Ministry of **Transport**
TE MANATŪ WAKA

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The purpose of this report is to provide technical information to inform consideration and further analysis of whether road pricing in Auckland could be implemented and whether it is desirable to do so. Accordingly, the report draws no conclusions on the case for road pricing and makes no recommendations on a proposed course of action.

Acknowledgements and Caveats

In March 2004, Cabinet requested a study investigating the feasibility and desirability of road pricing on existing roads and parking levies in Auckland. This study provides information to help inform the Ministry of Transport's (MoT) advice to government on this issue. The study was managed by an Officials' Steering Committee (OSC) chaired by the MoT and comprising representatives from:

- the Treasury
- the Ministry of Economic Development
- the Ministry of Social Development
- Auckland Regional Council
- Land Transport New Zealand
- Transit New Zealand
- Local Government New Zealand.

The study was carried out by a consortium of consultants led by Deloitte. This final report therefore contains analysis and discussion compiled by Deloitte using material prepared by Deloitte and the following sub-contractors:

- Hyder Consulting Pty Ltd
- Market Economics Ltd
- Mein Consulting Ltd
- David Young Consulting
- Taylor Baines and Associates
- Nexus Planning and Research Ltd
- Hill Young Cooper Ltd
- National Institute of Economics and Information Research
- Accent Marketing and Research (UK)
- Colin Buchanan and Partners Ltd (UK)
- Massey University College of Humanities and Social Sciences.

This study was undertaken prior to the development of Transit New Zealand's proposal to complete and operate the Western Ring Route between Manukau City and Albany via SH20, SH16 and SH18 as a toll road. The schemes developed during the study would, therefore, need further work to determine how they could be made to work best with a tolled Western Ring Route in terms of the outcomes central government and the region wish to see from directly charging for road use in Auckland.

It is important to note that the modelling carried out for this study has been designed to be fit for purpose for a comparative analysis of the options. Care should therefore be taken in examining the results for each option in terms of their actual absolute impact on congestion, i.e. it is more useful to examine the comparative results of each of the schemes than the figures presented for each in isolation. The model outputs have been the subject of sensitivity analysis to establish their likely ranges, however, ultimately, the outputs from the transportation, financial and spatial impact (household and business) models are only as good as the inputs, and the predictive ability of the models.

Part A: Introduction and Overview

Introduction

1. This Executive Summary accompanies the final report on the findings of the Auckland Road Pricing Evaluation Study (ARPES). The study examines the feasibility and desirability of implementing a road pricing scheme to reduce congestion across the wider Auckland region, and to raise revenue.

2. The report assesses the potential of four road pricing schemes and a parking scheme to reduce congestion and raise revenue, and to positively contribute towards achievement of the New Zealand Transport Strategy (NZTS) objectives.

3. Within this report, road pricing is defined as charging for the use of an *existing road*:

    - for the purpose of reducing congestion; and
    - to provide revenue for investment in land transport.

4. Parking levies, though not a form of road pricing, are also considered in this study as a means to reduce congestion and raise revenue. Parking levies are defined as a charge for parking on public and/or private property within a defined area(s), in addition to any parking charges already in place.

Background

5. Preliminary work on road pricing and parking charges was undertaken as part of the Joint Officials' Group (JOG) work on Auckland Transport Strategy and Funding in 2003. JOG was established following a May 2003 agreement between ministers and the Auckland Mayoral Forum to examine transport strategy and funding issues in the Auckland region, and comprised officials from central government and Auckland local authorities. Its aim was to develop a funding package to enable the timely implementation of an agreed network strategy, having assessed the fit of the Auckland Regional Land Transport Strategy (RLTS) with the NZTS and other public policy outcomes.

6. JOG identified and assessed a range of policy options including road pricing. Road pricing was found to have significant demand management and revenue potential, and the ability to make a major contribution towards the achievement of the NZTS objectives. The major concern was the potential for road pricing to cause adverse social impacts (e.g. in terms of access and mobility). Accordingly, this study has focused on social and economic impacts of road pricing, along with the identification of feasible mitigation measures such as additional public transport (PT).

7. This report builds on the interim report (July 2005) which presented a preliminary assessment of potential road pricing and parking scheme designs and assessed initial outcomes in terms of the viability of technical and systems options for the:

    - implementation of each scheme;
    - reductions in congestion levels across the Auckland region; and
    - revenue-raising potential of each scheme.

8. This final report evaluates five schemes modified in response to those initial findings, and assesses the social, economic and environmental impacts of each of these schemes, and also considers public acceptability. The report takes into account proposals for mitigation of the social impacts such as enhanced public transport, and these have been incorporated into the final results.

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Feasibility and Desirability

9. This report presents the findings on feasibility and desirability in terms of each area of analysis. It then summarises on a scheme by scheme basis each of the key performance indicators. Although conclusions are reached in the report as to the scheme which appears best based on a comparison across all of the indicators, no recommendations are made as to the next steps.

10. This report emphasises the *desirability* of implementing a road pricing scheme in Auckland. Feasibility is examined at a high level only, as technical "implementability" is largely found to be proven for the types of schemes considered, given that many free-flow toll roads (i.e. toll roads where there is no requirement to slow or stop to make payment) and several road pricing schemes are in operation internationally. That said, technical issues would need more detailed examination should any particular scheme be progressed further.

