Upper Hutt City Council

Akatarawa Road Upgrade Study

June 2009

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Contract No 284

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1.0 EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to examine the feasibility of upgrading the Akatarawa Road route linking Waikanae and Upper Hutt, to identify a proposed upgrade strategy, and to present a case for national and regional funding. The study is for the full length of the route linking the intersection of State Highway 1 (SH1) and Elizabeth Street in Waikanae, and the intersection of State Highway 2 (SH2) at Brown Owl in Upper Hutt.

1.2 Overview

The distance between SH1 and SH2 is 35km and the route's prime function is currently a local access road. The route also serves as a scenic tourist route providing access to Staglands. The study route is partly in Upper Hutt City (21km) and partly in the Kapiti Coast District (14km).

The majority of properties that access the route are rural/residential although there are a number of businesses in the Upper Hutt area covering tourism, agriculture and logging.

The existing road is narrow and, in places, lacks sufficient width for two vehicles to pass. The existing alignment is tortuous with many tight corners and poor sight lines, particularly in the hill areas.

The topography is generally difficult from an engineering perspective, and poor soil stability in some areas compounds these difficulties. Large cut/fill slopes are often required even for relatively small amounts of widening, resulting in high construction costs.

The geometric standards applied to upgrade options are as follows:

- Two 3.0m wide lanes.
- Shoulders each side 0.5m wide.
- Widening on bends to enable a car and truck to pass.
- Design speed of 60-70km/h for curves on flat/rolling sections.
- Design speed of 50km/h for curves on the hill section.

The sections of the road already meeting the geometric constraints have not been considered for improvement.

Provision for cyclists has been considered over the improved sections but it is felt that the relatively low numbers of vehicles and cyclists, and the disproportionate cost of widening the road to provide space for them specific measures are not appropriate. However the proposed improvements by virtue of providing improved road widths and sight distances will greatly improve safety for cyclists.

The options assessed during this study were:

- "Do Minimum" - maintain the current road without changing the existing layout.
- "Online Widening" - follow the same alignment as the existing road, with additional widening where necessary to allow a car and a semi-trailer, traveling in opposite directions, to pass at all locations.

- "Offline Realignment" - deviates from the existing alignment to provide a route that meets the design standards required for the selected design speed between 50-70km/h.

Upgrading Akatarawa Road provides a number of challenges given the terrain, narrowness of the road and instability of the soil and rocks. Extensive cuts and fills are required to achieve either option, requiring a detailed geotechnical assessment.

Enviro Solutions NZ Ltd (Enviro) produced a report for Upper Hutt City Council (UHCC) in May 2003 to assess the environmental impacts of upgrading the road within the Upper Hutt section of the study route. The Enviro study highlighted a number of environmental issues that are relevant to the upgrade and these are discussed within the report.

The Greater Wellington Regional Council's Wellington Transport Strategy Model (WTSM) has been used to assess the travel time and distance benefits. The WTSM model represents road and infrastructure at a strategic level and includes changes in population and employment, mode choice, trip distribution and trip re-timing in its forecasts. Forecasts are consistent with Statistics New Zealand December 2007 data release.

It is estimated that the upgrade options result in travel time savings of 11 minutes for online option and 20 minutes for the offline options.

The online improvements have an estimated cost of $41 million whereas the offline improvement is estimated to cost $56 million. However, the offline route is estimated to be 2km shorter than the online option and provides greater travel time and vehicle operating cost savings. As a consequence, the annualised benefits as calculated by the WSTM is greater for the offline improvements. The economic analysis indicates a benefit cost ratio (BCR) of 0.38 for the online improvement whereas the offline improvement has a BCR of 0.75.

1.3 Recommendation

The preferred option is the offline realignment. While it is the highest cost option, the cost for online widening is of a similar order, and the standard of road constructed would be far higher with the offline realignment. The alignment would also be safer and provide a greater benefit in an emergency.

There are a number of benefits not included in the calculation. These include the availability of an alternative route as a result of closures to the State Highways, reduction of traffic on State Highways, improved revenues for businesses on the route, and the cross-section adjustment for accident costs do not consider roads as narrow as Akatarawa Road, suggesting the accident cost benefits should be higher.

Both upgrading options will contribute to the objectives of the Land Transport Management Amendment Act as follows.

(a) **Assisting economic development** through increased patronage to businesses along the route and lower transport costs associated with those businesses. Easier access between Waikanae and Upper Hutt will provide increased market opportunities for businesses located in those areas. Other opportunities for tourist development could be developed to utilise the increased passing traffic and easier access. The route also provides economic benefit through reduced vehicle operating costs, an alternative route avoiding the economic cost of closure to SH1, a reduction in congestion, and reduced travel times.

(b) **Assisting safety and personal security** by reducing the potential for loss of control and head-on accidents with improved road geometry (alignment, carriageway width),

delineation and safety barriers, removing traffic from heavily congested routes where nose-tail accidents occur, and improving pedestrian/cyclist safety.

(c) **Improving access and mobility** by removing vehicles from congested routes, improving the availability of the route and providing an alternative route to existing routes.

(d) **Protecting and promoting public health** by increasing walking and cycling activity with the wider carriageway and shoulder, and reducing vehicle emissions.

(e) **Ensuring environmental sustainability** by removing vehicles from other congested routes reducing emissions, and reducing emissions by shortening and improving driving conditions on the route.

It is recommended that the next stage of work be a preliminary geotechnical appraisal with some limited site investigation mapping the options to enable a more accurate assessment of the parameters to be used for each cut slope and fill. A budget of $70,000 should be provided for this work.

2.0 INTRODUCTION

2.1 Scope of Works

This study is to investigate the feasibility of upgrading the Akatarawa Road route linking Waikanae and Upper Hutt. The study is jointly funded by Upper Hutt City Council (UHCC), Kapiti Coast District Council (KCDC) and Land Transport New Zealand (LTNZ). The objective is to provide:

(f) A scheme plan of the upgrade.

(g) The total cost to upgrade the road to the required standard with a high degree of accuracy.

(h) A case for national and regional funding of the project.

The scope of work for the study includes the following specific requirements:

(a) A scheme plan of the upgrade.

(b) The total cost to upgrade the road to the required standard with a high degree of accuracy.

(c) Calculation of the work required.

(d) Calculation of the costs and benefits of the work.

(e) Sensitivity analysis.

(f) Preparation and submission of a study report.

The upgrading of the Akatarawa Road is supported in the following plans and programmes.

2.2 National Land Transport Programme

The project has been assessed for inclusion in the National Land Transport Programme with a project profile of MMH (medium seriousness and urgency, medium effectiveness and high efficiency). Financial assistance has been provided for the investigation in the National Land Transport Programme.

2.3 Regional Land Transport Programme

The Regional Land Transport Programme 2007 (RLTP) has included the Akatarawa Road upgrade in the 10 year period beyond 2016/2017 at a cost of $20 million but with no specific construction date.

The proposal in the RLTP is to widen the road to two lanes suitable for vehicles up to 12m in length including 45 to 50 seater buses and non-articulated trucks, providing an alternative regular and emergency route between the SH1 and SH2 corridors.

Akatarawa Road is not identified as a Strategic Road in the RLTP.

The Hutt Corridor Transport Study concluded that the Akatarawa Road upgrade is a stand alone project largely independent of the rest of the network which will proceed on its own merits.

2.4 Upper Hutt City Long Term Council Community Plan

The Long Term Council Community Plan (LTCCP) notes that excellent road links with Wellington, Lower Hutt and Kapiti Coast are essential if businesses and residents of Upper Hutt are to continue to thrive.

The LTCCP also notes that UHCC will continue to advocate to ensure that there is sufficient recognition of and provision for the needs of the Wellington Region.

The LTCCP supports the investigation of the upgrading of Akatarawa Road, which provides a strategic link between State Highways 1 and 2, to a two lane road. A provision of $1.442 million is included in the LTCCP for roading safety improvements on Akatarawa Road.

2.5 Kapiti Coast District Long Term Council Community Plan

There is no specific or general reference to the investigation or proposed upgrade of Akatarawa Road in the Kapiti Coast LTCCP.

3.0 PROBLEM DESCRIPTION

The Akatarawa route (Elizabeth Street-Reikorangi Road-Akatarawa Road) is a direct link from SH1 at Waikanae to SH2 at Upper Hutt, approximately 35km long. The route is very narrow and windy with blind corners and is generally avoided by drivers as indicated by the low vehicle numbers using the route despite it being shorter than alternative routes. It is unsuitable for larger vehicles such as trucks and buses, though they do use the route from time to time

The travel time over the Akatarawa route is approximately 50-55 minutes. Doing the equivalent trip over SH58, which is significantly longer at 58km, takes 50 minutes indicating the difficulty of driving the Akatarawa Road and that there are opportunities for improvements.

