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Shepherd, S. (1998) Towards the Sustainable City: The Impact of Land Use – Transport Interactions. A Comparison of the impact of the initial and final coefficients on location choice on transport strategies and land use scenarios. Working Paper. Institute of Transport Studies, University of Leeds , Leeds, UK.

Working Paper 516

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1. INTRODUCTION

Over the last decade the concept of integrated transport strategies for urban areas and a means of evaluating them have been developed and widely accepted into practice by major studies of cities such as London (May and Gardner, 1990), Birmingham (Wenban-Smith et al, 1990) and Edinburgh (May, Roberts and Mason, 1992). The development of integrated transport strategies (May, 1991) has been based on the identification of synergy between transport policy instruments (May and Roberts, 1995). These concepts led indirectly, particularly through experience in Birmingham, to the introduction by the Department of Transport of the Package Approach for urban transport funding (May, 1994a) and more directly to the development of the Common Appraisal Framework for assessing Package Approach bids (MVA et al, 1994). It is now generally accepted that transport strategies designed to meet the objectives of economic efficiency and sustainability will require a combination of measures to manage the existing infrastructure more effectively, to provide selective enhancements to that infrastructure and to impose appropriate pricing mechanisms on both public and private transport. In a recent study, funded by EPSRC, we have developed a methodology for identifying optimal specifications for such strategies, and have shown that their performance is particularly sensitive to the contribution of pricing measures such as fares and road pricing (May, Bonsall, Bristow and Fowkes, 1995).

However, while we are now able to formulate optimal transport strategies, very few studies have been able to demonstrate that transport policy measures alone will achieve a sustainable situation in which fuel consumption and emissions are maintained at or below current levels (May and Roberts, 1995). In most cases, land use changes will need to be co-ordinated with transport measures if sustainability is to be achieved, and recommendations for appropriate land use measures are beginning to emerge (DoE, DoT, 1993; DoE, 1994). An initial assessment of the potential for co-ordinating transport and land use strategies was carried out using the results of the Edinburgh study (Still, 1992), and showed that the preferred transport strategy would be up to 10% more effective in achieving sustainability when combined with a concentrated land use strategy. However, that study assumed no feedback from transport measures to land use effects. Literature reviews and interviews have demonstrated that the impact of transport on land use is perceived as a serious gap in policy understanding. Interviews also revealed that land use-transport models are treated with some scepticism, because there is insufficient understanding of the relationships within them and because the existing models are perceived as unduly complex (Still, 1996).

As a result of this lack of understanding, there is a danger that impacts of transport on land use might have counter-productive effects on the land use - transport strategy. For example, road pricing, which may be a key element in a sustainable transport strategy (May, 1994b), may reduce accessibility by private car, and hence lead to outmigration of business, thus producing a less sustainable land use pattern. Conversely it could enhance the city centre environment, and hence encourage certain firms to relocate to the centre. These twin impacts of transport policy on accessibility and on environmental quality are the key elements in predicting the resulting location decisions of individuals and firms, and need to be better understood if sustainable land use - transport strategies are to be developed.

The principal objectives of the project are :

(i) to increase our understanding of the impact of accessibility and environmental quality on individuals' and firms' location decisions;

(ii) to use the findings of (i) to enhance a newly developed strategic transport and land use interaction model;

(iii) to use the enhanced model to assess the implications for urban sustainability of the impact of transport policy on location choice;

(iv) to use the enhanced model to assess the relative performance of different combinations of transport and land use strategy.

The research is divided into six tasks :-

1) Literature review
2) Integration of START and DELTA and initial matrix of tests
3) Edinburgh household survey and analysis
4) Edinburgh business survey and analysis
5) Incorporate estimated coefficients from tasks 3 and 4 into START-DELTA and carry out a range of tests
6) Dissemination and final report

Deliverable 3 has been split into 3 parts, part 1 describes the application of the new estimates of the location coefficients and draws comparisons with the task 2 results, part 2 describes the results for task 2 and task 5 coefficients applied with a second land use scenario, while part 3 acts as a reference document and describes in detail the development of the location coefficients used in task 5.

Within this part one, section 2 describes the seven strategy assumptions and section 3 reports the results for the new set of coefficients, drawing a comparison between these and those for response 1 and response 0 from task 2.

For a description of the development of the new coefficient estimates see part 3. Within this report the task 2 best estimates are referred to as response 1 whilst the estimates from the SP analysis are referred to as response 5 throughout.

2. Strategy Tests

Seven basic transport strategies were tested in both task 2 and task 5.

The seven strategies were based upon:-

do-minimum (described below);
do-minimum plus Light Rapid Transit (LRT), involving two lines North-South and East-West with a high frequency of 30 trains per hour;
do-minimum plus two way road pricing cordon around the city centre with a charge of £1.50 per crossing in either direction;
do-minimum plus a reduction in bus fares of 50%;
do-minimum plus LRT and road pricing as above;
do-minimum plus bus fare reduction and road pricing;
do-minimum plus LRT, bus fare reduction and road pricing.

The do-minimum strategy has the following features: SCOOT traffic control, M8 extension, increases in city centre parking charges, switch from private to more public parking spaces, greenways on major radials (corridors with significant bus priority and traffic calming), fare inflation of 1.29 over 20 years, and earnings index 1.8 over 20 years.

2.1 Other assumptions

Zero change in toll on the Forth Road Bridge for all periods i.e. toll increases with earnings index

Operator sensitivity set to zero as justified in note SPS6

Linear growth factors assumed.

2.2 Land Use Scenario

The land use model inputs and scenario used is described in detail Simmonds and Still (1997). Essentially the elements of the land use scenario can be summarised as follows :-

(i) The rates of in and out migration and rates of employment change by sector.
(ii) The rates of change of people's income over the forecast period.
(iii) The amount of floor space under construction for the base period 1991, for each floorspace type.
(iv) The supply of floorspace, i.e. the amount of planning consents granted.
(v) The land use policies of granting consents over time.

All the above were defined in line with the Edinburgh Structure Plan for the base land use scenario.

