DEVELOPMENT OF A SUSTAINABLE MAINTENANCE FUNDING PROCESS FOR DIER TASMANIA

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ABSTRACT

ARRB was commissioned by the Department of Infrastructure, Energy and Resources of Tasmania (DIER) to provide input into the development of a sustainable maintenance funding plan. The main outcomes of the project were focussed on giving the Department a mechanism to examine the effect of different budget levels on future performance and road user costs.

A number of strategic level analyses were undertaken using HDM-4 and the network results were compared to a number of key performance indicators. These analyses were aimed at quantifying the level of financial investment required to achieve a range of intervention thresholds related to a set of desirable or specified minimum levels of service.

Following completion of the analyses and supporting documentation, a number of key findings were presented to the Department, some of which have been incorporated into their submission to Treasury for additional funding to facilitate planning and the development of a sustainable maintenance and rehabilitation program.

INTRODUCTION

This paper deals with the development of the Department of Infrastructure, Energy and Resources (DIER) and its sustainable maintenance funding process which considered strategies using existing intervention standards, maintaining existing conditions through to the acceptance of lower levels of service. The aim of the work is to provide DIER with the capability to examine the effect of different budget levels on future performance and road user costs.

The capacity to develop a robust, quantitative process has been enabled through collaboration between the DIER and the ARRB Group, who were engaged initially to assist in the implementation of HDM4, Version 2.0 into Tasmania. The work undertaken included the enhancement of the Department's modelling capacity and financial reporting requirements, which had been preceded by extensive studies into the performance of road assets in Tasmania and the identification of appropriate maintenance and rehabilitation measures.

The scope of the analysis to support the sustainable maintenance plan aimed to account for varying road use including loading, configuration, pavement construction, surface type and age and response of the network to different interventions.

BACKGROUND TO THE DIER/ARRB RELATIONSHIP

The DIER first introduced the PIARC-owned Highway Development and Management tool HDM-4 (Kerali 2000) soon after its release and has used this and similar technology for a number of studies since with the assistance of ARRB.

A major road deterioration (RD) and works effects (WE) model calibration and subsequent application in a strategic analysis of the state road network was undertaken in 2003 (Toole et al. 2004, Michel et al. 2004a and 2004b). This study (Phases 1 and 2), provided a comprehensive performance-based calibration of the HDM-4 RD models which were subsequently applied in supporting the development of DIER's road asset management strategy.

Following completion of Phases 1 and 2, a number of areas for further improvement were identified and consequently, in July 2004, DIER re-engaged ARRB (Phase 3) to provide assistance with developing improved surface performance predictions and treatment strategies, improved works effects models and a full specification for HDM-4 related asset management tools (Toole et al. 2005). In late 2005, as the HDM-4 Version 2.0 software was released, DIER again engaged ARRB (Phase 4) to collaborate in migrating the department from the currently configured HDM-4 Version 1.3 to the newly released HDM-4 Version 2.0 and undertake a detailed investigation of the asset valuation techniques available to road network managers, including that which is currently supplied in HDM-4 Version 2.0 (Roper et al. 2007, Michel et al. 2007).

With the outcomes of Phase 4 highlighting the need to develop a stand-alone application to facilitate DIER's annual asset valuation procedure, Phase 5 was commissioned by DIER. As part of the output requirements, ARRB was also required to develop a method and proposal to undertake a project to investigate and develop a maintenance funding plan that will ensure the department's sustainability in its annual pavement maintenance and rehabilitation activities. Phase 6 has naturally developed from this plan, with the adopted approach and some of the key outcomes detailed in this paper.

SCOPE OF THIS PAPER

This paper provides an overview of the HDM-4 development and its strategic application to develop and investigate the range of sustainable maintenance and rehabilitation options available to DIER. The focus of these outcomes is to supplement and strengthen a submission the department is putting together to Treasury to ensure adequate funding is secured into the coming years.

ARRB in consultation with DIER asset management staff has investigated a number of different investment scenarios, as part of the development of this long term sustainable maintenance funding plan, including incorporation of road user costs and budget effects on network performance.

This paper outlines the approach adopted to assess the long term sustainable maintenance funding requirements. It was anticipated that in order to accurately address these issues, a number of 'what-if' scenarios would need to be developed and investigated to highlight the impacts of varying budgets on network performance and road user costs. A number of analyses were undertaken, the implications of outcomes being summarised here.

Project goals

A series of strategic analyses were carried out during Phases 1 and 2 of the work undertaken for DIER; however, these were more targeted at establishing the economic efficiency of the existing and alternative pavement intervention standards and ensuring that the 'business rules' adopted in the system reflected the department's current practices. The analysis was also focussed on verifying that the current system configuration and predicted pavement performance reflected that which is currently observed on the network and that the resource estimates matched those currently expended.

As DIER manages roads of varying use including loading, configuration, pavement construction, surface type and age, there were a number of issues identified and processes to be considered in the development of this strategic maintenance and renewal plan for the road network the department manages. This was carried out with the objective of optimising the return on both the expenditure levels and the user benefits into which DIER invests annually in the upkeep of its road network.

In considering possible future needs, it was important that the reasons for asset renewal or replacement were identified so that these could be accounted for in the forward identification of need, and in the assignment of appropriate improvement standards and costs. Specific examples included:

- essential routine maintenance activities
- the extent of asset preservation needs, including resurfacing to maintain waterproofing and adequate road user surface characteristics
- pavement reshaping or reinstatement, through overlay or replacement, aimed at minimising road user costs and increasing ride comfort
- configuration changes, including through pavement, surface or shoulder widening, to improve capacity and safety.