There are a number of problems with Akatarawa route arising from its width, alignment, geology and elevation which are discussed in the following sections.

The road hazards are not restricted to motor vehicles only. The close proximity of urban areas, lifestyle blocks, and Wellesley Country Club results in the road being used by pedestrians, cyclists and, to a lesser extent, horse riders. School parties walk along the road between the Camp and Clouston Park. The route is popular with cyclists being one of the few hilly sealed roads on the Kapiti Coast. These activities pose a risk both to and from vehicle traffic using the road because of the narrow width, poor sight distances and lack of shoulder.

3.1 Road Width

The width of the existing road varies along its length. In many locations the road width is insufficient for two cars travelling in opposite directions to pass each other.

This occurs primarily along the hill section of the route between chainage 1800 and 10300, where chainage 0 is the start of Akatarawa Road at its junction with Reikorangi Road and Ngatiawa Road in the Kapiti Coast District.

There is also a section of the route in the low lying area between chainage 20800 and 23500, which also has many narrow sections of insufficient width.

The adverse effects of this problem include:

- High risk of head-on collision or alternatively leaving the pavement.
- High risk of rear end collision with vehicles reversing along road.
- Increased travel time due to slowing for oncoming traffic.
- Increased vehicle operating costs due to the existing alignment and the stop/start nature of driving when oncoming traffic is encountered on narrow sections.
- Lack of capacity.
- Use of the road is largely limited to motor cars.
- Increased risk to and from pedestrians, cyclists and horse riders.

3.2 Tortuous Alignment

The existing horizontal alignment features many tight corners with some radii as little as 10m with little or no forward visibility.

This occurs mainly along the hill section of the route between chainage 1800 and 10300.

The adverse effects of this problem include:

- Poor forward visibility.
- High risk of loss of control accidents.
- Increased travel time due to low operating speed.
- Increased vehicle operating costs due to braking and acceleration related to tight bends.
- Lack of capacity.
- Poor safety.

3.3 Road Stability

The route is often closed by adverse weather with a number of slips which are generally relatively minor in extent though make the road impassable. There have also been a number of washouts that have taken considerably more time to repair.

The adverse affects of this problem include:

- Loss of access.
- Loss of confidence in the route.
- Maintenance costs.

3.4 Weather

The higher elevations of the route are shrouded in mist when there are low clouds, particularly resulting from the prevailing northwest winds. This reduces visibility and exacerbates the road geometry problems.

3.5 No State Highway Alternative

Between Levin and Wellington, a distance of 100km, there is only one other route, SH58, between the SH2 (eastern corridor) and SH1 (western corridor). While there are alternative route options at either end (Paekakariki Hill Road, Grays Road, Moonshine Hill Road) there are no options for the central section of SH58. The nearest alternative links between SH1 and SH2 are via Pahiatua Track or Manawatu Gorge in the north and SH1 at Ngauranga Gorge.

South of Waikanae there is a number of sections of SH1 for which there is no alternative route. These include between Te Moana Road (Waikanae) and Otaihanga Road, and Waterfall Road (Raumati) and Paekakariki Hill Road. The Akatarawa route could provide an alternative for vehicles travelling to or from SH2 and the Hutt Valley.

While the Akatarawa route is significantly shorter than the other routes between Upper Hutt and Waikanae, because of the varying and limited road width, tortuous alignment and slow speed environment of the road, the route is not a viable alternative route for SH1 or SH2 in the case of an emergency closure of either State Highway.

The adverse effects of this include:

- Longer diversionary route.
- No route security.
- Increased vehicle operating costs.
- Increased delays.
- Increased congestion.
- Driving frustration.

4.0 SITE DESCRIPTION

4.1 Extent of Study Area

The study area extends from the intersection of SH1 with Elizabeth Street in Waikanae to the intersection of SH2 and Akatarawa Road in Upper Hutt. The distance between SH1 and SH2 is 35km of which 21km is within Upper Hutt City. The remaining 14km is in the Kapiti Coast District. The road runs approximately north-south, from Upper Hutt in the south to Waikanae in the north (see Appendix 1).

The study does not include the intersections with the State Highways at either end as both are being assessed in separate studies as detailed below. The forecast traffic volumes will have a significant impact on both State Highway intersections, which is discussed further in Section 7.

The SH1/Elizabeth Street intersection is being considered for alteration and possible relocation as part of Greater Wellington Regional Council's proposal for a new railway station and park 'n' ride facility at Waikanae. Electrification of the North Island Main Trunk for commuter trains will have a significant impact on this route with restricted clearance height under the catenary and frequent level crossing closures.

KCDC's long-term vision for Waikanae Town Centre is also expected to have an impact on this intersection. Transit New Zealand (TNZ) has also commissioned a strategy study for SH1 through Kapiti Coast District and it is expected that this will also consider the Elizabeth Street intersection in Waikanae.

The SH2/Akatarawa Road intersection forms part of TNZ's study to improve the State Highway between Featherston and Upper Hutt and therefore has not been included in this study. The study recommends that no work be done on this intersection.

Should improvements to Akatarawa Road proceed the predicted increase in traffic flows will warrant investigation into the improvements required to both the SH1 and SH2 intersections at either end of the study route.

The extent of works proposed along the route is from a 175m south of Rangiora Road, Kapiti Coast (approximately 5.3km from SH1), to approximately 700m north of Gillespies Road, Upper Hutt (approximately 2.7 km from SH2). Refer to Appendix 2 for the scheme location.

There are a number of sections of the route where no works have been proposed, these sections are either within the design standards or constrained by either geotechnical issues, properties or by bridges. These include the urban areas at both ends and the historic intersection with Reikorangi and Ngatiawa Roads. The upgrade of the bridges along the route is not part of this assessment.

4.2 Side Roads Affected

A number of rural side roads will be affected by the proposed works. In the Kapiti Coast District area, the side roads affected are Ratadale Private Road, and Waiotauru Road. Karapoti Road and Crest Road are affected in Upper Hutt City. The designs have reshaped the intersections where necessary to maintain access. No other improvement works have been proposed for these intersections.

4.3 Utilities and Facilities

The only significant utility is a Telecom underground fibre optic cable from Upper Hutt as far as Staglands Reserve.

Other utilities include a few roadside power poles located approximately 16km from Upper Hutt and one near Waikanae are affected by the proposed works.

4.4 Topography

From SH1 the road passes through Waikanae urban areas before taking a flat course paralleling the Waikanae River at 3.4 km. The road becomes very windy as it climbs steeply along the side Waikanae River catchment to the saddle at 530m.

Over the summit the road descends through the Akatarawa Valley flattening out approximately 18km from Upper Hutt.

4.5 Speed Limit

From the Upper Hutt end the speed limit is 50km/h through the urban area increasing to 70km/h after 2.7km. At approximately 18.6km from Upper Hutt the speed limit is reduced to 50km/h for 10km over the summit. The speed limit increases to 100km/h for the remainder of the route to Waikanae reducing to 70km/h then 50km/h through the urban area.

Within the Upper Hutt City area there are three bridges subject to restrictions. A temporary speed limit of 10km/hr has been imposed on Bridge B1/5 along with a weight restriction. Bridges B1/4 and B1/6 both have 30km/hr speed restrictions.

4.6 Road Conditions

From Upper Hutt the road has a well maintained smooth road surface which is clearly defined by edge lines, edge marker posts, sight rails and raised reflective pavement markers. There is no centre line for approximately 26km of the route. Between the boundary of Upper Hutt City and the summit the road delineation deteriorates as does the road surface. From the summit to Waikanae the road is has a well maintained smooth road surface which is clearly defined with edge lines and temporary sight rails.

Apart from two major slips approximately 7 and 8km from Waikanae the roadside banks appear stable. Most slip sites appear to have been minor slips with small volume though sufficient to block a single lane road. The number of retaining structures in the Upper Hutt section would suggest that over time there have been numerous washouts with most structures below road level.

Many of the corners have been widened particularly on the Kapiti Coast section though the road narrows between the corners.

Barrier gates to close the road have been installed at the summit and approximately 18.5km from Upper Hutt.

4.7 Traffic Volumes

The two-way Annual Average Daily Traffic (AADT) along this route is around 200 vehicles per day across the summit. The percentage of HCV's is estimated at 2%.

4.8 Bridges and Culverts

There are six bridges/large diameter culverts within the extent of work proposed in the Upper Hutt section. Three of the bridges are single lane timber truss bridges dating from 1920s and are due for replacement. The proposed works do not include upgrading of any bridges which will be upgraded separately as part of the Council's asset renewal programme as set out in its Asset Management Plan. The replacement bridges will be two lane bridges.

There are no bridges on the section of road in the Kapiti Coast district. There are two bridges before the start of the length to be upgraded crossing the Waikanae River and the Rangiora Stream. The Rangiora Stream bridge is narrow and has poor alignment and sight distance which are restricted by bends in the road and vegetation on private property. KCDC have no plans to improve this bridge.

