ŌTAKI TO NORTH OF LEVIN PFRs

Report 4: Ohau Settlement Project Feasibility Report

Prepared for NZ Transport Agency

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Executive Summary

This Project Feasibility Report (PFR) is one of a number of reports being undertaken to determine the package of improvements that should be implemented in the short to medium term to improve the safety and efficiency of the highway between Ōtaki and north of Levin as part of the Wellington Northern Corridor Road of National Significance (RoNS).

The main purpose of this report is to determine the feasibility of improving road safety and traffic management on State Highway 1 through the Ohau settlement.

A variety of road safety and traffic management improvement options were considered, for which benefits and costs were determined. The options considered included;

- reducing the speed limit through Ohau to 80 km/h;
- installing threshold treatments at either end of the settlement;
- widening the highway to install a flush median and wider shoulders;
- removing the passing lane to the south of the settlement;
- closing Vista and Victoria Street intersections (requires a new link road within the local network) with SH 1, redirecting traffic to one safer, more efficient crossroads;
- Relocating Bishops Road intersection; and
- Improving horizontal curves – one just south of the settlement and the other between Marsden Tce and Vista Road (rail would also need to be shifted).

Option 4-1 considered carrying out all safety and traffic management improvments, and was considered with both a five year and ten year crash history.

Option 4-2 considered most of the safety and traffic management improvements, but excludes the realignment of the curve a Bishops Road as it has lower benefits.

A summary of the economic analysis is shown below.

Table 1-1: Option Summary

Option Description	Capital Costs	NPV Benefits	Benefit Cost Ratio
Option 4-1: Safety and Traffic Management Improvements	$4.90M	$4.00M	**0.8**
Option 4-2: Excluding Bishops Road Realignment	$3.80M	$3.92M	**1.0**

The expected costs estimate to achieve these option improvements are $4.90M and $3.80M. Indicative BCRs were derived from predicted crash cost savings (with travel time and vehicle operating cost deemed neutral at this PFR stage – i.e. modelling required):

- All improvements BCR 0.8 (5 year crash history) or 1.2 (10 year crash history)
- All improvements minus horizontal curve at Bishops Road BCR 1.0 (5 year crash history) or 1.6 (10 year crash history).

Options are such that each can also be considered as standalone, but a BCR for each has bot been derived at this stage.

This report should be read in conjunction with the other Ōtaki to north of Levin PFRs, which includes an option in PFR 5 for a potential re-routing of SH 57 around Ohau to the south, with the potential for this route to also become the heavy vehicle bypass. This would have many positive benefits for Ohau settlement (most heavy vehicles removed, approximately one third less traffic, etc.).

The economic result indicates that the All Improvements minus horizontal curve package of work is viable and this is recommended to be taken forward into the Scheme Assessment Report (SAR) phase, whilst also testing whether inclusion of horizontal curve improvements are still warranted (e.g. curve at north end does not need improvement if the 80km/h speed limit is implemented).

NZ Transport Agency

Report 4: Ohau Settlement

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1 Introduction and Background

Using the outcomes of the Ōtaki to North of Levin Scoping Report and addendum, the NZTA decided that the most appropriate strategy for the highway between Ōtaki and North of Levin is to upgrade the existing highways as the first stage of a long term strategy. This allows the NZTA to realise important safety benefits in the short to medium term whilst deferring the need to construct four lanes for the time being.

This Project Feasibility Report (PFR) is one of a number of reports being undertaken to determine the package of improvements that should be implemented to improve the safety and efficiency of the highway between Ōtaki to Levin as part of the Wellington Northern Corridor Road of National Significance (RoNS).

The objectives of the Wellington Northern Corridor RoNS, which runs from Wellington Airport to north of Levin, are:

- To enhance inter regional and national economic growth and productivity;
- To improve access to Wellington's CBD, key industrial and employment centres, port, airport and hospital;
- To provide relief from severe congestion on the state highway and local road networks;
- To improve the journey time reliability of travel on the section of SH1 between Levin and the Wellington Airport; and
- To improve the safety of travel on state highways.

For the Ōtaki to north of Levin section; the objectives are:

- To provide best value solutions which will progressively meet (via a staged approach) the long term RoNS goals for this corridor of achieving a high quality four lane route;
- To provide better Levels of Service, particularly for journey time and safety, between north of Ōtaki and north of Levin;
- To remove or improve at-grade intersections between north of Ōtaki and north of Levin;
- To engage effectively with key stakeholders; and
- To lodge Notices of Requirement and resource consents as appropriate with the relevant consent authorities for the first individual project by the 2013/14 financial year.

The projects that are being developed to help meet these objectives are presented in Section 2.

The purpose of this report is to determine the feasibility of undertaking road safety and traffic management improvements on the section of State Highway 1 through Ohau Settlement.

The geographical extent of this project is for approximately 1.5km of State Highway 1, from south of Bishops Road to north of Vista Road.

The outcome of this PFR will be considered alongside the outcomes of the other PFRs and used to determine the best package of works to progress as the first stage towards the long term strategy.

2 Projects Currently Being Investigated

The projects that are currently being investigated to meet the short to medium term objectives of the Ōtaki to north of Levin RoNS project are presented in the figure below.

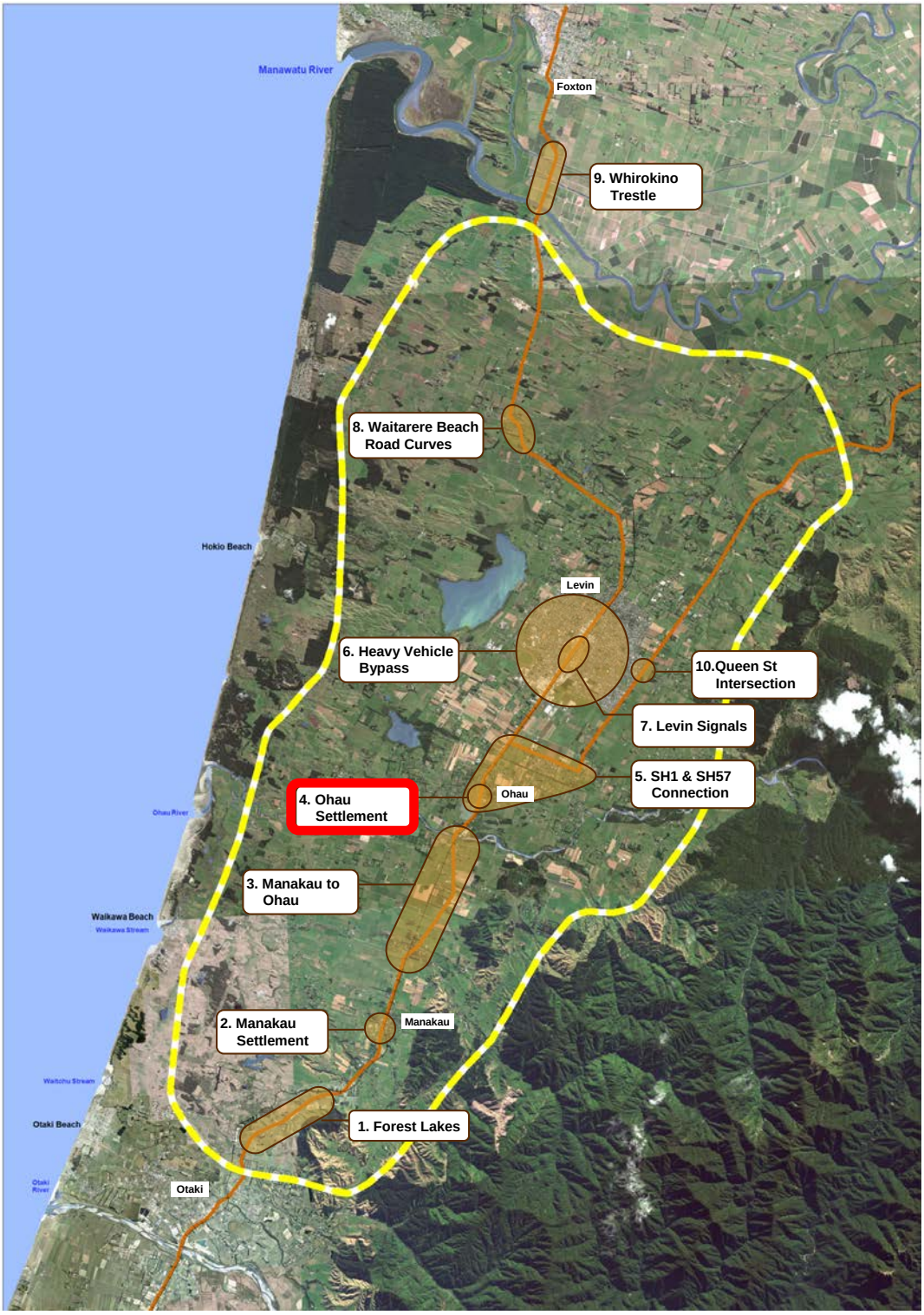


Figure 2-1: Projects Currently Being Investigated

In addition to the above PFRs, reports are also being undertaken on Route Improvements (i.e. edge treatment, passing lanes, walking and cycling, side friction etc; Report No. 11) and on Four Lane Alignments (Report No. 12).

3 Description of Problem

3.1 Ōtaki to North of Levin

State Highway 1 and State Highway 57 through the study area have a number of deficiencies, resulting in a poor crash history and a number of locations where the free flow of vehicles is restricted by the physical characteristics of the highway.

State Highway 1 currently follows the historic route established in the late 19th and early 20th centuries. As a consequence it is constrained by a now substandard alignment, towns and settlements, narrow curved bridges and significant side friction caused by local roads, commercial frontages and property accesses for the entire stretch.

3.2 Ohau Settlement

The section of road under consideration in this PFR is approximately 1.5km in length, from south of Bishops Road to north of Vista Road, running through the Ohau settlement. This does not include the short northbound passing lane to the south of the settlement, but the passing lane has been included as part of the problem and solution discussion.

The key issues that are being considered for improvement are:

- Northbound passing lane leading into settlement (approx. 650 m long).
- Speed; 100 km/h posted speed zone conflicts with safety and settlement identity.
- Pedestrian and cyclist facilities generally limited.
- Side friction; residential and retail/commercial development close to roadside.
- Many side roads.
- High number of vehicles crossing the highway.
- Increasing heavy vehicle volumes.
- Short distance between limit line and railway line on Bishops Road (currently 15 m).
- Narrow cross section; including narrow shoulders.
- Curve at Bishops Road deficient with approx. 500 m radius, which is also within the passing lane.
- Deficient vertical crest curve at Marsden Tce limiting sight distance.
- Curve south of Vista Road deficient with approx. 450 m radius.
- Close proximity of power poles to carriageway, especially in the township.
- Steep batter slopes at northern end of section, along with large trees within the clear zone.

4 Site Description

The project area consists of a 1.5 km length of SH 1 (RP 985/0.90 - 2.40).

- Of the 1.5 km project area, approximately 300 m is within the more built-up part of Ohau Settlement.
- The speed limit through the entire project area is currently 100 km/h.
- There are two horizontal curves within the section with undulating vertical geometry, particularly towards the northern end of the section.
- The vertical profile changes just after Muhunoa Road (East and West) intersection, when viewed from the northbound direction, to a climbing gradient of approximately 2%, flattening out again around Vista Road.

- The road is a two way undivided carriageway with 3.5 to 3.6 m sealed lanes and variable sealed shoulders, particularly around the passing lane merge taper.
- The road widens for a right turn bay into Muhunoa West Road and the passing lane.
- There is a pedestrian underpass under SH 1 adjacent to Muhunoa Road within the road reserve.
- The North Island Main Trunk Railway runs to the east of SH 1 and through the settlement.
- There is a rail underpass on Muhunoa East Road which is unsuitable for heavy or high profile vehicles.