3. Presentation of Results

3.1 Format of Presentation

Each run produces output for ten separate years over a 20 year period. For a global comparison of results it is not wise to view the results in too much detail. The first analysis concentrates on a set of final year (2011) indicators for transport-related variables and for land-use related variables. The transport related indicators were chosen as total trips further split by car, bus and LRT; total trip-km again split by car, bus and LRT and fuel consumption by cars. The land use indicators were chosen as housing rents, population, households, resident workers and floorspace (office and other) all of which were reported for the centre of Edinburgh and the centre plus the rest of Edinburgh.
Tables 1-19 present the results for no response to transport related variables as in the task 2 report with the top left cell of each table giving the absolute value for the do-minimum strategy with response 0. The other strategy results are then presented as percentage changes from this base response 0 for response 0, response 1 (the best estimate of coefficients derived from literature) minus response 0 (labelled R1-R0) and response 5 (the new estimate of coefficients) minus response 0 (labelled R5-R0) shown in columns 1-3 respectively. The final two columns for each table show the percentage change for response 1 and response 5 from their respective do-minimum values for each strategy s (labelled R1s-R1dm and R5s-R5dm).

Thus a comparison of changes due to a change in response coefficients is possible across strategies using columns 2 and 3 whilst a comparison of responses due to strategy implementation (for each set of coefficients) is possible using the relative changes in the last two columns.

3.2 Comparison Of Transport Indicators

Table 1: Total trips (thousands) in 2011

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	1060	-1.9	3.0	0.0	0.0
LRT (LT)	0.7	2.4	4.6	5.0	2.2
Road Pricing (RP)	-1.4	-1.5	3.3	-1.1	-1.1
Fare Reduction (FA)	0.8	-1.7	3.0	1.0	0.7
LRT+RP (LR)	-0.8	2.5	5.1	3.7	1.2
Fare +RP (FR)	-0.7	-1.2	3.4	0.0	-0.3
LRT+fare+RP (A3)	-0.2	1.6	4.6	3.4	1.4

The different transport strategies have very little impact on trip making; the greatest change is a 1.4% reduction with road pricing. The do-minimum with response 5 increases total trips by 4.9% compared to response 1. The implementation of LRT strategies gives rise to a lower increase in total trips with response 5 than with response 1, e.g. 2.2% compared to 5% for LRT only. Changes due to road pricing and fare reduction strategies are of similar magnitude for both sets of coefficients.

Table 2: Car Trips (thousads) in 2011

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	672.3	-1.5	3.0	0.0	0.0
LRT (LT)	-2.1	0.2	2.8	-0.4	-2.3
Road Pricing (RP)	-10.5	-1.4	3.0	-10.6	-10.2
Fare Reduction (FA)	-3.2	-1.4	2.9	-3.1	-3.2
LRT+RP (LR)	-12.8	0.0	2.5	-11.4	-12.9
Fare +RP (FR)	-13.9	-1.0	2.7	-13.6	-13.8
LRT+fare+RP (A3)	-15.4	-0.1	2.4	-14.3	-15.6

While the strategies have little effect on overall trips they do, as expected, change modal shares. Road pricing achieves a 10.5% reduction in car trips, fare reduction 3.2% and light rail 2.1%, and these effects are broadly cumulative in combined strategies. The do-minimum with response 5 increases car trips by 4.5% compared to response 1. The implementation of LRT strategies gives rise to a greater reduction in car trips with response 5 than with response 1, (e.g. -2.3% compared to -0.4% for LRT only). Changes due to road pricing and fare reduction strategies are of similar magnitude for both sets of coefficients.

Table 3: Bus Trips (thousands) 2011

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	332.4	-3.3	3.9	0.0	0.0
LRT (LT)	-23.2	2.6	5.3	-18.0	-21.0
Road Pricing (RP)	15.7	-2.2	5.0	17.3	16.1
Fare Reduction (FA)	11.2	-3.0	4.2	11.9	11.1
LRT+RP (LR)	-7.6	3.1	6.2	-1.3	-5.2
Fare +RP (FR)	27.4	-2.3	5.8	29.3	28.2
LRT+fare+RP (A3)	7.9	1.6	6.7	13.2	10.2

The strategies also have large effects on bus trips (from response 0), with road pricing achieving a 15.7% increase, fare reduction an 11.2% increase, and light rail a 23.2% reduction. As with the impact

on car trips, these effects are broadly cumulative in combined strategies; with the exception of the total combined strategy which has a greater than expected increase. The do-minimum with response 5 increases bus trips by 7.2% compared to response 1. The implementation of LRT strategies gives rise to a greater reduction in bus trips with response 5 than with response 1 for LRT and LRT plus road pricing, with a lower increase for the combined strategy. Changes due to road pricing and fare reduction strategies give a slightly lower increase in bus trips for response 5 compared to response 1.

Table 4: Light Rail Trips (thousands) 2011

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)					
LRT (LT)	102.4	9.6	12.0	0.0	0.0
Road Pricing (RP)					
Fare Reduction (FA)					
LRT+RP (LR)	1.5	10.0	13.9	1.7	3.0
Fare +RP (FR)					
LRT+fare+RP (A3)	-19.4	6.8	10.0	-20.2	-19.2

The effects of the strategies on LRT trips are as expected; their numbers are higher with road pricing and lower when bus fares are reduced. In all cases the effect of including responses to accessibility is to increase light rail trips by 10% or more. The do-minimum with response 5 increases LRT trips by 2.4% compared to response 1. The implementation of LRT plus road pricing gives rise to a 3% increase in LRT trips for response 5 compared to a 1.7% increase for response 1. The effect of the combined strategy is a slightly lower decrease in LRT trips for response 5 compared to response 1.

Table 5: Total km (thousands) in 2011

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	14252	-0.5	1.6	0.0	0.0
LRT (LT)	0.7	1.3	1.8	2.5	0.9
Road Pricing (RP)	-0.7	-0.4	1.7	-0.5	-0.6
Fare Reduction (FA)	0.9	-0.5	1.4	0.9	0.6
LRT+RP (LR)	-0.1	1.6	2.1	1.9	0.3
Fare +RP (FR)	0.0	-0.3	1.5	0.3	-0.1
LRT+fare+RP (A3)	0.6	1.5	2.2	2.6	1.2

The effects of the strategies on trip-km are, as with those on trips, small. For light rail and fare reduction the effects on trip-km are virtually identical to those on trips; for road pricing trip-km fall by less than trips, suggesting a small increase in trip-length. This effect is reflected also in the combined strategies, all of which include road pricing. The do-minimum with response 5 increases total trip-km by 2.1% compared to response 1 suggesting a reduction in average trip length with response 5 as total trips increased by 4.9%. The implementation of LRT strategies gives rise to a lower increase in total trip-km with response 5 than with response 1, e.g. 0.9% compared to 2.5% for LRT only. Changes due to road pricing and fare reduction strategies are of similar magnitude for both sets of coefficients.

