Post Implementation Review

SH2 Matahorua Gorge Realignment

Napier Highways and Network Operations

October 2016

The purpose of NZ Transport Agency Post Implementation Reviews are to:

- assess how well a project (or package) has delivered its expected benefits
- explain any variation between actual results and expected benefits and costs
- identify any lessons learned that can be used to improve future projects

Executive summary

The Matahorua Gorge Realignment project shortened and improved a formerly very poorly aligned and substandard section of SH2, approximately 50km north of Napier.

Summary assessment of project outcomes

This Post Implementation Review (PIR) found the project has successfully reduced travel times in the locality by two and a half minutes on average. Safety has improved, with reduced crashes in the area. Maintenance costs for the section of highway may have reduced although this is unconfirmed due to an absence of data.

Project delivery and cost

The project was completed at a cost substantially below budget, mainly due to innovative construction techniques used. The outturn cost of $19.7m was 37.3% lower than the budgeted cost of $31.4m.

The project was brought forward as part of a government accelerated investment package and opened in March 2011.

Good practice identified and lessons learned

Good practice aspects are listed below and discussed in more detail in *Section 3: Good practice identified* of this report:

- The project introduced an innovative bridge design and associated construction method which substantially reduced project costs.
- Project implementation was achieved with minimal disruption to the state highway, parallel rail line, local landowner access, and the natural environment.
- The project justification explicitly recognised the interaction with parallel rail freight competition.

Lessons with relevance for other future projects are also listed below and discussed in more detail in *Section 4: Lessons learned* of this report: Lessons with relevance for other future projects were identified as follows:

- A number of project forecasts proved to be optimistic and were based on relatively basic analysis given the large project cost.
- Accuracy of information provided in official project-related communications should be checked and verified.
- Limited before and after monitoring data was done or available to assist with evaluating how well the project realised its predicted benefits.
- Record keeping on the project was poor, and consequently key information was not available for review purposes.
- The economic evaluation of the project varied considerably over time.

1. Project benefits

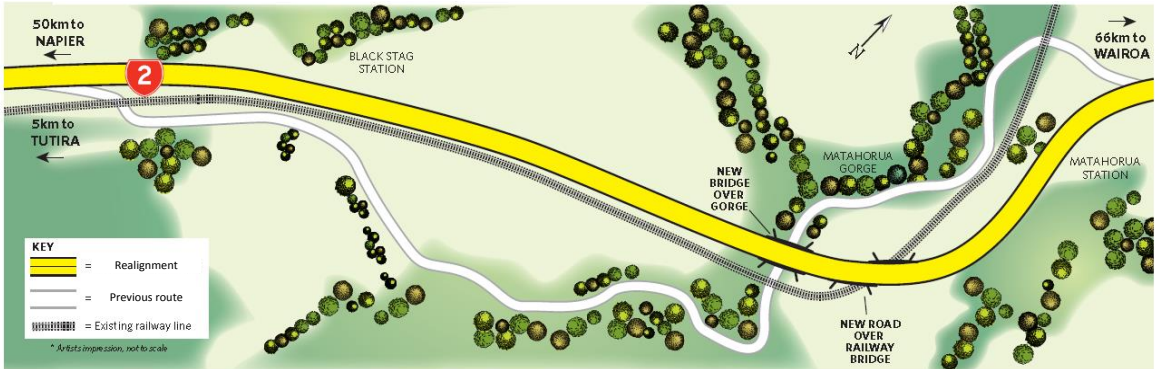
Project description

The Matahorua Gorge Realignment project shortened (by 1.4km) and improved 4.5km of a formerly very poorly aligned and substandard section of SH2, located approximately 50km north of Napier on the 214 km 'Pacific Coast Highway' to Gisborne. The previous section of SH2 was reportedly the worst part of the route between Napier and Gisborne. Figure 1 illustrates the previous and realigned section of state highway.