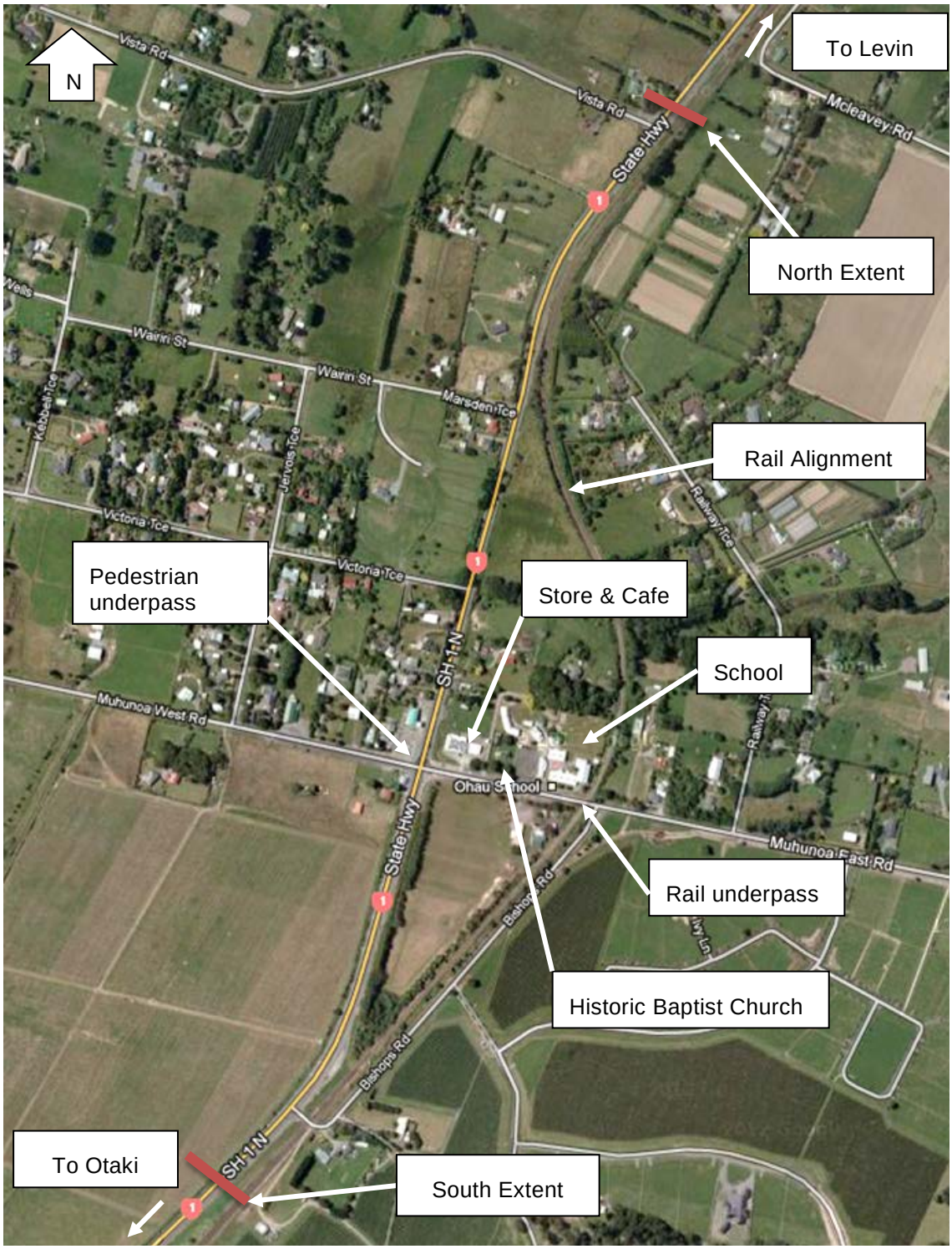


Figure 4-1: Study Area Location Plan

There are five intersections within the study area, all with priority control, with the latter four closely spaced:

- Bishops Road (RP 985/2.28), serving as a heavy vehicle route for traffic coming from the east of Ohau heading south or west restricted by the rail underpass on Muhunoa East Road.
- Muhunoa East/West Road (RP 985/1.84), main crossroads connecting the surrounding settlement and farmland to SH 1.
- Victoria Terrace (RP 985/1.61), connecting several blocks of urban and lifestyle properties to SH 1.
- Marsden Terrace (RP 985/1.40), very small cul-de-sac connecting three residential dwellings to SH 1, with no vehicle through access to Victoria Terrace and Muhunoa West Road however there is a pedestrian link.
- Vista Road (RP 985/1.01), 800 m long no-exit road serving several rural properties.
- Land use is a mix of residential, commercial/retail and horticultural/cropping.

5 Traffic Statistics

The Annual Average Daily Traffic (AADT) flow at the NZTA telemetry count site at Ohau (Count Site ID: 01N00988) was 14,600 vehicles per day (2011) with the proportion of Heavy Commercial Vehicles (HCVs) at 10%. The traffic volume within the Ohau Township will likely be higher than this on account of the school, residential dwellings and businesses. However further traffic counts would be required to determine the actual volumes – this can be considered at the SAR stage if required.

The traffic growth rate at the count site is calculated to be 1.3%, using data from 1992 to 2011. Volumes typically increased from 1992 to 2005; however since then volumes have remained generally stable.

Annual average daily side road traffic volumes, as far as the data from Horowhenua DC reveals, are as follows (south to north);

- Bishop Road (RHS): 60 vpd
- Muhunoa West Road (LHS): 700 vpd
- Muhunoa East Road (RHS): 650 vpd
- Victoria Terrace (LHS): 250 vpd
- Marsden Terrace (LHS): Unknown, services three dwellings.
- Vista Road (LHS – no exit): 80 vpd

6 Crash History

6.1 Crash Data

A review of NZTA's CAS database over the five-year period from 2007 to 2011 revealed a total of 19 crashes along the 1.5 km section of highway (SH1 RP 985/0.9 – RP 985/2.4). The extended 1.5 km length was chosen to include crashes from the influence of the intersections and at either end of the site, and the horizontal curve at the southern end.

The following tables provide a summary of the CAS output data.

Table 6-1: Annual Distribution of Crashes 2007-2011

Year	Fatal	Serious	Minor	Non-Injury	Total	DSi*
2007	-	-	1	5	**6**	-
2008	-	-	1	5	**6**	-
2009	-	-	-	2	**2**	-
2010	-	-	2	-	**2**	-
2011	-	1	1	1	**3**	1
Total	**-**	**1**	**5**	**13**	**19**	**1**

* Death and serious injury casualties

Table 6-2: CAS Crash Type

Crash Type	Number of Reported Crashes	Percentage of Reported Crashes
Overtaking Crashes	2	11%
Straight Road Lost Control/Head On	3	16%
Bend – Lost Control/Head On	2	11%
Rear End / Obstruction	7	37%
Crossing / Turning	5	26%
Pedestrian Crashes	-	0%
Miscellaneous Crashes	-	0%
Total	**19**	**100%**

Table 6-3: HRRRG[1] Crash Type

Crash Type	Number of Reported Crashes	DSi	Percentage of Reported Crashes
Head on	-	-	0%
Run off Road	5	1	26%
Intersection Crashes	5	-	26%
Other	9	-	48%
Total	**19**	**1**	**100%**

[1] High Risk Rural Roads Guide (HRRRG), NZTA, September 2011

Table 6-4: Crash Causation Factors of Reported Injury Crashes

Causation	Number of Reported Injury Crash Causation Factors
Alcohol	1
Too fast	1
Failed giveway/stop	3
Overtaking	1
Incorrect lane/position	4
Poor handling	3
Poor observation	10
Poor judgement	3
Fatigue	1
Vehicle factors	1
Road factors	6
Other	3

Table 6-5: Environmental Factors

	Wet	Dry		Night	Day		Weekend (Fri 6:00PM to Monday 5:59AM)	Weekday
No.	6	32		9	10		5	14
%	13	68		47	53		26	74

- Of the 19 reported crashes over the five year period analysed, one was serious injury, five were minor injury and 13 were non-injury.
- The serious injury was incurred during a run off road crash just north of Victoria Tce in 2011. This was attributed to driver distraction and a slippery road from rain.
- Poor observation was the single highest crash causation factor towards injury crashes, being attributed to 10 of the 37 crash causation factors.
- Nearly half (47%) of crashes happened at night time.

A further five year period between 2002 and 2006 was also analysed. During this period there were three fatal and one serious injury crashes. The fatal in 2002 was a head-on caused by a car swinging wide on the curve to the south of Vista Road. The fatal in 2004 was caused by a northbound car losing control on the curve north of Bishops Road. The fatal in 2006 was caused by a car losing control in the wet on the curve to the south of Vista Road. The serious injury crash in 2006 was a rear-end on the curve near Bishops Road, attributed to following too closely. These crashes clearly indicate the risk associated with this section and reinforces the need to provide a better balanced solution between the service provided to through traffic and the service provided to the community. None of the recent work (e.g. pedestrian underpass, turning lane widening at Muhunoa Road intersection) has addressed these severe crashes. The crashes from the additional 5 year period from 2002-2006 are summarised in Table 6-6, below.

Table 6-6: Annual Distribution of Crashes 2002-2006

Year	Fatal	Serious	Minor	Non-Injury	Total	DSi*
2002	1	-	3	2	**6**	2
2003	-	-	1	4	**5**	-
2004	1	-	1	3	**5**	1
2005	-	-	2	-	**2**	-
2006	1	1	2	5	**9**	4
Total	**3**	**1**	**9**	**14**	**27**	**7**

* Death and serious injury casualties

6.2 Crash Risk

The section of SH1 was analysed according to the High-Risk Rural Roads Guide (HRRRG) which identifies that crash risk can be generally defined in two ways:

- Actual Crash Risk; which is based on crashes reported in the last 5 years. This is separated into collective risk, which is also known as crash density, and personal risk, which is also known as crash rate.
- Predicted Crash Risk; which is based on KiwiRAP road protection score (RPS) and the KiwiRAP star rating.

In terms of crash risk this 1.5 km section of SH 1 has:

- A collective risk of 0.13 high-severity (fatal and serious) crashes per km per year;
- A personal risk of 2.49 high-severity crashes per 100 million vehicle km; and
- An average KiwiRAP star rating of 2.5, giving a published KiwiRAP rating of 2 stars, together with an RPS of 19.4.

The personal risk value equates to the highway having a low risk. However; the collective risk was calculated as medium high, therefore meaning this length of SH1 is classified a high risk rural road. It would also be classified as a high risk rural road due to the KiwiRAP star rating and the RPS.

It should be noted that this crash history period did not have the number of fatal or serious crashes required under section 4.1 of the HRRRG to accurately determine the Actual Crash Risks. Further analysis using the 10 year crash history, which does have the minimum crash numbers, reinforces the site as being high risk, with the collective risk calculated as high and the personal risk calculated as medium.

Further Crash Data can be found in Appendix C**.**

7 Alternatives and Options Considered

The alternatives and options available should be seen as all individually and collectively contributing to road safety and traffic management improvement. They are such that each can be standalone, or they can be considered in clusters or as a total package. Given that horizontal curve realignment is more major in cost, the economics, whilst kept simple at this stage, does look at with and without curve improvements. There is also overlap with other PFRs, so the next stage can be influenced by their outcomes (e.g. PFR No. 5 SH 1/57 has the potential to have a major influence on this PFR if the highway split is adopted south of Ohau).

The alternatives and options are described below and presented in Appendix D.

7.1.1 Northbound Passing Lane

Report No 11 addresses overall route improvements, with passing lanes one of the features considered. The report recommends the removal of the northbound passing lane in favour of a better package of longer, more evenly distributed passing lanes. For the Ohau Settlement PFR the removal of the

northbound passing lane is noted as having a positive effect on the settlement (i.e. less aggressive speeds at the end of the short passing lane (approximately 650 m), which is close to the settlement main residential activity. Cost and economic benefits have been factored into the route improvements report.

7.1.2 Posted Speed Limit

The NZTA Palmerston North office has a proposal in hand to lower the speed limit through Ohau to 80k m/h. This will extend the current 80k m/h speed limit south of the SH1/57 intersection through to just south of the settlement.

The introduction of an 80 km/h zone allows the opportunity to consider a flush median, which together with threshold treatments at both ends will give the town an identity (see Section 8 for threshold treatment examples). There is an opportunity for the community to participate in the design of the threshold signs as indicated in one of the example signs.

7.1.3 Pedestrian and Cycle Facilities

The predominant pedestrian movements are across the highway at Muhunoa Road and the pedestrian underpass constructed in recent years has provided the level of relief required. It is not considered that a footpath on the western side of the highway is required, particularly if the proposed road closures below eventuate. Pedestrians should be encouraged to use the local road network. Safety footpaths were considered in this study, but were not favoured, in order to encourage pedestrians use the local road network.

Cyclists on the highway are currently not well catered for (non uniform sealed shoulder widths) and the proposal is to increase the cross section width (see Section 7.1.9 below), including uniform 2.0 m sealed shoulders to provide an improved level of service standard to cyclists. Cyclists will also value the flush median when turning into properties or side roads.

7.1.4 Side Friction

The frequency of properties, and access to them, results in significant side friction, often resulting in delays to following vehicles as they adjust speeds to avoid turning vehicles. This conflict can also lead to crashes at accessways. Provision of a wider cross section, particularly sealed shoulders and a flush median, will allow turning vehicles to move more smoothly out of the traffic stream, hence avoiding much of the conflict. In addition it is proposed to provide enhanced access layout (see Figure 8-4) to the highway boundary, in conjunction with the seal widening, to further facilitate conflict reduction. For the commercial/retail properties on the SH1/Muhunoa Road north-western quadrant, application of the Planning Policy Manual (PPM) principles is proposed. NZTA have noted that these properties could be changing use in the near future, so the opportunity should be looked at in the consent application process to protect the functioning of the highway at this busy intersection (given also the proposal below to close side roads on the western side, in favour of the Muhunoa Road intersection).

Off highway parking provision should be reviewed, at the SAR stage, with Horowhenua DC, to ensure that retail/commercial businesses meet District Plan requirements.

7.1.5 Side Roads

For each of the road closures proposed an appropriate physical closure will be required. Closures will have a small route choice change imposed on property owners/occupiers affected, but the safety gains are considered to outweigh these disbenefits by diverting all traffic through one higher standard intersection.

See also PFR No 5 which could influence the above side road treatment.

7.1.5.1 Bishops Road

The intersection of Bishops Road and SH1 is substandard, with the rail only 15 m from the limit line. Whilst closure would be the first preference, this is not practical as the heavy vehicle users are unable to use the alternative of Muhunoa Road East, because of the rail underpass width and height restrictions. Consideration was given to widening the rail underpass, but this has impact on the school operation and hence was not pursued at this stage of investigation. It can be considered further at the SAR stage. The Bishops Road intersection will therefore need to be investigated in the next phase to improve its function. There are two possibilities;

- Move the intersection to the north by 160 m to gain better separation with the rail and highway. This is challenging with the rail being elevated at this point.

