A cost-benefit analysis of improved working at heights regulation

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1. EXECUTIVE SUMMARY

BRANZ was commissioned by the Scaffolding, Access and Rigging Association New Zealand to independently investigate the costs and benefits of the Working at Heights (WAH) programme. Stricter WAH guidelines setting out appropriate solutions for WAH were introduced in November 2011. Guidance includes specific safety systems such as netting, guardrails and scaffolding.

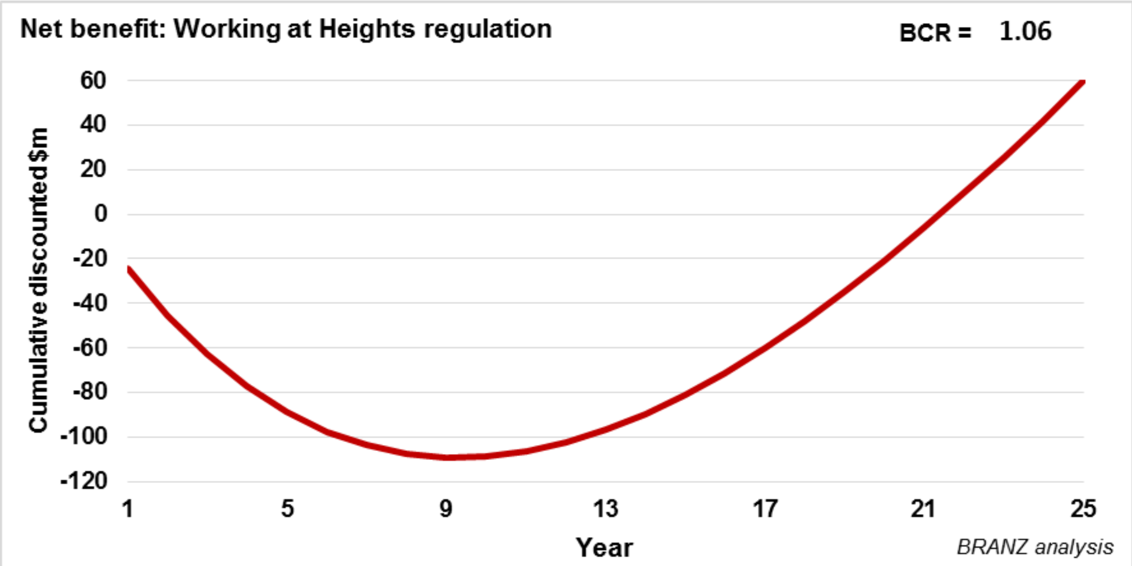
The focus of this study is on the costs and benefits to the **residential construction sub-sector**. A comprehensive analysis of the calculation of costs and benefits is set out in the following sections, as is a sensitivity analysis. This section presents a conservative, defensible estimate of the benefits and costs of the WAH programme.

The programme is estimated to reduce accidents resulting in injuries by at least 3.7% in the residential construction sub-sector. This decline yields the following **annual** reductions in injuries associated with the WAH programme:

- 22 fatalities and life-altering injuries / permanent disabilities per year
- 68 other severe injuries per year
- 486 non-severe injuries per year.[1]

However, the WAH programme does make it more expensive to build, a cost against which the various benefits to the individual, taxpayer and firm must be compared. Figure 1 shows the estimated net benefit of the WAH programme over a 25-year period.

Figure 1 The net benefit of the WAH programme



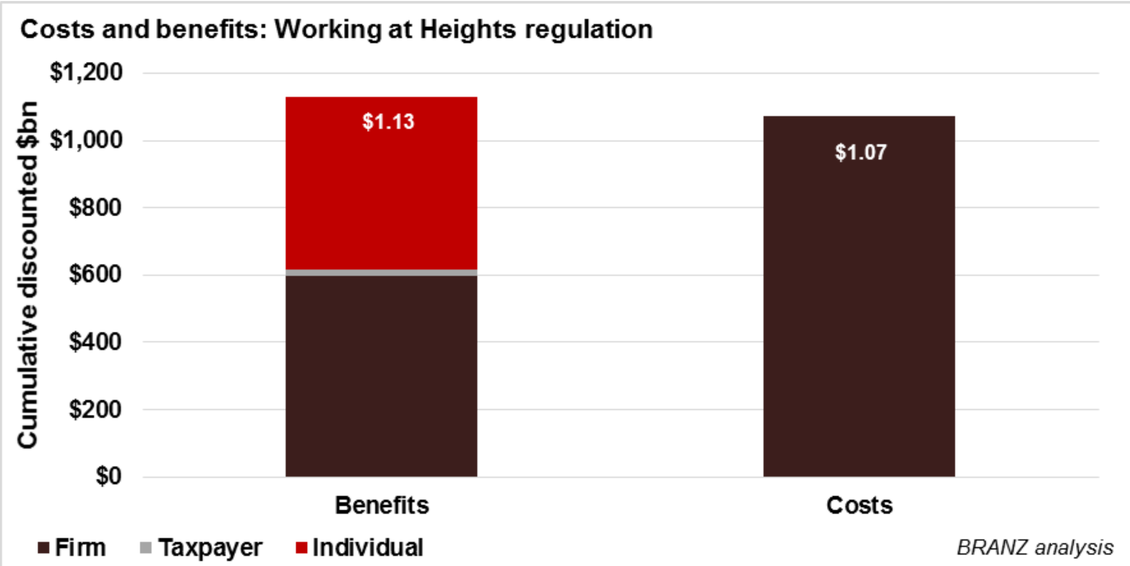
The benefit-cost ratio (BCR) is 1.06, meaning the discounted, cumulative benefits of the programme are estimated to outweigh the discounted, cumulative costs of the programme by 6%, or a net $60 million over 25 years.[2]

[1] There are an average 24,000 recorded injuries a year in construction, according to ACC.
[2] A BCR above 1.0 indicates that the benefits of a project or programme outweigh its costs.

The shape of the curve in Figure 1 is worth some additional explanation. In the first 10 years of the analysis period, the programme has a net loss in discounted terms of around $109 million. However, over time, the cumulative impact of the deaths and permanent disabilities avoided rises such that the annual benefits of new injuries avoided plus the quality of life improvements due to avoided injuries in previous years outweigh the annual costs. By Year 22, the programme has a net positive impact, which grows to the end of the 25 year analysis period and beyond.

