Executive Summary

Background and Context

Over recent years, interest has been increasing, in New Zealand and internationally, in the application of tolling policies to contribute to the funding of major new road infrastructure projects in larger urban areas. Typically these policies result in a major tolled route being inserted in a network of 'free' roads. Often private sector funding is involved.

To date, the experience with urban road toll routes in New Zealand has been very limited, the main (past) examples being the Auckland and Tauranga Harbour Bridges. Potential tolled roads now being considered in New Zealand include two in the Auckland area (ALPURT B2, PenLink), the Tauranga Harbour Link scheme, and the Wellington Transmission Gully route. Australia is ahead of New Zealand in the development of urban toll roads and is one of the world leaders in this field. Toll roads are already operational in Sydney (several schemes, including the Sydney Harbour Bridge/Tunnel), Melbourne (the City Link project) and Brisbane.

In New Zealand, such toll routes are being seen as one solution to the desire to increase urban road network capacity, in the Auckland area in particular, in a situation of constrained funding. The issue has been given greater prominence through the recent introduction of the Land Transport Management Act 2003 (LTMA), which will facilitate the implementation of toll roads subject to certain conditions (including that the schemes must essentially relate to new infrastructure, not tolling of existing roads). In response to this Act, Transit New Zealand has been working intensively over the last two years both in formulating policies and approaches in relation to toll roads, and also in undertaking market research, traffic modelling and economic/financial appraisal of potential toll projects. As noted by Transit NZ: *"Funding repaid from user tolls is the only genuine alternative that increases funding levels over time. It is therefore the only alternative that allows more projects to be built."*

A number of significant implications arise from the differential charging policies inherent in having individual tolled routes in an urban network of 'free' routes:

- **Traffic distribution/assignment** – some trips that would use the new route if 'free' are deterred from its use by the charges, and continue to use the existing network. Hence the extent of congestion relief provided by the new route is less than would be achieved if it were 'free'.
- **Environmental** – this traffic distribution towards existing roads will typically (but not necessarily) result in adverse environmental impacts (relative to a 'free' new route).
- **Economic** – this sub-optimal traffic distribution typically (but not necessarily) also has adverse effects on road user benefits and hence the underlying economic

merits of the project (although the costs to the public sector are generally reduced).

- **Financial** – the existence of more-or-less parallel free routes limits the maximum feasible toll charges, the associated toll revenue and hence the 'fundability' of the new road project.

Hitherto, studies have been very limited (in New Zealand or internationally) on the importance of these issues for urban road tolling policies; and on their implications for decisions on whether a proposed new route should be tolled, how the toll charges should be set, the design of the scheme, etc. In particular, relatively little attention appears to have been paid to the implications of tolling on scheme economics and on overall socio-economic welfare. This project was designed to fill this knowledge gap through combining both theoretical considerations and empirical evidence, and providing better information to assist policy formulation on urban road tolling in the New Zealand context.

Project Objectives and Scope

The **overall objective** of the project was *"To examine the implications of road tolling policies applying to selected major roading projects in larger urban areas, and in particular the traffic, environmental, economic and financial implications."*

The project involved three main tasks:

- Review of New Zealand and international practice on traffic modelling and economic evaluation for urban toll road schemes, and formulation therefrom of a best practice framework and guidelines for assessing tolling policies.
- Selection of appropriate toll road case studies in New Zealand and internationally (principally Australia); examination of modelling and evaluation studies for these schemes; and summarising findings for each scheme on the traffic/environmental and economic implications of tolling.
- Drawing together the outcomes from these two tasks and developing conclusions on:
  - best practices in urban toll road traffic modelling and economic appraisal,
  - issues to be considered in the development of potential new toll schemes, including whether or not to toll, price setting, design aspects, etc.,
  - comments on the development work undertaken to date for proposed New Zealand tolling schemes, in particular relating to the traffic and economic implications of tolling.

The project did not attempt to provide a comprehensive review of all aspects of New Zealand urban tolling policies and scheme proposals. In particular:

- The project focus was on the implications of tolling individual schemes (rather than making them 'free') in the context of an otherwise 'free' urban road network: it was not concerned with appraising the intrinsic economic merits of proposed toll schemes (relative to not constructing these schemes).

- The main emphasis in practice was on new road proposals under consideration as tolled schemes, because economic evaluations had been undertaken for a selection of such schemes, and because the New Zealand toll road legislation allows tolling for new road schemes only. However, most of the issues discussed and conclusions drawn would be generally applicable to the tolling of existing roads.
- The project was not concerned with the merits of alternative funding sources (in particular private sector funding), nor with the implications of tolling policies for the overall New Zealand road programme and project priorities.