The project was a longstanding proposal, dating back over 50 years and investigated, evaluated and designed in detail over the period 1989–2008, before funding approval was awarded in 2009.

The project consisted of a single carriageway alignment starting in the south at the Kahika overbridge then running parallel to the Napier to Gisborne railway line until it meets the 40m deep Matahorua River Gorge, crossing this immediately west of the railway viaduct on a 137m long bridge. The alignment then crosses over the existing railway line by way of a 'road over rail' over-bridge and curves to the left, before finally curving to the right to tie back into the existing State Highway 2.

Figure 1: Matahorua Gorge realignment and project features



The realignment was constructed mainly off-line from the original route, with the exception of the southern and northern tie-ins to the existing highway and the improvement of 800m of existing SH2 at the northern end of the project.

Expected project benefits

The project objectives were to improve safety and operational efficiency (through reduced travel times and greater reliability), enhance route security. and reduce maintenance costs. The project was also launched as part of government jobs and growth stimulus.

This project was intended to improve alignment, width, speed and visibility of SH2 in a manner commensurate with its role in the strategic regional road network.

One of the motivations for the project was the substantial proportion of heavy commercial vehicles using the stage highway.

In terms of the economic evaluation used to support the project's funding, travel time cost savings accounted for 46% of the total expected benefits, crash cost savings 33%, lower vehicle operating costs benefits 20% and reduced vehicle emissions a residual 1%.

Some forecasts of the project's benefits were optimistic

The traffic forecasting used for the project was basic. This is understandable to some extent, given that this was a state highway in a remote area. However, in terms of the estimated project cost of $31.4m scheme, better forecasting would have been appropriate.

In particular, the traffic base used for the traffic forecasts appears to be higher than the Average Annual Daily Traffic (AADT). This was compounded by a projection of past trends from which a high future annual growth rate was derived.

The estimation of Heavy Commercial Vehicle (HCV) demand was better, with a core assumption of 15% of total traffic on the route, moving to 25% through sensitivity testing. This was a a plausible and prudent approach.

Safety forecasting was based on earlier, more problematic, crash histories and modelled rates. Comparing before and after data does not correlate well with the evaluation safety forecasts, which have proved to be optimistic. However, since implementation, the realigned section of state highway has a good safety record.

Less than forecast travel time savings have been achieved

Travel times were reduced by an average of two and a half minutes.

The project achieved overall reductions in travel times in both directions, particularly on the northbound upgrade. Substantial changes in operational speed were also recorded, as shown below in Figure 2.

Figure 2: SH2 Matahorua average speeds and travel times before and after realignment

	Before		After		Change	
	Time	Average speed	Time	Average speed	Time change	Speed change
Southbound	5m 5s	65.4 km/hr	4m 18s	86.8 km/hr	-1m 33s	21,4 km/hr
Northbound	8m 00s	47.9 km/hr	4m 17s	89.4 km/hr	-3m 43s	41.5 km/hr

Note: The above represents a full year of data, comparing 2010 with 2012.

Source: TomTom Traffic Stats database

An average travel time saving due to the project of 4 minutes and 18 seconds was forecast in the 2007 economic evaluation. This review's analysis of actual before and after travel times indicates an average travel time saving of 2 minutes and 37 seconds, still substantial but not as high as forecast.

A project newsletter in 2011 quoted a 12-minute time saving expected as a result of the project. This figure does not appear to be reliable and could not be verified by the material available for this review.

In the context of travel time between Napier and Gisborne (of around three hours) the travel time savings from the realignment represents a 1% reduction in total travel time.

Travel time variability has been largely unaffected by the realignment

Travel time variability was derived from the same dataset used for travel times and showed that the range of variability was marginally affected, increasing southbound but decreasing northbound (Figure 3).