While there is a mix of opinions on what productivity gains or losses accrue to various trades such as roofers, painters and the like due to the requirement for more scaffolding, guard-rails and the like, averaging results of figures submitted by builders suggested a small net gain in productivity of 0.8%. Across the 50,800 projects expected to be completed each year over the next 25 years (new builds, and alterations and additions), however, this figure was substantial, at $42.9 million. As a result, the biggest single benefit also accrues to the firm, as shown in Figure 2.

Figure 2 The split of costs and benefits across the economy



Cumulative, discounted benefits are estimated at $1.13 billion over 25 years, with 53% of those benefits accruing to firms through improved productivity, reduced sick leave costs, and reduced work disruption due to accidents. A further 45% of the benefits accrue to individuals through improved quality of life through lower injury rates. Finally, around 2% of the benefits accrue to the taxpayer through reduced healthcare and compensation for lost earnings pay-outs. These benefits are offset against $1.07 billion in additional health and safety system costs.

It is acknowledged that this study is based on a limited amount of data, particularly for the period post-WAH programme implementation. It is recommended that the question be revisited in two to three years' time to incorporate new data to improve the accuracy of the study.

2. INTRODUCTION

BRANZ was commissioned by the Scaffolding, Access and Rigging Association New Zealand to independently investigate the costs and benefits of the Working at Heights (WAH) programme.

2.1 The WAH programme

Stricter WAH guidelines setting out appropriate solutions for WAH were introduced in November 2011. Best practice guidelines for the programme were released in April 2012.[3]

The purpose of this greater emphasis on WAH was to reduce falls from heights (FFH), a major contributor to workplace injuries, particularly in industries like construction. For instance, an internal study by WorkSafe NZ estimates that there were around 90 Serious Harm Notifications (SHNs) for FFHs in construction in 2011. A similar measure – FFHs investigations – were around 120 in 2011.

There are likely to have been many more FFHs that may not have been reported in this way and would therefore not have been subject to an investigation. For example, in the year to October 2011, there were around 140 long-bone fractures in construction. This type of injury is typical of a fall from height, and when added to sprains, dislocations and other injuries typical of falls, indicates that the number of injuries from FFHs is likely to be far larger.

The types of injuries associated with FFHs also tend to be severe. Long-bone fractures, for example, tend to have high associated medical costs, high personal disability and discomfort impacts, and long recovery times, all of which make them a major negative impact on an economy.

2.2 The scope of this study

The additions to guidance primarily affected the residential building industry, as non-residential projects (particularly those focused on multi-storey buildings) already had a fair amount of WAH safety guidance and best practice in place. The focus of this study is therefore on the **costs and benefits to the residential construction sub-sector**.

It must be acknowledged at the start that only two years have passed since the introduction of new guidance. This means in many cases it may be too early to identify a meaningful trend in injury rates since the WAH was introduced. It is **recommended that this question be re-visited in two years' time when more post-programme data is available**.

Wherever possible, available data has been used. Where assumptions have been made, these have been highlighted as such.

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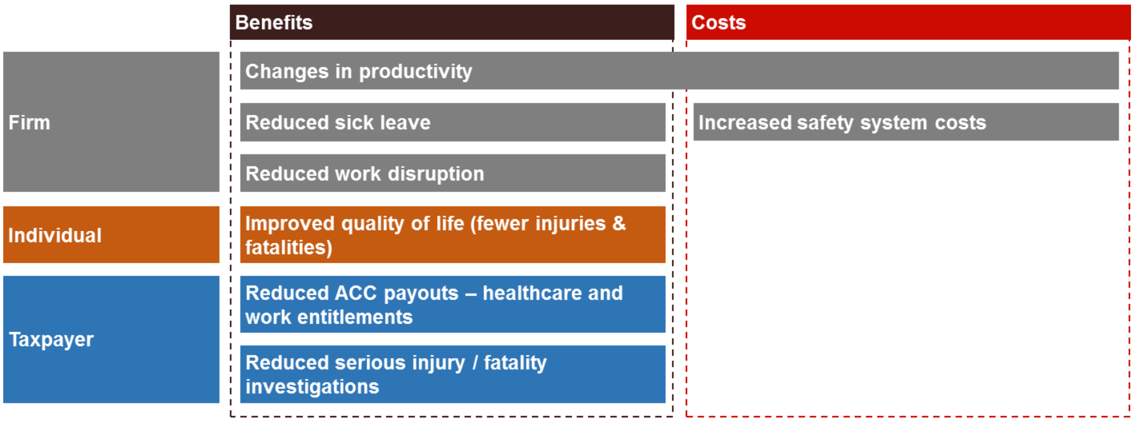
[3] Ministry of Business, Innovation and Employment. (2012). *Best practice guidelines for working at height in New Zealand*. Published in April 2012.

2.2.1 Introducing the costs and benefits of the WAH programme

A number of costs and benefits associated with the WAH programme were identified and estimated. These are set out in Figure 3.

Figure 3 Costs and benefits of the WAH programme



Benefits accrue to the firm, individual, and the taxpayer, while the increased costs associated with WAH programme are borne by the firm (and partly or fully passed on to the purchaser of a new house). Note that, at the outset of the project, it was not known whether changes in productivity would prove to be positive or negative, as indicated in the figure.

We acknowledge that there may well be other peripheral costs and benefits associated with the WAH programme that are not captured in this study, but these categories cover the bulk of impacts. Some of the smaller impacts that are excluded are mentioned where appropriate.

3. ESTIMATING THE COSTS

The estimated **additional cost imposed** on firms by the WAH programme is **$79.0 million per year** over the next 25 years.[4] The estimate of **costs per project is $1,555**, consisting of $697 per Alteration and Additions (A&A) project, and $2,651 per new build project. It is likely that the bulk of these costs are passed on to the purchaser of new housing or A&A services.

3.1 The cost of extra safety systems

The chief measurable expense associated with the WAH is the cost of additional safety systems associated with the new guidance. Builders across Auckland, Tauranga, Wellington and Christchurch were surveyed on the costs and benefits to their business of the changes in WAH guidance.

The survey began by asking how much **more** it cost in terms of safety systems such as netting, guardrails and scaffolding (generically referred to throughout as “safety systems”) since the changes in WAH guidance, for a typical 200 square metre single or double storey house.

Specific points to note were:

- Builders had widely varying approaches to meeting the requirements of the guidance. These varied from a pure “compliance-focused” approach, to working with regulators to develop safety systems that both met safety requirements and supported improved productivity. The cost varied in line with variations in approach.
- Builders had already adopted varying levels of safety systems before the new WAH guidance came into effect. This meant that the incremental cost of complying with the guidance varied sharply.

The mix of franchise group and independent builders, geographic locations, and approaches toward WAH safety systems meant that it was possible to canvas a fairly representative sample of builders in determining the numbers presented in this report.

