acquired for this option is previously disturbed land and not considered ecologically sensitive. As such, implementation of this option is not likely to have any significant adverse effects on any significant ecological, flora/fauna values.

This option requires, as with all the other short-listed options, an alteration of the SH10 and Maritime Road crossings over Whiriwhiritoa Stream. Details of these crossings are yet to be developed however, the design must ensure that alterations do not worsen the 100 year ARI upstream flood level, and do not worsen fish passage during high flow events (at least up to the 1 year ARI event). Due to a significant increase in impervious surfacing, this option has the greatest potential to increase stormwater runoff therefore compromising existing drainage infrastructure and susceptibility of surrounding land to flooding.

The change from the implementation of this option will translate to a significant change in the general characteristic of the township, especially as the through-traffic traverses on this section of SH10.

The vertical alignment correction due to the grade difference between SH10 and Skippers Lane will result in greater earthworks as compared to the other options, producing significantly more cut-to-waste.

Another important aspect resulting from the new pavement that will be produced from the implementation of this option will be the significant increase in the impervious surfaces of the area. This has the potential to reduce recharge quantities to the underlying aquifer which is used for potable drinking water for humans and stock drinking water.

1.4.6 Heritage/Archaeology

All short-listed options considered in the DBC were relatively equal in this regard. Desktop assessments confirm that the existing road reserve and the additional land in-take do not contain any significant Heritage / Archaeology values. However, as with all short-listed options, a Cultural Impact Assessment designed by the local hapû would be sought during the pre-implementation phase.

1.4.7 Land Acquisition

The Alternative Roundabout option will require the largest area of land acquisition to implement as currently suggested, with even more land requirements if it were designed to be feasible so as to meet the necessities of the intersection (safety and traffic constraints). This will translate into both the cost implication of land acquisition but additionally the increased time in consenting processes due to the additional land being zoned rural.

1.4.8 Contaminated Land

The additional land requirement for this option is largely the rural land to the east of the existing SH10. This land includes land used for orchard / agricultural purposes which are activities listed as hazardous and likely to cause land contamination under the Hazardous Activities and Industries List (HAIL). As a result, the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES Contam)[3] must be considered. This essentially means that the presence of potentially contaminated land needs to be investigated and managed accordingly.

1.4.9 Social Impact

This option would have a low impact on the local business, both during physical works and from permanent works. However, there is a possibility that the roundabout may take the drivers away from the industrial/commercial area west of SH10, due to its indirect link to this area. This will have an adverse effect to the businesses that is desired and will actually mean that one of the project objectives, *economic growth through integrated land-use*, is not met.

Impacts on Businesses from Permanent Works

The Alternative Roundabout option could improve the current patterns of movement for the community within the western extent of the town as it makes Skippers Lane more accessible. However, this option anticipates that Skippers Lane would become a connector road as opposed to a service lane with the removal of access to Waipapa Loop Road South off of SH10. This has the potential to deter customers from accessing the local businesses on this lane as traffic movements would increase as a result of the change in function and the lack of an alternative route.

There is also no information available to demonstrate how the eastern extent of the town will be connected to create a whole-of-community townscape and the businesses to the east could be adversely impacted as a result.

Furthermore, the layout of this option would be initially complex to understand how to manoeuvre, but could become more familiar in a faster timeframe than the right turn bay, head to head and closing of Waipapa Loop Road South. Improvements to traffic flow would be similar to the roundabout option therefore overall supporting of safer journeys (lesser head-to-head collisions).

This option would require moderate maintenance due to the changes in ground levels and installation of new drainage, however the risk of infrastructure failure is low so the community will receive a secure and functioning transportation route.

Impacts on Businesses During Works

The Alternative Roundabout option requires a substantial amount of new ground work to install infrastructure, resulting in extensive alteration to the existing environment with the most impact on amenity of the town and rural areas.

This option does provide businesses and the community with greater security of accessibility during works. Although traffic flow can be managed by utilisation of the existing intersection during physical work, the duration that this must occur is much longer than any of the other options due to the scale of the physical work involved.

Property rights are also impinged to a greater extent under this option with larger land acquisition required.

MCA Summary

A summary of the MCA analysis is presented below. Refer to **Appendix G** for the detailed analysis of the Alternative Roundabout option.

Table 3: Multi-criteria analysis results for each option

SUMMARY	DO MINIMUM – KLINAC LANE	RIGHT TURN BAY	ROUNDABOUT	TRAFFIC SIGNALS	HEAD TO HEAD RIGHT TURN BAYS	CLOSE WAIPAPA LOOP ROAD SOUTH	ALTERNATIVE ROUNDABOUT
Objective 1 - Economic growth through integrated land-use	0	+	+++	+++	+	–	++
Objective 2 - Improve network efficiency	––	0	++	––	+	–	+
Objective 3 - Improve safety by reducing crossing/turning crashes	––	––	++	–––	––	––	+
Objective 4 - Facilitate growth of multi-modal travel	0	++	+	++	+	+	+
Feasibility	0	–	––	–––	–	–	––
Affordability	0	0	0	0	0	0	0
Public / Stakeholders	–––	––	++	–––	––	––	+
Cultural, Social and Environmental Effects	0	++	+	+	+	+	––
Safety	––	––	++	–––	––	––	+
Economy	0	+	++	+	+	–	+
Customers	–	+	++	0	+	0	+
Ranking	**7**	**3**	**1**	**5**	**4**	**6**	**2**

Planning issues were considered neutral to all of the short-listed options, however this option will potentially require longer consenting statutory processing times due to the NoR approach for extending the road reserve into rural zoned land.

This option ranks 2nd when compared with all the other short-listed options, with the Roundabout option still ranking the highest.

2. ECONOMIC ANALYSIS

2.1 Methodology

2.1.1 Outline Economic Approach

A Benefit Cost Ratio (BCR) calculation was undertaken for the five shortlisted options, using the NZTA January 2016 Economic Evaluation Manual (EEM)[4] process. The travel time, vehicle operation cost and CO_2 were all based on SIDRA traffic modelling (**Appendix I**) outputs.

The existing crash cost was derived from weighted crash procedures, based on crash prediction models and the past five full calendar year (1st January 2011 – 31st December 2015) crash history from NZ Transport Agency Crash Analysis System (CAS). Future accident cost has been estimated according to the EEM and the Crash Estimation Compendium effective from 1 January 2016.

2.1.2 Assumptions

The general assumptions made for this Single Stage Business Case economic analysis are presented in the DBC[1].

2.1.3 Reference Case

The 'Do Minimum' option has been assumed to retain the existing intersection configuration. However, the economic evaluation assumes that the Klinac Lane link has been built as part of the Do Minimum network. Accordingly, the Do Minimum network has some change in trip distribution in the network, with more traffic using Waipapa Loop Road.

A sensitivity test has been carried out that excludes the Klinac Lane link in the Do Minimum network.

For all options (including the Do Minimum) and sensitivity tests only the benefits from the SH10/Waipapa Road intersection have been considered. Hence, any cost and benefits from the Klinac Lane extension has been ignored. The reason for this is to simplify the economic evaluation and capture the main benefits which are associated with the SH10/Waipapa Road intersection.

2.2 Economic Summary: Assessed Options

Table 4 provides a summary of the assessed options for the SH10 / Waipapa Intersection. The values in the table all reflect the net cost or benefit for the short-listed options in comparison with the Do minimum option. All values are the net present values over the 40-year analysis period using a discount factor of 6%.

Table 4: NPV net cost and benefits for short-listed options including the additional option

SHORTLISTED SCHEME OPTIONS	OPTION 1 RIGHT TURN BAY	OPTION 2 ROUND-ABOUT	OPTION 3 TRAFFIC SIGNALS	OPTION 4 HEAD TO HEAD RIGHT TURN BAY	OPTION 5 CLOSE WAIPAPA LOOP ROAD	OPTION 6 ALTERNATIVE ROUNDABOUT
COSTS						
NPV Option Cost (k)	$5,061	$6,260	$5,837	$5,434	$4,998	$8,294

SHORTLISTED SCHEME OPTIONS	OPTION 1 RIGHT TURN BAY	OPTION 2 ROUND-ABOUT	OPTION 3 TRAFFIC SIGNALS	OPTION 4 HEAD TO HEAD RIGHT TURN BAY	OPTION 5 CLOSE WAIPAPA LOOP ROAD	OPTION 6 ALTERNATIVE ROUNDABOUT
BENEFITS						
NPV Travel Time Savings (k)	$11,199	$14,572	-$8,840	$11,200	$10,834	$16,555
NPV Vehicle Operating Costs (k)	$3,180	$4,086	$2,826	$3,181	$2,897	$4,399
NPV CO2 Emissions (k)	$195	$273	$180	$195	$181	$293
NPV Accidents (k)	$320	$452	$23	$320	$320	$132
NPV Total (k)	$14,895	$19,384	-$5,810	$14,896	$14,232	$21,379
BCR	**2.9**	**3.1**	**N/A**	**2.7**	**2.8**	**2.6**

As the table above illustrates, all assessed options have a BCR between 2.5 and 3.1, with the exception of the signalised option that has negative benefits and hence a BCR on this option was not considered further. The Roundabout option has the highest benefits in comparison with the Do Minimum option but also has slightly higher costs. The Alternative Roundabout has the highest costs for implementation.

The economics assessment worksheets are presented in **Appendix J**.

The Original Roundabout is still the Preferred Option in this analysis because of the following reasons:

- The two roundabout options are the only options that increase the capacity in the intersection, which means that the initial investment for a roundabout will:
  - provide benefits for a longer period of time;
  - will best manage high traffic growth; and
  - will not be as sensitive to change in traffic turning patterns.

- A roundabout caters well for all traffic movements in the intersection, whilst most other options, except traffic signal, prioritise SH10 movements at the expense of a still quite poor level of service for side traffic.
- The original Roundabout option is preferred over the Alternative Roundabout as it is considered to be a safer option and it also provides a more efficient route for local traffic accessing the Waipapa commercial zone.
- From a safety perspective, the original Roundabout option provides intersection rationalisation with Waipapa Loop Road north being closed as part of the design. The original Roundabout concept is also positioned further away from Mawson Avenue, therefore reducing the risk of crashes at the Waipapa Road / Mawson Avenue intersection.
- From an efficiency point of view, the Alternative Roundabout makes it harder for traffic to access Waipapa Commercial area as they will have to drive via Skippers Lane, which will take longer and also impose a conflict with other traffic, parked vehicles, and pedestrians using this road. The original Roundabout option is a more cost effective option with the construction estimate being approximately $2M lower in cost.

- One of the only benefits offered by the Alternative Roundabout is that it has less impact on the local businesses and it can be constructed 'offline' to the existing SH and therefore with less disruption during the construction period.

2.3 Comparison with Earlier Stages

This project is a Single Stage Business Case and no previous economics were undertaken for this project.

2.4 Sensitivity Analysis

A sensitivity test has not been undertaken for the Alternative Roundabout option. This is due to the fact that the BCR for this option will always be lower than the original Roundabout option as the cost for this option is higher and the benefits are similar.

2.5 Incremental Analysis

An incremental benefit analysis has been undertaken to illustrate the economic return for the additional investment between each of the options. However, it should be noted that the variation in construction cost estimates between the different options is relatively small, and there is little scope to implement this project in stages. As Figure 2 illustrates the construction cost for all options range from approximately $5M to $8.4M.

Key points from incremental Analyses are:

- The two roundabout options provide the most benefits.
- The incremental BCR for the original Roundabout option is 3.2 in comparison with Option 1.
- The incremental BCR for the Alternative Roundabout option is below 1.0 in comparison with the original Roundabout option.

From an incremental; perspective the original Roundabout provides the best option. The incremental analysis shows that the additional $1.6M invested in the original roundabout will give an economic return of around $5M.

The alternative roundabout construction cost is approximate $2M more than the original roundabout but is generate similar benefits. Hence, the incremental BCR is lower than 1.0 and is considered a poor investment.