- Investigate the horizontal curve improvement (which will be outside of the 80 km/h zone), which will provide the required separation from the rail.

Both of these options have been included in the pricing of the all improvements package; however it should be noted that if the horizontal curve improvement is carried out, the full realignment of the Bishops Road intersection may no longer be necessary. Investigation will be required at the SAR stage to determine the extent of this.

7.1.5.2 Muhunoa Road East & West

See Section 7.1.4 and 7.1.6 for proposed improvements and investigation recommendations.

7.1.5.3 Victoria Terrace

It is proposed to close this road. Access to the highway would be instead available via the western network and Muhunoa Road West. The intersection enters the highway on a gradient and is only 200 m away from Muhunoa Road. It is a very low traffic generator, so closure in favour of improved safety is recommended.

7.1.5.4 Marsden Tce

Marsden Tce is a very short cul-de-sac serving a small number of residential properties with no vehicle through access to the local road network. It is recommended that the NZTA maintain the status quo, noting that the flush median, wider shoulders and reduced speed limit will improve safety and efficiency.

7.1.5.5 Vista Road

It is proposed to close this road. Currently it is a no exit road, hence if closed will require a link across to the local western network (as shown on the drawing). The cost of providing this link versus the benefit of closure will need to be investigated in the SAR. Visibility to the south is also restricted for Vista Road. See section 7.1.12 below.

7.1.6 Cross Movements

The only cross highway movements are at the crossroads of Muhunoa Road East and West. With the pedestrian underpass now in place, the cross movements are vehicles and occasionally cyclists. The layout of the intersection is considered to be of a good standard and the only proposed work is that indicated in 4 above around influencing the form of the commercial/retail activities on the western side through the consenting process. The property on the south-western quadrant is very close to the highway and should be researched to ensure there is no encroachment into the highway reserve and that it functions safely in accordance with District Plan requirements (e.g. off road parking, etc.).

7.1.7 Heavy Vehicle Volumes

The predicted increase in on road freight movement will inevitably result in more, heavier and potentially longer HCV's in the future. This puts more strain on other road users. Hence this adds weight to the argument to widen the cross section and install a flush median as safeguards against a reducing road safety and traffic management performance.

7.1.8 Rail Seperation on Bishops Road

The NIMT railway has a separation for the limit line on SH1 of 15 m. See Section 7.1.5.1 above, for a possible treatment to increase the rail and limit line separation to at least 23 m, current. Given that the vast majority of HCVs are turning left out of the intersection, a back-up option is to provide sufficient shoulder width beyond the left hand radius to allow a HCV driver to pull off onto a sealed area adjacent to the highway (not an acceleration lane, but a protection width).

7.1.9 Cross Section and Shoulder Width

There is reference in the sections above to a consistent cross section. The current cross section nominally consists of two 3.5 m wide lanes and sealed shoulders which vary from 0.6 m to 1.7 m, with some less than 0.6 m. The proposal is to provide a consistent cross section - two 3.5 m lanes, two 2.0 m shoulders and a 2.0 m flush median between the threshold treatments. If road reserve width is tight, kerb and channel can be introduced to ensure widening stays as close to current road reserve width as possible (to be investigated). At intersections, particularly Muhunoa Road, the seal width is determined by turning lanes, both left and right or by the requirements of the PPM. The cross section

finally provided should be consistent with ultimate four laning (if it is constructed this far north) which will likely see widening on the western side.

7.1.10 Bishops Road Horrizontal Curve

As mentioned in Section 7.1.5.1 the 500 m radius curve, if improved, will alleviate the deficient rail to limit line separation at Bishops Road. It would potentially be a sounder investment, eliminating future redundancy, to increase the curve radius to 1100 m (desirable RoNS standard). However, if the SH1/57 split is south of Ohau and it also becomes the point where four laning ultimately finishes, then an 800 m radius would be an acceptable standard. Noting that of all the traffic on SH 1, two thirds (less possibly HCV's which would potentially use an eastern bypass) would still use this route while a third would bifurcate onto SH57. See PFR No 5 for SH1/57 options.

7.1.11 Marseden Terrace Vertical Curve

The current K factor for the vertical curve at Marsden Tce is 64. The K factor for safe stopping distance for 100k m/h is 83.6 and for 80 km/h is 42.9. The need for any improvement is governed by the speed limit. With NZTA likely progressing an 80 km/h speed limit, there is no need to lower the crest curve.

7.1.12 South of Vista Road Horrizontal Curve

Similar to 7.1.11 above, the intended 80 km/h speed limit will result in this curve being consistent with the operating speed. Should the 80 km/h speed limit not eventuate then this curve would need to be considered for improvement, noting the railway line is adjacent and would need to be shifted. A radius of around 700 m appears viable if the four laning stops to the south, but would be below standard if four laning ends to the north. A larger radius would have increasing impact on the rail and property, but should be investigated based on the outcome from PFR No 5. This potential realignment has not been included in the cost estimate and economics in this stage of the investigations.

7.1.13 Proximity of Lighting and Power Poles to Carraigeway

The lighting on the southbound side of the road through Ohau consists of frangible light poles, whilst on the northbound side lighting arms were retrofitted to the existing power poles. All are within 1 – 2 m of the edge of seal. Consideration should be given to undergrounding the overhead power, hence eliminating power poles. Lighting poles can be relocated as far back as practicable as part of the seal widening proposal. This reduces hazards which figure prominently in objects hit in the crash history. Impact absorbing crash cushions are another option if undergrounding or relocating the poles far enough away is not feasible.

7.1.14 Edge Protection

Protection of embankments with safety barrier and either removal or protection with safety barrier of large trees is proposed. At least one serious injury crash is attributed to an embankment as a contributing factor.

8 Design Statement

This project is at a feasibility stage, and therefore several assumptions have been made in the design, particularly in relation to the seal widening and intersection rationalisation aspects.

The design assumptions include the following:

- The cost estimate has been based on the judgement of an engineer who has knowledge of the site.
- The cost estimate has been based on the assumption that the project can be built using proven technology.
- No adverse ground conditions are encountered (e.g. contaminated material or large areas of peat).
- Regrading the carriageway would not be required but new surfacing would be laid across the entire width and length of the project.

- Earthwork batter slopes are assumed to be 6H:1V for fills and 3H:1V for cuts. Earthwork extents have been estimated as no topographical survey data is available.

Whilst the overall project length is 1.5 km, the section over which the general improvements such as seal widening would take place is 1.27 km, between Vista Road (RP 1.01) and Bishops Road (RP 2.28). Therefore, while the economics of the option are considered only for this 1.27 km length, the full 1.5 km has been considered in the crash analysis in order to ensure that all crashes influenced by the Vista and Bishops Road intersections as well as the horizontal curve near Bishops Road have been included in the analysis.

It has been assumed that the existing carriageway will largely be retained, with a seal widening formed on either side of the existing formation to achieve the design road width. In lieu of geotechnical testing the depth of pavement construction has been based on local knowledge and typical sections provided for RoNS projects to the south. This allows for 350 mm of sub-base and 150 mm of M4 basecourse with a chip seal surface.

NZTA have recently checked the speed limit warrant for the Ohau Settlement and have a proposal under action to extend the current 80 km/h section to the north of the settlement to south of the settlement (coinciding with the position of a threshold treatment). This report assumes that this reduced speed restriction will be progressed through to implementation.

Thresholds can be installed in accordance with Guidelines for Urban-Rural Speed Thresholds RTS 15 (LTSA, 2002), such as the examples in Figure 8-1 and Figure 8-2, below. The threshold signs may include a symbol or message designed by the local community (Figure 8-3: Threshold sign concept).

A flush median and widened shoulders will address some of the safety issues caused by turning traffic, and improve the safety of pedestrians. The flush median, along with kerb and channel in parts of the settlement, will create a road environment that reflects the 80km/h speed limit. Typical cross sections are shown in Figure 8-4. Kerb and channel would be installed in constrained locations. As part of the widening, the private property accesses can be improved to a safer standard.