There are 169 culverts within the extent of work proposed. Culverts will be extended/replaced as necessary. No assessment has been made of the adequacy of these culverts.

4.9 Retaining Structures

There are 49 retaining structures in the Upper Hutt section of the road which are mainly railway and timber or tied back driven rails installed below road level. The average expected residual life is 38 years compared to an expected life of 52 years. A large number of the retaining walls have been replaced over the last four years with some very small structures still to be replaced over the next two years. The next significant expenditure will not be required until 2029/30.

KCDC advise that they have no records of retaining walls on their section of the road within the Kapiti Coast.

4.10 Maintenance

Particular maintenance issues include extensive vegetation control given the proximity of roadside banks and bush over a significant length of the route and the clearing of slips and /or repair of slips and washouts after heavy rain. There is no other out of the ordinary maintenance issues.

4.11 Climate

The Akatarawa Valley experiences high rainfall (approximately 3m per year). The area is also sheltered from the strong winds by the surrounding hills which are about 600m high.

The upper reaches of the Waikanae River Valley also has higher rainfall, where the Tararua Ranges forms a barrier to the prevailing northwest winds which can have high humidity levels.

This, coupled with the steep terrain and high road cuts (2-10m) with hillside slopes of 30^{o} to 70^{o} above the cuts, has led to instability in severe weather conditions.

4.12 Surrounding Land Use and Zonings

The adjoining land use along the proposed scheme is primarily dense bush with occasional farm buildings/houses. Towards both ends of the proposed upgrade the density of houses increases. There are also a number of pockets of houses particularly in the Upper Hutt area.

There are a number of businesses, particularly tourism related, mainly in Upper Hutt including a café, blueberry farms, book binding, farming, conference centre, equestrian, sawmilling, gardens, chicken farm, strawberries, logging, fish farm, art studio, and Staglands Wildlife Reserve.

Staglands Wildlife Reserve is situated in the Akatarawa Valley, 16km from the SH2 junction. Staglands is a nature reserve which as well as being open to the general public is involved in several aspects of conservation including threatened native species and rare breeds of animals.

The surrounding land zonings within Upper Hutt City are primarily a combination of “Rural Hill”, “Rural Valley Floor”, and “Rural Lifestyle”, with a small amount being designated “Open Space” where the road comes close to the Akatarawa River. In the Kapiti Coast the adjoining land zoning is primarily “Rural” with some “Conservation”. The conservation area is Tararua Forest

Park which bounds the road to the east as shown in Appendix 1 - Location Plan. There is also a small area of the park to the west of the road which bounds the road to the west for approximately 150m.

The route passes through a section of the Akatarawa Forest (see Appendix 1 - Location Plan) which covers 15,000ha of wilderness area between Upper Hutt and Kapiti Coast. The forest is a blend of native and exotic forest, and is a very popular location for many outdoor pursuits.

The Akatarawa Forest has been identified as a future water collection area for the Wellington Region by Greater Wellington Regional Council (GWRC). The area is managed in accordance with the Regional Forest Lands Plan - Future Water Collection Areas published by GWRC.

While not having any specific designation, the Waikanae River Valley is a water catchment area for the principle water supply for Paraparaumu and Waikanae (2006 population 35,493) being taken from the Waikanae River. KCDC has bores which are used during droughts, however for most of the time the river is the sole source of supply.

The Akatarawa River and Waikanae River are both recognised trout fisheries.

4.13 Sites of Cultural/Archaeological Significance

There are two recorded cultural sites listed in the UHCC District Plan near the Upper Hutt end of the road; “Tea Bureau Rotunda” and “Akatarawa Cemetery”. Neither of these sites will be affected as the proposed works do not extend far enough towards Upper Hutt. The KCDC District Plan does not list any recorded cultural sites near the road in the Kapiti Coast.

There are no recorded sites of archaeological interest along the route, listed in either the UHCC or KCDC District Plans.

5.0 DETAILS AND ASSESSMENT OF COLLECTED DATA

5.1 Topographical Survey

Route options were originally developed using 20m contour data but during the design and subsequent cost estimates, it became clear that due to the steep nature of the topography this data was not sufficiently detailed or accurate enough to allow for a realistic design and cost estimate to be produced.

It was therefore decided to commission a LiDAR survey along the path of the route through the hill section, with a specified accuracy of ±0.25m horizontally and a level accuracy of ±0.10m in clear areas, and ±0.10 to 1.0m in areas of dense bush. The options were then re-designed using the more accurate LiDAR survey data.

5.2 Traffic Modelling

The GWRC's Wellington Transport Strategy Model (WTSM) has been used to assess the travel time and distance benefits of upgrading Akatarawa Road. A copy of the report, Akatarawa Road Upgrade Travel Time Benefits (February 2008), is included as Appendix 3.

Two options were tested; Option 1 (Online widening) assumed travel time on an upgraded route would be 11 minutes quicker than current, Option 2 (Offline widening) assumed 19 minutes quicker travel time and 2km shorter distance. Option 2 was subsequently re-estimated to give a 20 minute travel time saving. Committed future projects elsewhere in the network were included, eg rail improvements, Dowse to Petone, Western Link Road.

Both options provide benefits to the network, by reducing the travel time between SH1 and SH2 in the northern part of the network as well as resulting in minor traffic relief further south. Most of the benefits for both options are generated by travel time savings, but Option 2 also sees significant distance related benefits. HCV's also benefit from both options as the existing road for them is currently too tortuous for regular use.

The improvements resulted in slight road travel increases in the area, with some travel being attracted to the upgraded route away from SH1 and SH58, thereby freeing up those routes which in turn shifts some rail users back to car use.

Table 5.1 summarises the projected Annual Average Daily Traffic (AADT) for each of the options considered.

AADT	2006	2016	2026
Do Minimum	667	680	902
Online Widening	NA	1851	2220
Offline Realignment	NA	3464	3935

Table 5.1 - Summary of modelled AADT figures

Traffic count data indicates that the model over-estimates traffic over the summit by about 467 vehicles so the benefits calculated in the economic assessment include an adjustment to allow for this.

The Wellington Transport Strategy Model is a regional strategic model. As such, it is used to examine regional transport patterns and patterns within a transport corridor. Due to its regional strategic nature, it is impossible for the model to get flows on individual roads exactly right. The

model is calibrated so that flows across screenlines in the network are roughly right, but this means flows on individual roads may not be.

The Akatarawa Road is also on the extremity of the model's geographical coverage, with the level of detail in the model getting lower in areas of lower population and employment density. Also, the flows across the road are small at a regional level.

There are a number of factors that are not included in the strategic modelling, e.g. gradient, the perceived personal disbenefit of having single lane in some areas, and an accurate representation of travel times, that is there is probably a large variation in how fast people drive the route. So there may be some aspects of that in the over-estimation of demand in the base model and therefore an argument for not correcting for the over-estimate in traffic volume. A compromise may be to use a 50% correction, however there is no basis for doing that.

Given the limitations of the strategic modelling for Akatarawa Road it was decided that the analysis should be based on the corrected traffic flows derived from existing traffic flow measurements.

The model's main purpose is to give indicative numbers and impacts at a strategic level. More detailed analysis should be undertaken on a project-specific model which has been built specifically for the purpose of evaluating Akatarawa Road. It is expected that a detailed assessment of the traffic volumes on Akatarawa Road would be done in conjunction with the corridor or State Highway plans.

The online widening (Option 1), compared to the do minimum, increases car use on the road by approximately 120% in 2016 to 1499 and approximately 170% in 2026 to 1833. The online widening also enables HCV's to use the upgraded road with 352 in 2016 and 387 in 2026.

The offline realignment (Option 2), compared to the do minimum, increases car use on the road by approximately 300% in 2016 to 2,695 and approximately 360% in 2026 to 3,124. The offline widening also attracts approximately double the amount of HCV's in comparison to the online widening option with 769 in 2016 and 811 in 2026.

Model results showed the overall net present value (NPV) of travel time and distance benefits assuming opening in 2013 of $8.1 million for Option 1, and $16.6 million for Option 2, after adjusting for an over-estimation of 2006 model demand on the existing road.

Benefits for Option 2 are twice that of Option 1. Additional traffic benefits may result from route security, accident savings, reliability and environmental improvements, but need to be assessed separately. These are assessed separately and are not produced by the WTSM.

Benefits are seen for all Territorial Authorities either through direct use of the road (in the case of Kapiti, Upper Hutt and Wairarapa) or indirectly through reductions in congestion in other parts of the network.

5.3 Consultation/Liaison

Duffill Watts consulted on the proposed upgrade of the Akatarawa Road with the authorities and organisations listed in Table 5.2. Property owners, businesses, iwi and environmental groups have not been consulted at this preliminary stage.