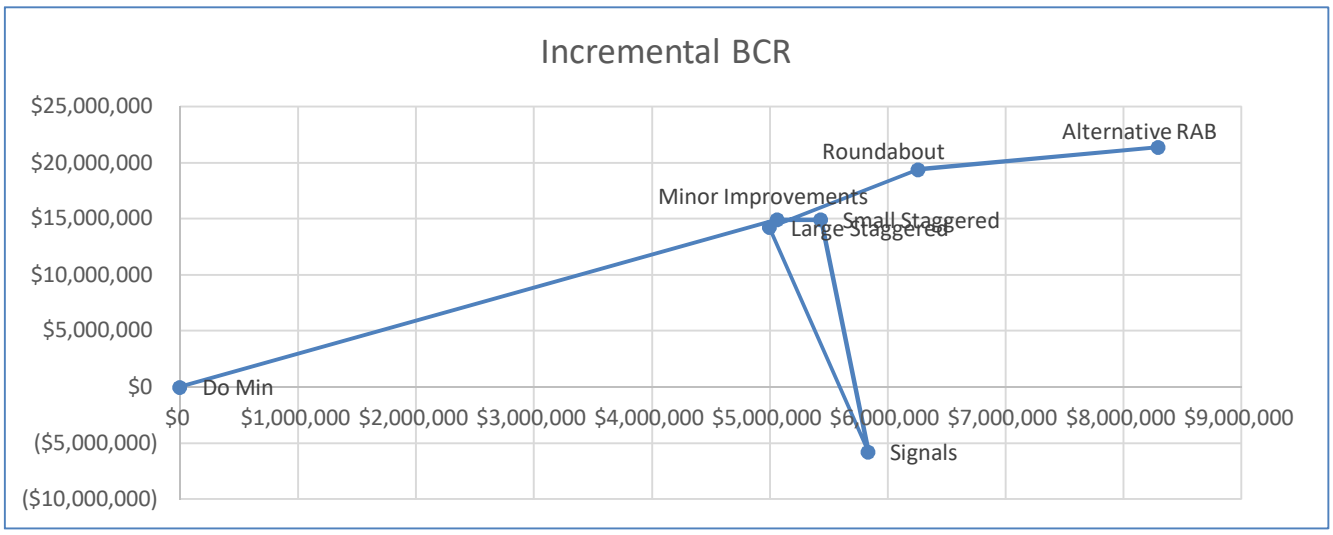

Figure 2: Incremental analysis

2.6 Assessment Profile

An assessment profile of **MHM** has been determined for the Preferred Option of the Roundabout and Corridor Treatment. The derivation of the assessment profile is discussed in detail in the DBC[1].

The assessment profile for the Alternative Roundabout option is **MML**[2].

2.7 Recommended Option – Conclusions

The Roundabout option remains the Recommended Option, which scored well to very well on almost all the main criteria.

The DBC[1] concluded that the Roundabout option scored low on just one criteria, 'feasibility / constructability', but this is only relative to the other options, and it remains perfectly feasible. The score simply recognises that this option has the largest physical 'footprint' and is likely to have higher ongoing maintenance costs than other options due to factors like seal stress and landscaping upkeep.

Importantly, the Roundabout is clearly the stand-out option in terms of meeting the four main project Objectives.

On comparison of the Roundabout and the Alternative Roundabout options, the following salient points are noted in Table 5.

Table 5: Assessment comparison – Roundabout versus Alternative Roundabout

CRITERIA	ROUNDABOUT OPTION	ALTERNATIVE ROUNDABOUT OPTION
Objective 1 - Economic growth through integrated land-use	· This option provides a significantly better situation than the Do Minimum in terms of ease of movement in all directions. · This option provides a gateway treatment to the Waipapa area. For tourism, this option is considered optimum, especially for Twin Coast Discovery Highway movements. · This option will allow a more integrated intersection in terms of connections to the commercial areas to the west of SH10.	· This option also provides a significantly better situation than the Do Minimum in terms of ease of movement in all directions. · This option also provides a gateway treatment to the Waipapa area. For tourism, this option is considered optimum, especially for Twin Coast Discovery Highway movements. · This option will allow for a less integrated intersection in terms of connections to the commercial areas to the west of SH10. Due to the circuitous nature of the route from the roundabout to the commercial area, motorists are more likely to continue to use Kahikatearoa Road to access the commercial area.
Objective 2 - Improve network efficiency	· This option provides the best overall efficiency benefits. The roundabout would be constructed	· This option would be constructed offline to the east of the existing SH10. While this will furnish benefits during the construction

[2] Also refer to the detailed MCA sheet in Appendix C.

CRITERIA	ROUNDABOUT OPTION	ALTERNATIVE ROUNDABOUT OPTION
Objective 2 - Improve network efficiency *(continued)*	on the existing alignment, making use of the existing infrastructure. · Pedestrian crossing points are necessarily some distance from the desire lines for crossing, but careful design can still accommodate suitable facility.	phase, minimising disruption to traffic and businesses, in terms of permanent affects it will only provide an indirect link to the commercial area. · Pedestrian crossing points may be even further than the desire lines for the '*Roundabout*' option. · Inefficiencies around the Skippers Lane intersection due to the proximity to the roundabout.
Objective 3 - Improve safety by reducing crossing / turning crashes	· Roundabouts significantly reduce the number of conflict points and, for most users, will represent a safe and easy option. Even though they can have a higher number of crashes compared to some other intersection treatments, incidents tend to be of a lesser severity due to lower speeds. · It is reasonably assumed that safe cycling provision can be addressed satisfactorily by careful design.	· Similar to the other roundabout option, it will reduce the volume of head-to-head collisions and therefore reduce the severity of crashes. · Due to nature of this option, it will generate additional hazards that are not present for the other roundabout option. These are related to the proximity of the Skippers Lane and Mawson Ave intersections.
Objective 4 - Facilitate growth of multi-modal travel	· Pedestrian movements can be well provided-for with uncontrolled crossing points, but some of the designed walking routes across the intersection will unavoidably be at some distance from the 'desire lines' due to practical constraints. · Cycling provision can be carefully designed for but less confident cyclists may find roundabouts less desirable.	· Pedestrian movements can be well-provided for but the desire-lines may be unavoidably even further away from the businesses, etc. as compared to the other roundabout option due to practical constraints. · Cycling provision can be carefully designed for but less confident cyclists may find roundabouts less desirable.

3. REFERENCES

1. Supporting Waipapa Growth: Detailed Business Case, NZTA, October 2017
2. Supporting Waipapa Growth – Strategic Business Case, NZTA, February 2016
3. Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health), Regulations 2011
4. Economic Evaluation Manual, NZTA, January 2016

APPENDIX A
Option Drawing

DRAWING IN PROGRESS

PLOTTED ON 2017-10-10 AT 2:52 PM

CONCEPT - NOT FOR CONSTRUCTION

Revision	Amendment	Approved	Revision Date
A	ISSUED FOR INFORMATION		2017-10-10

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Designed	Approved	Approved Date
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Drawn	Scales
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Project
NZ TRANSPORT AGENCY
STATE HIGHWAY 10 / WAIPAPA ROAD
INTERSECTION IMPROVEMENTS

Sheet
ALTERNATIVE ROUNDABOUT OPTION
PLAN

Project No.	Sheet. No.	Revision
1-11751.00	X100	A

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1:1000 @ A3
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APPENDIX B Environmental Social Responsibility Screen (ESR)

ENVIRONMENTAL AND SOCIAL RESPONSIBILITY SCREEN V2.FEBRUARY 2016

Use to assess options in the Indicative Business Case

Use this screen to identify opportunities and risks and assess options for state highway projects. Complete the screen for each option to distinguish them from one another or bundle options where appropriate. Screen results will signal where technical assessments are required and provide a written record to support the alternatives assessment required for statutory applications. For further assistance contact the EUD Team.

Additional instructions and content, including information sources, to help complete the screen can be found on the Highways Information Portal Screen pages here

Decide how many times screen should be filled out (Group Options) ▶ Answer screen questions using project information and suggested information sources ▶ Refer to screen questions explanation, particularly if you answered yes to any of the questions ▶ Complete page 2 of screen ▶ Incorporate page 2 text in IBC assessment of options table (Background and MCA)

PROJECT LOCATION:	PROJECT PURPOSE:	DATE:	OPTION DESCRIPTION:
Waipapa State Highway 10	Intersection Upgrade	29/09/2017	Alternative Roundabout

CATEGORY		QUESTION	ANSWER				USEFUL INFORMATION SOURCES
GENERAL	G1	What is the zoning of adjacent land? Are there any encumbrances on the land? e.g. Maori Reserve or other reserve/covenants	Rural	◉	Commercial	○	District/Unitary Plan Zoning Maps
			Industrial	○	Residential	○	
			High density residential	○	Parks/open space	○	
	G2	Does the option disturb previously undisturbed land?	Y	○	N	●	
	G3	What is the construction timeframe?	>18 months	○	<18 months	●	
NATURAL ENVIRONMENT	NE1	Are there any outstanding/significant natural features (e.g. geological or geothermal)/landscapes?	Y	○	N	●	NZTA MapHub Environmental and Social Risk Map- Natural Environment
	NE2	Will the option affect the coastal marine area, wetlands, lakes, rivers, streams or their margins?	Y	●	N	○	Regional Plan Maps and Schedules
	NE3	Will the option affect areas of the conservation estate, or areas of known significance for biodiversity or known habitats of uncommon or threatened species?	Y	○	N	●	District Plan Maps and Schedules
	NE4	Is the option in an area of potential hazard risk e.g. fault lines, significant erosion, flooding, sea level rise etc?	Y	●	N	○	Department of Conservation
	NE5	Will more than 0.5 hectares of vegetation be removed?	Y	○	N	●	
		What type?					
CULTURAL AND HISTORIC HERITAGE	CH1	Are there sites/areas of significance to Maori within 200m of the area of interest?	Y	○	N	●	Iwi NZTA MapHub Environmental and Social Risk Map- Culture and Heritage Heritage New Zealand List NZ Archaeological Association District Plan Maps and Schedules Regional Plan Maps and Schedules IPENZ Heritage List NZTA GIS predictive models
	CH2	Are any recorded, scheduled or listed archaeological sites within 200m of the area of interest?	Y	○	N	●	
	CH3	Are any scheduled, listed or other important heritage buildings/ structures within 200m of the area of interest?	Y	○	N	●	
	CH4	Will the option affect the setting of any historic building/structure or archaeological site?	Y	○	N	●	
	CH5	Is a group of archaeological sites or an area of historic built environment (even partially) within 200m of the area of interest?	Y	○	N	●	
HUMAN HEALTH	HH1	What is the One Network Road Classification?	National	○	Regional	◉	NZTA MapHub Environmental and Social Risk Maps- Human Health and Community which includes: - Designated airsheds (including one network classification) - Highly sensitive receivers Regional Council Contaminated sites Team
			Arterial	○	Collector	○	
	HH2	Is the area of interest designated as a non-compliant airshed?	Y	○	N	●	
	HH3	Are there medical sites, rest homes, schools, child care sites, residential properties, maraes or other sensitive receivers located within 200m of the area of interest?	Y	○	N	●	
	HH4	Does land use within 200m of the area of interest include industrial sites, chemical manufacturing or storage, petrol stations, vehicle maintenance, timber processing/treatment, substations, rail yards, landfills or involve other activities that may result in ground contamination?	Y	●	N	○	
		OR Are there HAIL or SLUR (contaminated) sites within 200m of the area of interest?	Y	●	N	○	
SOCIAL	S1	Does the option affect access to community facilities i.e. libraries, open space etc (either temporarily or permanently)?	Y	○	N	●	NZTA MapHub Project Team District Plan Maps Council and Community Strategy Documents
			Which?				
	S2	Does the option affect community cohesion and accessibility including vehicular connectivity on the local road network?	Y	●	N	○	
URBAN AND LANDSCAPE DESIGN	ULD 1	Are there opportunities to enhance infrastructure for, and/or improve access to, public transport and/or active modes of travel such as as walking and cycling?	Y	●	N	○	NZTA MapHub Environmental and Social Risk Map- Natural Environment (Scenic Routes) Regional Land Transport Plan Project Team Strategies and District Plan
	ULD2	Does the option enhance the development potential of adjacent land where appropriate?	Y	●	N	○	
	ULD3	Is the option located on a themed highway? Is the option part of or near a national cycle or walking route?	Y	●	N	○	
	ULD4	Are there opportunities to enhance the urban character, landscape character and visual amenity?	Y	●	N	○	

Answers and Comments	Refer to screen questions explanation to help complete this part.