General Merits of Tolling Selected Urban Roads

The project's review of international literature on urban road pricing policies indicated that the economic case for pursuing selected urban road tolling policies (involving individual tolled routes in a network of 'free' roads) is generally rather weak:

- Any selected road pricing policy will raise only a small proportion of the revenue and generate a small proportion of the welfare benefits that would result from 'first best' pricing, i.e. when all roads are priced on an economic optimal (marginal social cost) basis. By contrast, some other urban road pricing policies (e.g. parking surcharges, toll rings) can generate a much larger proportion of the welfare benefits achieved through 'first best' pricing.
- Of the selected road pricing policies generally examined by analysts, welfare-maximising ('second best') policies perform substantially better in welfare terms than revenue-maximising (or profit-maximising) policies:
  - Revenue-maximising policies are generally inferior in welfare terms to an 'all free' network;
  - Welfare-maximising policies are superior to an 'all free' network, but generate only a small fraction of the welfare benefits from 'first best' pricing.
- However, welfare-maximising toll levels are typically less than half the level of revenue-maximising tolls, and raise in the order of only half as much revenue.
- The structure of prices under welfare-maximising policies and that under revenue-maximising policies are also in conflict: revenue-maximising prices involve higher tolls when the free road is most congested, and when demand elasticity is lower; welfare-maximising policies involve the converse.

Tolling of selected (new) roads in an urban network results in diversion of some potential traffic to the alternative (old) routes. Typically in urban situations, this causes both road user disbenefits and environmental disbenefits: the tolled road is under-utilised and the remaining network over-utilised relative to the economic optimum. This effect is often substantial: for some schemes the extent of traffic diversion can be as much as half (or more) of the users of the road if it were free; and the economic benefits of the scheme can reduce by a broadly similar proportion.

Suitability of Roads for Selected Tolling: Economic Performance Indicators

While, in general, the economic case for selected road tolling policies appears rather weak, the evidence assembled in this project clearly identifies that some urban road schemes are much more 'suitable' for tolling than others. The prime measure of economic 'suitability' proposed is the (net) revenue raised through tolling relative to the resulting loss in economic welfare (NPV).

It is recommended that a set of economic-based performance indicators should be developed and applied to assess the suitability of proposed road schemes for tolling from an economic standpoint, i.e. trading-off the revenue impacts of tolling against the economic and related (traffic, environmental) impacts. The revenue raised**:**NPV loss measure suggested above would be one of the primary indicators in this set. Recommendations on the full set of such indicators are provided in the report.

Toll Scheme Modelling and Evaluation Methods

Our review of case studies and modelling/evaluation practices for tolling schemes in New Zealand and Australia has highlighted that:

- In many cases, there has been little or no consideration of the relative merits (from traffic and economic aspects) of tolled and untolled options, and even less consideration of alternative toll levels or structures: this is particularly the case for the Australian schemes.
- In the relatively few cases where both tolled and untolled options have been assessed on a comparable basis, deficiencies in both the modelling and evaluation aspects cast considerable doubt on the veracity of the outputs provided.
- Minimal post-implementation market research, which could potentially be used to develop improved ex ante forecasts and economic appraisals, has been carried out.
- The practice guide developed by Transit NZ covering traffic/toll modelling aspects is generally sound, but would benefit from greater detail on a number of significant issues relating to tolling schemes.

The review of the various tolling case studies in this report has helped to identify the main areas of deficiency in current modelling/forecasting and economic evaluation procedures and practices for toll schemes in particular (as distinct from the 'standard' well-established procedures for road schemes in general). These main areas of deficiency (not all applying in all cases) are summarised in Table 1. Against each area, the table also sets out our recommendations on future practices, to overcome the identified deficiencies and to achieve best practices in the traffic modelling and economic evaluation of tolling schemes.

Table 1 Toll scheme modelling and evaluation methods – existing practices and recommendations.

Aspects	Comments on Existing Practices	Recommendations on Future Practices
A. OPTIONS FOR CONSIDERATION		
1. Range of scheme options	• Most scheme evaluations have given little or no consideration (in economic terms) to tolled v untolled options; and even less consideration to alternative toll levels and structures.	• For (potential) toll schemes, options evaluated should include No Toll and a range of Toll options • Toll options should cover a range of toll levels and structures (including revenue-maximisation, welfare-maximisation and demand management options).
B. MARKET RESEARCH METHODS (NZ SP Surveys)		
1. Vehicle occupancy	• Unclear whether survey results relate to driver only or to all vehicle occupants combined.	• Surveys/analyses should explicitly analyse how VTTS are affected by vehicle occupancy, and model traffic behaviour accordingly.
2. SP methodology	• Some doubts on validity/robustness of semi-adaptive boundary-value SP method.	• Suggest independent review of methodology prior to any further SP surveys.
3. Representation of route choices	• Some doubts as to whether alternative route scenarios presented in the SP survey are sufficiently realistic representations of the alternatives.	• Ensure questionnaire provides realistic depiction of tolled and untolled alternatives.
4. Use of RP data	• Research methods to date have not attempted to check or calibrate SP survey results against RP data.	• For any toll roads implemented, recommend that undertake an 'After' survey and recalibrate 'diversion curve' functions using these survey results.
C. TRAFFIC MODELLING ASPECTS		
1. Matrix selection	• Almost all NZ schemes have been modelled/evaluated on a 'fixed trip matrix' basis, although evidence suggests this can lead to substantial errors in the evaluation of user benefits, particularly in congested situations.	• Recommend that 'variable trip matrix' ('full response') methods be adopted for major schemes where congestion is/will be a substantial issue for any options. • It may be appropriate to use the Transmission Gully project as a case study and undertake several runs of the Wellington Regional model (WTSM) allowing different responses, to assess sensitivity of the results to the matrix modelling methods.
2. Network representation	• Modelling may not adequately reflect either the current network conditions or the future conditions with the toll road operational.	• Modelling should include calibration of traffic volumes and speeds against the existing network. • Future year modelling needs to consider potential network changes that may be made in response to the new route (e.g. speed limits, capacity reductions).
3. Assignment methods	• Traffic assignment methods (to reflect choice between toll route and alternatives) often do not adequately replicate the range of travel behaviour indicated by the VTTS distribution from the market research.	• It is highly desirable to ensure consistency between SP survey responses, traffic modelling and economic evaluation aspects. This issue may need to be addressed further in the selection of assignment and evaluation methods (e.g. incremental loading methods, reflecting the VTTS distribution).
4. Future demand forecasting	• Most modelling assumes that current behavioural cost functions (from SP survey) will continue to apply for future years.	• Modelling should allow for likely future changes in VTTS as real incomes increase (at minimum, by way of sensitivity tests).
5. Annualisation	• Modelling methods are often inadequate in deriving annual toll road usage, revenues and user benefit estimates from assignment outputs.	• Detailed traffic modelling is needed for at minimum 3-4 separate time periods (including weekends) that will adequately capture the current/future range of travel conditions. • Expansion/annualisation factors need to be selected appropriate to toll route traffic patterns rather than general traffic flows in area.
D. ECONOMIC EVALUATION ASPECTS		
1. Treatment of VTTS distribution	• Current NZ evaluation practice (as per PEM) is to apply a single average ('equity') VTTS in calculating user benefits of all schemes. This project has highlighted that, for toll schemes, this practice is likely to result in wide divergence between the estimate of user (dis)benefits and an estimate based on the observed (SP) distribution of VTTS: the use of the observed distribution would result in user disbenefit estimates for tolling much lower than those derived in the 3 NZ case studies.	• The use of a single average VTTS for assessing the economic implications of tolling schemes is likely to be highly misleading. • Recommend that a consistent modelling and evaluation approach be adopted, based on the behavioural distribution of VTTS derived from the market research (SP surveys).

Abstract

Over recent years, interest has been increasing in the application, in New Zealand and internationally, of tolling policies to contribute to the funding of major new urban road infrastructure schemes. The project examines, in the context of policy developments in New Zealand, the traffic, environmental, economic and financial implications of tolling policies applying to selected major road schemes in larger urban areas.

The three main tasks were:

1. To review New Zealand and international practice on traffic modelling, price setting and economic appraisal for urban toll road schemes, and to formulate therefrom a best practice framework and guidelines for assessing tolling policies.
2. To select, appraise and summarise relevant toll road case studies in New Zealand and internationally (principally Australia).
3. From these outcomes to develop conclusions on: the general merits of policies for tolling selected roads in urban networks; criteria appropriate for assessing the traffic and economic merits of tolling specific schemes; and best practices in urban toll road traffic modelling and economic appraisal.