ŌTAKI TO NORTH OF LEVIN PFRs

Report No. 8: Waitarere Beach Road Curves

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 options for improving State Highway 1 through the Waitarere Beach Road Curves, north of Levin. The current alignment contains three out–of-context curves with negotiation speeds between 80 km/h and 90 km/h with narrower than desired sealed shoulder widths. The alignment is confined by culturally significant features including two marae, Urupa, Whare Rongopai, and rural residential dwellings.

Two options were considered; a cost estimate was undertaken for each of these options together with an economic assessment to obtain a Benefit-Cost Ratio.

The two options considered easing of the existing three 550 m radius curves with a 100 km/h design speed, or replacing the three curves with a short realignment with only two 800 m radius curves and a 110 km/h design speed.

A summary of the options is shown below.

Table 1-1: Option Summary

Option Description	Expected Costs	NPV Benefits	Benefit Cost Ratio
Option 8-2 Curve Easing	$5.62M	$10.9M	**2.1**
Option 8-3 Curve Realignment	$9.69M	$23.0M	**2.5**

Option 8-3 has the higher BCR and therefore purely in economic terms is favoured. It is also incrementally favoured with an incremental BCR of 2.3

Option 8-3 has higher costs, with some uncertainty around sensitive land requirements affecting rural dwellings and culturally significant buildings. Option 8-2 has lower capital costs, however it also has lower benefits and does not provide a robust solution to the current deficient alignment. Both options should be considered further in the Scheme Assessment stage.

Other potential features of this project such as a wire rope median barrier, northbound and southbound passing lanes, and altering the form of the Waitarere Beach Road intersection with State Highway 1 to a roundabout (penalises the SH TT and VOC, to achieve small safety gains) have not been assessed within this report, however all three should also be considered in the next stage for the benefits or disbenefits which they individually provide in association with the findings of related PFR's.

NZ Transport Agency

Report 8: Waitarere Curves

CONTENTS

Executive Summary ii
1 Introduction and Background 1
2 Projects Currently Being Investigated 1
3 Description of Problem 3
3.1 Ōtaki to North of Levin 3
3.2 Waitarere Beach Road Curves 3
4 Site Description 3
5 Traffic Statistics 5
6 Crash History 6
6.1 Crash Data 6
6.2 Crash Risk 7
7 Alternatives and Options Considered 8
7.1 Discarded Options 8
7.1.1 Western Alignment Option 8
7.1.2 Eastern Alignment Option 8
7.1.3 Long Alignment (Option 8-1) 9
7.2 Option 8-2 Curve Easing 9
7.3 Option 8-3 Curve Realignment 9
7.4 Other Potential Improvements 10
7.4.1 Median Barrier 10
7.4.2 Passing lanes 10
7.4.3 Intersection Form 10
8 Design Statement 10
9 Cost Estimates 11
10 Economic Assessment and Risk Assessment 11
10.1 Basis of Economic Analysis 11
10.1 Travel Time Analysis 13
10.2 Vehicle Operating Cost 13
10.3 Crash Benefits 13
10.4 Maintenance Costs 13
10.5 Benefit Cost Ratio Results 14
10.6 Risk Assessment 14
11 Assessment Profile 14
11.1 Strategic Fit 15

11.2 Effectiveness 15
11.3 Efficiency 15
12 Social and Environmental Assessment 16
13 Geotechnical Requirements 16
14 Land Requirements 16
15 Resource Management Issues 17
15.1 District Plan Provisions 17
15.1.1 Designation 17
15.2 Regional Plans 17
15.3 Other Provisions 18
16 Maintenance Issues 18
17 Conclusions and Recommendations 18

LIST OF TABLES

Table 1-1: Option Summary ii
Table 6-2: CAS Crash Type (2007-2012) 6
Table 6-3: HRRRG Crash Type (2007-2012) 6
Table 6-4: Crash Causation Factors of Reported Injury Crashes 7
Table 6-5: Environmental Factors 7
Table 9-1: Cost Estimates 11
Table 10-1: Travel Time Benefits 13
Table 10-2: Vehicle Operating Cost Benefits 13
Table 10-3: Crash Benefits 13
Table 10-4: Economic Analysis Summary 14
Table 11-1: Waitarere Beach Road Curve assessment profile 15

LIST OF FIGURES

Figure 2-1: Projects Currently Being Investigated 2
Figure 4-1: Study Area Location Map 4

APPENDICES

Appendix A Photographs
Appendix B Traffic Data
Appendix C Crash Data
Appendix D Outline Plans
Appendix E Cost Estimates
Appendix F Economic Analysis Worksheets

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 and north of 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 improvements to aid road safety and traffic flow efficiency through the deficient curves surrounding the intersection of Waitarere Beach Road with State Highway 1 north of Levin.

The geographical extent of this project is from the marae north of Clay Road (967/7.30) in the south to north of Waitarere Beach Road (RP967/5.00) in the north, a length of approximately 2.3 km.

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 of 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.

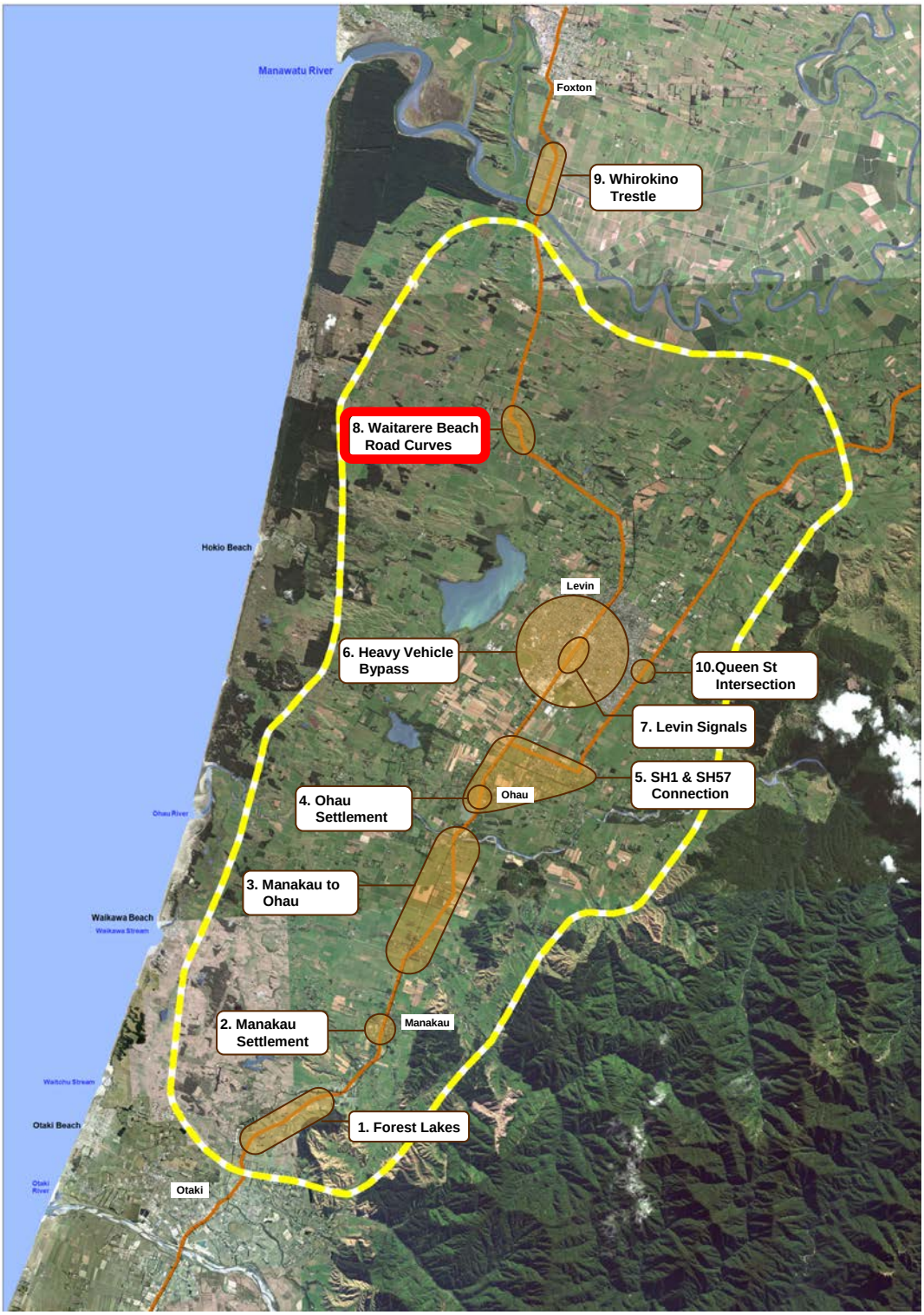


Figure 2-1: Projects Currently Being Investigated

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 tight 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 Waitarere Beach Road Curves

The section of road through Waitarere Curves had curve easing prior to the mid-1970s; however this section has had a high number of crashes in recent years. Of particular concern are the run-off-road and cross-centreline crashes, due to the severe nature of such crashes.

Key safety and geometric deficiencies for the Waitarere Beach Road Curves, determined through site inspections and previous reports, are presented below.

- Out of context curves – the curves between Clay Road and Waitarere Beach Road are below the standard required for a 100 km/h highway.
- No median barrier – Austroads and NZTA guidance indicates that a median barrier should be provided when there is a high percentage, or high average daily number, of heavy vehicles, or severe consequences for vehicles crossing the centreline.
- Inconsistent clear zone and a large number of accesses with resultant side friction concerns.
- Highly trafficked Waitarere Beach Road is within the back to back deficient curve section.
- Substandard combinations of vertical and horizontal curves.
- No intersection improvements exist at Paeroa Road. Noting that this is a low key intersection and hence can be considered with the NZTA Planning Policy Manual in mind.

The above deficiencies are considered to have contributed to the significant number of high severity injury crashes on this section of highway.