Table 6: Car km (thousands) 2011

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	10020	-0.5	1.9	0.0	0.0
LRT (LT)	-1.2	-0.6	0.9	-1.3	-2.2
Road Pricing (RP)	-6.4	-0.4	2.1	-6.4	-6.1
Fare Reduction (FA)	-2.7	-0.5	1.7	-2.7	-2.9
LRT+RP (LR)	-7.8	-0.8	0.7	-8.1	-8.9
Fare +RP (FR)	-9.3	-0.3	1.6	-9.1	-9.4
LRT+fare+RP (A3)	-10.3	-0.4	1.0	-10.3	-11.1

In all cases the strategies reduce car-trip-km by less than car-trips, thus resulting in an increase in trip length. The do-minimum with response 5 increases car trip-km by 2.4% compared to response 1 again implying a decrease in average car trip length with response 5. The implementation of LRT strategies gives rise to a slightly greater decrease in car trip-km with response 5 than with response 1. Changes due to road pricing and fare reduction strategies are of similar magnitude for both sets of coefficients.

Table 7: Bus km (thousands) 2011

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	2428	-2.1	3.0	0.0	0.0
LRT (LT)	-19.5	2.6	4.2	-15.1	-17.8
Road Pricing (RP)	18.3	-1.6	3.4	19.2	18.1
Fare Reduction (FA)	23.4	-2.2	3.0	23.8	22.7
LRT+RP (LR)	-0.9	2.8	5.3	4.2	1.3
Fare +RP (FR)	42.3	-2.1	3.9	43.2	41.9
LRT+fare+RP (A3)	25.1	2.9	6.3	30.7	27.5

The strategies have very different impacts on bus-trip-km from those on bus trips. Light rail reduces bus-trip-km by less than bus trips, while road pricing increases them more; both imply an increase in trip length. A fare reduction increases bus-trip-km by double the amount that it increases bus trips, thus substantially increasing trip length. Once again these effects are broadly cumulative in the combined strategies. The do-minimum with response 5 increases bus trip-km by 5.1% compared to response 1 again implying a decrease in average bus trip length compared to response 1. The implementation of LRT alone gives rise to a greater reduction in bus trip-km with response 5 than with response 1, -17.8% compared to -15.1%. Changes due to all other strategies give a slightly lower increase in bus trip-km for response 5 than for response 1.

Table 8: Light Rail Trip-km (thousands) 2011

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)					
LRT (LT)	603.1	9.6	11.4	0.0	0.0
Road Pricing (RP)					
Fare Reduction (FA)					
LRT+RP (LR)	-0.9	10.2	12.5	-0.2	0.2
Fare +RP (FR)					
LRT+fare+RP (A3)	-21.5	6.3	9.1	-22.6	-21.4

The do-minimum with response 5 increases LRT trip-km by 1.8% compared to response 1. The implementation of LRT plus road pricing gives rise to an increase in LRT trip-km of 0.2% with

response 5 compared to a 0.2% decrease with response 1. The combined strategy gives a slightly lower decrease in LRT trip-km for response 5.

Table 9: Fuel consumption (cars - millions litres)

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	353.5	-1.2	2.7	0.0	0.0
LRT (LT)	-0.8	1.2	3.4	1.5	-0.1
Road Pricing (RP)	-7.4	-0.8	2.9	-7.2	-7.1
Fare Reduction (FA)	-3.5	-0.9	2.5	-3.3	-3.6
LRT+RP (LR)	-8.1	0.5	2.5	-6.5	-8.0
Fare +RP (FR)	-10.8	-0.5	2.5	-10.3	-10.8
LRT+fare+RP (A3)	-10.9	0.5	2.7	-9.4	-10.7

The effect of the strategies is to reduce fuel consumption by cars, with road pricing being most effective, producing a 7.4% decrease. The effects are broadly additive when strategies are combined. The do-minimum with response 5 increases fuel consumption by 3.9% compared to response 1. The implementation of LRT strategies gives rise to a greater reduction in fuel consumption with response 5 than with response 1, for LRT alone there is a reduction of 0.1% compared to an increase of 1.5%. Changes due to road pricing and fare reduction strategies are of similar magnitude for both sets of coefficients.

3.3 Comparison of Land Use Indicators

First of all the response 0 is for an effective fixed demand i.e. the land use output does not change with a change in strategy hence all land use indicators are the same as for the do-minimum response 0 and there is no strategy effect for this column.

The indicators presented are shown for the Centre of Edinburgh (zones 1,2 and 12) and the Centre plus the Rest of Edinburgh (zones 1-14,16 and 21). The Rest of Edinburgh figures alone can be a little mis-leading as changes in these figures can imply in or out-migration. For example the road pricing results showed an out-migration from the city centre compared to the do-minimum but with a smaller decrease in population in the rest of Edinburgh compared to the do-minimum. Obviously there are more people relocating in the rest of Edinburgh from the city centre with road pricing than without road pricing. The following analysis therefore takes the city centre results and the city centre plus the rest of Edinburgh.

Land Use Outputs in 2011

Table 10: Housing rents in the City Centre (£ per m sq per week)

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	0.947	-2.0	-17.1	0.0	0.0
LRT (LT)	0.0	12.7	-14.8	15.0	2.8
Road Pricing (RP)	0.0	-1.8	-14.5	0.2	3.2
Fare Reduction (FA)	0.0	-1.2	-16.7	0.9	0.5
LRT+RP (LR)	0.0	16.8	-11.0	19.2	7.4
Fare +RP (FR)	0.0	-0.6	-14.0	1.4	3.7
LRT+fare+RP (A3)	0.0	16.5	-10.9	18.9	7.5

The do-minimum with response 5 decreases rents in the city centre by 15.1% compared to response 1. The implementation of LRT strategies gives rise to much smaller increases in rents with response 5 than with response 1, e.g. 2.8% compared to 15% for LRT only. Changes due to road pricing give a

slightly greater increase in rents and fare reduction strategies give a slightly lower increase in rents for response 5 compared to response 1. The effect of the combined strategy is to increase rents by 7.5% with response 5 compared to 18.9% with response 1.

