RESHAPING SUBURBS

A report produced as part of the EPSRC SOLUTIONS project - the sustainability of land use and transport in outer neighbourhoods

University of the West of England
BRISTOL

The cover pictures are of Bradley Stoke, Bristol, and Vauban, Freiburg, Germany. They represent two extremes of car dependence. Around Bradley Stoke the businesses are 95% car dependent, and people living there use the car for 80% of 'local' trips. By comparison the residents of Vauban use the car for 10% of trips, and 70% are by foot or bike. The Bristol suburb is designed as a series of single use campus-style development pods, linked by main roads. The Freiburg suburb, on re-used land, is designed as a mixed use low-car, green environment around a public transport spine. The physical differences mesh with the divergent values and lifestyle choices of the inhabitants, reinforcing them, building unhealthy conditions into the very fabric of the town in one case, while facilitating healthy and sustainable behavioural choices in the other.

A study tour of Freiburg, funded by the Director of Health South West, was organized as part of the SOLUTIONS local design work.

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Reshaping suburbs for local and global health

Preface

According to one estimate 86% of England's population live in suburban areas (Civic Trust 2002). Yet until recently the planning of suburbs was a largely forgotten agenda. Suburbs were assumed to look after themselves. The government has not had an explicit policy for suburban or exurban areas. Rather it has relied on the application of general policies of urban compaction, mixed use, higher densities and brownfield development. However at the same time many urban edge areas have actually experienced something quite different: a continuation of the late twentieth century model of lower density, single use, campus style developments, especially in relation to commercial activity.

The outcome has been increased car-dependence, reduced levels of healthy active travel, and the effective exclusion of many non-car-users from the opportunities and facilities that the car owning majority take for granted. Despite the rhetoric of "sustainable communities", therefore, there has been little if any progress towards sustainability in outer city areas. Part of this failure relates to a lack of awareness of how best to shape suburban areas as they evolve. With the notable exception of some contemporary designs for new urban extensions, there has been a conspicuous gap in practice and research as to what local urban forms work best.

This paper reports on research which attempted to fill that gap. The research examined a range of suburban, urban fringe and exurban localities in three different city regions: London, Cambridge and Newcastle. Localities selected were identified by local authority partners as having potential for growth over the next 25 years. The localities were analysed in terms of their spatial form, the levels of accessibility afforded to residents, and the behaviour of residents in using and accessing local facilities. Then alternative neighbourhood designs were devised and applied to the localities. The designs were inspired by different urban design philosophies and practice. The research evaluated these options for their likely feasibility and sustainability. The social aspect of sustainability is a particular theme, i.e. the degree to which different designs are likely to provide for local needs, are socially inclusive, and promote health and well-being.

The work reported here was part of the SOLUTIONS research project, which was concerned with the Sustainability Of Land Use and Transport in Outer NeighbourhoodS. This was funded by EPSRC as part of the 'sustainable urban environment' (SUE) programme. It ran from 2005-2009 and involved a consortium of universities including Cambridge, Leeds, Newcastle and UCL. The main focus of the SOLUTIONS research concerned analysis of strategic land use and transport options for greater compaction or dispersal. The same three city regions were studied at this broader level and the interrelationship between planning at the strategic and the local levels was an important component of the research.

This report concentrates on the results of the 'local design' element of SOLUTIONS, undertaken by the University of the West of England, and focuses on suburban neighbourhood form. It compares traditional neighbourhood forms with modern cul-de-sac layouts and linear alternatives. The conclusions are salutary: the optimum neighbourhood form in terms of both feasibility and sustainability depends strongly on context. Traditional neighbourhood designs were sometimes appropriate. Modern cul-de-sac, campus style developments were never appropriate. Linear forms often performed best.

The research also demonstrates that in most cases, current policy has sacrificed good, healthy, sustainable neighbourhood planning on the altar of pragmatism.

Hugh Barton
Director of the WHO Collaborating Centre for Healthy Urban Environments

Further details on the case studies and the whole SOLUTIONS researcg programme can be found on www.suburbansolutions.ac.uk

1. Research aims and process

This report deals with the outer city at a neighbourhood level. It offers a perspective on the future of suburbs. Its central purpose is to explore the appropriate shape and structure of neighbourhoods so as to achieve healthy, inclusive and sustainable suburban environments.

Policy context

The government does not have an explicit policy for suburbs (Kochan 2007). Planning Policy Statements take a broad brush approach, advocating mixed use, higher density compact development without examining what this might mean at a more local level. The Urban Task Force went further in its 1999 report, advocating high density levels and close knit neighbourhood clusters for outer urban as well as inner urban development. The Task Force picture is in tune with the general principles (though not the precise specification) of the urban village movement in Britain, and the new urbanism movement in the United States. Both stress the concept of compact walkable neighbourhoods with mixed housing, permeable grid-based networks, a core of local facilities and good public transport connections. The same principles, but generally at lower dwelling densities, underpinned the earlier British new town model of 'neighbourhood units'. All contrast markedly with what has actually happened in the last thirty years. British outer suburbs and exurbs are characterised by hierarchical road networks designed for ease of car use, land use segregation, cul-de-sac housing layouts (until very recently) and campus-style commercial and institutional development. This pattern can be observed around European and American cities as well and commonly termed 'urban sprawl' (European Environment Agency 2006).