It was also understood that configuration improvements may be undertaken when pavement treatments are triggered, thereby providing additional benefits to road users through crash reduction and improved safety on the road network. The potential therefore for such benefits to be considered in the evaluation of candidate improvement schemes was identified, and will contribute to the further development of the plan.

In developing this process, ARRB and DIER broadly aimed to address the following questions:

1. How much funding is required to maintain the network to DIER's desirable standards?
2. What would be the expected condition of the network under current and alternative funding scenarios?
3. How much funding is required to maintain the network in its current condition?
4. If funding is insufficient to maintain the network in its current condition, what will the network condition be in 5 years and 10 years?
5. What are the expected road user costs and net benefits associated with alternative standards and funding scenarios?
6. If funds are insufficient to maintain the whole network, which roads should be given priority?
7. What is the optimal break-up of available funds considering road function and use?
8. What is the sustainable funding level required over 1, 3, 5, 10 and 20 years?
9. What are the different requirements of different parts of the network, taking account of physical conditions and historical works and investment levels?

METHOD

The following sections outline the detailed steps undertaken to address the above questions and develop a long term plan for DIER to ensure the sustainable management of the designated road network. It comprised the following steps:

1. detailed review and modification of the Microsoft Access interface to the departments Road Information Management System (RIMSi), this task focusing on ensuring that the latest network data is accessible to the asset management department, including pavement condition and traffic data
2. reviewing all of the fundamental aspects of the HDM-4 modelling environment to ensure only the latest data was adopted in the analyses. Items such as the maintenance standards, works costs, vehicle specifications, calibration items and traffic, including AADT, composition and loading were reviewed. Verification was essential as the outcomes of the system are heavily reliant on correct and accurate input data and configuration of the software for analysis

3. definition of a number of different maintenance scenarios which were either modified or varied to better investigate the questions DIER wished to answer. Comparisons of the economic impact of alternative strategies involved determining the total transport costs for each alternative
4. evaluating the network asset value (condition and age based) from the HDM-4 modelled outcomes to demonstrate the effectiveness of the proposed investment strategies in terms of the performance of the network asset value, and
5. benchmarking current condition statistics and future performance estimates in relation to widely accepted key performance indicators, such as the AusLink Ride Quality Indicator (RQI) and Pavement Maintenance Indicator (PMI), and against DIER's own criteria.

Examples of the strategies considered included:

1. ***Existing standards no delay***. The investment required to address deficiencies found on the entire road network immediately involving direct application of DIER intervention standards in order to clear the backlog of works that exists on the road network. By analysing this strategy, the long term consequences of the DIER engineering based standards are investigated. It was noted however, that these may not be truly economically ideal, but take account of such pragmatic considerations as perceived engineering risk, road user perceptions and safety concerns.
2. ***Existing standards with delay.*** The optimal economic timing and funding requirements for addressing defects on all road sections in the network with delayed application of the DIER intervention standards over the next seven years. For this strategy, and a number of other strategies, the selected strategy competes on an economic basis with a base case (either a specified minimum strategy or an alternative strategy to determine which should be applied on each section. Thus a program of treatments will be available for each section over its life cycle.
3. ***Existing standards with delay and budget constraint.*** Identification of the road sections whose deficiencies can be addressed within DIER's existing 'base' budget over the next five or so years.
4. ***Maintain current condition.*** This would involve determining average conditions for different parts of the network, and analysing the performance and budget consequences of maintaining these into the future. It is underpinned by the basic premise that users will not wish poorer conditions in future. However, it is likely to be an expensive strategy therefore estimation of broader community benefits will be important. Alternatives could examine varying intervention standards on particular parts of the network.
5. Exploring a number of different investment ('what if') scenarios, where the network performance consequences of varying budget allocations are investigated. These analyses help to give an appreciation of the sensitivity of the network performance to changes in intervention standards. Examples include extending investment over a longer time frame, or the consequences of delivering a lower level of service delivered to road users.

In addition, following the successful completion of a new method for performing asset valuation from the HDM-4 modelled outcomes during Phase 5, it was also possible to demonstrate the effectiveness of the proposed investment strategies in terms of the performance of the network asset value.

Generally various levels of investment in road maintenance and improvement help to extend the life of pavement assets. This investment typically reduces the need for earlier intervention by the road authority, hence extending the pavement's natural rate of deterioration under no maintenance. A consequence of this extension to the otherwise typical pavement life is the improvement in the asset value (or delay of the need for complete reinvestment to bring the pavement to an as-new condition).

In light of the above, it was possible to demonstrate the effectiveness of the different investment strategies that DIER employs in terms of not only pavement performance, but also in terms of the impact varying levels of investment have on asset value. DIER typically has three main strategies in place, namely:

- Routine maintenance program – general activities to ensure minimum levels of safety and asset protection.
- Preservation program – regular resurfacing to waterproof the surface to extend the pavement life and improve road surface characteristics.
- Rehabilitation program – generally targeting road user issues by improving roughness and rutting.

The effectiveness of these pavement management strategies were evaluated and an appreciation of their ability to delay the onset of large scale reinvestment in the network, which is often required when the maintenance and rehabilitation strategies employed do not adequately target problem areas. The decrease or improvement in the yearly asset value is a good indication of the suitability of the employed practices at managing these pavements to satisfy both functional and structural performance whilst taking into consideration the level of regular investment required to maintain the cumulative backlog of large scale works that is required with an ageing network.

