Quantifying the Intangible Benefits of Stabilisation

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ABSTRACT

The tangible and intangible benefits of incorporating chemical stabilisation as a design option for new or rehabilitated pavements can be substantial. Social benefits can be accrued through a reduction in traffic delays while environmental benefits can include reutilisation rather than disposal of existing material, and the quarrying\haulage of the replacement material.

The 2005 Whangaparaoa Road Four Laning was used as a case study to demonstrate these benefits. Due to the nature of the project, the travel time savings provided a significant proportion of assessed benefits. In other types of projects or design treatment options the benefits attained are expected to vary significantly depending on the site setting and specific project parameters (for example proximity to quarries, traffic volumes, adjacent development and availability of alternative routes).

It is recommended that for project evaluation the environmental and social benefits are considered in addition to the economic benefits as required by the New Zealand Resource Management Act.

While many of the benefits assessed for this paper are unconfirmed and possibly subjective, the main purpose has been to identify their significant influence on the evaluation process. This paper has attempted to demonstrate that the Project Evaluation Manual provides a solid base from where these benefits can be included in contract evaluations. Contract specifications need to be more flexible to allow tenders to demonstrate intangible benefits and innovation – without the need to have an accompanying alternative tender that may not be incorporated into the evaluation process.

Until the Weighted Attributes evaluation method is widely accepted in conjunction with a flexible tender document, significant social, environmental and economic benefits will be overlooked.

1 INTRODUCTION

The stabilisation of pavements is a technology that is well recognised throughout the world, and is playing an increasingly important role in the roading construction industry in New Zealand. The methods by which subgrades and base courses are stabilised, and the economic benefits associated with the construction of a stabilised pavement are well established and comprehensively documented.

There are many positive benefits associated with stabilisation that are often not considered as part of the standard evaluation process, while the perceived risk generally is. This paper assesses several social and environmental benefits and provides some simple cost estimations. The categories to which these benefits apply correspond to those used in Transit New Zealand's triple-bottom line reporting standards. However, this paper aims to improve the current reporting procedures by quantifying some of the economic, environmental and social benefits; a process which appears to have not consistently occurred in the past.

The current methods for tender evaluation under Transfund's 'Competitive Pricing Procedures' are reviewed, and the practices used to apply intangible benefits are discussed. Finally this paper considers potential barriers to increasing the importance of intangible benefits in pavement evaluation, and what is required to align these practises with New Zealand's "pure green" aspirations.

In the course of preparing this paper, a balanced approached was achieved by inviting a recognised consultant to be co-author of this paper, while several other consultants reviewed all or part of this paper.

2 QUANTIFIED TANGIBLE BENEFITS

2.1 ECONOMIC BENEFITS

2.1.1 Construction

When a stabilised pavement is to be used as part of a construction or rehabilitation project, it is typically because of the cost and design/performance benefits associated with this type of pavement. The cost of purchasing and mixing a binder throughout the pavement materials is inherently cheaper than purchasing, transporting and compacting high volumes of aggregate. Savings in the order of 30% are typical, although it has been known for savings to reach in the order of 50%. Examples of cost savings associated with stabilised pavements were reported as 18 – 27 % (Boocock: 2004) and the Gisborne District Council has recorded savings of 34%, typical for stabilised pavements.

However in the process of stabilising 20 km of pavement the Hurstville City Council (Sydney, Australia) recorded construction cost savings close to 60%.

A case study has been used in order to demonstrate how many of the benefits discussed in this paper can be quantified. The case study chosen is the 4-laning of Whangaparaoa Road, which utilised a stabilised basecourse pavement that was implemented as an alternative design to the conforming TNZ M/4 granular overlay.

Details regarding the pavement design options are presented in another paper at this conference, however in a general sense, the pavement options (both providing a 25-year design life) were:

- Conforming granular pavement:
  TNZ M/4 AP40 overlay & basecourse = 10,300m^3
  AC14 shape correction (existing within 100mm finished levels) = 700m^3

- Alternative stabilised pavement:
  GAP65 overlay & basecourse = 10,600m^3
  Stabilise GAP65 & existing basecourse = 38,320m^2

The wearing course was the same for both of the pavement options, therefore it is not included in the above figures. The volume of GAP65 required for the alternative pavement was slightly larger than that required for the conforming pavement as the designed finished levels of the pavement were altered after the quantities stated in the contract were calculated (i.e. conforming quantities would be increased).