It is well attested that this pattern of suburban and exurban dispersal leads to increased car dependence (Halcrow Group et al 2009; Furguson and Woods 2010). Attendant on that dependence are lower levels of active travel and the disenfranchisement of people without access to a car. But the claims of the alternative forms to be more sustainable and inclusive are not all proven (Bramley 2006). There is an assumption behind government policy that higher residential densities and permeable street networks will create sustainable communities. There is an assumption behind the Urban Task Force compact model that it will not only improve local accessibility and social interaction, but that it is a practical way forward. There is little analysis of how, in practice, suburban areas can evolve spatially so that greater sustainability is achieved. In other words there is a research gap.

Research aims

1. Suburban retrofit

The first aim was to assess whether suburban and exurban localities that mostly exhibit unsustainable patterns of behaviour could be 'retrofitted' for sustainability. The intention was to choose areas where further expansion was planned so that there was a real opportunity for the development of new, more effective, spatial forms. The emphasis within the broad sustainability agenda was on accessibility: the ability of households to access local facilities by foot and public transport systems and reduce their car dependence.

2. Neighbourhood form

The second aim was to contribute to theories of neighbourhood form. The research would identify basic spatial form alternatives, such as those emerging from new town plans and proposals from the Urban Task Force (1999) that could then be used as starting points for the redesign of suburban and exurban localities. The research would assess the degree to which, in real situations, these model forms could deliver a step change in key sustainability criteria.

3. Strategic policy

The third aim was to provide a local perspective on the main strategic studies of SOLUTIONS. The strategic modelling of the three city regions undertaken by partner universities provided a low level of spatial articulation – particularly in the cases of London and the Greater South East and Tyne and Wear. The local studies, while not predictive in the same way, could give insight into the local interpretation of broad strategy and evaluate feasibility and aspects of sustainability performance, drawing on discussions with local partners and stakeholders as well as design analysis. This strategic/local analysis is not included in the report. It may be seen in chapter 7 of the final SOLUTIONS report on the website.

The research process

The local design research process is illustrated in Figure 1. It was a exploratory and design-led process, applying basic neighbourhood design archetypes (emerging from the literature) to local study areas, and assessing their effectiveness. The support and involvement of the local planning authority was critical to the choice of area, the baseline data and subsequent assessment. Another important input to the baseline situation was the neighbourhood household survey, which was undertaken in parallel (see section 3).

The archetypes cannot normally be directly transferred to actual suburban situations. They have to be adapted and adjusted to reality as possible scenarios of development. The process of deriving the optimum scenarios in each study area is a creative one – essentially experimental. In some instances a number of plans were devised and then rejected or adapted by the designer before submission to more formal evaluation. In some cases the degree of distortion means that particular archetypes could not be applied.

The scenarios were assessed by a combination of quantitative and qualitative measures, involving the design process, GIS analysis and stakeholder workshops.

- Spatial feasibility was assessed through the design process: is it possible to devise a workable scenario based on the particular archetype? How well does it fit with the land available, the transport networks and the configuration of existing activities?
- Sustainability was assessed primarily from the viewpoint of local accessibility: is the scenario likely to support local facilities and what proportion of households will be living within convenient walking distance of them? The facilities include public transport services, schools, local/district centres and open space. Accessibility was assessed through GIS using a simple threshold approach. Accepted walkable distances were adopted from Shaping Neighbourhoods (Barton et al., 2003), for example 400m to a bus stop and 800m to a local shopping centre.
- Market feasibility and political acceptability were assessed through stakeholder workshops: is the market likely to respond positively to the opportunities presented by the scenario? Will local public and political interests respond positively or negatively to the scenario? Two main stakeholder workshops were run in each area, one early in the process, when baseline data was available and possible scenarios being considered; the other late in the process, when competing scenarios could be evaluated.

The three city regions were studied in sequence, and performed different roles in the research. Cambridge, which was tackled first, provided the opportunity for refining and testing all the neighbourhood forms in a range of situations. Some consistent findings emerged in relation to the strengths and weaknesses of the designs. The London study areas were much larger in order to fit with the requirements of the SOLUTIONS strategic modelling. Because all three areas were substantially built up already, they provided insights into current trends, future plans and options in a constrained situation. The Newcastle study areas then allowed various provisional conclusions from Cambridge and London to be tested further.