ANALYSIS APPROACH

A number of the analyses undertaken throughout the project have been documented here to give an appreciation of the process and approach that would be undertaken in developing such investment plans. The first stage in identifying the range of investment plans that could be undertaken is to obtain an appreciation of the current network health. This 'current status' analysis is then generally followed by a series of more detailed analyses which extend the current network state into the future under the different defined investment and performance intervention strategies.

Current network condition

The current network condition was examined and classified in relation to the following indicators:

- The AusLink Preventative Maintenance Indicator (PMI) (Clarke 2007), reflecting the age of a surfacing in relation to a locally defined target age, this varying according to road category and surface type. The classification is illustrated in Table 1. Typical values for seals in Tasmania are 13 years for Category 1 roads, 15 years for Categories 2 and 3 and 17 years for Categories 4 and 5. Asphalt surfaces were typically estimated to last 5 years more.
- The AusLink Ride Quality Indicator (RQI) (Clarke 2007) reflecting different ride quality categories of good mediocre, poor and very poor which vary according to AADT, commercial vehicle composition and speed zone. The classification is illustrated in Table 2 based on defined ranges of traffic and typical speed zones.
- DIER's roughness based intervention levels by traffic level, these being an approximation of the standards applied at a road category level to allow comparison with the AusLink RQI (see Table 3).

Table 1: Definition of pavement maintenance indicator (PMI)

Good	< Target age
Mediocre	1 – 1.3 * Target age
Poor	1.3 – 1.6 * Target age
Very poor	> 1.6 * Target age

Table 2: Illustration of Queensland AusLink ride quality indicator

Example QDMR AUSLINK	Traffic range (vehicles per day)					
Roughness range (IRI)	0-500	501-1500	1501-3000	3001-5000	5001-10000	>10000
	VL	LL	BM	AM	HH	VH
0-2.8	Good	Good	Good	Good	Good	Good
2.8-3.2	Good	Good	Good	Good	Good	Mediocre
3.2-3.6	Good	Good	Mediocre	Mediocre	Mediocre	Mediocre
3.6-4.0	Good	Mediocre	Mediocre	Mediocre	Mediocre	Poor
4.0-4.6	Mediocre	Mediocre	Poor	Poor	Poor	Poor
4.6-5.2	Mediocre	Poor	Poor	Poor	Poor	Very Poor
5.2-5.7	Poor	Poor	Very Poor	Very Poor	Very Poor	Very Poor
5.7-6.3	Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor
>6.3	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor

Where: VL = Very Low traffic
LL = Low traffic
BM = Below Medium traffic
AM = Above Medium traffic
HH = High traffic
VH = Very High traffic

Table 3: DIER ride quality categories (approximate)

Roughness		Traffic range (vehicles per day)						
		EL Traf	VL Traf	L Traf	M Traf	H Traf	VH Traf	EH Traf
Condition	IRI	< 200	200 – 500	501 - 1500	1500 - 2500	2501 - 7500	7501 – 15000	>15000
EG	< 2.3	Desirable	Desirable	Desirable	Desirable	Desirable	Desirable	Desirable
VG	2.3 – 3.1	Desirable	Desirable	Desirable	Desirable	Desirable	Desirable	Desirable
G	3.1 – 3.8	Desirable	Desirable	Desirable	Desirable	Desirable	Desirable	Desirable
F	3.8 – 4.6	Desirable	Desirable	Desirable	Desirable	Poor	Poor	Poor
B	4.6 – 5.3	Desirable	Desirable	Desirable	Poor	Undesirable	Undesirable	Undesirable
VB	5.3 – 6.1	Desirable	Desirable	Poor	Undesirable	Undesirable	Undesirable	Undesirable
EB	> 6.1	Poor	Poor	Undesirable	Undesirable	Undesirable	Undesirable	Undesirable
	>6.9	Undesirable	Undesirable	Undesirable	Undesirable	Undesirable	Undesirable	Undesirable

Where: EL = Extremely Low traffic
VL = Very Low traffic
L = Low traffic
M = Medium traffic
H = High traffic
VH = Very High traffic
EH = Extremely High traffic

In addition, a number of other commonly used parameters have been employed, such as rehabilitation age and construction age.

Current condition statistics, based on 2006 data, were produced, for example:

- the percentage of the network, by length, exceeding the target maximum surface age
- the percentage of the network possessing ride quality values in excess of DIER's desirable standards, and its minimum operating standards
- the percentage of the network, by length, possessing mediocre or poor ride quality in relation to the AusLink RQI, or in a very poor condition
- the percentage of the network which has not received a rehabilitation treatment within the last 20 years, or in the last 50 years.

Development of different maintenance policies

To facilitate the analysis of the different sustainable maintenance funding options that could be adopted by DIER, a range of investment policies were developed. These were aimed at quantifying the level of financial investment required to achieve the defined maximum intervention thresholds related to a set of desirable or specified minimum levels of service, or to maximise economic benefits. The following maintenance policies were examined:

- Current Funding, involving application of preventative maintenance comprising essential routine maintenance and resurfacing at the target age for each surface type, with the total funding requirement close to DIER's current five year plan. This was used as the base case in determining economic benefits.