If the project is identified as being feasible and is taken further, it is UHCC's intention that further consultation will be undertaken with the general public, iwi and other interested or affected parties as part of the Long Term Council Community Plan consultation.

Local and Regional Councils	Government Authorities	Other Organisations
Kapiti Coast District Council	Land Transport New Zealand	Automobile Association of NZ
Horowhenua District Council (HDC)	Transit New Zealand	St John's Ambulance
Palmerston North City Council	New Zealand Police	Rental Vehicle Association
Manawatu District Council	New Zealand Fire Service	Road Transport Forum Inc
Horizons Regional Council		Wellington Regional Road Transport Association
GWRC (transport, rivers, forests)		
Porirua City Council		
Hutt City Council (HCC)		
South Wairarapa District Council (SWDC)		
Masterton District Council (MDC)		
Carterton District Council (CDC)		

Table 5.2 - List of Organisations Consulted

Copies of responses are included in Appendix 4. Table 5.3 gives a summary of the responses received and how the proposed upgrade may affect them.

Organisation	Summary of Response	Conclusion
HCC	• Clear benefit to UHCC. • Provides some benefit to the region but little to HCC. • Supports the scheme and sees no reason to object.	• The upgrade will benefit UHCC, HCC and the whole region by providing an alternative route, improved access for existing and future businesses
Manawatu District Council	• No great interest in the route. • Useful as a bypass/alternative result in an emergency.	• Agreed the upgrade would provide an alternative route.
GWRC	• No view on specific design standards of the route. • Demonstration of the economic benefits needed to promote the scheme. • Akatarawa Road upgrade identified as a long term roading project (2016).	• An economic assessment has been undertaken as part of this study. • 2016 is still a viable date for start of construction.

Organisation	Summary of Response	Conclusion
TNZ	• Confirming that Transit adopts a 7m seal width on State Highways which carries 500 to 1,000 vehicles per day.	• The upgraded route would be 6m wide plus 0.6m shoulders and has a predicted increase in AADT of either 1,851 or 3,464 vehicles (in 2016) depending on the option chosen. Therefore the route is of benefit to the State Highway network.
LTNZ	• Do not expect Detailed Design in this study. • BCR of 3.0 is likely to be needed if proposal is of regional significance. • It would be worth carrying out a rough BCR calculation.	• Proposed route now designed digitally making a detailed design easier and quicker to complete. • An economic assessment has been undertaken as part of this study.
Wellington Regional Road Transport Association	• Fully agree and in favour of the proposals. • Practical alternative route in and out of Upper Hutt should be given high priority. • Local businesses will benefit greatly. • Alternative route in times of emergencies on SH1 and SH58.	• Proposed upgrade would provide a viable alternative route. • Businesses and residents will benefit.
HDC	• Supports any project that improves travel time and transport connectivity with Greater Wellington. • Supports proposal from Lifeline's perspective as it diversifies transport linkages.	• Upgrade will improve connectivity and provide alternative route.
SWDC	• Noted they would respond once the Council has had an opportunity to discuss the maths.	
MDC	• Submission to RCTS was to ensure strong linkages to south (Wellington) and north (Manawatu and Hawkes Bay). • Unable to provide comment on the potential significance of Akatarawa Road without expert assessment from transport planner and access to the analysis in the report.	

Table 5.3 - Summary of Responses

Further consultation is recommended with a broader range of people, iwi and interest groups if the project proceeds to the next stage. Should the upgrade proceed it will be necessary to complete a more detailed assessment on the options, and in particular:

- A visual/landscape study.
- A noise assessment study.
- An amenity study to assess impacts.
- Safety assessment.
- Sustainability assessment.

This work needs to be done before the detailed design stage.

5.4 Geotechnical Testing and Assessment

A preliminary desktop study was carried out by Samcon Ltd, Geotechnical Engineers, based on the preliminary alignments which used the 20m contour data. The desktop study is included in Appendix 5. The main area of concern related to where fill would be placed over existing fill slopes. Because the material in the area is highly fractured, the proposed fill slope (2V:1H) could be unstable. It was recommended that a slope of 1V:1.5H would be more suitable.

A geotechnical walkover survey was conducted by Samcon Ltd and Duffill Watts. The walkover followed the route of the preliminary alignment and identified where the route should be altered to avoid steep valleys and areas of particular poor geology.

The findings of the investigations highlighted the fact that a more detailed survey was required to be able to produce a viable alignment and cost estimate.

After further discussions with Samcon Ltd, it was decided that once a LiDAR survey has been completed the following slope parameters would be acceptable as long as certain areas were avoided:

- Cut and Fill Slope - 2V:1H.
- Where cut or fill slopes are over 10m high, a 3m wide bench is to be used.
- Toe walls used where fill/slope interfaces are particularly steep.
- Vertical earth reinforced retaining can be used in locations where the standard slope is not realistic due to the steepness of the terrain or where there's a need to avoid rivers.

Due to the poor ground conditions and steep terrain of the Akatarawa Valley it is recommended that a full geotechnical assessment of the proposed routes be carried out. This assessment should be done prior to detailed design stage to reduce the need for design changes, large cost increases and reduce the risk. This assessment will look at the risks associated with natural slope failure in weather or seismic events as well as the design of new shapes and fills.

6.0 UPGRADE OPTIONS

Three options were considered for comparison. These were Do Minimum, Online Widening and Offline Realignment. The minimum standards for the upgrade were specified in the brief for the study as:

Number of lanes:	2 (except for bridges).
Lane width:	3m.
Shoulder width:	0.5m on flat and rolling sections. Concrete dish channel on hill sections where possible.
Horizontal curves:	Design speed - 60-70km/hr for flat and rolling sections. - 50km/hr for hill sections.
Grades/vertical curves:	Identify where improvements can be made or where it is a constraint on road use, noting the route is used by tour buses and has potential for a freight bypass.
Pavement:	25 year design life.
Other standards:	Comply with relevant UHCC and KCDC standards for rural roads, structures, accesses and works associated with the upgrade.

Plans showing the proposals are included in Appendix 2. The drawings have incorporated appropriate designs for intersections, existing bridges, property access, culvert extensions and utility assets affected by the upgrades.

The drawings and costings include upgrading intersections and property access as required. Where the road moves away from the existing alignment, recommendations are made on replacement access.

The cost of extending culverts to match the new road formation has been included and the requirements shown on the drawings. No assessment has been made of the adequacy of the culverts and the capacity has not been upgraded.

It has been assumed the upgrade will be staged to balance cut and fill quantities to minimise the amount of surplus fill requiring disposal. No attempt has been made to optimise the earthworks balance with the costs for each section calculated as a stand-alone construction.

6.1 Do Minimum

The Do Minimum for this scheme is taken as maintaining the existing road without any improvements. The majority of the alignment through the hill section does not meet the minimum design standards and the carriageway width in places is insufficient for two cars travelling in opposite directions to safely pass each other. The road geometry also poses a risk to other users such as cyclists and pedestrians because of poor sight distances and lack of shoulder in addition to the narrow carriageway.

Maintenance has been assumed to involve resealing the existing carriageway every 10-12 years, vegetation control, roadmarking and maintenance of drains, sight rails, bridges and any repair work due to slips and washouts.

6.2 Online Widening Option

6.2.1 Geometric Standards

The Online Widening design follows the existing alignment horizontally and vertically, and therefore does not conform fully to the design standards. The proposed upgrade is shown in drawings 161297 P01 to P06 in Appendix 2.

The carriageway has been widened to provide a minimum 6m carriageway with 0.5m shoulders on both sides. Curve widening has been applied where necessary to allow for a car and a semi-trailer, travelling in opposite directions, to pass each other safely.

Widening of the route would allow for two-way traffic flows along the entire route. This would also allow for a higher speed than currently exists, with speeds up to 50km/h on the hill sections where at present only 20-30km/h is possible. This is expected to reduce the journey time for the whole route by 11 minutes. The current journey time is approximately 50-55 minutes.

6.2.2 Effect of the Alignment

6.2.2.1 Earthworks

Due to the steep topography the majority of the widening has been applied on the hillside creating cut slopes, with some slopes reaching 40m in height. The cut volume is approximately 232,000m^3.

There are also many areas along the route where fill is required with a total volume of 157,000m^3. Although this volume is quite high it is spread along the route with few major fill embankments.

Excavation volume exceeds the fill volumes therefore 75,000m^3 of fill will need to be removed to fill sites elsewhere. These sites have not been identified.

6.2.2.2 Retaining Walls

The alignment has been designed in such a way to avoid the need for retaining walls although there may be a need for retaining structures at the toe of some fill embankments. For the purpose of this study, mass stabilised earth retaining walls have been proposed.

6.2.2.3 Construction Issues

Widening of an existing road tends to make construction difficult as the road needs to be kept open during construction. With the location of the Akatarawa Road being very remote with steep topography on both sides, it will make its construction even more difficult. This will be exacerbated by the need to operate at several work sites to minimise the quantity of material going to waste.