1. **Summarize the potential environmental and social risks/impacts associated with this option. Consider short and long term risks and impacts.**

NATURAL ENVIRONMENT:	Works footprint is pre-disturbed, contains no significant ecological/flora/fauna values. SH10 and Maritime Road both cross a stream. Any crossings of the stream must not worsen upstream flooding up to 100 year ARI, and must not worsen fish passage up to 1 year ARI. This option is less ideal than the others as it will take up a substantial portion of rural land outside of the existing road reserve, these areas will be impermeable, resulting to significant increases in rainwater runoff and need for additional drainage, and significant amounts of earthworks will be required to establish vertical alignment.
CULTURAL AND HISTORIC HERITAGE:	Works footprint is pre-disturbed, contains no significant archaeology/heritage values.
HUMAN HEALTH:	Substantial portion of land needs to be taken from former orchard. Possible ongoing use of persistent pesticides on this land. Contaminated land investigation would be required.
SOCIAL:	Will be less disruptive to traffic utilising current alignment during works. However will take a substantial portion of rural land away from the community.

The responses above will be used in the IBC assessment of options summary table: MCA of the Option.

URBAN AND LANDSCAPE DESIGN:	This option would result in a substantial change to the existing intersection and the township of Waipapa. Significant urban/landscaping design inputs would be required to "blend" it in.

Incorporate the relevant comments from above into the economy, social and geography sections of the IBC assessment of options summary table.

2. **What are the environmental, social integration, landscape design or urban design benefits or opportunities presented by this option? Particularly record opportunities that could be lost if not considered early in the design process.**

The main benefit of this option is that the construction works could primarily occur offline. Therefore this option minimises disruption to traffic and businesses on existing alignment during works. The community perception should be sought regarding the permanent loss of rural land, and the high likelihood that the general amenity/characteristic of Waipapa will change as a result of this significant shift in road alignment.

3. **Are there any impacts, risks or opportunities which require preliminary technical assessments to help understand risks or opportunities? Is further information required to support the development of the detailed business case or can it be left until the detailed business case/pre-implementation?**

Potential flooding risks/fish passage risks from SH 10 and Maritime Road Creek Crossings need to be addressed. This option will significant increase impermeable surfaces and will increase runoff during rainfall, possibly impacting on flooding issues at this location. Contaminated land investigation will also be important on the former orchard.

Completed by	Mark Farrey	
Reviewed by NZTA Project Manager		
Incorporated results into IBC assessment of options summary table?	**Yes** ●	**No** ○

APPENDIX C
Multi Criteria Analysis

ASSESSMENT SUMMARY TABLE – ALTERNATIVE ROUNDABOUT

Business case name	SH10 Waipapa Road Intersection Improvements	Name of Project Manager & Region	Sebastian Reed, Auckland / Northland
Business case purpose	To upgrade the SH10 Waipapa Road Intersection to improve the economic growth, efficiency, safety, and to promote of multi-modal travel in the Northland region.		

Option description

Description: This option, unlike the other Roundabout option, does not include intersection rationalisation with both the northern Waipapa Loop Road access to SH10 and Skipper Lane access onto Waipapa Loop Road being closed. It is understood that urban roundabouts typically have a 55% effectiveness in crash reduction (Austroads Road Safety Engineering Toolkit). However, facilities for pedestrians and cyclists would have to be incorporated into the design.

Dependencies: None

Estimated total public sector funding requirement	Lower	Upper
Capital cost ($m):	$7,753,811	$9,353,609
Net property cost ($m):	$1,946,750	$2,336,100
Opex ($m/30yr):		
Maintenance ($m/30yr):		
Present value of cost to govt. ($m):		

Estimated BCR range						
Timing of need:	***Optimal programme**:*		***Likely**:*			
IAF profile	*Strategic fit*	M	*Effectiveness*	M	*Efficiency*	L

ASSESSMENT SUMMARY TABLE – ALTERNATIVE ROUNDABOUT

Criterion	Score	Discussion
Objective 1: Economic Growth through integrated land-use	++	Even though a roundabout option provides a significantly better situation than *Do Minimum* in terms of ease of movement; as compared to the other *roundabout option*, this option does not provide equal movement in all directions. It does provide a gateway treatment to the Waipapa area, but because of the circuitous nature of the route into the commercial area, motorists are more likely to continue to use Kahikatearoa Road. This could adversely impact the businesses as a result with the SH10 traffic and pedestrian traffic from the east of the township having a perception of disconnectivity to the commercial area to the west of SH10.
Objective 2: Improve network efficiency	+	This option provides some efficiency benefits in terms of SH through traffic but there will be inefficiencies introduced due to the proximity of Skippers Lane to the roundabout. The pedestrian crossing points will necessarily be some distance from the desire lines for crossing.
Objective 3: Improve safety by reducing crossing/turning crashes	+	This option will significantly reduce the number of conflict points and, for most users, will represent a safe and easy option. Even though roundabouts can have a higher number of crashes, compared to other intersection treatments, but these tend to be of a lesser severity due to lower speeds. It is assumed cycling provision can be carefully designed for. However, the alternative roundabout introduces additional risks at both Skippers Lane and Mawson Ave because of the lack of separation.
Objective 4: Facilitate growth of multimodal travel	+	This option can provide well thought out pedestrian movements, with uncontrolled crossing points. But some of the walking routes across the intersection are at some distance from the desire lines, even more so than for the other *roundabout option*. Cycling provision can be carefully designed for but less confident cyclists may find roundabouts less desirable.
Feasibility	--	This option will require the most land take, and will have the largest overall footprint of all the considered options. And as this land take will be of rural zoned land, it will lead to the consenting route to be longer due to statutory timeframes. In terms of whole of life operation/maintenance this option is similar to the other *roundabout option*, and will pose greater stress on seal requiring higher maintenance and/or earlier reseal, and requiring ongoing landscaping maintenance. This option can be constructed offline and therefore will be less inconvenient to businesses and traffic but as it will require a larger scale construction (of new pavement, drainage, etc. and additional earthworks not required by other options) any time saving in the offline construction will be consumed by these additional works.
Affordability	0	Whilst costs vary somewhat between options, the affordability of whatever becomes the preferred option will be considered to be "affordable" if economically viable overall.
Public/Stake-holders	+	The community are all very much expecting the solution to be a roundabout, based on various prior forms of awareness of a potential project at this intersection. The community is also expecting this option to be selected due to the success of the nearby SH10 / Kerikeri Rd Roundabout. This option has less impact on existing businesses that than the other *roundabout option*. However, the community may have concerns around the viability of this option compared to the other *roundabout option*.

ASSESSMENT SUMMARY TABLE – ALTERNATIVE ROUNDABOUT		
Environmental and social	--	This option will require the largest amount of land take, a good portion of which is currently zoned 'rural'. This would require the road reserve to be extended, and would require a Notice of Requirement (NoR), however as the rural zoned land to be acquired is previously disturbed land and not considered ecologically sensitive, it is not likely to have any significant adverse effects on any significant ecological, flora/fauna values. The change from the implementation of this option will translate to a significant change in the general characteristic of the township. The vertical alignment correction due to the grade difference between SH10 and Skippers Lane will result in greater earthworks as compared to the other options, producing significantly more cut-to-waste. Also, the construction of new pavement will mean significant increase in the impervious surfaces of the area. The pedestrian and vehicular traffic connectivity to all amenities, both to the east and west of SH10 will have to be considered carefully as it will be potentially affected by the positioning of the roundabout and the free-flowing traffic.
Safety	+	This option will significantly reduce the number of conflict points at the intersection and, for most users, will represent a safe and easy option. Even though roundabouts can have a higher number of crashes, compared to other intersection treatments, these tend to be of a lesser severity due to lower speeds. It is assumed cycling provision can be carefully designed for. Inadequate intersection separation distances between proposed roundabout and local roads including Skippers Lane and Mawson Avenue Intersection. There will also be an increase of traffic using Skippers Lane, which is currently a service lane, which will increase potential conflicts between parked cars, deliveries and through traffic.
Economy	+	A Traffic Modelling Study was conducted and found that that this option is the second most preferred among all the options considered.
Environmental opportunities	There is some opportunity to clean up any potential contamination from the land in-take from the orchard and adjacent agricultural section. Also, for some landscaping on the actual roundabout.	
Social opportunities	There are no social opportunities associated with this option.	
Rationale for selection or rejection of alternative	This option is rated 2nd of the options considered as it provides some benefits related to it being a '*roundabout*' and the offline construction causing less disruption during the physical works. The disbenefits being that this option is the most expensive of the options considered, has some safety concerns due to inadequate intersection separation distances between the roundabout and the local roads, has some negative environmental impacts, and longer consenting timeframe.	

APPENDIX D
Traffic Modelling

Author of Spreadsheet: Kristoffer Hansson
Reviewed: Joanna Jarvie, Nerissa Harrison

Opus International Consultants

Waipapa Road/SH10 Intersection
Economic Analysis Inputs - using SIDRA model outputs

Assumptions and input data | **Worksheets A2.1 to A2.8**

Evaluation carried out in accordance with

Manual:	NZTA's EEM (volume 1)
Revision:	First Edition, Amendment 0
Date:	Effective from 1 July 2013

Project Timing:

Date of Evaluation:	31-Mar-17			
Base date is 1 July	2016			
Time Zero is 1 July	2017			
Discount Factor	6.00%			
Earliest Start of Construction is	1-Oct-18	ie at Time =	1.25	
Construction Period is	6.0	months		
Construction Period ends	1-Apr-19	ie at Time =	1.75	2016
		Analysis period extends to 40 years after the start of construction, to Time=	41.25	2041

Construction Cost of Options (+MSQA)

Expected Construction Costs - 1st July	**1st period**	**Total Expected Estimate**
Time Period		
Discount period - midpoint	1.50	
Do Min		
Option 1 (Right Turn Bay))	$4,926,802	$5,722,276
Option 2 (4 Leg Roundabout)	$5,362,676	$7,069,265
Option 3 (Signals)	$5,575,956	$6,597,650
Option 4 (Head to Head Right turn Bays)	$5,142,295	$6,141,090
Option 5 (Close Waipapa Loop)	$5,058,386	$5,652,450
Option 6 Alternative Roundabout	$6,330,048	$9,353,609

Expected Land Cost of Options	**1st period**
Time Period	Oct-18
Discount period	1.25
Do Min	$0.0
Option 1 (Right Turn Bay))	$329,700.0
Option 2 (4 Leg Roundabout)	$1,198,500.0
Option 3 (Signals)	$492,900.0
Option 4 (Head to Head Right turn Bays)	$512,100.0
Option 5 (Close Waipapa Loop)	$112,500.0
Option 6 Alternative Roundabout	$2,336,100.0

Expected **Fees** -	**1st period**	**2nd period**
Time Period	I/R	Specimen Design And Project Documentation
Discount period - midpoint	0.25	0.75
Do Min		
Option 1 (Right Turn Bay))	$232,887.0	$232,887.0
Option 2 (4 Leg Roundabout)	$254,044.5	$254,044.5
Option 3 (Signals)	$264,397.0	$264,397.0
Option 4 (Head to Head Right turn Bays)	$243,347.5	$243,347.5
Option 5 (Close Waipapa Loop)	$239,408.0	$242,156.0
Option 6 Alternative Roundabout	$343,730.5	$343,730.5

Accident Savings are based on:

			Action			
Step 1	More than 1500vpd	Yes	Five year accident data	AADT	3,857	source: NZTA Count S
Step 2	Crash history adequate	Yes	Go to step 3	Traffic growth rate	2.20%	source: Based on 5 yea
Step 3	Significant change in last three years	No	Go to step 4	Growth rate ajustment for use in crash cost =	-2.00%	
Step 4	Minimum of crashes ≥ 5 injury or ≥ 2 serious and fatal	No	Go to step 5	Accident growth rate = 0.20%		
Step 5	Are Crash Prediction Models or crash rates available for the do minimum and project	Yes	Go to Step 7			
	Fundamental Change	Yes	Method C for do min and Method B for Project Option			
Step 7					Table A6.1(a)	
	Fundamental Change	No	Method C for do minimum and project Option	Accident Trend Adjustment	0.965	
Conclusion	Do Min	Method C				
	Option 1 (Right Turn Bay))	Method B				
	Option 2 (4 Leg Roundabout)	Method B				
	Option 3 (Signals)	Method B				
	Option 4 (Head to Head Right turn Bays)	Method B				
	Option 5 (Close Waipapa Loop)	Method B				