Table 11: Housing rents in the City Centre plus rest of Edinburgh

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	0.8759193	-3.2	-7.6	0.0	0.0
LRT (LT)	0.0	3.2	-6.9	6.6	0.7
Road Pricing (RP)	0.0	-3.0	-6.5	0.2	1.2
Fare Reduction (FA)	0.0	-2.9	-7.3	0.4	0.2
LRT+RP (LR)	0.0	4.1	-5.6	7.6	2.2
Fare +RP (FR)	0.0	-2.4	-6.3	0.8	1.4
LRT+fare+RP (A3)	0.0	3.4	-5.7	6.9	2.0

The do-minimum with response 5 decreases rent in the city centre plus the rest of Edinburgh by 4.4% compared to response 1. Once again the implementation of LRT strategies gives rise to a lower increase in rents with response 5 than with response 1, e.g. 0.7% compared to 6.6% for LRT only. Changes due to road pricing give a slightly greater increase in rents and fare reduction strategies give a slightly lower increase in rents for response 5 compared to response 1. The effect of the combined strategy is to increase rents by 2.0% with response 5 compared to 6.9% with response 1.

Table 12: Population in the City Centre

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	41016	-3.7	-17.7	0.0	0.0
LRT (LT)	0.0	20.9	-7.2	25.6	12.8
Road Pricing (RP)	0.0	-5.5	-15.9	-1.8	2.2
Fare Reduction (FA)	0.0	-2.6	-17.0	1.2	0.8
LRT+RP (LR)	0.0	27.2	-0.6	32.1	20.8
Fare +RP (FR)	0.0	-3.9	-14.9	-0.2	3.4
LRT+fare+RP (A3)	0.0	26.0	-0.6	30.9	20.8

The do-minimum with response 5 decreases population in the city centre by 14% compared to response 1. The implementation of LRT strategies gives rise to much smaller increases in population with response 5 than with response 1, e.g. 12.8% compared to 25.6% for LRT only. Changes due to road pricing give an increase in population of 2.2% with response 5 compared to a decrease of 1.8% with response 1 thus reversing the decentralising effect of road pricing. Fare reduction alone gives a slightly lower increase in population for response 5 compared to response 1. The effect of the combined strategy is to increase population in the city centre by 20.8% with response 5 compared to 30.9% with response 1.

Table 13: Population in the City Centre plus rest of Edinburgh

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	429643	-3.9	-0.4	0.0	0.0
LRT (LT)	0.0	1.6	1.4	5.7	1.8
Road Pricing (RP)	0.0	-3.3	0.4	0.6	0.8
Fare Reduction (FA)	0.0	-3.8	-0.5	0.1	-0.1
LRT+RP (LR)	0.0	1.0	1.7	5.1	2.1
Fare +RP (FR)	0.0	-3.1	0.3	0.8	0.7
LRT+fare+RP (A3)	0.0	-0.9	0.7	3.1	1.1

The do-minimum with response 5 increases population in the city centre plus the rest of Edinburgh by 3.5% compared to response 1. This implies an in-migration from outside the Edinburgh area but with a reduction in population in the city centre, as explained for table 12, for response 5 compared to response 1. The implementation of LRT strategies gives rise to much smaller increases in population with response 5 than with response 1, e.g. 1.8% compared to 5.7% for LRT only. Changes due to road pricing give a slightly greater increase in population and fare reduction strategies give a small decrease compared to a small increase in population for response 5 compared to response 1. The effect of the combined strategy is to increase population by 1.1% with response 5 compared to 3.1% with response 1.

Table 14: Households in the City Centre

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	27554	-2.0	-13.0	0.0	0.0
LRT (LT)	0.0	8.9	-11.8	11.1	1.4
Road Pricing (RP)	0.0	-2.4	-10.4	-0.5	3.0
Fare Reduction (FA)	0.0	-1.3	-12.7	0.7	0.4
LRT+RP (LR)	0.0	12.4	-8.4	14.7	5.3
Fare +RP (FR)	0.0	-1.5	-10.1	0.5	3.3
LRT+fare+RP (A3)	0.0	12.0	-8.4	14.3	5.3

The do-minimum with response 5 decreases households in the city centre by 11% compared to response 1. This taken with the decrease in population of 14% implies a slightly smaller average household size in the city centre with response 5. The implementation of LRT strategies gives rise to much smaller increases in households with response 5 than with response 1, e.g. 1.4% compared to 11.1% for LRT only. Changes due to road pricing give an increase in households of 3% compared to a 0.5% reduction, and fare reduction strategies give a smaller increase compared to response 1. The effect of the combined strategy is to increase households by 5.3% with response 5 compared to 14.3% with response 1.

Table 15: Households in the City Centre plus rest of Edinburgh

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	227912	-2.3	-10.0	0.0	0.0
LRT (LT)	0.0	0.5	-9.7	2.9	0.3
Road Pricing (RP)	0.0	-1.9	-9.7	0.4	0.3
Fare Reduction (FA)	0.0	-2.2	-10.0	0.1	0.0
LRT+RP (LR)	0.0	0.3	-9.4	2.6	0.6
Fare +RP (FR)	0.0	-1.7	-9.7	0.6	0.4
LRT+fare+RP (A3)	0.0	-0.6	-9.5	1.7	0.5

The do-minimum with response 5 decreases households in the city centre plus the rest of Edinburgh by 7.7% compared to response 1. This taken with the increase in population of 3.5% implies a larger average household size in the city centre plus the rest of Edinburgh with response 5. The implementation of LRT strategies gives rise to much smaller increases in households with response 5 than with response 1, e.g. 0.3% compared to 2.9% for LRT only. Changes due to road pricing and fare reduction strategies give similar results for both responses. The effect of the combined strategy is to increase households by 0.5% with response 5 compared to 1.7% with response 1.

Table 16: Resident workers in the City Centre

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	20145	-3.7	-12.4	0.0	0.0
LRT (LT)	0.0	20.5	-3.9	25.1	9.7
Road Pricing (RP)	0.0	-5.1	-11.4	-1.5	1.1
Fare Reduction (FA)	0.0	-2.3	-11.6	1.4	0.9
LRT+RP (LR)	0.0	27.2	1.5	32.1	15.9
Fare +RP (FR)	0.0	-3.4	-10.4	0.3	2.3
LRT+fare+RP (A3)	0.0	26.4	1.8	31.3	16.2

The do-minimum with response 5 decreases resident workers in the city centre by 8.7% compared to response 1. This taken with the decrease in population of 14% implies a slight increase in the proportion of resident workers in the city centre with response 5. The implementation of LRT strategies gives rise to much smaller increases in the number of resident workers with response 5 than with response 1, e.g. 9.7% compared to 25.1% for LRT only. Changes due to road pricing give an increase in resident workers of 1.1% compared to a 1.5% reduction, and fare reduction strategies give a smaller increase compared to response 1. The effect of the combined strategy is to increase resident workers by 16.2% with response 5 compared to 31.3% with response 1.

Table 17: Resident workers in the City Centre plus rest of Edinburgh

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	179552	-4.3	8.8	0.0	0.0
LRT (LT)	0.0	1.9	10.7	6.5	1.7
Road Pricing (RP)	0.0	-3.6	9.7	0.7	0.8
Fare Reduction (FA)	0.0	-3.9	9.0	0.4	0.2
LRT+RP (LR)	0.0	1.3	10.9	5.9	2.0
Fare +RP (FR)	0.0	-3.1	9.8	1.2	1.0
LRT+fare+RP (A3)	0.0	-0.6	9.9	3.8	1.1

The do-minimum with response 5 increases resident workers in the city centre plus the rest of Edinburgh by 13.1% compared to response 1. This taken with the 3.5% increase in population implies a slight increase in the proportion of resident workers in the city centre plus the rest of Edinburgh with response 5. The implementation of LRT strategies gives rise to much smaller increases in the number of resident workers with response 5 than with response 1, e.g. 1.7% compared to 6.5% for LRT only. Changes due to road pricing and fare reduction strategies are of similar magnitude for both sets of coefficients. The effect of the combined strategy is to increase resident workers by 1.1% with response 5 compared to 3.8% with response 1.

Table 18: Floorspace "office/other" in the City Centre (thousands m sq)

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	1185	-0.2	-0.1	0.0	0.0
LRT (LT)	0.0	2.2	2.4	2.4	2.5
Road Pricing (RP)	0.0	-0.4	-0.3	-0.3	-0.3
Fare Reduction (FA)	0.0	-0.1	0.0	0.1	0.1
LRT+RP (LR)	0.0	2.9	3.3	3.0	3.4
Fare +RP (FR)	0.0	-0.3	-0.3	-0.2	-0.2
LRT+fare+RP (A3)	0.0	2.6	3.0	2.8	3.1

The changes in floorspace are very similar for both sets of coefficients i.e. floorspace changes occur in response to strategy rather than to location decisions.

Table 19: Floorspace "office/other" in the City Centre plus rest of Edinburgh

Strategy	Response 0	R1-R0	R5-R0	R1s-R1dm	R5s-R5dm
Do-min (DM)	3530	-0.1	0.1	0.0	0.0
LRT (LT)	0.0	1.8	2.1	1.9	2.0
Road Pricing (RP)	0.0	-0.1	0.0	0.0	-0.1
Fare Reduction (FA)	0.0	0.0	0.1	0.1	0.1
LRT+RP (LR)	0.0	2.2	2.5	2.2	2.4
Fare +RP (FR)	0.0	0.0	0.1	0.1	0.0
LRT+fare+RP (A3)	0.0	1.9	2.2	2.0	2.2

The changes in floorspace are very similar for both sets of coefficients i.e. floorspace changes occur in response to strategy rather than to location decisions.

4. Summary

The changes from the effects of policies under R1 to their effects under R5 are due to the combination of :

- new local evidence on WTP for reductions in noise and air pollution, which replaces older, non-local evidence;
- new local evidence on WTP for improvements in accessibility
- a review of assumptions regarding overall sensitivities to the variables in the location model.

Given that:

- there are similarities between new and old WTP values
- no new evidence has entered into the thinking on overall sensitivities
- the rest of the model is unchanged

It is to be expected that the R5 model will produce broadly similar results to those of R1 with detailed differences. This has been seen to be the case, and we would expect to find still greater differences if we compared the results in greater detail.

Overall the response 5 coefficients do give very similar changes in transport indicators relative to the do-minimum scenario with the general exception of strategies which include LRT as a component

where the response 5 results are slightly different to response 1 although in the same general direction for each indicator.

For the land use indicators there is a greater shift in the do-minimum scenario compared to the transport indicators' shift although this too is relatively large for a shift in transport indicators and is possibly due to relocation of households outside Edinburgh thus increasing car use (though this should be verified by further reseacrh). The population in the Edinburgh area (city centre plus rest of Edinburgh) has increased compared to response 1, however the number of households has decreased. This decrease in households has caused a reduction in rent in the Edinburgh area. A feature of the response 5 results is the redistribution of household size and resident workers compared to the even distribution with response 1 where changes in household size and resident workers follow the population movements. This response is probably due to the income relationships derived for accessibility for response 5 compared to the response 1 relationships which were based on one value for each SEG.

In general as strategies are introduced the overall location response is lower with response 5 than with response 1 (especially for LRT strategies) which is to be expected as the relative responses are lower for accessibility, noise, pollution and area quality as shown by figures 8-11.

One interesting result is that the decentralising effect of road pricing with response 1 coefficients is reversed with the response 5 coefficients.

Floorspace is not affected by the location model coefficients but rather by the strategies implemented and so the changes in floorspace are almost identical for response 1 and response 5.

5: Results for The Alternative Land Use Scenario

5.1 Introduction

The land use scenario used as a basis for the study in tasks 2 and 5 was developed in line with data given in the Edinburgh structure plan and is termed land use scenario 1 (LU1). A second theoretical land use scenario has been developed to test the effect of concentrating exogenous development within the Edinburgh area. The broad aim of the second scenario (LU2) being to develop land around the LRT corridors rather than in the outer areas as in the first scenario which was constrained by the Edinburgh structure plans.

The policy development files were adapted so that all exogenous development from zones 8, 16-19 and 21 was set to zero and re-allocated to the inner zones for the Edinburgh area 1-14 excluding zones 4 and 7, as these were to the East of the city and were not well served by the LRT system, and zone 8 as this is an outer zone. The development was distributed evenly across the remaining 11 inner zones as no detail on the LRT routes was readily available. All OD pairs in the inner areas were served by LRT routes. The development in the surrounding zones i.e. zones 15, 20, 22-25 was left unchanged.

The following table A shows the percentage change in floorspace for household, retail and office + other categories resulting for each land use scenario (LU1 and LU2) between 1991 and 2011 for the do-minimum strategy with response 5 coefficients over the 14 inner zones.

START Zone	% change in household floorspace 91-11		% change in retail floorspace 91-11		% change in office+other floorspace 91-11	
	LU1	LU2	LU1	LU2	LU1	LU2
1	24	51	10	12	20	22
2	30	63	9	12	12	12
3	6	12	9	11	10	10
4	7	7	9	2	6	6
5	49	59	10	18	57	71
6	14	30	9	13	6	7
7	3	3	9	2	5	5
8	9	2	9	1	8	6
9	5	22	9	11	24	24
10	5	16	9	13	9	10
11	8	23	86	93	2	2
12	15	46	9	12	4	5
13	10	25	9	12	4	5
14	11	31	44	47	2	2

Table A : Changes in floorspace for LU1 and LU2

It can be seen that LU2 increases all floorspace in the inner areas except for zones 4,7 and 8 as expected.

The second land use scenario has been simulated for the four main strategies i.e. do-minimum, LRT, road pricing and fare reduction alone, plus the total combined strategy with response 1 and response 5 coefficients.

5.2 Presention of Results

The attached tables 1-19 show the main indicators with the percentage change across land use scenarios for each set of response coefficients given by strategy. LU1 represents the standard land use scenario and LU2 represents the alternative described above.

The columns are headed as follows :-

Strategy : strategy tested
LU1 R1 : Land use scenario 1 response coefficients 1
LU2 R1 : Land use scenario 2 response coefficients 1
%LU2-LU1 R1 : Percentage change in indicator between land use scenario 2 and land use scenario 1 for considered strategy for response coefficients 1
LU1 R5 : Land use scenario 1 response coefficients 5
LU2 R5 : Land use scenario 2 response coefficients 5
%LU2-LU1 R5 : Percentage change in indicator between land use scenario 2 and land use scenario 1 for considered strategy for response coefficients 5

The percentage change columns between land use scenarios are the most important measures as they indicate the shift in each indicator due to a change in land use scenario for each set of responses. If we assume that the difference between the do-minimum scenario for each indicator is the expected shift due to this change in land use assumptions, then the other results are dependent upon or affected by the strategy if the change is significantly different to this first value. The following analysis compares the shift in indicators for the do-minimum between the response 1 and response 5 coefficients for the do-minimum scenario and then notes any exceptions to this shift in terms of strategies.

5.3 Comparison Of Transport Indicators

Table 20: Total trips (thousands) in 2011

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	1040	1059	1.8	1092	1103	1.0
LRT (LT)	1092	1115	2.1	1116	1128	1.1
Road Pricing (RP)	1029	1048	1.8	1080	1091	1.0
Fare Reduction (FA)	1050	1070	1.9	1100	1111	1.0
LRT+RP (LR)	1078			1105		
Fare +RP (FR)	1040			1089		
LRT+fare+RP (A3)	1075	1100	2.3	1107	1118	1.0

For response 1 total trips increase by 1.8% for the do-minimum compared to only 1.0% with response 5. For response 1 the LRT and the combined strategy show slightly larger increases in trips. For response 5 only LRT has a slight increase in total trips compared to the do-minimum.

Table 21: Car Trips (thousands) in 2011

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	662.4	668.8	1.0	692.6	695.9	0.5
LRT (LT)	659.5	665.9	1.0	677	679.4	0.4
Road Pricing (RP)	592.3	600	1.3	621.8	622.8	0.2
Fare Reduction (FA)	641.6	648.2	1.0	670.3	673	0.4
LRT+RP (LR)	586.6			603.5		
Fare +RP (FR)	572.1			596.8		
LRT+fare+RP (A3)	567.6	573.8	1.1	584.3	586.1	0.3

For response 1 the car trips increase by 1% for the do-minimum compared to only 0.5% with response 5. For response 1 car trips increase by 1.3% with road pricing alone, all other strategies give similar shifts to the do-minimum. For response 5 the increase due to road pricing alone is lower than in the do-minimum, 0.2% compared to 0.5%; also the combined strategy results in a lower increase in car trips. The response 5 shift is lower than the response 1 shift for all strategies.

Table 22: Bus Trips (thousands) in 2011

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	321.5	332.3	3.4	345.5	352.1	1.9
LRT (LT)	263.7	271.9	3.1	272.9	277.8	1.8
Road Pricing (RP)	377.1	386.7	2.5	401.1	411.2	2.5
Fare Reduction (FA)	359.8	372.1	3.4	383.8	390.9	1.8
LRT+RP (LR)	317.2			327.7		
Fare +RP (FR)	415.7			442.8		
LRT+fare+RP (A3)	364	376.5	3.4	380.9	386.5	1.5

For response 1 the bus trips increase by 3.4% for the do-minimum compared to only 1.9% with response 5. For response 1 bus trips increase by only 2.5% with road pricing alone, all other strategies give similar shifts to the do-minimum. For response 5 the increase due to road pricing alone is higher than in the do-minimum, 2.5% compared to 1.9% (the same as response 1); also the combined strategy results in a lower increase in bus trips. The response 5 shift is lower than the response 1 shift for all strategies except road pricing.

Table 23: Light Rail Trips (thousands) in 2011

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)						
LRT (LT)	112.2	119	6.1	114.7	118.2	3.1
Road Pricing (RP)	0					
Fare Reduction (FA)	0					
LRT+RP (LR)	114.1			118.1		
Fare +RP (FR)	0					
LRT+fare+RP (A3)	89.5	95	6.1	92.7	95.4	2.9

The shift for response 1 due to a change in land use scenarios is 6.1% compared to 3.1% with response 5 (for LRT alone). The shift with the combined strategy is similar to that for LRT alone for both responses.

Table 24: Total km (thousands) in 2011

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	14182	14133	-0.3	14483	14438	-0.3
LRT (LT)	14543	14529	-0.1	14614	14573	-0.3
Road Pricing (RP)	14105	14064	-0.3	14397	14354	-0.3
Fare Reduction (FA)	14313	14270	-0.3	14572	14533	-0.3
LRT+RP (LR)	14457			14530		
Fare +RP (FR)	14218			14472		
LRT+fare+RP (A3)	14550	14528	-0.2	14651	14604	-0.3

The shifts due to a change in land use scenarios for total trip-km is identical for all strategies and responses with the exception of response 1 road pricing and response 1 combined strategy where the shift is slightly lower than the usual 0.3% decrease.

Table 25: Car km (thousands) in 2011

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	9966	9874	-0.9	10213	10143	-0.7
LRT (LT)	9837	9743	-1.0	9988	9903	-0.9
Road Pricing (RP)	9333	9247	-0.9	9588	9495	-1.0
Fare Reduction (FA)	9697	9601	-1.0	9921	9842	-0.8
LRT+RP (LR)	9156			9301		
Fare +RP (FR)	9061			9255		
LRT+fare+RP (A3)	8939	8836	-1.2	9080	8984	-1.1

For response 1 the car trip-km decrease by 0.9% for the do-minimum compared to only 0.7% with response 5. All other strategies give similar shifts in car trip-km across responses. The largest decrease is for the combined strategies.

Table 26: Bus km (thousands) in 2011

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	2377	2407	1.3	2502	2523	0.8
LRT (LT)	2018	2041	1.1	2056	2074	0.9
Road Pricing (RP)	2834	2852	0.6	2955	3002	1.6
Fare Reduction (FA)	2943	2988	1.5	3069	3098	0.9
LRT+RP (LR)	2476			2535		
Fare +RP (FR)	3403			3550		
LRT+fare+RP (A3)	3107	3149	1.4	3191	3218	0.8

For response 1 the bus trip-km increase by 1.3% for the do-minimum compared to only 0.8% with response 5. For response 1 bus trips increase by only 0.6% with road pricing alone, 1.1% for LRT alone, 1.5% for fare reduction and 1.4% for the combined strategy. For response 5 the increase due to road pricing alone is higher than in the do-minimum, 1.6% compared to 0.8%. The response 5 shift is lower than the response 1 shift for all strategies except road pricing.

Table 27: Light Rail Trips km (thousands) in 2011

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)						
LRT (LT)	660.7	697.3	5.5	671.8	690.8	2.8
Road Pricing (RP)	0					
Fare Reduction (FA)	0					
LRT+RP (LR)	659.3			673		
Fare +RP (FR)	0					
LRT+fare+RP (A3)	511.3	540.9	5.8	528.1	541.8	2.6

The shift for response 1 due to a change in land use scenarios is 5.5% compared to 2.8% with response 5 (for LRT alone). The shift with the combined strategy is similar to that for LRT alone for both responses.

Table 28: Fuel consumption (cars - millions litres)

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	349.4	349	-0.1	363.1	362.9	-0.1
LRT (LT)	354.8	354.5	-0.1	362.7	362.1	-0.2
Road Pricing (RP)	324.4	323.5	-0.3	337.5	335.4	-0.6
Fare Reduction (FA)	337.9	337.2	-0.2	350	349.4	-0.2
LRT+RP (LR)	326.6			333.9		
Fare +RP (FR)	313.5			323.9		
LRT+fare+RP (A3)	316.7	315.2	-0.5	324.3	322.1	-0.7

The changes due to a change in land use scenario are very small in magnitude for both sets of coefficients with the exception of road pricing and the combined strategy. For response 5 the decrease in fuel consumed with road pricing is 0.6% compared to 0.1% with the do-minimum and 0.7% for the combined strategy.

5.4 Comparison of Land Use Indicators

The indicators presented are shown for the Centre of Edinburgh (zones 1,2 and 12) and the Centre plus the Rest of Edinburgh (zones 1-14,16 and 21). The Rest of Edinburgh figures alone can be a little mis-leading as changes in these figures can imply in or out-migration. For example the road pricing results showed an out-migration from the city centre compared to the do-minimum but with a smaller decrease in population in the rest of Edinburgh compared to the do-minimum. Obviously there are more people relocating in the rest of Edinburgh from the city centre with road pricing than without road pricing. The following analysis therefore takes the city centre results and the city centre plus the rest of Edinburgh.

Again the analysis concentrates on the shift due to the change in land use scenarios and any exceptions to the expected shift.

Land Use Outputs in 2011

Table 29: Housing rents in city centre (£ per m sq per week)

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	0.928	0.84	-9.5	0.785	0.721	-8.2
LRT (LT)	1.067	0.958	-10.2	0.807	0.739	-8.4
Road Pricing (RP)	0.93	0.84	-9.7	0.81	0.747	-7.8
Fare Reduction (FA)	0.936	0.848	-9.4	0.789	0.725	-8.1
LRT+RP (LR)	1.106			0.843		
Fare +RP (FR)	0.941			0.814		
LRT+fare+RP (A3)	1.103	0.993	-10.0	0.844	0.772	-8.5

For response 1 the rents decrease by 9.5% for the do-minimum compared to 8.2% for the response 5 do-minimum. All strategies give similar shifts with the exception of LRT and combined strategies for both responses which give slightly greater decreases in rents.

Table 30: Housing rents city centre plus rest of Edinburgh

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	0.847	0.794	-6.3	0.809	0.768	-5.1
LRT (LT)	0.903	0.843	-6.7	0.815	0.772	-5.3
Road Pricing (RP)	0.849	0.796	-6.3	0.819	0.777	-5.1
Fare Reduction (FA)	0.850	0.798	-6.2	0.811	0.769	-5.2
LRT+RP (LR)	0.912			0.827		
Fare +RP (FR)	0.854			0.820		
LRT+fare+RP (A3)	0.905	0.845	-6.7	0.826	0.781	-5.4

For response 1 the rents decrease by 6.3% for the do-minimum compared to 5.1% for the response 5 do-minimum. All strategies give similar shifts with the exception of LRT and combined strategies for both responses which give slightly greater decreases in rents.

Table 31: Population in city centre

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	39482	45287	14.7	33754	38134	13.0
LRT (LT)	49570	56726	14.4	38070	42763	12.3
Road Pricing (RP)	38759	44409	14.6	34505	39231	13.7
Fare Reduction (FA)	39950	45914	14.9	34039	38457	13.0
LRT+RP (LR)	52155			40772		
Fare +RP (FR)	39418			34910		
LRT+fare+RP (A3)	51683	59523	15.2	40782	45943	12.7

For response 1 the population increases by 14.7% for the do-minimum compared to 13.0% for the response 5 do-minimum. LRT strategies give slightly lower increases for both responses. Road pricing alone gives a greater increase in population for response 5 as does the fare reduction and combined strategy for response 1. This is the direct opposite of the combined strategy result for response 5 which shows a slightly lower increase in population.

Table 32: Population city centre plus rest of Edinburgh

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	412890	428727	3.8	427766	438372	2.5
LRT (LT)	436393	454290	4.1	435552	447014	2.6
Road Pricing (RP)	415390	432332	4.1	431272	441938	2.5
Fare Reduction (FA)	413483	429906	4.0	427545	438076	2.5
LRT+RP (LR)	433899			436752		
Fare +RP (FR)	416325			430909		
LRT+fare+RP (A3)	425853	445030	4.5	432644	443543	2.5

For response 1 the population increases by 3.8% for the do-minimum compared to 2.5% for the response 5 do-minimum. LRT strategies give slightly greater increases for both responses. Road pricing alone and the combined strategy give a greater increase in population for response 1 whereas all other strategies give the same as the do-minimum for response 5.

Table 33: Households in city centre

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	27006	31504	16.7	23975	28487	18.8
LRT (LT)	30009	34917	16.4	24312	28907	18.9
Road Pricing (RP)	26881	31343	16.6	24689	29352	18.9
Fare Reduction (FA)	27199	31767	16.8	24061	28597	18.9
LRT+RP (LR)	30981			25240		
Fare +RP (FR)	27141			24760		
LRT+fare+RP (A3)	30870	36011	16.7	25252	30002	18.8

For response 1 the household size increases by 17.7% for the do-minimum compared to 18.8% for response 5, one of the few indicators which gives a greater change with response 5. LRT alone, response 1, gives a slightly lower increase, other strategies being similar to the do-minimum. All strategies give similar results for response 5.

Table 34: Households city centre plus rest of Edinburgh

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	222658	232296	4.3	205119	216313	5.5
LRT (LT)	229009	239197	4.4	205774	217093	5.5
Road Pricing (RP)	223504	233432	4.4	205813	217095	5.5
Fare Reduction (FA)	222991	232842	4.4	205220	216410	5.5
LRT+RP (LR)	228504			206380		
Fare +RP (FR)	223985			205909		
LRT+fare+RP (A3)	226478	237023	4.7	206171	217531	5.5

For response 1 the household size increases by 4.3% for the do-minimum compared to 5.5% for response 5, one of the few indicators which gives a greater change with response 5. All strategies give similar if not identical shifts with the exception of the combined strategy for response 1 which gives a slightly greater increase in household size.

Table 35: Resident workers in city centre

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	19398	22551	16.3	17649	20066	13.7
LRT (LT)	24275	28074	15.6	19357	21813	12.7
Road Pricing (RP)	19110	22192	16.1	17851	20390	14.2
Fare Reduction (FA)	19676	22932	16.5	17807	20226	13.6
LRT+RP (LR)	25621			20453		
Fare +RP (FR)	19461			18051		
LRT+fare+RP (A3)	25461	29620	16.3	20515	23063	12.4

For response 1 the increase in resident workers is 16.3% for the do-minimum compared to 13.7% for response 5. The LRT strategy gives a lower increase in resident workers for both responses. For response 1 other strategies give similar shifts to the do-minimum shift. For response 5 road pricing alone gives a greater increase in resident workers in the city centre whereas the combined strategy gives a lower increase in workers.

Table 36: Resident workers city centre plus rest of Edinburgh

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	171863	179194	4.3	195326	200113	2.5
LRT (LT)	183043	191352	4.5	198680	203824	2.6
Road Pricing (RP)	173100	180946	4.5	196945	201694	2.4
Fare Reduction (FA)	172523	180271	4.5	195697	200336	2.4
LRT+RP (LR)	181936			199209		
Fare +RP (FR)	174010			197193		
LRT+fare+RP (A3)	178461	187311	5.0	197412	202146	2.4

For response 1 the increase in resident workers is 4.3% for the do-minimum compared to 2.5% for response 5. For response 1 all other strategies give an increase of 4.5% with the exception of the combined strategy which gives an increase of 5%. For response 5 the LRT strategy gives an increase of 2.6% and all other strategies give and increase of 2.4%.

Table 37: Floorspace "office/other" in city centre (thousand m sq)

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	1183	1192	0.8	1184	1194	0.8
LRT (LT)	1211	1229	1.5	1214	1233	1.6
Road Pricing (RP)	1180	1188	0.7	1181	1189	0.7
Fare Reduction (FA)	1184	1194	0.8	1185	1195	0.8
LRT+RP (LR)	1219			1224		
Fare +RP (FR)	1181			1182		
LRT+fare+RP (A3)	1216	1236	1.6	1221	1240	1.6

The changes in floorspace are very similar for both sets of coefficients i.e. floorspace changes occur in response to strategy rather than to location decisions. The LRT and combined strategy doubles the change in floorsapce due to the change in land use scenarios.

Table 38: Floorspace "office/other" city centre plus rest of Edinburgh

Strategy	LU1 R1	LU2 R1	%LU2-LU1 R1	LU1 R5	LU2 R5	%LU2-LU1 R5
Do-min (DM)	3527	3544	0.5	3533	3551	0.5
LRT (LT)	3595	3623	0.8	3605	3633	0.8
Road Pricing (RP)	3526	3542	0.5	3531	3548	0.5
Fare Reduction (FA)	3529	3548	0.5	3535	3552	0.5
LRT+RP (LR)	3606			3618		
Fare +RP (FR)	3529			3534		
LRT+fare+RP (A3)	3598	3626	0.8	3609	3636	0.7

The changes in floorspace are very similar for both sets of coefficients i.e. floorspace changes occur in response to strategy rather than to location decisions. The LRT and combined strategy almost double the change in floorsapce due to the change in land use scenarios.

3. Summary

The shifts in transport indicators are typically less than 2% with the exception of LRT trips which supports the hypothesis that the second land use scenario would aid the LRT system.

Response 5 coefficients generally give a smaller shift in indicators due to the land use scenario changes made. This is expected as the response to accessibility is lower for response 5 than for response 1.

Larger changes occur for the land use indicators. Population increases significantly in the inner areas with large decreases in rent due to the extra floorspace available in land use scenario 2.
The change in households is the only indicator to have a greater change with response 5 than with response 1 coefficients. This could be due to the income relationships developed for response 5 which is correlated with household type.?

The LRT results are significantly different to the shift in the do-minimum for a number of indicators including rents, population, resident workers and floorspace in the city centre along with floorspace in the rest of Edinburgh; this too supports the hypothesis that the second land use scenario may aid the LRT system results.

However the road pricing results are also significantly different to the do-minimum for a number of indicators indicating that the land use assumptions may affect strategies based around the central area.

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