- Desirable Minimum Standards, which aimed to ensure that all pavements are subject to preventative maintenance at the target age for each surface type, and that no pavement operates below DIER's minimum ride quality standards.

- DIER Engineering Standards, where all pavements operate in accordance with DIER's intervention standards for ride quality, surface condition and age, and receives appropriate preventative maintenance and intermediate treatments to help manage pavement risk, safety and from an economic perspective.

- Economic Policy, where strategy selection is based on maximising economic benefits by comparing the Desirable Minimum Standards and the DIER Policy on a section by section basis. This aims to achieve desirable minimum operating standards and channel additional funds to those sections where positive economic benefits are possible.

- Alternative Economic Policy, where strategy selection is based on maximising economic benefits by comparing the current funding policy and the DIER Policy on a section by section basis. In this case desirable minimum standards will not be met.

The HDM-4 analyses were conducted on a data set representing individual pavement management sections covering the entire defined DIER road network over a 20 year analysis period with a discount rate of 7%. The network configuration and condition data was obtained from the Departments road information database.

ANALYSIS OUTCOMES

A number of specific and specialised reports have been developed and supplied to DIER in support of its submission to Treasury for additional funding to ensure a sustainable maintenance and rehabilitation approach is adopted in the coming years. A number of these reports are used in this paper to demonstrate the range of different approaches that could be adopted to present information to decision makers to facilitate informed decision making.

Budget needs and justification

A summary of the main economic analysis associated with a selection of the investment scenarios is provided in Table 4, where the Current Funding Policy is applied as the economic base case (and reference) against which the alternative strategies are compared. This means that the aim is to only undertake essential routine and preventative surface maintenance, and to only select a more costly alternative where net economic benefits occur, i.e. where a positive NPV (or NPV/C) is obtained, or the BCR is greater than unity.

Table 4: Summary of 5 year major works budget and economic indicators

Strategy	DTTC	DRAC	DRUC	RUC savings	NPV	NPV/C	BCR
Current Funding (Base)	35096	211	34885	0	0	-	1.00
Desirable Minimum Standards	35110	242	34869	16	-15	(0.48)	0.52
01 – DIER Strategy	35233	428	34805	80	-137	(0.63)	0.37
02 – Economic Strategy	35078	252	34827	58	17	0.43	1.43
03 – Alternative Economic Strategy	35058	225	34833	52	38	2.70	3.70

Notes:

DTTC - Discounted total transport costs (the sum of DRAC and DRUC)

DRAC - Discounted road agency costs

DRUC - Discounted road user costs

RUC savings - Difference in road user costs between base strategy and project strategy

NPV - Net present value of benefits = DTTC (base) – DTTC (selected strategy)

NPV/C - NPV divided by increase in Road Agency Costs

BCR - Marginal Benefit Cost Ratio

A number of general comments and an interpretation of the results has been provided for each of the economic analyses undertaken:

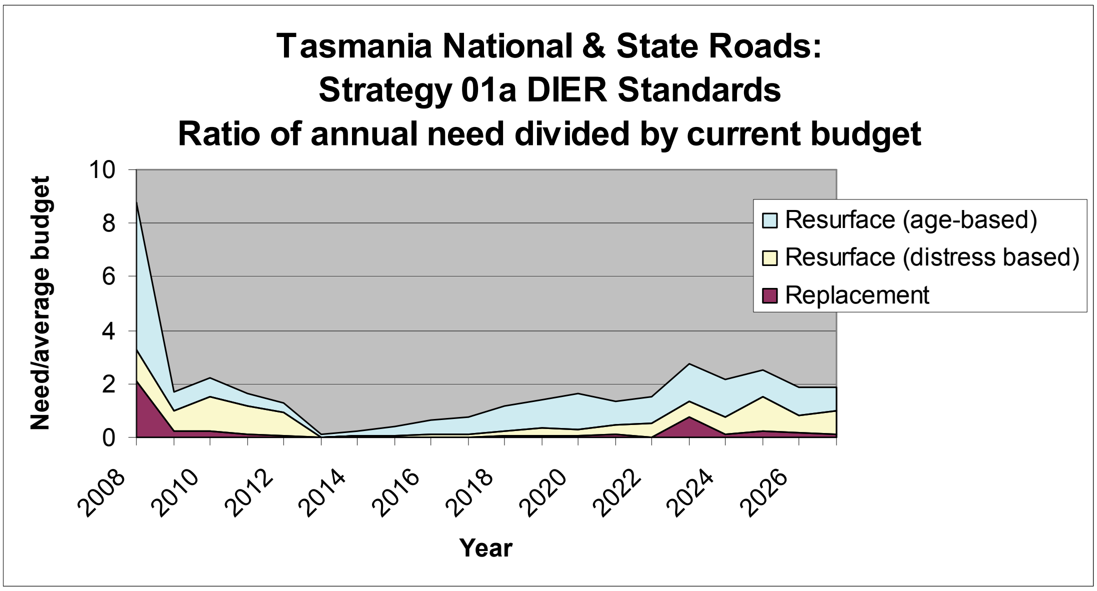
- The TTCs of Strategy 03, the Alternative Economic Strategy, are shown to be the least, with the DIER Engineering Strategy having the highest total transport cost. Correspondingly, the net economic benefits are also the highest for Strategy 03, these being equivalent to slightly less than $3 for every additional dollar of investment, or a program level BCR of 3.7. However, minimum desirable standards will not be maintained on the entire network.