4 Site Description

The project area consists of a 2.3 km section of SH1 (see also Section 7.3 Option 8-3 extent) from north of Clay Road (967/7.30) to north of Waitarere Beach Road (RP967/5.0).

The project area consists of three low radius curves with design speeds between 80 and 90 km/h.

The section of road is a two lane undivided carriageway. Lane widths are typically 3.5 m but shoulder widths vary along the length from approximately 0.6 m to approximately 1.8 m. The posted speed limit is 100 km/h with terrain that is generally flat to gently rolling.

Figure 4-1 below shows the study location.

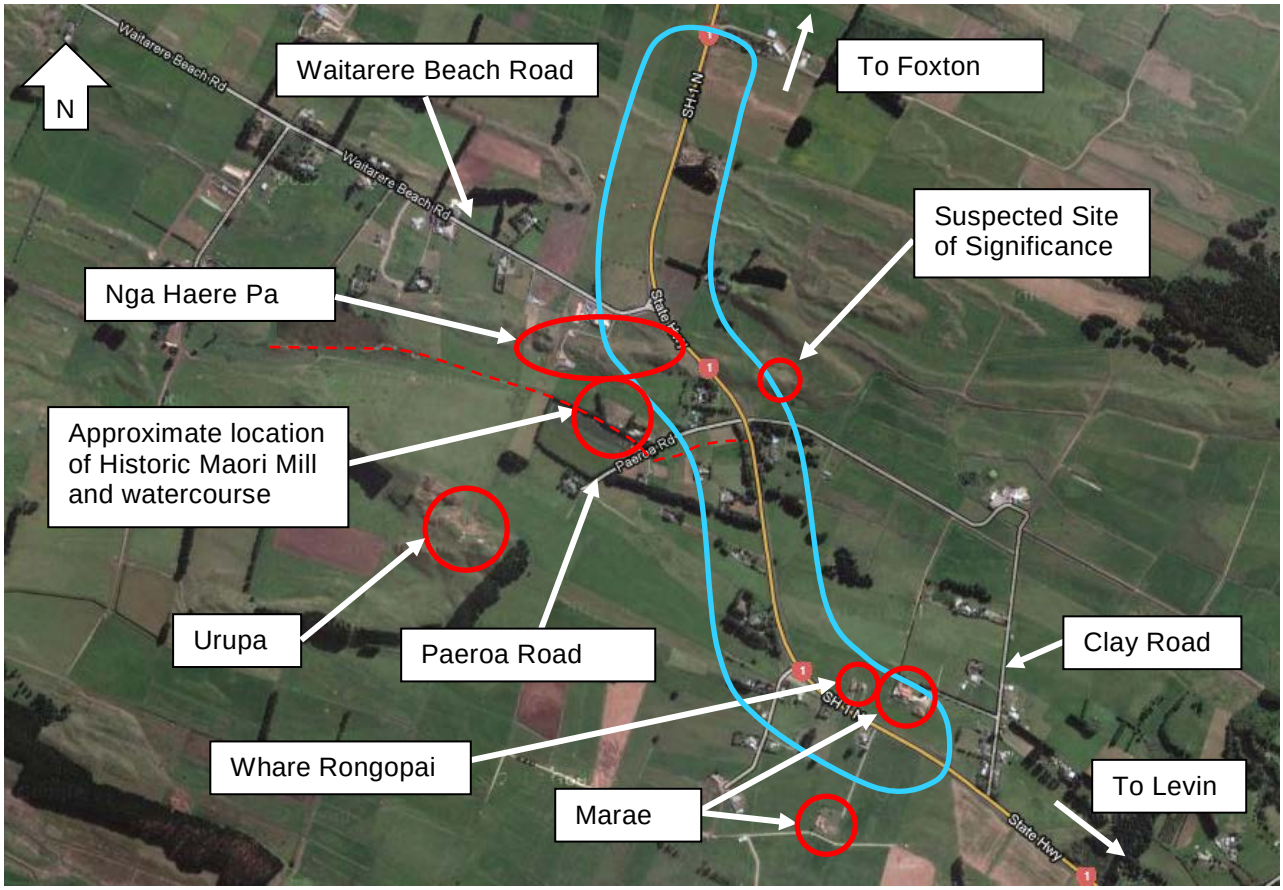


Figure 4-1: Study Area Location Map

There are two side roads that intersect the state highway along the study length, being Paeroa Road at RP 967/6.25 and Waitarere Beach Road at RP 967/5.9. Clay Road intersects just south of the study area at RP 967/7.5. In addition to the side roads, there are a number of private properties that gain access directly from the limited access road (LAR) state highway.

Key features of the project length include:

- Three horizontal curves along the project area[1] including;
    - Waitarere Beach Road curve – 240 m radius with an estimated negotiation speed of 81 km/h and 5.3% superelevation.
    - Paeroa Road curve – 290 m radius with an estimated negotiation speed of 89 km/h and 6.9% superelevation.
    - Whare Rongopai curve – 310 m radius with an estimated negotiation speed of 90 km/h and 5.7% superelevation.
    - Additionally there is a higher radius curve just south of the project area near Clay Road – 800 m radius, left (viewed towards the north) hand curve
- Two vertical curves within the project area;
    - 1 km north of Waitarere Beach Road – 20 m long, 67 K value, Crest
    - 250 m north of Clay Road – 140 m long, 70 K value, Crest

There are currently no dedicated pedestrian or cycle facilities along this section of SH1.

The surrounding land use primarily consists of farm land and several rural residential properties.

[1] RAMM Curve Context Table

Other special features identified during the constraint mapping undertaken as part of the Ōtaki to North of Levin Scoping Report (see Figure 4-1) are:

- Multiple hilltop urupa on both sides of the highway around Waitarere Beach Road;
- Whare Rongopai (Maori Church);
- Historic Maori Flour Mill site (1840's – 1850's) located on Paeroa Road with altered watercourse the only remaining feature, (New Zealand Transverse Mercator Projection 5506605N, 1791629E);
- Historic Nga Haere Pa, from 1872, site located on the small ridge on the southern side of Waitarere Beach Road, (New Zealand Map Grid 6068483N, 2701625E);
- Marae on the northern (Matua Marae) and southern (Huia Marae) sides of the highway.

5 Traffic Statistics

The Annual Average Daily Traffic (AADT) flow at the NZTA count site Whirokino (ID: 01N00965) was 7,700 vehicles per day (2011) with the proportion of Heavy Commercial Vehicles (HCVs) at 14%.

The traffic growth rate at the count site is estimated to be -0.5%, using data from 2002 (when this site was installed) to 2011. However volumes have typically fluctuated around the mean of 7,900 vpd with a standard deviation of 4% and a range of values between 8,500 vpd and 7,300 vpd. It should be noted that this count station is not permanent and therefore there can be variation in the traffic volumes recorded.

Over the last 20 years the telemetry stations on SH1 either side of the site (at Ohau and Sanson) record 1.3% traffic growth.

Side road traffic volumes were obtained from the Horowhenua District Council databases and are as follows:

- Waitarere Beach Road: 1,740 ADT (21/10/2009-30/10/2009 count) Labour Weekend
- Paeroa Road: 70 ADT (2009 count)

Waitarere Beach Road has considerable volumes of holiday variation in traffic, the limited data available shows a range between 2360 at New Year 2010/11 to as low as 1220 East of Forest Road (17/06/2009-29/06/2009).

From the traffic turning counts carried out in May 2011, 75% of Waitarere Beach Road traffic turns to or from the south (Levin). This corresponds to 50% of Waitarere Beach Road traffic added to the state highway volumes south of Waitarere Beach Road, or an average AADT of approximately 8,750 vpd for the southern half of this project.

The Ōtaki to north of Levin SATURN base network model outputs[2] showing link and intersection Level of Service (LoS) for 2011 and 2041 for the intersection of SH1 and Waitarere Beach Road are expected to be A/B. The model does not include intersection nodes for Paeroa Road.

Therefore level of service long term for Waitarere Beach Road intersection suggests that a proposed layout similar to that which currently exists will deliver the required performance.

Further traffic information can be found in Appendix B Traffic Data.

[2] See Otaki to north of Levin Scoping Report

6 Crash History

6.1 Crash Data

A review of NZTA's CAS database over the five year period from January 2007 to December 2011 revealed a total of 12 crashes along the 2.3 km section of highway (SH1 RP 967/5.0 – RP 967/7.30) and on Waitarere Beach Road within close proximity of the SH1 intersection, and an additional 2 crashes in 2012 to date.

The following tables provide a summary of the CAS output data for the study area:

Table 6-1: Annual Distribution of Crashes

Year	Fatal	Serious	Minor	Non-Injury	Total	DSI*
2007	-	1	1	-	**2**	1
2008	-	-	1	-	**1**	-
2009	2	1	-	2	**5**	7
2010	-	-	1	1	**2**	-
2011	-	-	-	2	**2**	-
Total	**2**	**2**	**3**	**4**	**12**	**8**
2012	-	1	-	1	2	1

* Death and serious injury casualties

Table 6-2: CAS Crash Type (2007-2012)

Crash Type	Number of Reported Crashes	Percentage of Reported Crashes
Straight Road Lost Control/Head On	1	7%
Bend – Lost Control/Head On	10	71%
Rear End / Obstruction	1	7%
Crossing / Turning	2	14%
Total	**14**	**100%**

Table 6-3: HRRRG[3] Crash Type (2007-2012)

Crash Type	Number of Reported Crashes	DSI	Percentage of Reported Crashes
Head on	3	6	21%
Run off Road	8	2	57%
Intersection Crashes	2	1	14%
Other	1	-	7%
Total	**14**	**9**	**100%**

The crash classified as 'Other' is a vehicle hitting a non-vehicular obstruction (animal).