Figure 3: SH2 travel time variability at Matahorua

	Before	After	Change
	Range	Range	Range change
Southbound	15.9 km/hr	17.1 km/hr	1.2 km/hr
Northbound	5.2 km/hr	7.6 km/hr	-2.25 km/hr

Source: TomTom Traffic Stats

The range described above is the difference between the 15th and 85th percentile speed and this indicates there was little change in variability following project implementation.

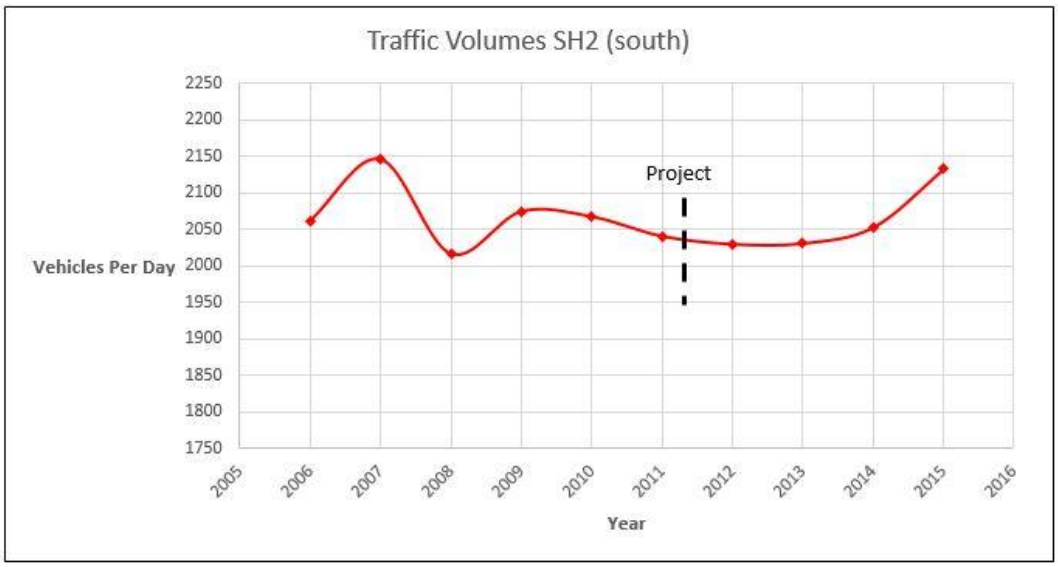
Traffic volumes along the route are lower than forecast

Post implementation traffic volumes are lower than forecast, for two reasons:

i) A base year (2008) traffic volume of 2,184 was adopted from the Tangio Telemetry AADT site 25km to the south. This figure is high compared with data from the new State Highway Traffic Volume (SHTV) count location established post implementation (from 2011). The new site is in close proximity to the project and shows demand to be 1,645 AADT in 2011, 25% lower than the adopted base year figure.

ii) Forecast traffic growth rates of 2.5% p.a. over a 25-year period were adopted for project evaluation purposes, based on a 1995 to 2006 trend. However, based on the more recent data from the Tangio Telemetry site for an equivalent period, the growth rate (between 2004 and2015) has been 0.5% p.a.