- The Economic Strategy also produces net economic benefits equivalent to 43 cents in every additional dollar spent, or a program level BCR of 1.43. In so doing, minimum desirable standards are also maintained across the entire network.

- The minimum RUCs are those of Strategy 01, the DIER Engineering Strategy, as the aim is to deliver desirable service levels. However, the net RUC savings of $80 million are offset by an additional investment cost of $217 million, leading to a net economic loss.

The annual budget consequences of the DIER Policy is shown in Figure 1, and the condition performance consequences of the Current Funding Policy and the DIER Policy is illustrated in Figure 2.

Such presentations can be used to good effect in demonstrating needs, with the level of backlog need clearly illustrated as being some 8 times current annual funding levels, whereas the long term annual need is almost double the current level of funding. Also, the backlog need associated with achieving the Current Funding Policy requires up to 2.5 times current funding levels, whereas the . Figure 2 also shows the significant change in average network performance which can be expected to result. Whereas the DIER policy manages to hold current conditions for a substantial proportion of the analysis period, this is not the case for the Current Funding Policy. The economic strategy, not illustrated here, delivered intermediate results.



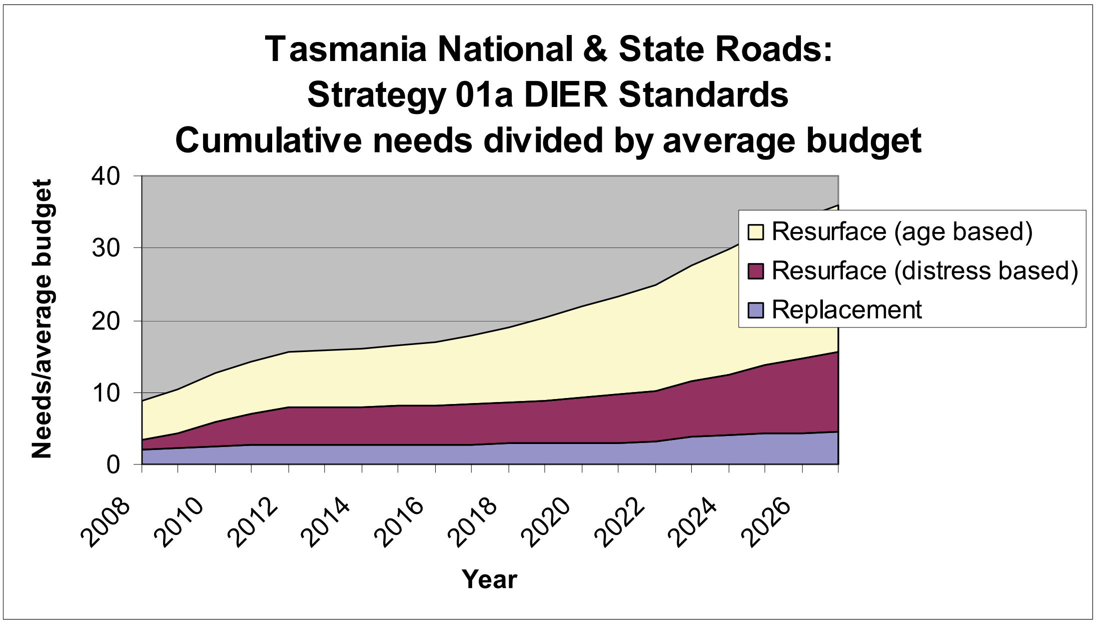
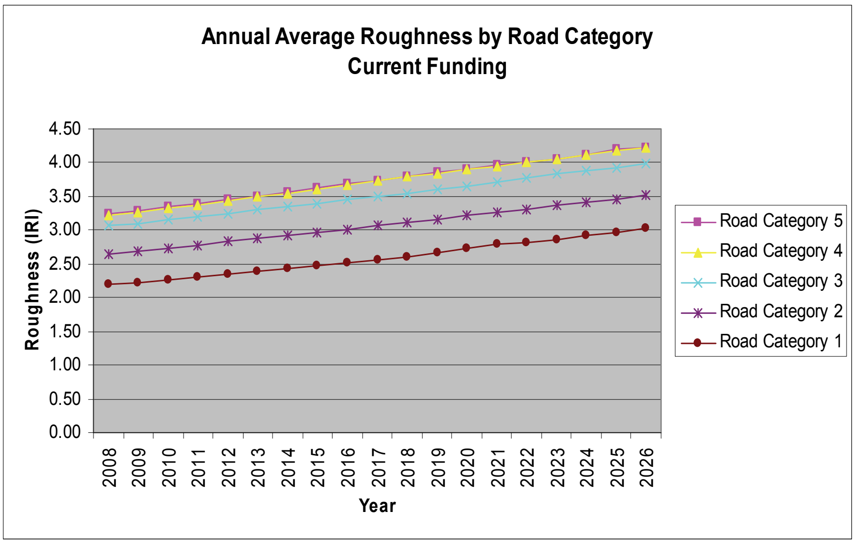