Study Objectives and Approach

11. This study aims to show:

- how much the proposed schemes would reduce congestion at peak times;
- what the positive and negative social, economic and environmental impacts of the schemes are, and the extent to which the negative impacts can be mitigated;
- whether there is a financial business case for each of the schemes, and assuming there is, how much net revenue might be generated over time;
- whether the schemes are technically feasible to implement;
- whether the schemes are acceptable to the public; and
- whether the schemes are consistent with central and regional government policies and development strategies.

12. The scope of assessment of all impacts (transport, social, economic and environmental) included in the study evaluation methodology are described in the table below:

Figure 1 Auckland Road Pricing Evaluation Framework

1. Social, economic and environmental impact assessment (including equity and efficiency dimensions)	
2. Evaluate scheme against NZTS objectives:	
• Assisting economic development • Assisting safety and personal security	• Improving access and mobility • Protecting and promoting public health • Ensuring environmental sustainability
3. Identify and assess:	
• revenue potential • demand management • social distributional effects • consistency with Akld Regional Policy Statement land-use policies • privacy issues	• technical feasibility/ implementation issues (including establishment and operating costs, enforcement) • administrative simplicity • public acceptability • legislative implications
4. Identify and assess mitigation proposals (e.g. additional public transport services, discounts/exemptions from potential charges)	
5. Re-assess 1-3 in light of mitigation proposals	

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13. While we recognise that implementation of a road pricing scheme would never be universally beneficial, our central question is "what level of costs are appropriate?". These costs are then compared against the potential benefits. This study assesses desirability in terms of the extent to which road pricing schemes may generate adverse impacts on households and businesses which may need to be mitigated and whether they can be mitigated to acceptable levels.

14. The analysis tool used for this study is the Revised Auckland Regional Transport (RART) model for a relative comparison of the schemes performance against the chosen assessment criteria. The RART model is a strategic level model and is a reliable basis for the comparative analysis of the schemes. The model's outputs should not be taken as an accurate indicator of the absolute effects of each scheme. In practice results may differ from those indicated and this has been accounted for in this report through the sensitivity analysis performed for each scheme.

Why is Congestion in Auckland a Problem?

15. Auckland's traffic congestion damages the quality of life in the city and the region and affects businesses and residents through delays, unreliable journey times, and the opportunity cost of time spent sitting in traffic jams.

16. During this study, surveys of businesses and residents of Auckland were carried out which show that most Aucklanders consider traffic congestion across the Auckland region to be a serious problem. Ninety-four percent of residents surveyed identified the reduction of traffic congestion as "important" or "very important".

17. Businesses feel even more strongly about traffic congestion. Over 80% of all businesses surveyed thought it "very important" to reduce traffic congestion, with virtually all of the remainder feeling it was "important". The strong message is that "something needs to be done". Considerable expenditure on motorway construction is underway but this will not be sufficient to address congestion throughout the region in the long term.

Historical Role of the Car in Auckland

18. The underlying causes of congestion in Auckland are multifaceted, relating to regional growth, geographical and capacity constraints, and a high reliance on cars. In 2004, the Auckland region had a population of over 1.3 million, or 32% of the national total, and a total vehicle fleet of 837,000 including 721,000 passenger cars or vans. Current population growth averages 1.5% a year, significantly higher than the rate for New Zealand as a whole (0.6%).

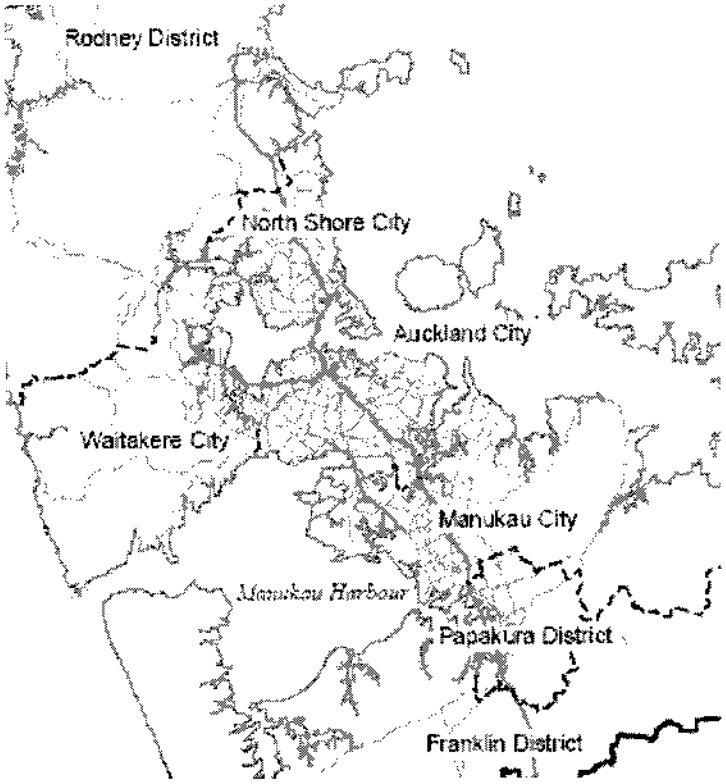
19. The patterns of development in Auckland, combined with limited public transport, have fostered a strong reliance on private vehicles as the dominant mode of transport. This can be attributed to low-density development of the region, with peripheral expansion based on historically good accessibility by road, resulting in a central business district with a relatively low share of regional employment (currently 12% of total employment). Consequently, Auckland displays high levels of car ownership, comparable with the USA, Australia and Canada, and low public transport utilisation - currently around 7% of all trips during the peak period (compared with around 17% in Wellington, for example).