[3] 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	3
Failed giveway/stop	1
Failed keep left	2
Poor handling	3
Poor observation	1
Poor judgement	1
Fatigue	2
Vehicle factors	1

Table 6-5: Environmental Factors

	Wet	Dry		Night	Day		Weekend (Fri 6:00PM to Monday 5:59AM)	Weekday
No.	4	10		6	8		4	10
%	29	71		57	43		29	71

Of the crashes occurring on this 2.3 km section of SH1 (from 2007 to 2012 to date):

- Two were fatal, three were serious, three were minor and six were non-injury.
- There has been an average of more than one death or serious injury per injury crash, which is a very high rate.
- Eight (57%) involved run-off road movements resulting two serious crashes, with two DSI, and two minor injury crashes.
- Three (21%) were head on with two fatal crashes, with six DSI, and one minor injury crash. One of the fatal crashes had causes of alcohol, returning from unsealed shoulder, and attention diverted, with the other caused by fatigue and swinging wide.
- Two (14%) were intersection related crashes resulting in one serious, with one DSI, and one non-injury crash, both these crashes occurred at Waitarere Beach Road.
- One (7%) crash was had a movement codes classed as ‘Other’, resulting in non-injury
- The percentage of wet crashes is similar to the network average of approximately 30%.
- The percentage of dark crashes (57%) is much higher than the network average of approximately 30%.
- Eight (57%) crashes involved vehicles crossing the centreline from either; losing control, head on, or hitting an object; this excludes crossing/turning movements at intersections. This included eight of the nine deaths and serious injuries and two minor injury crashes. Two of these crashes occurred on Waitarere Beach Road close to the SH1 intersection.
- Four crashes occurred on Waitarere Beach Road or turning movements from Waitarere Beach Road including two serious injury crashes.
- Nine crashes involved objects being struck; the most common of which was fence, and poles or trees being hit in three separate crashes.

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 2.3 km section of SH1 from north of Clay Road to north of Waitarere Beach Road has:

- A collective risk of 0.34 high-severity (fatal and serious) crashes per km per year;
- A personal risk of 12.1 high-severity crashes per 100 million vehicle km; and
- An Extent Average KiwiRAP Star Rating of 2.7, and a published KiwiRAP rating of 3 stars.

Both the personal risk and collective risk was calculated as high and therefore this means this length of SH1 is classified a high-risk rural road.

Undivided state highways with over 6,000 vpd generally have higher numbers of deaths and serious injuries as a result of head-on crashes than run-off-road crashes. This site is not an exception with six death and serious injuries from head-on crashes, and one from run-off-road crashes in the five year period from 2007 to 2011.

It is clear from this crash analysis that the majority of crashes which result in high severity resulted from drivers having difficulty with the out of context curves. Therefore by addressing these curves it is reasonable to assess that the crash risk is substantially reduced.

Further Crash Data can be found in Appendix C Crash Data

7 Alternatives and Options Considered

Two options, which address the out of context curves, have been considered for the section of SH1 from north of Clay Road to north of Waitarere Beach Road with the main aim of improving safety and efficiency. Both options considered include curve realignment, shoulder widening, and roadside hazard protection. Both options will retain the existing intersection layout and form for Waitarere Beach Road and Paeroa Road.

The Do Minimum has been assumed to be the continued maintenance and operation of the existing highway.

The two options considered are outlined below:

Option 8-2 Curve Easing – Slight easing of all three curves on existing alignment to a minimum 550 m radius with a design speed of 100 km/h. This realignment will also allow for the closure of excess accessways throughout the project area after consultation with local land owners.

Option 8-3 Curve Realignment – Realignment of the highway on approximately the current alignment to have two 800 m radius curves with a design speed of 110 km/h.

7.1 Discarded Options

During the initial expressway investigations significant limitations were discovered in the vicinity of the Waitarere Curves which limited the viable alternative options for the Waitarere Curve realignment.

7.1.1 Western Alignment Option

A western alignment of SH1 through the Waitarere Curves has been discounted due to the land ownership arrangements with multiple parties and the presence of an Urupa between Waitarere Beach Road and Paeroa Road.

7.1.2 Eastern Alignment Option

An eastern alignment of SH1 would lie too close to the Whare Rongopai and the Matua Marae and so has not been considered further due to the cultural significance of these sites.

7.1.3 Long Alignment (Option 8-1)

A long alignment of SH1 removing the Waitarere Beach Road and Paeroa Road curves with easing of the Whare Rongopai curve would require extensive earthworks and may cross unidentified Maori archaeological sites and the purchase of several dwellings as the highway bisects the houses and small land parcels. It would also cost significantly more than the retained options with very few additional benefits.

7.2 Option 8-2 Curve Easing

This option provides a lower value solution with lower cost, see Appendix D. It is important to note this option does not realise all the potential safety and travel time benefits when compared with Option 8-3. A typical cross section of the 13 m carriageway (noting that safety barrier would reduce this width) (11 m seal) is shown in Figure 7-1 below. The risk with this option is that NZTA may require further realignment improvements at some stage in the future if the upgrade fails to satisfactorily address the crash performance.

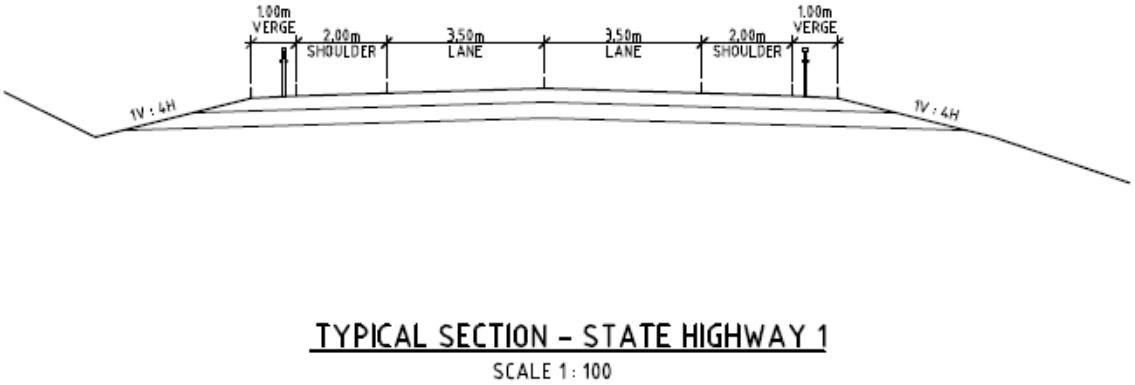


Figure 7-1: Option 8-2 and 8-3 Typical Section

The option consists of:

- Two 3.5 m lanes;
- Two 2.0 m shoulders;
- Easing each of the curves to 550 m radius (100 km/h design speed);
- Shifting the Waitarere Beach Road intersection to meet the new alignment.

Option 8-2 will upgrade the existing two lane undivided carriageway with 3.5 m lanes and 2.0 m shoulders. It will extend from RP967/7.2 to RP 967/5.35 for 1850 m. The option includes the easing of all three curves to 550 m radius. This option will be approximately 120 m shorter than the existing highway alignment.

7.3 Option 8-3 Curve Realignment

This option realigns the highway through the Waitarere Beach Road Curves, altering the double-S bend to two curves in the same direction separated by a straight. Waitarere Beach Road joins the northern end of this straight. A typical cross section of the 13 m carriageway (noting that safety barrier would reduce this width) (11 m seal) is shown in Figure 7-1 above.

The option consists of:

- Two 3.5 m lanes;
- Two 2.0 m shoulders;

- Realignment with two curves at approximately the Whare Rongopai curve and Waitarere Beach Road curve with 800 m radius (110 km/h design speed);
- A new intersection on the realigned section of highway for Waitarere Beach Road, but retaining the existing layout and features.

Option 8-3 will realign the existing highway and will achieve travel time, vehicle operating cost and crash saving benefits, particularly addressing loss of control crashes. It will extend from RP967/7.28 to RP 967/5.0 for 2280 m. This option will be approximately 330 m shorter than the existing highway alignment.

7.4 Other Potential Improvements

7.4.1 Median Barrier

Undivided state highways with over 6,000 vpd generally have higher numbers of deaths and serious injuries as a result of head-on crashes than run-off-road crashes. There have been six head on crash related deaths and serious injuries on this relatively short section of highway in the five year crash history.

A median barrier would protect against head-on, run-off-road to the right and other cross centreline crashes. A median barrier with appropriate turn around facilities at either end should be considered as part of a larger treatment extending as far north as Koputaroa Road and as far south as Kawiu Road with a gap for Waitarere Beach Road only. This would restrict Paeroa Road, Clay Road and all accesses to left in left out (LILO) arrangement.

7.4.2 Passing lanes

The northbound and southbound departure from the Waitarere Beach Road intersection are ideal passing lanes locations as this is approximately 5 km from other proposed and existing retained passing lanes on this section of highway north of Levin. These have been discussed in the Ōtaki to Levin Route Improvements Report (Report No. 11). Integration with Waitarere Beach Road intersection will require careful consideration.

7.4.3 Intersection Form

Roundabouts have fewer conflict points than T-junction intersections and are NZTA's preferred major intersection layout at grade. However, roundabouts induce significant delays to through traffic. Waitarere Beach Road does not have a particularly severe crash history with only one injury crash in the last five years, so a roundabout would result in unjustifiable travel time and vehicle operating cost disbenefits. As indicated in Section 5, the existing layout, which would be retained with the two proposed options, will provide a high level of service beyond the analysis period.

8 Design Statement

This project is at a feasibility stage, and therefore several assumptions have been made in the design.

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).
- Where the existing carriageway is retained, regrading the carriageway would not generally be required but new surfacing would be laid across the entire width and length of the project.
- Drainage provision has been included (subsoil drains, sumps, culverts, headwalls) within the cost estimation but this is estimated based purely on the judgement of a drainage engineer.

- Clear zones have not been incorporated into the design. The provision of safety barrier has been allowed for in the options that where there are embankments and bridge structures.
- A standard pavement design of 350 mm subbase, 170 mm M4 type basecourse and two coat chipseal has been incorporated, based only on known projects in the general area.