Figure 4: SH2 Traffic volumes



Source: NZ Transport Agency, State Highway Traffic Volume data

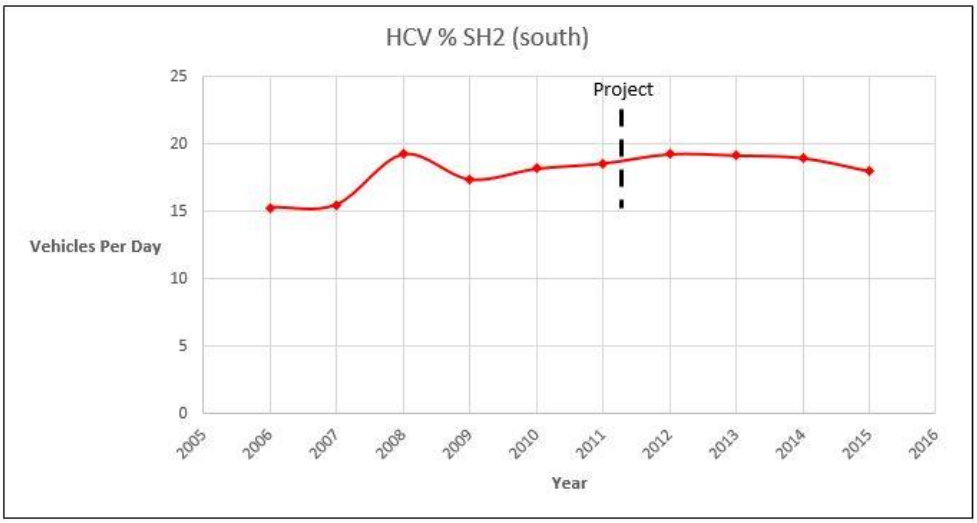
Whether an increase in traffic volumes has occurred as a result of the project is unclear although it seems unlikely. But this can't be confirmed as continuous data is not available for the project section of SH2.

A December 2009 project newsletter, stated: *''this section of SH2 currently sees around 4,000 vehicles using it each day. Many of these are logging and farming trucks on their way to and from Napier's port.''* The source of the traffic flow figure of 4,000 vehicles is unclear and could not be verified by the material available for this review.

Heavy Commercial Vehicles use on the route is increasing

SH2 in the vicinity of the project has a substantial proportion of use by heavy commercial vehicles (HCVs). This is in the range 15% to 20% of total vehicles. Both the proportion and overall numbers of HCVs on SH2 have been increasing over the ten-year period illustrated below, although there was a modest reduction in 2015 (Figure 5).

Figure 5: SH2 Heavy Commercial Vehicle volumes have grown



Source: NZ Transport Agency, State Highway Traffic Volume data

Economic fluctuations and logging operation variability are likely to be responsible for some of the observed fluctuations in demand.

The SH2 route between Napier and Gisborne has some restriction of High Productivity Motor Vehicle movements (including a height restriction of 4.45m). Nevertheless, the size of vehicle on SH2, in terms of length and weight, is anecdotally reported to be increasing.

Wider economic benefits are unclear

The project received expedited funding through the government ''Jobs and Growth Stimulus Package'' of February 2009. The project assisted in maintaining capacity, continuity and capability in the road construction industry, and employed 60 people during the 18-month construction period.

The project was also intended to support longer term regional growth by providing an infrastructure upgrade. It is difficult however to establish whether this has have occurred and to quantify the scale of any associated benefits.

The monetised economic benefits recorded in project evaluations varied considerably over the course of the project planning period 1989-2007. This is discussed further in the Appendix.

Maintenance and route security benefits were unable to be measured

Project documentation stressed the need for better route security due to maintenance and repair problems:

- *''The primary objective of this project is to improve route security…''* Regional Management Team Paper 2010.
- *''Whilst route security, safety and efficiency are the main drivers for this project, heavy maintenance of bridges, retaining walls and pavement will be necessary in the near future.''* Land Transport Online, 2009.
- *''The steep sides within the Matahorua Gorge result in significant falls of rock and debris, which together with flood damage, erosion and guardrail repair, generates a high annual maintenance expenditure. Periodically the gorge is closed to traffic because it is impassable offering a low level of route security''* Transit NZ Board Paper, 2007

During the PIR site visit it was also stated that the project had resulted in a lowering of maintenance costs, and that slips and remedial retaining walls could typically cost $1m for a 30 metre section, without providing a permanent solution. Furthermore, it was said that at some stage on difficult sections a new alignment is needed to eliminate the need for costly maintenance work. Unfortunately no data, cost records, examples or other documentation were available for this review to confirm and quantify these reported benefits.