20. The combination of these factors has meant that Auckland's recent growth has outstripped the capacity of its transport system to cope with demand. In addition there is a gap to bridge to provide a realistic alternative to cars for much of the population.

Auckland Geography

21. The Auckland region's geographic characteristics, particularly its harbours and waterways, impose constraints on the transport system. This means the main transport links are confined to narrow corridors. For many trips, these constraints mean that few alternatives are available, and providing new routes or additional capacity has significant financial, environmental and community costs. Some major structures are operating at capacity in places where expansion would pose major difficulties. The map below provides an overview of the greater Auckland region:

Figure 2 Auckland Geographic Characteristics



22. This map illustrates how geography plays an important role in transportation patterns throughout the region. There are three points are to highlight:

- It is not possible to travel from south of Auckland to north of Auckland without traversing the Auckland "isthmus" (essentially Auckland City as shown in green above);
- The Auckland City isthmus is bounded by water with only relatively narrow land attachments south and west. The Auckland Harbour Bridge (or "AHB") and Manukau Harbour crossing ("I Bridge") provide additional access routes north and south; and
- The motorway network (shown in red above) relies heavily on a single, fully integrated north-south corridor, with a secondary "Western Ring Route" being completed in stages[1].

23. The dispersed residential character of Auckland suburbs reduces the number of households that are within easy walk/cycle distance of employment or non-work destinations, and limits the usefulness of some major potential public transport modes.

[1] Transit proposes to complete and operate the Western Ring Route between Manukau City and Albany via SH20, SH16 and SH18 as a toll road. The integration between this toll road proposal and a road pricing scheme would need careful consideration.

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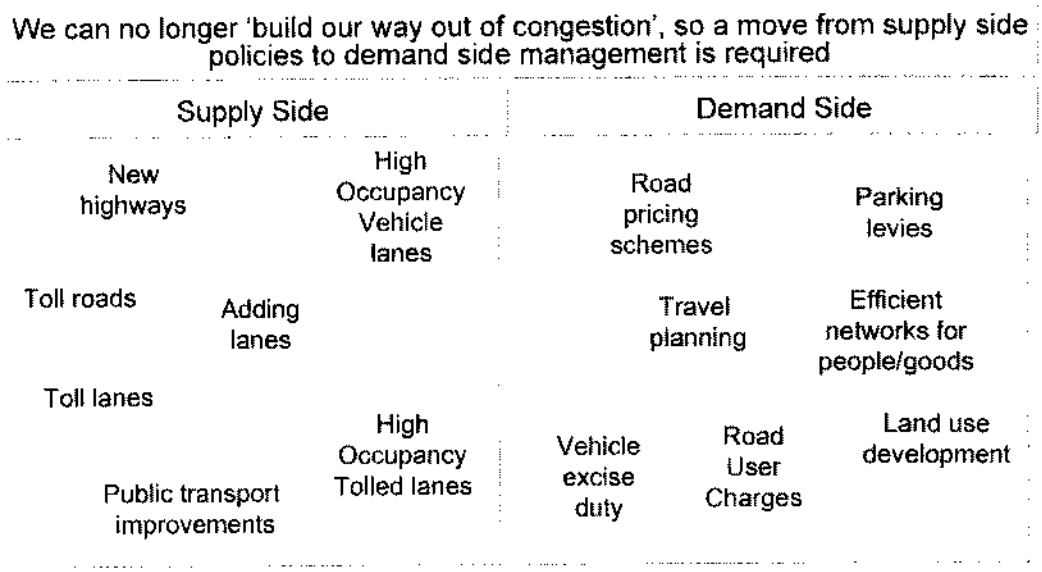
Why Consider Road Pricing?

24. Recent and future large-scale investment in road building to provide a complete and efficient road transport system is critical to Auckland's transport future. However, it is now widely accepted that cities cannot build their way out of congestion in the long term and the factors above underline why this is particularly the case for Auckland. The spectrum of demand and supply side measures available for managing congestion are depicted in the figure below.

Figure 3 Supply and Demand-side Congestion Management Levers



Projected Congestion Levels in 2016

25. Analysis of model outputs from the 2001 RART model compare the 2001 network conditions against the 2016 conditions reported in this study. The 2001 model shows a total demand of around 358,265 trips compared with the 2016 No Pricing outcome of 446,299 trips (which includes substantial investment in roading infrastructure, public transport and other non-pricing demand management measures).

26. This indicates that there is an increase in traffic demand of about 1.5% per annum. Working backwards from 2016, congestion should be up to 20% higher by 2016 than current conditions. To look at it another way, current conditions are probably 20%-25% less congested than projections for 2016, even allowing for planned investments in roads, passenger transport and other measures.