The contractor's rates for M/4 AP40 aggregate were approximately twice that of the locally available GAP65. The cost of stabilising the GAP65 in order to provide (at least) the same performance of M/4, was relatively small compared to the cost of TNZ M/4 itself, so the alternative design was an attractive option.

2.1.2 Construction Time

The construction of a stabilised pavement is inherently quicker than that of a granular pavement. This paper utilises the actual construction time of the pavement and compares it to the time it would have taken to build a conventional, conforming pavement. Some of the intangible expenses associated with a road works project have been assumed to be consistent per day for both construction methods, but it is the difference in construction time that provides some of the benefits of stabilisation.

Some of these benefits would be difficult to assign a monetary value to. For example, an increased number of days to construct a pavement results in an increased chance that the program will be delayed further by inclement weather. If an assumption was made that, say, 1 day in every 6 was lost due to weather, some of the benefits recognised in this paper would increase further. The stabilisation program would have a slight increase from 12 days to 14, but the conventional pavement would require 33 days instead of 28. These figures are not included in the calculations in this paper, but are provided for discussion purposes.

Several items in a project schedule may be directly influenced by the construction time, although this is not always made apparent in the tender documents. One example is traffic control and site management/supervision, which have been assumed to cost the client $1500 per day on a typical site for a contract of this scope.

- Conforming granular pavement: $1500 x 28 = $42,000
- Alternative stabilised pavement: $1500 x 12 = $18,000

Where heavily trafficked strategic arterials require rehabilitation / pavement construction lane rentals are becoming more common. With the high costs (up to $10,000/day depending on environment) and risks attributed to the duration of lane rentals a reduction in construction time where quicker design options are feasible can provide significant benefits

2.1.3 Reduced Maintenance Expenditure

When pavement design options are being considered, it appears that most cost comparisons between stabilised and non-stabilised options relate primarily to the initial construction cost (capital cost). On-going maintenance costs of the stabilised pavement are generally considered identical to those of a conventional pavement, despite there being reasonably wide agreement that a well constructed stabilised pavement is less likely to rut or densify compared to a conventional pavement, resulting in lower maintenance costs. This is reinforced by figures from the Gisborne District, where it has been noted that maintenance costs for stabilised pavements with 8 years service are 65-70% less than those of conventional pavements.

Initial test data compiled by Transit New Zealand's Engineering Policy Manager, Dr Greg Arnold, shows that every 1 million Equivalent Standard Axles on a granular pavement increases rut depth by 2 mm, but this figure reduces to 0.5 – 1.0 mm for a stabilised pavement.

Furthermore, the risk of an early pavement failure is reduced if a stabilised pavement is chosen when building in wet conditions, as was the case for Whangaparaoa Road.

If the full life-cycle costs of the stabilised pavement were determined and taken into consideration, this would have a beneficial effect on the benefit-cost ratio.

The following analysis and maintenance schedule has been adapted from a paper by AustStab titled "Life Cycle Costing of Stabilised Pavements". The maintenance patterns for a stabilised pavement are estimated on this basis and compared to those of a conventional granular pavement, and the expenditure required is calculated in terms of the Net Present Worth.

- Conforming Pavement
  - Patching granular base to 200mm with thin A/C surfacing @ \$60/m^2, patching 1% of pavement at year 3,6,9,12,15,18:
    0.01 x \$60 x (0.751 + 0.564 + 0.424 + 0.319 + 0.239 + 0.18) = \$1.49
  - Reseal @ \$2.50/m^2 at years 8 and 16:
    \$2.50 x (0.467 + 0.218) = \$1.71
    TOTAL = \$3.20/m^2 = \$122,500

- Alternative Pavement:
  - Patching stabilised base to 200mm with A/C surfacing @ \$90/m^2, patching 1.5% pavement at year 10:
    0.015 x \$90 x 0.386 = \$0.52
  - Reseal @ \$2.50/m^2 at years 8 and 16:
    \$2.50 x (0.467 + 0.218) = \$1.71
    TOTAL = \$2.23/m^2 = \$85,500

2.1.4 Salvage Value

The salvage value of a pavement is the residual value of the pavement at the end of the analysis period. The Austroads Pavement Design Manual states that the salvage value of a pavement is dependant on things such as:

- the continued use of the existing alignment
- the feasibility of upgrading the existing pavement by using an overlay
- the possibility of recycling the pavement materials
- any need to remove the pavement materials prior to reconstruction

The AustStab paper "Life Cycle Costing of Stabilised Pavements" states that the salvage value of some pavements can be as high as 20% of the initial rehabilitation cost of the pavement. This is because less cementitous binder is required the second time the pavement is stabilised, while the seal is distributed throughout the pavement resulting in an improved particle size. The AustStab paper does not refer to the fact that there is often a need to introduce new aggregate to the pavement a second time it is being stabilised due to a reduction in particle size. However the AustStab paper does assume that if a new analysis period was used once a pavement had reached 16 years of age, the remaining life of a conventional pavement is worth 50% of its construction cost, but for a stabilised pavement the figure is 62.5%. If these figures are extrapolated to the end of the 25 year design life for the Whangaparaoa Road example (assuming construction cost of $2,000,000 and remaining life worth 15% for conventional and 25% for alternative pavement), the benefits of a stabilised pavement are observed:

- Conforming = $2,000,000 x 15% = $300,000
- Alternative = $2,000,000 x 22% = $440,000

3 QUANTIFIED INTANGIBLE BENEFITS

3.1 ECONOMIC BENEFITS

3.1.1 Vehicle Operating Costs (VOC)

While vehicles are idling in traffic queues, the running costs increase, in the form of fuel, oil, and general maintenance costs. A simplified analysis was used to model the effect of vehicle delay over the contract period. The PEM states that each stationary vehicle on an 'urban arterial' costs 1.82 cents / minute. In order to calculate the VOC of each vehicle it was assumed that the delay time was equivalent to the time that the vehicle is stationary (conservative as the speed change and low-speed travel was not included in analysis). The assessed average stationary time is 60 min. (refer 3.2.1).

Morning peak:	60 min/veh x 2,000 veh/day x $0.0182/min	=	$2,184
Daytime inter-peak:	10 min/veh x 16,000 veh/day x $0.0182/min	=	$2,912
Afternoon peak:	60 min/veh x 2,000 veh/day x $0.0182/min	=	$2,184
Total per day:		=	<u>$7,280</u>

The total time requirement for each construction option and the corresponding travel time cost has been calculated by comparing the original construction schedule to the construction times that were actually achieved.

- 28 day conforming pavement: $7,280 x 28 = $203,840
- 12 day alternative stabilised: $7,280 x 12 = $87,360

3.2 SOCIAL BENEFITS

3.2.1 Travel Time Delays

While a road pavement upgrade is underway, delays are inevitable. On many occasions entire lanes need to be closed down, while in other instances lane blockages may not be required but traffic will still need to travel at a reduced speed through the construction site.

A simplifying assumption is required in order to determine the total travel time delays. The actual delay per vehicle is assumed to be constant regardless of the construction method used, however the number of days required for pavement construction is altered. A New Zealand Herald Article dated 8th June 2005 and titled "Whangaparaoa Commuters Revel Fast Run" reports that many peak-time commuters experienced delays in the order of 2.5 hours. It has been assumed that 4,000 vehicles per day (2000 in each peak) were delayed by 1 hour, and the remaining 16,000 were delayed by 10 minutes.

The Project Evaluation Manual states that vehicles travelling on an "urban arterial" road at different times of day have varying associated travel time costs. The values below are in 2004 dollar terms, and are obtained from Table A4.3, which considers all traffic types.

Morning peak:	$15.88/hr
Daytime inter-peak:	$18.85/hr
Afternoon peak:	$15.71/hr

The travel time costs associated with each of the periods are:

Morning peak:	60 min/veh x 2,000 veh/day x $15.88 /hr	=	$31,800
Daytime inter-peak:	10 min/veh x 16,000 veh/day x $18.85 /hr	=	$50,300
Afternoon peak:	60 min/veh x 2,000 veh/day x $15.71 /hr	=	$31,400
TOTAL per day		=	<u>$113,500</u>

• 28 day conforming pavement	= $113,500 x 28	=	$3,178,000
• 12 day alternative stabilised	= $113,500 x 12	=	$1,362,000

Travel time delay can also have a profound effect on business that may not be included in the above figure. If a conventional pavement had been constructed at Whangaparaoa Road, the effect on business would likely have increased exponentially. Not only would employees struggle to travel to the office, visit clients or make deliveries, but fewer customers would be willing to travel through the continued delays in order to do their shopping.