While the existing pavement will largely be unaltered, road closures will be necessary to undertake the online improvement. The large cuts required above the road and narrow road width will require extensive road closures probably pre-programmed over fixed periods of the day.

Another area of concern is in the stability of the existing road. There are likely to be areas where the entire width of the road would need reconstructing, not just the newly widened areas.

A detailed construction methodology and programme of works will have to be prepared by the Contractor.

6.2.3 Cost of the Alignment

The estimated cost of the Online Widening option is $41,288,000 (including 15% investigation, design, documentation and supervision, 35% contingencies). This figure allows for:

- Preliminary and general.
- Site clearance.
- Earthworks (cut, fill, disposal to waste).
- Drainage.
- Retaining walls.
- Road pavements.
- Road signs and roadmarking.
- Landscaping.
- Land acquisition.
- Traffic management and temporary works.

6.2.4 Land Acquisition

The Online Widening option requires acquisition of an additional 122.1ha of land adjoining the road reserve. No estimate has been made of the amount of land that may be released as it is unlikely to be significant given the nature of the works widening an existing road.

6.2.5 Utilities

No assessment has been made of how the online widening option will affect the Telecom fibre optic cable on the Upper Hutt side. It is expected to have a minimal impact, with the cable ending up under the carriageway in parts.

6.2.6 Construction Periods and Staging

The Online scheme can be divided into a number of sections to allow a phased implementation to match available budgets, each of which can be constructed independently of each other if necessary. The improvements have been split into 19 sections which have been determined by where the road alignment matches or returns to the existing road alignment. Table 6.1 shows the approximate length, and extent of each section of the online widening and the cost. The boundary between Kapiti Coast and Upper Hutt is very near the southern end of Section 9. Refer also to drawing numbers 161297-50 P01 to P06.

A construction schedule has not been prepared. The road can be upgraded as a single project, as a number of separate large projects with balanced fill/cut volumes or as a series of discrete projects over an extended period as funding allows. For the large scale projects a detailed assessment in conjunction with a contractor is required once potential dump sites have been identified. Given existing access difficulties it is likely the preferred option would be to commence work at either end of the road to utilise the widened road for construction traffic. This would also provide an immediate improvement to local traffic serving the businesses and properties located nearer the ends of the road.

	Section	Proposed Length (km)	Existing Chainage (Approx)	Cost (excl GST)
Kapiti Coast	1	0.8	900 to 1700	$ 811,000
	2	0.7	1700 to 2400	$ 936,000
	3	0.7	2400 to 3100	$1,041,000
	4	1.0	3100 to 4100	$1,633,000
	5	1.0	4100 to 5100	$1,689,000
	6	1.0	5100 to 6100	$1,512,000
	7	1.0	6100 to 7100	$2,477,000
	8	1.1	7100 to 8200	$2,787,000
	9	0.9	8200 to 9100	$1,644,000
			Subtotal	$14,530,000
Upper Hutt	10	1.2	9100 to 10300	$3,966,000
	11	1.2	10300 to 11500	$2,041,000
	12	1.8	11500 to 13300	$2,363,000
	13	1.2	13300 to 14500	$1,986,000
	14	5.0	14500 to 19500	$6,415,000
	15	1.9	19500 to 21400	$2,583,000
	16	2.0	21400 to 23400	$3,303,000
	17	1.5	23400 to 24900	$1,529,000
	18	0.3	24900 to 25200	$ 303,000
	19	2.2	25200 to 27400	$2,269,000
			Subtotal	$26,758,000
			TOTAL	**$41,288,000**

Table 6.1 - Online Widening Section Lengths

6.3 Offline Realignment Option

6.3.1 Geometric Standards

The Offline Realignment design has been designed to meet the standards, specified in Austroads “Rural Road Design” manual, for design speeds of 50km/h, 60km/h or 70km/h. The design speed for each section is based on the terrain and is generally 50km/h across hill terrain, 60km/h across undulating terrain and 70km/h in reasonably flat areas.

The minimum carriageway width provided is a 6m carriageway with 0.5m shoulders on both sides. Curve and stopping sight distance widening has been applied throughout the route to Austroads standards allowing for a safe two-way flow of vehicles along the entire route.

6.3.2 Effect of Alignment

6.3.2.1 Earthworks

Due to the offline nature of the alignment there is a need for both large cut and fill embankments, with both fill and cut embankments reaching 40m in height in many areas. The volume of excavation exceeds the volume of fill by in excess of 200,000m³. Further detailed assessment at the design stage may result in a reduced volume of excavations.

- Cut Volume - 448,300m^3
- Fill Volume - 245,500m^3

6.3.2.2 Retaining Walls

Unlike the Online Widening option, it has not been possible to avoid the use of retaining walls. The majority of the retaining walls are in fill locations where the construction of a fill embankment would either be too large, or where the topography is too steep to enable a suitable footing to be attained.

6.3.2.3 Construction Issues

The Offline design suggests that it is completely away from the existing road, but it actually follows the existing road for the majority of the Akatarawa Road, removing sub-standard bends and improving the gradients along the road.

It is expected that it will be necessary to keep the road open during construction, possibly with pre-programmed closure periods. At present the community manages during periods when the road is closed by slips in the hill section. Whether or not it will be possible to close the hill sections for extended periods needs further assessment.

It is expected to be more difficult to keep the offline option open with different road elevations and the need for tie-ins to the existing road. This may lead to the conclusion that the road should be upgraded in one go.

If the road is upgraded in stages from either end so that construction traffic can use the road safely it is likely that traffic volumes will increase progressively as the length of substandard road reduces, resulting in greater inconvenience from any closure.

A detailed construction methodology and programme of works will need to be produced and traffic management will need to be robust.

6.3.3 Cost of the Alignment

The total cost of the offline realignment option is $55,572,000 (including contingencies, design, investigation and supervision).

6.3.4 Land Acquisition

The Offline Widening option requires acquisition of an additional 175.8ha of land adjoining the road reserve. No estimate has been made of the amount of land that may be released. This is likely to be more than the Online Widening as sections of the existing road will no longer be required.

6.3.5 Utilities

No assessment has been made of how the offline realignment option will affect the Telecom fibre optic cable on the Upper Hutt side. It is expected to have a minor impact, with the need to relocate the ducting to the new road reserve in the sections it is realigned.

6.3.6 Construction Periods and Staging

The scheme is divided into 19 sections, each of which can be constructed independently of each other if necessary. The boundary between Kapiti Coast and Upper Hutt falls very near the southern end of Section 4. For the purposes of this report the cost of this section has been assigned to Kapiti Coast rather than splitting the costs between the councils. Table 6.2 shows the approximate length, and extent for each section of the offline realignment. Refer also to drawing numbers 161297-50 P07 to P12 in Appendix 2.

As with the online option, a construction schedule has not been prepared as there are a number of ways the road can be upgraded depending on funding.

Should it be decided to stage the works, the estimated time for undertaking each section from concept to completion ranges from 18 months to 39 months which will be extended by funding and approval processes. If this approach is adopted and depending on how the road is upgraded, a number of sections will be upgraded concurrently to minimise the amount of waste disposed of to dump.

	Section	Proposed Length (km)	Existing Chainage (Approx)	Cost (excl GST)
Kapiti Coast	1	0.7	970 to 1680	$895,000
	2	2.3	1680 to 4640	$5,954,000
	3	2.6	4640 to 7620	$9,129,000
	4	1.3	7620 to 9020	$3,360,000
			Subtotal	$19,338,000.00
Upper Hutt	5	0.7	9020 to 9840	$2,136,000
	6	0.1	9840 to 9890	$174,000
	7	1.8	9890 to 11770	$6,906,000
	8	0.7	11770 to 12450	$968,000
	9	0.6	12940 to 13600	$1,145,000
	10	1.1	13600 to 14700	$2,555,000
	11	1.1	14700 to 15850	$2,094,000
	12	0.6	15850 to 16510	$987,000
	13	0.4	16620 to 17020	$289,000
	14	0.4	17490 to 18030	$1,018,000
	15	1.1	19200 to 20400	$4,511,000
	16	0.8	20400 to 21290	$2,546,000
	17	1.5	21290 to 22900	$4,677,000
	18	1.8	23180 to 24960	$2,551,000
	19	2.1	24960 to 27130	$3,677,000
			Subtotal	$36,234,000
			TOTAL	**$55,572,000**

Table 6.2 - Offline Realignment Section Lengths

7.0 ASSESSMENT OF OPTIONS

7.1 Environmental Effects

This section of the report is based on the preliminary environmental assessment on the proposed upgrade prepared by Enviro Solutions New Zealand Ltd in May 2003. The assessment which was largely a desktop assessment was based on site visits, interviews with residents and businesses, and existing information. The assessment only considered the Upper Hutt section of the road.