27. An overview picture of the congestion problems likely to exist in 2016 in the absence of road pricing is provided below[2]. Highlighted links show where the level of service (LOS) is expected be at level "E/F"[3] as measured by average vehicle speeds in the 7-9am period. LOS E/F is defined as speeds less than 67km/h on motorways and less than 25km/h on local roads. These are the speeds at which traffic no longer flows smoothly. Motorways are shown in red and local roads in blue.

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[2] The analysis takes into account best estimates of transportation capacity in 2016, including additional road, public transport and non-pricing TDM measures, using information from the latest draft Auckland Regional Land Transport Strategy, as well Transit's 2005/06 State Highway Plan and the Land Transport NZ 2005/06 National Land Transport Programme.

[3] LOS = level of service. This refers to the driving conditions on any particular road and is measured on a scale of A-F, where A is optimal and F is poor (stop/start) conditions. LOS is primarily measured based on average travelling speed by reference to the specific road characteristics (e.g. motorways, local roads).

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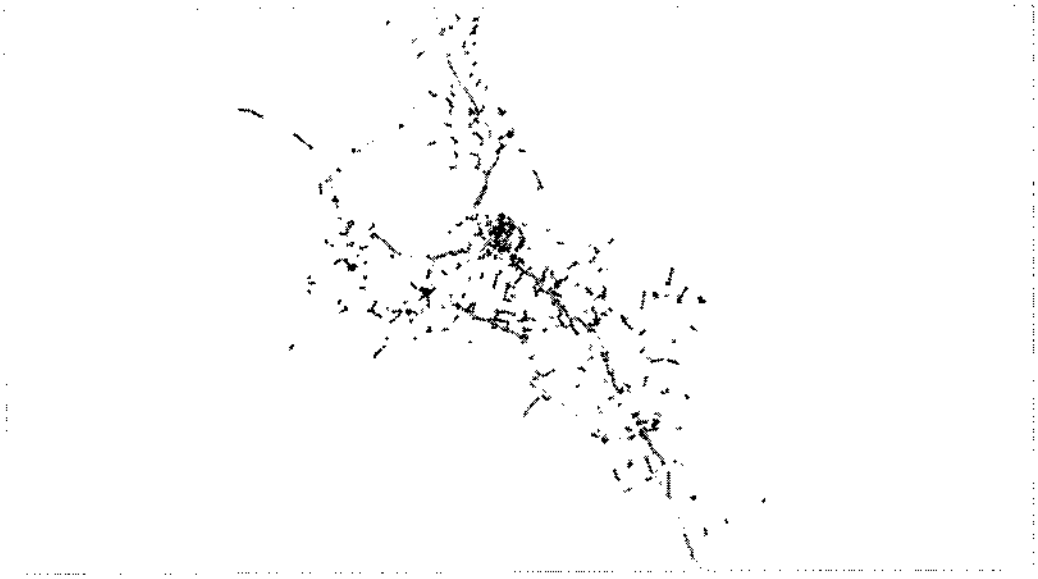
Figure 4 Overview Map of Congested Links Across the Auckland Network



28. The data suggests that, without road pricing, there will be high levels of congestion in the Auckland CBD, on the main arterial routes (and feeder roads onto those routes) leading towards the CBD and on certain critical cross-town routes particularly on the Auckland isthmus. Existing and planned investment in Auckland will struggle to keep pace with the growth in traffic volumes, leaving Auckland a more congested city than it is today. After taking into account planned investments RART estimates that by 2016 20% of vehicle kilometres travelled during the morning peak period will be in these "E/F" (congested) conditions.

29. To restore congestion just to the level of 2005, this statistic will need to be pulled back to 16% or less. For any road pricing scheme to achieve this, it would need to apply charges:

    - to areas or routes which encompass the most congested parts of the network (i.e. the Auckland City CBD and immediate environs); and
    - to areas or routes which are the primary destinations of traffic travelling along other congested routes, since this traffic would be influenced by the requirement to pay a road pricing charge before reaching its destination and hence congestion outside the area covered by a road pricing scheme should also be reduced.

Theory of Road Pricing

30. Congestion comes from drivers failing to take into account the effect that their vehicle has on others, i.e. the delay that a vehicle causes to other vehicles using the network. This means that drivers sometimes use private vehicles when the benefit to society of making the trip is less than the overall cost the trip imposes on society.

31. In theory, the best method of dealing with this is by charging each road user for their use of the road according to the extra cost to society that their use imposes. For example, road users should be charged more for using roads at the times of the day when society places the greatest value on traffic movements - such as commuter travel periods.

32. Although this approach is theoretically sound it is not easy to implement in dense urban networks because it is still technically difficult to track individual vehicle movements across the city's entire roading network. However, increasing moves towards fuel efficiency and alternative fuels combined with the environmental effects of vehicle emissions all point to a future roading system that is ultimately funded by direct road user charges for all vehicles.

International Comparisons

33. Given the issues above, policy makers overseas are implementing simpler, less expensive and more practical and transparent options such as cordon tolls and area licensing schemes.

34. The two best known examples of road pricing to manage demand are Singapore (where electronic congestion pricing has been in use since 1999 and a paper-based scheme since 1975), and London (where a congestion charging scheme was introduced in the central city area in February 2003).