Traffic Volume Inputs & Model Assumptions

SIDRA 7.0.5.6563 software used to determine the annual operating costs

Author of Spreadsheet: Kristoffer Hansson
Reviewed: Joanna Jarvie, Nerissa Harrison

Opus International Consultants

Project Operating Costs

Operating costs are based on SIDRA outputs
Vehicle Operating costs are determined from fuel usage outputs
Travel time costs are based on average sidra delays
CO2 is calculated from Sidra CO2 outputs
Benefits begin after construction (all benefits prior to construction are assummed to be equal)

Annualisation Factors

TIME PERIOD DATA				
PERIOD	DESCRIPTION	hr/day	days/year	*hrs/year*
1	AM Peak (1hr)	1	245	*245*
2	PM Peak (1hr)	2	245	*490*
3	IP Peak (1hr)	8	245	*1960*
4	Saturday (1hr)	6	52	*312*
5 Sunday	Sunday (1hr)	6	68	*408*
5 off peak	Off peak			*5345*

8760.00 8760

TT and VOC Cost Values used in economics

TT & CRV COST/HR	**tab A4.3**	**RS**
Period	**TT**	**CRV**
1	15.13	3.88
2	14.96	3.79
3	17.95	3.60
4	14.09	4.26
5	14.09	4.26

VOC based on total fuel used and an equivalent resource cost
other VOC components considered to be the same

VOC costs (BASED ON $1.49/LITRE * 1 (factor to get total VOC))	
Period	$/litre
all periods	1.49

UPDATE FACTORS 2002 TO		2016
OPERATING COSTS		
	TT	1.45
	VOC	0.98
	ACC	1.03
CONSTRUCTION COSTS		
	Estimate at year	2017
	Base date =	2016
	Factor for base date =	0.96

YEARLY OPERATING COST WORKSHEET

1 hour modelled period

ALTERNATIVE ROUNDABOUT

Year	Time Period	Total Travel Time	Number of Vehicles (veh/hr)	Travel Time Cost			VOC		CO2		Periods/Yr	Yearly Cost		
				Travel Time Cost	V/C	CRV Additional Congestion Cost	Fuel use litres/period	Cost/litre	CO2 Tonnes	Cost/Tonne		TT	VOC	CO2
2016	AM Peak (1hr)	2.95	1435	$45	0.47	$0	185.50	1.49	0.44	40	245	$10,944	$67,717	$4,345
	PM Peak (1hr)	2.89	1339	$43	0.36	$0	173.50	1.49	0.42	40	490	$21,207	$126,672	$8,136
	IP Peak (1hr)	2.02	1055	$36	0.24	$0	132.70	1.49	0.32	40	1960	$71,208	$387,537	$24,853
	Saturday (1hr)	2.02	1055	$29	0.24	$0	132.7	1.49	0.317	40	312	$8,898	$61,690	$3,956
	Sunday	1.60	858	$23	0.47	$0	107.9	1.49	0.2576	40	408	$9,188	$65,595	$4,204
	Night											$6,223	$11,690	
											TOTAL	$127,668	$720,900	$45,494
2026	AM Peak (1hr)	4.20	1845	$64	0.63	$0	241.5	1.49	0.577	40	245	$15,568	$88,160	$5,657
	PM Peak (1hr)	4.29	1780	$64	0.51	$0	233.7	1.49	0.559	40	490	$31,427	$170,624	$10,954
	IP Peak (1hr)	2.92	1419	$52	0.38	$0	180.4	1.49	0.431	40	1960	$102,729	$526,840	$33,790
	Saturday (1hr)	2.92	1419	$41	0.38	$0	180.4	1.49	0.431	40	312	$12,836	$83,864	$5,379
	Sunday	2.28	1157	$32	0.27	$0	146.4	1.49	0.3499	40	408	$13,097	$88,999	$5,710
	Night											$7,592	$14,262	
											TOTAL	$183,249	$972,750	$61,491
2036	AM Peak (1hr)	8.03	2335	$122	0.86	$16	316.3	1.49	0.756	40	245	$33,755	$115,465	$7,411
	PM Peak (1hr)	7.62	2289	$114	0.75	$5	309.2	1.49	0.739	40	490	$58,285	$225,747	$14,490
	IP Peak (1hr)	4.12	1829	$74	0.49	$0	235.4	1.49	0.563	40	1960	$144,991	$687,462	$44,147
	Saturday (1hr)	4.12	1829	$58	0.49	$0	235.4	1.49	0.563	40	312	$18,117	$109,433	$7,027
	Sunday	3.14	1491	$44	0.38	$0	190.5	1.49	0.4555	40	408	$18,080	$115,809	$7,434
	Night											$8,961	$16,833	
											TOTAL	$282,189	$1,270,749	$80,509
2056	AM Peak (1hr)	12.24	2517	$185	0.94	$38	349.7	1.49	0.836	40	245	$54,663	$127,658	$8,191
	PM Peak (1hr)	10.95	2474	$164	0.88	$25	341.8	1.49	0.817	40	490	$92,633	$249,548	$16,015
	IP Peak (1hr)	4.51	2011	$81	0.54	$0	260.9	1.49	0.624	40	1960	$158,800	$761,932	$48,937
	Saturday (1hr)	4.51	2011	$64	0.54	$0	260.9	1.49	0.624	40	312	$19,842	$121,287	$7,790
	Sunday	3.55	1640	$50		$0	211	1.49	0.5044	40	408	$20,393	$128,271	$8,232
	Night											$8,961	$16,833	
											TOTAL	$355,293	$1,405,530	$89,165

ACCIDENT BY ACCIDENT ANALYSIS - DO MINIMUM

WORKSHEET A6.2

Project Name:	Waipapa Road/SH10 Intersection	**Posted Speed Limit:**	70	km/h
Vehicle Involvement:	All	**Mean Speed:**	100	km/h
		Road Category:	70	
		Traffic growth rate	2.20%	%

Crash Type	Crash Cost (per Year)
Lost Control off Road	2,303
Head On	5,613
Crossing, Direct	0
Crossing Turning	9,211
Rear End, Crossing	8,635
	25,762

Lost Control off Road	**Injury Severity**				
	Fatal	**Serious**	**Minor**	**Non-Injury**	**Total Cost**
1. No. of Years of typical accident rate records	5	5	5	5	
2. No. of Reported Accidents over Period	0	0	0	1	
3. Proportion of Fatal to Serious (Table A6.19 (a) to (c))	0.2	0.8			
4. No. of Reported Accidents Adjusted by severity **(2) x (3)**	0	0	0	1	
5.Accidents per year **(4)/(1)**	0	0	0	0.2	
6. Adjustment Factor (table A6.1(a))	1.028	1.028	1.028	1.028	
7. Adjusted Accidents per Year **(5) x (6)**	0.000	0.000	0.000	0.206	
8. Under-Reporting Factors (table A6.20(a)&(b))	1.0	1.5	4.5	7	
9. Total Estimated Accidents/Year **(7) x (8)**	0.000	0.000	0.000	1.439	
10. Accident Cost, 50 km/h Speed Limit (Table A6.21(a)-(d))	5,000,000	505,000	27,000	1,800	
11. Accident Cost, 100 km/h Speed Limit (Table A6.21(e)-(h))	4,600,000	505,000	28,000	1,600	
12. Mean Speed Adjustment = ***(Do Min Mean Speed - 50) / 50***	1	1	1	1	
13. Cost per Accident = **(11) + (12) x [(10) - (11)]**	4,600,000	505,000	28,000	1,600	
14. Total Accident Cost per Year **(9) x (13)**	0	0	0	2,303	**2,303**

Head On	**Injury Severity**				
	Fatal	**Serious**	**Minor**	**Non-Injury**	**Total Cost**
1. No. of Years of typical accident rate records	5	5	5	5	
2. No. of Reported Accidents over Period	0	0	0	1	
3. Proportion of Fatal to Serious (Table A6.19 (a) to (c))	0.12	0.88			
4. No. of Reported Accidents Adjusted by severity **(2) x (3)**	0	0	0	1	
5.Accidents per year **(4)/(1)**	0	0	0	0.2	
6. Adjustment Factor (table A6.1(a))	1.028	1.028	1.028	1.028	
7. Adjusted Accidents per Year **(5) x (6)**	0.000	0.000	0.000	0.206	
8. Under-Reporting Factors (table A6.20(a)&(b))	1.0	1.5	4.5	7.0	
9. Total Estimated Accidents/Year **(7) x (8)**	0.000	0.000	0.000	1.439	
10. Accident Cost, 50 km/h Speed Limit (Table A6.21(a)-(d))	4,550,000	585,000	32,000	3,200	
11. Accident Cost, 100 km/h Speed Limit (Table A6.21(e)-(h))	5,400,000	610,000	36,000	3,900	
12. Mean Speed Adjustment = ***(Do Min Mean Speed - 50) / 50***	1	1	1	1	
13. Cost per Accident = **(11) + (12) x [(10) - (11)]**	5,400,000	610,000	36,000	3,900	
14. Total Accident Cost per Year **(9) x (13)**	0	0	0	5,613	**5,613**

Crossing, Direct	**Injury Severity**				
	Fatal	**Serious**	**Minor**	**Non-Injury**	**Total Cost**
1. No. of Years of typical accident rate records	5	5	5	5	
2. No. of Reported Accidents over Period	0	0	0	0	
3. Proportion of Fatal to Serious (Table A6.19 (a) to (c))	0.21	0.79			
4. No. of Reported Accidents Adjusted by severity **(2) x (3)**	0	0	0	0	
5.Accidents per year **(4)/(1)**	0	0	0	0	
6. Adjustment Factor (table A6.1(a))	1.028	1.028	1.028	1.028	
7. Adjusted Accidents per Year **(5) x (6)**	0.000	0.000	0.000	0.000	
8. Under-Reporting Factors (table A6.20(a)&(b))	1.0	1.5	4.5	7.0	
9. Total Estimated Accidents/Year **(7) x (8)**	0.000	0.000	0.000	0.000	
10. Accident Cost, 50 km/h Speed Limit (Table A6.21(a)-(d))	4,600,000	490,000	31,000	2,800	
11. Accident Cost, 100 km/h Speed Limit (Table A6.21(e)-(h))	4,650,000	525,000	35,000	3,200	
12. Mean Speed Adjustment = ***(Do Min Mean Speed - 50) / 50***	1	1	1	1	
13. Cost per Accident = **(11) + (12) x [(10) - (11)]**	4,650,000	525,000	35,000	3,200	
14. Total Accident Cost per Year **(9) x (13)**	0	0	0	0	**0**

Crossing Turning	**Injury Severity**				
	Fatal	**Serious**	**Minor**	**Non-Injury**	**Total Cost**
1. No. of Years of typical accident rate records	5	5	5	5	
2. No. of Reported Accidents over Period	0	0	0	2	
3. Proportion of Fatal to Serious (Table A6.19 (a) to (c))	0.09	0.91			
4. No. of Reported Accidents Adjusted by severity **(2) x (3)**	0	0	0	2	
5.Accidents per year **(4)/(1)**	0	0	0	0.4	
6. Adjustment Factor (table A6.1(a))	1.028	1.028	1.028	1.028	
7. Adjusted Accidents per Year **(5) x (6)**	0.000	0.000	0.000	0.411	
8. Under-Reporting Factors (table A6.20(a)&(b))	1.0	1.5	4.5	7.0	
9. Total Estimated Accidents/Year **(7) x (8)**	0.000	0.000	0.000	2.878	
10. Accident Cost, 50 km/h Speed Limit (Table A6.21(a)-(d))	4,500,000	475,000	31,000	2,900	
11. Accident Cost, 100 km/h Speed Limit (Table A6.21(e)-(h))	4,650,000	525,000	35,000	3,200	
12. Mean Speed Adjustment = ***(Do Min Mean Speed - 50) / 50***	1	1	1	1	
13. Cost per Accident = **(11) + (12) x [(10) - (11)]**	4,650,000	525,000	35,000	3,200	
14. Total Accident Cost per Year **(9) x (13)**		0	0	9,211	**9,211**

