

# **Auckland Road Pricing**

## **ENVIRONMENTAL AND LAND USE ANALYSIS**

**Report for Ministry of Transport  
by Hill Young Cooper Ltd**

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# Environmental and Land Use Impact Assessment

## Glossary of Terms and Abbreviations

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ASF	Auckland Sustainability Framework 2007
CBD	Central Business District
OECD	Organisation for Economic Cooperation and Development
NO <sub>x</sub>	a general term for the oxides of nitrogen, including nitric oxide (NO), nitrogen dioxide (NO <sub>2</sub> ) and nitrous oxide (N <sub>2</sub> O). Nitrogen oxides react with other compounds in the atmosphere to create particulates or other new pollutants which among other effects, contribute to health (respiratory) problems, the formation of acid rain, water quality effects, reduced visibility and global warming.
PM <sub>10</sub>	Fine particles with a diameter of 10 micrometres or less. Particles of this size and below are particularly important because they penetrate deep into human lungs, carrying with them the surface coatings which include many organic chemicals. There is a documented relationship between levels of PM <sub>10</sub> particulates and rates of disease and death.
RGS	Auckland Regional Growth Strategy 1999
VKT	Vehicle kilometres travelled (the total number of kilometres travelled by all vehicles over a set period).
VOC	Volatile organic compounds, such as benzene or 1,3-butadiene, some of which may have short- and long-term adverse health effects.
Agglomeration	An extended city area comprising a built-up CBD and any suburbs linked by continuous urban area.
Amenity values	Those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.
Arterial links	Major or main route through the urban areas
Monocentric city	City with one clearly defined spatial, political social or financial core. Usually where employment is focused and land prices and density all highest.
Polycentric city	City where the population is distributed almost evenly amongst several political, social or financial centres.
Severence effects	Effects of cutting communities off from key facilities or from each other as a result of road layout or traffic volumes.

## Executive Summary

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The Ministry of Transport has commissioned further research on road pricing in Auckland as a means of reducing congestion and raising revenue for investment in land transport. This further research aims to gain a better understanding of the issues raised by submitters to the previous *2005/6 Auckland Road Pricing Evaluation Study*.

This report provides an assessment of the likely impacts of road pricing in Auckland on environmental values in the region and on regional and local land use patterns.

This assessment uses two base road pricing schemes:

1. **"Revenue" scheme** – cordon-based scheme, 24-hours / 7-days-a-week, \$3 toll charge; and
2. **"Congestion" scheme** – area-based scheme, peak traffic times (Monday to Friday / 6am to 10am), \$6/day toll charge.

### A. Auckland Under No Pricing scheme

#### *Environmental*

Key Indicator (% change compared to 2001)	No Pricing	
	2016	2021
Amenity (traffic volumes on arterials)	-10.8%	-14.8%
VKT – sensitive catchments	-16.5%	-21.6%
Air discharges – PM10	16.6%	13.2%
Greenhouse Gases	19%	25%

- Overall regional traffic volumes are predicted to increase by over 10% above 2001 volumes without road pricing. However the localised effects will vary. Significant increases in traffic volumes are expected along the main link arterials within the North and South Auckland sectors, and the communities around these links could expect a reduction in the general amenity values and accessibility. Conversely, significant improvements to public transport and traffic demand management, and the proposed Western Ring route (SH 20 / 18) is expected to either maintain traffic volumes or decrease below 2001 levels in the main Isthmus and Western sectors.
- Contaminant loads in stormwater runoff to sensitive catchments are predicted to progressively increase in the majority of region's catchments, but particularly in the central, Northern and Southern sectors. This will increasingly result in adverse impacts on these sensitive ecosystems. These impacts may be mitigated by advances in stormwater treatment on new or upgraded roads in these catchments.
- Although traffic volumes and VKT will increase in the future, vehicular emissions of NO<sub>x</sub>, PM10 and VOC will decrease from 2001 levels as more effective fuel and emission standards are established.

- At a regional level, current data indicates that greenhouse gas emissions from Auckland traffic would increase to around 25% above 2001 levels by the year 2021 for the peak 7-9am period.

### Land Use

- By 2021, the ARC's transport model predicts that 26% of regional employment will be located within the area affected by the proposed road pricing schemes, down from 28% of regional employment in 2001. That is by 2021, 176,300 people will be employed in the affected area out of a regional total of 676,000. 89,000 of these people work in the CBD (on the inside of the central motorway junction). The area affected is home to 11% of regional households, up from 10% in 2001.
- These jobs and households are expected to generate just over 155,000 trips in the AM peak period. 48% of trips into the CBD are expected to involve walking, cycling or public transport, up from 34% in 2001.
- The average generalised cost of travel by vehicle to and within the charged area is predicted to be 541, down from 617 in 2001, or a 12% decrease. This compares to a generalised cost for the regional network as a whole of 398, down from 424, or a 6% decline. The ratio of the cost of travel to the charged area compared to the rest of the region therefore falls from 1.45 to 1.35 implying some improvement to the relative accessibility of the central Isthmus.

## B. Revenue scheme

### Environmental

- The Revenue scheme sees modest reductions in environmental impacts, compared to the no pricing situation. The scheme generally sees a lesser reduction in environmental impacts during the peak times than the Congestion scheme. This reflects the lower charging rate and also suggests that the 24 hour charging basis may result in drivers being less likely to avoid travelling during peak times, when impacts are at their greatest.

Key Indicator (% reductions from 'No Pricing')	Revenue scheme	
	2016	2021
Amenity (traffic volumes on arterials)	-0.1%	0.1%
VKT – sensitive catchments	4.4%	3.9%
Air discharges – PM10	6.7%	5.8%
Greenhouse Gases	3.5%	3.0%

- Reductions in water and air quality impacts are influenced by advances in emissions technology and stormwater treatment which would be experienced even with 'no pricing'. These advances are built into the air emission factors and stormwater impact modelling

between 2016 and 2021, and explain why the benefits of the revenue scheme are less at 2021, compared to 2016.

- At a regional level, the Revenue scheme in 2016-2021 is predicted to be contributing around 8-11% of the New Zealand Transport Strategy's target of a 50% reduction in 2007 greenhouse gas emissions per capita by 2040.
- On this basis, the Revenue scheme is not expected to contribute as much as the Congestion scheme to meeting the government targets set out in the updated NZ Transport Strategy to reduce local environmental impacts of transport (including air and water quality) to accepted international standards.

### **Land Use**

- Modest support for the Auckland Regional Growth Strategy (RGS) in terms of assisting with the concentration of land uses into selected centres. In particular it should help to support the existing concentration of office-based employment and related development into the CBD / Newmarket areas.
- Some support for the Auckland Sustainability Framework (ASF) goals / shifts in terms of assisting with a shift towards less carbon intensive forms of transport (public transport, walking and cycling).
- However, the scheme is likely to have a particular effect on retail and service-orientated activities near the boundary, in business areas that are not on key public transport routes and which are not supported by a local catchment. It can be expected that some retail and service activities will seek to relocate out of the cordon area, opting instead to locate on the more car-dominated, East-West alignment of the proposed western-ring route. This may not be so beneficial in terms of regional land use and sustainability outcomes, if a dispersed pattern occurs.

## **C. Congestion scheme**

### **Environmental**

- The AM Peak Period is the time of day when the most pronounced environmental impacts are currently experienced (i.e., the worst case scenario). Therefore, the Congestion scheme which is focussed around these peak times has the largest benefit.
- The Congestion scheme generally sees a higher reduction in environmental impacts, which reflects the higher charging rate. Benefits are concentrated in the inner Isthmus. However these benefits come with a greater displacement of some adverse effects on air and water resources onto the western sector, and additional severance and amenity affects in the southern Isthmus area.

<b>Key Indicator</b> (% reductions from 'No Pricing')	<b>Congestion scheme</b>	
	<b>2016</b>	<b>2021</b>
Amenity (traffic volumes on arterials)	5.3%	5.6%
VKT – sensitive catchments	10.8%	10.4%
Air discharges – PM10	16.9%	15.4%
Greenhouse Gases	9.8%	9.4%

- At a regional level, the Congestion scheme in 2016-2021 is predicted to be contributing around 26-30% of the New Zealand Transport Strategy's target of a 50% reduction in 2007 greenhouse gas emissions per capita by 2040.
- On this basis, the Congestion scheme is expected to contribute more than the Revenue scheme to meeting the targets set out in the updated NZ Transport Strategy to reduce local environmental impacts of transport (including air and water quality) to be at accepted international standard, provided that steps are taken to mitigate the identified adverse effects.

### *Land Use*

- The Congestion scheme should assist with a higher quality environment for business activities within the core CBD / Newmarket areas, strengthening the agglomeration process, provided that public transport services are ramped up. This is an outcome consistent with regional strategies.
- The improvement to the quality of the environment within the charged area and the increased use of passenger transport is also consistent with goals associated with the ASF.
- In fringe CBD areas, off the main public transport routes where retail and service-related activities are more dominant, then some relocation of activities out of the charged area can be expected (but to a lesser extent than the Revenue scheme), with land converted to residential use especially for households without school aged children (singles, couples, retired households). This may be consistent with regional strategies, provided that the displaced activities can be accommodated in centres on the outside of the charged area, rather than through a process of dispersal.
- Equally if the area-based charge leads to some displacement of future housing demand to outside the heritage dominated charged area, then this may be positive, provided it is accommodated in the nodal areas identified by the RGS and the Council's urban development strategy.

## 1. Introduction

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In 2005/6, the Ministry of Transport undertook the Auckland Road Pricing Evaluation Study (ARPES) to investigate road pricing in Auckland as a means of reducing congestion and raising revenue for investment in land transport. The study examined four different road pricing options and one parking levy.

As part of the ARPES investigations, Hill Young Cooper Ltd assessed the environmental and land use impacts of the various options. The analysis highlighted the main advantages and disadvantages of the schemes in the context of both direct environment impacts and longer-term land use impacts. The two issues are interlinked in that longer-term pressures on the Region's environment (such as air and water pollution) are closely related to regional land use patterns. Equally, the Region's desire for a more compact and contained urban environment is closely associated with an improved natural environment.

The analysis was an input in the preliminary evaluation of the desirability and feasibility of road pricing as a traffic demand management tool for the Auckland Region. The ARPES report found that road pricing was a feasible option to meet the transport objectives for the region, and was released in March 2006 for public consultation and submissions.

Submissions on the ARPES study identified the following relevant issues:

- the social/economic impact of the "do minimum" – there are social, economic and environmental impacts associated with the rising vehicle usage and congestion in Auckland not withstanding any congestion charging response
- the range of options available to the region and central government in managing these pressures and the potential role of road pricing
- impacts on commercial/retail areas, particularly in central Auckland.

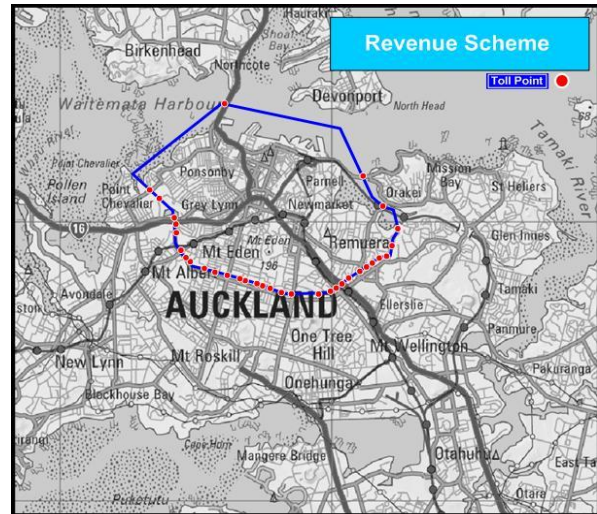
In response to submissions received, the Ministry of Transport has commissioned further research using two base schemes to gain a better understanding of the issues raised by submitters. (A description of the two base schemes – the "Revenue" scheme and the "Congestion" scheme – is provided in the following section.)

The key purpose of this report is to gain additional understanding of the impacts of road pricing on environmental values in the Auckland Region and on regional and local land use patterns. By necessity the analysis of land use impacts is qualitative in nature, and at a high level, consistent with the purpose of determining whether the road pricing schemes are likely to assist with the attainment of regional and local land use strategies.

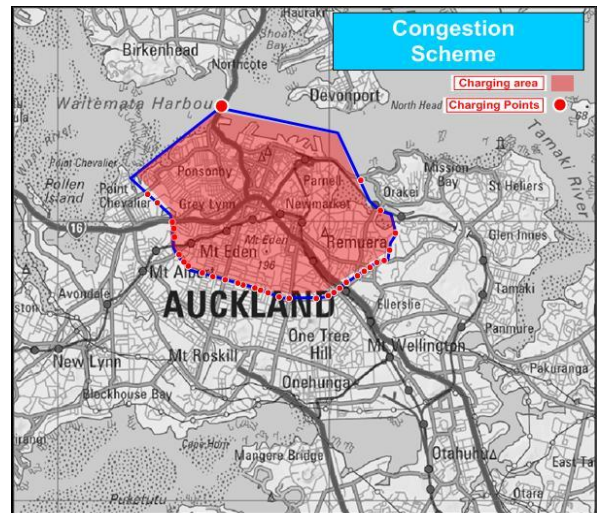
## Overview of road pricing schemes

The two road pricing schemes that have been evaluated in this round are as follows:

- **Revenue Scheme** (Cordon approach) – drivers would pay a toll to cross boundary at all times of the day
- **7 days per week**
- **Toll charge = \$3**



- **Congestion Scheme** (Area approach) – drivers would pay a toll to cross the boundary and drive within the area surrounded by the between 6 – 10 am Monday to Friday
- **Toll charge = \$6/day**



### 1.1. Policy Background

The environmental and land use future of the Auckland Region is influenced by a similar set of policies and plans. Since the ARPES report was prepared, national and regional policy has evolved, and it is necessary to identify the new policy issues that are emerging which need to shape the evaluation of the additional road pricing schemes.

This section of the report briefly outlines the key planning instruments for the region in terms of land use, the environment and transport interactions.

#### New Zealand Transport Strategy 2002

New Zealand transport policy sets out Government's commitment to providing transport solutions that consider, amongst other factors, the impacts of transportation on the quality of the environment. This is reflected in the key principles and objectives underpinning the New Zealand Transport Strategy which seek to ensure environmental sustainability, by "*improving the transport system in ways that enhance economic, social, and environmental well-being*". These principles have also carried through into Auckland regional policy as discussed below.

The government plans to update the New Zealand Transport Strategy in 2008. The updated Strategy will set a vision for the New Zealand transport system in 2040 and will set targets for the transport sector (to 2040) which reflect the government's sustainability, energy and climate change policy. Overarching outcome targets which have already been agreed by Government and which should be considered in this assessment of proposed road pricing schemes include (only relevant targets listed):

- *Government Agreed High Level Outcome Target* - *halve the domestic greenhouse gas transport emissions (per capita) by 2040.*
- *Government Agreed Intermediate or Detailed Outcome Target* - *reduce the kilometres travelled by single occupancy vehicles in major urban areas on weekdays by 10% per capita by 2015 compared to 2007.*

In addition, other outcome targets have been proposed to be included in the updated Strategy which also should be considered in this assessment (again only relevant targets listed below):

- *Proposed High Level Outcome Targets for 2040*
  - *travel times by principal routes to be improved relative to 2007 for identified critical intra and inter-regional connections, as determined with each region.*
  - *all individuals have access to the facilities and activities they need, such as work, education, medical care and shopping centres, to participate in society.*
  - *public health effects of transport to be at accepted international standard.*
  - *local environmental impacts of transport (including air and water quality) to be at accepted international standard.*
- *Proposed Intermediate or Detailed Outcome Targets for 2040*
  - *increase the public transport mode share of peak hour travel (journeys to work) in Auckland, Wellington and Christchurch from an average of nine percent to 20% and work with each region to optimise peak hour travel targets.*
  - *at least double the overall public transport mode share to seven percent of all passenger trips (currently about 2 to 3% percent).*
  - *increase walking and cycling and other "active modes" to 30% of total trips in urban areas (currently about 17%).*
  - *ensure a substantial reduction in premature deaths and serious illnesses arising from air pollution from motor vehicles.*
  - *manage noise to minimise any public health effects.*
  - *no net loss of indigenous vegetation or fauna from infrastructure construction or maintenance.*

Other targets generally relate to emissions standards and so are not listed above.

### **Auckland Regional Land Transport Strategy 2005**

The Auckland Regional Land Transport Strategy 2005 is a 10-year vision (2006-2016) which identifies key actions to improve the liveability and movement around the Auckland region. It focuses on land and marine transportation around the region, as well as land use and urban design solutions to transport problems.

Its vision and objectives reflect the key principles and objectives underpinning the New Zealand Transport Strategy. In relation to environmental and land use issues, the Regional Transport Strategy's vision and objectives including seeking to provide a transport system;

- where *"people and goods are able to move as necessary"* and in an *"integrated, safe, and effective"* manner;
- which *"improves access and mobility"*;
- where *"transport supports vibrant town centres"*
- which supports the Auckland Regional Growth Strategy; and
- where *"the environment and human health are protected and enhanced"* and *"ensures environmental sustainability"*.

The strategy signals a significant commitment to improved infrastructure for public transport, walking and cycling, as well as demand management programmes like mixed land uses to reduce trip making, travel planning and walking school buses.

### **Auckland Regional Growth Strategy**

The 1999 Auckland Regional Growth Strategy is a vision for what Auckland could be like in 50 years time with a population of two million. It sets policy for urban growth, including Metropolitan Urban Limits for the Auckland Region and a compact, contained urban area to promote a high quality environment and a more liveable, functional urban area.

The key principles of the Regional Growth Strategy are:

- Protection of the coast and surrounding natural environment;
- Providing for growth in a manner that enhances the social, cultural, environmental and economic wellbeing of those that live and work in the city.
- Containing growth within existing metropolitan areas focused around town centres and major transport routes to create higher density communities, with a variety of housing and mixed use activities to provide for employment, services and recreation, resulting in a compact urban form.
- The transport systems are safe, reliable, efficient and environmentally friendly.
- Limited managed expansion into greenfield areas outside of current Metropolitan Urban Limits (MUL) where environmental quality, accessibility and infrastructure development criteria can be met.

To implement these principles, the Strategy aims to accommodate up to 70% of future growth within the existing urban footprint. To this end a range of growth centres have been identified. These growth centres are spread across the region in a poly centric form.

Implementation of the Regional Growth Strategy was strengthened through the provisions of the Local Government Auckland Amendment Act (2005). However, as highlighted in the recent 2007 evaluation of the Regional Growth Strategy<sup>1</sup>, implementation has been "patchy" to date. Critical to its implementation is the intensification of residential and business activities around defined growth centres. However to date only some development has been occurring in and around growth centres, and there is continued pressure for peripheral development. The reasons for this are diverse, but include:

- Lack of appropriate zoning in growth centres;
- Congestion in inner areas favours access to peripheral areas;
- Lack of amenity / poor quality of the environment within some growth centres.

Following the 2007 Growth Strategy evaluation, the Auckland Regional Council has identified priorities for progressing the implementation of the Strategy's principles, including more focused and pro-active land use planning and improving access and amenity in the key growth centres.

### **Auckland Sustainability Framework 2007**

The recently released Auckland Sustainability Framework, jointly prepared by Auckland local authorities with the support of the Auckland Regional Growth Forum and in collaboration with central government agencies, also reinforces the core principles of the Regional Growth Strategy.

It sets a vision for the Auckland region as “...*an interconnected community, celebrating knowledge, diversity and opportunity, working within the ecological limits of the region to nurture social and economic prosperity, creating a regional that will enjoyed... forever.*” [emphasis added].

The Framework will guide future regional growth, transport and economic policy and align local government policy and plans under this vision. It identifies 8 “goals” and 8 major “shifts” in social values and expectations, and in systems and processes to achieve this vision. In relation to environmental sustainability, the Framework focuses on creating prosperity based on sustainable practices, reducing the region’s ecological footprint, and building a carbon neutral future.

The Framework considers current and future transport issues, including potentially reduced fuel availability (through shortages and/or rising fuel prices), responding to climate change and access to key growth and business centres that will present challenges to developing the region in accordance with the ASF goals and shifts. It identifies a range of strategic responses and actions that may be used to address these challenges, including road pricing.

The eight interrelated long-term goals are:

1. A fair and connected society
2. Pride in who we are

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<sup>1</sup> Auckland Regional Council (2007): *Growing Smarter: the Auckland Regional in the 21<sup>st</sup> Century. An Evaluation of the Auckland Regional Growth Strategy 1999.* July 2007.

3. A unique and outstanding environment
4. Prosperity through innovation
5. Te Puawaitanga o Te Tangata (self sustaining Maori communities)
6. A quality compact urban form
7. Resilient infrastructure
8. Effective, collaborative leadership

The eight shifts in thinking, planning, acting and investment are:

1. Put people at the centre of thinking and action
2. Think in generations, not years
3. Value Te Ao Maori
4. Activate citizenship
5. Create prosperity based on sustainable practices
6. Reduce our ecological footprint
7. Build a carbon neutral future
8. Integrate thinking, planning, investment and action.

### **Auckland Economic Development Strategy**

The Auckland Economic Development Strategy promotes economic transformation through:

- Exceptional people, cultures, environment and infrastructure, including improved transport infrastructure, such as access to airport, port, broadband, reduced congestion overall
- Provide a high quality living environment - creating a region rich in arts and culture, vibrant, cosmopolitan, safe, and attractive, offering a wide variety of choices for living, working, playing and visiting.
- Promotion of clusters such as the marine industry, and the creative, information communication technology and biotechnology sectors.

An important recent focus of policy development is improving agglomeration economies. This refers to the economic benefits that derive from a concentration of people, common infrastructure, an available and diverse labour force and market size available in central city employment areas. The benefits of agglomeration can be reduced however, if central city areas become too congested, and the quality of the environment declines.

A report on agglomeration in the Auckland region states<sup>2</sup> that there is evidence that accessibility is constraining economic growth in Auckland:

*In a recent survey of the motivations for businesses locating within or not within the CBD the key drivers of CBD location included:*

- *Image.*
- *A central (hub) location including easy access for staff, to/from clients.*
- *Proximity to clients, suppliers, competitors.*
- *Access to supporting amenities.*

*However, the report also concluded that “possibly the biggest attractor to an out of CBD location is the access it provides and the ability to provide more parking at lower cost”*

While agglomeration benefits can be experienced in a poly centric urban pattern (that is numerous non-CBD centres), it is likely that agglomeration benefits are likely to be most generated in larger centres, and hence the Auckland CBD has a particularly important role to play in the region.

The implications of agglomeration economies is that in areas of high transport accessibility and good amenity (such as the CBD), a process of land use change where less intensive, lower order activities are replaced by more intensive, higher value added activities should be encouraged. For the CBD and its environs, this means that the shifting out of manufacturing activities and extensive retail activities ( e.g. car yards, wholesale and distribution activities) and their replacement with office-based activities and associated services and activities is a desirable trend.

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<sup>2</sup> Page 21: Assessing Agglomeration Impacts in Auckland: Linkages with Regional Strategies, February 2007. Sourced from: <http://www.arc.govt.nz/albany/fms/main/Documents/Auckland/Aucklands%20growth/Assessing%20agglomeration%20impacts%20in%20Auckland%20linkages%20with%20regional%20strategies%20Feb%202007.pdf>

## 2. Environmental Assessment

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This part of the report assesses the likely impacts of road pricing on environmental values in the Auckland Region, and in particular whether the road pricing schemes will enhance or detract from the predicted environmental values in Auckland with no road pricing.

This part of the report is structured as follows:

- Section 2.1 sets out the approach and methodology used and provides background analysis which has supported the review of the environmental impacts of road pricing
- Section 2.2 discusses the cordon-based Revenue scheme
- Section 2.3 discusses the area-based Congestion scheme.

### 2.1. Approach and methodology

The initial assessment of the environmental impacts associated with the preliminary road pricing options was reported in 2006. The following assessment of the refined “Revenue” and “Congestion” schemes applies similar principles for the analysis of environmental impacts as in the 2006 study, however it builds upon that study to respond to issues and requests for further information raised in public submissions on that report.

The key environmental issues relating to traffic congestion in Auckland are identified as:

- Severance and amenity effects – including ease of movement and traffic noise
- Effects of stormwater runoff from roads on sensitive receiving environments and ecosystems
- Effects of vehicular air emissions on health
- Greenhouse Gas emissions associated with vehicular air emissions.

Details of the approach taken for assessing each of the above environmental issues under the two road pricing schemes are described in the following sections

#### 2.1.1. Common approach

In general, the evaluation of the environmental implications of the schemes primarily relies upon outputs of the Auckland Regional Council's RART (Auckland Regional Transport) model. The model outputs relate to the AM Peak Period in 2016 and 2021. For the most part, the environmental parameters assessed are linearly related to traffic volumes. In other words, the greatest effects are expected during the peak period, when traffic volumes and exposures are highest as the commuting population moves around the city.

Both schemes are assessed against the ‘No Pricing’ scenario. Most figures are expressed as percentage change over the modelled ‘No Pricing’ scenario. A positive percentage represents an improvement over the ‘No Pricing’ scenario, while a negative percentage represents deterioration in conditions. Percentage changes in key environmental conditions are used in most cases as the data used in the analysis is derived from a range of assumptions in the RART model about traffic-

related conditions and effects and are therefore an approximation only of likely future environmental conditions. The outputs provide a robust picture of relative differences in conditions.

In most tables, red and green highlighting has been used to note particular effects. Red cells indicate conditions that are worse than the 'No Pricing' scenario, while green cells highlight measurable improvements in conditions compared to 'No Pricing' scenario, generally where a 10% or greater improvement is expected.

In addition, the 'No Pricing' scenario is assessed against 2001 data to show the likely changes in traffic-related environmental effects with no pricing scheme in place.

### **2.1.2. *Amenity / severance / noise impacts assessment***

There is increasing concern about growing traffic volumes affecting the amenity and liveability of the city in general, in particular around identified growth centres. Concerns about noise (and emissions) are the most commonly raised by the public in response to transport initiatives. As traffic volumes increase, noise issues may arise in key locations and additional pressure is put on road design and layout, resulting in further impacts on amenity and accessibility. For example, more and more traffic lanes would be required with less and less space for footpaths, trees and parking and impacting on walking, cycling and other activities along the road corridors.

Approximately 3.2% of the New Zealand population is exposed to “unacceptable” road noise levels (according to OECD figures), which potentially result in adverse social impacts (annoyance, reduced work performance, impaired learning, and sleep disturbance) and considerable economic costs. In 2006, Cabinet considered a scoping paper on national controls for managing land transport noise and directed that the issue be addressed through integrated package of methods, including the development of a national Road Noise Standard (draft expected to be released in early 2008), the development of a land transport noise framework and legislation, and to investigate the use of land use controls and individual vehicle controls to appropriately address the social impacts of excessive vehicles noise.

Traffic noise can be managed either at source, or by controlling the transmission or exposure to noise at the receiving end. At source controls are considered to be the most effective in most circumstances – examples include introducing vehicle noise emission standards, managing the texture of the road surface to reduce tyre or road noise, or controlling traffic volumes and/or speed.

Amenity effects such as traffic noise and severance effects are generally related to traffic volumes and speeds. Therefore, the impacts of the road pricing schemes on traffic noise and overall general amenity values were assessed by modelling traffic volumes on 100 selected road links within the region. Focus was given to local and arterial links within suburban areas where there is a concentration of community activities (for example, in town centres). The modelled links include:

- North: 72 links;
- West: 38 links;
- Isthmus: 76 links;
- “Area” part of the Isthmus: 18 links; and
- South: 70 links.

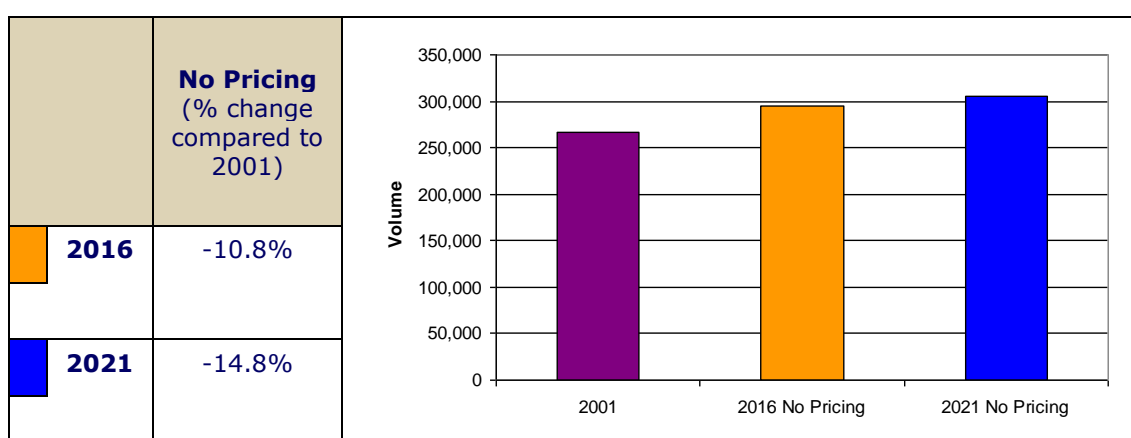
This traffic volume modelling was also the basis for the consideration of severance. While this assessment cannot determine the traffic volume threshold levels above which severance or significant adverse noise or general amenity effects would be experienced, it will indicate whether conditions may be improved or made worse by the pricing schemes.

**Changes in traffic volumes with no future pricing regime**

On an overall regional level, the following graph (Figure 1) presents the total modelled traffic volumes on the selected arterial links across the whole region.

The model indicates that future increases in overall regional traffic volumes from 2001 volumes, based on the no pricing scenario, would be around 10.8% in 2016 and 14.8% in 2021.

**Figure 1 Traffic volumes on selected local and arterial links with no road pricing**



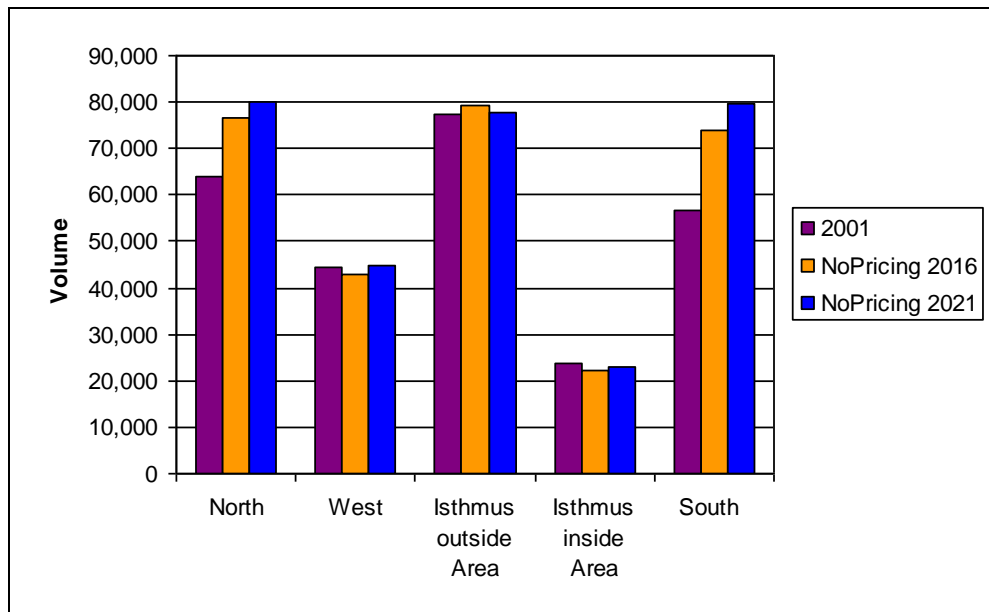
*Note: Positive %'s are reductions in traffic volumes and negative %'s are increases in traffic volumes*

Grouping the local and arterial links into urban sectors provides an insight into how the volumes on these key links change with time on a local level. Figure 2 below shows data by urban sector. Note that this data focuses on selected local and arterial links within suburban areas where there is a concentration of community activities (and where amenity effects from traffic are most likely to be experienced) and does not count for traffic on motorway systems.

Significant increases in volumes along local and arterial roads within the North and South Auckland sectors are anticipated. As a result of these increases in traffic volumes, the community around these links could expect a reduction in the general amenity and accessibility, and potentially noticeable increases in traffic noise.

In contrast, without road pricing, volumes on local and arterial roads are predicted to either decrease from, or be maintained at 2001 volumes by 2016 in the main Isthmus and Western sector. This is due in a large part to the expected effects of major motorway projects (SH18 Hobsonville and SH20 Avondale) which are assumed to be in place by 2016, and which the model predicts will take a great amount of traffic off local and arterial roads in the Western and Isthmus areas (particularly Hobsonville Rd in Waitakere, St Lukes Rd and Richardson Rd). It also reflects significant improvements to public transport and traffic demand management in 2016, particularly trips to the CBD area, which are accounted for in the model. These changes will support the maintenance or enhancement of the general amenity of the western and central areas.

**Figure 2 Traffic volumes on selected links with no road pricing**



### 2.1.3. Stormwater quality impacts assessment

As described in the 2006 preliminary report, Aucklanders rate highly their access to clean coastal waters for recreational and amenity benefits. There is increasing focus at regional and local levels on the treatment of stormwater at source, so as to improve water quality in the receiving coastal environment as well as to protect the natural values of contributing stream systems (e.g. erosion).

Road transport activities have an adverse effect on the quality of stormwater running off urban roads and draining to urban streams and coastal waters. Motor vehicle usage results in the discharge of contaminants such as oil, lead (historically), copper (from brake linings) and zinc (from tyres) onto the road surface, which are subsequently entrained in stormwater flows and discharged to these aquatic receiving environments. The contaminant loading rates increase approximately linearly with increasing vehicle number on roads. Several of these contaminants are major biohazards, and can accumulate to the point where they occur at levels that may have adverse effects on ecological values.

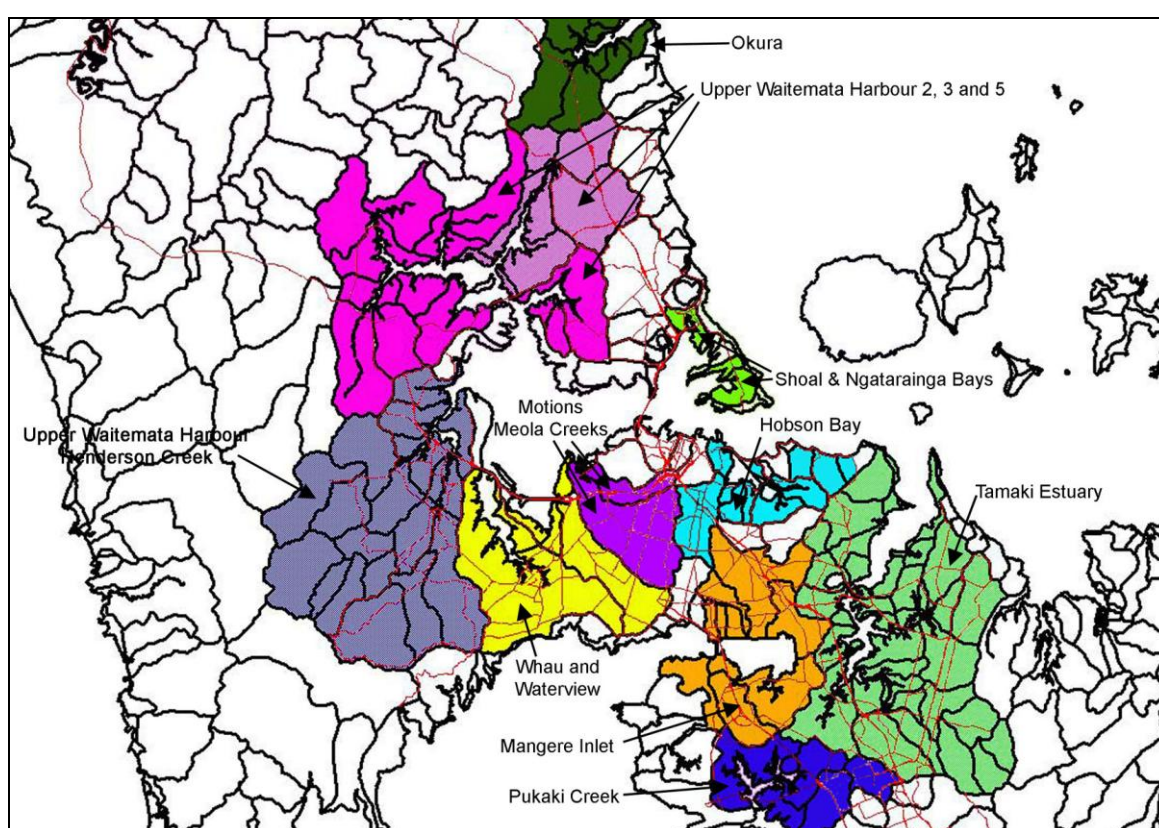
Studies by the Auckland Regional Council (ARC) and Auckland City / Metrowater are currently underway to investigate the key sources and pathways of contaminants entering the marine receiving environment in stormwater. Preliminary results indicate that zinc is the primary concern in sensitive marine receiving environments. Roofs currently contribute by far the highest levels (80+%) of zinc entrained in the urban stormwater runoff and deposited in marine sediments. However the studies also indicate that the sources of zinc in marine sediments are changing with time and it is predicted that, under current growth scenarios, road transport activities will become the dominant contributor to contaminant loads (particularly zinc) in 30 years time from now.

The ARC and ACC / Metrowater are now focussing on the trends in motor vehicle use that may change contaminants loadings. Initial modelling supports the view that effects are more likely to be localised and occur in specific estuarine environments rather than be seen across the wider harbour environment. In these low energy estuarine systems, contaminants discharged in stormwater flows, especially those in particulate form, settle out and accumulate within the marine

sediments of the estuary. In high energy open coastal areas, contaminants are dispersed more widely, and accumulation of contaminants is less common.

Accordingly, the following assessment focuses on the adverse effects/benefits on sensitive estuarine environments associated with changes in traffic volumes. Catchments with receiving environments that are likely to be sensitive to contaminants from road runoff have been identified and the changes in traffic volumes in these catchments, as a result of the different road pricing schemes and level of charges, have been assessed. This has enabled some broad conclusions to be drawn in respect of potential benefits to the identified sensitive marine environments, of the various road pricing options. The identified catchments draining to sensitive receiving environments are shown in the figure below:

**Figure 3 Selected stormwater catchments**



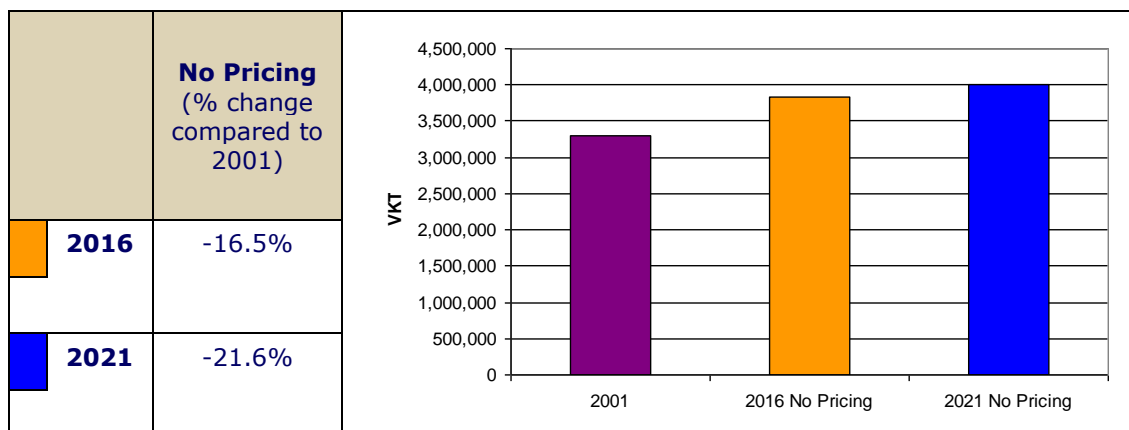
As in the 2006 preliminary assessment, traffic flow modelling provided projections of vehicle kilometres travelled (VKT) along key arterials draining to sensitive estuarine environments, for each scheme and for both 2016 and 2021. These projections enabled an assessment of the two charging schemes in terms of the effects on these sensitive environments against the ‘No Pricing’ scenario<sup>3</sup>. As also noted in the 2006 preliminary assessment, this is a broad, first order assessment. Road runoff is only one factor that may affect the quality of a marine receiving environment and in some instances, especially catchments with large areas of industrial land use, road usage may not be the dominant cause of contaminant discharge and accumulation. In other words, a reduction in road-based contamination may result in no appreciable benefit due to the continued existence of other pollutants.

<sup>3</sup> Account is taken of treatment of stormwater from roads by assuming that for all roads built after 2001, VKT (and therefore contaminant loads) is reduced by 50%. Due to a lack of data, it has not been possible to identify the extent to which run-off from existing roads is treated.

### Changes in VKT with no future pricing regime

On an overall regional level, the following graph (Figure 4) presents the total modelled traffic volumes on the selected arterial links across the whole region. The model indicates that future increases in overall regional vehicle kilometres travelled from 2001 volumes, with no intervention would be around 16.5% in 2016 and 21.6% in 2021.

**Figure 4 Total VKT with no road pricing**



**Note:** Positive %'s are reductions in traffic volumes and negative %'s are increases in traffic volumes

The increases in VKT with time reflects in part the increases in volumes, as well as the growing trend for increased trip lengths as the population becomes increasingly mobile (as reported at the national level in the recent state of the environment report by the Ministry for the Environment<sup>4</sup>).

In terms of how the predicted future contaminant loads entering identified sensitive catchments change over time with no road pricing, the table below sets out the percentage change in VKT by selected catchment against the 2001 data:

**Table 1 VKT for catchments with sensitive marine receiving environments – trends over time with no road pricing**

Selected runs	% change in VKT (compared to 2001) for catchments with sensitive marine receiving environments	
	2016	2021
Okura	-32.96%	-40.56%
Upper Waitemata	-19.65%	-25.87%
Shoal Bay	1.85%	0.58%
Henderson	-24.63%	-30.93%
Whau, Waterview	-8.27%	-12.37%
Hobson	-9.17%	-11.77%
Mangere	-21.99%	-27.24%
Tamaki	-24.33%	-24.87%
Pukaki	-60.72%	-70.80%
Meola/Motions	(no 2001 data)	(no 2001 data)

**Note:** Positive %'s are reductions in VKT from the 'No Pricing' scenario and negative %'s (in red) are increases in VKT

<sup>4</sup> Ministry for the Environment: *Environment New Zealand 2007*. January 2008.

As the VKTs are predicted to progressively increase in the majority of these sensitive catchments, the associated contaminant loads will increasingly result in adverse impacts on these sensitive ecosystems. This is particularly the case in catchments in the Northern and Southern sectors – Okura and Pukaki – reflecting the increases in volumes that are predicted in these sectors (as described in section 2.2.1 above).

Although volumes are predicted to increase in the central areas, the model still predicts an increase in VKT in the Hobson and Whau / Waterview catchment, albeit not as considerable as in the outer catchments. This indicates longer trips within these areas than at present.

#### **2.1.4. Air quality impacts assessment**

Health effects from air pollutants are a major concern in the Auckland region because of the prevalence of respiratory and heart disease. As noted above, concerns about emissions (and noise) are the most commonly raised by the public in response to transport initiatives. In addition, air pollution could also seriously affect our 'clean green' image and consequent enjoyment of the city, as well as potentially affecting tourism and export earnings.

The ARC identifies motor vehicles as a primary source of air pollutants in the region, in addition to industry and domestic fires.

Many pollutants released in vehicular emissions potentially result in respiratory or cardiovascular problems and other health effects, which in turn have considerable implications on hospital resources, lost work and school days and restricted personal activity. Fine airborne particles with a diameter of 10 micrometres (known as "PM10") or less (PM2.5, etc) are particularly important because they penetrate deep into human lungs, carrying with them the surface coatings which include many organic chemicals. A recent report commissioned by Health Research Council of New Zealand, Ministry for the Environment and Ministry of Transport (Fisher et al, 2007<sup>5</sup>) found a positive correlation between PM10 emissions and mortality and health impacts, as well as concomitant effects from with other pollutants. Both the 2007 report and an earlier report by Fisher et al (2002)<sup>6</sup>, although taking different approaches and methodology, estimated that over 400 deaths in Auckland a year could be attributed to PM10 emissions. The 2002 report estimated that around 250 of these deaths could be related to vehicle emissions.

Other key air pollutants typically monitored include nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOC), which both result in health and environmental effects, either directly or by the formation of other toxic or damaging compounds (refer to Glossary for typical effects).

National Ambient Air Quality standards were introduced via the 2004 Resource Management Regulations. Under the Regulations, Regional Councils are required to monitor air quality, and where "exceedances" are identified, develop strategies and plans to achieve the ambient standards. Resource consents and designations for public works (including roads) have to take into account the air quality standards, monitoring results and air quality management frameworks.

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<sup>5</sup> G. Fisher, T. Kjellstrom, S. Kingham, S. Hales & R. Shrestha (2007): *Health and Air Pollution in New Zealand*. A research project funded by: Health Research Council of New Zealand, Ministry for the Environment, Ministry of Transport, June 2007.

<sup>6</sup> Fisher, G.; Rolfe, K.A.; Kjellstrom, T.; Woodward, A.; Hales, S.; Sturman, A.P.; Kingham, S.; Petersen, J.; Shrestha, R.; King, D. (2002). *Health effects due to motor vehicle pollution in New Zealand*. Report to the Ministry of Transport, 2002.

Monitoring by the ARC (Auckland Air Emissions Inventory 2004<sup>7</sup>) shows that both ambient PM10 and NOx concentrations are often at levels which exceed the accepted health guidelines and standards. Motor vehicles are single largest individual source of total annual emissions of these pollutants (70% of total emissions are from vehicle exhaust, 41% PM10, 71% NOx). Further, most vehicular PM10 emissions are attributable to diesel exhaust (30% of regional total). There are seasonal effects to an extent, with the contribution of PM10 from natural sources (marine aerosols, windblown material, etc) on winter days higher than in summer.

Emissions are highest in the urban area, however the air quality monitoring across the region highlights numerous hot spots, coinciding with areas of concentrated urban development and high traffic volumes.

The air quality of these key areas is likely to become worse and more widespread if action is not taken. Improved technology and better maintenance of cars is likely to have a significant effect on air pollution levels at the regional level. Road pricing has the potential to reduce region-wide as well as localized air pollution problems through changing patterns of transport use within the region.

To assess the impacts of the Revenue and Congestion schemes on air quality, the likely vehicle emissions to air have been estimated based on RART modelled traffic flows, for five urban sectors within the region, and for the region as a whole. Based on VKT data from the RART model, vehicle emission factors are applied to determine vehicular air emissions for each urban sector, scheme and charging scenario. The vehicle emission factors are the same as those used by the ARC for the evaluation of the 2005 Regional Land Transport Strategy packages. They take into account the extent to which traffic is congested, with the emission factors increasing as traffic flows become more congested, as well as the road type (motorway/non-motorway). The vehicle emission factors decrease over time, reflecting assumptions about improved technology.

This assessment considers three primary vehicular air pollutants – nitrogen oxides (NOx), particulate matter (PM10) and volatile organic compounds (VOC). The air emission data has been compared against a minimum intervention scenario and is expressed in terms of the percentage reduction or increase in air emissions from the “No Pricing” scenario.

Only a broad, first order assessment is possible. While data on emissions is presented by urban sector, it is not possible to definitively say that reduced air emissions for a particular sector will lead to improved air quality within that sector (as noted in London). This assessment only covers one input into local and regional air-sheds. Other factors include the existence of other sources of emissions – such as pollution - and the extent of exposure. In addition, the assessment has only been conducted for morning peak traffic flows which are only a component of the total traffic load in some areas.

### **Changes in air emissions with no future pricing regime**

On an overall regional level, Table 2 presents the changes in total modelled air emissions from vehicles to the regional air shed over time, with no road pricing in place.

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<sup>7</sup> Auckland Regional Council (2004). *Auckland Air Emissions Inventory 2004*.  
<http://www.arc.govt.nz/albany/fms/main/Documents/Environment/Pollution/Auckland%20Air%20Emissions.pdf>.

**Table 2 Vehicle-related emissions to regional air shed – no road pricing**

<b>Emissions to regional air shed</b> (% reduction from 2001)	No Pricing	
	2016	2021
NO <sub>x</sub> (kg)	20.8%	16.6%
PM <sub>10</sub> (kg)	16.6%	13.2%
VOC (kg)	14.4%	9.4%

The model predicts that, although volumes and VKT will increase in the future, vehicular emissions of NO<sub>x</sub>, PM<sub>10</sub> and VOC will decrease from 2001 levels as more effective fuel and emission standards are established.

### 2.1.5. *Greenhouse gas emissions impacts assessment*

There is now considerable interest in climate change issues and the implications of human activities on the global environment. Greenhouse gases (mainly being carbon dioxide, methane and nitrous oxide) are produced and emitted to the atmosphere from both natural and manmade sources – the primary human sources are from the combustion of fuels and agriculture. These gases form a thick layer around the earth’s atmosphere and generally trap heat inside the atmosphere. This in turn is predicted to result in more extreme weather events (floods, storms, cyclones, droughts and slips) and rising sea levels and coastal erosion. International scientists project the world’s average temperature could rise by 0.2 °C per decade over the next two decades. In addition to emitting more greenhouse gases, the problem is exacerbated by large scale removal of forests which have provided a natural “sink” for greenhouse gases in the atmosphere.

It is generally considered that taking no action to address climate change will be much more expensive than the costs of any actions to mitigate the effects of climate change.

New Zealanders place a high value and dependency on our environment and our green image. Our economy is underpinned by our big export earners – agriculture, horticulture, forestry and tourism. However, our per capita greenhouse gas emissions are high in the global context and have been growing rapidly – currently we are producing 25% more greenhouse gases than in 1990.

To address these issues and reduce our net greenhouse gas emissions, the government is developing a range of programmes and policies to encourage change. Amongst other sectors, particular focus is being given to transportation and vehicular emissions – both increasing fuel and emissions standards and changes in behaviour to reduce congestion. The government has also released plans for an emissions trading scheme to encourage the use of fuel and energy resources more efficiently and to support the reduction of greenhouse gases. The scheme will involve ‘emission units’, which will be able to be traded and which will be needed to offset emissions from key activities and industry sectors, including the transport sector from January 2009.

On a regional level, the Auckland Air Emissions Inventory 2004 reports current carbon dioxide emissions from transport sources are around 48% of regional emissions, and that the relative transport-related emissions are rising with urban growth. Therefore, a focus of the Auckland Sustainability Framework is reducing carbon emissions.

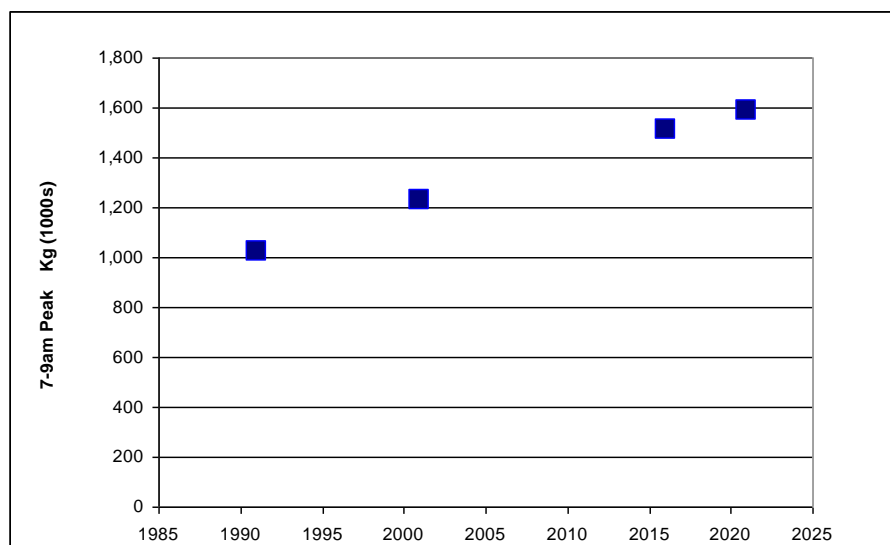
To assess the impact of the road pricing schemes on greenhouse gas emissions, the average quantity of CO<sub>2</sub> emitted in the AM peak, per vehicle kilometre travelled, was modelled for 2016 and 2021. The figures were then related to an estimate of CO<sub>2</sub> production in 1991 (which is one year different from the benchmark for Kyoto Protocol commitments of 1990).

The modeled estimates were also considered in the context of the proposed updated New Zealand Transport Strategy target to halve the per capita greenhouse gas transport emissions by 2040, relative to 2007 emissions. Clearly it is not expected that road pricing in Auckland will in itself meet this overall national greenhouse gas transport emissions. However, the contribution of the road pricing schemes towards meeting this target at a regional level was assessed, by applying the UNZTS emissions target to only Auckland traffic emissions within the peak 7-9am period (as an indicative first order assessment). Based on estimated Auckland population figures for 2040<sup>8</sup>, it was determined that by that year, the per capita carbon dioxide emissions from Auckland traffic would have to be reduced to levels which are similar to 1991 levels. Therefore a direct comparison of the schemes and no pricing scenario was made with respect to the changes in emission levels from 1991 levels.

### **Changes in greenhouse gas emissions with no future pricing regime**

Around 18% of New Zealand's greenhouse gas emissions are carbon dioxide emissions from the transport sector, and road transport represents around 89% of these emissions<sup>9</sup>. The following figures shows the increase in carbon dioxide emissions from vehicles in the Auckland region as modelled by the ARC – this data indicates an average increase of vehicular emissions of around 18,000kg/year.

**Figure 5 CO<sub>2</sub> production – no pricing**



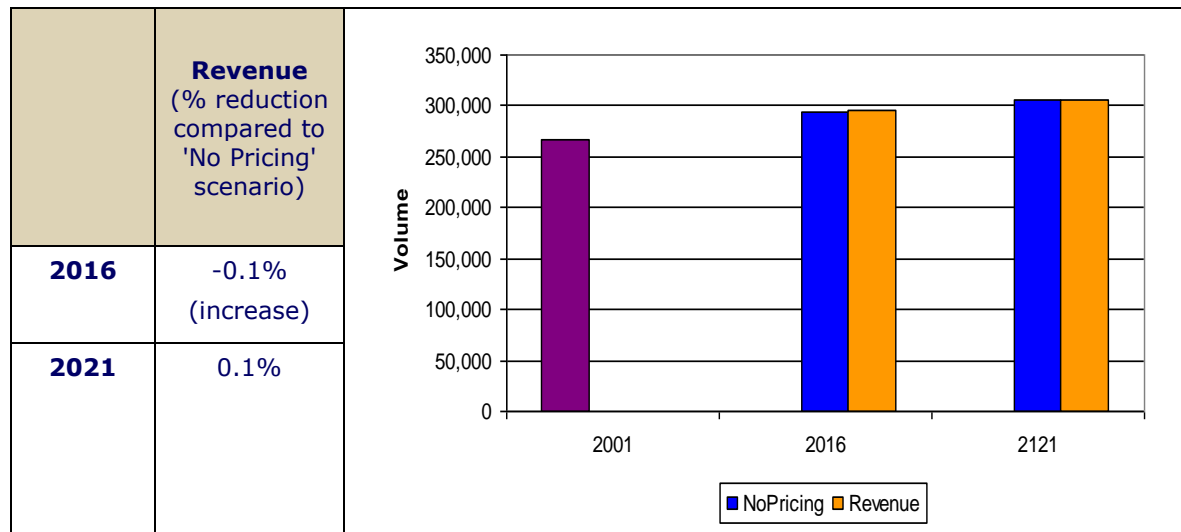
<sup>8</sup> Statistics NZ estimated populations for the Auckland Region ('Medium' projections): <http://www.stats.govt.nz/NR/rdonlyres/6DAAECD9-9983-48F8-9600-017AD35C6FD5/21674/Localpopulationtrends2007.xls>  
<sup>9</sup> Ministry for the Environment: *Environment New Zealand 2007*. January 2008.

## 2.2. Revenue scheme

### 2.2.1. Amenity / severance / noise

Figure 6 presents the total modelled traffic volumes on the selected arterial links across the whole region under the Revenue scheme.

**Figure 6 Traffic volumes on selected links under Revenue scheme**



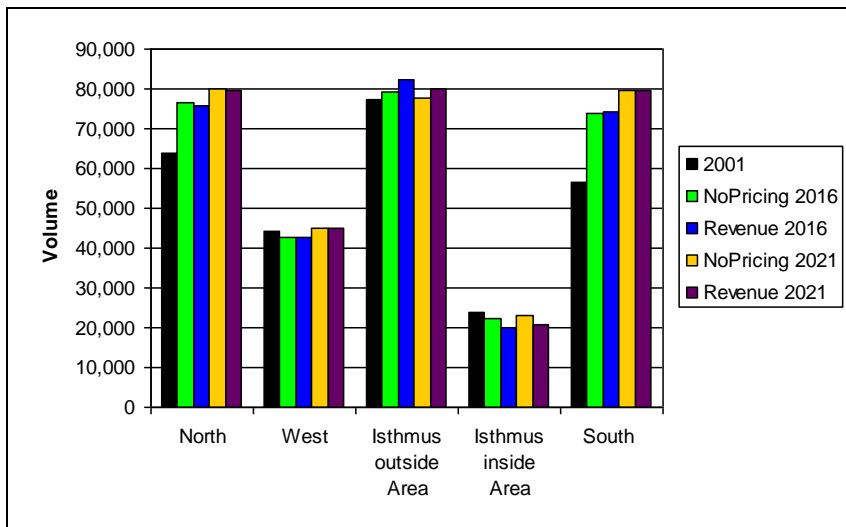
**Note:** Positive %'s are reductions in traffic volumes and negative %'s are increases in traffic volumes

At the regional level, there is little impact on traffic volumes associated with the Revenue scheme in peak times, compared to the no pricing situation. This is because many drivers are prepared to pay the toll / charge, or the effect of the charge is to change routes, rather than divert trips onto public transport.

Grouping the arterial links into urban sectors provides an insight into whether the effects of this pricing scheme may be more localised. Figure 7 below shows data by urban sector.

This shows that the Revenue scheme would decrease volumes at 2016 and 2021 inside the scheme boundaries. This is also illustrated in the following Figure 8 showing the changes to traffic volumes along the main arterials. Note that the modelled volumes decrease from 2001 volumes in any case without road pricing inside this area – reflecting significant improvements to public transport and traffic demand management in 2016, particularly trips to the CBD area. However, on top of these improvements, further reductions in traffic volumes of around 10% are possible under the Revenue scheme on the selected links in the central urban area, which would further improve the amenity values of the central urban environment.

**Figure 7 Traffic volumes on selected arterial links by urban sector – Revenue scheme**



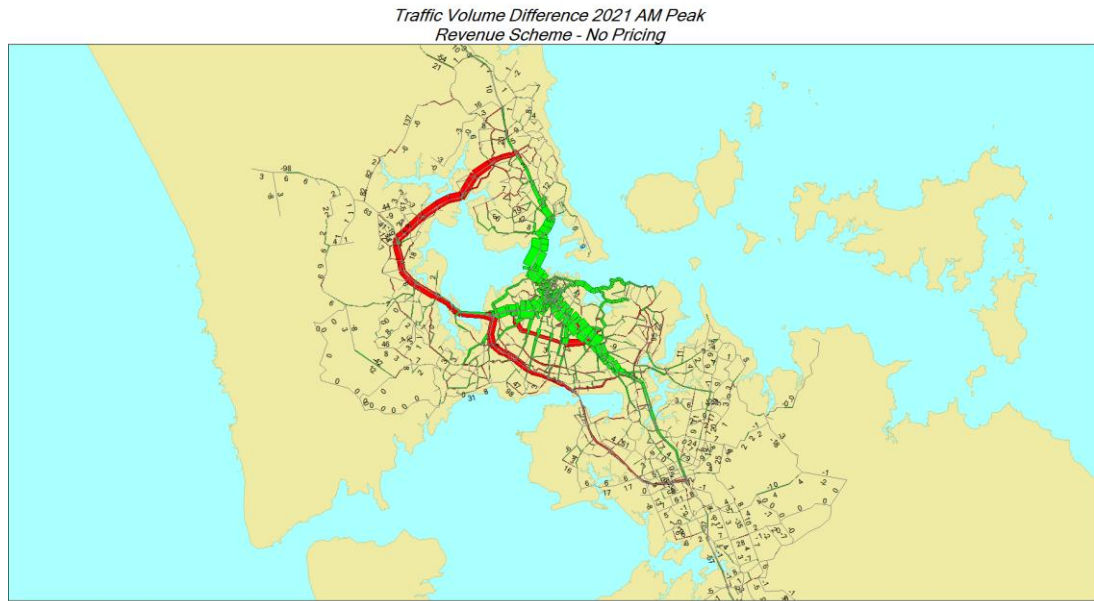
In the North and South areas where the greatest increases in volumes on key links would be seen over time (compared to 2001 volumes), the Revenue scheme has little impact on reducing these increases and mitigating the likely reductions in amenity values over time. Furthermore, as shown in Figure 8, traffic volumes are predicted to increase above the 'No Pricing' scenario along the arterials forming the scheme boundaries and along State Highways 20 and 16 / 18, as north-south traffic diverts around the scheme area.

It is noteworthy that the diversion of north-south traffic around the scheme boundaries that causes the increases in traffic volumes is predicted to be generally confined to the main motorway network, and the St Lukes / Greenlane Road corridor. Other arterials would not generally be affected, with the possible exception of some links in the Panmure / Glen Innes area. In the Isthmus area, the increases along these links offset to a degree any reductions in traffic volumes, lessening the overall impact of the Revenue scheme so that there is a slight increase in overall 2016 and 2021 volumes in the outer Isthmus sector.

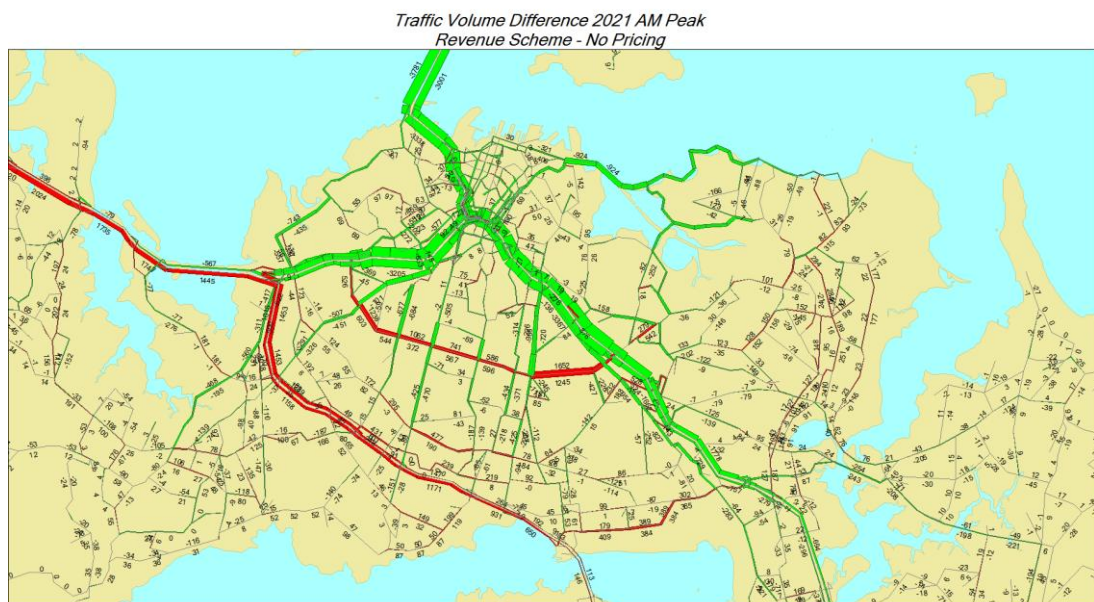
While the St Lukes / Greenlane corridor is already a busy road with severance and amenity affects, the pricing scheme will acerbate these effects. Mitigation of the severance and amenity impacts of the additional traffic volumes on the affected East/west corridors should be considered. This may involve additional controlled pedestrian crossings of the corridor in relevant areas, traffic management (speeds, turning movements), and enhanced pedestrian amenity, such as wider footpaths, solid medians and enhanced streetscapes. Parts of the existing affected corridors are restricted in terms of space to accommodate such features, and so careful design would be required.

Conversely, on the arterial links, where there will be some reduction in future traffic pressures, the opportunity should be taken to lessen existing severance issues and to enhance the quality of the road corridor as a public space.

Figure 8 Changes to traffic volumes on selected arterial links - Revenue scheme



2021 RART Model, ARPES 2007  
Scenario 2113, 2021 AM Revenue Scheme, \$3 charge  
2007-12-14 08:47 (logV)



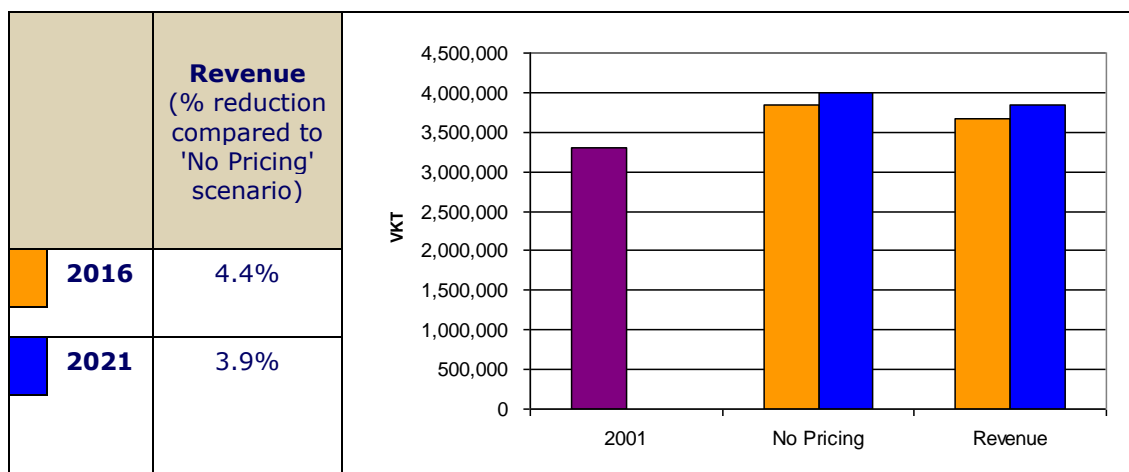
2021 RART Model, ARPES 2007  
Scenario 2113, 2021 AM Revenue Scheme, \$3 charge  
2007-12-14 08:47 (logV)

## 2.2.2. Stormwater quality effects

Looking first at the urban-wide level, Figure 9 below presents the total modelled VKT for all catchments covered by the RART model.

The Revenue scheme sees a fall in VKT travelled, compared to the 'No Pricing' case, and this should translate into less contaminants entering streams and the marine environment, however not in comparison to 2001 levels. However, as noted in the 2006 preliminary study of low charging schemes, the changes in VKT from the 'No Pricing' scenario are not large.

**Figure 9 Total VKT under Revenue scheme**



**Note:** Positive %'s are reductions in Total VKT from the 'No Pricing' scenario

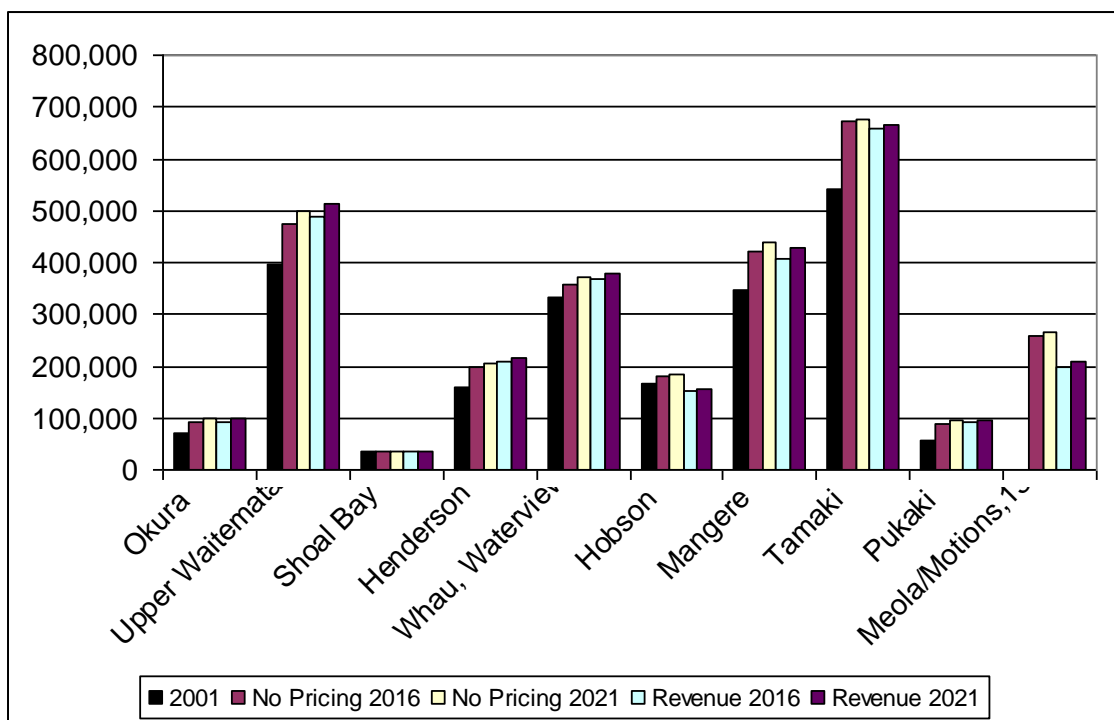
Turning from the regional picture to the likely impact of the pricing schemes on contaminant loads entering the identified sensitive catchments, the table below sets out the percentage change in VKT by selected catchments under the Revenue scheme:

**Table 3 VKT for catchments with sensitive marine receiving environments – Revenue scheme**

Selected runs	% Reduction (compared to 'No Pricing' scenario) in VKT for catchments with sensitive marine receiving environments	
	2016	2021
Okura	2.51%	1.45%
Upper Waitemata	-2.94%	-2.62%
Shoal Bay	2.45%	2.25%
Henderson	-5.13%	-4.56%
Whau, Waterview	-2.33%	-2.21%
Hobson	16.29%	15.58%
Mangere	3.05%	2.52%
Tamaki	1.86%	1.55%
Pukaki	-2.57%	-3.20%
Meola/Motions	22.79%	21.02%

**Note:** Positive %'s are reductions in VKT from the 'No Pricing' scenario and negative %'s (in red) are increases in VKT

Figure 10 VKT by catchment – Revenue Scheme



As expected, the Revenue scheme sees significant reductions in contaminant loads in the central Isthmus catchments lying inside the road pricing area (Hobson Bay and Meola/Motions catchments). However, these benefits are offset by small increases in VKT in other sensitive catchments around the city - the Upper Waitemata Harbour, Henderson, Whau/Waterview and Pukaki catchments. This appears to be the result of north-south traffic diverting around the Isthmus area under this all day scheme rather than a significant reduction in overall traffic volumes.

This assessment is too coarse to quantify the overall benefits or impacts to these sensitive receiving environments, and a direct relationship between reduced contaminant loadings from roads and environmental quality may not be evident in the short term. As noted in the 2005 study, other contaminant sources and factors play a large part in the ultimate quality of these receiving environments. For example, a reduction in contaminant inputs under the road pricing schemes may make little or no material difference to ecological values in the Hobson catchment which is likely to be already heavily polluted. Conversely, the more pristine estuarine environments in the outer areas (such as Upper Harbour) may be much more vulnerable in terms of changes to their condition from small increases in contaminant loads under the road pricing schemes (in particular the Revenue scheme).

However, as road transport activities become more major contributors to contaminant loads (as predicted by the preliminary ARC and ACC/Metrowater studies), these impacts are expected to become more pronounced. Should a road pricing scheme be adopted, mitigation should be considered to address the issue of increased contaminant loads on outer catchments. This could involve additional stormwater quality treatment of road run-off in the affected areas to offset the increased contaminant loads. This will lead to an overall enhancement of the sensitive catchments under the road pricing schemes, by decreased traffic flows in the inner areas and offsetting impacts in the outer catchments.

Based on the model outputs, the Revenue scheme could be expected to contribute to meeting the government target in the updated NZ Transport Strategy to reduce local water quality impacts to "accepted international standards", although it cannot be said if the scheme will in itself mean that this target can be met, as the Strategy does not identify what "accepted international standards" will be applied.

### 2.2.3. Air quality effects

Table 4 summarises the modelling results for region-wide air emissions under the Revenue scheme, for the three parameters NOx, PM10 and VOC.

**Table 4 Vehicle-related emissions to regional air shed – Revenue scheme**

Emissions to regional air shed (% reductions against 'No Pricing')	Revenue scheme	
	2016	2021
NOx (kg)	4.3%	3.6%
PM10 (kg)	6.7%	5.8%
VOC (kg)	10.8%	9.3%

Although air emissions are predicted to decrease from 2001 levels through to 2016 and 2021 even without road pricing, the Revenue scheme may result in further reductions in emissions, particularly inside the charging area. The following key points can be noted:

- The reductions in air emissions under the Revenue scheme compared to the 'No Pricing' scenario are relatively low, suggesting that the 24 hour charging basis may result in drivers being less likely to avoid travelling during peak times.
- The reductions in emissions to air from the 'No Pricing' scenario are slightly lower in 2021 than in 2016 – this is expected to relate to the advances in emissions technology which would be experienced even in a 'No Pricing' situation.

Air emissions were also modelled for the main urban sectors to identify possible localised impacts on air quality (to the extent that this is possible given the issues associated with climate, mixing, urban form and exposure). Tables 5, 6, and 7 below set out this data for each of the three parameters.

**Table 5 NOx**

% change (compared to minimum intervention scenario) in NOx		
Sector	Revenue scheme	
	2016	2021
Isthmus (inside area)	11.5%	10.7%
Isthmus (outside area)	3.6%	3.0%
North	5.7%	5.1%
West	-11.0%	-11.1%
South	1.2%	0.5%

**Table 6 PM 10**

<b>% change (compared to 'No Pricing' scenario) in PM10</b>		
Sector	Revenue scheme	
	2016	2021
Isthmus (inside area)	15.1%	14.7%
Isthmus (outside area)	5.5%	5.6%
North	10.0%	8.5%
West	-16.7%	-18.3%
South	2.7%	2.1%

**Table 7 VOC**

<b>% change (compared to 'No Pricing' scenario) in VOC</b>		
Sector	Revenue scheme	
	2016	2021
Isthmus (inside area)	24.4%	23.5%
Isthmus (outside area)	12.4%	12.4%
North	14.7%	13.5%
West	-29.8%	-33.1%
South	3.5%	1.5%

The following key points can be made in terms of the localised impacts:

- As expected and as seen in the water quality impact modelling results, the most significant reductions in air emissions under the Revenue scheme are in the central Isthmus area, inside the road pricing area.
- However, there are also significant reductions in emissions seen in other urban areas outside of the road pricing area, which were not seen in the water quality modelling results.
- These benefits are offset by significant increases in emissions in the West Auckland urban areas, which would effectively negate a proportion of the reduction in NOx and PM10 emissions resulting from more effective fuel and emission standards. As seen in the modelled traffic volumes, this is likely to be due to north-south traffic diverting around the Isthmus area into the West Auckland area, with traffic remaining on the motorway / main arterial road network, but tending to slow vehicle speeds, and as a result increasing air emissions in the western sector.
- As noted above, the reductions in emissions to air from the 'No Pricing' scenario are slightly lower in 2021 than in 2016 – this is expected to relate to the advances in emissions technology which would be experienced regardless of road pricing.

The health risks associated with air emissions depends heavily on exposure potential as well as concentrations of pollutants (air quality). In terms of air quality, there are reports that in London, although congestion charging and other changes were predicted to lead to substantial reductions to emissions, these have not necessarily fed through to observable improvements to air quality. This was also noted in the Stockholm road pricing trials for certain air pollutant, which saw much less pronounced impact on NOx concentrations at key monitoring points than the reduction in NOx emissions from vehicles. This reflects the extent and diversity of other influences on ambient air quality measurable at air quality monitoring stations, as opposed to emissions. These influences

have a diluting and obscuring effect on the original emissions change. Nonetheless, the Stockholm trials saw PM10 concentrations significantly decrease as result of the road pricing trials.

To derive significant benefits from reduced emissions, the reductions should mainly be made in the most densely populated areas, where many people are exposed to a negative impact on health. The Stockholm road pricing trial report estimated that reductions in emissions by congestion charging in higher density areas would result in around 3 times the health benefits than would be gained by reductions in emissions across the country by other measures.

The updated NZ Transport Strategy does not identify what "accepted international standards" will be applied to the government targets relating to public health effects or air quality impacts. However, the modelling of air emissions from the Revenue scheme indicates that this scheme will contribute to lower overall emissions to the regional airshed, albeit with varying localised effects. In terms of the government target to significantly reduce effects on health and premature deaths associated with vehicular emissions, assuming at a crude level, a linear relationship between emission levels and public health effects (and a neutral exposure factor at the local level), the reduced emissions to the regional airshed as a result of the Revenue scheme could be expected to proportionally reduce the number of premature deaths in Auckland (for example, the Revenue scheme may reduce premature deaths by up to 6% across the region).

The Revenue scheme will particularly benefit the inner Isthmus area. Whilst there are likely to be sites of high exposure in each urban sector modelled, the inner city is likely to contain a cluster of high exposure sites. Air pollution levels are affected by topography and in built up areas such as the wider CBD area, contaminants are not blown away as easily as in more open areas because of the high buildings. In addition, traffic flows in the central areas are often slower and more congested than in the outlying areas. The central area will also have relatively high pedestrian levels and an increasing number of high-density residences (apartments). On this basis, the reductions in air emissions in the central area are likely to have particular benefits.

However the adverse impacts of the Revenue scheme on air emissions in the western urban sector may make road pricing less acceptable in this sector. Mitigation options may need to be considered to offset these negative local effects – the most effective mitigation to reduce air emissions is traffic management and other initiatives in that respect will be required.

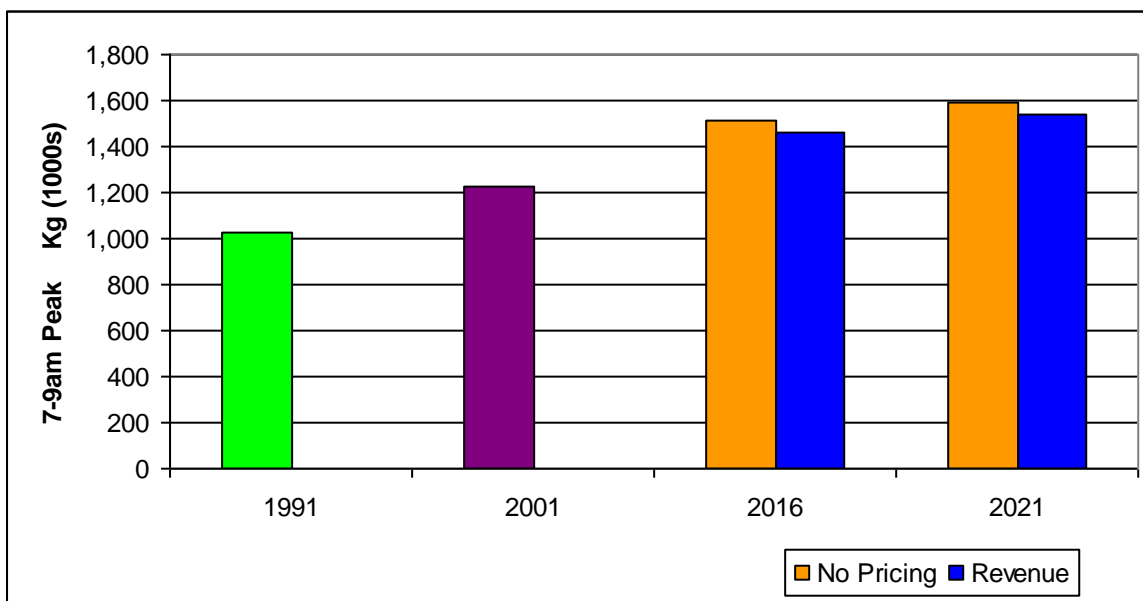
It is also important to also consider the effects on air quality that will arise from the use of alternative transport brought about by the introduction of road pricing. Road pricing will reduce traffic volume by travellers either choosing alternative routes, car-pooling, reducing the number of trips taken, or transferring to public transport. Increases in the number of buses on the roads may lead to additional air emissions, depending upon the quality of the bus fleet. The majority of Auckland's public transport system involves diesel buses of various ages.

Fine particulate matter is a particular concern in the Auckland Region and diesel vehicles contribute between 60-80% of the Region's PM10 emissions. Currently, around 3% of the diesel traffic on Auckland roads is diesel buses and the relative contribution of PM10 from buses is between 40 – 200 times the average petrol-run car. Therefore, based on the current situation and with no improvements to the existing bus fleet or fuel standards, the effectiveness of the road pricing schemes in reducing air emissions may be off-set to an extent by increased bus use. One solution to this would be for bus fleets to be comprised of low emission vehicles, and some of the revenue from the road pricing schemes could be directed to assisting bus companies to phase out older buses as a mitigation measure.

## 2.2.4. Greenhouse gases

To assess the impact of the Revenue scheme on greenhouse gas emissions, the graph below sets out the estimated emissions of CO<sub>2</sub> under the different time periods. The quantum of greenhouse gas is based on the average quantity of CO<sub>2</sub> emitted in the AM peak, per vehicle kilometre travelled, for 2016 and 2021. The Revenue scheme sees a reduction in CO<sub>2</sub> production compared to the ‘No Pricing’ scenario.

Figure 11 Carbon dioxide emissions – Revenue scheme



These figures can be related to an estimate of CO<sub>2</sub> production for the peak 7-9am period in 1991 (which is a year different from the benchmark for Kyoto Protocol commitments of 1990). The data is expressed as a percentage increase over 1991 levels.

Table 8

Estimated Changes in CO <sub>2</sub> Emissions 1991 – 2016 and 1991 - 2021				
Production (kg 000s)	1991	2001	No Pricing	Revenue
		1,024		
Estimated 2016 production (kg 000s)			1,513	1,461
% increase over 1991			47.8%	42.6%
Estimated 2021 production (kg 000s)			1,590	1,542
% increase over 1991			55.3%	50.6%

Revenue scheme sees increased production from 1991, although at a rate that is lower than the ‘No Pricing’ scenario.

The latest national greenhouse gas inventory<sup>10</sup> shows that New Zealand's emissions are increasing, with overall carbon dioxide emissions in 2004 about 34% higher than they were in 1990. Transport sector emissions are continuing to grow rapidly and now make up around 18% of New Zealand's total greenhouse gas emissions. It could be estimated that Auckland's traffic would make up a third

<sup>10</sup> National Inventory Report: 1990-2003. New Zealand Climate Change Office

of this figure, or perhaps between 6 to 7% of national emissions. The differences between the ‘No Pricing’ and Revenue schemes (approximately 5%) therefore represent at the most, a 0.4% difference at a national level in terms of future total emissions.

Specifically in relation to greenhouse gas emissions from transport, the proposed updated New Zealand Transport Strategy (UNZTS) sets a target to halve the per capita greenhouse gas transport emissions by 2040, relative to 2007 emissions. As described in section 2.1.5, applying the UNZTS emissions target to only Auckland traffic emissions within the peak 7-9am period (as an indicative first order assessment), would mean that by 2040, the per capita carbon dioxide emissions from Auckland traffic would have to be reduced to levels which are similar to 1991 levels.

Based on the 2016 and 2021 model results, the 'peak-period' carbon dioxide emissions without road pricing would be around 48-55% higher than 1991 levels. The Revenue scheme will provide some buffering of this increase – the reduction provided by the Revenue scheme from the No Pricing scenario is around 8-11% of the 48-55% increase above higher levels.

In other words, while the Revenue scheme would not in itself meet the regional transport emissions target (ie reverse the total increases in carbon dioxide levels predicted with no road pricing), it would contribute around 8-11% of the reduction needed to meet the target. The Revenue scheme would therefore have to be considered as only one of a number of the several initiatives instigated or planned to meet the UNZTS target.

### 2.2.5. Summary – Revenue Scheme

Table 9

Key Indicator (% Reductions from 'No Pricing')	Revenue scheme	
	2016	2021
Amenity (traffic volumes on arterials)	-0.1%	0.1%
VKT – sensitive catchments	4.4%	3.9%
Air discharges – PM10	6.7%	5.8%
Greenhouse Gases	3.4%	3.4%

The following points are highlighted for the analysis relating to environmental conditions:

- The Revenue scheme generally sees a lesser reduction in environmental impacts during the peak times than the Congestion scheme. This reflects the lower charging rate and also suggests that the 24 hour charging basis may result in drivers being less likely to avoid travelling during peak times. In fact, the modelled total traffic volumes under the revenue scheme during peak times in 2016 are even slightly higher than the ‘no pricing’ scenario.
- On this basis, the Revenue scheme is not expected to contribute as much as the Congestion scheme to meeting the government targets set out in the updated NZ Transport Strategy to reduce local environmental impacts of transport (including air and water quality) to be at accepted international standard.
- Reductions in water and air quality impacts are influenced by advances in emissions technology and stormwater treatment which would be experienced even with ‘no pricing’. These advances are built into the air emission factors and stormwater impact modelling

between 2016 and 2021, and explain why the benefits of the Revenue scheme are less at 2021, compared to 2016.

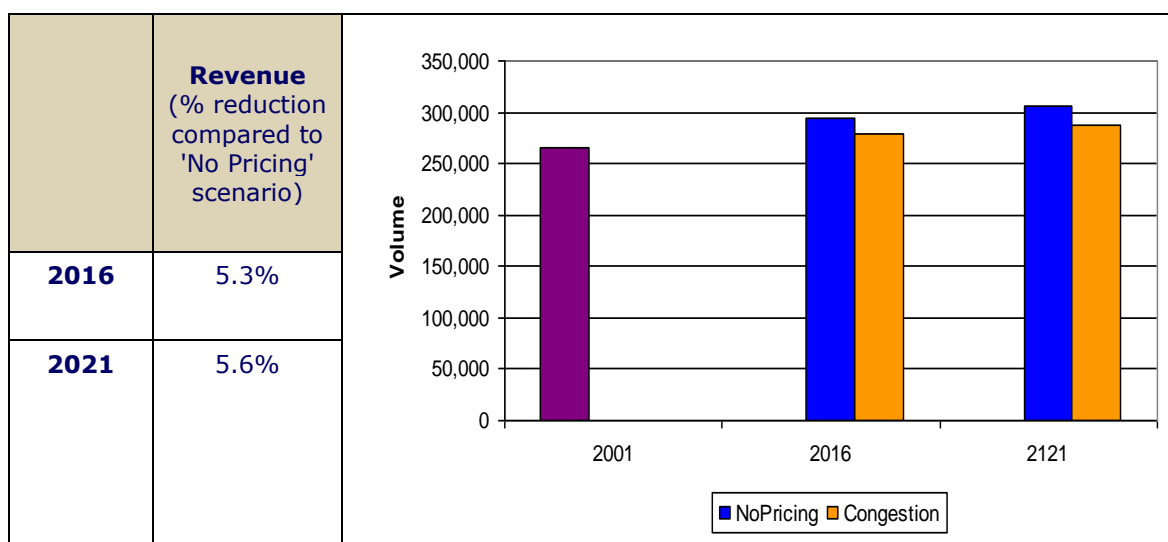
- At a regional level, the Revenue scheme in 2016-2021 is predicted to be contributing around 8-11% of the New Zealand Transport Strategy's target of a 50% reduction in 2007 greenhouse gas emissions per capita by 2040.

## 2.3. Congestion scheme

### 2.3.1. Amenity / severance / noise

Figure 12 presents the total modelled traffic volumes on the selected arterial links across the whole region under the Congestion scheme.

**Figure 12 Traffic volumes on selected links under Congestion scheme**



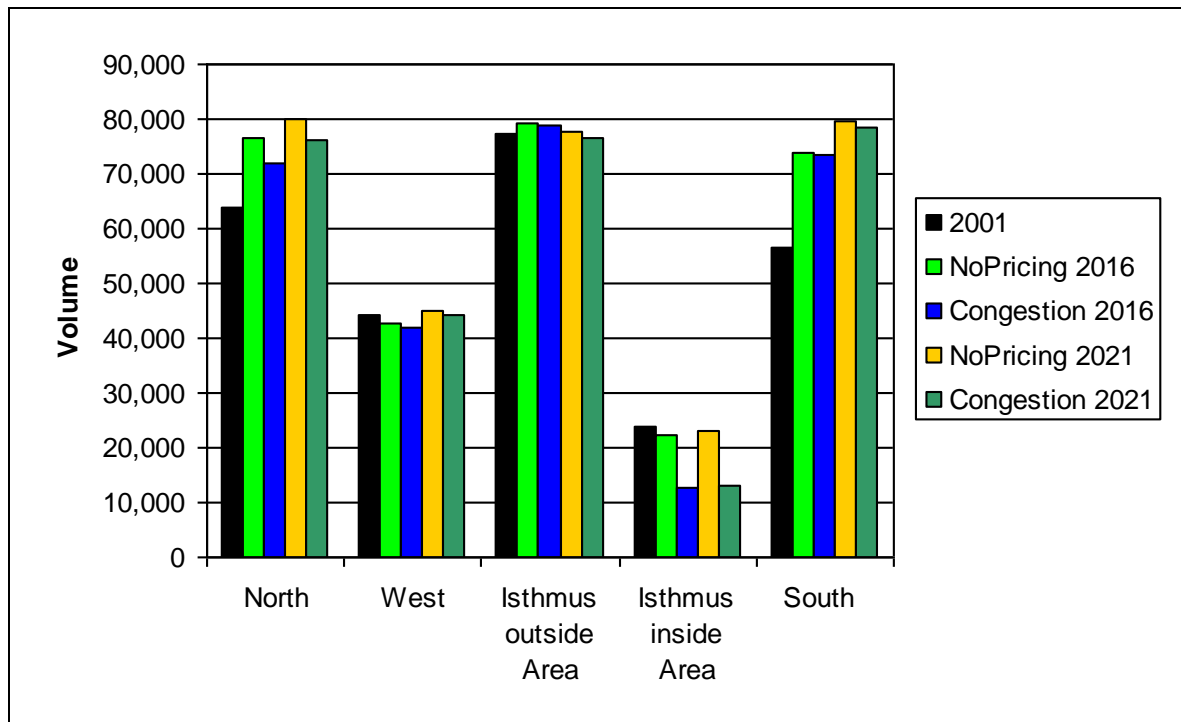
**Note:** Positive %'s are reductions in traffic volumes and negative %'s are increases in traffic volumes

The decreases in traffic volumes during peak traffic periods, and therefore positive impacts on noise and amenity values as these times are more likely under the Congestion scheme, than the revenue scheme. It is possible that the decrease in traffic volumes and amenity effects under the Congestion scheme during peak periods could be offset to some extent by any increase in volumes outside of the peak period. However as noted above, it is not considered highly likely that there would be a shift of **peak** traffic volumes to outside of current the peak period without a widespread change in current school and business hours and therefore commuting patterns. Overseas studies on the adaptation of commuters to road pricing schemes (e.g., Stockholm<sup>11</sup>), have not found any evidence that road pricing schemes change commuting times – rather commuters reorganise their travel to make it less frequent or more efficient by mode shifts or change in routes and destination).

Grouping the arterial links into urban sectors provides an insight into whether these effects of the pricing schemes may be more localised. Figure 13 below shows data by urban sector.

<sup>11</sup> Stockholmsforsoket: *Facts and results from the Stockholm Trials* (December 2006)

Figure 13 Traffic volumes on selected arterial links by urban sector – Congestion scheme



The most marked impacts of the Congestion scheme are predicted in the Isthmus area within the scheme boundaries (as expected) and in the North Auckland sector. The decrease in volumes along the main arterials at 2016 and 2021 is also illustrated in the following Figure 14. The modelled volumes along main links within the central area decrease from 2001 volumes without road pricing (reflecting significant improvements to public transport and traffic demand management in 2016, particularly trips to the CBD). However, on top of these improvements, significant further reductions in traffic volumes (more than 40%) on the selected links in the central urban area are possible under the Congestion scheme. With such considerable reductions, the quality of the central urban environment would be expected to improve significantly.

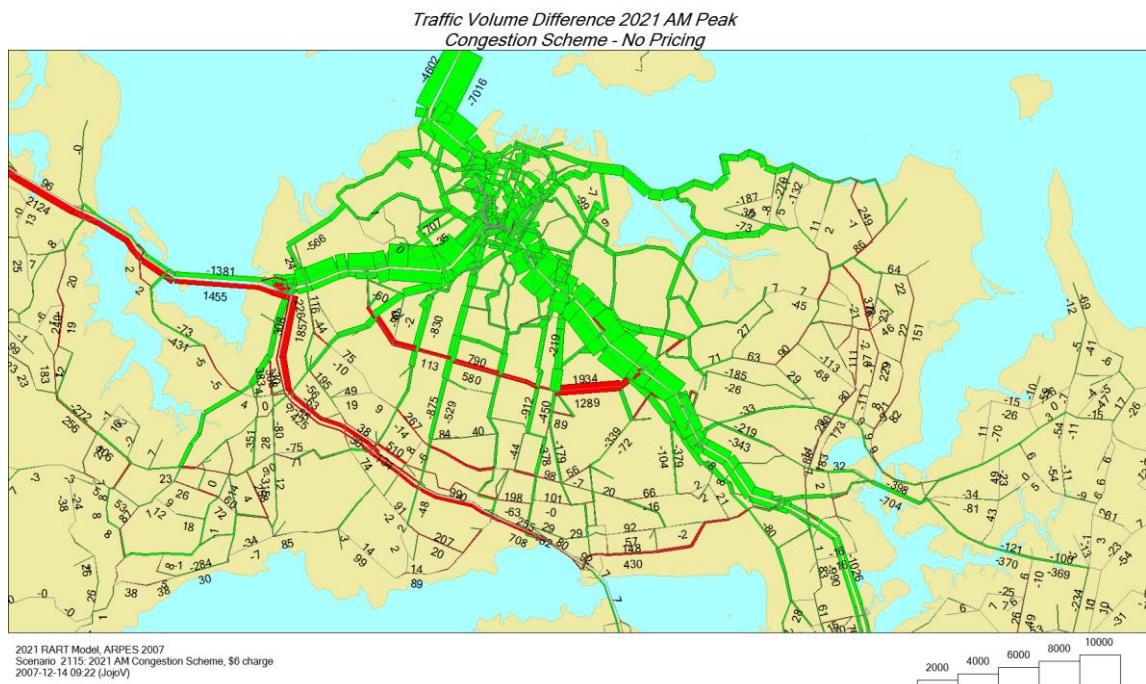
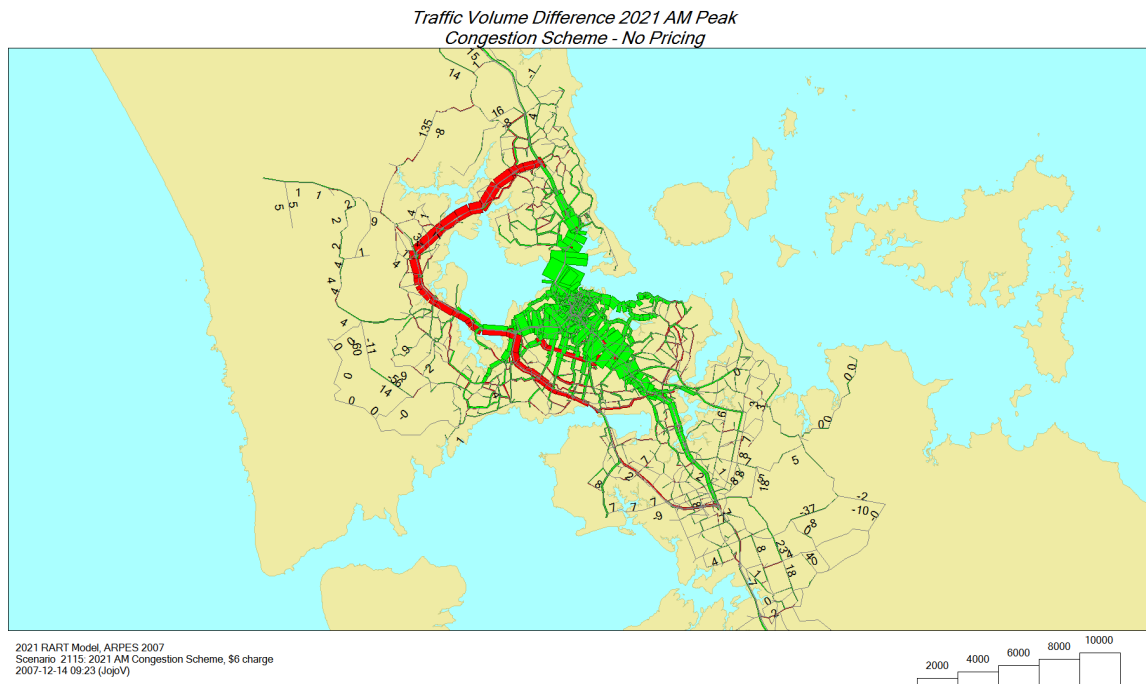
The Congestion scheme is also predicted to lessen, by up to one third, the considerable increases in traffic volumes above 2001 on main arterials in the North Shore area that would be seen with no pricing scheme. This will likewise lessen the potential reductions in amenity values that would be experienced in these areas with no road pricing.

However, on the other side of the region, in the South Auckland sector, the Congestion scheme would have little impact on the increases in volumes on key links in 2016 and 2021.

Furthermore, as shown in Figure 14, traffic volumes are predicted to increase above the 'No Pricing' scenario along the arterials forming the scheme boundaries under the Congestion scheme, and the model indicates a divergence of traffic around the scheme area increasing traffic volumes along State Highways 20 and 16 / 18. In the Isthmus area, the increases along the St Lukes / Greenlane corridor is particularly evident, along with minor links particularly in the Panmure / Glen Innes and Richardson / Stoddard Road areas.

As with the Revenue scheme, there is likely to be the need to mitigate the local amenity / community affects of this additional traffic through appropriate upgrading of the street environment.

Figure 14 Changes to traffic volumes on selected arterial links – Congestion scheme

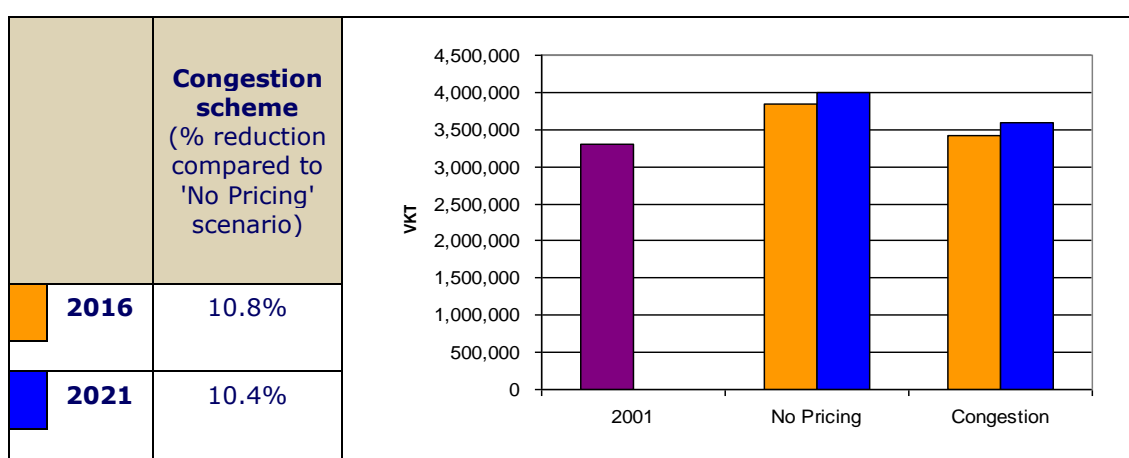


### 2.3.2. Stormwater quality effects

Figure 15 presents the total modelled VKT at the urban-wide level (i.e., for all catchments covered by the RART model) under the Congestion scheme:

The Congestion scheme sees a fall in VKT travelled compared to the 'No Pricing' case, almost to 2001 levels, and this should translate into less contaminants entering streams and the marine environment than would be expected with no road pricing. The reductions in VKT are more significant than under the 'Revenue' scheme (around 4 – 4.5%). This is consistent with the conclusions of the 2006 preliminary study, with the greatest reduction in VKT (and therefore contaminants entering waterways), with schemes that impose the highest charge on the greatest number of motorists.

**Figure 15 Total VKT under Congestion scheme**



**Note:** Positive %'s are reductions in Total VKT from the 'No Pricing' scenario

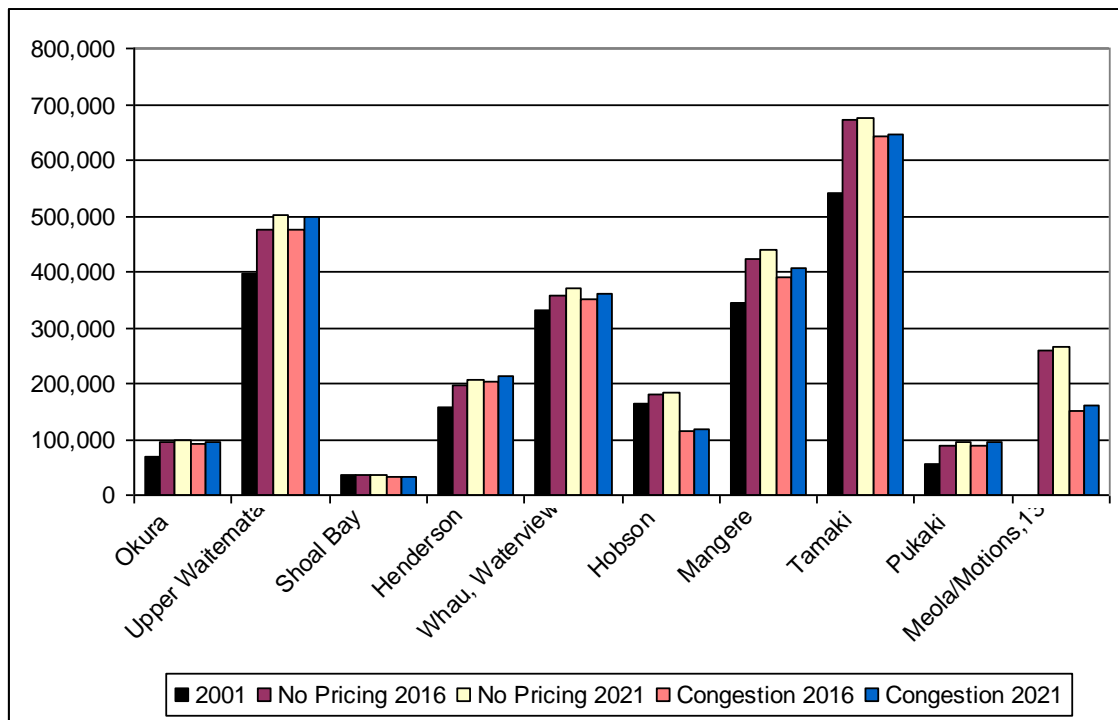
Turning to the more localised effects of contaminant loads entering the identified sensitive catchments under the Congestion scheme, Table 11 sets out the percentage change in VKT by selected catchment under the Congestion scheme:

**Table 10 VKT for catchments with sensitive marine receiving environments – Congestion scheme**

Selected runs	% Reduction (compared to 'No Pricing' scenario) in VKT for catchments with sensitive marine receiving environments	
	2016	2021
Okura	3.58%	2.67%
Upper Waitemata	0.17%	0.29%
Shoal Bay	5.85%	5.10%
Henderson	-3.37%	-2.92%
Whau, Waterview	2.47%	2.77%
Hobson	36.02%	35.54%
Mangere	7.66%	7.17%
Tamaki	4.26%	4.03%
Pukaki	-1.38%	-1.48%
Meola/Motions	41.39%	40.08%

**Note:** Positive %'s are reductions in VKT from the 'No Pricing' scenario and negative %'s (in red) are increases in VKT

Figure 16 VKT by Catchment – Congestion Scheme



As expected, the Congestion scheme sees significant reductions in VKT (and therefore contaminant loads) in the central Isthmus catchments lying inside the road pricing area (Hobson Bay and Meola/Motions catchments). The reductions in the Hobson catchment, and less significant reductions in VKT in the Shoal Bay catchment, improve the contaminant loading to these catchment below 2001 levels. Although the reductions in VKT (contaminant loads) in the Okura, Whau / Waterview, Mangere and Tamaki catchments are not as sizeable or an improvement on 2001 levels, the Congestion scheme would lessen the potential impacts of increased contaminant loadings which would be seen without road pricing.

These benefits are offset to a minor extent by small increases in VKT in the Henderson and Pukaki catchments (however not to the extent of the Revenue scheme), probably reflecting the diversion of north-south traffic around the Isthmus area.

The benefits from reduced contaminant loads in these sensitive catchments are more likely to be seen under the time-focussed Congestion scheme which generally shows around twice the reduction in contaminant loads than the Revenue scheme. While the assessment has only been conducted for morning peak traffic flows, these peak traffic periods are when the highest deposition of potential contaminants is expected on the city roads. Therefore, the Congestion scheme is likely to produce the greater benefits from reduced VKT and contaminant loads in these sensitive catchments.

As noted above, this assessment is too coarse to quantify the overall benefits or impacts to these sensitive receiving environments, and a direct relationship between reduced contaminant loadings from roads and environmental quality may not be evident in the short term. As noted in the 2006 study, other contaminant sources and factors play a large part in the ultimate quality of these receiving environments. For example, a reduction in contaminant inputs under the road pricing schemes may make little or no material difference to ecological values in the Hobson catchment which is likely to be already heavily polluted.

Based on the model outputs, the Congestion scheme could be expected to contribute to meeting the government targets in the updated NZ Transport Strategy to reduce local water quality impacts to "accepted international standards", although it cannot be said if the Congestion scheme will in itself mean that this target can be met, as the Strategy does not identify what "accepted international standards" will be applied.

Mitigation should be considered to address the issue of increased contaminant loads on outer catchments. This could involve additional stormwater quality treatment of road run-off in the affected areas to offset the increased contaminant loads. This will lead to an overall enhancement of the sensitive catchments under the road pricing schemes, by decreased traffic flows in the inner areas and offsetting impacts in the outer catchments.

### 2.3.3. Air quality effects

The results of the air emission modelling, for the three parameters NO<sub>x</sub>, PM<sub>10</sub> and VOC under the Congestion scheme, are summarised in the table below, for the Region as a whole.

**Table 11 Vehicle related emissions to regional air shed – Congestion scheme**

Emissions to regional air shed (% reductions against 'No Pricing')	Congestion scheme	
	2016	2021
NO <sub>x</sub> (kg)	12.6%	10.4%
PM <sub>10</sub> (kg)	16.9%	15.4%
VOC (kg)	24.9%	21.6%

Although air emissions are predicted to decrease from 2001 levels through to 2016 and 2021 even without road pricing, the Congestion scheme is expected to result in further reductions in emissions, particularly inside the charging area. The following key points can be noted:

- The Congestion scheme sees the larger decreases in emissions across the three parameters, reflecting the focussed timing of this scheme and charges imposed. The reduction in emissions under the Congestion scheme (from the "No Pricing" scenario) are between 2-3 times that provided in peak times under the Revenue scheme.
- The reductions in emissions to air from the 'No Pricing' scenario are slightly lower in 2021 than in 2016 – this is expected to relate to the advances in emissions technology which would be experienced even in a 'No Pricing' situation.

Air emissions were also modelled for the main urban sectors to identify possible localised impacts on air quality (to the extent that this is possible given the issues associated with climate, mixing, urban form and exposure). The tables below set out this data for each of the three parameters.

Table 12 Nox

<b>% change (compared to minimum intervention scenario) in NOX</b>		
Sector	Congestion scheme	
	2016	2021
Isthmus (inside area)	22.4%	23.3%
Isthmus (outside area)	10.2%	9.4%
North	12.2%	10.6%
West	-1.5%	-8.5%
South	6.8%	2.8%

Table 13 PM 10

<b>% change (compared to 'No Pricing' scenario) in PM10</b>		
Sector	Congestion scheme	
	2016	2021
Isthmus (inside area)	28.8%	29.7%
Isthmus (outside area)	13.7%	14.6%
North	20.2%	17.1%
West	-6.5%	-12.5%
South	8.0%	6.3%

Table 14 VOC

<b>% change (compared to 'No Pricing' scenario) in VOC</b>		
Sector	Congestion scheme	
	2016	2021
Isthmus (inside area)	40.3%	39.3%
Isthmus (outside area)	25.7%	24.3%
North	27.8%	24.0%
West	-2.3%	-19.5%
South	9.9%	9.4%

The following key points can be made in terms of the localised impacts:

- As expected and as seen in the water quality impact modelling results, the most significant positive impacts on air emissions under the Congestion scheme are in the central Isthmus area lying inside the road pricing area.
- However, there are also significant reductions in emissions seen in other urban areas outside of the road pricing area, in North Auckland and the rest of the Isthmus area, which were not seen in the water quality modelling results.
- These benefits are offset by increases in emissions in the West Auckland urban areas (however not to the extent of the Revenue scheme and not above 2001 levels). As seen in the modelled traffic volumes, this is likely to be due to north-south traffic diverting around the Isthmus area into the West Auckland area, with traffic remaining on the motorway / main arterial road network, but tending to slow vehicle speeds, and as a result increasing air emissions in the western sector.

- Decreases in emissions are more likely to be seen under the time-focussed Congestion scheme which generally shows around twice the reduction in emissions than the Revenue scheme. The Congestion scheme also sees much smaller increases in emissions in the West Auckland area than under the Revenue scheme.
- As noted above, the reductions in emissions to air from the 'No Pricing' scenario are slightly lower in 2021 than in 2016 – this is expected to relate to the advances in emissions technology which would be experienced even in a 'No Pricing' situation.

As noted above in the discussion of the Revenue scheme, the health risks associated with air emissions depends heavily on exposure potential as well as concentrations of pollutants (air quality). Overseas reports on other congestion schemes (e.g., London, Stockholm) have reported that substantial reductions to emissions of certain pollutants have not necessarily lead to observable improvements to air quality, as a result of other potential influences on ambient air quality which dilute and obscure the impacts of the reduced emissions.

To derive significant benefits from reduced emissions, the reductions should mainly be made in the most densely populated areas, where many people are exposed to a negative impact on health. The Stockholm road pricing trial report estimated that reductions in emissions by congestion charging in higher density areas would result in around 3 times the health benefits than would be gained by reductions in emissions across the country by other measures.

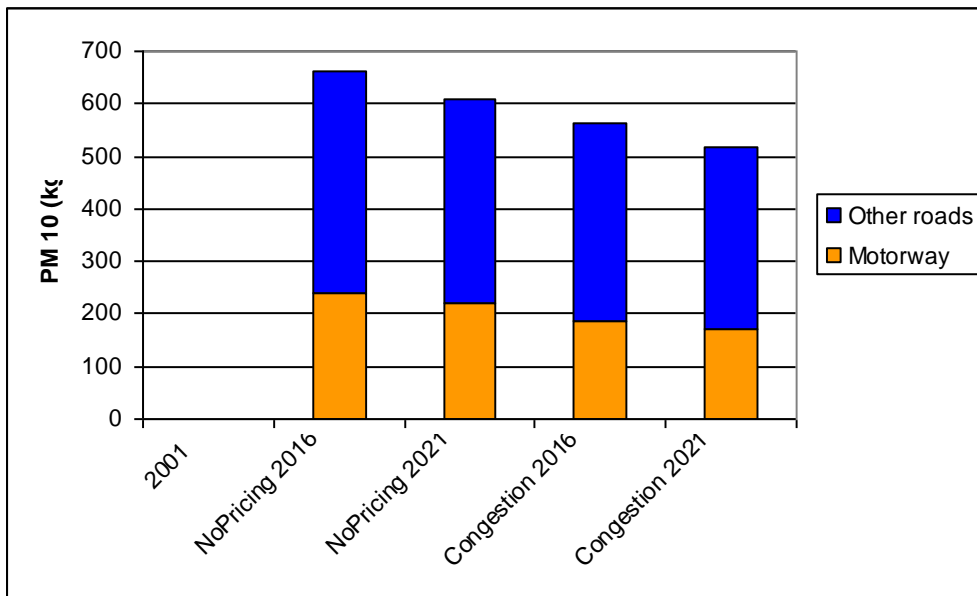
Based on the model outputs, the Congestion scheme could be expected to contribute to meeting the government targets in the updated NZ Transport Strategy to reduce public health effects relating to vehicular emissions to "accepted international standards" and local air quality impacts to "accepted international standards", although it cannot be said if the Congestion scheme will in itself mean that this target can be met, as the Strategy does not identify what "accepted international standards" will be applied. In terms of premature deaths associated with vehicle emissions, as a crude assessment (assuming that the relationship between PM10 emission levels and public health effects is linear and a neutral exposure factor at the local level), the Congestion scheme may also reduce premature deaths by up to 16% across the region (proportional to the reduction in PM10 emissions).

The Congestion scheme will particularly benefit the inner Isthmus area. Whilst there are likely to be sites of high exposure in each urban sector modelled, the inner city is likely to contain a cluster of high exposure sites. Air pollution levels are affected by topography and in areas such as the wider CBD area, contaminants are not blown away as easily as in more open areas because of the high buildings. In addition, traffic flows in the central areas are often slower and more congested than in the outlying areas. The central area will also have relatively high pedestrian levels and an increasing number of high-density residences (apartments). On this basis, the reductions in air emissions in the central area are likely to have particular benefits.

However the adverse impacts of the Congestion scheme on air emissions in the western urban sector may make road pricing less acceptable in this sector.

As a further check on localised impacts, the amount of air emissions generated by traffic on motorways versus other roads can be calculated from RART model outputs. This data is presented in Figure 17 for PM10 discharges.

Figure 17 PM 10 emissions generated by motorway and non-motorway traffic – Congestion scheme



This shows that the overall emissions will reduce on both motorways and other roads under both schemes, however the greater reductions in emissions will generally be on non-motorway roads.

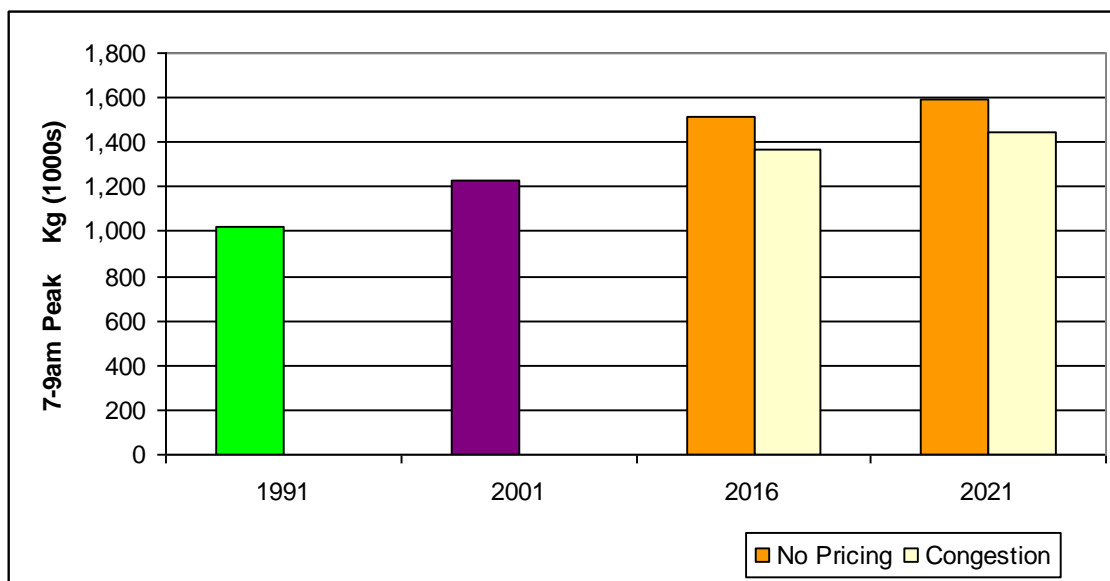
As noted in the discussion of the Revenue scheme, it is important to also consider the effects on air quality that will arise from the use of alternative transport brought about by the introduction of road pricing. Road pricing will reduce traffic volume by travellers either choosing alternative routes, car-pooling, reducing the number of trips taken, or transferring to public transport. Increases in the number of buses on the roads may lead to additional air emissions, depending upon the quality of the bus fleet. The majority of Auckland’s public transport system involves diesel buses of various ages.

Fine particulate matter is a particular concern in the Auckland Region and diesel vehicles contribute between 60-80% of the Region’s PM10 emissions. Currently, around 3% of the diesel traffic on Auckland roads is diesel buses and the relative contribution of PM10 from buses is between 40 – 200 times the average petrol-run car. Therefore, based on the current situation and with no improvements to the existing bus fleet or fuel standards, the effectiveness of the road pricing schemes in reducing air emissions may be off-set to an extent by increased bus use. One solution to this would be for bus fleets to be comprised of low emission vehicles, and some of the revenue from the road pricing schemes could be directed to assisting bus companies to phase out older buses as a mitigation measure.

### 2.3.4. Greenhouse gases

To assess the impact of the Congestion scheme on greenhouse gas emissions, the graph below sets out the estimated emissions of CO<sub>2</sub> under the different scenarios. The figures are based on the average quantity of CO<sub>2</sub> emitted in the AM peak, per vehicle kilometre travelled, for 2016 and 2021.

**Figure 18 Carbon dioxide emissions – Congestion scheme**



The Congestion scheme sees more significant reductions in CO<sub>2</sub> production from the ‘No Pricing’ scenario than the Revenue scheme – this reflects both the focussed timing of the Congestion scheme and the higher charges.

These figures can be related to an estimate of CO<sub>2</sub> production for the peak 7-9am period in 1991 (which is a year different from the benchmark for Kyoto Protocol commitments of 1990). The data is expressed as a percentage increase over 1991 levels.

**Table 15 CO<sub>2</sub> – Congestion scheme**

<b>Estimated Changes in CO<sub>2</sub> Emissions 1991 – 2016 and 1991 – 2021</b>				
Production (kg 000s)	1991	2001	No Pricing	Congestion
		1,024		
Estimated 2016 production (kg 000s)			1,513	1,365
% increase over 1991			47.8%	33.3%
Estimated 2021 production (kg 000s)			1,590	1,441
% increase over 1991			55.3%	40.7%

The Congestion scheme sees increased production from 1991, although at a rate that is lower than the ‘No Pricing’ scenario.

As noted above in the discussion of the Revenue scheme, transport sector emissions make up around 18% of New Zealand's total greenhouse gas emissions and it is estimated that Auckland’s traffic would make up a third of this figure, or perhaps between 6 to 7% of national emissions. The differences between the ‘No Pricing’ and Congestion schemes therefore represent at the most, a 1% difference at a national level in terms of future total emissions.

Specifically in relation to greenhouse gas emissions from transport, the proposed updated New Zealand Transport Strategy (UNZTS) sets a target to halve the per capita greenhouse gas transport emissions by 2040, relative to 2007 emissions. As described in section 2.1.5, applying the UNZTS emissions target to only Auckland traffic emissions within the peak 7-9am period (as an indicative

first order assessment), would mean that by 2040, the per capita carbon dioxide emissions from Auckland traffic would have to be reduced to levels which are similar to 1991 levels.

Based on the 2016 and 2021 model results, the 'peak-period' carbon dioxide emissions without road pricing would be around 48-55% higher than 1991 levels. The Congestion scheme will buffer this increase to some degree – the reduction provided by the Congestion scheme from the No Pricing scenario is around 26-30% of the 48-55% increase above higher levels.

In other words, while the Congestion scheme would not in itself meet this regional transport emissions target (ie reverse the total increases in carbon dioxide levels predicted with no road pricing), it would contribute around 26-30% of the reduction needed to meet the target. The Congestion scheme would therefore have to be considered as only one of a number of the several initiatives instigated or planned to meet the UNZTS target.

### 2.3.5. Summary – Congestion scheme

Table 16

Key Indicator (% Reductions from 'No Pricing')	Congestion scheme	
	2016	2021
Amenity (traffic volumes on arterials)	5.3%	5.6%
VKT – sensitive catchments	10.8%	10.4%
Air discharges – PM10	16.9%	15.4%
Greenhouse Gases	9.8%	9.8%

The following points are highlighted for the analysis of the Congestion scheme relating to environmental conditions:

- The AM Peak Period is the time of day when the most pronounced environmental impacts are currently experienced (i.e., the worst case scenario). Therefore, the modelled reductions in impact are mostly seen under the Congestion scheme which is focussed around these peak times. (Note that these results could also be seen were the peak traffic period to “shift” as a result of Congestion charging (i.e. a shift outside of the modelled AM peak period), however, even with road pricing in place, the “peak period” is unlikely to significantly shift without a widespread change in current school and business hours and therefore commuting patterns. Overseas studies on the adaptation of commuters to road pricing schemes (e.g., Stockholm), have not found any evidence that road pricing schemes change commuting times – rather commuters reorganise their travel to make it less frequent or more efficient by mode shifts or change in routes and destination).
- The Congestion scheme generally sees a higher reduction in environmental impacts during the peak times than the Revenue scheme. This reflects the higher charging rate.
- On this basis, the Congestion scheme is expected to contribute more than the Revenue scheme to meeting the government targets set out in the updated NZ Transport Strategy to reduce local environmental impacts of transport (including air and water quality) to be at accepted international standard.
- As with the Revenue scheme, total traffic volumes decrease with time under the Congestion scheme (compared to the ‘No Pricing’ scenario).

- Reductions in water and air quality impacts are influenced by advances in emissions technology and stormwater treatment which would be experienced even with ‘no pricing’. These advances are built into the air emission factors and stormwater impact modelling between 2016 and 2021, and explain why the benefits of the Revenue scheme are less at 2021, compared to 2016.
- At a regional level, the Congestion scheme in 2016-2021 is predicted to be contributing around 26-30% of the New Zealand Transport Strategy's target of a 50% reduction in 2007 greenhouse gas emissions per capita by 2040.

Overall, the Congestion scheme is expected to provide the better environment benefits across the Region during the peak impact times.

## 3. Land Use Implications

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This part of the report considers the implications of the possible road pricing schemes for land use development in the region, and in particular whether the road pricing schemes will assist with or detract from the agreed regional land use strategies. A particular issue to address is also whether longer term land use changes will undermine the benefits of road pricing. An issue noted in the submissions on the ARPES was the effect of the schemes on central area land uses. If a pricing scheme leads to a dispersal of activities away from the area affected, then the rationale for the pricing scheme is undermined, as well raising potential adverse consequences for regional urban containment strategies.

This part of the report is structured as follows:

- Section 3.1 sets out the methodology used and provides background analysis which has supported the review of the implications of the two road pricing schemes
- Section 3.2 discusses the cordon-based Revenue scheme
- Section 3.3 discusses the area-based Congestion scheme.

### 3.1. Methodology and background

A qualitative analysis of the land use implications of the road pricing schemes was undertaken, as occurred with the ARPES. This approach reflected the lack of available quantitative analysis tools, as well as the fact that the analysis needed to indicate the general level of support for the road pricing schemes in terms of regional and local land use strategies.

The methodology adopted for the study has involved the following steps:

1. Understand existing Auckland land use context
2. Identify key influences / outcomes sought from relevant regional strategies
3. Review literature on likely land use impacts of road pricing
4. Obtain outputs of transport modelling for key transport variables which are likely to influence future land use changes
5. Discuss likely impacts of the two road pricing schemes at a qualitative level.

#### 3.1.1. Existing land use context

The Auckland region has experienced a period of rapid growth over the past 10 years. The 2005 APRES set out land use trends for the period 2001 to 2004. This analysis is updated below with data through to 2006.

Between 1996 and 2006 the region's population grew at an annual average rate of 2%, adding over 230,000 people to its resident base. Meanwhile employment has grown at around 4.6% per annum over the five years between 2001 and 2006; with 120,000 jobs added to the regional workforce.

Projections indicate a continuation of fast growth rates. The most recent projections from Statistics New Zealand (2006 base year, medium projection series) suggest a regional population in the order of 1.82m by 2026, up from 1.37m in 2006.

Figure 19 shows the recent pattern of population growth in the region. For this analysis, the region has been broken down into a number of geographical categories:

- Nodal – this refers to development within the growth nodes specified by the Regional Growth strategy (as briefly described in Section 3.1.2). It includes the Auckland CBD
- Rural – non urban land, outside of the Metropolitan urban limit line
- Satellite – townships and settlements outside of the main urban area
- Edge – suburbs on the edge of the urban area that have developed since the 1970s
- Middle – the middle ring of suburbs, mostly developed in the period 1950 to 1970.
- Inner – suburbs generally within a 5km radius of the CBD, generally the older pre War neighbourhoods.

Numerically, the middle ring of suburbs is the largest area, but the urban edge has added the most population over the period 2001 to 2006 (See Figure 19).

**Figure 19 Population change 2001 to 2006, by location, for the Auckland Region**

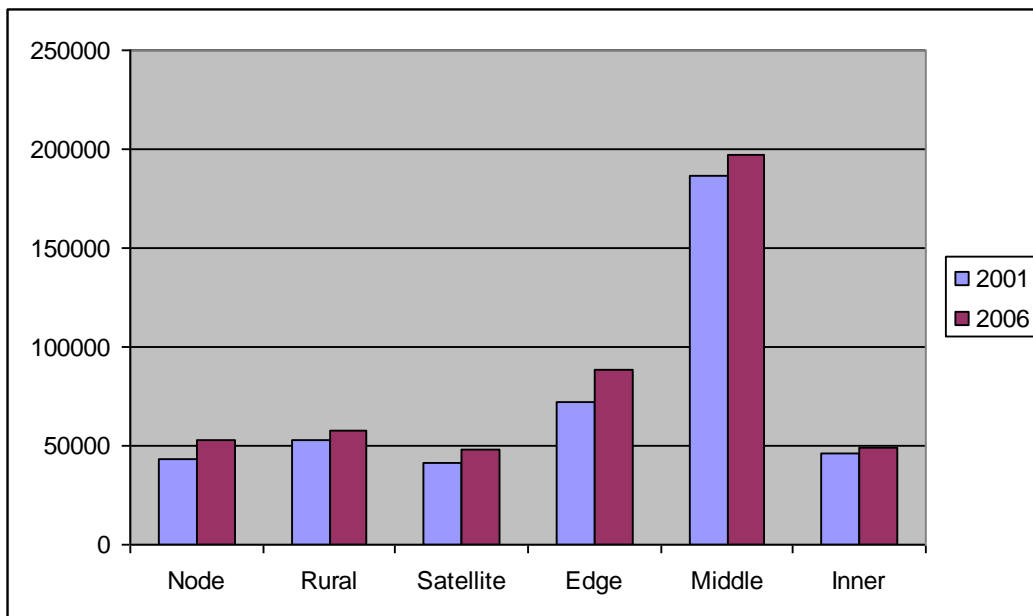
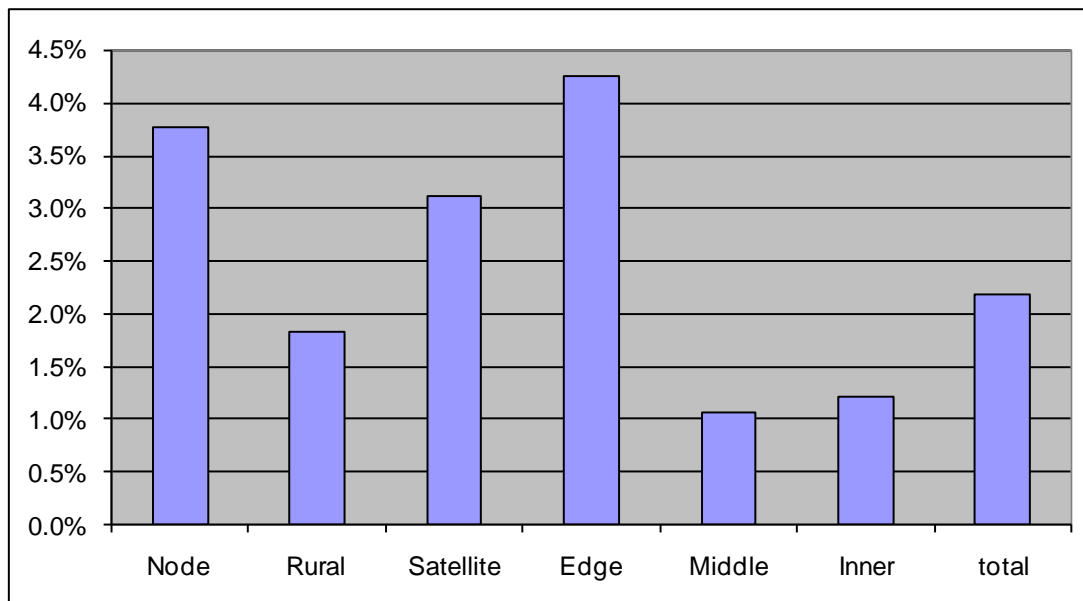


Figure 20 Annual rate of population growth 2001 to 2006



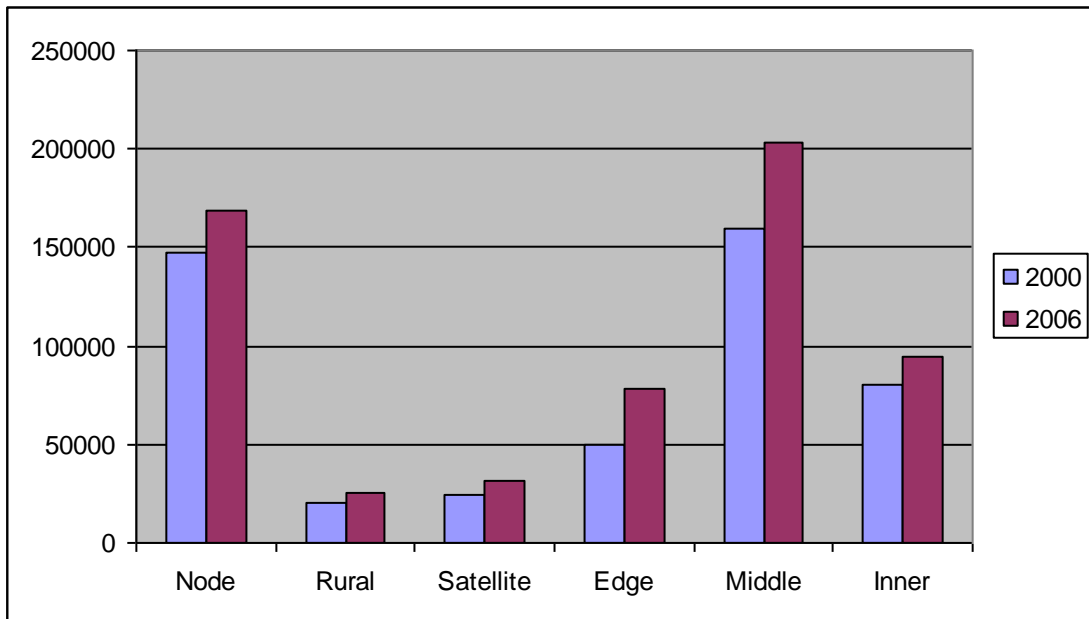
Relevant points to note include:

- The nodal areas identified in the RGS make up only a small proportion of the total population. However their rate of growth is fast, albeit of a low base, with much of this growth accounted for by the Auckland CBD. The fast rate of growth is in part a response to the priorities for intensification provided in the RGS. The investment market has also had a particular influence on growth patterns in the CBD and inner Isthmus area and recent financial turmoil raises questions about on-going investment in these areas. However there are signs that with reduced housing affordability, more owner occupiers are beginning to move into the more intensive housing options provided within the nodal areas. Longer term constraints exist in terms of appropriate zoning to accommodate more growth in many of the nodal areas.
- The high rate of growth at the urban edge reflects a continuing market demand for new sections close to orbital transport routes and suburban shopping centres. The rate of growth may well reduce over the next 10 years as these areas are used up and if the Metropolitan Urban Limits are retained as presently delineated. There is a distinct trend towards more intensive use of greenfields land with many new developments (Takanini, Albany, Flat Bush) offering a range of stand alone houses and apartments. This suggests that transport pressures will increase in these fringe areas.
- The relatively lower rate of dwelling growth in middle and inner urban areas is partly reflective of infrastructural constraints (such as stormwater issues) but also the established character of these locations which makes it difficult to provide for a substantial increase in dwellings in these areas.

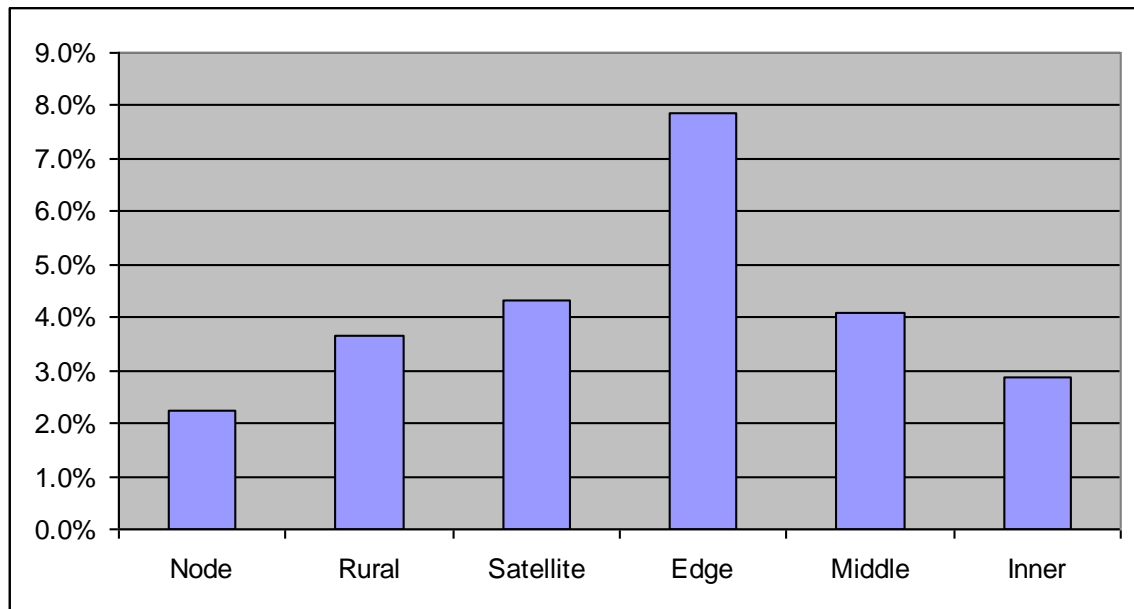
Turning to employment, Figures 21 and 22 sets out the picture with regard to employment growth for the same geographical areas. Figure 21 shows the growth in employment numbers, while Figure 21 shows annual growth rates.

From Figure 21 it can be seen that regional employment is concentrated in the nodal and middle areas, but the edge areas are growing at a fast rate.

**Figure 21 Employment Growth 2000 to 2006 by location, for the Auckland Region (total persons employed)**



**Figure 22: Annual employment growth rates 2000 to 2006, by location for the Auckland Region**



Points to note include:

- Employment has been growing faster in the outer ring of the metro area, compared to the middle and nodal areas. This is likely to reflect factors such as land availability, transport access and proximity to labour
- The growth centres proposed by the Regional Growth Strategy (nodes) have seen modest rates of growth. While the CBD has been growing, the other nodes have seen much less

growth, with growth mostly in response to increases in the number of people in their wider catchment.

The North-South motorway spine (Albany, Wairau / Smales, CBD, Great South Rd, Highbrook) remains a powerful attractor of employment activities. Over time the western ring route is likely to emulate this spine.

These patterns reflect the fundamental drivers of current business location decision, which are heavily influenced by transport access. The table below (Figure 23) is sourced from an Auckland Regional Council report on business land development. Based on a number of surveys, it ranks the key factors in location decisions. There is obviously a trade off between transport accessibility and cost of land and premises, with more accessible land priced more. Accessibility to workforce is more of an issue than accessibility to suppliers or customers, apart for the retail sector.

**Figure 23 Location factors for business activities**

Table 7: Ranked Location Factors for a Sample of Auckland Businesses

Order of Importance	Location Factor	Comment
1	Transport and accessibility	Consistently rated highly.
2	Cost of land/ premises	Some businesses rated this low, and as being a small part of total costs.
3	Proximity to workforce	Consistently rated high.
4	Carparking	An important factor especially for the services sector.
5	Quality of premises	A factor for manufacturers.
6	Technology available	Quite a range of responses.
7	Proximity to clients/customers	An important factor for retail.
8	Exposure/profile	The widest range of responses.
9	Co-location/clustering	Some businesses rated this high, others low.
10	Lifestyle/amenity	A factor for the service industry.
11	Proximity to support services	Not generally seen as a factor.
12	Proximity to home	Some mainly historical decisions.
13	Proximity to suppliers	Not usually an issue.

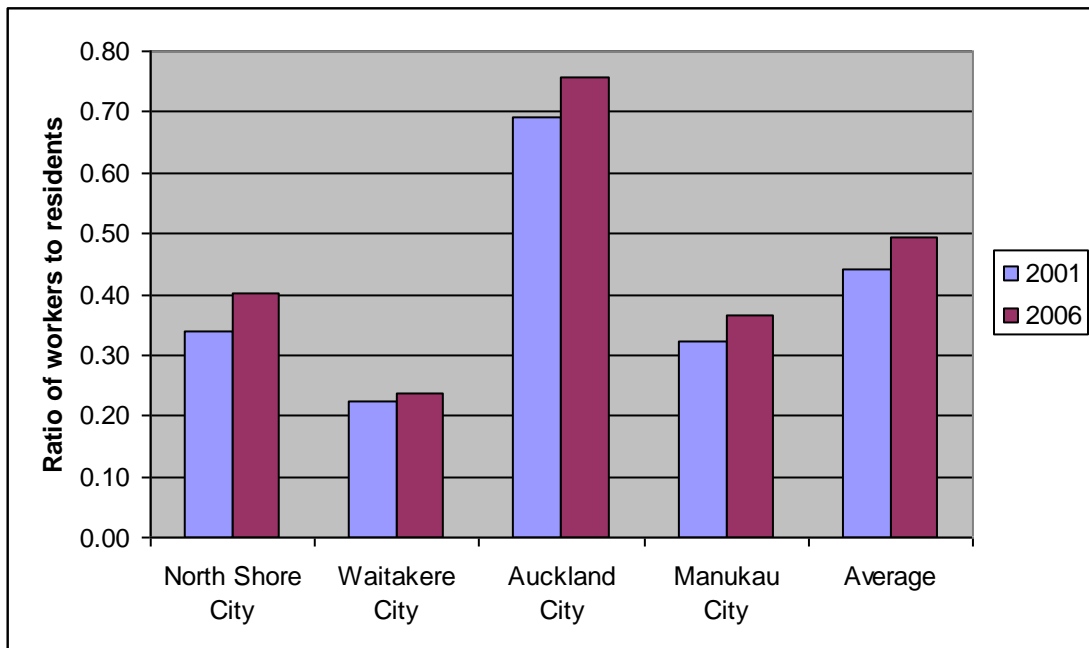
Information provided by Bayleys Research<sup>12</sup> on their web site note the same important influence of transport accessibility:

*Many of the new office buildings that have been built ....over recent years are characteristic of the high standard of office accommodation now sought, generally offering large floor plates, proximity to amenities, adequate car parking and quick and easy access to the motorways and main arterial routes.*

Figure 24 combines the data on population and job growth for the four main urban councils in the Auckland Region. The figure shows the number of jobs per resident for 2001 and 2006.

<sup>12</sup> Sourced from: [http://www.bayleys.co.nz/Research/Commercial/SOUTHERN\\_CORRIDOR\\_REPORT\\_ANNUAL\\_2007.htm](http://www.bayleys.co.nz/Research/Commercial/SOUTHERN_CORRIDOR_REPORT_ANNUAL_2007.htm)

Figure 24 Employment versus population, 2001 and 2006



From Figure 24 the basic structure of the region is apparent. The central Isthmus area (covered by Auckland City) has a large number of jobs, almost equal to its population, well above the regional average of 0.5 jobs per resident. It is a net importer of jobs. In contrast Waitakere exports many workers, with a job/residents ratio about half the regional average. North Shore's ratio of workers to residents has been steadily increasing and is close to the regional average, while Manukau is also seeing an improved balance between residents and workers, but still exports some workers.

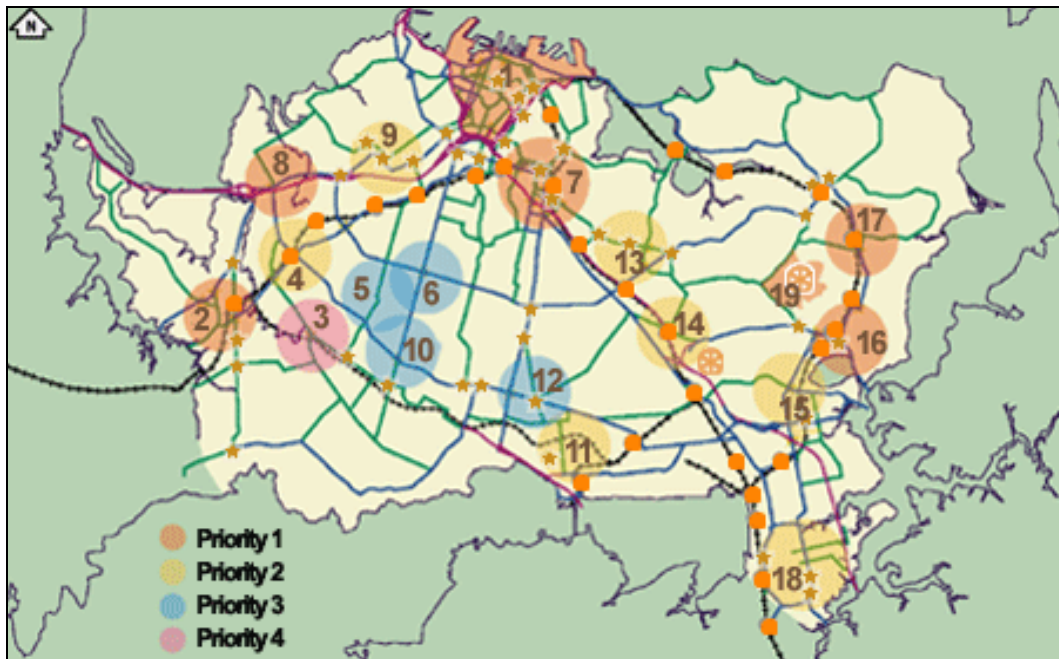
The increase in jobs in the North Shore and Manukau areas is increasing the number of cross regional home-to-work trips. While the number of more centrally focused work trips (into the Isthmus area) is increasing, these are reducing as a proportion of total trips. In other words there is a dual process underway in the Auckland Region of some centralisation of jobs and households and some decentralisation.

### 3.1.2. *Isthmus land use patterns*

Looking more closely at the situation within the Isthmus area (the area covered by Auckland City Council and the focus of the road pricing schemes), the Auckland City Urban Living Strategy is in response to the Auckland Regional Growth Strategy. It identifies areas of change and places for intensification. These areas have been selected on the basis of a number of factors, including:

- Existing built character / heritage
- Infrastructure
- Transport accessibility, particularly access to passenger transport
- Social and community services and facilities.

Figure 25 Auckland Urban Living Strategy



As can be seen in Figure 25, the areas of change tend to be concentrated in the middle to outer Isthmus. This reflects the fact that the inner Isthmus is dominated by heritage areas and older infrastructure (such as combined sewer and stormwater systems) that is less able to cope with growth.

The areas of change are expected to accommodate a substantial proportion of future growth, but far from all of it. The rest of the city will continue to see rates of growth consistent with current trends.

Within the proposed road pricing areas, areas of change include:

- CBD,
- Newmarket and
- Grey Lynn.

Outside the proposed road pricing area, but near the boundary, important areas of change include:

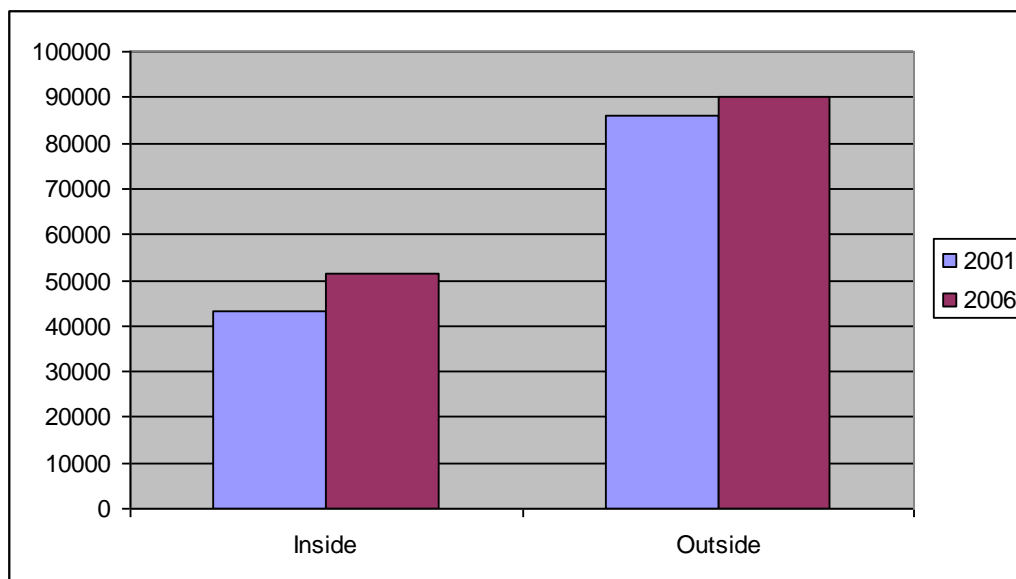
- Pt Chevalier,
- Dominion Road,
- Remuera and
- Ellerslie.

The business areas of Mt Wellington / Penrose and wider the Tamaki edge are also important areas for the city, in that these areas are identified for redevelopment and enhancement, with an expectation that older, lower intensity industrial activities will be replaced with more intensive employment activities.

A recent focus for the city is the future of the main arterial corridors in the city. It is possible that through the review of the Regional Growth Strategy, there will be an increased focus on corridor-based growth, particularly for business and mixed use activities. The Council is currently preparing a strategy as to how it will manage the arterial roads in the city from a transport perspective.

Figure 26 sets out data on the number of dwellings in the inner and outer Isthmus. The delineation of the inner and outer Isthmus generally corresponds with the boundary of the two proposed road pricing schemes, with the “inside” area generally being on the northern side the proposed road pricing boundary.

**Figure 26: Dwelling growth 2001 – 2006 for Auckland City**



There is a noticeable difference between the two areas. The area outside the proposed pricing schemes has a higher number of new dwellings but the rate of growth is higher within the proposed cordon / area.

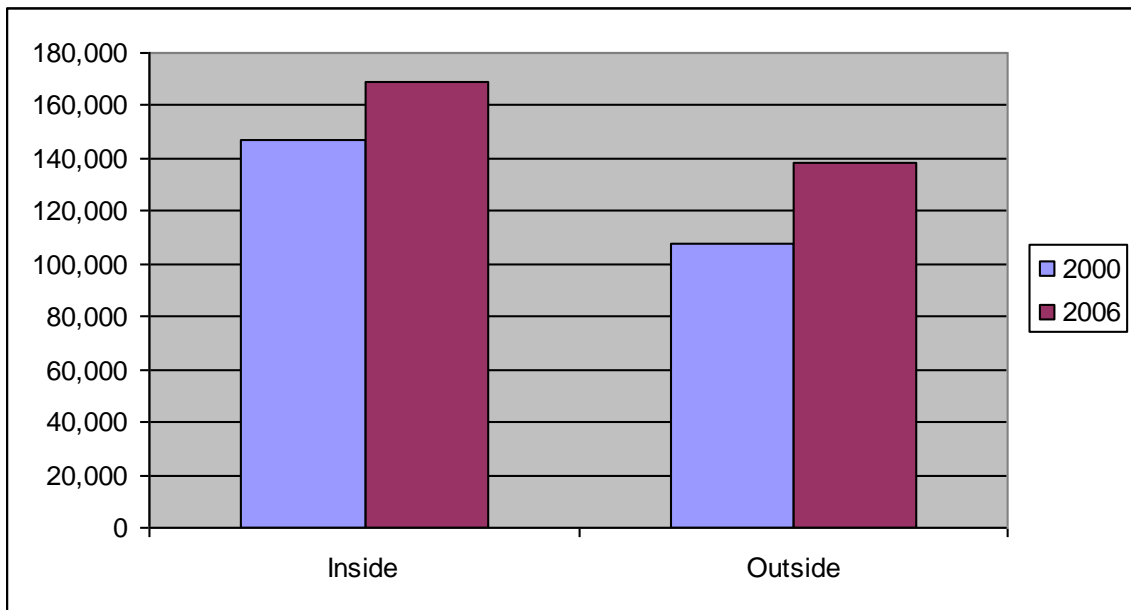
This higher rate of growth is in part a result of a significant increases in the number of apartments, resulting from the general increase in land values which makes it more necessary to undertake higher density, more complex, urban developments in the inner Isthmus. Many of these developments are not within the nodal areas identified by the regional growth strategy, an issue that is discussed further in the next section.

The higher rate of growth within the inner Isthmus is also evident of a market preference for property located closer to the amenities of the central area (CBD, heritage areas) with correspondingly shorter travel times (by private car or public transport) to major employment nodes like the CBD and Newmarket.

Outside the proposed cordon / area, housing development within the nodal areas is less common, partly due to lower land prices, but also more opportunities for infill development. At a strategic level, the challenge for the council is to spark more development around the outer suburban nodes, rather than to fuel further redevelopment in the inner Isthmus.

The following two tables look at employment within and outside the pricing cordon / area. As the proposed boundary of the cordon / area straddles a number of business areas, Figure 28 provides more detail of these areas in terms of their size and growth rates.

Figure 27: Employment in ACC inside and outside scheme boundaries 2000 and 2006



Relevant points to note are:

- Employment inside the proposed cordon/area has not grown as fast as locations outside of the cordon / area
- However, the total number of people employed inside the proposed cordon/area is still higher than the number employed outside which is a significant indicator of the economic importance of the Auckland CBD and surrounding area.

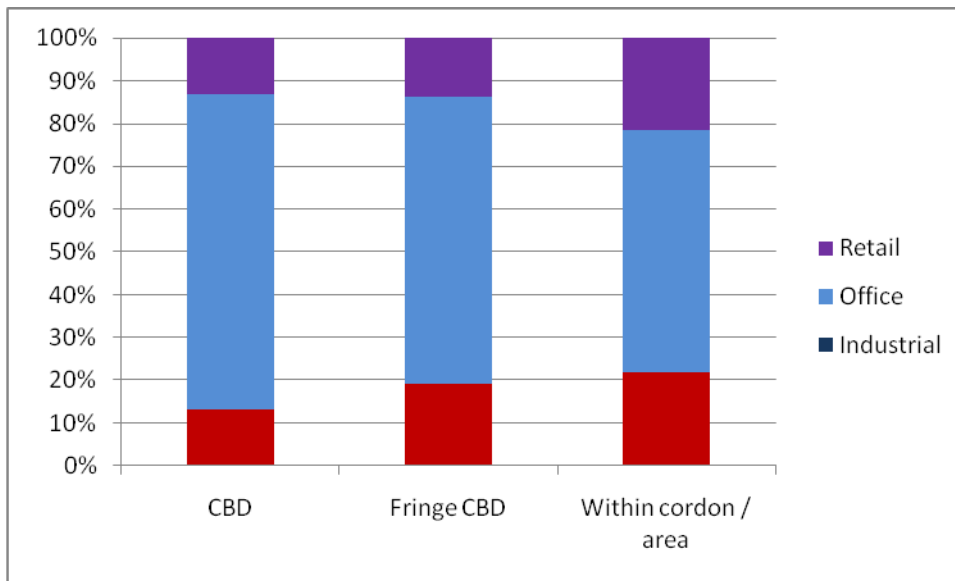
In terms of the structure of employment within the cordon / area, Figures 28 and 29 set out employment data categorised into three different broad types of activities. These are retail-based jobs (including cafes and accommodation), office-based jobs (communications, property, finance, government, business and personal services) and factory-based jobs (manufacturing, transport, wholesale)

As can be seen from Figure 28, the CBD has expanded, but the CBD fringe areas (College Hill, Netwon, Newmarket, Parnell) have been growing at a faster rate. This faster rate of growth is typically attributed to the fringe area offering easier access to the motorway network and more liberal parking provisions that apply in the CBD

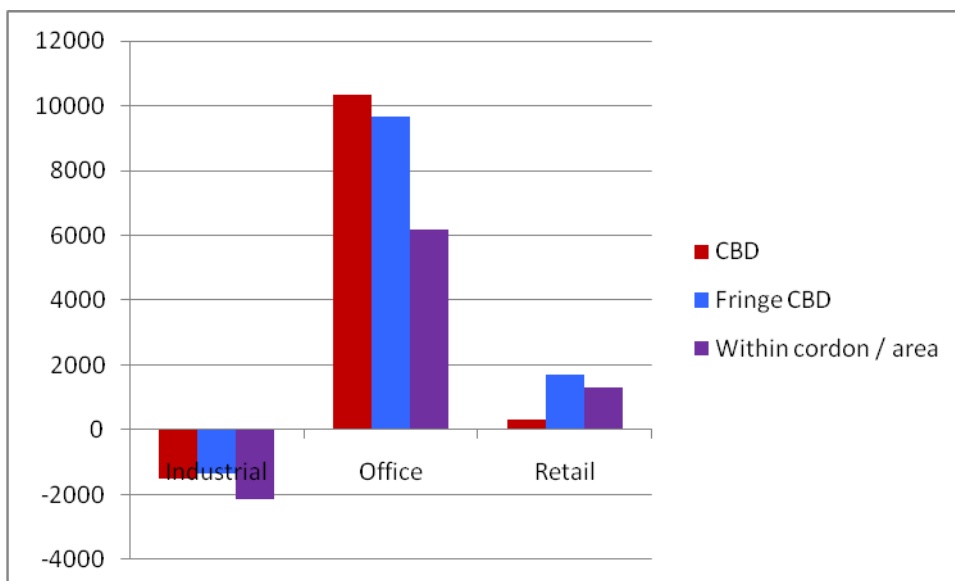
Factory-based employment has been steadily declining, while office-based employment has been growing. This reflects the transitional stage that much of the CBD fringe area is in, as older factories are replaced with offices and mixed use development.

Retail activities make up about a 15 to 20% of total employment.

**Figure 28 Make up employment within charged areas, 2006**



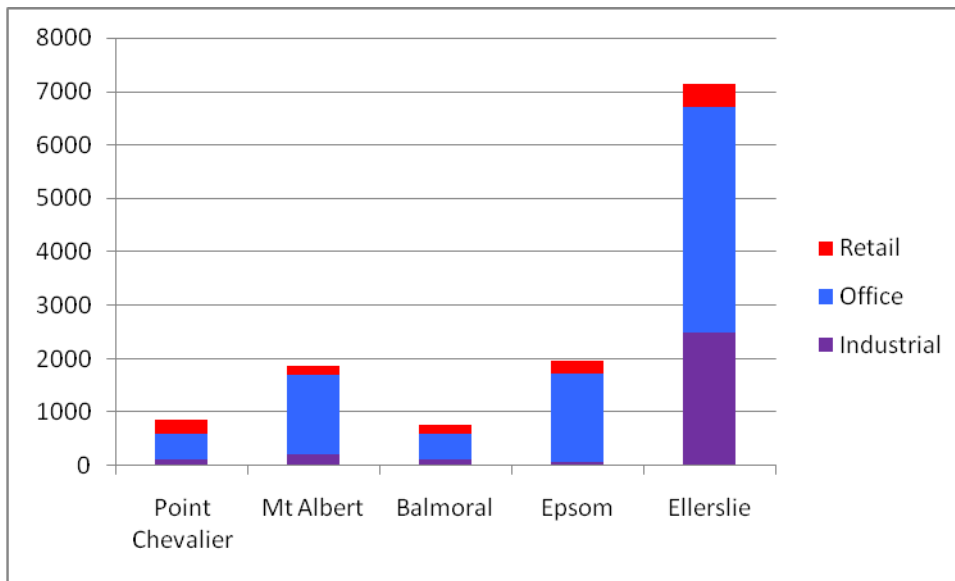
**Figure 29 Changes in employment type between 1996 and 2006 for the charged area**



Along the boundary of the cordon / area lie a number of larger shopping areas, including St Lukes and Greenlane. The impacts of any pricing scheme are likely to be particularly important to these areas.

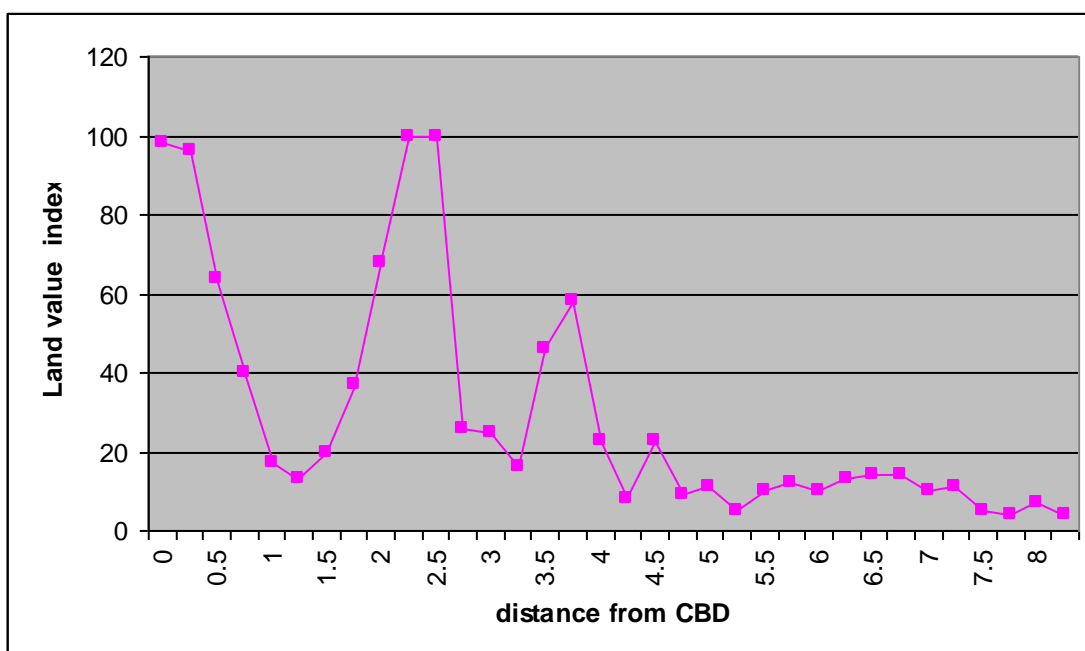
There are also a number of important employment areas on the outside of the cordon /area. Figure 30 shows employment levels and employment make up in these areas. The importance of the Ellerslie area is obvious, and highlights the strength of the motorway corridor in attracting employment activities.

**Figure 30 Employee statistics for centres that are on the outside of the proposed Cordon/Area**



To complete the picture of the inner Isthmus, and to show the complexity of the urban structure of the area, Figure 31 sets out a stylised land value profile for the CBD / Newmarket / Great South Rd area. The profile was generated by reviewing land value data available on the ARC website and converting that data into an index, where the inner CBD is set at 100. The profile shows the poly centric form of the region, with the Newmarket area having land values equal to that of the CBD. As distance increases from the CBD, values fall, there are secondary peaks around key commercial areas. The boundary of the two pricing schemes would fall at around the 5.5km mark. In this area, the land value gradient is not as steep as it is within the CBD / Newmarket area, suggesting that any boundary effects on land values may be minor.

**Figure 31 Land value profile – CBD – Great South Rd corridor**



### 3.1.3. Future land use patterns

Future land use patterns are influenced by a range of factors, including changing patterns of demand, land use planning and the infrastructure availability. As noted, a particularly important influence is transport costs, and whether changing transport costs provide a negative or positive incentive for land use to congregate in the areas identified for growth under regional and local growth strategies.

The following section of the report briefly outlines likely transport influences on future land use patterns, based on current policies and projects as outlined in the 2005 Regional Land Transport Strategy.

The ARC's transport model contains assumptions about future land use patterns. These assumptions are drawn from the Regional Growth Strategy. By 2021, the ARC's transport model predicts that 26% of regional employment will be located within the area affected by the proposed road pricing schemes, down from 28% of regional employment in 2001. That is by 2021, 176,300 people will be employed in the affected area out of a regional total of 676,000. 89,000 of these people work in the CBD (on the inside of the central motorway junction). The area affected by the road pricing schemes is home to 11% of regional households, up from 10% in 2001.

Figure 32 sets out the average generalised cost of vehicle travel to all RGS and non-RGS areas in 2001 and 2021, as predicted by the ARC's transport model, for the AM peak period. Generalised costs is an estimate of the total costs (driver time as well as vehicle running costs) in cents of travel to the selected destinations.

**Figure 32 Generalised costs of vehicle travel to RGS centres compared to non-RGS areas, no pricing.**

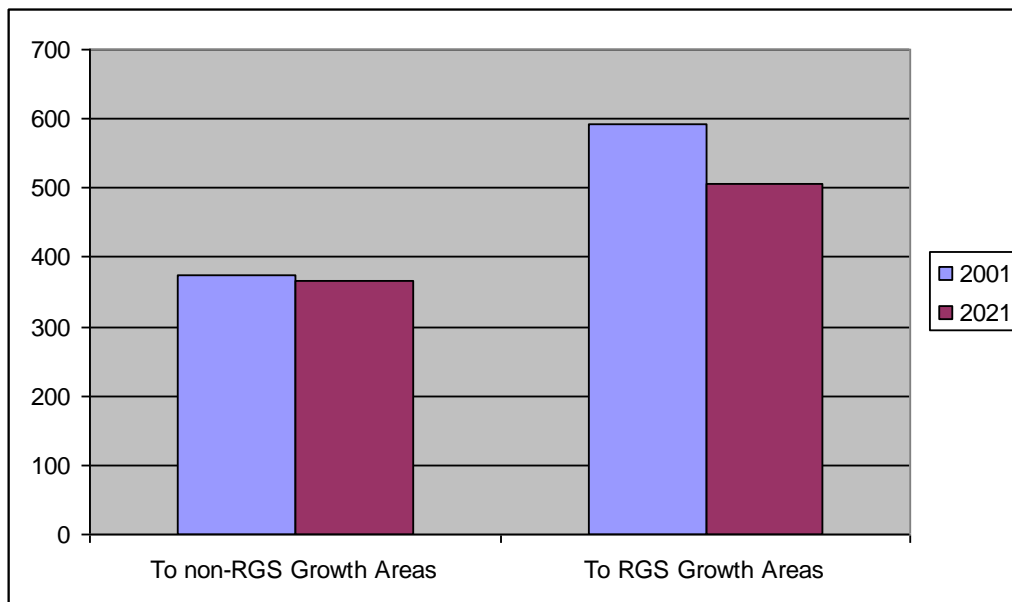
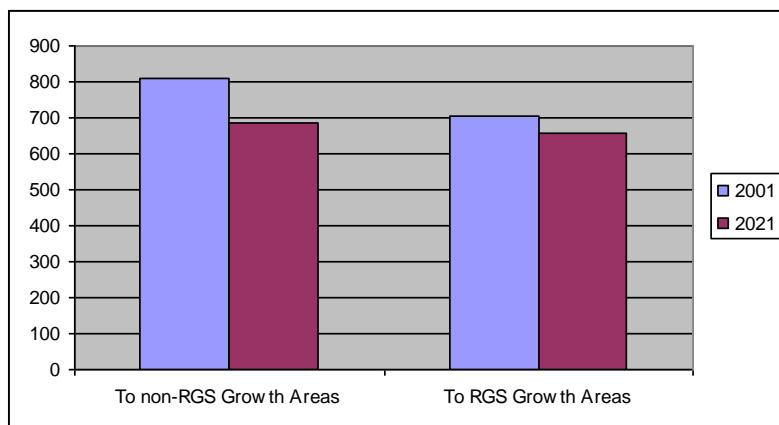


Figure 32 indicates that under current plans, the costs of travel to RGS growth areas will fall relative to non-RGS areas; however travel to RGS areas remains more expensive than travel to non-RGS areas. This suggests that while current policies are likely to help somewhat with the “hubbing” of land uses in the RGS centres, the basic driver of peripheral expansion remains.

Turning to the costs of travel by passenger transport, the above picture is reversed (See Figure 33). The cost of travel by passenger transport to RGS centres is less than costs of travel to non-RGS

areas. This reflects the fact that the RGS centres relate strongly to the main public transport spines in the Region. For activities that are particularly dependent upon high capacity transport infrastructure (such as intensive office activities), the trends in Figure 33 suggest some strengthening of the RGS hubs, particularly the centrally located, office dominated CBD / Newmarket cluster.

**Figure 33 Generalised cost of travel by passenger transport to RGS and non RGS areas, for 2001 and 2021, AM Peak**



In-line with this trend, the number of people gaining access to regional growth centres by passenger transport will increase over the period to 2021. It is anticipated that the percentage of AM peak trips to the sub-regional centres identified by the RGS made by vehicles will fall from 74% in 2001 to 72% in 2021.

Table 17 provides the other side of the coin to this picture. It sets out the expected change in travel costs to areas on the edge of the urban area. In particular is the large fall in the costs of travel to the south and eastern sectors, relative to other areas.

**Table 17 Generalised cost of vehicle travel to selected peripheral areas, without road pricing**

Area	2001	2021	Change (%)
<b>To charged zones (CBD, inner Isthmus)</b>	<b>617</b>	<b>541</b>	<b>12.1%</b>
All Zones excl Edges	424	398	6.1%
To Northern Edge	385	353	8.2%
To Western Edge	384	353	8.0%
To South Eastern Edge	396	310	21.7%
To Southern Edge	341	253	25.8%

Transport modelling outputs suggest that the inner Isthmus area will increasingly take on a public transport / walking / cycling character to it, although traffic numbers will still increase. In the AM peak the number of vehicles accessing destinations in the inner Isthmus will grow by 9%, compared to a region-wide increase in traffic of over 30%. This growth in traffic into the inner area will place significant pressure on the road network. See Table 18.

**Table 18 Trip patterns into the Inner Isthmus – AM peak period**

Type of trip	2001	2021	Change (%)
Vehicle	77,545	84,805	9.4%
Car Passenger	19,504	19,776	1.4%
Walking / cycling	16,459	26,685	62.1%
Public Transport (PT)	15,793	23,861	51.1%

**Figure 34 Generalised cost of travel by vehicle Isthmus area, 2001 and 2021**

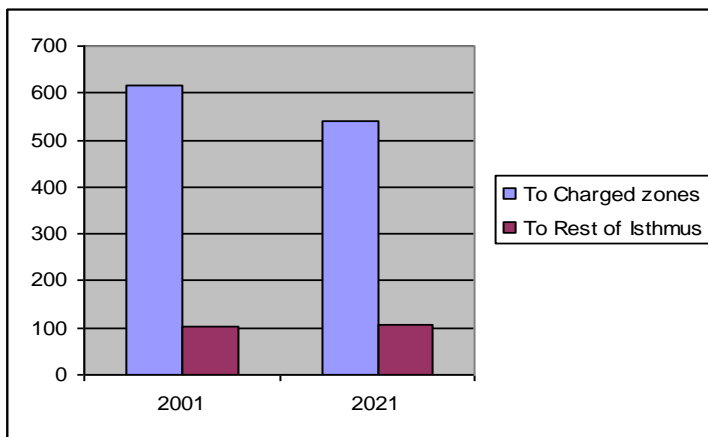


Figure 34 indicates that current projects will see reduced costs in accessing central areas by car (due to improvements to passenger transport and the diversion effect of SH 20). However costs of travel to destinations on the outer Isthmus will increase marginally.

At a regional level, the modelling outputs therefore suggest a continuation of current land use trends:

- Investment in passenger transport will support further land use intensification within the central area, and in the centres identified by the RGS
- But investment in roading (such as the western ring route) will also support peripheral expansion.

However, it can be expected that over the long term (post 2021 once the western ring route is complete and the capacity available largely taken up) then the balance will increasingly weigh towards centralisation.

### **3.2. Implementation challenges of regional strategies**

Section 3.1.2 of this report outlined the key regional strategies. This section considers their implementation and likely influence on future land use patterns. Important points are:

## **Sustainable development**

The ASF sustainable development framework is likely to see a greater focus on the long term economic, social and environmental costs and benefits of future land use and infrastructure decision making. It is likely that:

- Consumers and businesses will face more of the direct and indirect costs of resource use
- Demand management techniques will become more prevalent.

Overall, the strategy is likely to see the more effective use of existing resources (like land and infrastructure) ahead of continuing to expand city systems to meet future demand. Consequently, policies that assist with the intensification of existing urban areas are needed.

## **More balanced communities**

Most population growth will continue to occur outside of the Isthmus area. While Auckland City makes up around 30% of regional population, it is expected to take only 27% of future population growth. The target of the Regional Growth Strategy sees a fairly even spread of this growth across the four urban councils. This means that the three edge cities of North Shore, Waitakere and Manukau will continue to grow, but with a greater emphasis on more balanced growth in population, demographic and employment terms. Further satellite type development in Rodney and Franklin can be expected.

## **More growth centres**

The 2007 evaluation of the Regional Growth Strategy notes that while progress has been made, the region needs to take a more sophisticated approach to implementing the RGS using new tools and approaches to achieve better, quicker implementation and on a larger scale. In particular, quality comprehensive development and intensification in and around town centres (nodal areas) is critical to achieve the RGS vision.

The review does not indicate a shift away from the core elements of the growth strategy. In fact the Local Government (Auckland) Amendment Act, and the more recent sustainability framework both reinforce a commitment to the overall principles of the growth strategy.

As part of the RGS evaluation process, the region has embarked upon a review of the role, function and nature of growth centres. The review process may lead to a reconsideration of the number and nature of growth centres identified in the region. It is possible the number of centres will increase, but it is unlikely that the fundamental structure involving the centre and periphery of the Auckland region, outlined above, will alter. It is likely that the focus will be on providing form more growth in the middle and outer ring of suburbs, while ensuring that where peripheral development does occur, it does so in a more “nodal” pattern.

## **Integrated planning**

The review of the growth strategy is also likely to see the development of a wider set of growth management tools, including:

- Rezoning of land in and around growth nodes
- Promotion of land amalgamation and comprehensive redevelopment

- Strategic use of infrastructure to promote growth in the nodal areas
- Greater levels of funding
- Better co-ordination amongst agencies.

Time and again, reviews of regional land use strategies note the key importance of the integration of land use and transport planning. To this end, improvements to the accessibility of regional growth centres is vital to their long term viability, along with improvements to their amenity and quality of environment.

Road pricing is a potential tool in terms of helping to:

- Manage the negative environmental effects of traffic in congested growth areas
- Fund improved infrastructure into these areas, particularly passenger transport.

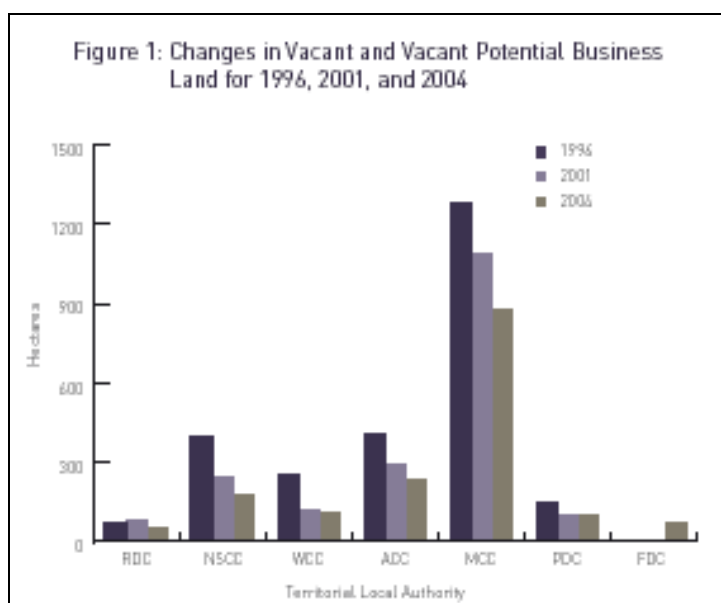
### Focus on Employment Land

It is acknowledged that the current Regional Growth Strategy has a focus on population growth. To help fill this gap, pending a more fundamental review of the growth strategy, the Auckland Regional Business Land Strategy has been prepared.

This strategy promotes the intensification of existing business land ahead of the release of additional greenfields land. Where greenfields land is to be provided, it should be provided for the needs of land extensive employment activities.

The report notes that in terms of vacant business land, the greatest reservoir lies in the south of the Region (Manukau City). See Figure 35.

**Figure 35 : Vacant business land in the Auckland Region**



Essentially, Auckland City is looking at a situation of redevelopment of its business areas. The central Isthmus area is likely to remain the main business hub of the region, with the CBD – Newmarket – Great South Road corridor being a key location.

The size of the business land reservoir in the south, and the constraints on land supply which apply in the Waitakere and North Shore areas suggests that there will continue to be a significant movement of workers from the north and west to the south, possibly contrary to moves to create a stronger jobs / housing balance in the northern and western urban sectors. This west/north to south flow will place a significant pressure on the region's transport network.

### 3.3. Literature review - possible land use impacts

This section of the report considers the potential impacts of the road pricing schemes on land uses, based on research into the links between road pricing and land use dynamics. It is based on a desk top review of available literature. The reports and research papers reviewed are outlined in Appendix A.

It is important to first note that there are many influences on land use development, with transport but one important influence. Further more, the extent of road pricings influence is itself subject to a range of factors, including:

- Level of charge
- Driver behaviour change
- Size of cordon/area
- Hours of operation of scheme
- Alternative routes
- Public transport accessibility and efficiency.

It can be expected that there will be three levels of response to road pricing:

1. Changing route, travel time or mode
2. Relocation of activities to take advantage of new accessibility or urban quality changes
3. Responses to demand created from (2) leads to decisions being made on new floorspace and/or further public-private investment in public transport/urban quality.

It is the third level of change that is relevant to this analysis.

Long term land use changes may reinforce or undermine the purposes of road pricing:

- Road pricing could provide an incentive for out-of-centre developments. This may weaken centrally located activities (i.e. within charging area), and overtime shift the area of congestion
- Alternatively, road pricing may be able to provide signals for development to occur in appropriate locations, managing the impacts of traffic congestion and supporting improved transport accessibility to these areas, such as improved public transport and increased traffic speeds.

The literature commonly notes the following caveats in terms of the transferability of its findings:

- Road Pricing has tended to be for the purpose of funding new infrastructure and/or reducing congestion, therefore the focus has been on the direct impacts, i.e. reduction in congestion or, the number of new roads funded, rather than for land use outcomes
- There is little comprehensive review of land use changes as a result of road pricing. Any consideration of land use impacts has tended to be theoretical and/or anecdotal
- Most reviews conclude that impacts are uncertain, and regional-level spatial effects of road pricing are likely to be marginal when modest pricing schemes are applied, however there may be localised effects
- For land uses, much depends upon whether the additional financial costs of the road pricing schemes outweigh the time savings (and the value placed on those time savings), and whether revenue generated by the road pricing schemes is used to off set the increased cost of driving into the charged areas, such as improved public transport into the charged area.

### 3.3.1. Overall city form

Economic theory<sup>13</sup> indicates that if road use is not correctly priced then:

- Rent gradients are flatter – that is, the city tends to spread out more, with a smaller incentive for households to locate near central areas
- Land markets are distorted and the market price of land close to the urban core is less than its social value (land in the CBD is under utilised).

Road pricing that leads to the price of transport more truly reflecting total costs should therefore lead to a denser inner city and support agglomeration economies - outcomes sought by the regional strategies. This is due to households and businesses moving closer to the core of the city so as to off-set increased transport costs.

In terms of the land value profile set out in Figure 28, the theory would suggest that land values in the central area should increase, while prices on the edge of the city would decrease. That is, the profile would be steeper, post road pricing.

However this conclusion is based on a comprehensive pricing scheme being in place and a monocentric city model. The conclusions are therefore open to debate. It relies upon an assumption that the concentrating effect of the road pricing scheme can be accommodated by transport infrastructure in the central area. For example it is possible to suggest that road pricing will lead to a decentralization of jobs as central areas if the effect of the pricing is to see central areas become too congested, and therefore a more dispersed pattern will arise. Equally, in a poly centric city, non-CBD hubs may be more attractive locations than the central CBD hub, such as is the case with Newmarket, which already has land values equal to the CBD.

A review of theoretical modeling of cordon-based road pricing schemes<sup>14</sup> suggests that a two way two process of land use change is more likely:

<sup>13</sup> See for example "Urban spatial structure", UCTC 357. Sourced from: <http://www.uctc.net/papers/357.pdf>

<sup>14</sup> Department of Transport, uk: discussion paper - Transport and land use interaction in the context of road pricing. Sourced from: <http://www.dft.gov.uk/pgr/economics/rdg/landusediscussionpaper>

- Households move in closer to the core to reduce the effect of higher transport costs. This should increase residential property prices closer to the core and reduce prices on the outskirts. However the scale of this effect may be small
- On the other hand, firms move out of central areas because of concerns that customers and workers will avoid travel to within the charging area. This may depress central area commercial property prices.

However the dynamics involved are very dependent upon a range of factors, including what changes are to be made to the transport infrastructure within the region as a result of the pricing scheme. For example, modeling of possible effects of a cordon-based scheme in Stockholm suggested that a toll ring around the central area would result in decentralisation of some businesses due to associated infrastructure investment outside the toll ring, rather than the toll per se. It should also be noted that the schemes modelled appear to most closely replicate the revenue scheme, rather than the area-based congestion scheme.

Some specific comments about the nature and extent of possible land use changes include:

### **3.3.2. *Business and retail impact***

Business land use impacts are likely to depend upon the relative importance of transport costs to businesses:

- For business sectors (like the corporate / IT / creative sectors) that are attracted to central areas due to proximity / image factors more so than transport factors, improvement to the quality of the environment within the charged area should assist in promoting their growth, along with improved travel times and reliability offered to road users and from improved public transport.
- Transport costs tend to be higher for businesses involved in the retail and café / restaurant and distribution sectors. Consumer behaviour / response is also important to the retail sector. Tolling therefore may create a disincentive to visit business/retail locations within charged areas (during the charging period), especially more isolated / stand alone retail activities and those not on main public transport routes. Conversely charging may improve the viability of retail areas outside charge/cordon area.

In London, Transport for London monitoring (Fifth monitoring report) of the congestion charge that applies in the inner area of London indicates:

- The key business sectors – financial and business services, hotel and restaurants, and retail – show no evidence of differential effects between the charging zone area and comparator locations that might be indicative of a congestion charging effect.
- The hotel and restaurants sector and retail sector have registered stronger business performance and have outperformed other areas of London after an initial drop when the scheme was first introduced.
- Analysis of commercial property rental values suggests that the property market does not appear to have been impacted adversely by the charging scheme even though performance both before and after the introduction of charging has been mixed.

Transport for London's view is somewhat questioned by industry bodies. For example a Confederation of British Industry report noted the following<sup>15</sup>:

*Some businesses, primarily those in the services sector, have gained through efficiencies arising from quicker travel across central London and better journey time reliability. However, for a number of sectors including delivery companies, retail and distribution, logistics and utilities (some of whom operate hundreds of vehicles) the scheme has added significant costs without delivering commensurate benefits. While tolls on cars may encourage people to transfer their journey to public transport, no such choice exists for freight. Moreover, some firms have had to employ an additional person to manage the charge. There is no clear evidence that the benefit of time savings to firms has been sufficiently large to lead to tangible improvements in productivity (e.g. in the form of extra deliveries), which might otherwise have been expected to counterbalance the direct cost of the charge.*

The Royal Institute of Chartered Surveyors echo some of these points, while noting that industry views are often more negative than property professionals. In a 2005 survey, the following points were noted:

- There continues to be a mixed response to the congestion charge from businesses. The commercial and professional sectors largely support the scheme whereas the retail and leisure sectors are far more concerned. Other businesses such as clinics and tradesmen also express concern. The congestion charge is having a particularly adverse impact on small businesses in all sectors but most notably in the retail sector.
- The congestion charge has not had any significant effect on capital values.
- When leases have been re-negotiated the main outcome has been shorter leases. Many businesses see the need to integrate the congestion charge more closely with transport strategy with a strong need to improve public transport.
- In relation to land values, generally surveyors were of the opinion that economic factors together with accessibility, improved public transport and being close to other businesses in the same sector were more important than the congestion charge in determining land values. To a lesser degree they also thought that locations in relatively prosperous areas, where pedestrian flows were high and where the environment had been improved, had influenced choice of location.

It therefore appears that the two-way process noted above where businesses move out of the charged area is not likely to occur in practice for all employment types, while any impacts on land values may well be small and easily masked by wider market trends.

### **3.3.3. Residential Impacts**

Effects on residential land use are likely to be longer term rather than short term.

Simulation studies indicate that any relocation effect tends to be strongest near to the boundary of the cordon area, with models suggesting a relocation of residents from just outside the cordon to areas within the cordon. As a result, real estate within in the cordon boundary should become more attractive, while real estate outside the cordon boundary may decline somewhat. For those outside

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<sup>15</sup> Sourced from <http://www.cbi.org.uk/ndbs/Regions.nsf/802737AED3E3420580256706005390AE/E98F7054FD93A6CF80256CCA005B7F58>

the cordon, the reduced rentals implied by such a reduction may help to offset some of the additional transport costs that households outside the charged area face.

Residential location decisions on the edge of the city tend to not be affected, as in general, a higher proportion of people work in non central locations.

In general, influences on house prices are expected to be small, due to the wide range of other factors that influence demand and supply. For example, in the case of Auckland, house prices in the inner Isthmus are heavily influenced by the restrictive zoning that is in place, coupled with the high amenity that households in the area enjoy (schools, beaches, reserves, shopping etc).

As noted, the range of transport investments accompanying the pricing scheme is also critical. In Stockholm, modelling of road pricing schemes suggested a 1.3% redistribution of residents out of the charged area, with this shift resulting from proposed infrastructure investments outside of the toll ring, rather than the toll itself. This is analogous to Auckland and the potential impact of the western ring route on location decisions.

In London, a study of house prices post the congestion scheme being implemented indicated that the price gap between houses outside and inside the London Congestion Charge area has narrowed, with housing prices within the charged area growing more slowly than outside. The report speculated that this may be due to a drop in demand for commercial use of premises within the charge area, rather than lower residential demand.

#### **3.3.4. Summary**

The above analysis highlights the following fundamental issues for the Auckland region. The impact of a cordon /area based scheme on land uses is likely to be very dependent upon the purpose of the scheme and the effect of various transport investments that may accompany the scheme, or be in response to it:

- If the schemes are purely designed to limit traffic into central areas, then the increased costs of travel into the central areas coupled with the establishment and improvement to the western ring route may see development on the periphery of the city become more attractive for some activities, relative to the central area. This may lead to the decentralization of some businesses and households, particularly retail, warehouse and industrial activities.
- Equally through, if the scheme is designed to manage congestion so as to improve the quality of the environment within the central area with public transport into central areas significantly improved to provide enhanced accessibility over the non pricing situation, then the central area is likely to retain its importance in terms of a business and residential location, subject to some relocations of some types of businesses (e.g. some retail activities).

### **3.4. Revenue Scheme - Implications for land uses in the Auckland Region**

#### **3.4.1. Introduction**

The Revenue scheme is based on all trips that cross the cordon boundary, at all times of the day, being charged. Table 19 sets out the key impacts on trips. Over the 24hr period, around 3.7% of all regional trips are likely to be charged.

**Table 19 Key elements (2016)**

<b>Time of trip</b>	<b>Area Covered</b>	<b>Number of Trips</b>
Total network trips 24 hrs	For the Region as a whole, based on the ARC's transport modeled area	3,264,000
Total Trips 24 hours	Total Vehicle trips within and across the scheme boundary	588,000
Charged Trips 24 hours	Vehicle trips incurring a charge	121,383

The all-day nature of the scheme means that both peak and inter peak period travel will be affected, and so the Revenue scheme has particular implications for non-work related trips into the charged area, such as travel for educational or shopping purposes, or to visit social, community and medical facilities.

The following graphs and tables set out the results of the modelling of the revenue scheme for various transport-land use indicators discussed in Section 3.1. The data presented in only for the AM peak period, for 2021.

Figure 36 and 37 show the expected changes to the costs of travel by vehicle and passenger transport to all RGS compared to travel to all non-RGS destinations. The revenue scheme has only a modest impact on vehicle costs, but a much bigger benefit for public transport users. The figures suggest no significant difference in terms of transports influence on the desirability of the RGS centres as a business or residential location, at a regional level.

**Figure 36 Generalised cost of travel by vehicle to RGS and Non RGS areas, 2021, AM Peak, with and without road pricing**

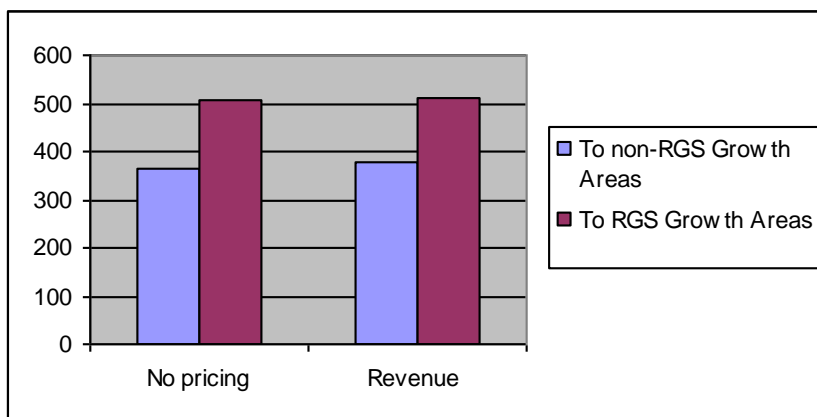
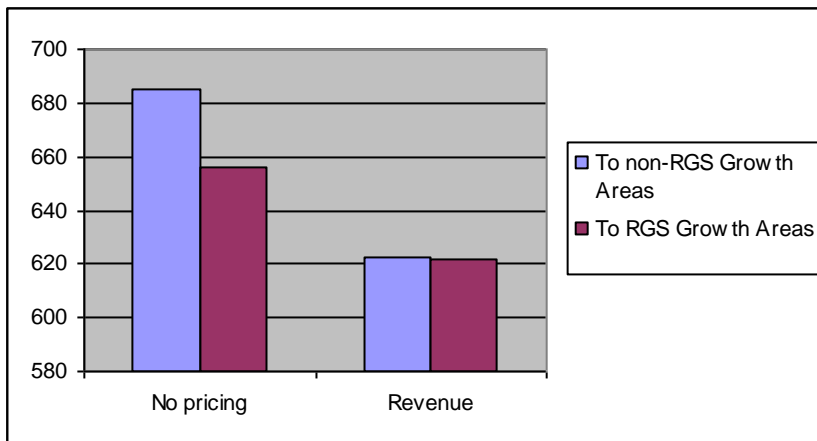


Figure 37 Generalised cost of travel to RGS and non-RGS areas by public transport, 2021 AM Peak



Turning to the situation within the Isthmus, Figure 38 shows that the revenue scheme will have a modest negative impact on the cost of travel by vehicle to destinations within the charged zone, increasing the cost of travel relative to destinations in the rest of the Isthmus. Model outputs indicate that compared to the no pricing situation, generalised costs will by vehicle will increase by about 12%. This would tend to suggest that the inner Isthmus will be a less attractive location for businesses. The increased costs partly come about from more trips being made within the cordon area. They also reflect that likelihood that the faster travel times do not compensate for the additional cost for people entering the cordon, but the charge is not so great they switch to public transport.

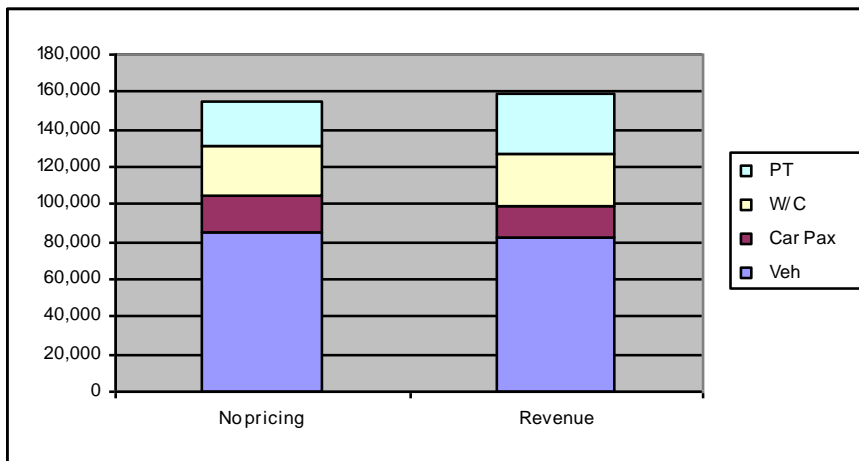
The scheme also increases the cost of travel to destinations in the outer Isthmus. This is likely to be the result of trips being diverted around the orbital western ring route, and well as the increased levels of traffic on the main East-West routes in the Isthmus area. Many employment destinations in the outer Isthmus locate along these East-West routes. However the increased costs of travel need to be seen within a general trend that expects to see improved travel conditions in the inner Isthmus due to the impact of SH 20 and improved public transport. .

**Figure 38 Generalised costs of travel by vehicle to and within the Isthmus area, 2021 AM Peak**



In terms of total trips in the AM peak period to destinations in the charged area, Figure 39 indicates that while car trips decline, the use of passenger transport will increase, and overall there is an increase in trips into the charged area. Total AM peak trips increase from 155,000 to 160,000. See Table 20.

**Figure 39 Trips, by mode, in the inner Isthmus area, 2021, AM Peak**



**Table 20 Trips AM Peak to Charged Area, 2021**

Mode	No pricing	Revenue	Change
Veh	84,805	82,195	-2,610
Car Pax	19,776	16,196	-3,580
W/C	26,685	29,081	2,397
PT	23,861	32,282	8,421
<b>Total</b>	<b>155,127</b>	<b>159,754</b>	<b>4,627</b>

While the generalised costs of travel to the inner Isthmus will increase under the revenue scheme, travel speeds by vehicle to the CBD and port area increase. Vehicle speeds to various destinations in the Region all increase, compared to no-pricing, as set out in Table 21. The more dispersed employment and education activities will see only modest benefits.

**Table 21 Vehicle speeds to selected destinations, 2021 AM Peak**

<b>Activity</b>	<b>No Pricing</b>	<b>Revenue scheme</b>
CBD	34	40
Port	38	43
Airport	44	45
Employment	36	38
Education	35	38

### 3.4.2. *Discussion*

#### **Business and employment**

At the scale of inner Isthmus, the increased trips into the central Isthmus area under the Revenue scheme - from greater use of public transport - and increased vehicle speeds suggest an overall benefit to central employment areas. However the generalised costs of travel into the central area increase at the same time, suggesting an overall neutral effect on transport accessibility to the Inner Isthmus, relative to the rest of the region.

On balance it would be expected that the major business centres within the charged area such as Newmarket, and the CBD would continue to trade well because of their pre-eminent role in Auckland's retail and business sector, as well as their location on the main public transport routes, but this would depend upon how the revenue gathered is used, particularly if it is used to support additional public transport services into the CBD / Newmarket area and to improve the quality of the environment in these areas.

However the Revenue scheme may not lift central area growth rates by any appreciable effect. It appears to support existing trends, as in general, the scheme appears to have only a modest impact on relative accessibility into central areas.

For other business areas on the fringes of the CBD, but within the charged area, the schemes may be a disadvantage, particularly for retail, manufacturing and distribution-based activities that rely on customers from inside and outside the charged area for their viability. For example businesses in the College Hill, Great North Rd, Newton, Great South Rd corridors that do not benefit from accessibility to the core public transport network are likely to see some increase in the costs of travel to them. For these businesses in these areas, there may be some pressure over time to relocate to outer Isthmus business areas. Local retail activities (corner dairy / pharmacy) are likely to continue to operate within the cordon due their important convenience role.

The incentive for sub-regionally orientated retail and service activities to relocate will be higher under the Revenue scheme, given its all day coverage. This is likely to affect retail locations on the edge of the cordon like the St Lukes area and the retail cluster around the Greenlane area, given that these centres are likely to draw customers from both sides of the charged area. As a result some disinvestment may also occur in these areas, with a negative effect on property prices and perhaps a conversion from retail to residential activities. It is possible that some of these retail and

distribution orientated activities will seek locations on the non-priced East-West routes across the southern Isthmus. This may not be in accordance with regional land use objectives.

At a regional level, the transference of traffic onto the western ring route (as well as the faster travel times on the main north-south motorway network) is likely to see a continuation of the peripheral relocation of some employment activities, a trend already evident. This may be of benefit to Waitakere (Westgate) and is likely to stimulate more employment in the upper North Shore and Wiri / airport areas along the SH 20 western ring route. While this may help to provide a better jobs / housing balance in these peripheral areas, it is debatable as to whether such patterns will help to shorten vehicle trips and increase public transport use.

The pricing scheme is likely to have little effect on the costs of travel to peripheral growth areas. This is consistent with the literature review which suggested that centrally-focused charging schemes are unlikely to significantly alter transport conditions (and hence land use fundamentals) on the edge of the city.

#### **Residential development:**

The scheme may contribute to a small upward demand for housing within the cordon area, particularly in areas with good public transport accessibility indices. However this is likely to be minor given the modest nature of the charge. The removal of some retail and related services out of the charged area may free up land to accommodate this additional housing. Any transference effect of households moving into the cordon to avoid paying it is likely to be muted by the house price differential that applies to housing inside the cordon compared to outside the cordon.

The diversion of traffic onto east-west orientated transport routes in the outer Isthmus may contribute a downward influence on house values / amenity in areas outside the cordon/area that have lower accessibility indices than other adjacent areas and which are likely to see additional traffic volumes, namely Greenlane Rd, St Lukes / Sandringham.

#### **Corridor development:**

The scheme has only a minor impact on congestion levels on the arterial roads inside the cordon, with some small benefits in terms of environmental quality.

Outside the charged area, traffic volumes on east-west arterial roads generally increase, indicating a less desirable place for residential development and greater conflicts over access to non-residential activities.

### **3.4.3. Overall assessment – Revenue scheme**

- Modest support for the RGS in terms of assisting with the concentration of land uses into selected centres. In particular it should help to support the existing concentration of office-based employment and related development into the CBD / Newmarket areas
- Some support for the ASF goals / shifts in terms of assisting with a shift towards less carbon intensive forms of transport (public transport, walking and cycling)
- However, the scheme is likely to have a particular affect on retail and service-orientated activities near the boundary, in business areas that are not on key public transport routes and which are not supported by a local catchment. It can be expected that some retail and service

activities will seek to relocate out of the cordon area, opting instead to locate on the more car-dominated, East-West alignment of the proposed western-ring route. This may not be so beneficial in terms of regional land use and sustainability outcomes.

### 3.5. Congestion scheme

As outlined in Section 1, the congestion scheme differs from the revenue scheme in that it:

- Operates only in the extended morning peak period (6am to 10am), rather than all day
- It affects all trips across the cordon as well as within the area, rather than just trips across the cordon boundary.

Data set out in Table 22 indicates that in the 4 hour, 6am to 10am period, around 16% of all trips in the region will incur the charge. Over the 24hr period, this falls to around 3% of all trips.

**Table 22 : Overview of congestion scheme**

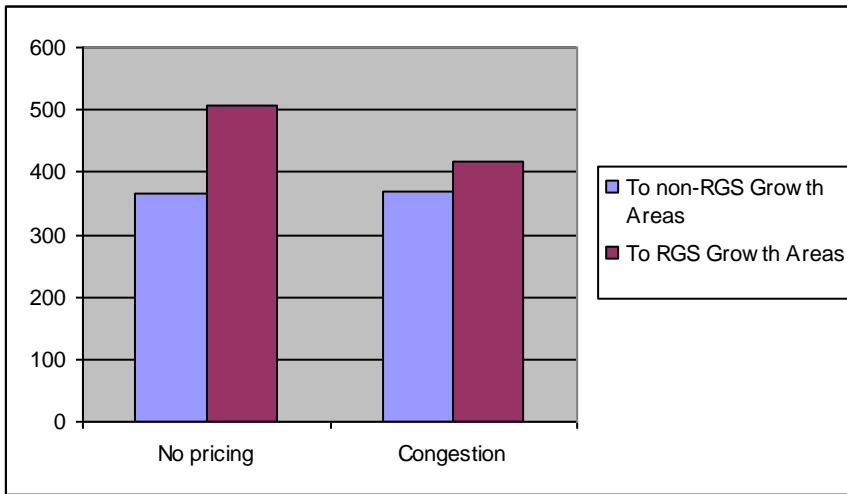
<b>Time of trip</b>	<b>Area Covered</b>	<b>Number of Trips</b>
Total network trips 24 hrs	ARC modeled area	3,275,000
Total network trips 6-10am	ARC modeled area	679,453
Total Trips 6-10am	Vehicle trips entering the scheme	111,430
Charged Trips 6-10am	Vehicle trips incurring a charge	108,535

A particular implication of the Congestion scheme is the affect it has on trip making behaviour within the area affected by the scheme. While it only applies in the morning period, it will affect a range of non-work related trips of people who live within the area boundary. This includes trips to schools, universities and medical services.

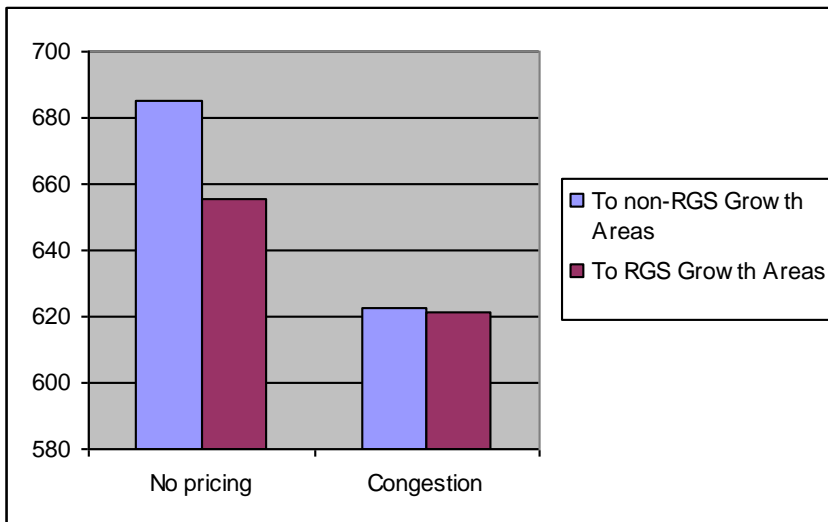
Key transport indicators, based on outputs of the ARC's transport model, for the area-based congestion scheme, are set out below.

At the regional level, Figure 40 shows that the proposed congestion scheme it likely to see a noticeable reduction in the relative cost of access to RGS growth areas, by vehicle. This should make these centres much more attractive from a business location perspective.

**Figure 40 Generalised cost of travel by vehicle to RGS and Non RGS areas, 2021, AM Peak, with and without road pricing**



**Figure 41 Generalised cost of travel to RGS and non-RGS areas by public transport, 2021 AM Peak**



Within the Isthmus area, the scheme reduces the cost of travel to locations within the inner Isthmus, compared to the Revenue scheme which increased costs. The model outputs suggest about an 8% reduction in the costs of vehicle travel, and a 11% reduction in the costs of public transport-based modes. See Figure 42.

**Figure 42 Generalised costs of travel by vehicle within the Isthmus area, 2021 AM Peak**

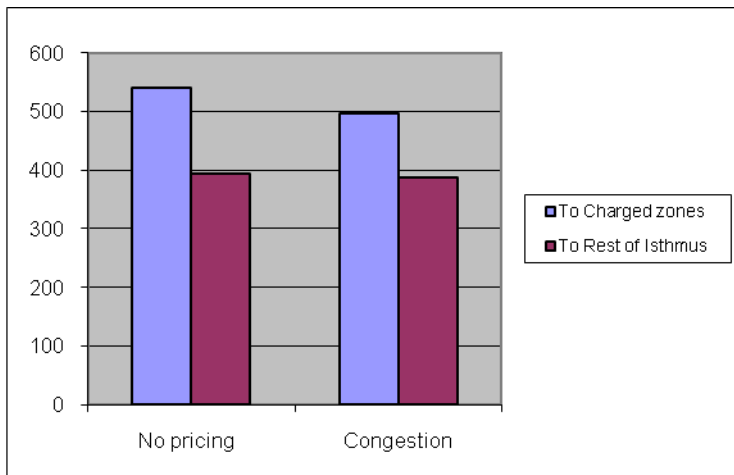
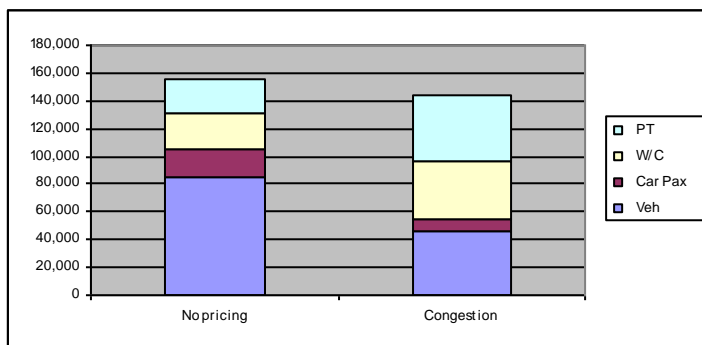


Figure 43 shows that total trips within the charged area falls, relative to the non-pricing situation. In the AM peak period daily trips to and within the charged area are expected to fall from 155,000 to 144,000. This is the result of some retiming of trips, as well as changes in destination brought about by the charge. Table 23 sets out the relevant figures. Public transport, walking and cycling use increases from 33% of trips to 62% of trips.

**Figure 43 Trips, by mode, in the inner Isthmus area, 2021, AM Peak**



**Table 23 Trip numbers by mode to charged area, 2021**

Mode	No pricing	Congestion	Change
Veh	84,805	46,789	-38,017
Car Pax	19,776	7,642	-12,133
W/C	26,685	42,658	15,973
PT	23,861	46,848	22,987
<b>Total</b>	<b>155,127</b>	<b>143,937</b>	<b>-11,189</b>

Table 24 sets out the number and share of trips into the CBD, compared to the no pricing scheme. The number of trips into the CBD decreases somewhat, but not to the extent seen across the inner Isthmus. The CBD sees an even larger increase in non-vehicle trips, compared to the wider inner Isthmus, climbing from 48% without road pricing to 77% with the congestion scheme (the equivalent figure for the revenue scheme is 55%). As noted in the 2005 ARPES, it will be important that the increased passenger transport trips are accommodated in a way that supports a

high quality street environment (rail and low emission buses). Current constraints to the long term growth of passenger transport, such as increasing the capacity of the rail system, will be important.

**Table 24 Trip number and mode share to CBD, 2021**

Mode	No pricing		Congestion	
	Number	Share	Number	Share
Veh	24,415	39%	11,267	18%
Car Pax	8,576	14%	3,039	5%
W/C	14,298	23%	19,632	31%
PT	15,967	25%	28,888	46%
Total trips	63,257	100%	62,826	100%

Average vehicle speeds to major destinations all see an increase, with a 8 to 13% increase over the speeds predicted by the Revenue scheme. See Table 25.

**Table 25 Vehicle speeds to selected destinations, 2021 AM Peak, Congestion scheme**

Activity	No Pricing	Congestion scheme
CBD	34	45
Port	38	47
Airport	44	47
Employment	36	41
Education	35	42

This model outputs indicate that the congestion scheme should positively assist with the concentration of higher value, more intensive employment activities in the central Isthmus area, particularly the CBD / Newmarket area. As with the Revenue scheme, the key question is what will happen to the popular fringe employment areas like College Hill/ Great North Rd, Newton and Great South Rd.

The model outputs suggest that while access to the inner Isthmus is generally improved, activities close to the main public transport spines are likely to benefit the most from this improvement. As noted in Section 3.1.2, the corridors of business activities leading into the CBD (Great North Road, New North Road, Great South Road) are popular locations for businesses seeking ample on-site parking and quick access to the motorway network.

The scheme also increases the cost of travel to areas in the outer Isthmus. This dynamic could see some impact on areas like the Tamaki edge - areas where the council is seeking to increase employment densities. It may be that under the area-based Congestion scheme, the employment areas outside the charged area become more attractive to lower intensity, more distribution-orientated activities displaced from the central area, with the more intensive land uses attracted to the inner Isthmus area in response to improved public transport services and a better quality urban environment.

### 3.5.1. *Discussion*

#### **Business development**

The Congestion scheme should support the growth of the CBD and Newmarket areas, more so than the Revenue scheme. This is because of the significantly improved quality of the environment within the charged area, as well reduced costs of accessing activities within the CBD area by both car (for those prepared to pay) and public transport.

Traffic levels in the peak period should fall to at or below 2001 levels. This will be a very noticeable improvement. However, this conclusion depends upon the revenue gathered being used to support improved passenger transport services into the CBD. If a high quality environment and improved accessibility can be provided to central business areas, then the scheme should assist with the agglomeration effects sought by the RGS and the economic development strategy.

However the scheme is likely to have a larger effect than the Revenue scheme on the fringe CBD areas – areas that are not so well served by passenger transport. Areas such as College Hill, Great North Rd, Dominion Road and New North Road are generally served by radial public transport routes that head into the CBD. They are therefore not as accessible as the Newmarket / CBD hub where the various radial routes coalesce. Increased costs of vehicle use are likely to have a negative impact on some businesses in these areas. It is therefore possible that there will be some movement of firms in these areas into the more public transport dominated CBD / Newmarket areas, or possible out to the key East-West routes in the southern part of the Isthmus. This influence is likely to be stronger than under the Revenue scheme.

The effect of the Congestion scheme on the retail sector is likely to see some changes to retail activity mix, however the effect may not be as great as under the all-day Revenue scheme. Within the core CBD / Newmarket areas it can be expected that retail will remain an important activity. This is because:

- A stronger office and resident sector will also support retail in this area, but perhaps with more of a focus towards café / restaurant and day-to-day needs.
- The focus of these two centres on higher order / specialist shopping suggest that customers are likely to see reduced travel times and more available parking as benefits rather than costs
- The effects of the road pricing scheme may be off-set by a change in trading hours (such as 10 to 6pm), rather than a change in location.

On the fringe the charged area, the pricing scheme is likely to affect sub regionally orientated retail activities, as predicted for the Revenue scheme, but to a lesser extent.

In terms of business areas on the periphery of the region, the congestion scheme sees increases in traffic on the orbital western ring route and this is likely to increase the costs of cross-regional travel. This would tend to suggest that some rebalancing of jobs / housing will occur in the various peripheral urban sectors, if the cost of travel between them increases. Given the preponderance of vacant employment land in the south, it could be expected that the south will attract a larger share of both jobs and households, than might be the case under the no pricing scenario.

## **Residential development**

Residential impacts are likely to be modest. The literature review noted a potential for households to move within a charged area to avoid paying the charge. However an area-based scheme may help to dampen down any incentive for residential activities to move within the charged area, as the charge is also payable within the area. In the Auckland city context, with the extensive areas of heritage zoning within the charged area, this may be a positive influence. Within the charged area, areas of change like the CBD and Newmarket are likely to continue to attract households who do not have a car, or do not need to use them on a regular daily basis.

An indirect affect that may well influence residential development more than the direct effect of charging is the possible impact on school rolls, especially those schools that have a large catchment which spans the boundary. Under the area-based Congestion scheme, households located outside of the boundary who have school aged members who travel to schools within the charged area are less likely to do so, while there may be a disincentive for households with school age children to locate in the charged area. This effect is especially relevant for primary school aged children as it is more complex for parents to substitute public transport for vehicle use in terms of the trip to school, then onto and back from work. As a result, housing within the boundary of the Congestion scheme may become less attractive for households with school aged members, and more attractive for non-family households.

Having said that, a displacement of some housing demand away from the central inner Isthmus area may actually be positive for the city in that it may assist with supporting the redevelopment proposed for the middle and outer suburban nodes - areas which are currently not strongly being pursued by the market.

## **Corridor development**

At the corridor-level, the Congestion scheme has a more major, positive impact on congestion levels on the North-South arterial roads in the Isthmus, compared to the Revenue scheme. This should bring about improved accessibility and reduced pollution effects resulting in greater desirability for residential development, leading to increased demand as a location for housing and some mixed uses. However demand for retail activities with a non-local catchment is likely to fall, within the charged area.

The opportunities provided by the reduction in traffic pressures should be taken to significantly improve the quality of the street environment of key North-South arterials. In particular there is the opportunity to develop arterial roads like Tamaki Drive and Dominion Road as high quality, multi-modal boulevards.

Outside of the charged area, the increased traffic flows on the East-West arterials suggest additional conflicts over land use access.

### **3.5.2. Summary - Congestion scheme**

- Should assist with a higher quality environment for business activities within the core CBD / Newmarket areas, strengthening the agglomeration process, provided that public transport services are ramped up. This is an outcome consistent with regional strategies.
- The improvement to the quality of the environment within the charged area and the increased use of passenger transport is also consistent with goals associated with the ASF.

- In fringe CBD areas, off the main public transport routes where retail and service-related activities are more dominant, then some relocation of activities out of the charged area can be expected, with land converted to residential use. This may be consistent with regional strategies, provided that the displaced activities can be accommodated in centres on the outside the charged area, rather than through a process of dispersal.
- Some concentration of households into the charged area (especially arising from the conversion of business land to residential use) is generally consistent with regional objectives, given the extent of the heritage areas that occur within the charged area. Equally some displacement of future housing demand to outside the charged area is not necessarily negative, provided it is accommodated in the nodal areas identified by the RGS and the Council's urban development strategy.

### Literature Reviewed

- *'Assessing Agglomeration Impacts in Auckland: Linkages with Regional Strategies'* 27 February 2007, Ascari Partners
- *'Modelling the Effect of Road Pricing on Urban Form in Auckland'*, 3 November 2000, for the ARC by HBA Specto Inc
- House of Commons- Transport Committee: *'Road Pricing: The Next Steps'* 16 March 2005
- *'Annexe F: Environmental and Wider Impacts'* (from, Feasibility Study of Road Pricing in the UK- A Report to the Secretary of State)
- *'The London Congestion Charge and Property Prices: An Evaluation of the Impact on Property Prices Inside and Outside the Zone'*, MPRA, August 2006
- Discussion Paper: *'Transport and Land Use Interaction in the Context of Road Pricing'*, UK, c.2006/07
- Department for Transport- *'Feasibility Study of Road Pricing in the UK- Full Report'*- 2004
- *'Rail Access and House Prices: An Evaluation of the Wider Benefits of Transport Improvements'*, Stephen Gibbons and Stephen Machin, November 2003
- *'Land Use Effects of Road Pricing – A Literature Review'*, Michael Lochl, Conference Paper – Swiss Transport Research Conference, March 2006
- *'Road Pricing in Urban Areas'*, Swedish National Road Administration, 2002
- US Dept of Transportation- Federal Highway Administration: *'International Urban Road Pricing- Issues and Options for Increasing the Use of Tolling and Pricing to Finance Transportation Improvements'* 9 June 2006
- *'Credit-Based Congestion Pricing: Travel, Land Value and Welfare Impacts'*, University of Texas, 2004
- *'Discussion Paper: Congestion Pricing- Long-Term Economic and Land Use Effects'* by Resources for the Future, Sept 2006
- *'Road Pricing Simulations: Traffic, Land Use and Welfare Impacts'*, Sept 2004

## Area Units

Area Units **within** the cordon/area:

-Arch Hill			
-Auckland Harbourside	-	Grey Lynn West	- Ponsonby East
-Auckland Central East	-	Herne Bay	- Ponsonby West
-Auckland Central West	-	Kingsland	- Remuera West
<b>-Balmoral</b>	-	<b>Mt Eden East</b>	- <b>Remuera South</b>
-Eden Terrace	-	Mt Eden North	- <b>Sandringham North</b>
<b>-Epsom Central</b>	-	Mt Hobson	- Sherbourne
-Epsom North	-	<b>Mt St John</b>	- St Lukes North
-Freemans Bay	-	Newmarket	- St Mary's Bay
-Grafton East	-	Newton	- Surrey Crescent
-Grafton West	-	<b>Orakei South</b>	- <b>Waiata</b>
-Grey Lynn East	-	Parnell East	- Waitaramoa
	-	Parnell West	- Westmere

NB: Area Units in blue ink are on the inside edge of the proposed cordon/area

## Area Units

Area units just **outside** the cordon/area:

- Abbott's Park
- Epsom South
- One Tree Hill East
- Orakei North
- Maungawhau
- Meadowbank North
- Meadowbank South
- Sandringham East

Area units **straddling** the cordon/area boundary:

- Mt Albert Central
- One Tree Hill Central
- Point Chevalier East
- Point Chevalier South
- St Lukes

RGS, ACC, and other Nodes and Corridors *inside* proposed cordon and area schemes

Nodes		
• <b>Auckland CBD</b>	• Parnell	
• <b>Newmarket</b>	• St Lukes	
• <b>Remuera</b>	• <b>Surrey Cres/Grey Lynn</b>	
• Mt Eden Station	• <b>Morningside/St Lukes</b>	
• Kingsland Station		
• <b>Morningside</b>	Corridors	
• Ponsonby	• Remuera Road	
• Jervois Road	• Dominion Road	
• Mt Eden Shops	• Great North Road	
• Newton	• Great South Road	

**Key**  
 ACC District Plan specified nodes/business areas, if the same as RGS, shown in red ink  
 ACC District Plan specified nodes/business areas, if the same as non- RGS, shown in blue ink  
 Non ACC and non-RGS nodes and businesses shown in black ink

RGS, ACC and other Nodes and corridors within Area Units adjacent to the *outside* of the proposed cordon and area schemes (ACC area only)

Nodes	Corridors
• Baldwin Ave Station	• Dominion Road
• <b>Mt Albert</b>	• Remuera Road- St Johns Road
• Greenlane Station	
• Greenwood's Corner	
• <b>Sandringham</b>	
• <b>Balmoral/Dominion (straddles boundary)</b>	
• <b>Point Chevalier</b>	
• <b>Great South Road/Greenlane</b>	

**Key**  
 ACC District Plan specified nodes/business areas, if the same as RGS, shown in red ink  
 ACC District Plan specified nodes/business areas, if the same as non- RGS, shown in blue ink  
 Non ACC and non-RGS nodes and businesses shown in black ink