9 Cost Estimates

The expected and 95th percentile estimates for the options are detailed in Table 9-1 below.

Table 9-1: Cost Estimates

Option	Expected estimate	95th percentile estimate
Option 8-2 Curve Easing	$5,620,000	$7,250,000
Option 8-3 Curve Realignment	$9,690,000	$12,560,000

The cost estimates for the options have been compiled using concept layouts of the options and with no survey data, and are based on the design statement assumptions as listed above. More detail of the cost estimates for the options are given in Appendix E.

Property costs have been included in the options cost estimation based upon areas derived from aerial photography. Property remains a major risk item during this PFR stage. It is also noted that the area of existing highway no longer required will have potential value.

10 Economic Assessment and Risk Assessment

10.1 Basis of Economic Analysis

Economic analysis was carried out in accordance with NZTA's Economic Evaluation Manual (EEM) using a modified version of the full procedures.

The following assumptions have been made in the calculation of the Benefit Cost Ratio. They are:

1. The base year is 2012 and time zero is 2013.
2. The project area is spilt into three for calculations using AADT with respective time zero AADT, traffic growth has been assumed to be 1.4% which is the same rate as the two closest permanent count stations on SH1 over the last 20 years:
    a. North of Waitarere Beach Road with approximately 7,900 vehicles per day (vpd).
    b. Waitarere Beach Road with approximately 1,740 vpd.
    c. South of Waitarere Beach Road with approximately 8,750 vpd. This volume was determined from the distribution of trips heading north compared to south from the May 2011 turning survey at this intersection.
3. Periodic maintenance costs on the existing or future alignment have not been considered as there is no significant scheduled work within the near future.
4. Travel time and vehicle operating cost (VOC) benefits have been calculated based on the following:
    a. Difference between the do minimum and Option 8-2 and Option 8-3.
        i. Highway length north of Waitarere Beach Road decreasing from 0.9 km to 0.79 km and 0.62 km respectively.

ii. Highway length south of Waitarere Beach Road decreasing from 1.4 km to 1.39 km and 1.369 km respectively.

iii. Length of Waitarere Beach Road increasing from approximately 0.21 km to 0.235 km and 0.275 km respectively.

b. The vehicle operating speed change for the state highway has been determined using the negotiation and design speeds of curves within the alignment lengths.

i. Do minimum speed being the minimum curve negotiation speed in the RAMM data base.

ii. Option 8-2 and Option 8-3 being 100 km/h and 110 km/h respectively.

c. Waitarere Beach Road is assumed to have an increase in speed from 70 km/h for the Do Minimum to 80 km/h for both options.

d. As the intersection will not change in form no vehicle operating costs or travel time saving would be gained.

5. The crash analysis has been done for the five year period 2007 – 2011, and considers the following;

a. The Do Minimum and option crash costs were calculated using Method C of the EEM as there is more than one fatal or serious injury crash per kilometre within this site and no fundamental change in road environment from the options.

b. Mid-block crash costs for 100 km/h near rural were used in midblock and curve crash models.

c. The intersection has not been considered as a separate model as the form is not changing and the single intersection injury crash has been counted on evenly on each two-lane rural road model.

d. Do Minimum: this used the following weighted models from Appendix 6 of the EEM:

i. For the state highway, two two-lane rural road models with lane widths of 3.6 m and shoulder widths of 1.2 m weighted with half an injury crash, for north and south of Waitarere Beach Road.

ii. For Waitarere Beach Road, a two-lane rural road model with lane widths of 3.25 m and shoulder widths of 0.25 m weighted with one injury crash.

iii. Three isolated rural curves, with design speed equal to negotiation, and with approach speeds determined from the Curve Context table in the RAMM data base.

e. Option 8-2: this used the following weighted models from Appendix 6 of the EEM:

i. For the state highway, two two-lane rural road models with lane widths of 3.5 m and shoulder widths of 2.0 m weighted with one injury crash, for north and south of Waitarere Beach Road.

ii. For Waitarere Beach Road, a two-lane rural road model with lane widths of 3.5 m and shoulder widths of 2.0 m weighted with one injury crash.

iii. Three isolated rural curves, with design speed equal to 100 km/h and approach speeds assumed to be 110 km/h.

f. Option 8-3: this used the following weighted models from Appendix 6 of the EEM:

i. For the state highway, two two-lane rural road models with lane widths of 3.5 m and shoulder widths of 2.0 m weighted with one injury crash, for north and south of Waitarere Beach Road.

ii. For Waitarere Beach Road, a two-lane rural road model with lane widths of 3.5 m and shoulder widths of 2.0 m weighted with one injury crash.

iii. As Paeroa Road Curve does not exist in this option, only the Do Minimum costs are considered.

6. The September 2011 update factors and a discount rate of 8% have been used.

A summary of the economic analysis is detailed in the sections below:

10.1 Travel Time Analysis

Travel time savings arise from the shortened carriageway length, increased consistent travel speeds, and reduced deceleration and acceleration through the curves which the curve easing and curve realignment would create for the two options. The expected travel time savings are shown in Table 10-1 below.

Table 10-1: Travel Time Benefits

Option	Travel Time Cost Savings (NPV)
Option 8-2 Curve Easing	$6,350,000
Option 8-3 Curve Realignment	$10,700,000

10.2 Vehicle Operating Cost

Vehicle operating costs savings occur from the shortened carriageway length, increased consistent travel speeds, and reduced deceleration and acceleration through for the curves which the curve easing and curve realignment would create for the two options. The expected vehicle operating cost savings are shown in the Table 10-2 below.

Table 10-2: Vehicle Operating Cost Benefits

Option	Vehicle Operating Cost Savings (NPV)
Option 8-2 Curve Easing	$1,630,000
Option 8-3 Curve Realignment	$5,920,000

10.3 Crash Benefits

The carriageway widening and the realignment of the curves will reduce to the rate of injury crashes. The expected accident cost savings are shown in the Table 10-3 below.

Table 10-3: Crash Benefits

Option	Accident Cost Savings (NPV)
Option 8-2 Curve Easing	$2,970,000
Option 8-3 Curve Realignment	$6,350,000

These two options do not realise the full benefits of a potential project at this location. If a fundamental change (such as adding median barrier or passing lanes) were included in the project then the EEM's accident-by-accident approach could be applied which would result in substantially greater crash benefits in the order of $10M to $15M or more. This is because of the high ratio of fatal and serious crashes compared to injury crashes. Further analysis is required of the benefits of median barriers in the SAR.

10.4 Maintenance Costs

Future maintenance costs have not been allowed for in the economic evaluation. It has been assumed maintenance for the existing and option maintenance areas are comparable as the options and the Do Minimum have similar carriageway area and there is no major periodic maintenance work scheduled.

10.5 Benefit Cost Ratio Results

Table 10-4: Economic Analysis Summary

Option Description	Total Cost (NPV)	Total Benefits (NPV)	BCR
Option 8-2 Curve Easing	$5.52M	$10.9M	**2.1**
Option 8-3 Curve Realignment	$9.16M	$23.0M	**2.5**

See Appendix F for economic evaluation cover sheets.

Option 8-3 has the greatest BCR and therefore purely in economic terms is favourable, additionally as this option has a 110 km/h design speed it provides a safer solution. However, this option also includes a significant higher capital cost to construct, and may adversely affect some culturally significant sites.

Option 8-2 provides a lower design speed which may require future realignment if the poor crash history persists.

10.6 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 Waitarere Beach Road Curves improvement project are considered to be:

- Project unable to get funded due to constrained funding environment.
- Important cultural features requiring relocation to accommodate the alignment.
- Inaccurate cost estimate due to level of available data at this feasibility state, including utility information and assumptions in regards to topography and land value / use.
- Unidentified historical and archaeological features and remains discovered in detailed investigation and construction.
- Project scope increase.
- Land acquisition difficulties.
- Opposition from local iwi.
- Environmental effects during construction & within the project.
- Geotechnical issues arising from unforeseen ground conditions.
- Traffic delays during construction.
- Impacts on existing services.
- Difficulties in obtaining resource consents and/or alteration to designation.
- Additional landowner accommodation works required.
- A lower standard of safety is progressed but later proves to be inadequate and the site requires to be revisited with additional works.

11 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.

Table 11-1 outlines the various options assessment profile[4] for the Waitarere Beach Road Curves.

Table 11-1: Waitarere Beach Road Curve assessment profile

Option	Strategic Fit	Effectiveness	Efficiency
Option 8-2 Curve Easing	High	High	Medium
Option 8-3 Curve Realignment	High	High	Medium

11.1 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**.

11.2 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.

11.3 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.

The BCRs of the options range from 2.1 to 2.5. As these are between 2.0 and 4.0 the project is considered to have **Medium** economic efficiency.

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

12 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 Waitarere Beach Road Curves PFR which will need to be assessed during the scheme assessment phase.

These are outlined below (see also Figure 4-1).

- A tangata whenua site of significance (urupa) near to the existing SH1 alignment at the intersection of Waitarere Beach Road (Nga Haere Pa)
- Whare Rongopai (Maori church) being culturally significant
- Maori owned land adjacent to existing SH1 including the Matua Marae (northern side of the highway) and Huia Marae (southern side of the highway)
- Historic Maori Flour Mill site (1840's – 1850's) located on Paeroa Road with altered watercourse (known as the Waitarere Stream)

Consultation has been carried out 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.

13 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 underlained by beach deposits (Ōtaki Sandstone). To investigate the subsurface conditions along the alignment which includes the Waiterere Beach Road Curves study area, MWH recommended field investigations consisting of hand-auger bores, boreholes, test pits and cone penetration tests (CPT).

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

14 Land Requirements

Land requirement has been included in the concept development and cost estimation and uses the following assumptions:

- Option 8-2 requires 25,400 m2 of land.
- Option 8-3 requires 66,500 m2 of land.