ACCIDENT BY ACCIDENT ANALYSIS - DO MINIMUM **WORKSHEET A6.2**

Project Name:	Waipapa Road/SH10 Intersection	**Posted Speed Limit:**	70	km/h
Vehicle Involvement:	All	**Mean Speed:**	100	km/h
		Road Category:	70	
		Traffic growth rate	2.20%	%

Rear End, Crossing	**Injury Severity**				
	Fatal	**Serious**	**Minor**	**Non-Injury**	**Total Cost**
1. No. of Years of typical accident rate records	5	5	5	5	
2. No. of Reported Accidents over Period	0	0	0	2	
3. Proportion of Fatal to Serious (Table A6.19 (a) to (c))	0.16	0.84			
4. No. of Reported Accidents Adjusted by severity **(2) x (3)**	0	0	0	2	
5.Accidents per year **(4)/(1)**	0	0	0	0.4	
6. Adjustment Factor (table A6.1(a))	1.028	1.028	1.028	1.028	
7. Adjusted Accidents per Year **(5) x (6)**	0.000	0.000	0.000	0.411	
8. Under-Reporting Factors (table A6.20(a)&(b))	1.0	1.5	4.5	7.0	
9. Total Estimated Accidents/Year **(7) x (8)**	0.000	0.000	0.000	2.878	
10. Accident Cost, 50 km/h Speed Limit (Table A6.21(a)-(d))	4,600,000	450,000	30,000	2,900	
11. Accident Cost, 100 km/h Speed Limit (Table A6.21(e)-(h))	4,250,000	525,000	34,000	3,000	
12. Mean Speed Adjustment = ***(Do Min Mean Speed - 50) / 50***	1	1	1	1	
13. Cost per Accident = **(11) + (12) x [(10) - (11)]**	4,250,000	525,000	34,000	3,000	
14. Total Accident Cost per Year **(9) x (13)**	0	0	0	8,635	**8,635**

Worksheets A6: Accident cost savings

Weighted accident procedure – do minimum **Worksheet A6.5**

Project option	Do minimum		
Posted speed limit	70	Traffic growth rate	2.20%
Road category	RS	Time zero	2017

	Site specific accident rate	
1	Number of years of accident records	5
2	Number of reported injury accidents over period	0
3	Number of accidents per year **(2)**/**(1)**	0
4	Trend adjustment factor (table A6.1(a))	1.028
5	Site-specific accident rate (accidents per year), A_S **(3)** x **(4)**	0
	Accident prediction model	
6	Table used	6.1
7	Parameter b_0	0.00108
8	Parameter b_1	0.51
9	Parameter b_2	0.21
10	Lowest or sideroad AADT, Q_{minor}	6050
11	Highest or primary AADT, Q_{major}	8581
12	Typical accident rate (accidents per year), $A_{T,dm}$ (formula from appendix A6.5)	0.681862355
		Go to step 13
	Exposure based accident prediction equation	
6a	Table used	
7a	Coefficient b_0 (/10^8 veh-km or /10^8 vehicles)	
8a	Cross-section adjustment factor from table A6.13 (1.0 for no adjustment)	
9a	Adjusted coefficient **(7a)** x **(8a)**	
10a	Exposure at time zero (10^8 veh-km or 10^8 vehicles)	
12	Typical accident rate (accidents per year), $A_{T,dm}$ **(9a)** x **(10a)**	0.681862355
13	Accident trend factor for adjusting typical accident rate, f_t (appendix A6.4 method B).	-0.02
14	Adjustment factor for accident trend (1 + **(8)** x (time zero year - 2006) (appendix A6.4 method B).	0.98
15	Typical accident rate per year adjusted for accident trends, $A_{T,dm}$ **(12)** x **(14)***	0.668225108
	Weighting factor	
16	k value (appendix A6.5)	2.3
17	Reliability of accident history, α_X (default is 1.0)	1
18	Reliability of accident prediction model or equation, α_M (default is 1.0)	1
19	Weighting factor, w, **(17)**^{2} x **(16)** / (**(17)**^{2} x **(16)** + **(18)**^{2} x **(15)**))	0.771330037
20	Do minimum weighted accident rate, $A_{W,dm}$ [**(19)** x **(15)**] + [**(1)** – **(19)**] x **(5)**	0.515422097
21	Cost per reported injury accident (table A6.22)	295000
22	Total do minimum accident cost per year **(20)** x **(21)**	**152050**

* For all mid-block analyses, the typical accident rate **(15)** must be divided by the mid-block length (in km).

ACCIDENT RATE ANALYSIS - Option **WORKSHEET A6.5**

Project:	Waipapa Road/SH10 Intersection		
Project Option :	Alternative Roundabout		
Option Posted Speed Limit :	70	**Traffic Growth :**	2.20%
Road Category:	RS	**Time Zero :**	2017

ACCIDENT PREDICTION MODEL						
1	Model used					
2	Approach from:	SH10	Waipapa Road	SH10	To Kippers Lane	
3	Qapproach	8012	6050	6173	1685	
4	bo	5.56E-04	5.56E-04	5.56E-04	5.56E-04	
5	b1	0.58	0.58	0.58	0.58	
6	Typical Accident Rate Per Approach	1.02E-01	8.68E-02	8.78E-02	4.14E-02	
7	Typical Accident Rate (Accidents per Year)	0.318				
		Proceed to Step 8				
EXPOSURE BASED ACCIDENT PREDICTION EQUATION						
1a	Method / Table Used:	Method B, Model 2				
2a	Coefficient b0 (/10^8 veh-kms or /10^8 vehicles)					
3a	Cross-section adjustment factor from table A6.13 (1.0 no adjustment)					
4a	Adjusted coefficient **(2a)** x **(3a)**					
5a	Exposure at Time Zero (10^8 veh-kms or 10^8 vehicles)					
7	Typical Accident Rate (Accidents per Year), Atdm **(4a)** x **(5a)**					
8	Accident trend factor for adjusting Typical Accident rate, ft (appendix A6.4 method B)	-0.02				
9	Adjustment factor (1 + **(8)** x (time zero year - 2006)) (appendix A6.4 method B)	0.980				
10	Typical Accident Rate per year adjusted for accident trends At **(7)** x **(9)****	0.312				
ACCIDENT COSTS				70	100	
11	Cost per Reported Injury Accident (Table A6.22)	$ 340,000.00		$ 340,000	$ 545,000	
12	Total Accident Cost per Year **(10)** x **(11)**	$ 105,995				
	Year	0				
	Year	2017				
	Traffic Growth at year Zero With adjustment	0.20%				
	Total Accident Cost/Year	**$ 105,995**				
	Growth					

(14)** For midblock analysis, the typical ax rate **(15)** must be divided by the length in km

Traffic Flows obatined from Tubecounts that have both directions

ACCIDENT RATE ANALYSIS - Option **WORKSHEET A6.5**

Project:	Waipapa Road/SH10 Intersection		
Project Option :	Alternative Roundabout - T Intersection		
Option Posted Speed Limit :	70	**Traffic Growth :**	2.20%
Road Category:	RS	**Time Zero :**	2017

ACCIDENT PREDICTION MODEL						
1	Model used					
2	Qmajor	8581				
3	Qminor	2408				
4	bo	5.65E-05				
5	b1	0.2				
6	b2	0.76				
7	Typical Accident Rate (Accidents per Year), At (formula from Section A6.5)	0.128				
		Proceed to Step 8				
EXPOSURE BASED ACCIDENT PREDICTION EQUATION						
1a	Method / Table Used:					
2a	Coefficient b0 (/10^8 veh-kms or /10^8 vehicles)					
3a	Cross-section adjustment factor from table A6.13 (1.0 no adjustment)					
4a	Adjusted coefficient **(2a)** x **(3a)**					
5a	Exposure at Time Zero (10^8 veh-kms or 10^8 vehicles)					
7	Typical Accident Rate (Accidents per Year), Atdm **(4a)** x **(5a)**					
8	Accident trend factor for adjusting Typical Accident rate, ft (appendix A6.4 method B)	-0.02				
9	Adjustment factor (1 + **(8)** x (time zero year - 2006)) (appendix A6.4 method B)	0.980				
10	Typical Accident Rate per year adjusted for accident trends At **(7)** x **(9)****	0.126	No cost for signal in 70 and 100km area so Priority T costs has been used			
ACCIDENT COSTS			50	70	100	
11	Cost per Reported Injury Accident (Table A6.22)	$ 295,000.00	$ 240,000	$ 295,000	$ 565,000	
12	Total Accident Cost per Year **(10)** x **(11)**	$ 37,142				
	No years	0				
	MID POINTYear	2017				
	Traffic Growth at year Zero With adjustment	0.20%				
	Total Accident Cost/Year	**$ 37,142**				
	Growth					

(14)** For midblock analysis, the typical ax rate **(15)** must be divided by the length in km

Traffic Flows obatined from Tubecounts that have both directions

2016	SH10 Northbound	SH10 Southbound
0700-1900	3821	3679
0000-0000	4237	4055
Difference	416	376
Geomeric delay (s)	5.5	5.5
Total TT	2288	2068
Additional TT Cost	3268.566889	2954.281611
Total TT	**6222.8485**	
Growth	2.20%	

	SH10 Northt	SH10 Southbound
0700-1900	3821	3679
0000-0000	4237	4055
Difference	416	376
Curve Speed	20	20
Initial Speed	70	70
Additional VC	4.1	4.1
Total VOC	6140.16	5549.76
Total VOC	**11689.92**	

2026	SH10 Nort	SH10 Southbound
0700-1900		
0000-0000		
Growth	507.52	458.72
Geomeric	5.5	5.5
Total TT	2791.36	2522.96
Additional	3987.652	3604.224
Total TT	**7591.875**	

	SH10 Nort	SH10 Southbound
0700-1900		
0000-0000		
Difference	507.52	458.72
Curve Spe	20	20
Initial Spee	70	70
Additional	4.1	4.1
Total VOC	7490.995	6770.707
Total VOC	**14261.7**	

2036	SH10 Nort	SH10 Southbound
0700-1900		
0000-0000		
Difference	599.04	541.44
Geomeric	5.5	5.5
Total TT	3294.72	2977.92
Additional	4706.736	4254.166
Total TT	**8960.902**	

	SH10 Nort	SH10 Southbound
0700-1900		
0000-0000		
Difference	599.04	541.44
Curve Spe	20	20
Initial Spee	70	70
Additional	4.1	4.1
Total VOC	8841.83	7991.654
Total VOC	**16833.48**	

EEM Table A5.41 Additional VOC due to Speed Change Cycle (cents/Speed cycle)