3.2.2 Noise

Residents and occupants of buildings in the vicinity of a roading project can be adversely affected by increased noise caused by road construction projects. The Project Evaluation Manual states that the effects can be sleep disturbance (assumed not to occur with day-time construction projects), speech interference, psychological impacts, annoyance and other behavioural impacts due to stress related factors. The calculation given by the Project Evaluation Manual as the method to be used for determining the influence of noise is:

Disruption = $190/yr ($0.52/day) x decibel change x number of affected houses

For the purposes of the calculation it was assumed that 500 houses would be affected by construction noise and construction traffic. A road with 20,000 veh/day, 5% heavy commercial vehicles, 50 km/hr with AC surfacing is calculated to have an average theoretical noise production in the order of 65dB. Most construction standards limit noise generation to 75dB, although this is often exceeded in spikes. A conservative estimate would be to assume that the average noise level during a construction period was 70dB:

Noise affecting 500 houses per day:	0.52 x 5 x 500	=	$1,300
• 28 day conforming pavement:	$1,300 x 28	=	$36,400
• 12 day alternative stabilised:	$1,300 x 12	=	$15,600

3.3 ENVIRONMENTAL BENEFITS

Stabilisation offers many environmental benefits that may be briefly reviewed before a typical roading project, but they are not often quantified. The costs that are occasionally considered as part of a typical pavement design are the direct cost of the disposal of unsuitable/contaminated aggregate (if required), quarrying of the new aggregate, and the transport associated with these activities (inherently included in unit rates). Factors that are generally not considered include the diminishing quantity of premium aggregate available for quarrying, the environmental cost of an increased number of quarries, and carbon dioxide emissions.

The Resource Management Act (RMA) requires that environmental factors shall be considered by those in positions relating to the management of physical resources. However it could be debatable how many road-controlling authorities are conducting their business in accordance with section 7 of the RMA, which states:

“In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development and protection of natural and physical resources, shall have particular regard to …

(b) The efficient use and development of natural and physical resources.”

It is likely that there are many ways in which this condition can be applied to a roading project, but perhaps the most obvious is the efficient use of quarry materials. This not only applies to materials that will be quarried in the future, but also places an emphasis on reusing and recycling materials that have already been quarried.

3.3.1 Supplying New Material

When a pavement is constructed utilising unstabilised aggregate, a finite natural resource is being depleted. In New Zealand the base cost of the raw material includes remediation of the quarry site and further exploration for another quarry. However the environmental impacts of opening up an increased number of new quarries for a limited resource is not always considered in the purchase cost of the aggregate (although commercial realities mean that in the end the user pays). While it is obvious that the cost of aggregate from any particular quarry will relate to the expenses incurred in establishing that quarry, it seems unlikely that the cost would relate to the expense of opening a new quarry in, say, 10 years time.

In the UK the value of the limited quarry resource has been established at a quarry tax of £1.60 per tonne, although it is planned that this rate will rise, which is consistent with a world-wide trend. The environmental effects of depleting this natural resource for this assessment have been set at a level equivalent to the UK quarry tax, which is $4.00NZ per tonne. The cost for each of the options is:

• Conforming pavement:	10,300m^3 solid x 1.5	=	15,450 loose
	15,450m^3 x 1.6 t/m^3	=	24,720 tonnes
	24,720 tonnes x $4.00	=	$98,800
• Alternative stabilised:	10,600m^3 solid x 1.5	=	15,900 loose
	15,900m^3 x 1.6 t/m^3	=	25,400 tonnes
	25,400 tonnes x $4.00	=	$101,600

Note that the quantity of aggregate is quite similar for each pavement option in this project, so there is negligible variation when a quarry tax is considered. This was primarily due to a change in finished pavement levels. For many projects where stabilisation is employed, it is likely that there will be a greater difference in aggregate requirements, and that this will favour the stabilised pavement.

3.3.2 Carbon Dioxide Emissions

One of the primary causes of carbon dioxide emissions on roading projects are truck movements associated with the transportation and placement of materials, while the manufacture of binders, processing of aggregates and the quarrying / manufacturing processes also contribute to CO_2 emissions.

Truck emissions make up a significant proportion of the CO_2 emissions associated with the roading industry. For this analysis the quantity of aggregate and the location from where it is obtained has an impact on the total distance that the aggregate trucks must travel. When a stabilised pavement is used, marginal aggregates from local quarries can be used in place of a similar volume of M/4, which, due to more finite sources, often has to be transported from a more distant location.