Similarly, no data relating to the frequency, duration or cause of route closures was available to quantify the effects of the project on route security.

The mothballing of the local rail line has increased truck volumes

The 2007 Transit NZ Board Paper referred to the inter-relationship between road and rail modes on SH2 as follows: *''road freight has become an integral part of the region's economy reflective of its reliance on primary production, proximity to the ports of Napier and Gisborne, and the historical underinvestment and underutilisation of the region's rail infrastructure. SH2 has been specifically identified by the forestry industry as being critical to their current activities, due in part to the extra cost and time delays involved in the double handling of logs when using rail.''*

Since project implementation, the rail line has been mothballed[1] and most if not all rail freight traffic is assumed to have transferred to the road network, much of this onto SH2.

Other project documentation (including the project's 2008 scheme assessment report) also explicitly referred to the interaction of SH2 road freight movements and the rail corridor. It was foreseen that a sharp increase in HCVs could result from the uncertainty surrounding the rail line. Since project implementation, there has been a rapid increase (25%) in the level of HCV movements on the project section of SH2 between 2012 and 2015.

Local walking and cycling demand is low and facilities minimal

On the basis of site observations, walking and cycling activity levels in the locality of the project are very low.

Localised shoulders have been provided on the project itself. However, these are of variable width, often narrow (minimum 0.75m), and therefore of limited potential for use for localised walking or cycling purposes.

Shoulders are also not continuous along the remainder of SH2 for longer distance cycling purposes. The speed environment is (in general) derestricted 100 km/hr and in combination

[1] There is a proposal to operate a dedicated log rail service from Wairoa to Napier Port from the end of 2017.

with the remote nature of SH2 in the vicinity of the project indicates there will be limited demand for leisure or tourist cycling.

The former SH2 alignment is either used for local access purposes or has been absorbed by adjacent land uses.

The long term role of the Napier Gisborne rail line is unknown. However, there is good access and crossing facilities, from a number of points on SH2 for any potential future uses.

Safety has improved as a result of the realignment

The number of crashes in the project area, reduced by 38% post-implementation, although the overall incidence of crashes overall is low, as shown in Figure 6.

The crash reduction was less than the 27% reduction recorded in the Napier District area over the same period. However, given that the project location is on a rural and remote part of SH2, it is not fully representative of the wider Napier District.

Figure 6: Record of crashes

	Total Recorded Crashes		
	Before Period	Actual after period	Change
	(12 March 2006-11 March 2011)	(12 March 2011-31 July 2016)	
	5 years	*5 years 4 months*	
Project Area (crash totals)	6	4	
Project Area (crash type)	0 fatal, 1 serious, 2 minor, 3 non-injury	0 fatal, 0 serious, 2 minor, 2 non-injury	
Project Area (crashes p.a.)	1.2	0.8	-38%
Napier District (crashes p.a.)	628	460	-27%

Reference was made in the project material to unrecorded crashes in the area, which may be true given the remote nature of the area.

Source: NZ Transport Agency, Crash Analysis System (CAS).

2. Project implementation (scope changes, cost and timeframe)

Scope changes were made to address issues identified in safety audit

The project scope was extended in July 2010, after the start of the project in response to safety audit findings to ease the transition of new build into the sub-standard alignment of the existing road over an 800 metre distance at the northern end of the project. The work was undertaken to reduce the accident migration risk, and was completed concurrently with the main project using approved but unassigned funding.

This additional work cost approximately $2 million. It has been successful in terms of preventing any substantial safety problems occurring at the northern termination of the project.

The project was completed substantially under budget

The outturn cost of $19.7m was much lower (-38%) than the budgeted cost of $31.4m (Figure 7). This was mainly due to innovative design and construction techniques. In keeping with good practice, the project budget surplus was reallocated to other state highway projects.