Initial speed(km/h)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115
5	0.1																							
10	0.2	0.1																						
15	0.3	0.2	0.1																					
20	0.5	0.4	0.2	0.1																				
25	0.7	0.6	0.5	0.3	0.2																			
30	1	0.9	0.7	0.6	0.4	0.2																		
35	1.3	1.2	1.1	0.9	0.7	0.4	0.2																	
40	1.7	1.6	1.4	1.2	1	0.7	0.5	0.2																
45	2.1	2	1.8	1.6	1.4	1.1	0.8	0.5	0.3															
50	2.5	2.4	2.3	2.1	1.8	1.5	1.2	0.9	0.6	0.3														
55	3	2.9	2.8	2.6	2.3	2	1.7	1.3	1	0.6	0.3													
60	3.6	3.5	3.3	3.1	2.9	2.5	2.2	1.8	1.4	1	0.7	0.3												
65	4.2	4.1	3.9	3.7	3.5	3.1	2.8	2.4	2	1.6	1.1	0.7	0.3											
70	4.9	4.7	4.6	4.4	4.1	3.8	3.4	3	2.6	2.1	1.7	1.2	0.7	0.3										
75	5.6	5.4	5.3	5	4.8	4.4	4.1	3.7	3.2	2.8	2.3	1.8	1.3	0.8	0.4									
80	6.3	6.2	6	5.8	5.5	5.1	4.8	4.4	3.9	3.5	3	2.5	1.9	1.4	0.8	0.4								
85	7.1	7	6.8	6.5	6.3	5.9	5.5	5.1	4.7	4.2	3.7	3.2	2.6	2.1	1.5	0.9	0.4							
90	8	7.8	7.6	7.4	7.1	6.7	6.3	5.9	5.4	5	4.5	3.9	3.4	2.8	2.2	1.6	0.9	0.4						
95	8.9	8.7	8.5	8.2	7.9	7.5	7.1	6.7	6.3	5.8	5.3	4.7	4.2	3.6	2.9	2.3	1.7	1	0.4					
100	9.8	9.6	9.4	9.1	8.8	8.4	8	7.6	7.1	6.6	6.1	5.6	5	4.4	3.8	3.1	2.4	1.7	1	0.4				
105	10.8	10.6	10.4	10.1	9.8	9.4	8.9	8.5	8	7.5	7	6.4	5.8	5.2	4.6	3.9	3.3	2.5	1.8	1.1	0.4			
110	11.9	11.6	11.4	11.1	10.8	10.3	9.9	9.4	9	8.4	7.9	7.3	6.7	6.1	5.5	4.8	4.1	3.4	2.7	1.9	1.1	0.4		
115	13	12.7	12.5	12.2	11.8	11.4	10.9	10.4	9.9	9.4	8.9	8.3	7.7	7.1	6.4	5.7	5	4.3	3.5	2.8	2	1.2	0.5	
120	14.1	13.9	13.6	13.2	12.9	12.4	11.9	11.5	10.9	10.4	9.8	9.3	8.6	8	7.4	6.7	6	5.2	4.5	3.7	2.9	2	1.2	0.5

Hourly Count Export

Site Ref: 01000015 (1km south of Waimate Nth Rd)
Start Date (dd-mon-yyyy): 01-Jan-2015
End Date (dd-mon-yyyy): 31-Dec-2015
Direction: Both
Data Type: ALL Vehicles

Day		00:00 - 01	01:00 - 02	02:00 - 03	03:00 - 04	04:00 - 05	05:00 - 06	06:00 - 07	07:00 - 08	08:00 - 09	09:00 - 10	10:00 - 11	11:00 - 12	12:00 - 13	13:00 - 14	14:00 - 15	15:00 - 16	16:00 - 17	17:00 - 18	18:00 - 19	19:00 - 20	20:00 - 21	21:00 - 22	22:00 - 23	23:00 - 00	Total
27-Feb	FRI	13	11	7	15	26	67	158	381	529	490	493	446	516	488	563	636	676	526	378	204	149	94	57	37	6960
6-Mar	FRI	16	13	10	16	28	85	132	379	545	458	495	550	508	507	577	624	645	539	339	240	162	106	78	37	7089
29-May	FRI	12	15	12	9	26	73	133	395	508	460	416	500	507	538	577	688	632	575	279	208	168	97	118	46	6992
7-Aug	FRI	11	7	11	12	23	61	155	365	484	445	431	436	470	440	481	561	605	471	259	149	98	75	60	35	6145
30-Oct	FRI	10	6	11	16	15	65	157	440	548	457	483	502	528	452	558	652	589	562	293	172	126	83	61	33	6819
6-Nov	FRI	19	14	16	11	19	67	150	395	549	474	480	518	529	507	554	667	607	584	337	208	140	116	90	27	7078
2-Mar	MON	15	16	9	24	27	70	176	456	536	435	423	509	455	398	419	570	566	503	251	164	77	60	35	31	6225
9-Mar	MON	15	8	12	18	37	67	149	406	509	419	421	432	414	387	479	477	530	546	249	122	88	53	18	20	5876
25-May	MON	7	9	7	16	31	77	162	388	519	421	396	423	430	426	438	522	528	498	172	116	54	40	40	11	5731
10-Aug	MON	12	7	14	16	25	62	142	397	468	373	338	394	422	384	468	455	535	420	196	117	67	45	27	12	5396
2-Nov	MON	15	13	10	13	26	90	165	448	537	452	458	427	475	463	480	547	591	532	294	149	78	48	41	16	6368
9-Nov	MON	14	9	14	19	25	71	185	426	577	441	453	495	484	438	493	549	591	550	280	156	114	59	36	15	6494
28-Feb	SAT	21	12	11	12	28	43	94	194	287	456	503	581	507	465	440	343	358	308	228	160	116	92	67	50	5376
7-Mar	SAT	26	13	12	10	13	40	88	171	271	416	533	560	527	496	464	379	316	304	212	139	94	99	66	31	5280
23-May	SAT	17	9	7	11	14	35	54	118	186	284	430	449	422	367	316	273	281	238	173	81	61	60	45	23	3954
8-Aug	SAT	17	10	9	8	26	30	54	144	250	410	512	521	499	397	377	343	271	242	180	106	87	61	44	24	4622
31-Oct	SAT	18	12	12	13	20	23	91	196	311	453	523	570	550	460	438	408	431	306	231	195	136	92	59	27	5575
7-Nov	SAT	17	12	11	7	16	40	86	193	332	475	571	549	504	424	399	354	363	314	354	315	232	290	195	30	6083
1-Mar	SUN	29	12	16	4	10	25	46	105	145	322	426	489	410	374	416	431	341	301	223	165	115	53	34	17	4509
8-Mar	SUN	17	14	9	5	10	18	48	81	148	286	425	468	420	405	409	374	354	335	228	158	120	60	30	18	4440
24-May	SUN	28	24	20	4	12	23	35	86	129	272	340	394	349	370	288	336	286	232	166	104	50	34	12	8	3602
9-Aug	SUN	22	11	6	4	9	14	34	71	126	226	311	309	391	320	340	289	284	248	156	104	69	44	20	13	3421
1-Nov	SUN	17	12	8	12	43	16	42	117	177	313	389	354	402	368	377	392	370	279	183	151	126	72	26	18	4264
8-Nov	SUN	19	14	7	6	11	20	55	129	202	305	422	433	414	352	347	448	321	313	230	151	117	55	25	22	4418
5-Mar	THU	12	8	9	19	15	72	141	393	592	469	484	479	481	510	530	594	590	579	325	193	126	87	46	35	6789
12-Mar	THU	7	3	13	21	24	77	149	397	551	439	460	502	469	481	478	540	596	590	313	187	136	91	55	30	6609
28-May	THU	9	9	15	13	18	77	172	394	553	484	426	474	472	444	504	582	604	552	248	146	101	62	59	21	6439
6-Aug	THU	19	8	13	8	20	50	139	384	499	442	459	404	425	439	494	515	530	487	217	120	88	61	46	22	5889
29-Oct	THU	7	8	15	14	21	69	158	402	547	469	493	482	512	457	489	572	562	563	255	167	84	68	37	24	6475
5-Nov	THU	8	7	12	9	24	77	160	421	536	544	478	531	549	503	556	566	604	614	294	196	118	87	57	22	6973
3-Mar	TUE	12	15	12	14	23	68	143	395	542	431	428	454	475	461	521	545	581	541	248	150	112	78	36	17	6302
10-Mar	TUE	4	7	11	13	25	55	143	384	528	470	456	439	486	445	447	546	581	524	260	175	107	74	36	20	6236
26-May	TUE	16	6	15	10	18	69	161	412	522	450	416	425	466	447	470	566	529	520	228	108	66	63	33	33	6049
11-Aug	TUE	12	6	7	13	18	49	152	369	477	429	417	432	455	384	412	487	563	471	205	104	60	49	22	18	5611
3-Nov	TUE	7	10	17	8	14	59	174	446	550	474	524	536	503	466	505	546	588	506	283	147	114	67	43	21	6608
10-Nov	TUE	9	9	14	15	25	83	187	396	605	481	475	437	491	459	540	589	574	518	303	179	110	73	50	16	6638
4-Mar	WED	7	7	14	14	19	81	139	432	536	449	464	528	480	405	471	563	572	601	293	176	103	82	42	19	6497
11-Mar	WED	8	17	9	13	22	63	164	419	554	465	489	523	478	484	460	545	580	568	286	169	118	78	40	20	6572
27-May	WED	10	11	11	11	23	66	171	402	515	461	422	440	467	416	474	529	539	504	233	127	80	87	28	17	6044
5-Aug	WED	8	9	7	14	13	60	142	364	482	398	407	423	432	454	460	525	528	422	198	108	74	73	35	17	5653
4-Nov	WED	10	11	11	16	16	77	159	387	538	500	489	494	547	467	534	536	585	562	302	173	103	87	44	20	6668
11-Nov	WED	10	5	10	10	29	74	173	441	572	517	461	484	537	494	505	549	600	603	311	200	124	108	53	30	6900
		00:00 - 01	01:00 - 02	02:00 - 03	03:00 - 04	04:00 - 05	05:00 - 06	06:00 - 07	07:00 - 08	08:00 - 09	09:00 - 10	10:00 - 11	11:00 - 12	12:00 - 13	13:00 - 14	14:00 - 15	15:00 - 16	16:00 - 17	17:00 - 18	18:00 - 19	19:00 - 20	20:00 - 21	21:00 - 22	22:00 - 23	23:00 - 00	Total
Weekday		11	9	12	14	23	69	156	404	534	457	451	471	482	455	498	561	580	534	271	161	105	75	47	24	
Sat		19	11	10	10	20	35	78	169	273	416	512	538	502	435	406	350	337	285	230	166	121	116	79	31	
Sun		22	15	11	6	16	19	43	98	155	287	386	408	398	365	363	378	326	285	198	139	100	53	25	16	

PERIOD	Days/Yr	hrs/day	Hrs/Year	flow/hr			
weekday night	240	13	3120	75			
week day AM	240	1	240	534			
week day PM	240	2	480	571			
week day IP	240	8	1920	469	Same as Saturday pe	Counte	
Saturday	52	6	312	468	Count was 11-12	Sidra Volmes reduced by	0.87
Sunday	68	6	408	383	82% of IP	Sidra Volmes reduced by	0.71
Weekend offpeak/night	120	18	2160	115			

TIME STREAMS AND DISCOUNTING — OPTION Option 6 Alternative Roundabout — WORKSHEET A1.1 and A1.2

BASE DATE 2016
TIME ZERO 2017

DESCRIPTION	PAYMENT TYPE T	START YEAR.	END YEAR	DURATION YEARS n	BASE YEAR COST/YR. $	BASE YEAR GROWTH. %	START YEAR COST/YR $	START YEAR GROWTH %	YEAR OF ESTIMATE	UPDATE FACTOR	PRESENT VALUE TIMEZERO $	DISCOUNTING SPPWF	UNSPWF	AGPWF
COSTS & MAINTENANCE														
Construction Cost	C	1.5	1.5	0.0	6,330,048		6,330,048		2017	0.96	$5,567,592	0.916	0.000	0.000
Fees	F	0.3	0.3	0.0	343,731		343,731		2017	0.96	$325,209	0.986	0.000	0.000
Fees	F	0.8	0.8	0.0	343,731		343,731		2017	0.96	$315,871	0.957	0.000	0.000
Property	L	1.3	1.3	0.0	2,336,100		2,336,100		2017	0.96	$2,084,867	0.930	0.000	0.000
Maintenance (ignored)	M													
OPERATING COSTS														
Travel Time 2016-2026	T	1.8	10.0	8.2	127,668	4.35%	137,406	4.04%	2002	1.45	$1,358,980	0.903	6.549	24.852
Travel Time 2026-2036	T	10.0	20.0	10.0			183,249	5.40%	2002	1.45	$1,398,718	0.558	7.579	34.234
Travel Time 2036-2056	T	20.0	41.3	21.3			282,189	1.30%	2002	1.45	$1,725,798	0.312	12.187	103.433
VOC 2016-2026	V	1.8	10.0	8.2	720,900	3.49%	765,026	3.29%	2008	0.98	$4,987,087	0.903	6.549	24.852
VOC 2026-2036	V	10.0	20.0	10.0			972,750	3.06%	2008	0.98	$4,592,549	0.558	7.579	34.234
VOC 2036-2056	V	20.0	41.3	21.3			1,270,749	0.53%	2008	0.98	$4,945,286	0.312	12.187	103.433
CO2 2016-2026	CO2	1.8	10.0	8.2	45,494	3.52%	48,297	3.31%	2008	0.98	$315,053	0.903	6.549	24.852
CO2 2026-2036	CO2	10.0	20.0	10.0			61,491	3.09%	2008	0.98	$290,649	0.558	7.579	34.234
CO2 2036-2056	CO2	20.0	41.3	21.3			80,509	0.54%	2008	0.98	$313,497	0.312	12.187	103.433
Crash Costs Period 1	A	1.8	41.3	39.5	143,137	0.00%	143,638	0.20%	2006	1.03	$2,115,831	0.903	15.444	197.192