Figure 1: Funding needs profile for DIER Policy



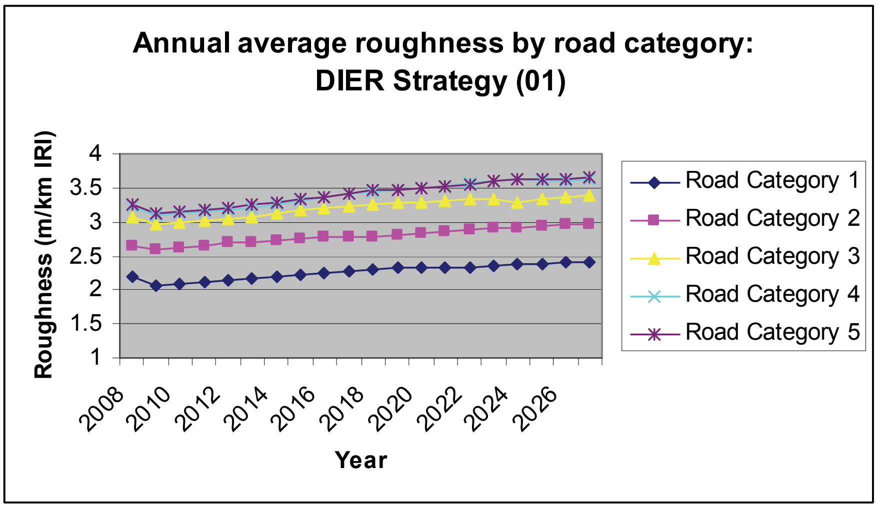


Figure 2: Performance consequences of Current Funding Policy and DIER Policy

As shown in Figure 2, there is a notable difference in performance, in terms of the network roughness by road class, between the two policies over the 20 year analysis period. This is largely attributed to the intervention criteria defined in the Current Funding Policy allowing roads to deteriorate to a greater degree than those defined in the DIER Policy. While this may appear to be reasonable and an alternative that may well be accepted, there are a number of other issues that need to be considered when weighing up the balance of allowing the asset to deteriorate more than the currently accepted levels.

One of the major issues that needs to be considered is the future cost associated with returning the network to its current level of service sometime in the future. While future costs are not accounted for in the analysis, as these are generally considered to be cancelled out by increasing costs to road users, there is a need to bear in mind that the road agency will be responsible to find significant funding resources at some stage to invest in returning the asset to its original in-service value. This may certainly be a more costly exercise over the life cycle of the asset when compared to ensuring a sustainable level of funding is allocated to maintain the asset value over its life.

This balance between the level of regular investment to meet current posted levels of service and allowing some shift in these targets to reduce pavement life cycle costs careful consideration as other issues such as network safety and asset preservation are key to delivering a better overall level of service to road users and the community as a whole.

Benchmarking road performance

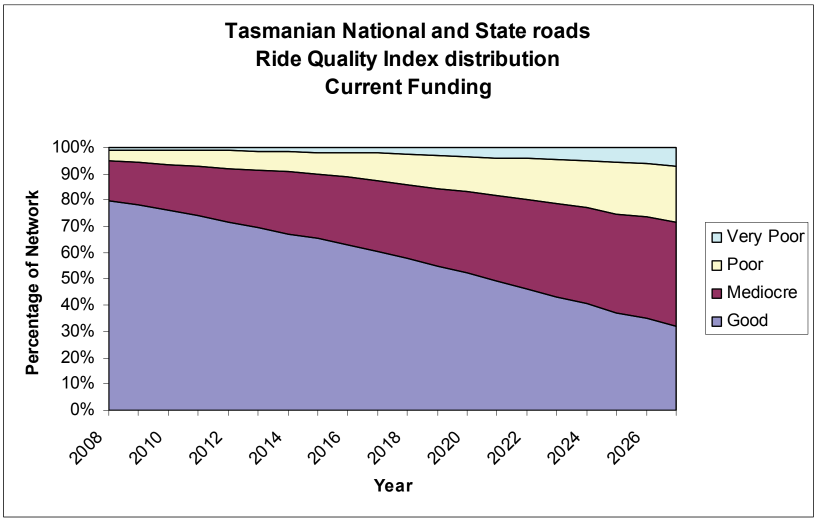
The road performance implications in terms of percentage of the network that achieves DIER's desirable ride quality based on operating standards and the AusLink RQI are presented in Table 5 and Figure 3.

Table 5: Ride quality distribution (%'s) based on DIER's standards

Strategy	Criteria	Year 1 (% of network)	Year 5 (% of network)	Year 20 (% of network)
Current Funding	Desirable	97	97	88
	Poor	2	2	6
	Undesirable	1	1	6
DIER	Desirable	97	97	95
	Poor	2	2	4
	Undesirable	1	1	1

Comments on the ride quality distribution in terms of the percentage of the network in these condition criteria are outlined below and relate to both Table 5 and Figure 3.

- Application of DIER's standards maintains the largest proportion of the network in a desirable condition with between 3% and 5% being in a poor or undesirable condition over the analysis period.
- The performance implications of the Current Funding Policy highlights that between 3% and 12% of the network is predicted to be in a poor or undesirable condition.
- Little distinction between strategies is noticeable where the AusLink ride quality indicator is applied. This is because DIER's intervention levels are of a lower standard than those implied by the AusLink categories, and therefore a significant length of 'poor' conditions is accepted. This implies that DIER's target standards are by no means conservative.