The environmental assessment noted that there was a divided opinion in the community as to the potential social and environmental impacts of an upgrade.

The potential impacts of upgrading Akatarawa Road applying to both options include:

- Construction effects:
  - Increased heavy traffic.
  - Traffic delays/road closures.
  - Silt runoff affecting watercourses and rivers.
  - Noise and vibrations.
  - Community disruption.
- Medium term effects:
  - Visual impact of construction scars.
  - Increased silt runoff from new cuttings and fill slopes.
  - Loss of and damage to vegetation with may also impact on birdlife.
  - Visual impact of new road.
- Long term effects:
  - Effects on amenity and quality of life arising from increased traffic and a change in traffic mix.
  - Increased noise.
  - Increased risk of contamination from increased use by freight vehicles.
  - Negative visual impact of the road in relation to landscape values for the area.
  - Subdivision/development pressure arising from improved access.
  - Safety concerns from high speeds, more vehicles and heavy vehicles.
  - Increased stormwater runoff arising from larger pavement surface, and concentration through stormwater management.
  - Impacts on the surrounding recreation areas of the region.

Both the Online Widening and Offline Realignment options encroach into the Akatarawa Forest which straddles the road but the Offline option would have a greater encroachment. As expected, the Online option merely increases the width of the existing road and would have little effect on the forest.

The Offline option will sever sections of forest. However, provided the old section of road is removed and returned to forest there should be no lasting impact. The road reserve no longer used would need to be stopped and the land returned to Greater Wellington Regional Council.

7.2 Construction and Constraints

7.2.1 Accessibility

The limited road width will pose a substantial constraint on construction, particularly if the road is to remain passable at all times. Ensuring the stability of newly cut banks will be a key factor. Both options require extreme earthworks, with the Offline realignment only having a limited section of the route separated from the existing road. This is further complicated by the need to operate at several sites simultaneously to balance cut and fill volumes as far as practicable.

7.3 Bridges

The upgraded roads have been designed to link into the existing bridge geometry, giving a number of the bridges wider approaches. While this will improve holding bays at one lane bridges, higher operating speeds are likely to increase the risks until the bridges are upgraded.

Upgrading the route will increase HCV traffic increasing the load on the bridges, three of which are single lane timber truss bridges dating from the 1920's. These bridges are currently undergoing substantial maintenance work to extend their life until they are replaced. In the 2006 LTCCP UHCC proposes to replace these bridges and another one between 2012 and 2020 and has budgeted $800,000 for each bridge. The timing may change when the LTCCP is reviewed in 2009. The replacement bridges will be two lanes.

The other three bridges in the Upper Hutt area will be replaced in 2031, 2037 and 2071. Of these the one at 6.7km from SH2 is a single lane bridge which is not scheduled for replacement until 2037. Consideration would need to be given to bringing this forward. The other bridges/large diameter culvert are two lane structures.

There are no bridges within the Kapiti Coast area affected by the proposed works though the Rangiora Stream Bridge just beyond the works has poor sight distances, alignment and width. No works are planned by KCDC to upgrade this bridge.

7.4 Dump sites

No fill dump has been identified on the route and the costings for surplus material have been based on transporting the fill off-site. Given the quantity of surplus fill it will be necessary to identify sites on the route to dispose it.

7.5 Maintenance

It is expected maintenance costs for both upgrade options will initially increase as newly cut slopes settle down. However after the initial period it is expected there will be a reduction in maintenance costs with the offline realignment having a greater reduction through the use of engineered slopes and fills, and better management of stormwater.

Road pavement maintenance will increase through having a significantly greater paved area and an increase in traffic volume and in particular HCV's using the road. This increase in traffic will however be offset by reductions in traffic elsewhere.

7.6 Land Transport Management Act

Both upgrading options will contribute to the objectives of the Land Transport Management Amendment Act as follows.

(a) **Assisting economic development** through increased patronage to businesses along the route and lower transport costs associated with those businesses. Easier access between Waikanae and Upper Hutt will provide increased market opportunities for businesses located in those areas. Other opportunities for tourist development could be

developed to utilise the increased passing traffic and easier access. The route also provides economic benefit through reduced vehicle operating costs, an alternative route avoiding the economic cost of closure to SH1, a reduction in congestion, and reduced travel times.

(b) **Assisting safety and personal security** by reducing the potential for loss of control and head-on accidents with improved road geometry (alignment, carriageway width), delineation and safety barriers, removing traffic from heavily congested routes where nose-tail accidents occur, and improving pedestrian/cyclist safety.

(c) **Improving access and mobility** by removing vehicles from congested routes, improving the availability of the route and providing an alternative route to existing routes.

(d) **Protecting and promoting public health** by increasing walking and cycling activity with the wider carriageway and shoulder, and reducing vehicle emissions.

(e) **Ensuring environmental sustainability** by removing vehicles from other congested routes reducing emissions, and reducing emissions by shortening and improving driving conditions on the route.

7.7 Preliminary Appraisal of the Options

The Online widening option would solve the problem of insufficient width on the existing road and would improve the level of service of the road. However, the issues with substandard alignment are not rectified. There is a large amount of curve widening required to provide sufficient width along the existing alignment. In some areas, consecutive curves could be replaced with straights while remaining within the footprint of the widened alignment. If the online widening option is to be brought forward to the next stage of design, minor offline realignments in some locations would achieve a better scheme.

The Offline Realignment option solves both the problem with insufficient width and substandard alignment, and provides a road that complies with design standards. Both the cost and the benefits are greater than that for the online widening option.

7.8 Summary of Pros and Cons

7.8.1 Do Minimum

Pros	Cons
• Low cost • Less environmental impact	• Poor quality alignment • Below design standards • Not a viable alternative route • Slow speed route - long travel times

7.8.2 Online Widening Option

Pros	Cons
• Full width carriageway • Two way movements throughout • Viable alternative route • Good travel time benefits	• High cost • Below design standards • High risk • Unusual alignment due to curve widening requirements

Pros	Cons
• Lower impact on Akatarawa Forest • Improved access • Low environmental impact long term	• Disruption to traffic/maintaining access during construction • Difficult construction • Medium environmental impact in the short to medium term • Maintenance issues • Low BCR funding unlikely

7.8.3 Offline Realignment Option

Pros	Cons
• Built to design standards • Viable alternative route • Excellent travel time benefits • Less disruption to existing road during construction • Possibility of adoption as a State Highway in the future • Construction more straightforward • Low risk • Higher BCR - funding as strategic link possible • Improved access • Low environmental impact in the longer term	• High cost • Greater impact on Akatarawa Forest • High environmental impact in the short to medium term

7.9 Risks (Financial and Physical)

The Risk register for the project is attached as Appendix 7. The key risks classed as very high risk have been identified as geotechnical issues, landscape and aesthetic issues, estimates, contract management and traffic management.

A number of these issues will be dealt with in the next stage of investigations with the geotechnical investigation being specific recommendation of this report.

A number of natural events, political, ecological and community aspects have been ranked as high risk indicating other areas requiring further work to reduce the project risk profile before commitment.

7.10 State Highway Intersections

The improvements to the route will increase traffic volumes by approximately 2,200 and 4,000 for options 1 and 2 respectively. This traffic will have an impact on the intersections with the State Highways in Upper Hutt and Waikanae and it is likely that they will need to be improved at some point in the future. At the Waikanae end where current AADT is approximately 7,000 the intersection will need to be reconfigured before Akatarawa Road is upgraded because of the electrification of North Island Main Trunk as far as Waikanae and the introduction of commuter

trains. A 15 minute schedule would mean this railway crossing is closed eight times per hour, or 25% of the time. It is beyond the scope of this study to investigate these issues.

At the Upper Hutt end the current AADT is approximately 5,000. The intersection is overly wide and approaches SH2 at an acute angle. Increasing traffic through this intersection may require it to be reconfigured with either traffic signals or a roundabout. However this would depend more on the traffic and development on SH2.

8.0 ECONOMIC EVALUATION

This section sets out the results of the economic evaluations, and the benefits and costs used in the calculations.

8.1 Results

The following sections detail the Benefit Cost Ratio, Incremental Benefit Cost Ratio and the First Year Rate of Return of the proposed improvements on Akatarawa Road. A discount rate of 10% per annum was used to calculate the net present values.

For the purpose of completing the economic evaluation it has been assumed that construction commences in 2010 and is completed in 2013.

8.1.1 Benefit Cost Ratio (BCR)

Table 8.1 shows the results obtained from the economic evaluation of the proposed options on Akatarawa Road. Option 1 involves the widening of the existing road to provide two lanes, while Option 2 involves the realignment of several sections of Akatarawa Road to improve the travel speeds and safety conditions on the road. These options are compared against the existing situation.