TRANSFERED IN FROM OTHER WORKSHEETS	TT/yr	growth/yr	VOC/yr	growth/yr	C02	growth/yr	crashes	growth/yr
2016	$127,668		$720,900		$45,494		143137	286
2026	$183,249	$5,558	$972,750	$25,185	$61,491	$1,600		
2036	$282,189	$9,894	$1,270,749	$29,800	$80,509	$1,902		
2056	355,293	$3,655	1,405,530	$6,739	89,165	$433		
								0.20%

APPENDIX E
Economics

COST-BENEFIT ANALYSIS OF THE OPTIONS

WORKSHEET 4

Const Starts 1-Oct-18

Const Ends 1-Apr-19

Project : Waipapa Road/SH10 Intersection

Calculated by : Kristoffer Hansson

Reviewed by:

Time Zero: 1-Jul 2017

Base Date: 1-Jul 2016

OPTION		Roundabout	Head Right turn Bays)	Option 5 (Close Waipapa Loop)	Signals	Option 1 (Right Turn Bay))	Option 6 Alternative Roundabout	Do Min	Roundabout	Option 4 (Head to Head Right turn Bays)	Option 5 (Close Waipapa Loop)	Signals	Option 1 (Right Turn Bay))	Option 6 Alternative Roundabout
TANGIBLE BENEFITS CALCULATION:											NET BENEFITS OF THE OPTIONS			
1. Travel Time		$6,465,175	$9,838,281	$10,203,623	$29,877,354	$9,838,281	$4,483,495	$21,037,803	$14,572,628	$11,199,523	$10,834,181	($8,839,551)	$11,199,523	$16,554,308
2. Vehicle Oper.		$14,838,274	$15,743,905	$16,027,995	$16,098,854	$15,743,905	$14,524,923	$18,924,446	$4,086,173	$3,180,541	$2,896,451	$2,825,592	$3,180,541	$4,399,524
3. Accidents		$1,794,968	$1,927,424	$1,927,424	$2,223,937	$1,927,424	$2,115,831	$2,247,576	$452,608	$320,152	$320,152	$23,639	$320,152	$131,745
4.Carbon dixiode ($40/tonne)		$939,343	$1,017,102	$1,031,307	$1,032,524	$1,017,102	$919,199	$1,212,531	$273,188	$195,429	$181,224	$180,007	$195,429	$293,332
6. TOTAL (1+2+3+4)		$24,037,760	$28,526,712	$29,190,348	$49,232,670	$28,526,712	$22,043,448	$43,422,356	$19,384,597	$14,895,645	$14,232,008	($5,810,313)	$14,895,645	$21,378,909
COSTS CALCULATION:											NET COSTS OF THE PROJECT OPTIONS			
1. Fees		$473,810	$453,859	$449,037	$493,118	$434,350	$641,080	$0	$473,810	$453,859	$449,037	$493,118	$434,350	$641,080
2. Property		$1,069,609	$457,027	$100,401	$439,892	$294,243	$2,084,867	$0	$1,069,609	$457,027	$100,401	$439,892	$294,243	$2,084,867
3. Construction		$4,716,741	$4,522,905	$4,449,102	$4,904,331	$4,333,368	$5,567,592	$0	$4,716,741	$4,522,905	$4,449,102	$4,904,331	$4,333,368	$5,567,592
4. Maintenance								$0						
5. TOTAL (1+2+3+4)		$6,260,159	$5,433,791	$4,998,541	$5,837,341	$5,061,960	$8,293,540	$0	$6,260,159	$5,433,791	$4,998,541	$5,837,341	$5,061,960	$8,293,540
TANGIBLE BENEFIT TO COST RATIO									**3.1**	**2.7**	**2.8**	**N/A**	**2.9**	**2.6**
Ranking B/C Ratio														
Intangible Benefits														

INCREMENTAL COST-BENEFIT ANALYSIS OF PROJECT OPTIONS

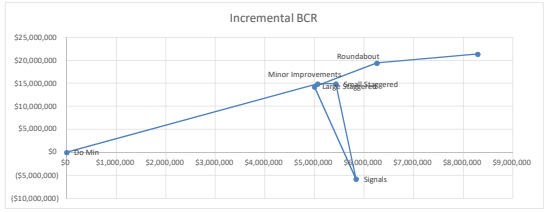
WORKSHEET 5

Incremental BCR in order of increasing cost:

Target BCR **3.0**

Ranked by increasing cost

Option	Net Costs	Net Benefits
Do Min	$0	$0
Minor Improvements	$5,061,960	$14,895,645
Small Staggered	$5,433,791	$14,895,645
Signals	$5,837,341	($5,810,313)
Large Staggered	$4,998,541	$14,232,008
Roundabout	$6,260,159	$19,384,597
PW Roundabout	$8,293,540	$21,378,909



Step	Option A Option	Costs	Benefits	Option B Option	Costs	Benefits	Incremental Costs	Incremental Benefit	Incremental BCR	
1	Option 1 (Right Turn Ba	$5,061,960	$14,895,645	Option 4 (Head to H	$5,433,791	$14,895,645	$371,830	$0	N/A	
2	Option 1 (Right Turn Bay))	$5,061,960	$14,895,645	Signals	$5,837,341	($5,810,313)	$775,380	($20,705,958)	N/A	
3	Option 1 (Right Turn Bay))	$5,061,960	$14,895,645	Option 5 (Close Waipa	$4,998,541	$14,232,008	($63,419)	($663,636)	N/A	
4	Option 1 (Right Turn Bay))	$5,061,960	$14,895,645	Roundabout	6260159.312	19384596.87	$1,198,199	$4,488,952		**3.7**
5	Roundabout	$6,260,159	$19,384,597	Option 6 Alternative Rc	$8,293,540	$21,378,909	$2,033,380	$1,994,312		**1.0**

APPENDIX F
Cost Estimates

Elemental Breakdown for Physical Works

PN4234 SH10 Waipapa Road Intersection Improvements Elemental Breakdown for Physical Works		ALTERNATIVE ROUNDABOUT		
Item	**Description**	**Unit**	**Sub-Element Totals**	**Element Totals**
C	**Pre-implementation Phase Fees**			**$ 490,354.76**
D1	**Implementation Phase fees**			**$ 377,195.97**
D2	**Physical Works**			**$ 4,939,510.44**
1.00	**Environmental Compliance**			**$ 50,000.00**
2.00	**Earthworks**			**$ 379,914.95**
2.01	Site clearance - greenfield such as small trees, shrubs, hedging etc.		$ -	
2.02	Demolition - building demolition, structures, fences, retaining walls, utility services, stormwater pipe, manholes, cesspits, surfacing, kerbs, lights, signs, temporary works etc.	m3	$ 350,000.00	
2.03	Temporary fencing		$ -	
2.04	Topsoil stripping,		$ -	
2.05	Cut to fill,		$ -	
2.06	Cut to waste (Option)	m3	$ 17,043.00	
2.07	Cut to waste (Waipapa Corridor)	m3	$ 12,871.95	
2.08	Borrow to fill		$ -	
2.09	Imported fill		$ -	
2.10	Undercutting soft spots		$ -	
2.11	Excavation in rock (state types)		$ -	
2.12	Conditioning of cut and/or fill materials		$ -	
2.13	Preloading, additional preload materials, settlement monitoring and removal of preload materials		$ -	
2.14	Respreading topsoil		$ -	
2.15	Imported topsoil		$ -	
2.16	Reclamation works		$ -	
2.16	Foreshore works		$ -	
2.17	Temporary earthworks		$ -	
2.18	Temporary haul roads		$ -	
2.19	Construct, maintain & remove temporary sediment control measures, temporary sediment control ponds, including temporary hydroseeding, rock check dams, silt fencing		$ -	
2.20	Dust control		$ -	
2.21	Archaeological treatment/mitigation works		$ -	
3.00	**Ground Improvements**			**$ -**
4.00	**Drainage**			**$ 691,368.24**
4.01	Stormwater drainage, temporary stream diversion and culverts including headwalls, chambers and rip-rap		$ -	
4.02	Subsoil and pavement drains		$ -	
4.03	**Kerb blocks (incl. subsoil) (Waipapa Corridor)**	m	$ 264,866.51	
4.04	**Kerb without Channel (Incl.subsoil) (Waipapa Corridor)**	m	$ 1,280.00	
4.05	**Kerb blocks (incl. subsoil) (Option)**	m	$ 146,422.69	
4.06	**Kerb without Channel (Incl.subsoil) (Option)**	m	$ 14,400.00	
4.07	Surface water channel		$ -	
4.08	Erosion control		$ -	
4.09	Flumes		$ -	
4.10	Rain gardens		$ -	
4.11	Permanent ponds		$ -	
4.12	Wetlands		$ -	
4.13	Grassed swales		$ -	
4.14	Treatment devices		$ -	
4.15	Manhole 1200mm	ea	$ 6,474.55	
4.16	RCRRJ Pipe - 300mm dia, Class 4 (Waipapa Corridor)	m	$ -	
4.17	RCRRJ Pipe - 375mm dia, Class 4	m	$ 4,791.60	
4.18	RCRRJ Pipe - 450mm dia, Class 4	m	$ 60,860.50	
4.19	RCRRJ Pipe - 600mm dia, Class 4	m	$ 110,716.67	
4.20	RCRRJ Pipe - 750mm dia, Class 4	m	$ -	
4.21	RCRRJ Pipe - 900mm dia, Class 4	m	$ -	
4.22	RCRRJ Pipe - 300mm dia, Class 4 (Option)		$ -	
4.23	RCRRJ Pipe - 375mm dia, Class 4	m	$ 21,202.83	
4.24	RCRRJ Pipe - 450mm dia, Class 4	m	$ 15,975.88	
4.25	RCRRJ Pipe - 600mm dia, Class 4	m	$ 26,572.00	
4.26	RCRRJ Pipe - 750mm dia, Class 4		$ -	
4.27	RCRRJ Pipe - 900mm dia, Class 4		$ -	
4.28	Single Sump Catchpit	ea.	$ 12,949.10	
4.29	Manhole 1200mm	ea.	$ 4,855.91	