In the case of Whangaparaoa Road, marginal aggregates from Flat Top Quarry (20 km from the project site) were used as an alternative to TNZ M/4 which was scheduled to come from a quarry in the Hunua Ranges – 90 km away. A total of 883 trips are required for the alternative pavement, and 853 for the conforming.

The Project Evaluation Manual states that carbon emissions are valued at $40/t, and that the emissions shall be calculated from:

CO_2 emissions (t) = Vehicle Operating Costs (VOC) x 0.0027

The Vehicle Operating Costs for an aggregate-laden truck (HCV-I) are given as 52.91 cents / km when traveling at 80 km/hr on a flat road (Table A5.8b of the Project Evaluation Manual)

Therefore the value of carbon emissions for each of the options is:

- Conforming pavement with aggregate from Hunua quarry:
  - 2 x 90 km x 853 = 153,540 km.
  - VOC = 153,540 km x $0.5291 / km = $81,238
  - CO2 = $81,238 x 0.0027 = 219t
  - Carbon Cost = 219t x $40 = $8,774

- Alternative pavement with aggregate from Flat Top quarry:
  - 2 x 20 km x 883 = 35,320 km.
  - VOC = 35,320 km x $0.5291 / km = $18,687
  - CO2 = $18,687 x 0.0027 = 50t
  - Carbon Cost = 50t x $40 = $2,000

When vehicles are delayed as part of a roading project they are obviously creating a larger volume of CO_2. The emissions of the vehicles that are on the road for a longer period of time are analysed in accordance with the PEM, utilising the VOC to calculate the volume of carbon dioxide emitted.

Carbon tonnes per day:	$11,648 x 0.0015	=	17.5t
Carbon cost per day:	17.5 x $40	=	$700

- 28 day conforming pavement: 28 x $700 = $19,600
- 12 day alternative stabilised: 12 x $700 = $8,400

One of the key components of a stabilisation project is the binder. While the environmental benefits discussed in this paper were achieved for Whangaparaoa Road, the question of binder production remains. The stabilisation of Whangaparaoa Road required 230t of cement, 200t of lime and 750t of KOBM (waste product from steel production). Cement production is responsible for 5% of carbon dioxide emissions world wide, and 222kg of CO_2 are released for every tonne of cement produced, so it is a factor that needs to be included in this analysis. In Europe planners often review the construction and production process to ensure that the most environmentally sound solution is found – and these reviews include binder selection.

- Conforming pavement: 0 tonnes of cement
- Alternative pavement: 230 tonnes of cement
  230 x 222 kg/t = 51 tonnes of CO_2
  51t x $40 = $2040

3.3.3 Air Pollution

The exhaust emissions from motor vehicles may include gases such as carbon monoxide and nitrogen oxide, while other small contaminants (known as particulates) are also generated from tyres, dust and diesel vehicle emissions. In the process of writing the PEM several reports have been reviewed in order to determine the cost associated with air pollution. Two methods are given for the calculation of this cost, and the simpler of the two is used here. The cost of air pollution (excluding CO2) from a light vehicle is set at 1 cent per km, while 20 cents per km is utilised for heavy vehicles (diesel engines). The effect of stationary delayed vehicles is not included in this analysis, but the trucks travelling to each of the two quarries is considered.

- Conforming pavement with aggregate from Hunua quarry:
  - 2 x 90 km x 853 = 153,540 km.
  - 153,540 km x $0.20 = $30,708

- Alternative pavement with aggregate from Flat top quarry:
  - 2 x 20 km x 883 = 35,320 km.
  - 35,320 km x $0.20 = $7,064

4 NON QUANTIFIED INTANGIBLE BENEFITS

4.1 ECONOMIC BENEFITS

4.1.1 Effects of Reducing Maintenance Expenditure

Section 2.1.3 demonstrates how the stabilised pavement option generally requires less maintenance than the conventional unmodified counterpart. Some of the effects associated with reduced maintenance are more difficult to quantify.

If a high proportion of pavements are constructed as typical granular pavements the maintenance costs associated with the entire road network are a lot higher. Consequently, a higher percentage of funds allocated to roading are spent on maintenance, rather than constructing new robust pavements. Furthermore, a reduced amount of funding for new projects results in fewer pavements being reconstructed, thus having a similar effect to compounding interest.