The BCR for Option 1 and Option 2 is 0.38 and 0.76 respectively. The benefits and costs included in calculating the BCR are explained in Sections 8.2 and 8.3. It should be noted that there are some intangible benefits which have not been included, such as a safer alternative route in the case of road closures on the SH2/SH58/Grays Road/SH1 route. The upgrade will also bring additional benefits to businesses on Akatarawa Road.

	Option 1	Option 2
	Online Widening	Offline Alignment
Benefits over 25 years		
Travel time Benefits (Car Time)	$5,886,464	$11,321,345
PT Time	$41,377	-$91,520
TT Benefits (HCV Time)	$2,867,445	$5,155,381
VOC Benefits (Car Distance)	$2,111,076	$5,891,538
VOC Benefits (HCV Distance)	$929,966	$2,102,410
VOC Roughness Benefits (Existing Traffic)	$1,077,325	$1,345,972
VOC Roughness Benefits (Diverted Traffic)	-$2,129,636	$498,347
CO^2 Emission Benefits	$152,052	$399,697
Accident Cost Savings (Existing Traffic)	$433,871	$1,447,404
Accident Cost Savings (Diverted Traffic)	$621,932	$3,095,162
Total Savings	$11,991,873	$31,165,736

	Option 1	Option 2
	Online Widening	Offline Alignment
Costs		
Project Costs	$31,316,274	$41,879,754
Maintenance Cost	-$77,640	-$124,620
Total Costs	$31,238,634	$41,755,134
BCR	0.38	0.75
FYRR	2.7%	5.7%
Incremental BCR		1.8

Table 8.1 - Results of Economic Evaluation for both Options 1 and 2.

8.1.2 Incremental Benefit Cost Ratio

The incremental benefit for Option 2 is 1.8 when compared against Option 1. This means the additional benefits are higher than the additional costs required to construct Option 2.

8.1.3 First Year Rate of Return (FYRR)

The FYRR for Option 1 is 2.7% while for Option 2 is 5.7%. This indicates that the project is viable from whenever it is determined construction should commence and is not time dependent.

8.1.4 Sensitivity Analysis

A simple sensitivity analysis was done by reducing/increasing the benefits and costs by 15% to analyse if the BCR is sensitive to change in the components. Sensitivity analyses on the traffic volumes and growth rate have not been done as they require the use of WTSM to output the travel times and distances associated with traffic volume change. However, to give an indication of how traffic volume affects the BCR, which is likely to be the most important variable, we have assumed a linear relationship between traffic volume and travel times and vehicle operating costs (Car and HCV Distance). For roughness and accident analysis, traffic volume have been changed to determine the effect. Tables 8.2 and 8.3 show the results of the sensitivity analysis. The values are after discounting at 10% per annum.

Option 1

Variable	Basic Assumptions	Base Case	Lower Bound		Upper Bound	
		Value	Value	BCR	Value	BCR
Maintenance Cost	-15% / +15%	-$77,640	-$65,994	0.38	-$89,286	0.38
Travel Times	-15% / +15%	$8,795,287	$7,475,994	0.34	$10,114,580	0.43
Speeds (VOC)	-15% (51km/h)/ +15% (69km/h)	$3,041,042	$3,042,035	0.38	$3,058,877	0.38

Variable	Basic Assumptions	Base Case	Lower Bound		Upper Bound	
		Value	Value	BCR	Value	BCR
Road Roughness on Existing Road	-15% (113 counts/km Akatarawa Rd, 68 counts/km Alternative route) / +15% (153 counts/km Akatarawa Rd, 92 counts/km Alternative route)	-$1,052,311	-$2,194,148	0.35	$1,248,321	0.46
Traffic Volumes	-15% / +15%	$11,991,873	$10,202,233	0.33	$13,778,977	0.44

Table 8.2 - Sensitivity Analysis results for Option 1.

Option 2

Variable	Basic Assumptions	Base Case	Lower Bound		Upper Bound	
		Value	Value	BCR	Value	BCR
Maintenance Cost	-15% / +15%	-$124,620	-$105,927	0.75	-$143,313	0.75
Travel Times	-15% / +15%	$16,385,206	$13,927,425	0.69	$18,842,987	0.81
Speeds (VOC)	-15% (51km/h)/ +15% (69km/h)	$7,993,948	$8,002,121	0.75	$8,034,268	0.75
Road Roughness on Existing Road	-15% (113 counts/km Akatarawa Rd, 68 counts/km Alternative route) / +15% (153 counts/km Akatarawa Rd, 92 counts/km Alternative route)	$1,844,319	$162,843	0.71	$6,075,579	0.85
Accident Traffic Volumes	-15% / +15%	$31,165,736	$26,570,977	0.63	$35,737,320	0.86

Table 8.3 - Sensitivity Analysis results for Option 2.

Based on the above results, changes in traffic volumes, road roughness and travel times would have the most significant effect on the BCR.

A rough analysis was conducted to find the effect of postponing the construction start date. The BCR and FYRR increase, with Option 2 having a BCR of 1.0 if the start date is delayed to 2021. However, it is likely the project costs will increase with time, and therefore would cancel out any additional benefits for delaying the project start date.

8.2 Benefits

The following section explains the various benefits included in the economic analysis. A section giving brief explanation of the traffic volume used in the economic calculations has also been included. It is assumed the benefits starts in 2013 after the completion of upgrade.

8.2.1 Traffic Volume

From the Greater Wellington Regional Council's report, the WTSM has estimated the traffic volumes on Akatarawa Road as follow:

	2006	2016			2026		
	Do Min	Do Min	Option1	Option2	Do Min	Option1	Option2
Car WB	337	349	763	1,373	448	912	1,567
Car EB	330	331	736	1,322	454	921	1,557
HCV WB	-	-	210	423	-	225	444
HCV EB	-	-	142	346	-	162	367
Total	667	680	1851	3464	902	2220	3935
Change from Do Min			1171 (172%)	2784 (409%)		1318 (146%)	3033 (336%)

Table 8.4 - AADT Volumes on Akatarawa Road.

These are based on the estimated travel time savings of 11 minutes for Option 1, and 19 minutes for Option 2. However, since the report was completed, the travel time savings for Option 2 has increased from 19 to 20 minutes. The travel time benefits in the section below have been prorated to obtain savings for 20 minutes. The travel time savings have been estimated from the proposed design.

However, the report also states that WTSM overestimates the traffic volume in 2006 by 467 vehicles per day. Therefore the final traffic volume after adjustment is as follow:

	Do Min	Option 1	Option 2
2006	200		
2016	213	1,384	2,997
2026	435	1,753	3,468

Table 8.5 - Traffic volume used in economic evaluation.

8.2.2 Travel Time Cost Savings

The travel time costs are obtained from the WTSM. The model represents road and public transport infrastructure at a strategic level, and includes changes in population and employment, mode choice, trip distribution, and trip re-timing in its forecasts. The forecasts are consistent with Statistics New Zealand December 2007 release. The model has been adjusted based on 2006 census data. The travel time is split into Car Time, Heavy Commercial Vehicle (HCV) Time and the Public Transport (PT) time.

Applying an update factor of 1.14 as recommended by Land Transport New Zealand's (LTNZ) Economic Evaluation Manual (EEM) Volume 1 Table A12.2 for $(2007) price base, the values of time used are shown below.

	Value of Time
Car Peak	$14.58
Car Other	$14.74
HCV All	$42.98

Table 8.6 - Value of Time used in economic analysis.

The annualisation factors used by the WTSM model are:

- 245 peak hours.
- 2,038 non-peak hours for cars.
- 1,324 non-peak hours for HCV.
- 1,613 non-peak hours for public transport.

8.2.3 Vehicle Operating Cost Savings

The vehicle operating costs are separated into costs by distance and roughness. The distances saved across the network are obtained from the WTSM and annualised using the same annualisation factors above. The distances are multiplied by the vehicle operating costs for speed and gradient from EEM volume 1 Tables A5.1 and A5.4. They are based on the 60 km/h travel speed across the network instead of 45km/h as in the GWRC report. It is assumed that both have 0% gradient. An update factor of 1.30 (EEM Vol.1 Table A12.2) is applied to the July 2002 costs in EEM to obtain the July 2007 costs.

	Option 1	Option 2
Car	$0.196	$0.196
HCV	$0.664	$0.664

Table 8.7 - Vehicle operating costs ($/km) based on speed and gradient

The evaluation of the vehicle operating costs due to roughness is split into existing traffic and diverted traffic.

For the existing traffic, the roughness of the existing road is obtained from the results of roughness surveys recorded in both KCDC and UHCC RAMM database. The average NAASRA count is 133 counts/km. The dates of the roughness surveys are June 2006 and February 2008 for KCDC and UHCC respectively. It is assumed Option 1 will improve the roughness to approximately 100 counts/km and Option 2 will have a NAASRA count of 80 counts/km. The vehicle operating costs are based on EEM Vol. 1 Table A5.13 and listed below:

	Do Min	Option 1	Option 2
NAASRA (counts/km)	133	100	80
Car	$0.0545	$0.0119	$0.0013

Table 8.8 - Vehicle operating costs ($/km) based on roughness for existing traffic

The existing traffic only consists predominantly of cars as few HCV use the current Akatarawa Road.