The key findings and calculations are summarised in Figure 4.

On average, additional safety systems as part of the WAH programme were estimated to add $3,304 to the cost of a 200 square metre single storey build, and $2,300 to a double storey build (where safety systems were already more widely used prior to the WAH guidance changes).

[4] As explained later, this study assumes 22,300 new builds and 28,500 A&As per year, in line with averages over the last 20 years.

3.2 Safety system costs associated with new builds

According to a 2014 study by BRANZ, around 65% of new builds in New Zealand are double storey.[5] This information, coupled with the safety system cost data, allowed an estimate of the **average safety system cost per new build project of $2,651**.

With an estimate of the average number of new builds per year expected over the next 25 years explained in the section entitled *Number of projects per year*, this made it straightforward to estimate the **national cost of new build safety systems per year, at $59.1 million**.

3.3 Safety system costs associated with alterations and additions (A&A)

On the other hand, most existing housing stock is still single storey, at around 70% according to the BRANZ House Condition Survey 2010 dataset. It was assumed that A&As are dispersed across single and double storey houses in the existing housing stock proportionate to their share of the total housing stock. The BRANZ Materials Survey dataset made it possible to estimate the proportion of all A&As that are additions, re-roofs or re-clads.[6]

The proportion of the typical single or double storey new build safety system cost likely to be spent on each of the three A&A categories was then estimated. These varied between 35% for a re-clad, and 45% for an addition. These estimates were based on the assumption verified with builders that **for a new build**, typically just under half the safety system cost is upfront, with the other half as a weekly rental cost. This was scaled down appropriately for the three different types of A&A work requiring safety systems.

Multiplying the share of additions, re-roofs or re-clads by their respective proportions of new build costs, and then by the mix of single storeys and multi storeys subject to A&As yielded an **average additional WAH safety system cost of $697 per A&A project**.

Nationally, this equates to **$19.9 million in annual safety system costs**.

[5] Curtis, MD. (2014). *Physical characteristics of new houses 2013*. BRANZ.

[6] We acknowledge that not all re-clads are likely to use scaffolding systems, so these cost estimates are likely to conservatively overestimate the cost side of the cost-benefit analysis.

Figure 4 Annual safety system costs of WAH guidance

Step / component	Notes / source	
Cost of extra new build safety systems		
Single storey	Builder Survey	$3,304
Multi storey	Builder Survey	$2,300
Share of new build houses		
Single storey	BRANZ SR309	35.0%
Multi storey	BRANZ SR309	65.0%
Share of alterations / additions (A&A)		
Single storey	House Condition Survey 2010	70.0%
Multi storey	House Condition Survey 2010	30.0%
Share of all A&A that require safety systems		**53.4%**
Additions	BRANZ Materials Survey	38.5%
Re-roof	BRANZ Materials Survey	9.7%
Re-clad	BRANZ Materials Survey	5.3%
A&A by share of new build safety system cost		
Additions	BRANZ estimate	45.0%
Re-roof	BRANZ estimate	42.0%
Re-clad	BRANZ estimate	35.0%
National cost of extra safety systems		**$78,998,761**
New builds		$59,126,953
A&A		$19,871,808
Extra safety systems cost at project level		**$1,555**
New builds		$2,651
A&A		$697

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4. ESTIMATING THE BENEFITS

4.1 Benefits to the firm

Benefits to the firm are estimated at $43.9 million per year. These are predominantly productivity benefits, along with some benefits from reduced work time lost to sick leave and to work disruption in the case of injuries.

4.1.1 Improved productivity

As Figure 5 points out, the estimated national benefit of **productivity gains stemming from the WAH guidance is $42.9 million a year**. This equates to around $844 per project.

At the outset of the study it was not evident whether builders were likely to indicate that the scaffolding, guardrails and other safety equipment improved or reduced productivity.

This was possibly the most contentious estimation in the report. Views among builders were decidedly mixed. Some builders saw large productivity gains to be made from approaching the Health and Safety Act requirements in a holistic manner aimed at also boosting productivity.

Other builders saw the guidance as no more than a large compliance cost imposed upon them. Within this latter group views were further mixed among those who acknowledged that the WAH guidance offered some benefit to some trades while penalising others (perhaps with a net impact of zero or a negative overall impact); and those who effectively stated that they were unwilling to provide estimates of productivity gains that might be used to "justify" the new guidance, regardless of whether there were actually positive impacts.

Nevertheless, wherever information was provided, either positive or negative, it was included in the model.

Estimated productivity impacts were averaged across all responses. The result was an estimate of an average 1.6% productivity gain on new builds, and a 0.2% productivity gain on A&A projects, based on the mix of single and double storey projects. The average labour productivity (value added per worker) in the residential construction industry was estimated at $55,400 in the year to March 2014, while the number of workers expected to work in the industry to meet the demand for new builds and A&A, and who are likely to work at heights, is estimated at 97,200.[7] The estimated productivity gains are applied across these workers working on residential projects (both builders and the associated construction trades such as electricians, plumbers and the like) at their average productivity level to estimate the productivity gain per worker of $441, and the national benefit of $42.9 million in productivity benefits.

[7] The total number of workers required on residential projects on an ongoing basis is expected to average around 123,200, but not all of these will need to work at heights.

It is important to note that the average figure of $441 per worker is not evenly distributed across trades. The survey of builders asked for their views on the impacts on individual trades (such as roofers, glaziers or painters). This information was combined with data from previous BRANZ studies that estimate the mix of labour costs across the different components of a residential building project to determine an overall gain of $844 per project.

Given the level of debate encountered on this question, the sensitivity analysis section provides three scenario tests for this component.

Figure 5 Annual productivity gains from WAH guidance

Step / component	Notes / source	
Productivity Change - Newbuild		**1.6%**
Single storey	Survey of Builders, SR309	0.3%
Double storey	Survey of Builders, SR309	2.2%
Productivity change - A&A		**0.2%**
Single storey	Survey of Builders, BRANZ Materials Survey	0.1%
Double storey	Survey of Builders, BRANZ Materials Survey	0.5%
Productivity change - all activity		**0.8%**
Newbuild	Summary of calculations	1.6%
A&A	Summary of calculations	0.2%
Labour productivity per worker	BRANZ estimate, Statistics New Zealand	**$55,400**
Labour productivity change per year per worker	Calculation	**$441**
Number of affected residential workers	HLFS / Business Demography estimate	**97,200**
Annual national change in work efficiency		**$42,860,121**
Change in efficiency of work per project		**$844**

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One further point to note from discussions with builders is that some pointed to the two days it could take for scaffolding to be erected as a further productivity cost. Others indicated that there was "always other work" that could be done while the scaffolding was being erected, and that it was more a project management issue. No allowance for erecting or dismantling scaffolding was made in the analysis.