The land calculations are based on that required for the construction of the road using aerial plan areas. It is entirely feasible that these areas will change the SAR investigation is done and when property negotiations take place and entire properties are required to be purchased, with either on-sale value or additional land for the NZTA to maintain.

Option 8-2 requires land from six land parcels, these appear to be three farm, two rural residential, and the Whare Rongopai. Option 8-3 requires land from 14 land parcels, these appear to be three farm, seven rural residential, three “lifestyle”, and the Whare Rongopai.

As noted earlier the existing highway which becomes surplus to requires should have a value which offsets property costs.

15 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.

15.1 District Plan Provisions

15.1.1 Designation

SH1 is designated under the operative Horowhenua District Plan for “state highway purposes” (D2) (Map 4). The existing designation is narrow in places and may need to be altered to accommodate the road improvements. Options requiring a realignment of sections of the highway may require a new designation. 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.

Alternatively, NZTA could apply for a resource consent (land use consent) to carry out the proposed works outside the designation.

15.2 Regional Plans

The final designs and construction plans will determine what regional consents are required. The options being investigated involve works that may include work on culverts.

The following resource consents are likely to be required under the proposed One Plan administered by the Horizons Regional Council:

- Land use consents for the placement/extension of structures in a water course;
- Temporary diversions of water during culvert works;
- Bore permit for geotechnical investigation;
- Stormwater discharges from bulk earthworks;
- Soil and vegetation disturbance;
- Discharges of contaminants to land; and
- Discharge of contaminants to air from road construction.

15.3 Other Provisions

Given that the proposed works may involve earthworks in an area with high tangata whenua values, there is the potential to unearth Maori artefacts. Current information identifies known sites and an archaeological authority may be required should unknown sites be discovered. While the historic Maori Flour Mill site located on Paeroa Road is not identified in the District Plan, it is identified in the NZ Archaeological Association's database. Any physical work that may potentially damage an archaeological site will require an archaeological authority.

16 Maintenance Issues

While both Option 8-2 and Option 8-3 decrease the length of carriageway, their increased carriageway width means that there is only a small change in carriageway area. As no other features requiring maintenance are being added to the project extent, maintenance costs have been considered to be the same as the do minimum.

Waitarere Beach Road, a local road, would marginally increase in length by approximately 30 to 70 m, which will result in increased maintenance costs for Horowhenua District Council.

17 Conclusions and Recommendations

This report explores the options for improving the Waitarere Beach Road Curves. There are currently three horizontal curves with design speeds between 80-90 km/h which are out of context. Previously there was curve easing prior to the mid-1970's.

Two options have been considered, Option 8-2 includes curve easing to a design speed of 100 km/h at this location, while Option 8-3 proposes a slightly different alignment with only two curves with a design speed of 110 km/h rather than the original three curves. Both options include 2.0 m shoulders and edge protection rather than clear zones. Waitarere Beach Road will retain its current form but will be shifted onto the new alignment.

Option 8-3 has a higher BCR than Option 8-2, with greater benefits but increased costs. Option 8-3 may require the relocation of the Whare Rongopai and has greater land requirements including more land requirements from apparently residential dwellings. Option 8-3 sits on the best case alignment.

Option 8-2 does not provide an ideal curve alignment and which may result in future improvements to further reduce the crash risk. However, Option 8-2 has a lower land requirement which local residence may find more acceptable. Option 8-2 sits on the smallest viable alignment change.

Other aspects such as median barriers, passing lanes, or modifications to the forms of the intersections have not been thoroughly investigated at this stage. The purpose of the PFR is to refine the alignment options to be taken through to SAR. It is considered that both Option 8-2 and Option 8-3 should be viewed alongside the outcomes of the other PFRs and used to determine the best package of works to progress as the first stage of the long term strategy.

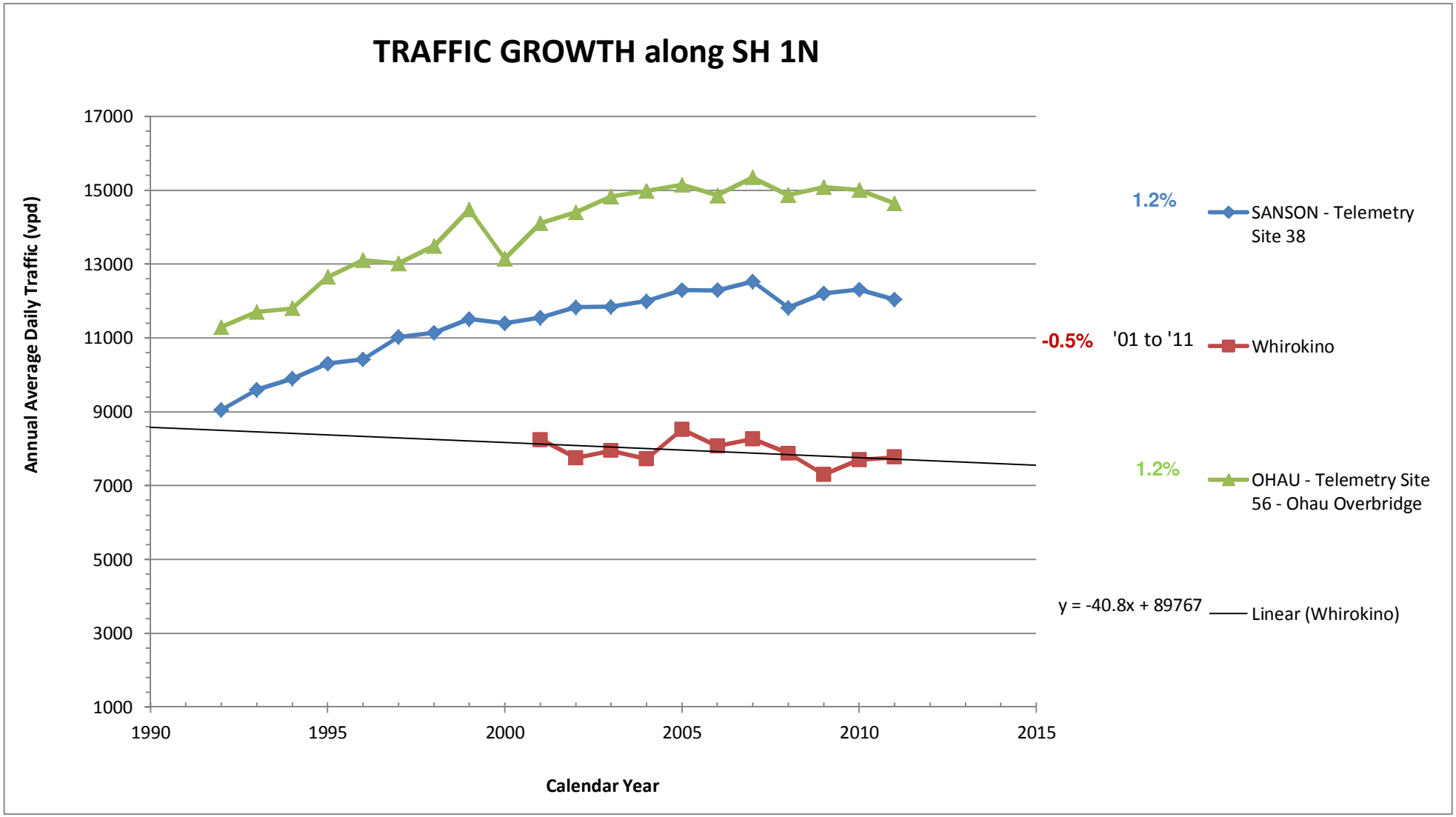
Appendix A Photographs

Looking north towards SH1 / Waitarere Beach Road intersection and curve

Looking south towards SH1 / Paeroa Road intersection and curve

Looking North towards Whare Rongopai Curve

Appendix B Traffic Data


TRAFFIC GROWTH along SH 1N
Annual Average Daily Traffic (vpd)
17000
15000
13000
11000
9000
7000
5000
3000
1000
1990
1995
2000
2005
2010
2015
Calendar Year
1.2%
SANSON - Telemetry Site 38
-0.5%
'01 to '11
Whirokino
1.2%
OHAU - Telemetry Site 56 - Ohau Overbridge
y = -40.8x + 89767
Linear (Whirokino)

Appendix C Crash Data

CRASH LIST DETAIL REPORT

Run on: 29 Nov 2012

Crash List: Waitarere Beach Road Curves Rework (14 crashes)

Total Injury Crashes:	8
Total Non-Injury Crashes:	6
	14

Crash Type	Number	%
Overtaking Crashes:	0	0
Straight Road Lost Control/Head On:	1	7
Bend - Lost Control/Head On:	10	71
Rear End/Obstruction:	1	7
Crossing/Turning:	2	14
Pedestrian Crashes:	0	0
Miscellaneous Crashes:	0	0
TOTAL:	14	100 %

Location	Local road	%	St.Highway	%	Total	%
Urban	0	0	0	0	0	0
Open road	2	14	12	86	14	100
TOTAL:	2	14	12	86	14	100 %

Intersection/Midblock	Number	%
Intersection:	3	21
MidBlock:	11	79
TOTAL:	14	100 %

Environmental Factors	Number	%
Light/Overcast Crashes:	6	43
Dark/Twilight Crashes:	8	57
TOTAL:	14	100 %
Wet/Ice:	4	29
Dry:	10	71
TOTAL:	14	100 %

Day/Period	Number	%
Weekday	10	71
Weekend	4	29
TOTAL:	14	100 %

Vehicles	Number	%
Car	12	79
Van/Ute	2	14
Truck	3	21
Bus	0	0
Motorcycle	1	7
Bicycle	0	0
TOTAL:	18	121 %