When viewed from another perspective, it could be stated that if more high-quality stabilised pavements were constructed, increased funds would be available for construction, since a smaller proportion of expenditure would continue to be required for maintenance.

The New Zealand Government recently approved an increase in the maximum loads that trucks are permitted to carry on New Zealand roads. Where a heavy vehicle's axle load is increased by 25%, it can be shown that applied stresses and the resulting damage to the pavement increases by the fourth power of the load on the axle with a significant increase in Equivalent Standard Axles (ESA). With the higher strengths that are achieved by a well constructed stabilised pavement, they are better suited to resist deformation due to an increase in traffic/axle loadings.

4.1.2 Damage to Existing Pavements

The damage caused to existing pavements in the vicinity of the project site by aggregate-laden trucks may be quite significant in reducing the pavement's useful life in some situations. They would thus increase the expenditure required to maintain the road in an acceptable condition. The effect that any extra trucks would have on existing pavements is highly dependant on the type and condition of the pavement.

In an area where the pavement is designed for heavy traffic (for example an arterial near a port) the extra trucks will not have a significant affect. Alternatively, if a residential street's pavement is already in a poor or marginal condition it will be adversely affected by the addition of heavy trucks transporting aggregates. If the site was located in a residential area of the network that was constructed within a short space of time, it is probable that all roads in the area are in a similar condition. If a high volume of aggregate-laden vehicles travels along a specific route to a granular-pavement reconstruction site, a series of roads leading to the site may be extensively damaged.

No monetary value has been used to quantify the damage caused to existing pavements because of the variability between sites. In the case of Whangaparaoa Road, the roads used to transport materials were high-volume roads, and the volume of the extra truck trips would be small when compared to the base flows, however the impact of construction traffic could be considerably larger in other projects.

4.1.3 Public Perception

The public at large is a dominant force in transportation policy. Whether the public is focused on traffic delays and the economic spin-offs, or ensuring the sustainability of the environment, roading can be a controversial topic of discussion.

No monetary value has been assigned to model the improved public perception that the benefits discussed in this paper provide, but there is undoubtedly an economic benefit associated with improving public perception of roading projects. These benefits may be in the form of an increased number of projects for a contractor, while other employees/subcontractors may enjoy increased financial security by remaining in their current employment.

4.2 SOCIAL BENEFITS

4.2.1 Safety around Road Works

Planning for safety around road works has become an increasingly important part of contract documentation in recent times. Even as recently as a few months ago, accidents and injuries around road works have become the focus of a dedicated campaign, with new signs and slogans appearing in order to refine the 'safety around road works' message to motorists.

If the time spent on any particular road construction project can be reduced, the exposure to risk of an accident is also reduced. There is no recognised way to quantify the benefits of improving safety in a numerical analysis, so we have not included it in the overall comparisons conducted in this paper. Rather, a method has been derived in order to demonstrate one way in which they could be recognised, and the benefits of adopting a stabilised pavement can be highlighted.

The total number of reported accidents that occurred around road works in the year 2000 was taken from the Site Safe website. In 2000 there were 90 minor injuries, 22 serious, and 3 fatal, which equates to 0.245, 0.060, and 0.008 per day respectively. Site Safe obtained these figures from the (then) Land Transport Safety Authority, who states that the figures are under reported. Nonetheless, they are used in conjunction with monetary values obtained from the PEM (Table A6.9), and the total cost of accidents per day (nationwide) was calculated.

If a high proportion of projects nation-wide were able to achieve similar time savings as achieved on Whangaparaoa Road, the productivity of the country would be increased.

Minor:	0.245 x $15,100	=	$3,700
Serious:	0.060 x $203,000	=	$12,200
Fatal:	0.008 x $2,280,000	=	$18,200
Total Injury Costs per day		=	$34,100

4.3 ENVIRONMENTAL BENEFITS

4.3.1 New Zealand Zero Waste Strategy

The New Zealand Government has adopted a Waste Management Strategy that provides guidelines and specific targets which are to be achieved over several years. An increased use of pavement recycling and stabilisation can form part of the overall strategy and aid in achieving some of the targets. Two of the guidelines that can apply to stabilisation are:

“By December 2005, all councils will ensure that procedures for waste minimisation have been addressed for all facilities and assets that manage and will have set target reductions based on public health, environmental, and economic factors.”