For the diverted traffic, the options are evaluated against the alternative SH2 / SH58 / Grays Road / SH1 route. It is assumed that the alternative route would be of high standard, and have a NAASRA of 80 counts/km. The vehicle operating costs are as below.

	Do Min	Option 1	Option 2
NAASRA (counts/km)	80	100	80
Car	$0.0013	$0.0119	$0.0013
HCV	$0.0042	$0.0413	$0.0042

Table 8.9 - Vehicle operating costs ($/km) based on roughness for diverted traffic

The alternative route has a length of approximately 61 km, while Option 1 is 36 km and Option 2 is 34 km has been used in the calculation. The lengths run from the intersection of SH1/Elizabeth Street to the intersection of north end of Fergusson Dr/SH2. This is because most trips will start/end at the city centre of Upper Hutt instead of Akatarawa Road.

8.2.4 Public Transport Savings

There are negative savings for public transport use in the earlier years for both options. This is because as traffic is diverted onto Akatarawa Road, it frees up the State Highways and some public transport users switch to cars. As the network becomes more congested in later years, they switch back to public transport. However, the change due to Akatarawa Road is very small so the BCR is not sensitive to it.

The amount of change is predicted by WTSM and the travel time value used is $5.74 at $July 2007 prices. This is a weighted average of seating and standing passengers, including commuting and non-commuting passengers.

8.2.5 Accident Cost Savings

The accident costs have also been split into two parts: existing traffic and diverted traffic.

For accident savings on the upgraded route, only the existing traffic volume is used as the upgrade will only affect the safety of existing users. Based on EEM Vol. 1 Appendix 6, the exposure equation for rural two-lane roads is used. This is because although the travel speed is less than 80km/h (38km/h for existing, 45km/h for Option 1 and 50km/h for Option 2), the travel environment is more rural and will affect both the behaviour of drivers and the reporting rates in the area.

The length of the upgrade is approximately 27km for Option 1 and 25km for Option 2. There are 14 recorded injury accidents in the LTNZ's Crash Analysis System (CAS) database on the proposed length. According to EEM Vol. 1 Appendix 6, a weighted accident analysis is used for the existing situation and Option 1, while an accident rate analysis is used for Option 2, as the realignment is considered a fundamental change. The cost per reported injury accident is $555,000 for mid-block accidents (EEM Vol. 1 Table A6.22). The whole upgrade length is treated as a mid-block section, including the intersections, because they are not major intersections.

For the diverted traffic, an exposure-based accident analysis has been undertaken. An accident rate is calculated for the alternative route, and for each proposed option on Akatarawa Road. The alternative route is separated into urban and rural environment, and the accident cost per

injury accidents for all sites (EEM Vol. 1 Table A6.22) are used instead as the route includes a few major intersections.

The time zero for both the above analyses is 2008 and the savings have been updated by 1.04 as recommended in EEM Vol. 1 Table A12.2.

It should be noted that for the cross-section adjustment factors for rural two-lane roads in EEM Vol. 1, the minimum lane width is 2.75m. This gives a carriageway width of at least 5.5m, whereas on Akatarawa Road, most sections of the road are effectively one lane, leaving no room for vehicles travelling in opposite directions to pass each other. This indicates that Akatarawa Road is in fact more dangerous than shown on the calculated accident costs, and there is potential for more savings with the upgrade.

8.2.6 Business Benefits

Using the profit figures in the Booz Allen report as a basis for additional business/tourist related profit in Upper Hutt, and applying a factor of say 1.25 to account for Kapiti, the BCR's would be as follows:

	Without Profit	With Profit
Option 1 - Online Widening	0.38	0.41
Option 2 - Offline Widening	0.75	0.76

As can be seen, the addition of the profit related sums has little effect on the BCR values.

8.2.7 Carbon Dioxide Emission Savings

A carbon dioxide emission savings have been included in the benefits. This is 5% of the vehicle operating costs savings (excluding savings due to roughness).

8.2.8 Intangible/Other Benefits

As mentioned in previous section, there are some intangible benefits which have not been included in the analysis. This includes using Akatarawa Road as an alternative route if any of the State Highways are closed as well as better route security on Akatarawa Road. There is also a possibility that there will be increased revenues for businesses on Akatarawa Road as more people use Akatarawa Road. However, this requires further investigation to determine the extent of benefits to the businesses.

8.3 Costs

There are two main costs considered in the economic analysis, which are the project costs and the maintenance costs.

8.3.1 Project Costs

The undiscounted cost for Option 1 is $41,288,000 and Option 2 is $55,572,000. The projects are assumed to take three years to complete and construction will start in 2010. The project costs are spread evenly over three years. They contain land purchase costs and include 35% contingencies.

8.3.2 Maintenance Costs

Two types of maintenance costs are included: annual maintenance costs and periodic maintenance costs.

The annual maintenance cost is $0.37/m^2 based on KCDC's RAMM maintenance data over the last 10 years. It is assumed that the cost is similar on UHCC side as there are no up to date maintenance data on RAMM. The annual maintenance costs for both upgrade options are higher than the existing road due to larger surface areas.

It is also assumed that there will be an additional $100,000 annual maintenance cost for the first three years after project completion to cover the increased debris on the road until the banks of new cuttings stabilise.

The periodic maintenance costs include resealing Akatarawa Road. The estimated life expectancy of the existing road is 12 years. The same life expectancy is used for both upgrade options. Although the traffic volume will increase and more HCVs will use Akatarawa Road due to the upgrade, the additional maintenance on Akatarawa Road would have been required on the roads where the traffic is diverted from. Therefore, the net additional maintenance cost for additional traffic is zero if not negative, since the alternative route is longer than Akatarawa Road.

Based on recent reseal rates on Akatarawa Road, the cost used in the economic analysis is $3.70/m^2.

8.4 Conclusions

From the economic evaluation, Option 2 (Offline Alignment) is the preferred option. It has a higher Benefit Cost Ratio and also a high Incremental Benefit Cost Ratio. The increased benefits obtained in Option 2 justify its additional cost of $14,284,000 from Option 1 (Online Widening).

Although the BCR for Option 2 is under 1.0, there are other intangible benefits such as an alternative route in the case of road closures on the State Highways, better security on Akatarawa Road, and probable increased revenues for businesses on Akatarawa Road. Also, the cross-section adjustment factors in EEM Vol. 1 (Table A6.13) do not provide factors for lane width less than 2.75m (which means the carriageway width would be 5.5m), which is the case on most sections of Akatarawa Road. Therefore, the existing accident costs on Akatarawa Road could be higher than indicated in the calculations.

9.0 RECOMMENDATION

The recommended option is the Offline Realignment which has a capital cost of $56 million. This option meets project objectives by providing a minimum of 2 x 3m lanes with 0.5m shoulders with both improvements in the horizontal and vertical alignment of the route and which complies with design standards.

Both upgrading options will contribute to the objectives of the Land Transport Management Amendment Act as follows.

(a) **Assisting economic development** through increased patronage to businesses along the route and lower transport costs associated with those businesses. Easier access between Waikanae and Upper Hutt will provide increased market opportunities for businesses located in those areas. Other opportunities for tourist development could be developed to utilise the increased passing traffic and easier access. The route also provides economic benefit through reduced vehicle operating costs, an alternative route avoiding the economic cost of closure to SH1, a reduction in congestion, and reduced travel times.

(b) **Assisting safety and personal security** by reducing the potential for loss of control and head-on accidents with improved road geometry (alignment, carriageway width), delineation and safety barriers, removing traffic from heavily congested routes where nose-tail accidents occur, and improving pedestrian/cyclist safety.

(c) **Improving access and mobility** by removing vehicles from congested routes, improving the availability of the route and providing an alternative route to existing routes.

(d) **Protecting and promoting public health** by increasing walking and cycling activity with the wider carriageway and shoulder, and reducing vehicle emissions.

(e) **Ensuring environmental sustainability** by removing vehicles from other congested routes reducing emissions, and reducing emissions by shortening and improving driving conditions on the route.

Given the risk profile a full geotechnical assessment of the proposed route is required before detailed design is undertaken. However, before this is done it is recommended that in the first instance a preliminary geotechnical field study be completed mapping the options to enable a more accurate assessment of the parameters to be used for each cut slope and fill. A budget of $70,000 should be provided for this work.

Other areas requiring particular attention in the next stage of investigations are environmental aspect and the effect of natural events, e.g. weather on the project. Environmental studies need to include a visual/landscape study, a noise assessment study, an amenity study to assess impacts, a safety assessment, a sustainability assessment, and consultation with public, iwi and interest group.

10.0 REFERENCES

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