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

Crash factors (*)	Number	%
Alcohol	4	29
Too fast	2	14
Failed Giveway/Stop	2	14
Failed Keep Left	2	14
Poor handling	5	36
Poor Observation	2	14
Poor judgement	2	14
Fatigue	2	14
Vehicle factors	1	7
Road factors	1	7
Weather	1	7
Other	1	7
TOTAL:	25	177 %
Crashes with a:		
Driver factor	21	149 %
Environmental factor	2	14 %

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

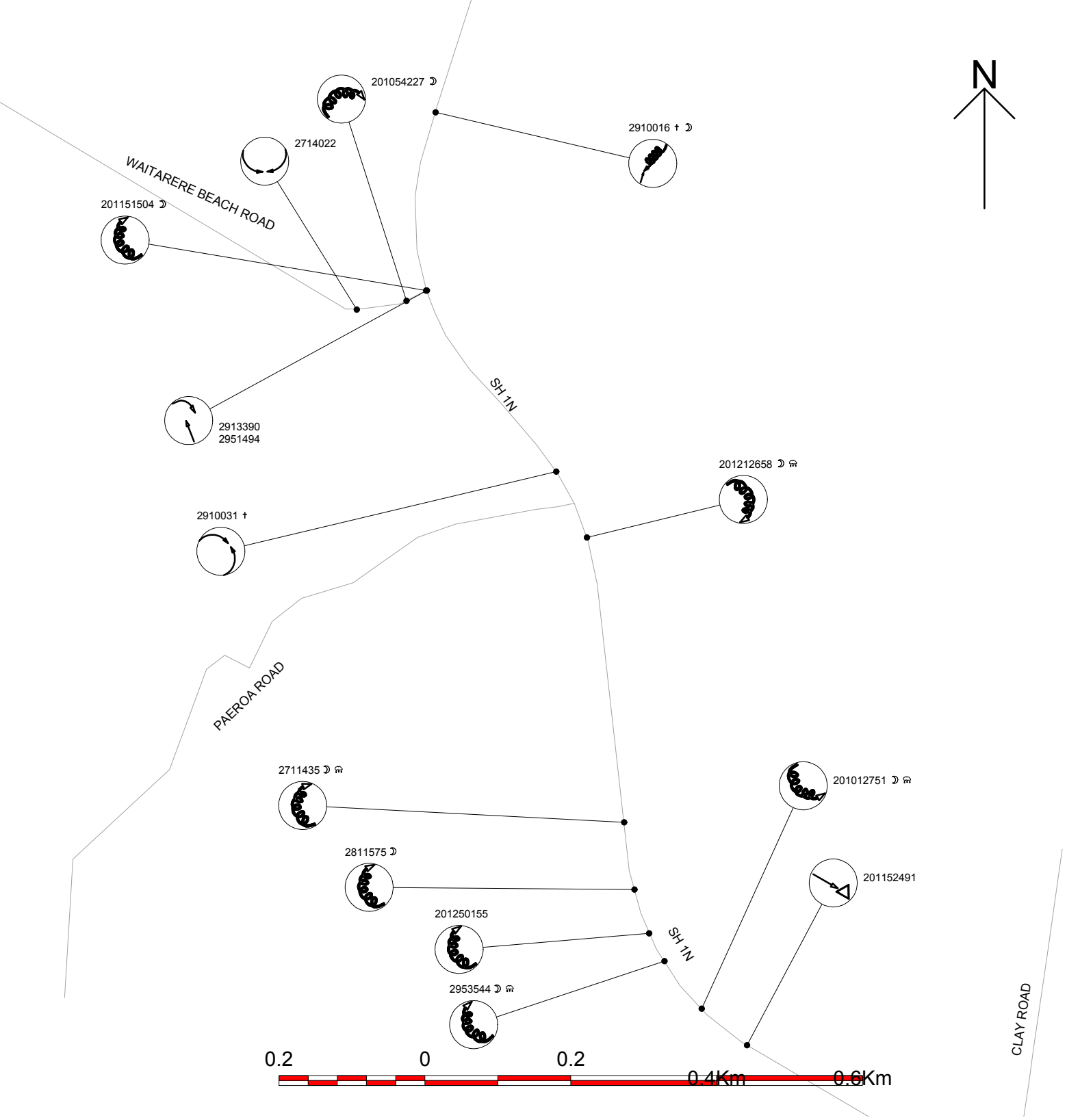
Note: Driver/vehicle factors are not available for non-injury crashes for Northland, Auckland, Waikato and Bay of Plenty before 2007. This will influence numbers and percentages.

Crashes with objects(s) struck	9	64 %

Object Struck	Number	%
Animals	1	7
Fence	6	43
Post Or Pole	3	21
Tree	3	21
Stray Animal	1	7
TOTAL:	14	99 %

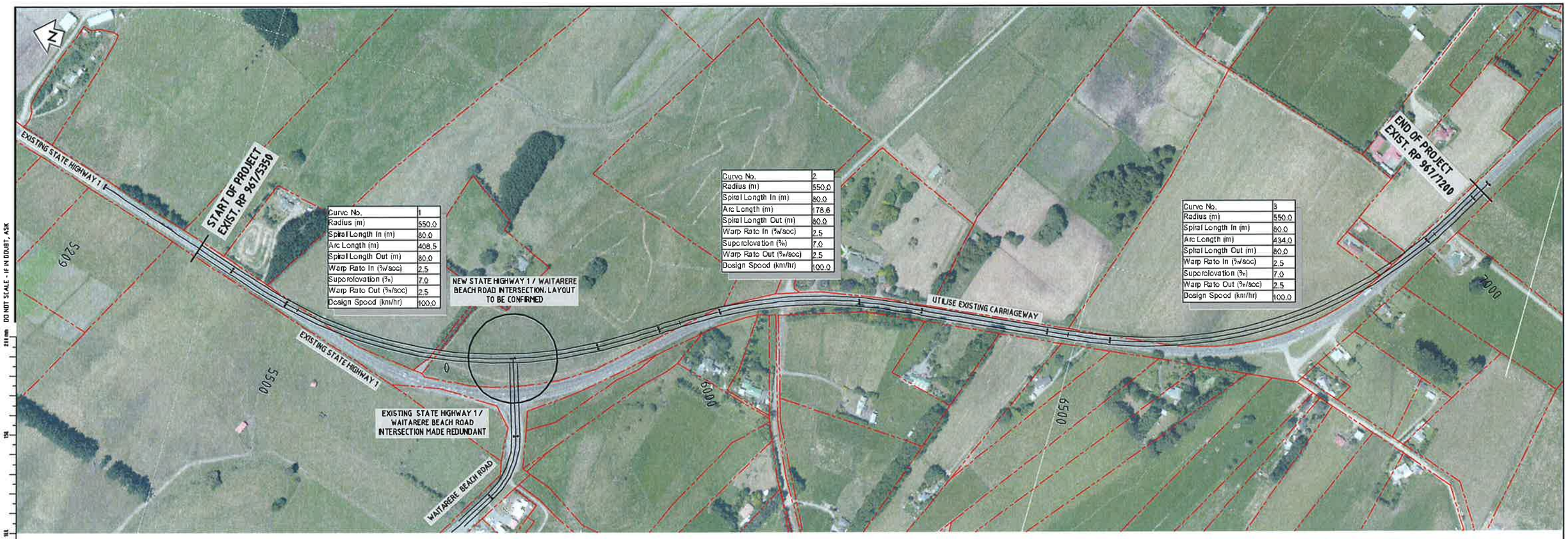
Crash Numbers

Year	Fatal	Serious	Minor	Non-Inj
2007	0	1	1	0
2008	0	0	1	0
2009	2	1	0	2
2010	0	0	1	1
2011	0	0	0	2
2012	0	1	0	1
TOTAL:	2	3	3	6


N
201054227
2910016
2714022
WAITARERE BEACH ROAD
201151504
SH 1N
2913390
2951494
201212658
2910031
PAEROA ROAD
2711435
201012751
2811575
201152491
201250155
SH 1N
2953544
CLAY ROAD
0.2
0
0.2
0.4Km
0.6Km