“By December 2005, all territory local authorities will have instituted a measurement programme to identify existing construction and demolition waste quantities and set local targets for diversion from landfills”

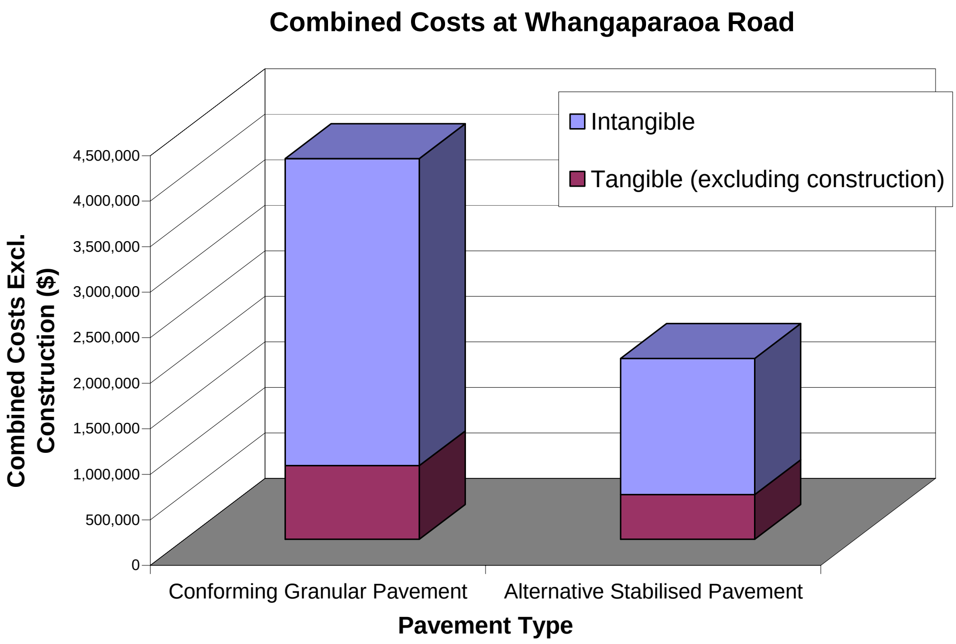
The benefits of stabilisation will be directly measurable when compared to the specific targets that are set by the waste strategy. These benefits should be viewed as an intangible benefit that can assist in achieving targets such as the one below:

“By December 2008, there will have been a reduction of construction and demolition waste to landfills by 50 percent of December 2005 levels by weight.”

4.3.2 Re-use of a Waste Material

The greatest proportion of stabilising binder used at Whangaparaoa Road was KOBM. KOBM is a waste product from the Glenbrook Steel Mill that has stabilisation properties when utilised with the correct materials. The analyses presented in this paper compare stabilised pavements with conventional pavements – therefore, if no pavements were stabilised we have assumed that all KOBM would be diverted to a landfill. If KOBM was diverted to a landfill, disposal costs would be incurred by the steel company, but it appears this figure would not capture the environmental effects of a landfill, so it has not been included in the overall analysis.

5 CONCLUSION



The chart illustrates that the intangible benefits of stabilisation can be substantial. Whangaparaoa Road was used as a case study to demonstrate these benefits, and due to the nature of the project, the travel time savings provided a significant proportion of benefits to the project. Similarly there were significant noise benefits due to close proximity of residential housing. In other types of projects or design treatment options the benefits attained are expected to vary significantly depending on the site setting and specific project parameters (for example proximity to quarries, traffic volumes, adjacent development and availability of alternative routes).

It is recommended that environmental and social benefits are considered in addition to the economic benefits. As discussed in Section 3.3, New Zealand law states this as a requirement, although it appears that a thorough application is a rare occurrence.

While many of the benefits assessed for this paper are unconfirmed and possibly subjective, the main purpose has been to identify their significant influence on the overall evaluation process. This paper has attempted to demonstrate that the Project Evaluation Manual provides a solid base from where these benefits can be included in contract evaluations. However there are other barriers that often prevent this from happening. Contract specifications need to be more flexible to allow tenders to demonstrate intangible benefits and innovation – without the need to have an accompanying alternative tender that may not be incorporated into the evaluation process.

Until the Weighted Attributes evaluation method is widely accepted in conjunction with a flexible tender document, significant social, environmental and economic benefits will be overlooked.

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