4.1.2 Reduced sick leave

Figure 6 sets out how the reduction in sick leave productivity losses associated with the WAH programme was estimated. It was estimated that reduced sick leave costs as a result of fewer injuries could save **businesses $523,000 a year, or $10 per project**.

Having already calculated the annual productivity of workers in the residential sector ($55,400), it was possible to calculate the weekly productivity of those workers, assuming 46 weeks of work per year. This yielded an estimate of $1,204 a week.

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The survey of builders included a question on the number of sick days associated with typical minor and severe injuries. The average given by builders was around eight working days for severe injuries, and three days for minor injuries.

It is important to note that these numbers are the typical number of **paid** sick days associated with these injuries, not the time it takes the worker to return to work. For example, a worker with a broken arm will not return to work after eight working days, but typically this is how much sick leave the worker may have before they start claiming off the ACC compensation for lost earnings. It is also important to note that this cost category does not include the cost of disruption to workflows of the project, which is dealt with separately.

Figure 6 Annual reduction in sick leave productivity losses from WAH guidance

Step / component	Notes / source	
Labour productivity per affected residential worker	BRANZ estimate, Statistics New Zealand	**$55,400**
Productivity per week per affected residential worker	Assume 46 weeks of work per year	**$1,204**
Weeks of sick leave lost		
Severe injury	Survey of Builders	1.6
Non-severe injury	Survey of Builders	0.6
Annual national increase in production from less sick leave		**$522,752**
Severe injury		$171,478
Non-severe injury		$351,273
Production gain from less sick leave per project		**$10.29**
Severe injury		$3.38
Non-severe injury		$6.91

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4.1.3 Reduced work disruption

A further cost linked to FFHs at work is the cost of disruption to the project. In the case of a large, multi-gang builder, it may be easier to manage an injury to a single individual, as workers can be shifted between sites, but for smaller builders, an apprentice or the builder themselves being injured may have major work disruption impacts.

Figure 7 shows the reduction in work disruption costs associated with the WAH guidance. It is estimated that reduced work disruption costs as a result of fewer injuries could save businesses **$565,000 a year, or $11 per project**.

Builders once again provided an estimate of the work disruption impacts expected to be associated with different severities of injury. For injuries resulting in death or permanent disability, a WorkSafe NZ investigation would be triggered, and the worksite could be shut down for a long period of time. In the worst cases, grief counselling may be required for other workers, and replacement workers would need to be found.

Even for injuries like broken limbs, builders estimated on average nine days of work disruption would result, again depending on the size of the organisation, with some small builders likely to be even more badly affected.

Non-severe injuries have a relatively small impact of three days of lost production in addition to sick leave time covered in the previous cost category. It was assumed that permanent disability, or what WorkSafe NZ refers to as "life-altering" injuries, would have a disruption impact midway between other severe injuries like broken limbs, and a fatality. i.e. 2.5 weeks.

Figure 7 Annual reduction in work disruption losses from WAH guidance

Step / component	Notes / source	
Labour productivity per worker	BRANZ estimate, Statistics New Zealand	**$55,400**
Productivity per week per affected worker	Assume 46 weeks of work per year	**$1,204**
Work disruption impact per accident (in weeks)		
Fatality	Survey of Builders	3.2
Permanent disability	Survey of Builders, BRANZ assumption	2.5
Severe injury	Survey of Builders	1.8
Non-severe injury	Survey of Builders	0.6
Annual national business disruption costs		**$564,535**
Fatality		$2,312
Permanent disability		$64,417
Severe injury		$146,533
Non-severe injury		$351,273
Reduced disruption per project		**$11.11**
Fatality		$0.05
Permanent disability		$1.27
Severe injury		$2.88
Non-severe injury		$6.91

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4.2 Benefits to the individual

One of the largest benefits is that which accrues to individual workers as improved safety standards reduce likelihood of death or injury. As Figure 8 shows, reduced injuries at the worksite lead to quality of life gains of **$9.0 million in Year One of the analysis at a national level, or $178 per project**.

Measured in Disability Adjusted Life Years (DALYs), the World Health Organisation (WHO) and others have estimated the loss of quality of life associated with a range of different injuries. Any illness or injury causes a fall in the quality of life through disability, although in the case of a minor illness or injury, this impact would be short-lived.

The WHO therefore considers the full range of illnesses and injuries and assigns a disability value to each of them. This disability value ranges from a small fraction of a life year for a minor injury (such as a sprain, at 0.064 of a life year) to permanent disabilities such as a spinal cord injury, which has an ongoing annual DALY fraction of 0.725 (where 1.00 would be death). So someone who experiences a sprain loses 6.4% of the value of their quality of life in the year in which the sprain occurs. The person with a spinal cord injury loses 72.5% of their quality of life through disability in each year they continue to experience that disability (most likely for the rest of their life).

The value of a DALY in New Zealand is estimated at $168,500. This value inflates an estimate by O'Dea and Wren (2010) in 2008 by the GDP deflator to March 2014.[8]

Proxy DALY values were used to represent four levels of injury. Death from injury carries an annually recurring loss of $168,500 (a ratio of 1.00 DALYs, recurring annually over the expected life of the individual).[9] Permanent disability due to an injury that does not allow the worker to return to work is assigned a value of 0.544 DALYs, also recurring annually across the analysis period.[10] Other severe injuries that are not permanent use the DALY ratio estimated by the WHO at 0.153 for a single year. Minor injuries such as sprains and the like assume a ratio of 0.064 DALYs for one year only.

Figure 8 Annual improvement in quality of life from WAH guidance

Step / component	Notes / source	
DALY	2008 estimate updated to March 2014	$168,500
DALY value by injury type		
Fatality	Definition of a DALY	1.000
Permanent disability	Injured spinal cord as example	0.544
Severe injury	Broken arm as example	0.153
Non-severe injury	Sprains as example	0.064
Annual national improvement in worker quality of life		**$9,046,014**
Fatality	Recurring annual cost	$101,076
Permanent disability	Recurring annual cost	$1,960,018
Severe injury		$1,742,620
Non-severe injury		$5,242,299
Improvement in worker quality of life per project		**$178.07**
Fatality	Recurring annual cost	$1.99
Permanent disability	Recurring annual cost	$38.58
Severe injury		$34.30
Non-severe injury		$103.19

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Deaths and permanent disabilities incur a **recurring annual cost**, meaning the importance of reducing deaths and injuries increases **exponentially** over time (see Figure 9). This is because the dollar value of each year's deaths and permanent disabilities prevented are added to the ongoing benefit of lives saved and permanent disabilities avoided in every preceding year of the analysis.[11] As a result, the quality of

[8] O'Dea, D; and Wren, J. (2010). *Five-year evaluation: New Zealand estimates of the total social and economic cost of "all injuries" and the six priority areas respectively, at June 2008 prices*. New Zealand Fire Service.