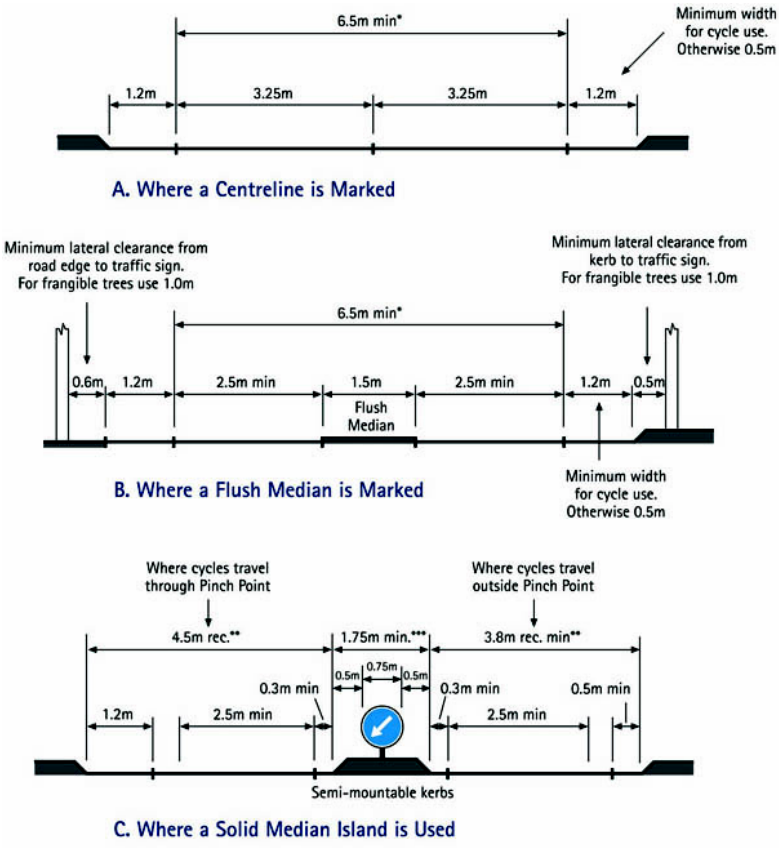


Figure 8-1: Threshold treatment cross-sections

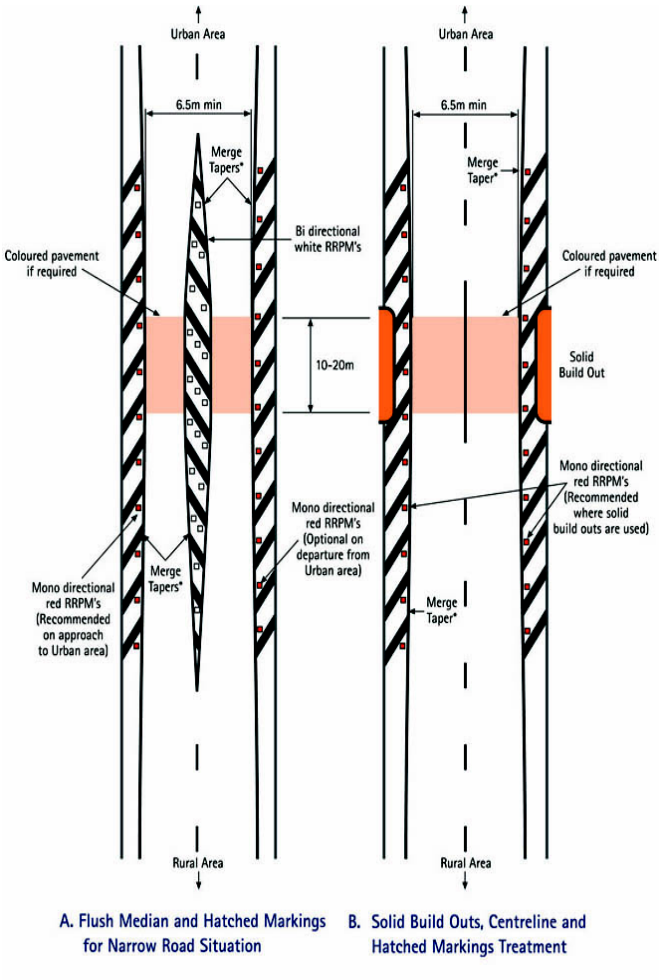


Figure 8-2: Threshold treatment plan views

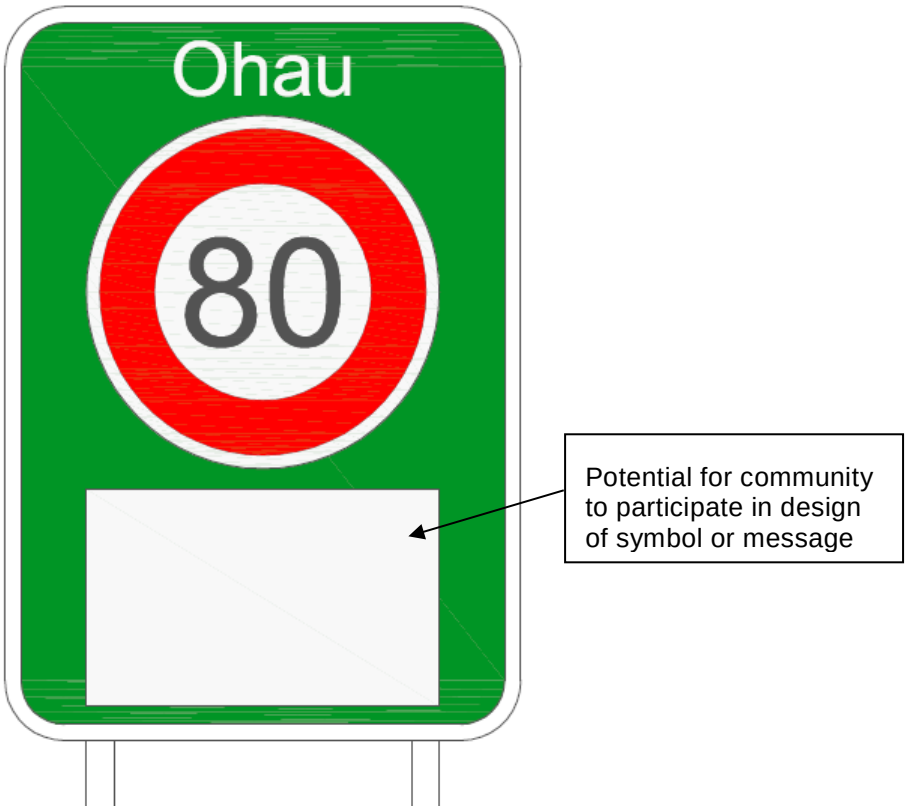


Figure 8-3: Threshold sign concept

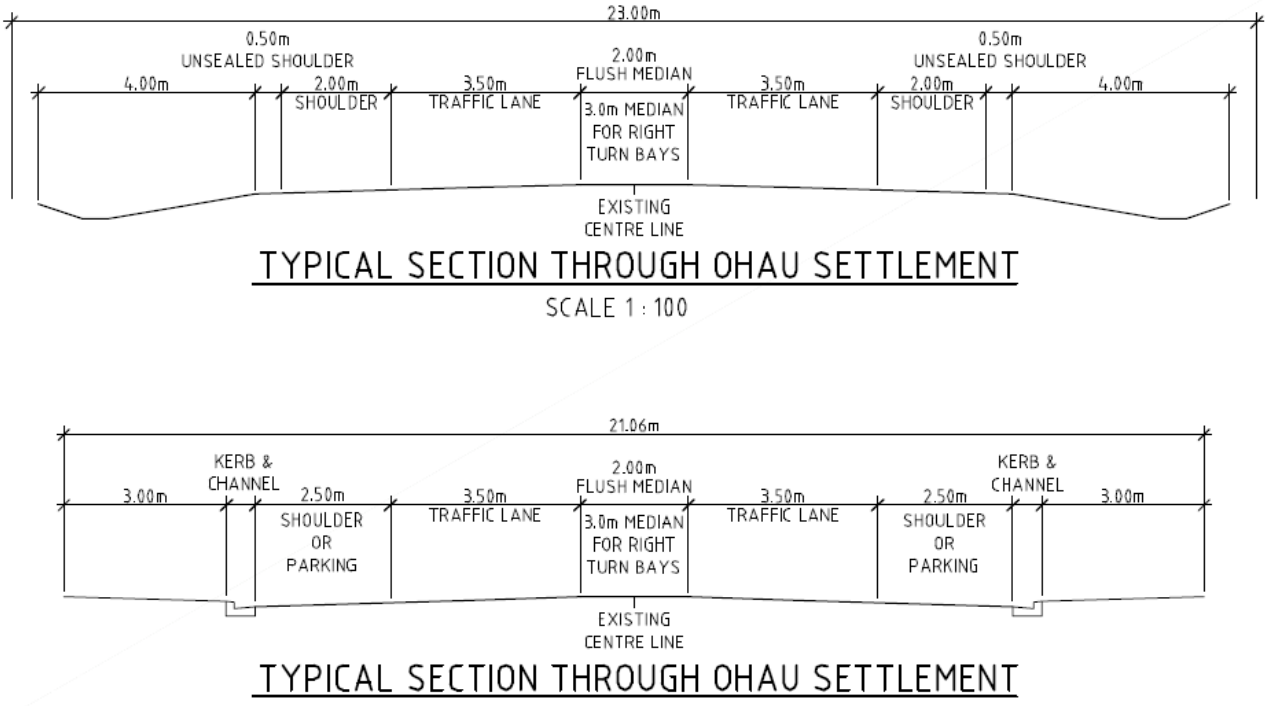


Figure 8-4: Typical cross sections

9 Traffic Modelling

No traffic modelling has been undertaken at this stage due to the high level of these assessments. However, some modelling should be undertaken in the SAR to determine travel time and vehicle operating costs changes within the surrounding network if the side road closures were to be pursued.

10 Cost Estimates

Fesibility estimates have been prepared and should be seen as very rough order costs, noting the level of data and information available at this PFR stage.

Table 10-1: Cost Estimates

Option	Expected estimate	95th percentile estimate
Option 4-1 All improvements including southern horizontal curve	$4,890,000	$6,235,000
Option 4-2 All improvements except southern horizontal curve	$3,823,000	$4,875,000

More detail of the cost estimates for the options are given in Appendix E.

11 Economic Assessment and Risk Assessment

Economic analysis was carried out in accordance with NZTA's Economic Evaluation Manual (EEM) using the simplified procedures (SP 3).

Whilst there are benefits and disbenefits associated with travel time (TT) and vehicle operating costs (VOC), these have not been quantified, particularly given that the 80 km/h speed limit is expected to be implemented separately by NZTA, and hence will be part of the Do Minimum and the improvements package (e.g. facilitates the flush median). The Do Minimum is otherwise deemed to be maintenance of the existing asset. The main economic comparison for this PFR is to assess the level of safety benefit that can be derived from the package of improvements outlined.

Because the realignment of the horizontal curve at the southern end of the site (adjacent to Bishops Road) is of significant cost, two BCRs have been produced, with and without the curve. It should be noted, however, that if this curve realignment is carried out, the full realignment of the Bishops Road intersection (included in the general improvements at a cost of approx. $480,000) may no longer be necessary due to improved storage between the railway tracks and the limit line at SH 1. This will need to be investigated at the SAR stage.

11.1 Crash Benefits

Both 5 year and 10 year crash histories have been extracted (to understand the underlying risk) and a crash by crash analysis undertaken to derive the annual crash cost. Given the diverse nature of the improvements proposed, an experienced Principal Safety Engineer/Economic Analyst has judged the likely crash saving for the two options.

Only those crashes which the improvement work is deemed to have a positive influence on have been counted towards the crash savings of the improvements. These, as a percentage of all crashes over the study periods, form the expected crash reductions used in the economic analysis. These have been noted as such in the crash list report in Appendix F. It should be noted that the percentage crash reductions determined from the two crash history periods are different, owing to the different severities of crashes that would have been prevented by the improvements.

Benefits have then been calculated based on the most optimistic, pessimistic and median crash reductions expected using engineering judgement. The optimistic scenario is that all of the crashes theoretically preventable by the improvements will in fact be achieved. The pessimistic scenario is that

only half of them will be achieved. The median crash reductions, that 75% of the theoretical reductions will be achieved, were taken forward for economic analysis. These are shown in Appendix F.

Table 11-1 : Benefits - crash costs annual and discounted (30 years at 8%)

Option Description	Annual Benefits	Discounted Benefits
Option 1 – including horizontal curve realignment (5 yr crash history)	$365,000	$4,000,000
Option 2 – excluding horizontal curve realignment (5 yr crash history)	$358,000	$3,920,000
Option 1 – including horizontal curve realignment (10 yr crash history)	$548,000	$6,000,000
Option 2 – excluding horizontal curve realignment (10 yr crash history)	$430,000	$4,710,000

11.2 Benefit Cost Ratio Results

Table 11-2: BCRs

Option Description	5 Year Crash History	10 Year Crash History
Option 1 – including horizontal curve realignment	0.8	1.2
Option 2 – excluding horizontal curve realignment	1.0	1.6

A comparison of BCR's for the range of crash reductions between the pessimistic and optimistic scenarios, as discussed in section 11.1, has been included as a sensitivity analysis.

Table 11-3: Sensitivity Analysis of BCRs

Option Description	5 Year Crash History	10 Year Crash History
Option 1 – including horizontal curve realignment	0.5 – 1.1	0.8 – 1.6
Option 2 – excluding horizontal curve realignment	0.7 – 1.4	1.0 – 2.1

11.3 Intangible benefits

Community comfort (or discomfort) is often under-estimated. For now this can be viewed as an intangible benefit, but in the SAR can be quantified. Communities will definitely respond in a positive manner to initiatives that make their environment safer. It remains to be seen if road closures will be endorsed by the community as a safer solution. Research does back this up as factual, with two similar side roads having some 60% greater crash risk compared to one consolidated side road.

11.4 Risk Assessment

The risks to the project have been assessed using the General Approach as determined in the NZTA Risk Management Process Manual (AC/Man/1).

The major potential risks associated with the Ohau Township improvement project are considered to be:

- Project unable to get funded due to constrained funding environment.
- Speed limit reduction to 80 km/h not being progressed by NZTA independent of this assessment
- Local opposition to the project primarily due to the road closures.
- Inaccurate cost estimate due to level of available data at this feasibility state, including utility information and assumptions in regards to passing lanes, turn around areas and seal type.
- Traffic delays during construction.

- Environmental effects during construction.
- Impacts on existing services.
- Land acquisition difficulties.
- Difficulties in obtaining resource consents and/or alteration to designation.
- Opposition from local iwi.
- Additional landowner accommodation works required.

12 Assessment Profile

The Government Policy Statement on Land Transport Funding (GPS) requires the NZTA to consider a number of matters when evaluating projects. To assist in understanding how projects perform against these matters and hence what investment decisions to make, the NZTA utilises an assessment profile process.

The assessment profile is a three-part rating for an activity, rated as high, medium or low e.g. HMM, and representing the assessment for Strategic Fit, Effectiveness and Efficiency respectively.

It is considered that the assessment profile[2] for Ohau Township is **HHL**. The following paragraphs outline how this profile has been created.

It should be noted that if this project in its entirety is not deemed economic or efficient, all or several of the improvements can be considered in isolation for the minor improvement programme.

12.1 Strategic Fit

The strategic fit factor is a measure of how an identified problem, issue or opportunity that is addressed by a proposed activity or combination of activities, aligns with the NZTA's strategic investment direction.

As this project is part of a Road of National Significance and is classified as a High Risk Rural Road, the Strategic Fit is **High**.

12.2 Effectiveness

The effectiveness factor considers the contribution that the proposed solution makes to achieving the potential identified in the strategic fit assessment and to the purpose of the Land Transport Management Act (LTMA).

A wide range of assessment factors are available for use in this effectiveness rating and these draw from the five LTMA areas of:

- Economic Development
- Safety and Personal Security
- Access and Mobility
- Public Health
- Environmental Sustainability

A number of other key criteria need to be considered including integration, consideration of options and responsiveness.

As this project is part of the Roads of National Significance programme, it is recommended that the effectiveness factor for RoNS projects of **High** is adopted.

This is considered appropriate as the project will contribute positively to safety and is consistent with NZTA's strategies and plans.

[2] NZTA Planning and Investment Knowledge Base, www.pikb.co.nz/assessment-framework

12.3 Efficiency

The economic efficiency assessment considers how well the proposed solution maximises the value of what is produced from the resources used. This is primarily undertaken by the Benefit Cost Ratio.

As this project has a BCR of between 0.8 and 1.3, the efficiency rating is **Low**.

13 Social and Environmental Assessment

The Scoping Report phase of the Ōtaki to Levin RoNS identified a number of social and environmental factors relating to the Ohau PFR which will need to be assessed during the scheme assessment phase. The main issues relates to potential permanent road closures at the intersections of Vista Road and Victoria Terrace with SH1, and the proposed link road between Vista Road and Wairiri Street.

Consultation has been carried out on a high level under the scoping phase of the Ōtaki to north of Levin RoNS and on-going consultation will continue with stakeholders throughout the planning and design process. The area is identified as being of cultural importance to the iwi of Rangitane o te Whanganui a Tara, Ngati Raukawa ki te Tonga and Ngati Toa Rangitira.

A Consultation Plan for the project area and consultation will be undertaken in accordance with the plan. The purpose of the plan is to:

- Provide a documented process for intended engagement with the community, including the project context, the parties involved, and desired outcomes;
- Maximise effective and efficient engagement of community within generally tight time constraints;
- Provide the specifics of consultation to be undertaken, including timeframes;
- Help the project team to proactively manage risks to the project/project future from inappropriate or inadequate community engagement; and
- Help the project team to constructively manage community expectations.

14 Geotechnical Requirements

A preliminary geotechnical appraisal report was prepared by MWH in 2011. This report outlined that the majority of the stretch of the highway is underlain by beach deposits (Ōtaki Sandstone). To investigate the subsurface conditions along the alignment which includes the Ohau settlement study area, MWH recommended field investigations consisting of hand auger bores, boreholes and test pits. The actual Ohau settlement testing schedule will be developed with NZTA at the SAR start-up phase, along with other PFR testing and will be linked to the improvements to be progressed.

The preliminary geotechnical appraisal report for the Ōtaki to Levin RoNS noted the following aspects in regards to the subject study area:

- It has moderate settlement potential;
- It has a seismic potential due to the proximity of the active Northern Ohariu Fault;
- It has moderate susceptibility to liquefaction; and
- It is not located within a tsunami influence zone.