35. In both schemes, the overriding objective was to manage demand for road use, with costs and revenues very much of secondary importance. Significant attention was paid to ensuring the main causes of congestion (essentially regarded as home-work trips) were tackled.

36. The Norwegian cities of Oslo, Bergen and Trondheim have also implemented schemes aimed primarily at raising revenue for transport investment. These have all demonstrated the effectiveness of using a pricing mechanism to manage the use of existing road capacity and generate funds to provide improved public transport alternatives and better road networks.

37. Other cities or regions where road pricing has been, or is being, considered to manage transport demand include Stockholm (commenced January 2006), New York, Hong Kong, Edinburgh, and the Czech Republic, although Edinburgh has decided not to proceed at this stage.

38. Road charging aimed at addressing congestion has not yet been implemented in a city like Auckland. The London and Singapore schemes are the most similar to that which would be needed for Auckland. However both were implemented in cities with dense population, a much more congested central business district, and much higher public transport mode shares. For example, London's public transport share was 85% prior to the introduction of their scheme.

Part B: Road Pricing Schemes

Scheme Designs Overview

39. Conceptually there are two broad categories of road pricing schemes:

    - **The first charges for travel either into, across, or within a defined area.** Charging can be based on a flat rate per day, varied according to actual levels of congestion or at least according to times of day when congestion is anticipated, e.g. peak periods. The charge aims to reduce congestion (and/or raise revenue) in the area subject to the charge.
    - **The second charges for travel on specific roads, or parts of those roads,** e.g. motorways. In this case, charges are applied on a distance travelled basis. Charges can be aimed at congestion and/or revenue, although one objective needs to be paramount when considering charging for part of the network only, since setting high charge levels to raise revenue will result in significant diversion of traffic onto uncharged routes.

40. Parking charges effectively charge for travel to a particular destination.

Scheme Refinement Process

41. The five schemes have been developed and refined based on their performance against the measures contained in the Evaluation Framework.

42. The scheme designs are fit for the purpose of the study but further development will be needed should work progress beyond this study. Consultation was undertaken through the Auckland Regional Council with designated Auckland territorial authority representatives working on the detail of the scheme designs, particularly in terms of boundary location, roads to which charging could be applied, and general "sensibleness" of the schemes.

Five Schemes Examined

43. This report evaluates five potential road pricing schemes for Auckland. These have evolved from generic schemes described in the project brief. The evolved schemes are:

    - **Single Cordon scheme** - charging vehicles that cross a single, defined cordon (inwards travel only). Charges would not apply to travel entirely within the cordon.
    - **Double Cordon scheme** - charging vehicles that cross either of two cordons (inwards travel only). Charges would not apply to travel entirely within either cordon.
    - **Area scheme** - charging vehicles entering or travelling within a defined area.
    - **Strategic Network Charging scheme** - charging vehicles that use motorways and major limited access arterial routes.
    - **Parking Levy scheme** - parking levies for parking on public and private property within defined areas, in addition to any parking charges already in place.

44. In addition to these five schemes, consideration was also given early in the project to:

    - **Toll Lanes** - use of toll lanes on specific parts of the strategic (motorway) network.
    - **Full Network Charging scheme** - charging for the use (by distance) of all roads within the network.

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45. These two schemes were not progressed further. Enabling technology for Full Network Charging is not yet developed, while toll lanes do not directly align with the central objective of reducing congestion across the wider Auckland network. This does not preclude the examination of such schemes for other purposes such as raising revenue to pay for new road capacity.

Variations and Combinations

46. The five schemes represent approaches which are most likely to apply to Auckland. It could also be possible to combine some of these schemes. Future work would need to consider how any scheme, particularly one to relieve congestion, fitted in with proposals to toll the Western Ring Route.

Scheme Characteristics

47. The final scheme designs balance congestion-reduction, revenue-raising, and social, economic and environmental impacts.

48. Results for each scheme were not "optimised" through multiple iterations of scheme characteristic variations as this was outside the terms of reference for the study. Such an optimisation process would be useful if one or two schemes were to be developed further. The characteristics of the schemes have, however, been refined sufficiently to enable meaningful comparison of the five schemes.

Charge Levels and Application

49. The interim report in July used common charge levels to give an idea of the relative effects of the schemes. Following further analysis, a charge level has been selected for each scheme that is considered to represent the best balance between congestion reduction and any undesirable social and economic impacts. These are the charges reported here. The average charge per trip for the Strategic Network Charging scheme is significantly lower than for the other schemes. This was necessary to minimise diversion impacts onto local roads.