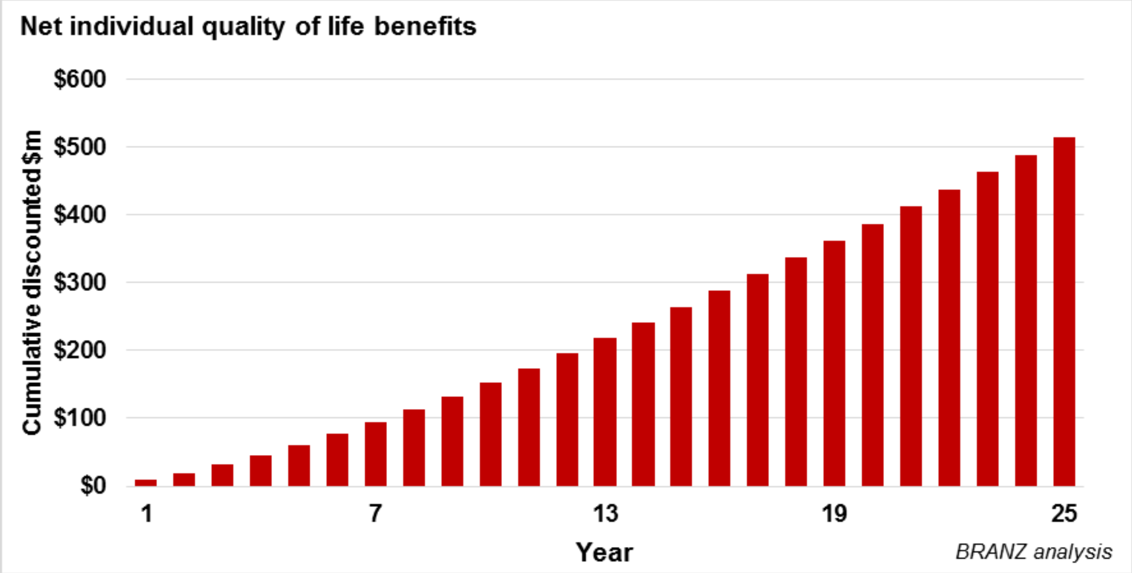
[9] Note that our analysis is limited to a 25-year period, so the annual recurring cost of lost quality of life captured is not in fact the whole-of-life cost of permanent disabilities and deaths prevented due to the WAH programme. It could be argued that this represents a large underestimate of benefits. The average age of injured workers is around 28, suggesting that they would otherwise be expected to have well over 25 years of additional life and health.

[10] This is a composite DALY value based on a group of representative long-term injuries that could be sustained from FFHs including: amputation—foot, leg or arm; motor deficit; mental retardation; vision loss; paraplegia; quadriplegia; hearing loss; severe or profound handicap; injured spinal cord.

[11] This is not the case for non-severe and other severe injuries, which are assumed to have an impact on quality of life only in the year in which they occur. We do not allow for the possibility that workers may leave workforce or may be less productive due to the stress of a prior workplace injury affecting resulting in long-term emotional distress or loss of confidence.

life benefits of reduced injuries rises from around 17% to around 56% of **annual** benefits over the 25 years of the analysis.

Figure 9 The growing benefit of lives saved and injuries avoided



4.3 Benefits to the taxpayer

Benefits to the taxpayer are predominantly through reduced healthcare and compensation for lost earnings covered by ACC when workers get injured, and through fewer WorkSafe NZ investigations required. Total benefits to the taxpayer are estimated at $1.6 million a year, or $31 per project.

4.3.1 Reduced healthcare and compensation for lost employment earnings

By reducing the number of injuries, the WAH programme is associated with lower healthcare and compensation for lost earnings. Figure 10 shows the estimated annual healthcare and ACC compensation for lost earnings. Healthcare costs and compensation for lost earnings are estimated to fall by about **$1.4 million per year at an annual level, or around $27 per project**.

WorkSafe NZ estimates that the whole-of-life cost to ACC of injuries in the construction industry is around $2,000. This is split between **severe** injuries (including permanent disabilities), which have a whole-of-life cost of around $14,000, and non-severe injuries with a whole-of-life cost of under $300.

Reduced injuries due to the WAH programme result in a commensurate reduction in healthcare and compensation for lost earnings borne by the taxpayer will occur.

Figure 10 Annual reduction in ACC costs from WAH guidance

Step / component	Notes / source	
Healthcare costs by accident type		
Fatality	Assumption of near-instant death	$0
Severe injury (including permanent disability)	WorkSafe NZ	$14,000
Non-severe injury	BRANZ calculation, WorkSafe NZ	$270
Annual national healthcare cost savings		**$1,377,101**
Fatality		$0
Severe injury (including permanent disability)		$1,245,849
Non-severe injury		$131,252
Healthcare savings per project		**$27.11**
Fatality		$0.00
Severe injury (including permanent disability)	Broken limb to permanent disability	$24.52
Non-severe injury	Minor sprain or muscle injury	$2.58

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4.3.2 Reduced WorkSafe NZ investigation costs

One further cost associated with injuries is the cost of investigating serious injuries and fatalities. WorkSafe NZ is informed whenever a serious injury is recorded at a place of work, via Serious Harm Notifications (SHNs). Where necessary, WorkSafe NZ investigates these incidents, often at considerable cost.

Figure 11 shows the estimate of national and per project incident investigation costs. Annually, a reduction in FFHs is expected to reduce investigation costs by $148,000, or $3 per project.

WorkSafe NZ were able to provide an approximate estimate of the cost of investigating a fatality. As data on the cost of investigating a "life-altering injury" as described by WorkSafe NZ was not available, it was conservatively estimated that this cost was only 30% of the cost of investigating a fatality. It was further assumed that the cost of all other severe injury investigations would be around $1,000 each (It is assumed only around one in four is investigated, at an average cost of $4,000).

It is important to note that the estimate of costs does not include legal costs associated with prosecutions, so this is again likely to be a **conservative estimate of costs saved**.