Figure 7: Budgeted and actual cost comparison

Description	Cost	Difference
2009 Construction Approval	$31,386,400	
Out-turn cost at project completion	$19,669,828	-$11,716,572 **(-37.3%)**

Excluded from the cost figures above are the preliminary investigation and design funding and some property funding, totalling just over $2 million.

The project was brought forward by approximately 12 months as part of a Government accelerated investment package. The timeframe for project implementation was 18 months. The project opened in March 2011, two months after the intended completion date estimated at the start of construction.

3. Good practice identified

This review identified several examples of good practice, as follows:

- **The project introduced an innovative bridge design and associated construction method.** The bridge design was a variation on the original design specification and resulted in a more aesthetic and much less disruptive solution with substantial cost savings.
- **Project implementation was achieved with minimal disruption to the state highway, parallel rail line, local landowner access and the natural environment.** Off-line construction techniques, the grade separation of road and rail, facilitation of local accesses for residents and livestock, the treatment of the old route and the lack of need for structures at the base of the gorge all contributed to this outcome.
- **Construction funding for the project was awarded on the basis of intangible benefits and a relatively low Benefit Cost Ratio (BCR).** The approval was based on identified needs and project readiness. This meant that a project which was commonly agreed to be needed was able to progress, despite not meeting the funding criteria at the time. (This was due to the relatively high cost and consequently low project BCR.)
- **The project justification explicitly recognised the interaction with parallel rail freight competition.** It is relatively uncommon for road projects to account for the interrelationship with other freight modes, particularly the effect of rural state highway projects with rail freight. The associated forecast of a substantial increase in road freight has proved to be accurate.

4. Lessons learned

Lessons with relevance for other future projects were identified as follows:

- **A number of project forecasts proved to be optimistic.** This is particularly true in terms of traffic volumes, future general traffic growth rates and travel time savings. Guidance in the Transport Agency's Economic Evaluation Manual has since been changed which should help avoid this for future projects.
- **Some statements issued in project related communications do not appear to be fully consistent with project evaluation documentation.** For example, the current traffic volume was given as 4,000 vehicles per day, when the reality was less than half of this. The forecast time saving was stated to be 12 minutes when the estimated saving in the project evaluation was four minutes. It is important that statistics and benefits realisation information used in official communication about projects is checked and confirmed for accuracy.
- **Limited before and after monitoring data was available for this review.** With exception of safety and travel time databases there was little available data for review purposes. For example, no pre-implementation traffic volumes in the vicinity of the project are available. No other project related outcomes appear to have been monitored or investigated in quantified terms. Monitoring of outcomes and extent of benefits realisation from major investments of public money should be standard practice for large capital projects.
- **Record keeping on the project was poor, and consequently information was not available for review purposes.** No evidence of maintenance incidents or costs was available and detailed electronic records were also not accessible.
- **The economic evaluation of the project has varied considerably over time.** Consequently, the quality of the information available to funding decision makers in respect of scheme economics fluctuated substantially, in the range 1.0 to 4.9 for the benefit cost ratio (see Appendix for more comment).

5. Napier Highways and Network Operation's response to findings

Overall comment

The report is fair in its findings. We need to have more rigor leading up to project investigations and post construction to ensure we can demonstrate that full benefits have been realised, both in terms of traffic volumes, crash data, and historical and current maintenance cost records.

Specific comments

- Ongoing professional development and approach to delivering projects has seen an improvement in most aspects of project delivery, quality control and assurance for the Transport Agency.
- New internal systems such as InfoHub [the Transport Agency's document management system] have allowed improved document management to be used on projects.
- The quantum of information and data that goes with delivering larger projects was probably under estimated – and this may have caused issues for the old project team to manage and store in an easily retrievable manner.
- The project team left great relationships in place with most stakeholders.