50. The charges applied to each scheme for the purposes of this final report are set out below:

Table 1 Charge Levels for Each Scheme in 2005 dollars

Name	Pricing level
Single Cordon	$6 on Harbour Bridge. $3 elsewhere. Maximum charge $6 per day
Double Cordon	Inner cordon charge ($3/day) and outer cordon charge ($3/day). Harbour Bridge $6/day. $3/day charge for travel along SH20 by including toll points on SH20 on Mangere Bridge (northbound) and on SH20 South of SH18 Waterview interchange (southbound). Maximum $3/day charge for use of SH20 and/or crossing outer cordon boundary. Maximum charge of $6 per day for multiple crossings.
Area	$5 per day
Strategic Network Charging	Charges applied to points of congestion and based on LOS in the 2016 unpriced network. Ranges from no charge for A/B LOS to greatest charge ($0.25/km) for E/F LOS, with moderate charge ($0.15/km) for C/D LOS. Maximum charge $6/day.
Parking Levy	Revenues calculated using $10 per trip terminating in the designated parking charge zone but with driver behaviour and congestion results based on $5 per terminating trip. It is assumed that only 50% of road users would in fact pay the charge directly (and hence change their behaviour) with the balance of parking charges collected from carpark owners/employers.

Charging Periods: Time of Day and Days of Week

51. Across all of the schemes, modelling has assumed that a charge would be applied during the **Monday to Friday morning peak period only, between 6am and 10am**[4].

52. This decision was based on the hypothesis that by addressing morning peak congestion, congestion throughout the day (the inter-peak) and in the evening would also be reduced, i.e. fewer commuters travelling into work by car would be reflected in fewer commuters travelling home in the evening by car.

53. The impacts of the 6-10am pricing charges on the interpeak are mainly caused by re-timed trips, though the total effect of re-timed trips on the interpeak periods before 6am and after 10am were analysed and not considered significant. The table below provides a comparison of the results achieved in the AM and PM Peak period:

Table 2 Absolute Reduction in % Congested VKT

Period	Single Cordon	Double Cordon	Area	Strategic Network	Parking Levy
AM Peak	-6.0%	-7.8%	-5.4%	-5.1%	-1.9%
PM Peak	-5.0%	-6.7%	-5.4%	-3.8%	-3.3%

54. The results suggest that by pricing in the AM peak period, significant reductions in congestion would occur in the PM period, although for some schemes this would be slightly less effective than for others. Extending the charging period outside 6-10am could be considered if these schemes were to be taken forward for further consideration.

Specific Scheme Characteristics

Cordon Schemes

55. Cordon schemes generally involve identifying an area of major congestion, drawing a line around that area, and charging vehicles that cross that line, to reduce congestion on routes leading into and through the cordoned area.

56. Cordon schemes influence only traffic which passes across the cordon and not traffic circulating inside the cordon. Consequently, congestion reductions rely largely on changes in the behaviour of commuters who travel into the cordon from areas outside it.

57. The Stockholm trial scheme is probably closest to the scheme design evaluated for this study for Auckland. The trial scheme, which began in January 2006, involves charging vehicles around €2 each time they cross the cordon boundary during peak periods, with lower charges outside these periods. The proposal uses transponder technology and has around 20 crossing points covering an area of similar size to the Auckland isthmus and also with similarities in terms of natural water boundaries. It is hoped the scheme could raise up to €100m p.a. and significantly reduce congestion, particularly in the centre. The trial period runs through to the end of July 2006, with a local referendum to be held in September 2006.

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[4] Note that the Revised Auckland Regional Transport (RART) model used to assess changes in trip patterns for this study, is configured to analyse a morning peak period of 7-9am only. For the purposes of financial modelling, these results have been extrapolated to cover the 6-10am period however; all of the results directly derived from the RART model, such as plots of congestion, are illustrative of the 7-9am period.

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58. This study examines two variations to a cordon scheme:

- A Single Cordon comprising one cordon ring, essentially around the Auckland City isthmus; and
- A Double Cordon comprising two cordon rings. The outer ring is similar to the Single Cordon boundary, but with its western boundary following SH20. The inner ring follows the same boundary as for the Area scheme described below.

59. For both cordon schemes, a free-flow toll collection mechanism is necessary to facilitate traffic flow and avoid congestion at crossing points, and enhance public acceptability.

Single Cordon Scheme

60. The size and shape of the isthmus area and the large proportion of traffic which moves within it makes it a logical choice for a cordon – see the map at the back of this Executive Summary[5]. This is a notable feature of the Single Cordon scheme design since, as the geography of the Auckland isthmus cuts off possibilities for diversion, there is no way drivers can travel from north to south during the AM peak without incurring the charge. The Single Cordon boundary would be controlled by a total of 16 toll points.

Double Cordon Scheme

61. The Single Cordon has little influence on congestion caused by traffic moving *within* the boundary of what is a very large cordon, as no charge is applied to this travel. The Double Cordon scheme concept was developed to replicate the positive decongestion effects experienced by creating a large chargeable area (as in the Single Cordon scheme), but without the enforcement difficulties that come with large area schemes (see below).

62. The Double Cordon scheme places two cordon boundaries around the Auckland isthmus and central Auckland. The outer cordon follows much the same boundary as the Single Cordon scheme but is relocated inside SH20 with the Avondale Extension and Manukau Harbour Crossing completed. The scheme described in this report has tolls applied at two points along SH20[6]. SH20 is a natural boundary, thereby limiting community severance that is sometimes associated with road pricing boundaries. The majority of the outer cordon is located through the harbour areas, similar to the Single Cordon scheme.

63. The inner cordon follows the same boundary around central Auckland as the Area scheme described below. This is a significantly smaller zone than the outer cordon, following a line from the harbour in the north, to immediately to the north of St Lukes Road and Remuera Road in the south.