Figure 11 Annual reduction in incident investigation costs from WAH guidance

Step / component	Notes / source	
Investigation costs by accident type		
Fatality	Worksafe NZ	$30,000
Permanent disability	Worksafe NZ	$12,000
Severe injury	Worksafe NZ	$1,000
Non-severe injury	Worksafe NZ	$0
Annual national investigation cost savings		**$148,231**
Fatality	Worksafe NZ	$17,996
Permanent disability	BRANZ estimate	$61,725
Severe injury	BRANZ estimate	$67,595
Non-severe injury		$0
Investigation cost savings per project		**$2.90**
Fatality		$0.35
Permanent disability		$1.22
Severe injury		$1.33
Non-severe injury		$0.00

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5. UNDERLYING ASSUMPTIONS AND CALCULATIONS

This section briefly introduces the underlying assumptions used across several of the cost and benefit calculations.

5.1 Number and rate of injury by type pre and post-WAH programme

The most important calculation in this study was to estimate the number of injuries of various severities before the WAH programme was introduced, and how the WAH programme may have impacted injury rates. The change in injury rates affects calculations on:

- Reduced sick leave
- Reduced work disruption
- Reduced taxpayer ACC healthcare and compensation for employment claims
- Reduced investigations
- Improved quality of life.

5.1.1 Fatalities in construction

ACC data on the number of fatalities per year in construction is available. For the three years prior to the WAH programme being launched (to December 2011), there were an average of **25.7 fatalities a year in construction**.

5.1.2 Severe injuries (including permanent disabilities) in construction

Severe injuries were defined as those that were subject to entitlement payments such as weekly compensation, rehabilitation, and death payments as per the ACC definition. For the three years prior to the WAH programme being launched, there were an average of **3,808 severe injuries a year in construction**.

Some of these injuries would be permanent disabilities, while others would be less severe, such as a broken limb, which may allow a worker to return to work after an appropriate amount of time.

Data on what proportion of severe injuries were what WorkSafe NZ refers to as "life-altering" (a proxy for permanent disability) was not available. However, before the introduction of the WAH programme, FFHs accounted for around 13.5% of all construction Serious Harm Notifications (SHNs). Assuming that FFHs accounted for the same proportion of investigations of life-altering injuries by WorkSafe NZ, suggests that there were around **915 life-altering injury** investigations in construction per year in the two years prior to introducing the WAH programme.[12]

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[12] The figure of 915, or 24% of all severe injuries, seems like a large number of construction workers receiving life-altering injuries each year (around 4% of all construction injuries recorded by ACC). Another possibility is that falls from heights accounted for a greater proportion of investigations than the assumed 13.5% before the WAH programme was introduced. But this would have the knock-on implication that falls from heights injuries were more likely to be investigated than other injury types, and were therefore more likely to have been life-altering. In other

5.1.3 Non-severe injuries in construction

In addition to the 25.7 fatalities and 3,808 severe injuries recorded by ACC per year over the three years prior to the introduction of the WAH programme, there were an estimated **20,800 non-severe injuries**.

5.1.4 From construction to residential construction injury rates

The focus of this study is on the costs and benefits of the WAH programme on the residential sub-sector, so it was important to split out residential construction injury rates from overall construction injury rates.

WorkSafe NZ were able to provide a breakdown of SHNs by construction sub-sector. SHNs for the five years to October 2013 are shown in Figure 12.

Figure 12 SHNs by sub-sector from 2008 to 2013

	Building Construction								
Year	Residential Building Construction	Non-Residential Building Construction	Non-Building Construction	Site Preparation Services	Building Structure Services	Installation Trade Services	Building Completion Services	Other Construction Services	TOTAL
Nov 2008 - Oct 2009	66	86	125	21	52	67	66	171	655
Nov 2009 - Oct 2010	63	71	116	17	46	59	76	169	617
Nov 2010 - Oct 2011	89	80	86	24	39	89	68	203	678
Nov 2011 - Oct 2012	110	95	91	26	33	70	50	220	695
Nov 2012 - Oct 2013	114	83	75	36	50	65	61	188	671

WorkSafe NZ, BRANZ analysis

In addition to the SHNs for the residential building construction sub-sector, there were many more SHNs in, for instance, "other construction services" or building structure services (such as roofers, machinery operators and so on). BRANZ has done previous work assigning workers from the various trades and sub-sectors to the three main construction sub-sectors. This made it possible to estimate the number of SHNs for the higher-level residential, non-residential, and non-building sub-sectors, as presented in Figure 13.

Figure 13 Estimated SHNs by sub-sector

	Sub-sector		
Year	Residential	Non-residential	Non-building
Nov 2008 - Oct 2009	293	179	183
Nov 2009 - Oct 2010	285	157	175
Nov 2010 - Oct 2011	341	179	158
Nov 2011 - Oct 2012	348	184	162
Nov 2012 - Oct 2013	360	172	139

WorkSafe NZ, BRANZ analysis

This calculation assumes that workers in the three main sub-sectors are likely to be subject to a SHN in proportion to each sub-sector's share of workers in each of the eight more detailed sub-sectors. Given that:

- a higher proportion of work in the Non-building sector is not done at heights

words, the quality of life benefit per injury from a reduction in falls from heights associated with the WAH programme would be higher. As these factors balance each other out (lower total number of life-altering injuries in construction, but a higher proportion of those life-altering injuries being from falls from heights), the net overall impact of revising these numbers up or down would be zero.

- stricter WAH guidance was in place in the non-residential sub-sector prior to introduction of the WAH programme
- the non-residential and non-building sub-sectors are dominated by larger firms

it is possible this apportioning SHNs across sub-sectors based on number of workers underestimates the scale of serious injuries in the residential sub-sector. If anything, this **could underestimate the benefit of reducing FFHs** in the residential sub-sector, meaning the values presented in this report are likely to be conservative. This point is highlighted again below.

5.1.5 The impact of the WAH programme on injury rates

Data is not available on how the WAH programme has affected non-severe injury rates. However, we do know the following:

- How the number of SHNs and investigations for FFHs has changed since the introduction of the WAH programme
- How the number of SHNs in construction overall has changed.

This made it possible to estimate the impact of the WAH programme on reducing the number of SHNs in the residential construction sub-sector.