Elemental Breakdown for Physical Works

PN4234 SH10 Waipapa Road Intersection Improvements Elemental Breakdown for Physical Works		ALTERNATIVE ROUNDABOUT		
Item	**Description**	**Unit**	**Sub-Element Totals**	**Element Totals**
5.00	**Pavement and Surfacing**			**$ 784,136.42**
5.01	Subgrade stabilisation/improvement (aggregate, lime or cement)		$ -	
5.02	Subgrade preparation and testing		$ -	
5.03	Sub-basecourse (Waipapa Corridor)	m3	$ 48,934.87	
5.04	Pavement Stabilisation (150mm, 4kg/m2, 1.5% Hydrated Lime)	m2	$ 8,159.00	
5.05	Base course	m3	$ 53,635.03	
5.06	Surfacing (chip seal)	m2	$ 12,228.25	
5.07	Surfacing (Stone Mastic Asphalt)		$ -	
5.08	Surfacing (second coat)	m2	$ 75,900.00	
5.09	Sub-basecourse (Option)	m3	$ 149,191.67	
5.10	Pavement Stabilisation (150mm, 4kg/m2, 1.5% Hydrated Lime)	m3	$ 25,273.00	
5.11	Base course	m2	$ 113,374.86	
5.12	Surfacing (chip seal)	m2	$ 48,614.75	
5.13	Surfacing (Stone Mastic Asphalt)	m2	$ 204,000.00	
5.14	Surfacing (second coat)	m2	$ 44,825.00	
5.15	Upgrade existing carriageway(s).		$ -	
5.16	Sawcutting		$ -	
5.17	Joints		$ -	
5.18	Scarifying		$ -	
5.19	Ancillary roadworks		$ -	
6.00	**Bridges**			**$ -**
7.00	**Retaining Walls and Access Works**			**$ 62,550.00**
7.01	Timber-piled walling		$ -	
7.02	Concrete-piled walling including ground anchors		$ -	
7.03	Gabion walling		$ -	
7.04	Crib walling		$ -	
7.05	Mechanically stabilised earth (MSE) walling		$ -	
7.06	Backfill behind retaining walls where the estimator is to consider the provisions included in the earthworks element and allow extra for special materials and/or placement requirements behind retaining walls).		$ -	
7.07	Stone strong walling		$ -	
7.08	Diaphragm walling		$ -	
7.09	Precast concrete facing panels		$ -	
7.10	Drainage in association with retaining walls		$ -	
7.11	Temporary works associated with retaining walls.		$ -	
7.12	Residential Vehicle crossing (Waipapa Corridor)	Ea	$ 6,000.00	
7.13	Commercial Vehicle Crossing (Waipapa Corridor)	Ea	$ 18,900.00	
7.14	Residential Vehicle crossing (Option)	Ea	$ 3,000.00	
7.15	Commercial Vehicle Crossing (Option)	Ea	$ 34,650.00	
8.00	**Traffic Services**			**$ 220,500.00**
8.01	Barrier (wire/concrete median barrier and verge barrier)		$ -	
8.02	Pavement markings, pavement markers (Waipapa Corridor)	LS	$ 5,000.00	
8.03	Pavement markings, pavement markers (Option)	LS	$ 12,000.00	
8.04	Road signs, gantries (Waipapa Corridor)	LS	$ 500.00	
8.05	Road signs, gantries (Option)	LS	$ 3,000.00	
8.06	Traffic signals		$ -	
8.07	Marker posts		$ -	
8.08	Lighting (Waipapa Corridor)	Ea	$ 150,000.00	
8.09	Lighting (Option)	Ea	$ 50,000.00	
8.10	Emergency cross-overs and phones		$ -	
8.11	Variable Message Signs		$ -	
8.12	Intelligent Traffic Signals/ATMS.		$ -	
8.13	Bus/cycleway green paint marking		$ -	
8.14	Guardrails		$ -	
8.15	Leading and trailing end terminals		$ -	
8.16	Crash cushions		$ -	

Elemental Breakdown for Physical Works

PN4234 SH10 Waipapa Road Intersection Improvements Elemental Breakdown for Physical Works		ALTERNATIVE ROUNDABOUT		
Item	**Description**	**Unit**	**Sub-Element Totals**	**Element Totals**
9.00	**Service Relocations**			**$ 1,040,000.00**
9.01	NZTA cost of local authority and utility companies (after cost share) and contractors on costs - **TOP ENERGY**		$ 300,000.00	
9.02	NZTA cost of local authority and utility companies (after cost share) and contractors on costs - **CHORUS**		$ 500,000.00	
9.03	NZTA cost of local authority and utility companies (after cost share) and contractors on costs - **FNDC**		$ 115,000.00	
9.04	NZTA cost of local authority and utility companies (after cost share) and contractors on costs - **KERIKERI IRRIGATION**		$ 10,000.00	
9.05	NZTA cost of local authority and utility companies (after cost share) and contractors on costs - **EDWARD LOCK**		$ 50,000.00	
9.06	Civil works associated with utility services such as trenching.		$ 50,000.00	
9.07	Temporary works associated with utility services		$ 15,000.00	
10.00	**Landscaping & Urban design**			**$ 168,490.10**
10.01	Landscaping (aesthetic and environmental)		$ -	
10.02	Grassing (Waipapa Corridor)	m2	$ 3,712.00	
10.03	Grassing (Option)	m2	$ 10,400.00	
10.04	Architecture		$ -	
10.05	Fencing	m	$ 1,178.10	
10.06	Streetscaping		$ -	
10.07	Land accommodation costs (also refer to project property cost funding)		$ -	
10.08	Footpaths (1.5m) and cycleway	m2	$ 63,000.00	
10.09	Footpaths (2.5m) and cycleway	m2	$ 43,500.00	
10.10	Building relocations		$ -	
10.11	Traffic islands - splitter	m2	$ 40,800.00	
10.12	Traffic islands - pedestrian	m2	$ 3,400.00	
10.13	Pram crossings with kerb and tactile pavers	Ea	$ 2,500.00	
10.14	Urban design features to bridges, structures, barriers, retaining walls etc.		$ -	
10.15	Mountable Concrete Apron		$ -	
11.00	**Traffic Management and Temporary Works**			**$ 375,000.00**
11.01	Temporary traffic diversions		$ -	
11.02	Traffic management physical works costs		$ -	
11.03	Temporary roads		$ -	
12.00	**Preliminary and General**			**$ 301,756.78**
12.01	Establishment, temporary accommodation, clean up, disestablishment and other site operating costs		$ 113,158.79	
12.02	Contractor's supervision, on site staffing, prescribed specialists and other time related costs.		$ -	
12.03	Insurances, bonds, warrantees/guarantees, as-built requirement plans and other non time-related costs.		$ -	
12.04	Temporary works design and traffic management planning		$ -	
12.05	Project plans, quality assurance, traffic management plans, environmental management plans, programming and reporting, consent fees, stakeholder management, health and safety, security management, contractor's escrow tender documents		$ -	
12.06	Network maintenance		$ -	
12.07	QA systems		$ -	
12.08	Testing		$ -	
13	**Extraordinary Construction Costs**			**$ 865,793.96**
	Base Estimate			**$ 5,807,061.16**

Date of Estimate	**1/10/2017**	
Estimate prepared by	**Signed**	**Naushaba Todd-Jones**
Estimate internal peer review by	**Signed**	**Chris Parker**
Estimate external peer review by	**Signed**	
Estimate accepted by NZTA project manager	**Signed**	

Note: These estimates are exclusive of Contingency, Funding Risk Contingency, Escalation and GST.

PN4234 SH10 Waipapa Road Intersection Improvements Nett Property Costs								
Property Acquisition Reference	Property Requirements	Purchased	Property Purchase Costs (A)	(Less) Disposal Value (B)	Nett Property Purchase Costs (A-B=C) Alternative Roundabout	Property Compensation Costs (D)	Property owner Accommodation Works (E)	Nett Project Property Cost (C+D+E=F)
	Waipapa Corridor Treatment: Lot 1 DP 153739, Lot 4 DP 98489, Lot 3 DP 98489, Lot 4 DP 102236, Lot 5 DP 102236, Lot 3 DP 99619		0	0	46,750	0	0	0
	Lot 1 DP 153739		0	0	1,000,000	0	0	0
	Lot 1 DP 164804		0	0	850,000	0	0	0
	Lot 1 DP 102334		0	0	50,000	0	0	0
			0	0		0	0	0
Fees	**Property Acquisition Agents Fees**	-	-	-		-	-	0
Base Estimate			**0**	**0**	**1,946,750**	**0**	**0**	**0**

Contingency	389,350
Expected Estimate	**2,336,100**

Funding Risk Contingency	194,675
95th Percentile Estimate	**2,530,775**

Date of Estimate	**Cost Index** Q04 / 2017
Estimate prepared by	**Signed** Naushaba Todd-Jones
Estimate internal peer review by	**Signed** Chris Parker
Estimate external peer review by	**Signed**
Estimate accepted by NZTA project manager	**Signed**

Note: These estimates are exclusive of escalation and GST.

Project Estimate - Form C

DBE

PN4234 SH10 Waipapa Road Intersection Improvements

Detailed Business Case Estimate
Alternative Roundabout

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	**Nett Project Property Cost**	**1,946,750**	**389,350**	**194,675**
	Project Development Phase			
	- Consultancy Fees	Nil	Nil	Nil
	- NZTA Managed Costs	Nil	Nil	Nil
B	**Total Project Development**	**Nil**	**Nil**	**Nil**
	Pre-implementation Phase			
	- Consultancy Fees			
	- NZTA Managed Costs			
C	**Total Pre-implementation**	**490,355**	**147,106**	**49,035**
	Implementation Phase			
	Implementation Fees			
	- Consultancy Fees			
	- NZTA Managed Costs			
	- Construction Monitoring Fees			
	Sub Total Base Implementation Fees	377,196	75,439	
	Physical Works			
1	Environmental Compliance	50,000	10,000	
2	Earthworks	379,915	75,983	
3	Ground Improvements	0	0	
4	Drainage	691,368	207,410	
5	Pavement and Surfacing	784,136	156,827	
6	Bridges	0	0	
7	Retaining Walls	62,550	12,510	
8	Traffic Services	220,500	44,100	
9	Service Relocations	1,040,000	312,000	
10	Landscaping	168,490	33,698	
11	Traffic Management and Temporary Works	375,000	75,000	
12	Preliminary and General	301,757	60,351	
13	Extraordinary Construction Costs	865,794	173,159	
	Sub Total Base Physical works	4,939,510	987,902	
D	**Total for Implementation Phase**	**5,316,706**	**1,063,341**	**1,000,000**
E	**Project Base Estimate** (A+C+D)	**7,753,811**		
F	**Contingency** (Assessed/Analysed)	**(A+C+D)**	**1,599,798**	
G	**Project Expected Estimate**	**(E+F)**	**9,353,609**	
	Nett Project Property Cost Expected Estimate		2,336,100	
	Project Development Phase Expected Estimate		**Nil**	
	Pre-implementation Phase Expected Estimate		637,461	
	Implementation Phase Expected Estimate		6,380,048	
H	**Funding Risk Contingency** (Assessed/Analysed)		**(A+C+D)**	**1,243,710**
I	**95th percentile Project Estimate**		**(G+H)**	**10,597,319**
	Nett Project Property Cost 95th percentile Estimate			2,530,775
	Project Development Phase 95th percentile Estimate			**Nil**
	Pre-implementation Phase 95th percentile Estimate			686,497
	Implementation Phase 95th percentile Estimate			7,380,048

Date of Estimate	**Cost Index (Qtr/Year)** **Q04 / 2017**
Estimate prepared by	**Signed** **Naushaba Todd-Jones**
Estimate internal peer review by	**Signed** **Chris Parker**
Estimate external peer review by	**Signed**
Estimate accepted by NZTA	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.
(2) Project Development Phase Estimates are set to Nil as these are now sunk costs.

APPENDIX G
Land Requirement Plan

LAND REGISTRATION DISTRICT : NORTH AUCKLAND

LOCAL AUTHORITY : FAR NORTH DISTRICT

SCHEDULES

LAND REQUIRED FOR ROAD

SHOWN	DESCRIPTION	CT	AREA
A	LOT 1 DP 153739	NA91C/871	10,434m²
B	LOT 1 DP 164804	NA97B/374	2,360m²
C	LOT 1 DP 164804	NA97B/374	191m²
D	LOT 1 DP 102334	NA56C/27	72m²
TOTAL AREA			13,057m²

DRAWING IN PROGRESS

PLOTTED ON 2017-10-4 AT 3:24 PM

PRELIMINARY

300 mm
200
100
50
10 mm
0

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

Revision	Amendment	Approved	Revision Date
A	ISSUED FOR INFORMATION		2017-10-04

NZ TRANSPORT AGENCY WAKA KOTAHI

OPUS
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125A Bank Street
PO Box 553
Whangarei 0110

Designed	Approved	Approved Date
C. NIXON	-	-

Drawn	Scales	Project No.	Sheet. No.	Revision
C. NIXON	1:500 AT A1	1-11751.00	V100	A

Project
NZ TRANSPORT AGENCY
STATE HIGHWAY 10 / WAIPAPA ROAD
INTERSECTION IMPROVEMENTS

Sheet
ROUNDABOUT - ALTERNATIVE OPTION
LAND REQUIREMENT PLAN

Original Sheet Size A1 [841x594] Plot Date 2017-10-04 at 3:24:15 PM Path G:\01 Clients\NZTA\1-11751.00 PN4234 SH10 Waipapa Road Intersection Improvements\200 Technical\210 Drawings\(V) Survey\+AutoCAD\1-11751.00_V100.dwg - V100