First Street	Distance	D/I/R	Second street or landmark	Crash Number	Date DD/MM/YYYY	Day DDD	Time HHMM	Description of Events	Crash Factors (ENV = Environmental factors)	Road	Natural Light	Weather	Junction	Cntrl	Tot Inj F A T	S E R	M I N
WAITARERE BEACH ROAD	30	W	SH 1N	201054227	30/08/2010	Mon	1800	CAR1 EBD on WAITARERE BEACH ROAD lost control turning right, CAR1 hit Fence, Post Or Pole on right hand bend	CAR1 alcohol test above limit or test refused, too fast for conditions, showing off racing	Dry	Twilight	Fine	Unknown	Nil			
WAITARERE BEACH ROAD	100	W	SH 1N	2714022	19/11/2007	Mon	1740	MOTOR CYCLE1 EBD on WAITARERE BEACH ROAD swinging wide hit VAN2 head on	MOTOR CYCLE1 swung wide on bend	Dry	Bright	Fine	Unknown	Nil			1
1N/967/5.644	250	N	WAITARERE BEACH ROAD	2910016	17/02/2009	Tue	2300	CAR1 SBD on SH 1N lost control on straight and hit TRUCK2 head on, CAR1 hit Tree, TRUCK2 hit Tree	CAR1 alcohol test above limit or test refused, lost control while returning to seal from unsealed shoulder, attention diverted	Dry	Dark	Fine	Unknown	Nil	3		
1N/967/5.894		I	WAITARERE BEACH ROAD	2951494	07/02/2009	Sat	1120	CAR1 NBD on SH 1N hit TRUCK2 turning right onto SH 1N from the left	TRUCK2 did not stop at stop sign	Dry	Bright	Fine	T Type Junction	Stop Sign			
1N/967/5.894		I	WAITARERE BEACH ROAD	2913390	26/10/2009	Mon	1508	VAN1 NBD on SH 1N hit CAR2 turning right onto SH 1N from the left	VAN1 didn't signal in time incorrect signal CAR2 failed to give way at give way sign, misjudged intentions of another party	Dry	Bright	Fine	T Type Junction	Give Way Sign		1	3
1N/967/5.895		I	WAITARERE BEACH ROAD	201151504	30/03/2011	Wed	0330	TRUCK1 NBD on SH 1N lost control turning right on right hand bend	TRUCK1 lost control when turning, attention diverted by cigarette etc	Dry	Dark	Fine	T Type Junction	Give Way Sign			
1N/967/6.201	50	N	PAEROA ROAD	2910031	25/03/2009	Wed	1123	CAR1 NBD on SH 1N swinging wide hit CAR2 head on	CAR1 swung wide on bend, fatigue (drowsy, tired, fell asleep) CAR2 alcohol not suspected, tested and -ve (MoT use only)	Dry	Bright	Fine	Unknown	Nil	2	1	
1N/967/6.302	50	S	PAEROA ROAD	201212658	16/07/2012	Mon	0435	CAR1 SBD on SH 1N lost control turning right, CAR1 hit Fence, Post Or Pole, Tree on right hand bend	CAR1 lost control due to road conditions ENV: road obstructed (flood waters), heavy rain	Wet	Dark	Heavy Rain	Unknown	Nil		1	1
1N/967/6.694	800	S	WAITARERE BEACH ROAD	2711435	18/03/2007	Sun	0156	CAR1 WBD on SH 1N lost control turning right, CAR1 hit Tree on right hand bend	CAR1 alcohol test above limit or test refused	Wet	Dark	Light Rain	Unknown	Nil		1	1
1N/967/6.788	700	N	CLAY ROAD	2811575	21/03/2008	Fri	2040	CAR1 NBD on SH 1N lost control turning right, CAR1 hit Animals, Fence on right hand bend	CAR1 fatigue (drowsy, tired, fell asleep)	Dry	Dark	Fine	Unknown	Nil			2
1N/967/6.852	600	S	PAEROA ROAD	201250155	13/01/2012	Fri	1622	CAR1 NBD on SH 1N lost control turning right, CAR1 hit Fence on right hand bend	CAR1 lost control when turning, new driver showed inexperience, driver over-reacted	Dry	Overcast	Fine	Unknown	Nil			
1N/967/6.894	1000	S	WAITARERE BEACH ROAD	2953544	29/04/2009	Wed	1935	SUV1 NBD on SH 1N lost control turning right, SUV1 hit Fence on right hand bend	SUV1 too fast entering corner	Wet	Dark	Light Rain	Unknown	Nil			
1N/967/6.979	510	N	CLAY ROAD	201012751	12/09/2010	Sun	0521	CAR1 SBD on SH 1N lost control turning left, CAR1 hit Fence, Post Or Pole	CAR1 alcohol test above limit or test refused, lost control when turning, worn tread on tyre	Wet	Dark	Light Rain	Unknown	Nil			1
1N/967/7.059	430	N	CLAY ROAD	201152491	26/06/2011	Sun	1534	CAR1 SBD on SH 1N hit obstruction, CAR1 hit Stray Animal	ENV: household pet rushed out or playing	Dry	Overcast	Fine	Unknown	Nil			

Appendix D Outline Plans



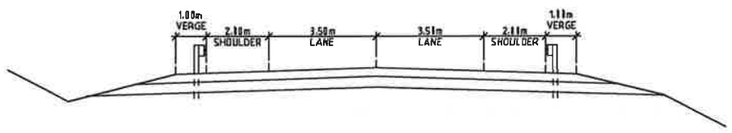
Curve No.	1
Radius (m)	550.0
Spiral Length In (m)	80.0
Arc Length (m)	408.5
Spiral Length Out (m)	80.0
Warp Rate In (%/sec)	2.5
Superelevation (%)	7.0
Warp Rate Out (%/sec)	2.5
Design Speed (km/hr)	100.0

Curve No.	2
Radius (m)	550.0
Spiral Length In (m)	80.0
Arc Length (m)	178.6
Spiral Length Out (m)	80.0
Warp Rate In (%/sec)	2.5
Superelevation (%)	7.0
Warp Rate Out (%/sec)	2.5
Design Speed (km/hr)	100.0

Curve No.	3
Radius (m)	550.0
Spiral Length In (m)	80.0
Arc Length (m)	434.0
Spiral Length Out (m)	80.0
Warp Rate In (%/sec)	2.5
Superelevation (%)	7.0
Warp Rate Out (%/sec)	2.5
Design Speed (km/hr)	100.0

PLAN – OPTION B – 2
SCALE 1 : 2500

NOTES
1. LENGTH OF OLD ALIGNMENT = 1851 m
2. LENGTH OF PROPOSED ALIGNMENT = 1738 m



TYPICAL SECTION – STATE HIGHWAY 1
SCALE 1 : 100

NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
B	TYPICAL SECTION UPDATED	GC	MO	PP	15.02.13
A	FOR REVIEW	GC	-	-	-

	Name	Date
SURVEYED		
DESIGNED	G. Carin	11/12
DRAWN	G. Carin	11/12
CHECKED	P. Peet	11/12
REVIEWED	M. Oppenhuis	11/12
APPROVED	P. PEET	02/13

MWH

NZ TRANSPORT AGENCY
WAKA KOTAHI

NZ TRANSPORT AGENCY
OTAKI TO LEVIN PFRs

WAITARERE BEACH ROAD CURVES PFR
PLAN – OPTION B – 2 (SHEET 1 OF 1)

Status Stamp: PRELIMINARY
Date Stamp: 05 FEB 2013
SCALES (A1) AS SHOWN

Drawing No.	Sheet No.	Rev.
80500902 0107	C003	B

XREFS :

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

START OF PROJECT
EXIST. RP 967/5000

END OF PROJECT
EXIST. RP 967/7280

Curve No.	1
Radius (m)	800.0
Spiral Length In (m)	80.0
Arc Length (m)	349.5
Spiral Length Out (m)	80.0
Warp Rate In (%/sec)	2.1
Superelevation (%)	5.5
Warp Rate Out (%/sec)	2.1
Design Speed (km/hr)	110.0

Curve No.	2
Radius (m)	800.0
Spiral Length In (m)	80.0
Arc Length (m)	561.8
Spiral Length Out (m)	80.0
Warp Rate In (%/sec)	2.1
Superelevation (%)	5.5
Warp Rate Out (%/sec)	2.1
Design Speed (km/hr)	110.0

NEW STATE HIGHWAY 1 / WAITARERE BEACH ROAD INTERSECTION. LAYOUT TO BE CONFIRMED

EXISTING STATE HIGHWAY 1

EXISTING STATE HIGHWAY 1 / WAITARERE BEACH ROAD INTERSECTION MADE REDUNDANT

WAITARERE BEACH ROAD

5000

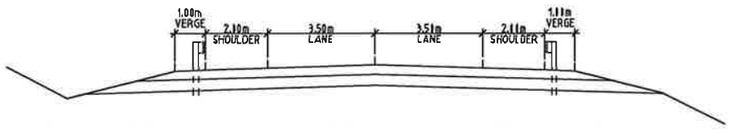
5500

6000

6500

PLAN - OPTION 8 - 3
SCALE 1 : 2500

NOTES
1. LENGTH OF OLD ALIGNMENT = 2280 m
2. LENGTH OF PROPOSED ALIGNMENT = 1950 m



TYPICAL SECTION - STATE HIGHWAY 1
SCALE 1 : 100

NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
B	TYPICAL SECTION UPDATED	GC	MO	PP	05.12.13
A	FOR REVIEW	GC	-	-	-

	Name	Date
SURVEYED		
DESIGNED	G. Carin	11/12
DRAWN	G. Carin	11/12
CHECKED	P. Peet	11/12
REVIEWED	M. Oppenhuis	11/12
APPROVED	P. PEET	02/13

MWH

NZ TRANSPORT AGENCY WAKA KOTAHI

NZ TRANSPORT AGENCY
OTAKI TO LEVIN PFRs

WAITARERE BEACH ROAD CURVES PFR
PLAN - OPTION 8 - 3 (SHEET 1 OF 1)

Status Stamp: PRELIMINARY
Date Stamp: 05 FEB 2013
SCALES (A1) AS SHOWN
Drawing No.: 80500902 0107
Sheet No.: C004
Rev.: B

XREFS :

Appendix E Cost Estimates

Project Estimate - Form A

Project Name: Waitarere Beach Rd Curve Improvements
Option 8 - 2

FE
Feasibility Estimate

Item	Description	Base Estimate	Contingency	Funding Risk
A	**Nett Project Property Cost**	145,000	29,000	47,900
	Investigation and Reporting			
	- Consultancy Fees	120,000	24,000	39,600
	- NZTA-Managed Costs	27,500	5,500	9,100
B	**Total Investigation and Reporting**	147,500	29,500	48,700
	Design and Project Documentation			
	- Consultancy Fees	159,000	31,800	52,500
	- NZTA-Managed Costs	27,500	5,500	9,100
C	**Total Design and Project Documentation**	186,500	37,300	61,600
	Construction			
	MSQA			
	- Consultancy Fees	200,000	40,000	66,000
	- NZTA-Managed Costs	22,500	4,500	7,475
	- Consent Monitoring Fees	2,500	500	825
	Sub Total Base MSQA	225,000	45,000	74,300
	Physical Works			
D1	*Environmental Compliance*	*52,000*	*10,400*	*17,200*
D2	*Earthworks*	*623,500*	*187,100*	*311,800*
D3	*Ground Improvements*	*0*	*0*	*0*
D4	*Drainage*	*127,200*	*25,400*	*42,000*
D5	*Pavement and Surfacing*	*1,259,050*	*251,800*	*415,500*
D6	*Bridges / Structures*	*0*	*0*	*0*
D7	*Retaining Walls*	*0*	*0*	*0*
D8	*Traffic Services*	*528,000*	*105,600*	*174,200*
D9	*Service Relocations*	*562,500*	*112,500*	*185,600*
D10	*Landscaping*	*65,000*	*13,000*	*21,500*
D11	*Traffic Management and Temporary Works*	*360,000*	*72,000*	*118,800*
D12	*Preliminary and General*	*350,000*	*70,000*	*115,500*
D13	*Extraordinary Construction Costs*	*0*	*0*	*0*
	Sub Total Base Physical Works	3,927,250	847,800	1,402,100
D	**Total Construction & MSQA**	4,152,250	892,800	1,476,400
E	**Project Base Estimate** (A+B+C+D)	4,631,250		
F	**Contingency** *(Assessed / Analysed)* (A+B+C+D)		988,600	
G	**Project Expected Estimate** (E+F)		5,619,850	
	Project Property Cost Expected Estimate		174,000	
	Investigation and Reporting Expected Estimate		177,000	
	Design and Project Documentation Expected Estimate		223,800	
	Construction Expected Estimate		5,045,050	
H	**Funding Risk** *(Assessed / Analysed)* (A+B+C+D)			1,634,600
I	**95th Percentile Project Estimate** (G+H)			7,254,450
	Project Property Cost 95th Percentile Estimate			221,900
	Investigation and Reporting 95th Percentile Estimate			225,700
	Design and Project Documentation 95th Percentile Estimate			285,400
	Construction 95th Percentile Estimate			6,521,450