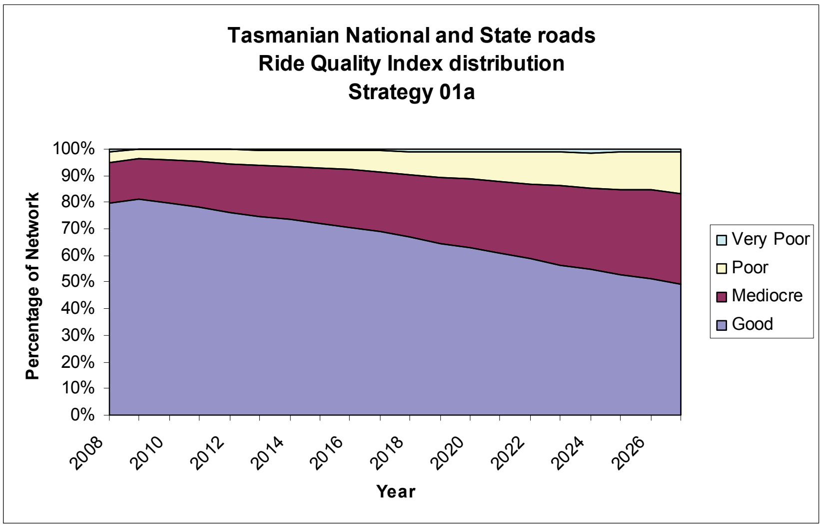


Figure 3: Distribution of RQI for strategies investigated

Correlation of analysis outcomes with asset value

As a final measure or Key Performance Indicator (KPI) in selecting an appropriate investment strategy, the predicted asset value profile (based on surface condition) over the analysis period was also generated from the HDM-4 outcomes. The potential differences have been highlighted in Figure 4 for DIER Category 1 roads only. In this example, the DIER Policy holds the asset value over the first five years, whilst the two alternative policies lead to a loss of between 10% and 15% in the same period. The fact that the asset value continues to reduce in future years is naturally a consequence of the network maturing. As noted, the higher intervention standards associated with the DIER Policy minimises the loss for Category 1 roads to 75% of their original value, whereas the Current Funding (or Base) Policy leads to a halving in asset value.

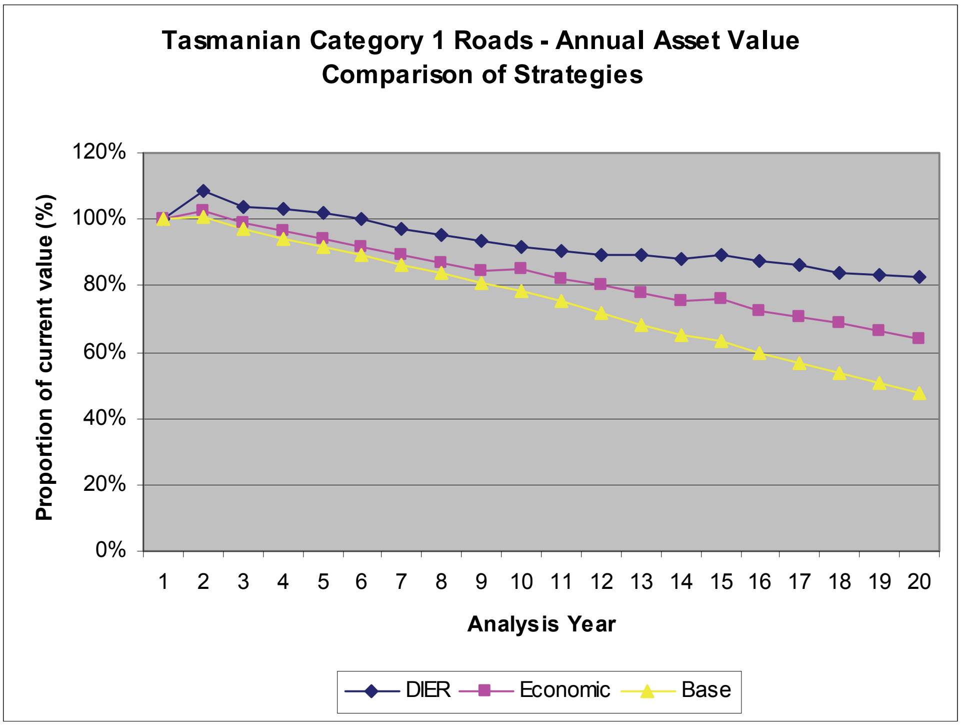


Figure 4: Change in asset value by investment strategy for Category 1 roads

In order to further extend benefits to DIER in evaluating the benefits or otherwise of selecting a particular investment scenario in the development of their sustainable maintenance funding plan, it is proposed that the analysis of the predicted asset value is extended to all roads to help inform investment decisions. This will yield an appreciation of the level of investment that will be required across the network to either maintain the asset or invest in it at some later stage to return the network to its current value if it has been permitted to deteriorate.

In addition, through the improved analysis functionality of HDM-4, it is possible to develop a series of asset valuation reports showing the annual asset value for the network with different financial investment levels. For example, Figure 5 provides an illustration of the increase in asset value of the total network compared with the total expenditure over the analysis period.

By correlating the predicted asset value with the level of financial investment in the upkeep of the road network, decision makers are able to assess and appreciate the relative loss (or gain) in value associated with variations in the funding allocation over time. In balancing this rationale to decision making, there are also a number of other external factors that must be kept in mind when deciding to either increase or reduce the level of investment in the upkeep of pavement assets.

A demonstration of this is highlighted in Figure 5, where through the improved analysis functionality of HDM-4, asset managers are now able to provide a series of asset valuation reports showing the annual asset value for representative sections with different levels of financial investment. For example, Figure 5 provides an illustration of the variation in asset value of the total network compared with the total expenditure over the analysis period under a condition based assessment. This example demonstrates a case most likely associated with a network which is badly deteriorated and subject to severe historic under funding, and, therefore, even a low level of investment improves asset value.