Figure 14 shows the SHN rates in the residential sub-sector before and after implementation of the WAH programme. It also shows a normalised injury rate, which is explained later. October years have been used because October 2011 was when the WAH programme was first introduced. The programme was rolled out over several months, with much of the new guidance being published in April to June 2012. As a result, the figure compares rates for the October 2011 year and the October 2013 year.[13]

Figure 14 SHN rates pre- and post-WAH programme implementation

				SHN rate per 1000 workers			Decline in rates Oct11 to Oct13	
Residential	**SHNs**	**FFH SHNs**	**Workers**	**Total**	**FFH**	**Non-FFH**	**FFH**	**Non-FFH**
Nov 2010 - Oct 2011	**340.9**	45.8	88,120	3.87	0.52	3.35	*NA*	*NA*
Nov 2012 - Oct 2013	**360.3**	36.5	103,524	3.48	0.35	3.13	67.9%	93.4%
Normalised FFH rates	***374.0***	*50.2*	*103,524*	*3.61*	*0.48*	*3.13*	*93.4%*	*93.4%*

BRANZ analysis

FFH SHNs data was apportioned based on the proportions of total SHNs accounted for by each sub-sector. This assumption is subject to the same caveats raised previously, where it was suggested that the number of FFH SHNs in the residential sub-sector may be higher than the estimates included here due to the nature of the residential sub-sector, and the fact that other sub-sectors have been subject to more stringent guidance for some time. A higher estimate of the number of FFH SHNs would further increase the

[13] As better data becomes available over time, it will be useful to revisit this question to see if SHN rates for falls from heights continue to fall or remain at lower levels.

benefits of a reduction in falls from heights, meaning we have once again taken a conservative approach to measuring benefits.

The overall SHN **rate** for residential construction is estimated to have fallen from around 3.87 in the October 2011 year to 3.48 in the October 2013 year. This is remarkable given both the increased workload and number of people in the industry (up by 15,000 in two years), and greater awareness of health and safety and enforcement. One may have expected reporting to have increased, and for recorded SHNs to have risen. This suggests an improvement in safety across the residential sub-sector.

Yet almost half of the improvement in SHN rates appears to have been the result of a fall in FFH SHNs. FFH SHN **rates** fell 32.1%, compared with a 6.6% decline in SHN rates for all non-FFH harm.

It can be argued that even much of the decline in the **non-FFH SHN** rates could be due to the WAH programme raising general awareness of safety, and due to greater enforcement encouraging workers to also ensure they comply more closely with guidance on other risk factors.

In the sensitivity analysis, a scenario where the full reduction in SHN rates is attributed to the WAH programme is considered, but here only the extent to which FFH SHN rates fell further than non-FFH SHN rates is considered. In other words, the assumption is that FFH SHN rates would have fallen 6.6% even without the WAH programme, in line with non-FFH SHN rates. **This minimises the share of the fall in SHN rates ascribed to the WAH programme**.

Figure 14 shows that if FFH SHN rates are normalised for the reduction in non-FFH SHN rates of 6.6%, an estimated **374 SHNs** would have been made in the year to October 2013, **rather than the 360 that were made**. In other words, the introduction of the WAH programme appears to be associated with **a fall in SHNs of at least 13.7 a year** in the residential construction sub-sector, or a **3.7% reduction in residential sub-sector SHNs**. As already pointed out, the reduction could be higher, but a conservative estimate has been adopted.

WorkSafe NZ data also indicates that SHNs do not capture the full story of serious harm. More **investigations** are undertaken than **SHNs** made. For instance, over the three years to October 2013, there were 254 SHNs for FFHs, but 326 investigations. In other words, SHNs are still not capturing all injuries that are life-altering and worthy of investigation. This is why the estimated number of injury **investigations** across construction is estimated at 915 a year prior to the WAH programme, compared with around 680 **SHNs**.

Assuming a 3.7% reduction in injuries of the various type – fatalities, permanent disabilities, other severe injuries, and non-severe injuries – yields the following **annual** reductions in injuries associated with the WAH programme (based on the estimated number of projects and residential construction workers):

- 22 fatalities and life-altering injuries / permanent disabilities per year
- 68 other severe injuries per year

- 486 non-severe injuries per year.

5.2 Real discount rates

A real discount rate of 6.0% is applied to all costs and benefits other than quality of life benefits. A lower real discount rate of 3.5% is applied to quality of life impacts in line with World Health Organisation and New Zealand Fire Service studies.[14]

5.3 Analysis period

A 25-year analysis period is assumed, a typical analysis period for cost-benefit studies. It must be pointed out that using 25 years means the full extent of the quality of life benefits are likely to be underestimated as many of the benefits of not experiencing a life-altering injury or death would continue beyond 25 years. The lower real discount rate used for future quality of life benefits (3.5%) indicates two things:

- People value their quality of life to the extent that they do not place significantly lower value on future quality of life benefits the way they often do on financial benefits
- A longer analysis period could dramatically increase the BCR as significant health benefits of reduced injuries would still accrue. A sensitivity analysis for a 30-year analysis period is conducted in this study.

5.4 2014 Dollars

All dollar values are expressed in March 2014 dollars. In other words, all values are expressed in real dollars of today.

5.5 Number of projects per year

The number of residential new builds is assumed to be around 22,300 a year for the 25 year analysis period, which is the average over the last 20 years. This provides a mix of slow building years and busy building years.

It is further assumed that on average, around 28,500 residential A&A projects are undertaken each yea, the average for the last 20 years. This figure has remained remarkably steady across the economic cycle, according to Statistics New Zealand data.

5.6 Number of workers in residential construction

A combination of Household Labour Force Survey (HLFS) and Business Demography (BD) data was used to estimate employment in residential construction today.

First, proportions of workers in the trades (e.g. roofing, bricklaying, and plumbing services) who work in the residential (as opposed to the non-residential or non-building sector) were estimated.

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[14] See for instance: O'Dea, D; and Wren, J. (2010). *Five-year evaluation: New Zealand estimates of the total social and economic cost of "all injuries" and the six priority areas respectively, at June 2008 prices*. New Zealand Fire Service.

These proportions were applied to estimates of the total number of workers in each of these trades in each of the last several years so we could estimate accident rates within the residential sub-sector prior to the change in WAH guidelines. These total estimates of workers in each trade were themselves estimated by scaling 2013 employment numbers up by the change in total employment in each trade in recent years relative to changes in overall construction.

For the **projected** number of workers in the residential construction sib-sector required to complete the 22,300 new builds and 28,500 A&A projects per year, we considered the typical workload of workers in residential construction over the last 10 years. Workload was determined by weighting new build and A&A work by calculating the value ratio of new build and A&A work for each of the last 10 years. Typically, new build projects are 5.6 times larger than A&A projects in value terms.

Knowing the relationship between the scale of A&A and new build projects made it possible to estimate the number of "work units". For instance, (5.6 X 22,300) + 28,500 = 153,380 work units per year over the 25 years of the projection. Taking the median work units per worker rate over the last 10 years (to avoid outliers) suggested that there is one residential construction worker per 1.25 work units. We could thus estimate that around 123,000 workers would likely work in residential construction on average over the next 25 years, of whom an estimated 97,200 would work at heights at some point in their work.