64. The two scheme boundaries create a total of 50 charging points. The boundaries are shown in the maps in Annex 1 at the back of this Executive Summary.

65. Traffic which crosses the outer cordon would pay an initial charge. Traffic which continues into the central city, and crosses the inner cordon, faces another charge. Journeys entirely within either the inner cordon or entirely within the outer cordon would not face any charge.

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[5] Annex 1 at the back of this Executive Summary provides enlarged maps depicting the scheme designs modelled.
[6] This scheme was designed prior to Transit NZ formulating proposals to build and operate the Western Ring Route as a toll road.

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Area Scheme

66. Area schemes are similar to cordon schemes in that they identify an area of major congestion, draw a line around that area and charges vehicles that cross that line, to reduce congestion on routes leading into and through the defined area. The major difference is that with an area charge, vehicle drivers who travel entirely within the scheme boundaries are also charged.

67. The best-known area scheme is the London Congestion Charging scheme, which commenced operation in early 2003. A decision has just been made to expand that scheme over a larger area.

68. As area schemes influence traffic which crosses the boundary as well as traffic circulating inside the area, congestion reduction inside the area is higher than the cordon schemes. However, congestion reductions outside the charging area are similar to the cordon schemes, with congestion reduction depending largely on changes in the behaviour of commuters who are travelling from locations outside the area to locations within it.

69. While cordon schemes effectively provide a free benefit to those travelling entirely inside the boundary, area schemes do not provide this free benefit, meaning that those who receive the greatest congestion reduction benefits also bear some of the costs.

70. The Area scheme is significantly smaller than the Cordon scheme, with its boundary around central Auckland from the harbour to the north, and following a line immediately to the north of St Lukes Road and Remuera Road in the south. This bounded zone creates a total of 34 fixed crossing/toll points as shown in the map included at the back of this Executive Summary. An additional 50 fixed internal checkpoint and 10[7] mobile units are also proposed to enhance scheme enforcement effectiveness.

71. The choice of a smaller area than the outer cordon of the Single Cordon scheme reflects the higher volumes of trips captured by an area charge, the more focused application of charges, and the technical challenges of applying charges across a large area.

72. The Area scheme would also need to include some form of free-flow tolling facility at the defined boundary crossing points, but these would be backed up by a network of fixed and mobile charging points *within* the defined area both to pick up internal trips and for enforcement purposes. These are shown on the map.

Strategic Network Charging Scheme

73. The Strategic Network Charging scheme would charge vehicles to use the main "strategic" – and most heavily congested – routes: motorways and a few limited access routes. Free alternative routes (local roads) are available which would mitigate some adverse social impacts. By providing a free alternative, this scheme might also be more publicly acceptable than other schemes, although the diversion of traffic to local roads would be of concern.

74. Of all of the schemes, the Strategic Network Charging scheme provides the greatest opportunity to avoid paying road user charges by travelling via an alternative free route, albeit one likely to be congested. A Strategic Network Charging scheme would also primarily influence traffic which may choose to travel by the tolled route, but would have only minimal influence on traffic travelling within or across other parts of the network which may also be congested.

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[7] These are initial estimates, consistent with the investigative nature of this study. Further work would be required to determine the definitive number of fixed and mobile toll points required to make the scheme effective.

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75. The technology required to apply road charges to only specific limited access routes is similar to that for toll roads and at its simplest would involve charging a fixed fee for each "link" or section of the road used. To ensure the scheme targets congestion but minimises the diversion from the charged network to local roads, the scheme design only charges for use of congested links, in the direction of the congested traffic flow.

76. This scheme is different from the Cordon and Area schemes because it is a distance-based charge, with different charges applied to sections of motorway experiencing greater or lesser congestion. The main objective of this approach is to influence demand on the motorways during the peak period, targeting the charge to those congested sections of predominantly State Highways, and not charging those sections that are un-congested.

77. This charging framework is more complicated than other possibilities considered. Its main benefit is that it concentrates the charge on those areas where the network is most congested. Diversion of traffic off the less congested sections of the network is reduced by either not charging or having a lower charge on those sections. This reduces the negative impact on local roads. The sections of the Auckland strategic network to be included in this scheme are shown in the map included at the back of this Executive Summary.

78. A major advantage is that fewer charging points are needed to capture all trips entering and leaving the charged routes. However, the charge level needs to be kept low to avoid high levels of diversion to local roads, which may exacerbate congestion rather than reduce it.

Parking Levy Scheme

79. Parking Levy schemes aimed at addressing congestion are generally applied to areas with high concentrations of businesses where large numbers of employees travel to work each day in private vehicles. This is because commuter traffic (home-work trips) tends to be the greatest contributor to congestion. Such schemes cannot affect through-traffic or most commercial vehicle trips.

80. In determining the Parking Levy scheme charging zones, two factors were considered:

- The need for enough car parks to be included within the scheme to influence the behaviour of a meaningful number of road users.
- The need for car parks to be in areas which are major destinations and/or suffer from serious congestion, including all car parks within a reasonable walking distance of the main employment locations.