15 Land Requirements

Given the nature of the work, land purchase is potentially required along one side of the project, as commented on below. There are four other possible land purchase requirements, with all being contingent on other decisions within this PFR or adjoining PFRs;

- Horizontal curve at the south end – the 1100 m radius area would require around 2000 m^2 and substantially more if land for 4 laning was purchased at the same time. It appears that only one landowner would be affected.
- Horizontal curve between Marsden Tce and Vista Road – both highway and rail affected, requiring around 4000 m^2, only if the 80 km/h speed limit does not proceed. Land ownership not known at this stage. This has not been priced as it is assumed in this PFR that the 80 km/h speed limit will proceed.
- Link road between Vista Road and Marsden Tce – would require around 8000 m^2 for a 20 m road reserve. Land ownership not known at this stage.
- Realignment of Bishops Road at SH 1 – would require around 1,700 m^2 for a 20 m road reserve. Land ownership not known at this stage.

Generally the widening, with flush median, will increase the existing road reserve width from just over 20 m, to 23 m, or 21 m if kerb and channel is used (in constrained locations). The SAR investigation will determine the extent of land required. Land to provide off road parking for retail/commercial businesses will need to be discussed with Horowhenua DC during the SAR stage.

16 Resource Management Issues

The project must meet all statutory requirements. There are a number of documents (both statutory and non-statutory) that must be considered when planning for the state highway improvements. In particular, the requirements of the Resource Management Act, the operative Horowhenua District Plan and the Horizons Regional Plan (proposed One Plan) will be assessed to ensure that the proposed project meets the plan provisions and follows the statutory process.

16.1 District Plan Provisions

16.1.1 Designations

SH1 is designated under the operative Horowhenua District Plan for “state highway purposes” (D2) (Map 27). The existing designation is narrow in places and may need to be altered to accommodate the road improvements. Accordingly, it is recommended that the designation boundaries be altered to accommodate these works under s181 RMA. NZTA will be required to give notice to the Council of its requirement to alter the designation (NOR). An outline plan will also be required to indicate the scale of the prosed works within the designation.

Sections of SH1 run alongside the railway line. The railway corridor is designated as D1 under the District Plan.

A further designation in the vicinity of the proposed works is the Ohau Primary School in Muhunoa East Road, Ohau (D28) (Map 27) with the Ministry of Education being the designating authority.

16.1.2 Heritage Issues

Schedule 2 – Heritage Features of the District Plan identifies the St John the Baptist Church (Muhunoa East Road, Ohau) (H33) (Map 27) in the vicinity of the proposed works. This heritage building is located adjoining the Ohau Primary School.

16.1.3 Contaminated Site

A site adjacent to the state highway is identified as a contaminated site. It is located at 390 SH1 Levin South (SAHS ID 70012) identified as service station and fuel storage facility containing hydrocarbons. It is classified as “Contamination Acceptable Managed/Remediated”.

16.2 Regional Plan Provisions

The final designs and construction plans will determine what regional consents are required. But given that there are no water courses in the immediate vicinity of the proposed works, it is unlikely that any consents will be required.

16.3 Other Provisions

Given that the proposed works may involve earthworks, there is the potential to unearth Maori artefacts. Current information does not identify any known sites but an archaeological authority may be required should a site be discovered.

Permanent road closures at the intersections of Vista Road and Victoria Terrace with SH1, as proposed in the project will be pursuant to the Local Government Act 1974.

17 Maintenance Issues

Routine maintenance costs can be considered to be neutral. A full-width reseal would be carried out as part of the improvements. This has been included in the comparison in costs between the improvements and the Do Minimum.

The current proposals would result in two specific changes to the maintenance regime:

- maintenance and repair of the w-section road safety barriers; and
- maintenance of a wider seal width.

Both these aspects have been included in the economic evaluations of the options.

18 Conclusions and Recommendations

A variety of road safety and traffic management improvement options were considered, for which benefits and costs were determined. The expected cost estimate to achieve all of the improvements considered is $4.9M, and $3.8M if the horizontal curve improvement at the southern end of the site was not pursued. The curve at north end will not need improvement if the 80 km/h speed limit is implemented.

Indicative BCRs were derived from predicted crash cost savings alone. For all improvements being carried out, the BCR is 0.8 (5 year crash history) or 1.2 (10 year crash history), and minus the horizontal curve realignment is 1.0 (5 year crash history) or 1.6 (10 year crash history). The options are such that many can also be considered as standalone, but a BCR for each is not credible to derive at this time but may be undertaken at SAR Stage.

The economic result indicates that all the improvements minus the horizontal curve realignment are viable as a package, and this is recommended to be taken forward into the SAR phase, whilst also testing whether inclusion of the horizontal curve improvement is still warranted.

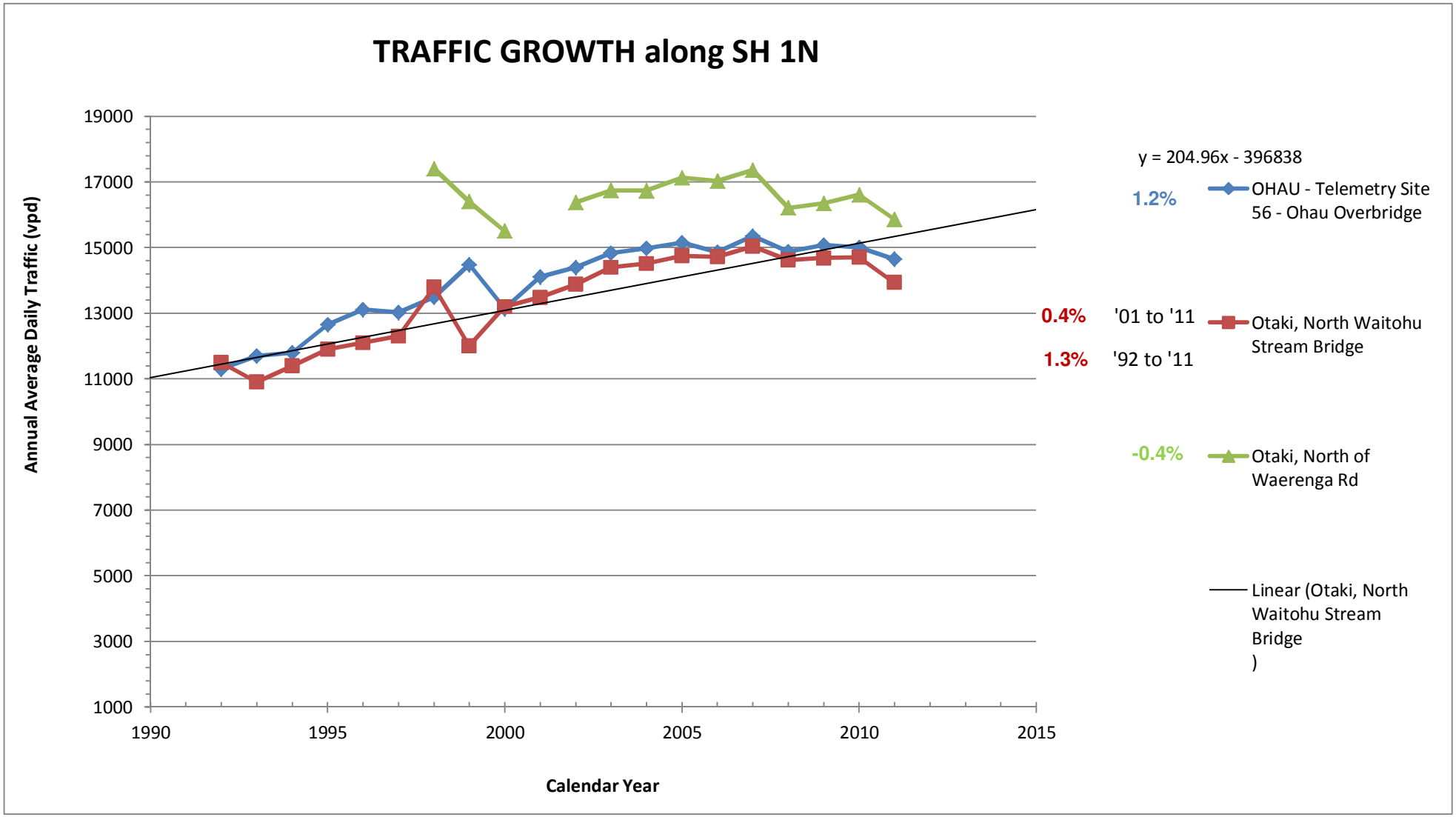
This report should be read in conjunction with the wider Ōtaki to North of Levin PFRs, which includes an option in PFR 5 for a potential re-routing of SH 57 around Ohau settlement to the south, with the potential for this route to also become the heavy vehicle bypass.

Appendix A Photographs

Figure 18-1: Looking south from Muhunoa Road West

Figure 18-2: Looking north from south of Muhunoa Road East

Appendix B Traffic Data


TRAFFIC GROWTH along SH 1N
Annual Average Daily Traffic (vpd)
19000
17000
15000
13000
11000
9000
7000
5000
3000
1000
1990
1995
2000
2005
2010
2015
Calendar Year
y = 204.96x - 396838
1.2%
OHAU - Telemetry Site 56 - Ohau Overbridge
0.4%
'01 to '11
1.3%
'92 to '11
Otaki, North Waitohu Stream Bridge
-0.4%
Otaki, North of Waerenga Rd
Linear (Otaki, North Waitohu Stream Bridge)

Appendix C Crash Data

CRASH LIST DETAIL REPORT

Run on: 22 Nov 2012

Crash List: Ohau Township 2007 to 2011 (19 crashes)

Total Injury Crashes:	6
Total Non-Injury Crashes:	13
	19

Crash Type	Number	%
Overtaking Crashes:	2	11
Straight Road Lost Control/Head On:	3	16
Bend - Lost Control/Head On:	2	11
Rear End/Obstruction:	7	37
Crossing/Turning:	5	26
Pedestrian Crashes:	0	0
Miscellaneous Crashes:	0	0
TOTAL:	19	100 %

Location	Local road	%	St.Highway	%	Total	%
Urban	0	0	0	0	0	0
Open road	0	0	19	100	19	100
TOTAL:	0	0	19	100	19	100 %

Intersection/Midblock	Number	%
Intersection:	6	32
MidBlock:	13	68
TOTAL:	19	100 %

Environmental Factors	Number	%
Light/Overcast Crashes:	10	53
Dark/Twilight Crashes:	9	47
TOTAL:	19	100 %
Wet/Ice:	6	32
Dry:	13	68
TOTAL:	19	100 %

Day/Period	Number	%
Weekday	14	74
Weekend	5	26
TOTAL:	19	100 %

Vehicles	Number	%
Car	26	79
Van/Ute	3	16
Truck	4	21
Bus	0	0
Motorcycle	1	5
Bicycle	0	0
TOTAL:	34	121 %

Note: Percentages represent the % of crashes in which the vehicle, cause or object appears.

Crash factors (*)	Number	%
Alcohol	1	5
Too fast	1	5
Failed Give way/Stop	3	16
Overtaking	1	5
Incorrect Lane/posn	4	21
Poor handling	3	16
Poor Observation	10	53
Poor judgement	3	16
Fatigue	1	5
Vehicle factors	1	5
Road factors	6	32
Other	3	16
TOTAL:	37	195 %
Crashes with a:		
Driver factor	27	142 %
Environmental factor	6	32 %

(*) factors are counted once against a crash - ie two fatigued drivers count as one fatigue crash factor.

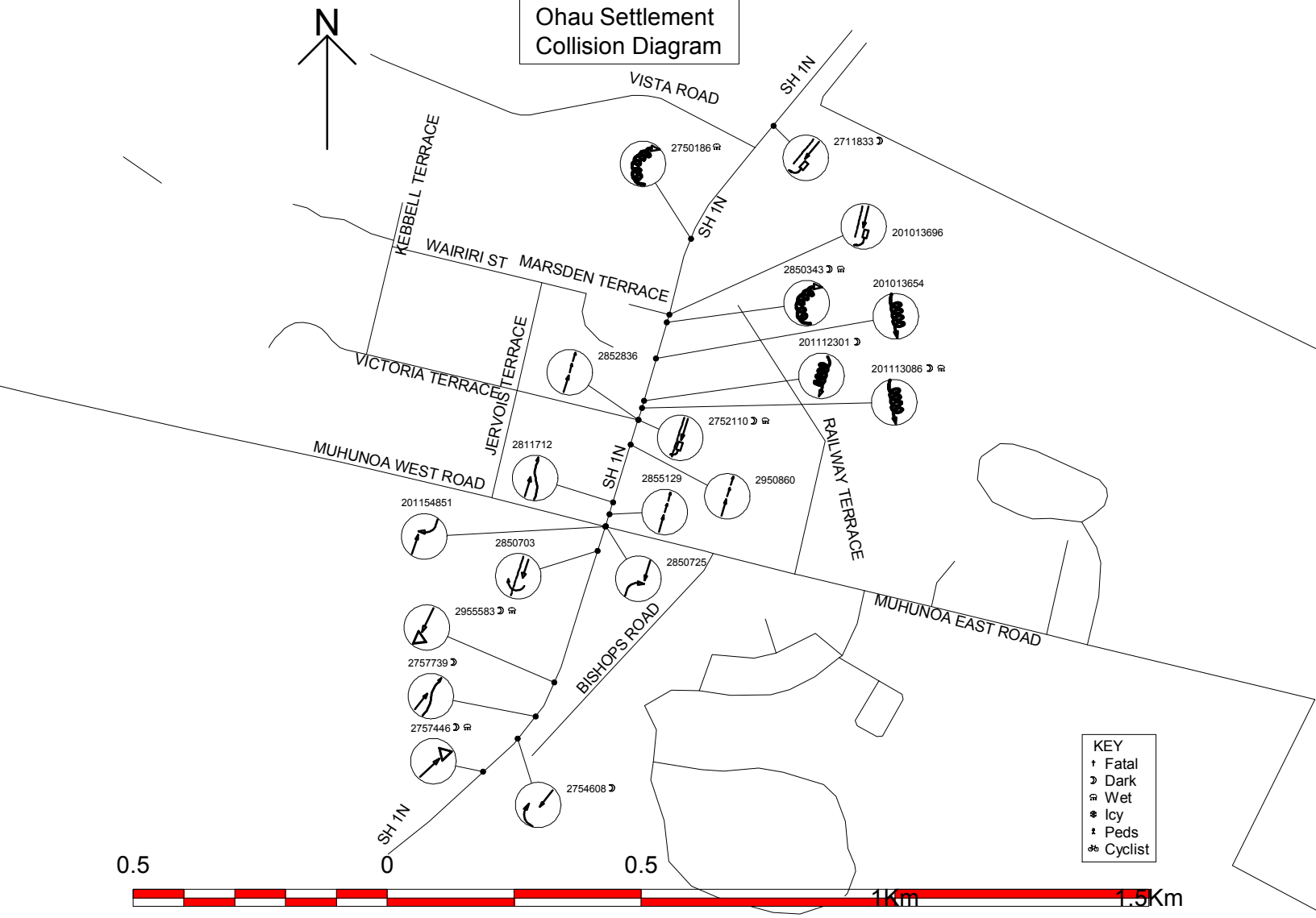
Note: Driver/vehicle factors are not available for non-injury crashes for Northland, Auckland, Waikato and Bay of Plenty before 2007. This will influence numbers and percentages.