5.7 Average labour productivity per worker

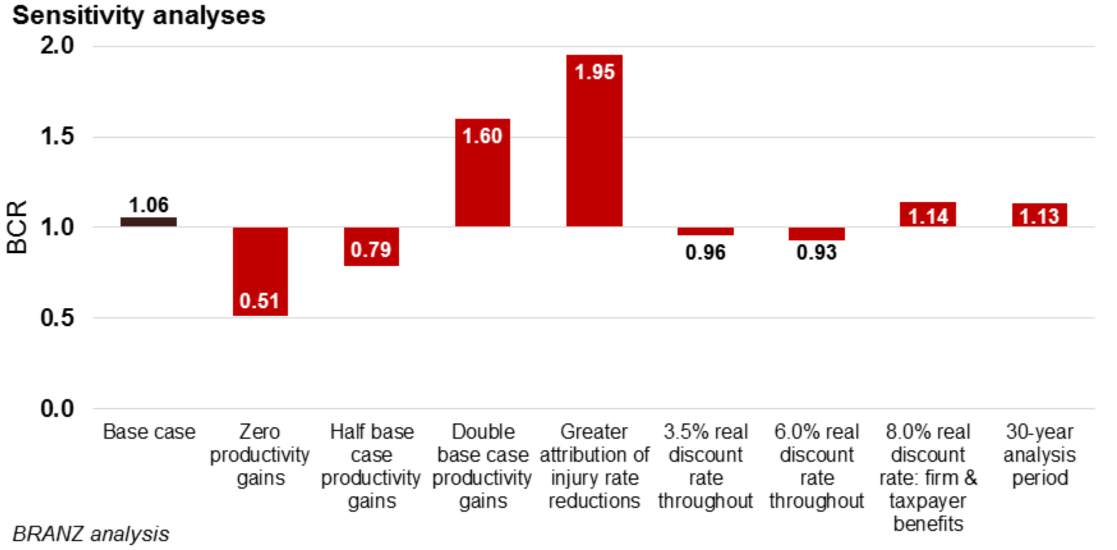
Relative labour productivity across sub-sectors was estimated using Statistics New Zealand estimates for 2011. This data was multiplied by the number of workers per sub-sector and then scaled such as that the total value added by all workers was equal to the GDP produced in the year to March 2014.

These labour productivities were then weighted by the number of workers in each sub-sector attributed to the residential construction sub-industry, to determine an overall labour productivity of residential construction workers.

6. SENSITIVITY ANALYSIS

Several sensitivity analyses were conducted to evaluate the importance of various assumptions used in the analysis. The base case BCR of 1.06 is compared with sensitivity test results. The results of these tests are set out in Figure 15.

Figure 15 Sensitivity test results



BRANZ analysis

Given the mix of productivity gains seen by different builders, often depending on their approach to health and safety regulations and regulators, three sensitivity tests related to productivity gains are presented – zero gains, half the gains estimated in the base case, and double the gains in the base case. These three assumption changes yield large fluctuations in the overall BCR.

The argument has been made that many of the reductions in overall injury rates in the residential sub-sector may well be because of greater enforcement of the WAH guidelines. This well-publicised approach may be encouraging workers to be more careful in other aspects of health and safety. As an upper bound test for attributing reduced injuries to the WAH programme, it is estimated that the programme may have led to as much as a 10% reduction in residential sub-sector injuries. This would imply a BCR of 1.95.

Variations in the real discount rates applied do not make significant differences to the BCRs.

Extending the analysis period by just five more years to 30 years captures a large number of additional quality of life benefits that are not captured in the base case analysis, such that the BCR rises to 1.13.

7. LIABILITY AND INDEMNIFICATION

BRANZ's agreement with its Client in relation to this report contains the following terms and conditions in relation to ***Liability and Indemnification:***

a. Limitation and Liability
   i. BRANZ undertakes to exercise due care and skill in the performance of the Services and accepts liability to the Client only in cases of proven negligence.
   ii. Nothing in this Agreement shall exclude or limit BRANZ's liability to a Client for death or personal injury or for fraud or any other matter resulting from BRANZ's negligence for which it would be illegal to exclude or limit its liability.
   iii. BRANZ is neither an insurer nor a guarantor and disclaims all liability in such capacity. Clients seeking a guarantee against loss or damage should obtain appropriate insurance.
   iv. Neither BRANZ nor any of its officers, employees, agents or subcontractors shall be liable to the Client nor any third party for any actions taken or not taken on the basis of any Output nor for any incorrect results arising from unclear, erroneous, incomplete, misleading or false information provided to BRANZ.
   v. BRANZ shall not be liable for any delayed, partial or total non-performance of the Services arising directly or indirectly from any event outside BRANZ's control including failure by the Client to comply with any of its obligations hereunder.
   vi. The liability of BRANZ in respect of any claim for loss, damage or expense of any nature and howsoever arising shall in no circumstances exceed a total aggregate sum equal to 10 times the amount of the fee paid in respect of the specific service which gives rise to such claim or NZD$50,000 (or its equivalent in local currency), whichever is the lesser.
   vii. BRANZ shall have no liability for any indirect or consequential loss (including loss of profits).
   viii. In the event of any claim the Client must give written notice to BRANZ within 30 days of discovery of the facts alleged to justify such claim and, in any case, BRANZ shall be discharged from all liability for all claims for loss, damage or expense unless legal proceedings are commenced in respect of the claim within one year from:
      - The date of performance by BRANZ of the service which gives rise to the claim; or
      - The date when the service should have been completed in the event of any alleged non-performance.

b. Indemnification: The Client shall guarantee, hold harmless and indemnify BRANZ and its officers, employees, agents or subcontractors against all claims (actual or threatened) by any third party for loss, damage or expense of whatsoever nature including all legal expenses and related costs and howsoever arising relating to the performance, purported performance or non-performance, of any Services.

c. Without limiting clause b above, the Client shall guarantee, hold harmless and indemnify BRANZ and its officers, employees, agents or subcontractors against all claims (actual or threatened) by any party for loss, damage or expense of whatsoever nature including all legal expenses and related costs arising out of:
   i. any failure by the Client to provide accurate and sufficient information to BRANZ to perform the Services;
   ii. any misstatement or misrepresentation of the Outputs, including Public Outputs;
   iii. any defects in the Products the subject of the Services; or
   iv. any changes, modifications or alterations to the Products the subject of the Services.