81. The Parking Levy scheme tested has additional charges applied to all parking (both public and private car parks) between 6am and 10am within four areas. The boundaries of these include:

- **Parking Zone A** - comprising the Auckland CBD and main Newmarket shopping area;
- **Parking Zone B** - the existing controlled parking areas around the Manukau central area;
- **Parking Zone C** - the central Henderson shopping area between the rail line and Newington Road; and
- **Parking Zone D** - the area of current parking restrictions around the central Takapuna business area.

82. To effectively reduce congestion, parking levies must apply not only to public car parks, but also to private spaces (e.g. commercial buildings, shopping malls, hotels, supermarkets, or on private residential properties). This raises several difficulties:

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- Enforcement of a daily levy on these carparks could be difficult where access is not public.
- "Residents' Parking Schemes" must be implemented outside the zones to avoid heavy competition for car parking on scheme boundaries.
- Owners of the non-residential car parks may find the commercial implications of charging customers for parking on their premises undesirable (e.g. supermarkets). An alternative is to allow the owners of the parking spaces to pay the charge, however this would reduce the impact on congestion as the driver would no longer face a direct charge, which promotes changed behaviour.
- The scheme developed would exempt residents from paying the charge for parking at home. Such exemptions may create secondary markets where residents have spare car parking capacity that they can make available. This would need to be monitored closely.
- A car park registration database would need to be developed and maintained to record all eligible car parks and also to record any changes.

Technology Proposals

Cordon, Area and Strategic Network Charging Schemes

83. The proposed technology for all the schemes (excluding Parking Levy) is based on microwave based Dedicated Short Range Communication (DSRC) technology with on-board transponders, combined with video camera enforcement technology (Automatic Number Plate Recognition, or ANPR). The primary reasons for this choice are that it:
    - provides for charge collection under free-flow traffic conditions;
    - is proven technology;
    - provides a low operating cost compared with other options; and
    - provides payment methods for infrequent users.
84. The choice is aligned with the technologies and processes currently being developed for the Toll Systems Project (TSP) by Transit NZ and Land Transport NZ.
85. There are some differences between the systems for each of the four road pricing-based schemes, primarily in the number of tolling points required to cover each scheme, as follows:
    - The Single Cordon scheme requires 16 charging points to cover the cordon boundary.
    - The Double Cordon scheme requires 50 toll points, effectively combining the Area scheme's boundary charge points with those of the Single Cordon.
    - The Area scheme needs 34 charging points on the boundary, and approximately 50 further checkpoints and 10 mobile enforcement units, because the scheme aims to charge road users for travel within the zone, rather than just for crossing a boundary[8].
    - The Strategic Network Charging scheme would require a network of 27 toll gantries to cover the roads included in the scheme.

[8] These 94 points compare with 260 fixed and mobile toll points in the London scheme. The difference is largely due to the natural water boundary in Auckland which reduces the number of entry points required to be covered by up to 75% compared with a similar land-locked scheme.

Parking Levy Scheme

86. The systems required for a parking scheme's revenue collection and enforcement differs significantly from those required for the other four schemes examined.

87. Similar to the on-street parking scheme in Wellington, drivers would be required to display a valid coupon for parking in the Parking Levy zone between the hours of 6am and 10am.

88. The potential difficulty with this scheme is that for the scheme to be effective, the enforcement authority must have access to parking locations within all private premises in order to confirm that vehicles parked there are correctly paying parking charges.

89. While there are various technical solutions for the automated collection of parking charges, no system suitably covers the variety of parking ownership options or access regimes anticipated.

Inclusion of Mitigation Strategies

90. Following the preliminary analysis, consideration was given to mitigation of the impacts of the different schemes. Recommendations for mitigation were incorporated into a revised set of schemes resulting in some scheme-specific mitigation measures to reduce social impacts.

Discounts and Exemptions

91. Providing discounts and exemptions to particular categories of users can mitigate adverse social impacts, and enhance public acceptability. However, if too widely applied, they can also damage the ability of the scheme to reduce congestion, as well as increasing administrative complexity. The following categories of exemptions and discounts have been considered:

    - ***Public transport and emergency service vehicles*** would be exempt in all of the schemes.
    - ***Taxis*** are *not* exempt or discounted, however this could be re-examined as part of any detailed scheme design, given the role of taxis under the Total Mobility Scheme.
    - ***Motorcycles*** are *not* exempt or discounted.
    - ***Commercial Vehicles*** are charged at the same rate as cars for all of the schemes, on the basis that each vehicle contributes roughly equally to congestion.
    - ***Residents*** would be exempt from the Parking Levy scheme (only), reflecting that some of the charging zones contain significant areas of residential property, for which imposition of a parking charge would be inequitable and would not give congestion benefits.

92. Additionally, certain groups should have "temporary exemptions" granted to ensure that their access and mobility options are not restricted. These groups probably include people with disabilities, people who need to access specific health or social services during the AM peak period, or specialist education services, and those in targeted employment training programmes.

Summary of Scheme-Specific Mitigation Measures

93. The cost of the mitigation required for each scheme has been considered and the implications of these costs have been included in the Financial Evaluation section of this executive summary.

94. These mitigation measures are summarised in Table 3. While these measures are proposed to mitigate against potential social impacts arising from any road pricing scheme, the benefits of enhanced investment in public transport would accrue to a much greater number of people than those affected by the scheme: