APPRAISING THE LIKELY REDEVELOPMENT AND INTENSIFICATION OF LAND USES: THE ROLE OF LAND USE AND TRANSPORTATION MODELS

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Abstract

The redevelopment of vacant and under-used land and buildings can impact upon the location of residents, jobs and other trip attractions, leading to increases in travel, traffic and congestion within towns and cities. Much of this development is unlikely to be identified (or quantified) in Local Plan documents but rather is likely to come forward in response to a combination of economic demand and poor rates of return from existing uses.

In a previous ETC paper (Dobson et al, 2010) we described this process as part of an overview of how planning policy is represented within land use and transport modelling. In this paper we develop the concept and describe how it has been introduced within the modelling of land use change within the DELTA land use model and applied in integrated Land Use and Transportation Model applications.

Through examples we show firstly how introducing the modelling of redevelopment and intensification of an existing land-use can provide a different pattern of land use (and the activity using that land use), secondly we describe how the introduction of a transport intervention can be the catalyst for redevelopment and intensification, resulting in additional activity within the area of influence of the transport intervention and also, as a secondary impact, resulting in redevelopment away from the transport scheme.

We would argue that this approach has two benefits. Firstly it better reflects the changing land use pattern within urban areas, as such it does not rely on a future 'scenario' that is based solely upon the allocations of the local plan. Secondly by allowing greater scope for the future land use pattern to respond to transport interventions it is reflecting the manner in which land use policy may respond to a changing context, with additional development permitted in areas of demand.

In concluding we make recommendations on the future application of this approach both as an input for transport modelling but also in terms of appraisal of transport schemes.

INTRODUCTION

Much of the development that occurs within towns and cities is the result of the redevelopment or intensification of use on previously developed sites. The

additional floorspace created by this development can have a significant impact upon the spatial distribution of population, households and employment. In turn, this can influence both the pattern and scale of traffic flows within the built environment.

In this paper we consider the additional floorspace that may be constructed through redevelopment and intensification and explore how a land use and transportation model can be used to assess the likely impacts that they have.

The paper contains four sections. In the first we provide a context; describing the relationship between land use and transportation, examining how they impact upon each other and the extent to which these processes are captured within statutory plans and other policy documents.

Secondly we describe the use of a land use and transport integrated model (LUTI model) to better understand the importance of this development. The model is an application of DSC's DELTA land use model in South Essex and was originally developed for Essex County Council to inform their work within the Thames Gateway. We report on model runs that examine the impacts, in terms of levels of development and the number of residents and jobs within an area that result from varying the levels of accessibility.

In the final section we draw the main points and findings of the analysis together and look at the wider lessons of this work for forecasting future traffic and land use.

THE RELATIONSHIP BETWEEN LAND USE AND TRANSPORT

It is commonly recognised that land use and the activities that occupy the land use are key generators of traffic. If a new retail park is constructed or an inner city warehouse is converted to flats then there will be an impact upon levels of traffic in the vicinity of the development and in the neighbourhood. Similarly in areas where there are a series of separate developments taking place then again it is recognised that the cumulative impact of the developments can have an impact upon the transport network both locally and across a wider area be it a swathe of the built environment or specific transport corridors.

The planning system within Great Britain acknowledges the importance of the inter-relationship. National Planning Guidance in both England and Wales[1] and Scotland[2] make reference to how authorities should seek co-ordination of transport and land use planning when looking at the future direction of development for an area. For example, the Scottish guidance states:

> 'the existing transport network, environmental and operational constraints, proposed or committed transport projects and demand management schemes should be taken into account in development plans and development management decisions. When preparing a development plan, planning authorities should appraise the pattern of land allocation, including previously allocated sites, in relation to transport opportunities and constraints based on the current or programmed capacity of the transport network and sustainable transport objectives.'

That type of guidance is largely concerned with how land use impacts on transport networks. However the impact of new transport schemes upon land use is not recognised to the same extent. We would argue that developers and landowners responses to the opening of a new transport scheme, in terms of new developments ought to be taken into account when forecasting future transport demand and distributions of population, households and employment. Changes in the relative accessibility of sites and locations as a consequence of a transport intervention may result in adjustments in rent levels and property prices. This may prompt developers and landowners to review their plans for the property or floorspace and in some instances make proposals either to re-develop the site for an alternative use or to redevelop more intensively (or perhaps less intensively with the existing use. For example improvements along a transport corridor may lead to a rise in demand, as businesses seek to locate there due to the improved accessibility, or commuters look to move to residential areas in the vicinity of the corridor so that they can take advantage of the improved transport facility and in response to the increased economic activity. Such decisions may result in intensification of occupation, or the substitution of high rent activities for previous low-rent activities.

The land use planning response to transport schemes typically fall into one of two. Firstly, where the site and phasing of a new transport scheme is known then related land use development may be planned for (and allocated in the land use plan). The planning authority may identify development opportunity sites and prepare planning briefs that prescribe a range of possible new land uses. The secondly response is where area-wide policies are adopted. These provide guidance on what may and may not be permitted in certain localities. For example they may be policies appertaining to a retail quarter or a cultural quarter that permit specified land uses subject to criteria on design or other matters. This type of policy may provide a steer to land owners or prospective developers looking to re-develop sites, as to what may be permitted following the introduction of a transport scheme.

Within Great Britain the local planning system focuses upon detailed policies that guide development in the short to medium term, with a ten year or similar horizon. Beyond that point there is less detail as to what will be developed in different locations (unless there is reference to large sites where construction is phased over a long time period).

There is a related issue, when we are considering the long term, as to whether we should assume that existing land use policies and strategies continue or whether we should look to qualify those policies in response to changing circumstances. Two examples explain this point. Firstly a city or sub-region may experience different pressures for growth over a twenty-thirty year period, this may require greater or lower levels of development than that planned in the next 5-10 years. Secondly policies may evolve or change to reflect new opportunities. The new accessibility associated with the completion of a transport scheme may present new opportunities and new pressures for development. These in turn may influence future reviews of land-use planning policy and lead to the allocation of sites for development that would not otherwise have been made.. This phenomenon was observed, within an UK context, by Headicar (1996). He provided some evidence on how

policies may change. He described the development and planning experience in the vicinity of the original section of M40 motorway opened in the 1970s in particular in the vicinity of High Wycombe. He observed how the planning policy relating to development on the periphery of the town changed following the opening. The pre-motorway policy had been one of curtailing development whereas the post-opening policy permitted development.

Most transport forecasts will consider the population, employment and trip generation associated with planned development. They are less likely to include assumptions on the additional residents or jobs in an area that may come forward as a result of area-wide policies or as planning policy changes in response to the new opportunities presented by different growth or a transport scheme.

In the following sections we go on to show how a land use and transport interaction model can be used to provide an insight into the likely scale of this additional development.

SETLUM, A LAND USE AND TRANSPORT INTERACTION MODEL

The analysis described in the following section has been undertaken using SETLUM (the South Essex Transport Land Use Model). In this section we provide a brief explanation of the model and its functionality.

This model was commissioned by Essex County Council in 2006. It consists of applications of David Simmonds Consultancy's (DSC's) DELTA land use modelling package and of TRL's strategic transport model package (STM), integrated to form a land-use transport interaction (LUTI) model.

DELTA was first developed in 1995. Since then there has been an on-going programme of enhancement and refinement of the model. However its basic structure and under-lying concepts have remained unchanged. The model forecasts land-use change over periods of time. It consists of six urban and three regional sub-models. The urban sub-models work at a zonal level and estimate:

- the development of buildings on land;
- the demographic change and economic growth (applying growth rates which are either exogenous or predicted in the regional components of DELTA;
- changes in car ownership;
- location and relocation of households and jobs;
- employment and status changes; and
- changes in the quality of urban areas.

The first and last deal with changes in the quantity and quality, respectively, of space that is available for households and firms to occupy. The other three model changes in activities.

The three regional-level sub-models work at a higher spatial level, the units being travel-to-work or functional areas rather than zones. The sub-models represent:

- migration between different labour market areas;
- investment in the regional economy
- production and trade in the regional economy.

Although the focus of the model is the South Essex area, SETLUM's Fully Modelled Area includes adjacent districts within Essex and also parts of Greater London and Kent (see Figure 1).

Figure 1 The SETLUM Fully Modelled Area

The model has a zone system which (in South Essex) is based largely upon the local authority wards. In key development areas there is a departure from this approach with smaller zones having been defined. Across the parts of the Fully Modelled Area that lie beyond South Essex the zones are larger and comprise either aggregations of several zones or whole local authority districts. There is a total of 128 zones within the Fully Modelled Area

The population and employment scenarios are based upon NTEM forecasts.

Local Planning Authorities were consulted on the likely levels of future development within their area. The information that they provided was used to generate a profile of where and when land was expected to come forward for development. Please note that the model does not necessary assume that all of the permitted development will actually take place, rather the amount that comes forward will also be dependent upon the modelled market demand

which itself is sensitive to other factors including the impact of transport changes.

The model has a base year of 2001 and forecasts forward to 2021 (the planning end date at the time of the model's construction). As with all DELTA models the model forecasts forward in single year steps, starting in the base year and then forecasting change in population, households, employment and levels of development and floorspace over the next twelve months. These forecasts then form the base for the following year's forecasts.

The future numbers of population, households etc are available at zone level at a disaggregated level. For example:

- population is disaggregated into four, children, retirees, adults in and not in work;
- households are disaggregated into ten main categories
- employment into twelve industrial sectors
- land use into seven land use types.

A full description of the model was presented to an earlier ETC (Dobson et al, 2007).

For the research that is reported in this paper we have introduced new functionality to the model that represents the redevelopment and intensification processes. These can be summarised as:

- where a site(s) become under-used or vacant, proposals come forward for alternative uses and subject to market conditions and land-use policy the site(s) is redeveloped for a different use.
- intensification occurs when the demand for floorspace in an area increases and rent levels rise. Proposals come forward for the redevelopment of the site with an intensification of the existing use. If this is consistent with planning policy then the site may be re-developed with an increase in floorspace.

MODELLING THE IMPACT OF IMPROVED ACCESSIBILITY

Having provided a brief overview of the model we now describe its application to isolate the additional development that takes place as a consequence of a transport scheme. Our approach has been to:

- model an improvement in the accessibility between Southend, within South Essex and Greater London
- quantify the impact of this in terms of increased population, households and employment in Southend
- isolate the proportion of this increase that occurs as a result of additional redevelopment and intensification of land use within Southend.

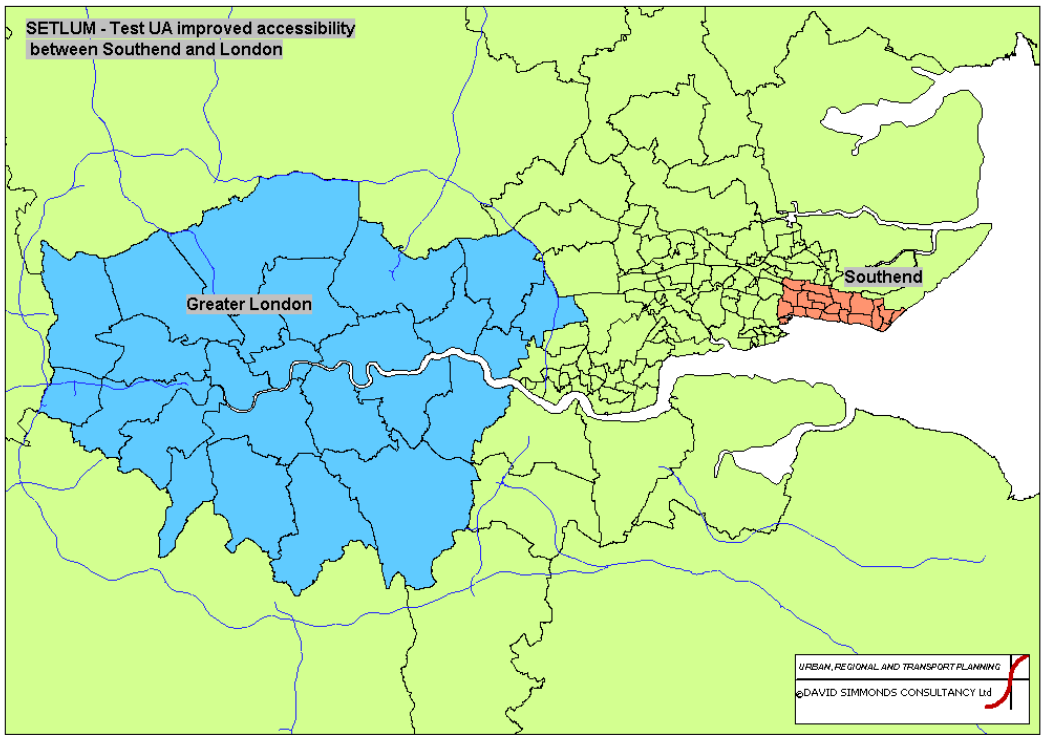

Figure 2 Locations of London and Southend

Three model test runs were produced. The first (Test UH) is a reference case. The inputs to this model run are:

- the base year information on population, households, employment, floorspace, rents etc
- information on the scale and distribution of likely future development based upon information provided by the local authorities
- a population and economic scenario based upon NTEM and regional planning policy
- the application of DELTA's redevelopment and intensification functionality to generate additional development in Southend (if there is a demand).

The second is a variation of the base case (Test UI) which is identical to the base except for the following adjustments:

- the area accessibility files have been adjusted to represent a significant improvement in travel between Southend and London. Both train and car generalised costs between these areas was reduced by a value of 150 pence.
- the application of DELTA's redevelopment and intensification functionality to generate additional development in Southend (if there is a demand).

The third test run (Test UJ) is a hybrid of UH and UI. In setting up this test we have taken the generalised costs generated from Test UI and run these with development outcomes generated in Test UH. As a result the development of new floorspace is fixed, and will not respond to the improved accessibility of Test UI.

In all three cases the model is run as an integrated land use and transport model with the land use model being run in every year and the transport model in every other year. Except for the generalised cost change imposed in UI and UJ, and development in UK being controlled to that forecast in UH, the full model is applied in each test, and the full range of responses is possible. The rationale behind these three model runs is that:

- the difference between Test UI and Test UH represents the effect of the transport intervention; whilst
- the difference between Test UJ and Test UH represents the additional growth that is a result of the transport intervention and the consequential reduction in generalised costs; and
- the difference between Test UJ and Test UI represents the additional growth that is a result of intensification and redevelopment that follows on from the transport intervention;

In reporting on these tests we start by describing the reference case, UH. This provides a context in terms of the scale of development that is being modelled. Table 1 summarises the overall level of growth concentrating upon Southend and South Essex. The latter is defined as the five local authority areas of Basildon, Castle Point, Rochford, Southend and Thurrock.

Over the period from 2001 to 2021 both the population and number of households within Southend are forecast to increase by 47%. This is a higher level of growth than for South Essex as a whole, where a 32% & 41% increase in population and households respectively are forecast.

The change in employment is comparatively less. Within South Essex the number of jobs is forecast to rise by 21% whilst in Southend employment is forecast to rise marginally by 5%.

This contrast between the substantial growth in population and households and the very modest growth in employment may appear unusual, but doesn't affect the discussion that is put forward in this paper regarding redevelopment and intensification.

Table 1 SETLUM Test UH summary forecasts

Measure	Area	2001	2021	increase	%
Population	Southend	157,232	230,941	73,709	47%
	South Essex	626,009	828,670	202,661	32%
Households	Southend	70,980	104,096	33,116	47%
	South Essex	265,884	373,647	107,763	41%
Employment	Southend	61,161	64,361	3,200	5%
	South Essex	233,118	282,151	49,033	21%

The second test (Test UI) involves an adjustment to the generalised costs to represent an improvement in accessibility between London and Southend. This adjustment was made using the functionality of the DELTA package; it involved reducing the generalised costs[3] between all parts of London and Southend by a value of 150.

The test also included a modelling of redevelopment and intensification. There is an assumption that in zones within Southend redevelopment of existing uses to one of residential, retail, office and industrial would be permitted. Similarly intensification of these land uses would be permitted where there was demand.

The model outputs show:

- the population of Southend grows by 56% over the period to 2021, this is 9% more than in the base case;
- the number of households increases by 52% or 5% more than in the base case;
- the number of jobs within Southend increases by 24% compared to 5% increase in the base case. This represents a 19% more growth than the base year.
- the changes in growth for households, population and employment at the sub-regional South Essex level between test UI and base UH remains insignificant.
- the net effect of the improved accessibility in Southend is to attract people and jobs from both other parts of South Essex and beyond.

Table 2 SETLUM Test UI summary forecasts

Measure	Area	2001	2021	increase	%
Population	Southend	157,232	244,656	87,424	56%
	South Essex	626,009	830,141	204,132	33%
Households	Southend	70,980	108,154	37,174	52%
	South Essex	265,884	374,276	108,392	41%
Employment	Southend	61,161	75,678	14,518	24%
	South Essex	233,118	282,252	49,134	21%

The following graphs compare the population, household and residential floorspace forecasts for Southend of Tests UH and UI. For all three measurements the levels forecast in Test UI are greater than in UH by 2021.

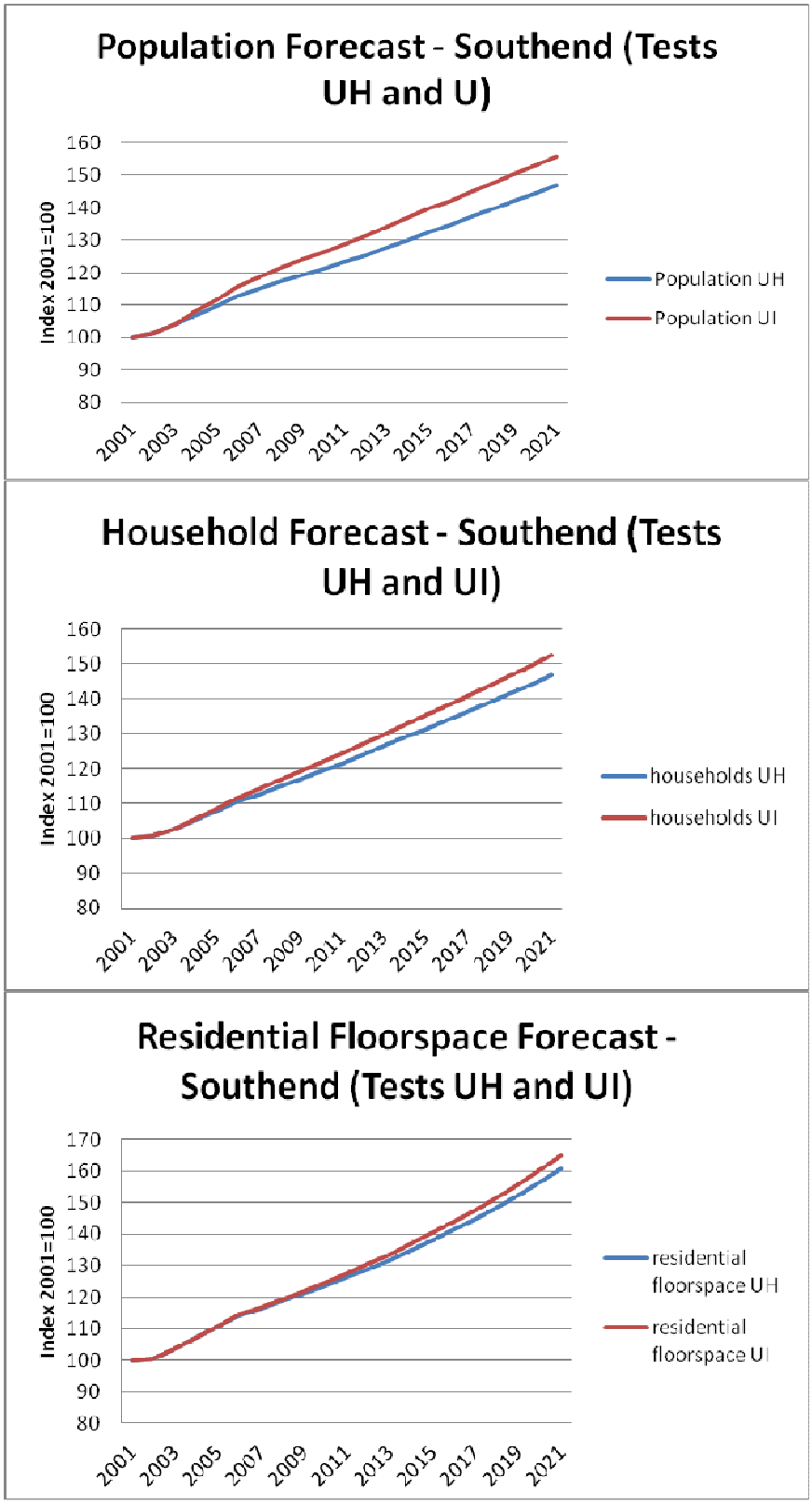

Figure 3 Comparison of tests UH and UI

The graph below compares the levels of retail, office and industrial employment in Tests UH and UI. For all three employment types there are

higher levels of employment in Test UI than in Test UH. This is in part due to additional provision of floorspace (coming through the redevelopment and intensification processes) and in part due to the improved accessibility.

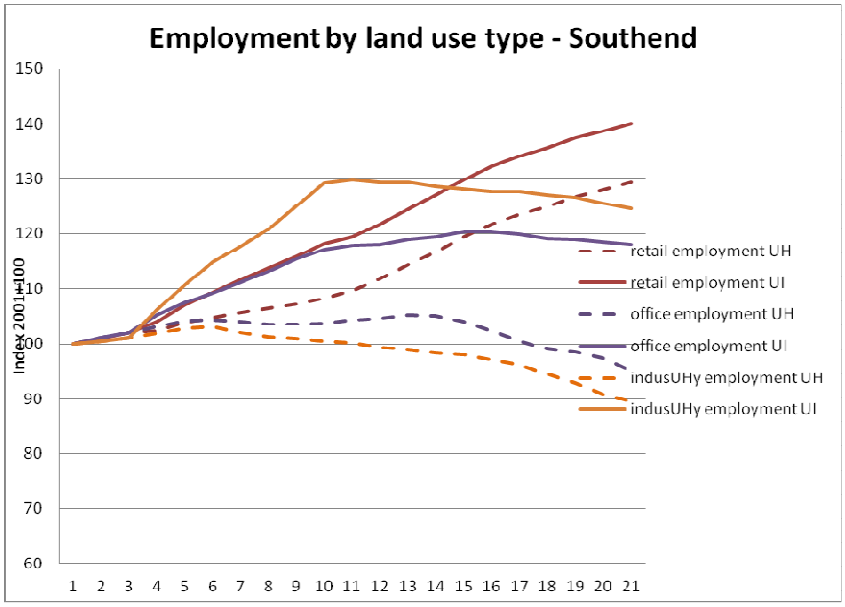

Figure 4 Employment by land-use type - Southend

The purpose of the final model run (Test UJ) is to isolate the growth in population, households and employment that is a direct consequence of the accessibility changes (and hence to isolate the growth that is the result of redevelopment and intensification that occurs in response to the accessibility changes. Test UJ has the same generalised costs as Test UI (with the reduction in costs between Southend and London) but the same development processes and levels of development as Test UH.

Table 3 compares the headline figures for Tests UJ, UI and UH whilst Table 4 draws out the key information for Southend.

Table 4 implies that of the additional 13,715 persons resident in Southend, 6,777 are as a consequence of the improved accessibility, that makes Southend a more attractive location to live (due to increased employment opportunities) and 6,938 are a result of the additional development that comes forward following the transport intervention.

In employment terms, the improved accessibility resulted in an improved employment scenario in Southend. Relative to a marginal employment growth of 5% or 3,200 jobs in absolute terms in the base case for Southend, the model is forecasting over 11,000 additional jobs as a result of the better accessibility and associated development. More specifically the improved accessibility results in additional floorspace being developed and over 4,500 extra jobs being located within the town.

Table 3 Comparison of forecasts for Tests UJ, UI and UH

Measure	Area	Test	2001	2021	increase	%
Population	Southend	UI	157,232	244,656	87,424	56%
		UJ	157,232	237,718	80,487	51%
		UH	157,232	230,941	73,709	47%
	South Essex	UI	626,009	830,141	204,132	33%
		UJ	626,009	829,938	203,929	33%
		UH	626,009	828,670	202,661	32%
Households	Southend	UI	70,980	108,154	37,174	52%
		UJ	70,980	105,459	34,478	49%
		UH	70,980	104,096	33,116	47%
	South Essex	UI	265,884	374,276	108,392	41%
		UJ	265,884	374,181	108,297	41%
		UH	265,884	373,647	107,763	41%
Employment	Southend	UI	61,161	75,678	14,518	24%
		UJ	61,161	71,132	9,972	16%
		UH	61,161	64,361	3,200	5%
	South Essex	UI	233,118	282,252	49,134	21%
		UJ	233,118	282,066	48,948	21%
		UH	233,118	282,151	49,033	21%

Table 4 Comparison of Tests - impact upon Southend

Measure	UI-UH	UJ-UH	UI-UJ
Population	13,715	6,777	6,938
Households	4,058	1,363	2,695
Employment	11,317	6,771	4,546

CONCLUSIONS

Transport modelling frequently bases demand upon current trend and committed development that is based upon short or medium term land use plans. In this paper we have argued that this may only give a partial picture. Whilst current development is critical transport modellers ought to be aware of the other development that is likely to come forward either through re-development and re-use of existing sites in built-up areas or as planning policies evolve or respond to transport interventions.

The model runs described in this paper demonstrate firstly how changes in accessibility may influence the distribution of population, households and employment and secondly that whilst some of this increase may come about through intensification of use within existing employment and/or household

floorspace a significant proportion may be as a result of the additional development that comes forward in response to a transport intervention.

In this instance the model forecasts suggest that by 2021 the additional impacts of the transport improvement due to induced development represent a 7.4% increase in employment and a 3.7% increase in households (as percentages of the base year numbers). In percentage terms this may appear modest, in absolute terms it may be a significant addition to a town such as Southend. To put our conclusion another way, we believe that the impacts of transport changes are likely to be significantly under-estimated if the analysis assumes that planning policies will wholly prevent developers responding to the resulting changes in demand.

ACKNOWLEDGEMENTS

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[1] Planning Policy Guidance 13: Transport DCLG revised Jan 2011

[2] Scottish Planning Policy , The Scottish Government , 2010

[3] Generalised Costs are a calculation of the combined cost and time of travel between two zones (origin and destination).