Crashes with objects(s) struck	5	26 %

Object Struck	Number	%
Cliff Bank	2	11
Fence	1	5
Tree	1	5
Ditch	1	5
Stray Animal	2	11
TOTAL:	7	37 %

Crash Numbers

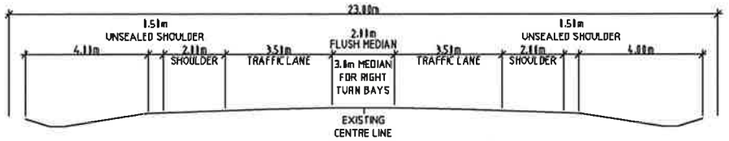
Year	Fatal	Serious	Minor	Non-Inj
2007	0	0	1	5
2008	0	0	1	5
2009	0	0	0	2
2010	0	0	2	0
2011	0	1	1	1
TOTAL:	0	1	5	13


Ohau Settlement
Collision Diagram
N
VISTA ROAD
SH 1N
KEBBELL TERRACE
WAIRIRI ST
MARSDEN TERRACE
VICTORIA TERRACE
JERVOIS TERRACE
MUHUNOA WEST ROAD
RAILWAY TERRACE
MUHUNOA EAST ROAD
BISHOPS ROAD
2750186
2711833
201013696
2850343
201013654
201112301
2852836
201113086
2752110
2811712
2855129
2950860
201154851
2850703
2850725
2955583
2757739
2757446
2754608
KEY
Fatal
Dark
Wet
Icy
Peds
Cyclist
0.5
0
0.5
1Km
1.5Km

CRASH ROAD	CRASH DIST	CRASH DIRN	INTSN	SIDE ROAD	CRASH ID	CRASH DATE	CRASH DOW	CRASH TIME	MVMT	TYPE	VEHICLES	CAUSES	OBJECTS STRUCK	ROAD CURVE	ROAD WET	LIGHT	WTHRa	JUNC TYPE	TRAF CTRL	ROAD MARK	SPD LIM	CRASH FATAL	CRASH SEV CNT	CRASH MIN CNT
1N/985/1.244	220	S		VISTA ROAD	2750186	24/01/2007	Wed	1540	DA	RUNOFF	4N1	132A		E	W	O	L		N	C	100	0	0	0
1N/985/0.967	500	S		BULLER ROAD	2711833	19/04/2007	Thu	1737	GC	OTHER	CS1V	372B 929		R	D	TN	F	D	N	L	100	0	0	2
1N/985/1.616			I	VICTORIA TERRACE	2752110	28/04/2007	Sat	1849	GD	INTERSECTION	CS1C	181A 191B		R	W	DO	F	T	N	L	100	0	0	0
1N/985/2.291			I	BISHOPS ROAD	2754608	28/05/2007	Mon	1708	JA	INTERSECTION	CS1C	301B 377B 830		E	D	TF	F	T	S	C	100	0	0	0
1N/985/2.385	550	S		MUHUNOA EAST ROAD	2757446	15/09/2007	Sat	1908	EC	OTHER	CN1C	370A 912	WW	E	W	DN	L		N	L	100	0	0	0
1N/985/2.235	400	S		MUHUNOA WEST ROAD	2757739	19/10/2007	Fri	2130	AC	OTHER	CN1T	386A		R	D	DO	F		N	C	100	0	0	0
1N/985/1.885	50	S		MUHUNOA EAST ROAD	2850703	4/02/2008	Mon	1645	MC	INTERSECTION	CS1CC	371B 410B		R	D	O	F		N	P	100	0	0	0
1N/985/1.416	200	N		VICTORIA TERRACE	2850343	5/02/2008	Tue	110	DA	RUNOFF	TN1	111A 130A		M	W	DN	L		N	C	100	0	0	0
1N/985/1.785	50	N		MUHUNOA EAST ROAD	2811712	19/02/2008	Tue	805	AC	OTHER	CN1T	159A 386A	C	R	D	B	F		N	C	100	0	0	1
1N/985/1.835			I	MUHUNOA EAST ROAD	2850725	26/02/2008	Tue	945	LB	INTERSECTION	CS1C	303B 382B		R	D	B	F	X	N	C	100	0	0	0
1N/985/1.616			I	VICTORIA TERRACE	2852836	30/05/2008	Fri	1430	FD	OTHER	CN1CC	181A 817 843		R	D	B	F	T	N	C	100	0	0	0
1N/985/1.81	25	N		MUHUNOA WEST ROAD	2855129	2/10/2008	Thu	1202	FD	OTHER	VN1CC	331A 352A 817		R	D	B	F		N	C	100	0	0	0
1N/985/1.666	50	S		VICTORIA TERRACE	2950860	27/03/2009	Fri	1200	FD	OTHER	CN1C	181A 817		R	D	B	F		N	C	100	0	0	0
1N/985/2.158	2000	N		KUKU BEACH ROAD	2955583	17/10/2009	Sat	2125	EC	OTHER	CS1	370A 910	W	E	W	DN	L		N	C	100	0	0	0
1N/985/1.396			I	MARSDEN TERRACE	2.01E+08	8/12/2010	Wed	1525	GC	OTHER	TS1C	174B 372B 832		R	D	B	F	T	G	L	100	0	0	1
1N/985/1.486	90	S		MARSDEN TERRACE	2.01E+08	28/12/2010	Tue	1905	CB	RUNOFF	VS1	101A	FT	R	D	O	F		N	C	100	0	0	1
1N/985/1.572	40	N		VICTORIA TERRACE	2.01E+08	31/07/2011	Sun	610	CA	RUNOFF	MS1	139A 363A 601A		R	D	DN	FF		N	C	100	0	0	1
1N/985/1.587	25	N		VICTORIA TERRACE	2.01E+08	8/11/2011	Tue	1919	CB	RUNOFF	CS1	358A 801	CV	R	W	TN	F		N	C	100	0	1	0
1N/985/1.831			I	MUHUNOA EAST ROAD	2.01E+08	12/11/2011	Sat	1240	LB	INTERSECTION	CN1C	301B 352B 377B		R	D	O	F	X	S	C	100	0	0	0

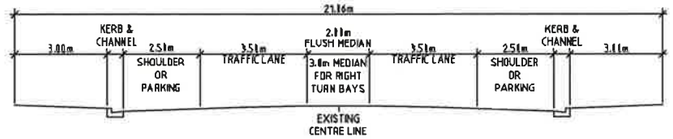
Crashes										
Movement	**#**	**%**	**F**	**S**	**M**	**N**	**Total**			**F+S Casualities (Dsi)**
INTERSECTION	5	26%	0	0	0	5	5			0
HEADON	0	0%	0	0	0	0	0			0
RUNOFF	5	26%	0	1	2	2	5			1
OTHER	9	47%	0	0	3	6	9			0
total	**19**	**100%**	**0**	**1**	**5**	**13**	**19**			**1**

Appendix D Outline Plans



TYPICAL SECTION THROUGH OHAU SETTLEMENT

SCALE 1 : 100



TYPICAL SECTION THROUGH OHAU SETTLEMENT

SCALE 1 : 100

NOTE: LONG TERM FOUR LANE WIDENING THROUGH OHAU IS ENVISAGED TO BE ON THE WESTERN SIDE, UNLESS A PART BYPASS OPTION IS PREFERRED SOUTH OF OHAU.

× PROPOSED THRESHOLD TREATMENT SIGN DESIGN CAN BE DEVELOPED IN CONJUNCTION WITH THE OHAU COMMUNITY (I.E. SCHOOL COMPETITION) SEE REPORT FOR TYPICAL LAYOUTS.

ALTERNATIVE POTENTIAL LINK ROAD

WAIRRI ST

POTENTIAL LINK ROAD

JERVOIS TCE

VICTORIA TCE

MUHUNDA WEST RD

MARSDEN TCE

VISTA RD

FLUSH MEDIAN AND SHOULDER WIDENING

POTENTIAL CURVE IMPROVEMENT WHICH REQUIRES A RAIL SHIFT (NOT REQUIRED FOR 80 km/h SPEED RESTRICTION) SEE REPORT FOR TYPICAL LAYOUTS.

START OF NORTHBOUND PASSING LANE 651m

PROPOSED INTERSECTION & PROPERTY ACCESS IMPROVEMENTS

POTENTIALLY CLOSE INTERSECTION

POTENTIALLY CLOSE INTERSECTION

EXISTING NORTHBOUND PASSING LANE TO BE POTENTIALLY REMOVED - SEE PFR 11 ROUTE IMPROVEMENTS (PASSING LANES)

POTENTIAL CURVE IMPROVEMENT (880m OR 1110m RADII SHOWN) ALSO SEE PFR 3 & 5

OTAKI

SH1

SH1

LEVIN

PROPOSED THRESHOLD & 80km/h SIGNS ×

PROPOSED THRESHOLD & 80km/h SIGNS ×

STORE & CAFE

EXISTING SUBWAY UNDER SH1

MUHUNDA EAST RD

NORTH ISLAND MAIN TRUNK RAILWAY

SCHOOL

INTERSECTION LAYOUT TO BE CONFIRMED

BISHOPS ROAD

ONE WAY ROAD UNDER RAIL

CURVE DATA - EXISTING	
DESIGN SPEED	80km/h
RADIUS	380m
SUPERELEVATION	5%

CURVE DATA - EXISTING	
DESIGN SPEED	90km/h
RADIUS	800m
SUPERELEVATION	5%

CURVE DATA - EXISTING	
DESIGN SPEED	90km/h
RADIUS	375m
SUPERELEVATION	5%

LEGEND

- ROAD CENTRELINE
- WIDENING OF EXISTING CARRIAGEWAY
- GREENFIELDS CARRIAGEWAY
- INDICATIVE GRADE SEPARATION
- INDICATIVE LAND REQUIREMENT
- LAND USE - RESIDENTIAL
- LAND USE - RETAIL/COMMERCIAL

NOT FOR CONSTRUCTION

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

REV	REVISIONS	BY DRN	PP CHK	PP APP	DATE
A	PRELIMINARY	BT	PP	PP	18.02.13

SURVEYED		
DESIGNED	B. Browne	11/12
DRAWN	B. TIMBLICK	11/12
CAD REVIEW	-	-
DESIGN CHECK	P. PEET	11/12
DESIGN REVIEW	M. OPPENHUIS	11/12
APPROVED	P. PEET	11/13
PROF REGISTRATION	-	

MWH

NZ TRANSPORT AGENCY

NZ TRANSPORT AGENCY
OTAKI TO LEVIN PFRs

OPTION 4-1 OHAU SETTLEMENT
SAFETY & TRAFFIC MANAGEMENT IMPROVEMENTS

Status Stamp: PRELIMINARY
Date Stamp: 08 FEB 2013
Scales: 1:2500 A1
Drawing No.: 80500902-04-001-C001
Rev.: A

Appendix E Cost Estimates

Project Estimate - Form A

Project Name: Otaki to Levin PFR Study
PFR 4 (Ohau Settlement) - all improvements

FE
Feasibility Estimate

Item	Description	Base Estimate	Contingency	Funding Risk
A	**Nett Project Property Cost**	**0**	**0**	**0**
	Investigation and Reporting			
	- Consultancy Fees	**120,356**	**24,070**	**39,700**
	- NZTA-Managed Costs	**0**	**0**	**0**
B	**Total Investigation and Reporting**	**120,356**	**24,070**	**39,700**
	Design and Project Documentation			
	- Consultancy Fees	**257,906**	**51,580**	**85,100**
	- NZTA-Managed Costs	**0**	**0**	**0**
C	**Total Design and Project Documentation**	**257,906**	**51,580**	**85,100**
	Construction			
	MSQA			
	- Consultancy Fees	**257,906**	**51,580**	**85,100**
	- NZTA-Managed Costs	**0**	**0**	**0**
	- Consent Monitoring Fees	**0**	**0**	**0**
	Sub Total Base MSQA	**257,906**	**51,580**	**85,100**
	Physical Works			
D1	Widen road and install flush median	1,073,650	214,700	354,300
D2	Realign SH 1 at Bishops Rd	776,200	155,200	256,100
D3	Don't do curve realignment (for quick adjust)	0	0	0
D4	Realign Bishops Rd at SH 1	481,790	96,400	159,000
D5	Close Marsden Tce	80,000	16,000	26,400
D6	Close Vista Road	587,600	117,500	193,900
D7	Threshold Treatments	40,000	8,000	13,200
D8	General Improvements	208,250	41,700	68,700
D9	Service Relocations	191,250	38,300	63,100
D10	Extraordinary Construction Costs	0	0	0
D11	(blank)			
D12	(blank)			
D13	(blank)			
	Sub Total Base Physical Works	**3,438,740**	**687,800**	**1,134,700**
D	**Total Construction & MSQA**	**3,696,646**	**739,380**	**1,219,800**
E	**Project Base Estimate** (A+B+C+D)	**4,074,907**		
F	**Contingency** (Assessed / Analysed) (A+B+C+D)		**815,030**	
G	**Project Expected Estimate** (E+F)		**4,889,937**	
	Project Property Cost Expected Estimate		**0**	
	Investigation and Reporting Expected Estimate		**144,426**	
	Design and Project Documentation Expected Estimate		**309,486**	
	Construction Expected Estimate		**4,436,026**	
H	**Funding Risk** (Assessed / Analysed) (A+B+C+D)			**1,344,600**
I	**95th Percentile Project Estimate** (G+H)			**6,234,537**
	Project Property Cost 95th Percentile Estimate			**0**
	Investigation and Reporting 95th Percentile Estimate			**184,126**
	Design and Project Documentation 95th Percentile Estimate			**394,586**
	Construction 95th Percentile Estimate			**5,655,826**

Base Date of Estimate	**29 Nov 2012**	**Cost Index**
Estimate prepared by:	**Ben Dodgshun**	**Signed**
Estimate internal peer review by:	**Marten Oppenhuis**	**Signed**
Estimate external peer review by:		**Signed**
Estimate approved by NZTA Project Manager:		**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

Appendix F Economic Analysis Worksheets

MWH

Simplified Procedure 3 - General Road Improvements

GENERAL ROADING IMPROVEMENT WORKS: 5 year crash history

EVALUATION SUMMARY — WORKSHEET 1

1 Evaluator(s) Ben Dodgshun
Reviewer(s) David Wanty

2 Project / Package Details

Approved Organisation Name	NZTA
Project / Package Name	Otaki to Levin: Ohau Township PFR
Your Reference	80500802
Project Description	Safety Improvements
Describe the problem to be addressed	Reduce crashes & improve community comfort

3 Location

Brief description of location: State Highway 1, north of Vista Road to south of Bishops Road, SH 1N-985/1.01 to 985/2.28

4 Alternatives and Options

Describe the Do Minimum	Scheduled maintenance
Summarise the options assessed	Shoulder widening and flush median installation; intersection closures and re-routing; intersection realignment; curve realignment; roadside hazard mitigation

5 Timing

Time Zero (assumed construction start date)	1 July 2013
Expected duration of construction (Months)	6

6 Economic Efficiency

Date economic evaluation completed (mm/yyyy)	30 November 2012
Base date for costs	1 July 2012
AADT at Time Zero	15000
Traffic Growth Rate at Time Zero (%)	1.2%

Existing Roughness	2.70	IRI or NAASRA	Existing Traffic Speed	80	km/hr	(est)
Predicted Roughness	2.70	IRI or NAASRA	Predicted Traffic Speed	80	km/hr	
Length of Job Before Improvements	1.27	km	Posted Speed Limit	80	km/hr	
Length of Job After Improvements	1.27	km	Road Type	Rural Strategic		
Length of new highway		km	Gradient Before Improvements	0 - 2%		
Length of existing highway used	1.27	km	Gradient After Improvements	0 - 2%		

7 PV Cost of Do Minimum — **Cost $** $197,639 — **A**

8 PV Cost of the preferred Option — **Cost $** $5,083,124 — **B**

9 Benefit values from Worksheet 4, 5 or 6

PV Travel Time Cost savings:	$ $0	**C**	x Update Factor^{TT}	1.33	= $	NIL	**W**
PV VOC & CO2 savings:	$ $0	**D**	x Update Factor^{VOC}	1.04	= $	NIL	**Y**
PV Accident Cost savings:	$ $3,419,184	**E**	x Update Factor^{AC}	1.17	= $	$4,000,445	**Z**
PV Passing Lane savings:	$ $0	**F**	x Update Factor^{AC}	1.00	= $	NIL	**X**

10 B/C Ratio = $\frac{W + Y + Z}{B - A}$ = $\frac{\text{BENEFITS}}{\text{COSTS}}$ = $\frac{0 + 0 + 4000445 + 0}{5083124 - 197639}$ = **0.8**

11 FYRR = $\frac{1^{st}\text{ Year BENEFITS}}{\text{COSTS}}$ = $\frac{[(0+0)/12.09+4000445/10.97] \times 0.9259}{5083124 - 197639}$ = **0.07**

ACCIDENT COST SAVINGS - 5 yr history

WORKSHEET 6

Movement Category:	All	**Posted Speed Limit:**	80	**Traffic Growth Rate (%):**	1.2%
Do Min Mean Speed:	80	**Option Mean Speed:**	80		

Includes crash types: all

		Injury Severity			Non-Injury
DO MINIMUM:		**Fatal**	**Serious**	**Minor**	
1	No of Years of typical accident records	5			
2	No of Reported Accidents over Period	0	1	5	10
3	Fatal / Serious Severity Adjustment (Tables A6.19 (a) to (c))	0.19	0.81		
4	No of Reported Accidents Adjusted by Severity (3 x 4)	0.19	0.81	5	10
5	Accidents per Year (4 / 1)	0.038	0.162	1	2
6	Adjustment Factor for accident trend (Table A6.1(a))	0.98			
7	Adjusted Accidents Per Year (5 x 6)	0.037	0.159	0.980	1.960
8	Under-Reporting Factors (Tables A6.20 (a) & (b))	1.0	1.9	4.5	18.5
9	Total Estimated Accidents per Year (7 x 8)	0.03724	0.301644	4.41	36.26
10	Accident Cost, 100 km/h Speed Limit (Table A6.21 (e) to (h))	3,800,000	405,000	24,000	2,400
11	Accident Cost, 50 km/h Speed Limit (Table A6.21 (a) to (d))	3,350,000	360,000	21,000	2,100
12	Mean Speed Adjustment = (Do Min Mean Speed - 50)/50	0.60			
13	Cost per Accident = 11 + (12 x (10 - 11))	3,620,000	387,000	22,800	2,280
14	Accident Cost per Year (9 x 13)	134,809	116,736	100,548	82,673
15	Total Cost of Accidents per Year	434,766			

OPTION:					
16	Percentage Accident Reduction	75.0%	75.0%	75.0%	57.8%
17	Percentage of accidents remaining [100- (16)]	25.0%	25.0%	25.0%	42.3%
18	Predicted Accidents per Year (9 x 17)	0.0093	0.0754	1.1025	15.3199
19	Accident Cost, 100 km/h Speed Limit (Table A6.21 (e) to (h))	3,800,000	405,000	24,000	2,400
20	Accident Cost, 50 km/h Speed Limit (Table A6.21 (a) to (d))	3,350,000	360,000	21,000	2,100
21	Mean Speed Adjustment = (Option Mean Speed - 50)/50	0.60			
22	Cost per Accident = 20 + (21 x (19 - 20))	3,620,000	387,000	22,800	2,280
23	Accident Cost per Year (18 x 22)	33,702	29,184	25,137	34,929
24	Total Cost of Accidents per Year	122,953			

0

25 Accident Cost Savings = (15 -24) x **DF** = $ 3,419,184 TOTAL E

Transfer TOTAL E to position $ E on Worksheet 1.

Note: Discount Factor, **DF** = 10.97

Discount Factors (**DF**) for different growth rates and speed limits for Years 1 to 30 inclusive

	Percent Traffic Growth Rate								
Speed Limit	**0**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
50 and 60 km/h	7.35	7.92	8.48	9.05	9.61	10.18	10.74	11.30	11.87
70km/h and above	9.61	10.18	10.74	11.30	11.87	12.43	13.00	13.56	14.13

MWH

Simplified Procedure 3 - General Road Improvements

GENERAL ROADING IMPROVEMENT WORKS: 5 year crash history

EVALUATION SUMMARY — WORKSHEET 1

1 Evaluator(s) Ben Dodgshun
Reviewer(s) David Wanty

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Approved Organisation Name	NZTA
Project / Package Name	Otaki to Levin: Ohau Township PFR
Your Reference	80500802
Project Description	Safety Improvements
Describe the problem to be addressed	Reduce crashes & improve community comfort

3 Location

Brief description of location: State Highway 1, north of Vista Road to south of Bishops Road, SH 1N-985/1.01 to 985/2.28

4 Alternatives and Options

Describe the Do Minimum	Scheduled maintenance
Summarise the options assessed	Shoulder widening and flush median installation; intersection closures and re-routing; intersection realignment; curve realignment; roadside hazard mitigation

5 Timing

Time Zero (assumed construction start date)	1 July 2013
Expected duration of construction (Months)	6

6 Economic Efficiency

Date economic evaluation completed (mm/yyyy)	30 November 2012
Base date for costs	1 July 2012
AADT at Time Zero	15000
Traffic Growth Rate at Time Zero (%)	1.2%

Existing Roughness	2.70	IRI or NAASRA		Existing Traffic Speed	80	km/hr	(est)
Predicted Roughness	2.70	IRI or NAASRA		Predicted Traffic Speed	80	km/hr	
Length of Job Before Improvements	1.27	km		Posted Speed Limit	80	km/hr	
Length of Job After Improvements	1.27	km		Road Type	Rural Strategic		
Length of new highway		km		Gradient Before Improvements	0 - 2%		
Length of existing highway used	1.27	km		Gradient After Improvements	0 - 2%		

7 PV Cost of Do Minimum — **Cost $** $197,639 — **A**

8 PV Cost of the preferred Option — **Cost $** $4,016,624 — **B**

9 Benefit values from Worksheet 4, 5 or 6

PV Travel Time Cost savings:	$ $0	**C**	x Update Factor^{TT}	1.33	= $	NIL	**W**
PV VOC & CO2 savings:	$ $0	**D**	x Update Factor^{VOC}	1.04	= $	NIL	**Y**
PV Accident Cost savings:	$ $3,419,184	**E**	x Update Factor^{AC}	1.17	= $	$4,000,445	**Z**
PV Passing Lane savings:	$ $0	**F**	x Update Factor^{AC}	1.00	= $	NIL	**X**

10 B/C Ratio = $\frac{W + Y + Z}{B - A}$ = $\frac{\text{BENEFITS}}{\text{COSTS}}$ = $\frac{0 + 0 + 4000445 + 0}{4016624 - 197639}$ = **1.0**

11 FYRR = $\frac{1^{st}\text{ Year BENEFITS}}{\text{COSTS}}$ = $\frac{[(0+0)/12.09+4000445/10.97] \times 0.9259}{4016624 - 197639}$ = **0.09**

ACCIDENT COST SAVINGS - 5 yr history

WORKSHEET 6

Movement Category:	All	**Posted Speed Limit:**	80	**Traffic Growth Rate (%):**	1.2%
Do Min Mean Speed:	80	**Option Mean Speed:**	80		

Includes crash types: all

		Injury Severity			Non-Injury
DO MINIMUM:		**Fatal**	**Serious**	**Minor**	
1	No of Years of typical accident records	5			
2	No of Reported Accidents over Period	0	1	5	10
3	Fatal / Serious Severity Adjustment (Tables A6.19 (a) to (c))	0.19	0.81		
4	No of Reported Accidents Adjusted by Severity (3 x 4)	0.19	0.81	5	10
5	Accidents per Year (4 / 1)	0.038	0.162	1	2
6	Adjustment Factor for accident trend (Table A6.1(a))	0.98			
7	Adjusted Accidents Per Year (5 x 6)	0.037	0.159	0.980	1.960
8	Under-Reporting Factors (Tables A6.20 (a) & (b))	1.0	1.9	4.5	18.5
9	Total Estimated Accidents per Year (7 x 8)	0.03724	0.301644	4.41	36.26
10	Accident Cost, 100 km/h Speed Limit (Table A6.21 (e) to (h))	3,800,000	405,000	24,000	2,400
11	Accident Cost, 50 km/h Speed Limit (Table A6.21 (a) to (d))	3,350,000	360,000	21,000	2,100
12	Mean Speed Adjustment = (Do Min Mean Speed - 50)/50	0.60			
13	Cost per Accident = 11 + (12 x (10 - 11))	3,620,000	387,000	22,800	2,280
14	Accident Cost per Year (9 x 13)	134,809	116,736	100,548	82,673
15	Total Cost of Accidents per Year	434,766			

OPTION:					
16	Percentage Accident Reduction	75.0%	75.0%	75.0%	57.8%
17	Percentage of accidents remaining [100- (16)]	25.0%	25.0%	25.0%	42.3%
18	Predicted Accidents per Year (9 x 17)	0.0093	0.0754	1.1025	15.3199
19	Accident Cost, 100 km/h Speed Limit (Table A6.21 (e) to (h))	3,800,000	405,000	24,000	2,400
20	Accident Cost, 50 km/h Speed Limit (Table A6.21 (a) to (d))	3,350,000	360,000	21,000	2,100
21	Mean Speed Adjustment = (Option Mean Speed - 50)/50	0.60			
22	Cost per Accident = 20 + (21 x (19 - 20))	3,620,000	387,000	22,800	2,280
23	Accident Cost per Year (18 x 22)	33,702	29,184	25,137	34,929
24	Total Cost of Accidents per Year	122,953			

0

25 Accident Cost Savings = (15 -24) x **DF** = $ 3,419,184 TOTAL E

Transfer TOTAL E to position $ E on Worksheet 1.

Note: Discount Factor, **DF** = 10.97

Discount Factors (**DF**) for different growth rates and speed limits for Years 1 to 30 inclusive

	Percent Traffic Growth Rate								
Speed Limit	**0**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
50 and 60 km/h	7.35	7.92	8.48	9.05	9.61	10.18	10.74	11.30	11.87
70km/h and above	9.61	10.18	10.74	11.30	11.87	12.43	13.00	13.56	14.13

MWH

Simplified Procedure 3 - General Road Improvements

GENERAL ROADING IMPROVEMENT WORKS: 10 year crash history

EVALUATION SUMMARY — WORKSHEET 1

1 Evaluator(s) Ben Dodgshun
Reviewer(s) David Wanty

2 Project / Package Details

Approved Organisation Name	NZTA
Project / Package Name	Otaki to Levin: Ohau Township PFR
Your Reference	80500802
Project Description	Safety Improvements
Describe the problem to be addressed	Reduce crashes & improve community comfort

3 Location

Brief description of location: State Highway 1, north of Vista Road to south of Bishops Road, SH 1N-985/1.01 to 985/2.28

4 Alternatives and Options

Describe the Do Minimum	Scheduled maintenance
Summarise the options assessed	Shoulder widening and flush median installation; intersection closures and re-routing; intersection realignment; curve realignment; roadside hazard mitigation

5 Timing

Time Zero (assumed construction start date)	1 July 2013
Expected duration of construction (Months)	6

6 Economic Efficiency

Date economic evaluation completed (mm/yyyy)	30 November 2012
Base date for costs	1 July 2012
AADT at Time Zero	15000
Traffic Growth Rate at Time Zero (%)	1.2%

Existing Roughness	2.70	IRI or NAASRA	Existing Traffic Speed	80	km/hr	(est)
Predicted Roughness	2.70	IRI or NAASRA	Predicted Traffic Speed	80	km/hr	
Length of Job Before Improvements	1.27	km	Posted Speed Limit	80	km/hr	
Length of Job After Improvements	1.27	km	Road Type	Rural Strategic		
Length of new highway		km	Gradient Before Improvements	0 - 2%		
Length of existing highway used	1.27	km	Gradient After Improvements	0 - 2%		

7 PV Cost of Do Minimum — **Cost $** $197,639 — **A**

8 PV Cost of the preferred Option — **Cost $** $5,083,124 — **B**

9 Benefit values from Worksheet 4, 5 or 6

PV Travel Time Cost savings:	$ $0	**C**	x Update Factor^{TT}	1.33	= $	NIL	**W**
PV VOC & CO2 savings:	$ $0	**D**	x Update Factor^{VOC}	1.04	= $	NIL	**Y**
PV Accident Cost savings:	$ $5,132,273	**E**	x Update Factor^{AC}	1.17	= $	$6,004,760	**Z**
PV Passing Lane savings:	$ $0	**F**	x Update Factor^{AC}	1.00	= $	NIL	**X**

10 B/C Ratio = $\frac{W + Y + Z}{B - A}$ = $\frac{\text{BENEFITS}}{\text{COSTS}}$ = $\frac{0 + 0 + 6004760 + 0}{5083124 - 197639}$ = **1.2**

11 FYRR = $\frac{1^{st}\text{ Year BENEFITS}}{\text{COSTS}}$ = $\frac{[(0+0)/12.09+6004760/10.97] \times 0.9259}{5083124 - 197639}$ = **0.10** (z)

ACCIDENT COST SAVINGS - 10 yr history

WORKSHEET 6

Movement Category:	All	**Posted Speed Limit:**	80	**Traffic Growth Rate (%):**	1.2%
Do Min Mean Speed:	80	**Option Mean Speed:**	80		

Includes crash types: all

		Injury Severity			Non-Injury
DO MINIMUM:		**Fatal**	**Serious**	**Minor**	
1	No of Years of typical accident records	10			
2	No of Reported Accidents over Period	2	2	14	23
3	Fatal / Serious Severity Adjustment (Tables A6.19 (a) to (c))	0.19	0.81		
4	No of Reported Accidents Adjusted by Severity (3 x 4)	0.76	3.24	14	23
5	Accidents per Year (4 / 1)	0.076	0.324	1.4	2.3
6	Adjustment Factor for accident trend (Table A6.1(a))	0.98			
7	Adjusted Accidents Per Year (5 x 6)	0.074	0.318	1.372	2.254
8	Under-Reporting Factors (Tables A6.20 (a) & (b))	1.0	1.9	4.5	18.5
9	Total Estimated Accidents per Year (7 x 8)	0.07448	0.603288	6.174	41.699
10	Accident Cost, 100 km/h Speed Limit (Table A6.21 (e) to (h))	3,800,000	405,000	24,000	2,400
11	Accident Cost, 50 km/h Speed Limit (Table A6.21 (a) to (d))	3,350,000	360,000	21,000	2,100
12	Mean Speed Adjustment = (Do Min Mean Speed - 50)/50	0.60			
13	Cost per Accident = 11 + (12 x (10 - 11))	3,620,000	387,000	22,800	2,280
14	Accident Cost per Year (9 x 13)	269,618	233,472	140,767	95,074
15	Total Cost of Accidents per Year	738,931			

OPTION:					
16	Percentage Accident Reduction	60.0%	60.0%	75.0%	63.8%
17	Percentage of accidents remaining [100- (16)]	40.0%	40.0%	25.0%	36.3%
18	Predicted Accidents per Year (9 x 17)	0.0298	0.2413	1.5435	15.1159
19	Accident Cost, 100 km/h Speed Limit (Table A6.21 (e) to (h))	3,800,000	405,000	24,000	2,400
20	Accident Cost, 50 km/h Speed Limit (Table A6.21 (a) to (d))	3,350,000	360,000	21,000	2,100
21	Mean Speed Adjustment = (Option Mean Speed - 50)/50	0.60			
22	Cost per Accident = 20 + (21 x (19 - 20))	3,620,000	387,000	22,800	2,280
23	Accident Cost per Year (18 x 22)	107,847	93,389	35,192	34,464
24	Total Cost of Accidents per Year	270,892			

0

25 Accident Cost Savings = (15 -24) x **DF** = $ 5,132,273 TOTAL E

Transfer TOTAL E to position $ E on Worksheet 1.

Note: Discount Factor, **DF** = 10.97

Discount Factors (**DF**) for different growth rates and speed limits for Years 1 to 30 inclusive

	Percent Traffic Growth Rate								
Speed Limit	**0**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
50 and 60 km/h	7.35	7.92	8.48	9.05	9.61	10.18	10.74	11.30	11.87
70km/h and above	9.61	10.18	10.74	11.30	11.87	12.43	13.00	13.56	14.13

MWH

Simplified Procedure 3 - General Road Improvements

GENERAL ROADING IMPROVEMENT WORKS: 10 year crash history

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1 Evaluator(s) Ben Dodgshun
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4 Alternatives and Options

Describe the Do Minimum	Scheduled maintenance
Summarise the options assessed	Shoulder widening and flush median installation; intersection closures and re-routing; intersection realignment; curve realignment; roadside hazard mitigation

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Time Zero (assumed construction start date)	1 July 2013
Expected duration of construction (Months)	6

6 Economic Efficiency

Date economic evaluation completed (mm/yyyy)	30 November 2012
Base date for costs	1 July 2012
AADT at Time Zero	15000
Traffic Growth Rate at Time Zero (%)	1.2%

Existing Roughness	2.70	IRI or NAASRA		Existing Traffic Speed	80	km/hr	(est)
Predicted Roughness	2.70	IRI or NAASRA		Predicted Traffic Speed	80	km/hr	
Length of Job Before Improvements	1.27	km		Posted Speed Limit	80	km/hr	
Length of Job After Improvements	1.27	km		Road Type	Rural Strategic		
Length of new highway		km		Gradient Before Improvements	0 - 2%		
Length of existing highway used	1.27	km		Gradient After Improvements	0 - 2%		

7 PV Cost of Do Minimum — **Cost $** $197,639 — **A**

8 PV Cost of the preferred Option — **Cost $** $4,016,624 — **B**

9 Benefit values from Worksheet 4, 5 or 6

PV Travel Time Cost savings:	$ $0	C	x Update Factor^{TT}	1.33	= $	NIL	W
PV VOC & CO2 savings:	$ $0	D	x Update Factor^{VOC}	1.04	= $	NIL	Y
PV Accident Cost savings:	$ $5,132,273	E	x Update Factor^{AC}	1.17	= $	$6,004,760	Z
PV Passing Lane savings:	$ $0	F	x Update Factor^{AC}	1.00	= $	NIL	X

10 B/C Ratio = $\frac{W + Y + Z}{B - A}$ = $\frac{\text{BENEFITS}}{\text{COSTS}}$ = $\frac{0 + 0 + 6004760 + 0}{4016624 - 197639}$ = **1.6**

11 FYRR = $\frac{1^{st}\text{ Year BENEFITS}}{\text{COSTS}}$ = $\frac{[(0+0)/12.09+6004760/10.97] \times 0.9259}{4016624 - 197639}$ = **0.13** (z)

ACCIDENT COST SAVINGS - 10 yr history

WORKSHEET 6

Movement Category:	All	**Posted Speed Limit:**	80	**Traffic Growth Rate (%):**	1.2%
Do Min Mean Speed:	80	**Option Mean Speed:**	80		

Includes crash types: all

		Injury Severity			Non-Injury
DO MINIMUM:		**Fatal**	**Serious**	**Minor**	
1	No of Years of typical accident records	10			
2	No of Reported Accidents over Period	2	2	14	23
3	Fatal / Serious Severity Adjustment (Tables A6.19 (a) to (c))	0.19	0.81		
4	No of Reported Accidents Adjusted by Severity (3 x 4)	0.76	3.24	14	23
5	Accidents per Year (4 / 1)	0.076	0.324	1.4	2.3
6	Adjustment Factor for accident trend (Table A6.1(a))	0.98			
7	Adjusted Accidents Per Year (5 x 6)	0.074	0.318	1.372	2.254
8	Under-Reporting Factors (Tables A6.20 (a) & (b))	1.0	1.9	4.5	18.5
9	Total Estimated Accidents per Year (7 x 8)	0.07448	0.603288	6.174	41.699
10	Accident Cost, 100 km/h Speed Limit (Table A6.21 (e) to (h))	3,800,000	405,000	24,000	2,400
11	Accident Cost, 50 km/h Speed Limit (Table A6.21 (a) to (d))	3,350,000	360,000	21,000	2,100
12	Mean Speed Adjustment = (Do Min Mean Speed - 50)/50	0.60			
13	Cost per Accident = 11 + (12 x (10 - 11))	3,620,000	387,000	22,800	2,280
14	Accident Cost per Year (9 x 13)	269,618	233,472	140,767	95,074
15	Total Cost of Accidents per Year	738,931			

OPTION:					
16	Percentage Accident Reduction	60.0%	60.0%	75.0%	63.8%
17	Percentage of accidents remaining [100- (16)]	40.0%	40.0%	25.0%	36.3%
18	Predicted Accidents per Year (9 x 17)	0.0298	0.2413	1.5435	15.1159
19	Accident Cost, 100 km/h Speed Limit (Table A6.21 (e) to (h))	3,800,000	405,000	24,000	2,400
20	Accident Cost, 50 km/h Speed Limit (Table A6.21 (a) to (d))	3,350,000	360,000	21,000	2,100
21	Mean Speed Adjustment = (Option Mean Speed - 50)/50	0.60			
22	Cost per Accident = 20 + (21 x (19 - 20))	3,620,000	387,000	22,800	2,280
23	Accident Cost per Year (18 x 22)	107,847	93,389	35,192	34,464
24	Total Cost of Accidents per Year	270,892			

0

25 Accident Cost Savings = (15 -24) x **DF** = $ 5,132,273 TOTAL E

Transfer TOTAL E to position $ E on Worksheet 1.

Note: Discount Factor, **DF** = 10.97

Discount Factors (**DF**) for different growth rates and speed limits for Years 1 to 30 inclusive

	Percent Traffic Growth Rate								
Speed Limit	**0**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
50 and 60 km/h	7.35	7.92	8.48	9.05	9.61	10.18	10.74	11.30	11.87
70km/h and above	9.61	10.18	10.74	11.30	11.87	12.43	13.00	13.56	14.13