Base Date of Estimate	**28 Nov 2012**	**Cost Index**
Estimate prepared by:	**G. Corin**	**Signed**
Estimate internal peer review by:		**Signed**
Estimate external peer review by:		**Signed**
Estimate approved by NZTA Project Manager:		**Signed**

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

Project Estimate - Form A

Project Name: Waitarere Beach Rd Curve Improvements
Option 8 - 3

FE
Feasibility Estimate

Item	Description	Base Estimate	Contingency	Funding Risk
A	**Nett Project Property Cost**	357,500	71,500	118,000
	Investigation and Reporting			
	- Consultancy Fees	195,000	39,000	64,400
	- NZTA-Managed Costs	38,500	7,700	12,700
B	**Total Investigation and Reporting**	233,500	46,700	77,100
	Design and Project Documentation			
	- Consultancy Fees	258,000	51,600	85,100
	- NZTA-Managed Costs	38,500	7,700	12,700
C	**Total Design and Project Documentation**	296,500	59,300	97,800
	Construction			
	MSQA			
	- Consultancy Fees	315,000	63,000	104,000
	- NZTA-Managed Costs	45,000	9,000	14,850
	- Consent Monitoring Fees	5,000	1,000	1,650
	Sub Total Base MSQA	365,000	73,000	120,500
	Physical Works			
D1	*Environmental Compliance*	*60,000*	*12,000*	*19,800*
D2	*Earthworks*	*1,439,000*	*431,700*	*719,500*
D3	*Ground Improvements*	*0*	*0*	*0*
D4	*Drainage*	*251,600*	*50,300*	*83,000*
D5	*Pavement and Surfacing*	*2,355,200*	*471,000*	*777,200*
D6	*Bridges / Structures*	*0*	*0*	*0*
D7	*Retaining Walls*	*0*	*0*	*0*
D8	*Traffic Services*	*602,000*	*120,400*	*198,700*
D9	*Service Relocations*	*843,750*	*168,800*	*278,400*
D10	*Landscaping*	*70,000*	*14,000*	*23,100*
D11	*Traffic Management and Temporary Works*	*480,000*	*96,000*	*158,400*
D12	*Preliminary and General*	*600,000*	*120,000*	*198,000*
D13	*Extraordinary Construction Costs*	*0*	*0*	*0*
	Sub Total Base Physical Works	6,701,550	1,484,200	2,456,100
D	**Total Construction & MSQA**	7,066,550	1,557,200	2,576,600
E	**Project Base Estimate** (A+B+C+D)	7,954,050		
F	**Contingency** *(Assessed / Analysed)* (A+B+C+D)		1,734,700	
G	**Project Expected Estimate** (E+F)		9,688,750	
	Project Property Cost Expected Estimate		429,000	
	Investigation and Reporting Expected Estimate		280,200	
	Design and Project Documentation Expected Estimate		355,800	
	Construction Expected Estimate		8,623,750	
H	**Funding Risk** *(Assessed / Analysed)* (A+B+C+D)			2,869,500
I	**95th Percentile Project Estimate** (G+H)			12,558,250
	Project Property Cost 95th Percentile Estimate			547,000
	Investigation and Reporting 95th Percentile Estimate			357,300
	Design and Project Documentation 95th Percentile Estimate			453,600
	Construction 95th Percentile Estimate			11,200,350

Base Date of Estimate	**28 Nov 2012**	**Cost Index**
Estimate prepared by:	**G. Corin**	**Signed**
Estimate internal peer review by:		**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

GENERAL ROADING IMPROVEMENT WORKS:
EVALUATION SUMMARY

WORKSHEET 1

1 Evaluator(s) Ian Robertson
Reviewer(s) David Wanty

2 Project / Package Details

Approved Organisation Name	NZTA
Project / Package Name	Otaki to Levin: Waitarere Beach Road Curves PFR
Your Reference	Z1925700
Project Description	Safety Improvements
Describe the problem to be addressed	Reduce crashes

3 Location

Brief description of location: State Highway 1, between Clay Road (967/7.3) and north of Waitarere Beach Road (967/5.0)

4 Alternatives and Options

Describe the Do Minimum	Retain the existing situation.
Summarise the options assessed	Option 8-2: Curve Easing of three out of context curves with low radius.

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)	25 November 2012
Base date for costs	1 July 2012
AADT at Time Zero	8750
Traffic Growth Rate at Time Zero (%)	1.4%

Existing Roughness	2.70	IRI or NAASRA	Existing Traffic Speed	100	km/hr	(est)
Predicted Roughness	2.70	IRI or NAASRA	Predicted Traffic Speed	100	km/hr	
Length of Job Before Improvements	2.51	km	Posted Speed Limit	100	km/hr	
Length of Job After Improvements	2.42	km	Road Type	Rural Strategic		
Length of new highway	2.30	km	Gradient Before Improvements	0%		
Length of existing highway used	2.18	km	Gradient After Improvements	0%		

7 PV Cost of Do Minimum — **Cost $** $0 — **A**

8 PV Cost of the preferred Option — **Cost $** $5,322,408 — **B**

9 Benefit values from Worksheet 4, 5 or 6

PV Travel Time Cost savings:	$	$4,776,705	**C**	x Update Factor^{TT}	1.33	= $	$6,353,017	**W**
PV VOC & CO2 savings:	$	$1,565,434	**D**	x Update Factor^{VOC}	1.04	= $	$1,628,051	**Y**
PV Accident Cost savings:	$	$2,537,032	**E**	x Update Factor^{AC}	1.17	= $	$2,968,327	**Z**

10 B/C Ratio = $\frac{W + Y + Z}{B - A} = \frac{\text{BENEFITS}}{\text{COSTS}} = \frac{6353017 + 1628051 + 2968327}{5322408 - 0} =$ **2.1**

11 FYRR = $\frac{1^{st}\text{ Year BENEFITS}}{\text{COSTS}} = \frac{[(6353017+1628051)/12.32+2968327/11.19] \times 0.9259}{5322408 - 0} =$ **$0.16**

MWH

Simplified Procedure 3 - General Road Improvements

GENERAL ROADING IMPROVEMENT WORKS:
EVALUATION SUMMARY

WORKSHEET 1

1 Evaluator(s) Ian Robertson
Reviewer(s) David Wanty

2 Project / Package Details

Approved Organisation Name	NZTA
Project / Package Name	Otaki to Levin: Waitarere Beach Road Curves PFR
Your Reference	Z1925700
Project Description	Safety Improvements
Describe the problem to be addressed	Reduce crashes

3 Location

Brief description of location: State Highway 1, between Clay Road (967/7.3) and north of Waitarere Beach Road (967/5.0)

4 Alternatives and Options

Describe the Do Minimum	Retain the existing situation.
Summarise the options assessed	Option 8-3: Realignment of the three out of context curves with two high radii curves.

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)	25 November 2012
Base date for costs	1 July 2012
AADT at Time Zero	8750
Traffic Growth Rate at Time Zero (%)	1.4%

Existing Roughness	2.70	IRI or NAASRA	Existing Traffic Speed	100	km/hr	(est)
Predicted Roughness	2.70	IRI or NAASRA	Predicted Traffic Speed	100	km/hr	
Length of Job Before Improvements	2.51	km	Posted Speed Limit	100	km/hr	
Length of Job After Improvements	2.26	km	Road Type	Rural Strategic		
Length of new highway	2.30	km	Gradient Before Improvements	0%		
Length of existing highway used	1.99	km	Gradient After Improvements	0%		

7 PV Cost of Do Minimum — **Cost $** $0 — **A**

8 PV Cost of the preferred Option — **Cost $** $9,163,808 — **B**

9 Benefit values from Worksheet 4, 5 or 6

PV Travel Time Cost savings:	$	$8,071,799	**C**	x Update Factor^{TT}	1.33	= $	$10,735,493	**W**
PV VOC & CO2 savings:	$	$5,695,325	**D**	x Update Factor^{VOC}	1.04	= $	$5,923,138	**Y**
PV Accident Cost savings:	$	$5,428,359	**E**	x Update Factor^{AC}	1.17	= $	$6,351,180	**Z**

10 B/C Ratio = $\frac{W + Y + Z}{B - A}$ = $\frac{\text{BENEFITS}}{\text{COSTS}}$ = $\frac{10735493 + 5923138 + 6351180}{9163808 - 0}$ = **2.5**

11 FYRR = $\frac{1^{st}\text{ Year BENEFITS}}{\text{COSTS}}$ = $\frac{[(10735493+5923138)/12.32+6351180/11.19] \times 0.9259}{9163808 - 0}$ = **$0.19**