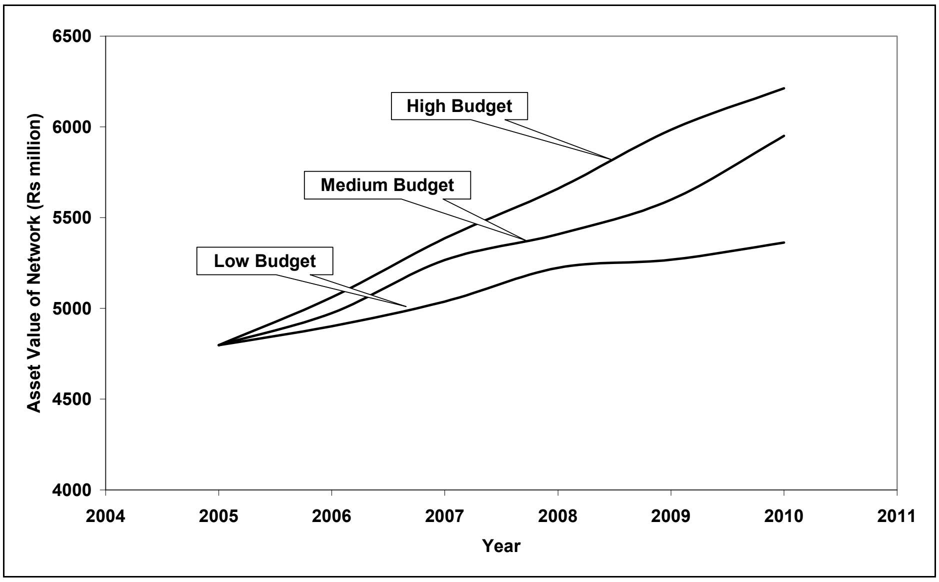


Figure 5: Asset valuation for the budget scenarios – condition based assessment
(Source: Applications guide for HDM-4 Version 2.0)

The HDM-4 process applied in evaluating the current asset value has been investigated and documented in detail during Phase 4 of the work with DIER (Michel et al. 2007). The report of this work contains details of the structure, equations and logic employed in the system to facilitate the calculation of the annual asset value.

CONCLUSIONS AND RECOMMENDATIONS

A number of key conclusions have been developed following completion of this analysis, some of which have been incorporated into the department's submission to Treasury for additional funding to secure a sustainable maintenance and rehabilitation regime into the future. A number of the key findings are detailed below:

1. The results of this study provided a sound basis for a pavement rehabilitation strategy for the State and National Road Network in Tasmania, having illustrated the need and consequences of different funding levels. Important in any decision is to ensure consideration is given to matching investment in the network with the rate of consumption.
2. The Current Funding Policy typically represents the lower investment, whereas the upper estimate corresponds with the full implementation of DIER's Policy which has been established on the basis of road safety, minimising asset loss and economic considerations. An intermediate strategy based on an Economic Policy is derived from both the Current Funding and DIER's Policy, where typically investment on a selected road section is derived from its economic merit.
3. Whereas the DIER's Policy maintains operating standards, in terms of ride quality and road user costs, in the short term, a reduction in network quality occurs as a result of application of the alternative policies in the same period. Clearly, both asset owners and managers and the community need to understand such consequences, including the possible reduction in operating standards as the network matures and investment levels are not increased to mitigate such consequences.
4. Consideration of changes in asset value is suggested as an additional KPI in selecting an appropriate investment strategy. In an example for Category 1 roads, the DIER strategy holds the asset value over the first five years, whilst the two alternative strategies lead to a loss of between 10% and 15% in the same period. Such impacts should be considered along with other KPIs to help inform investment decisions.

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AUTHOR BIOGRAPHIES

Ron Roper

Ron Roper joined ARRB Group in 1988 and currently holds a position of Senior Asset Management Specialist within the Consulting Division. His major activities include leading roles in the development of road user effect, pavement performance, life cycle costing and network analysis models. Current and recent projects include implementation and training of HDM-4 both in Australia and internationally, and developing software products for the implementation and enhancement of these models. Ron also has extensive experience collecting and analysing a wide range of road related data both locally and overseas and has developed many tools to assist in data management.

Norbert Michel

Norbert has had extensive experience developing, using and calibrating the ARRB Group designed PLCC Model and PLATO in evaluating pavement performance, and determining network needs and in using commercial software such as HDM-4. Current and recent projects include implementation and training and dissemination of HDM-4 in Indonesia and several Australian states and the development of a custom built Local Road Management System. He has also contributed to the development of the Road Safety Risk Manager system, including determining accident rates for various road configurations based on state road authority data.

Graeme Nichols

Graeme Nichols is a Senior Asset Management Engineer in the Roads and Traffic Transport Branch of the Tasmanian Department of Infrastructure, Energy and Resources. Between joining the Department in 1973 and 1994 Graeme was principally involved in the design and maintenance of bridges, and other road and marine structures. In 1994 he was appointed to the position of Project Engineer for the design of a new section of the Bass Highway and since

1997 has been the Project Manager in charge of several significant projects. Graeme was appointed the Senior Asset Management Engineer in 2007 and his present projects include the preparation of a sustainable funding plan for road maintenance and a skid resistance management policy.