6. Site photos

- **SH2 route theme**

- **Project location (at northern termination)**

- **SH2 project bridge and rail bridge (left)**

- **Project bridge structure**

- **Northern section**

- **Southern section**

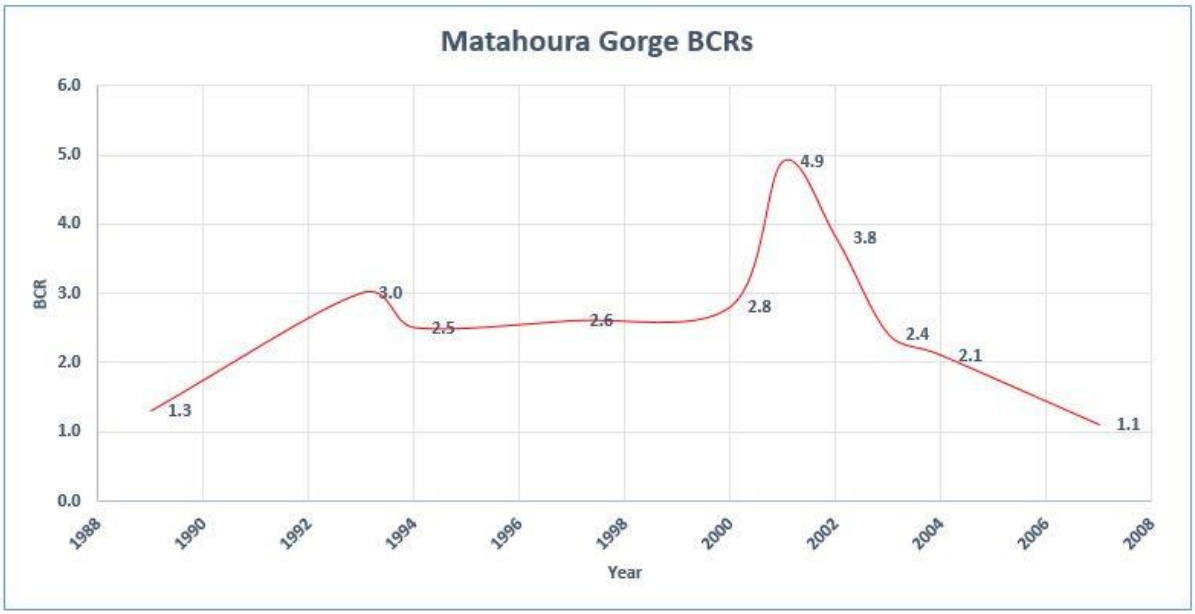
Appendix: Matahorua Gorge Realignment Economic Evaluation

Context

Ten separate economic evaluations or revisions were undertaken in the 19-year project planning period. The benefit cost ratio (BCR) figure was a material factor in prioritisation and approval of the project for funding purposes. The calculation of a project BCR remains a requirement for project evaluation and funding consideration purposes.

Because of the length of the planning period and the number of evaluations undertake over this time, the Matahorua Gorge project is an example, provided for illustrative purposes, of how economic evaluation results can vary over time, as shown below:

Figure A.1 History of Estimated BCRs



The reasons why the BCR has varied over time, could include changes in Economic Evaluation Manual rules, the techniques used by different evaluators, and changes in operational conditions between evaluations. It is also appreciated that the BCR was used to compare projects and establish relative priorities and rankings for national and regional funding allocation purposes.

In the early stages of the project, cautious assumptions were adopted. Later, as benefits were re-examined in detail without any detailed revision of costs, BCRs increased considerably. The highest period of BCR estimation (1993-2003) coincided with the increase in effort to win funding approval and the difficulty in obtaining recognition through the BCR process.

As the project moved closer to approval, investigations and design funding allowed more realistic costings to be developed and this had the effect of decreasing the BCR, illustrating what appears to be a tendency in project planning to update costs but not benefits during the later planning process.

Post-implementation costs came in substantially below budget estimates although it is likely that benefits were also reduced as a result of lower time savings, traffic volumes and safety benefits also being lower than forecast.