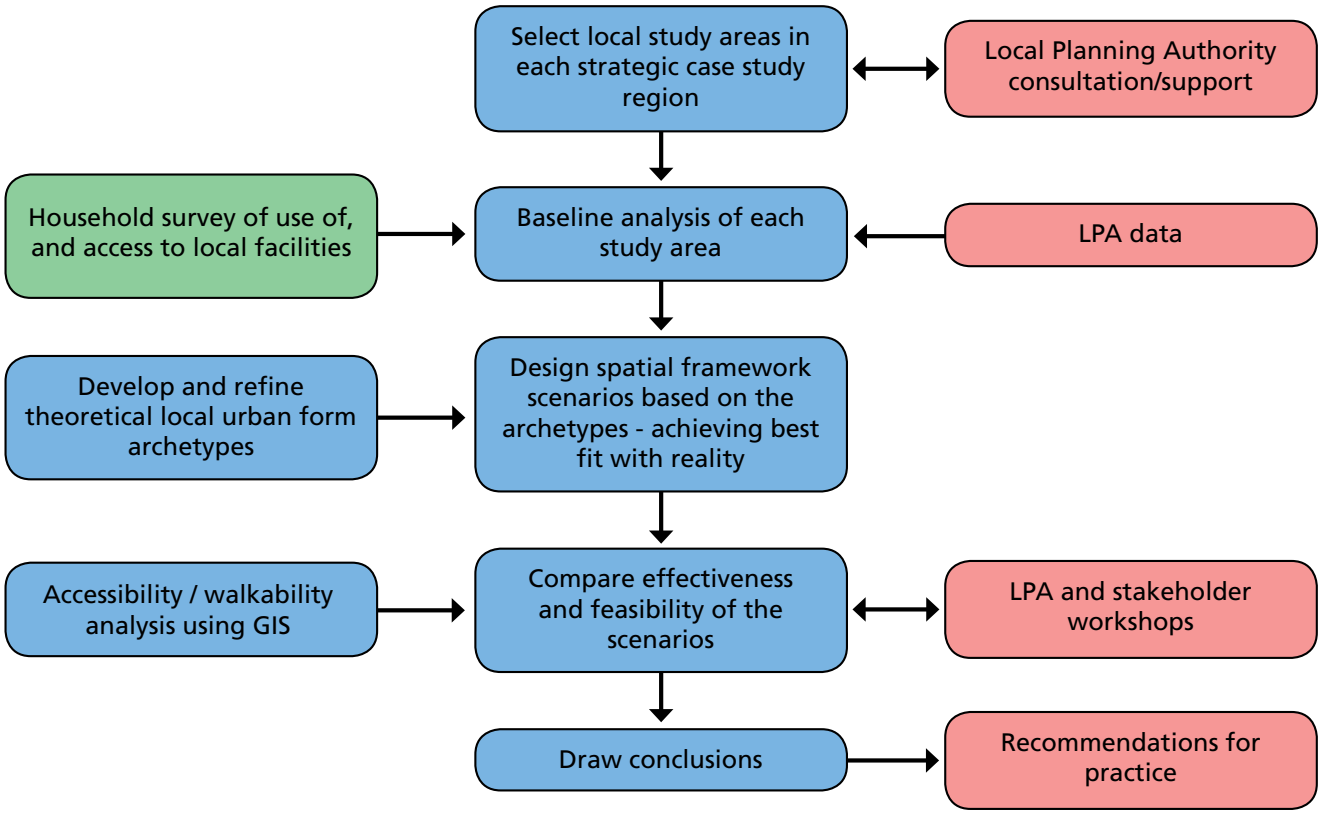

Figure 1 *The local design research process*

The content of the report

The report is structured to reflect the conclusions in relation to different settings (new settlement, urban extensions etc) rather than the sequence in which the work was done. It starts by setting out the rationale and character of the local study areas. It then reports briefly on the findings of the parallel empirical research which illuminates household behaviour in each study area (section 3). Then after presenting the neighbourhood design archetypes, the report examines their application in the series of different locational settings represented by the study areas: new settlements, urban extensions, the urban fringe and established suburbs. The new settlement setting is examined first because it is generally the least physically constrained location and allows the neighbourhood typology to be systematically explored. The subsequent settings are progressively more constrained by the patterns of existing development, so that the possibility of applying urban form theory is limited.

The overall conclusions (section 10) are oriented towards practice. What lessons emerge from the research?

2. Local study areas

The quality of the research depended in part on working closely with local authority partners who could provide data, insight and practical knowledge, also assisting by drawing in other local stakeholders to project workshops. The partners worked with the research team to identify study areas which could both be illuminating for the research and potentially of benefit to the local authority in its future policy making. The involvement of local partners was valuable in giving greater realism and a practical perspective to the research. But it also proved problematic in some cases because of local political sensibilities. Several partners that were involved early in the process later withdrew as they perceived the research could open up policy debates which might compromise the prevailing policy stance. This was particularly the case in relation to the London case studies.

The actual choice of study areas was therefore a matter of negotiation. Nine case study areas were selected – three in each of the three city regions. Selection was based on a number of criteria:

- variety in terms of location (commuter settlement, urban fringe, established suburb) and socio-economic characteristics
- opportunity for significant new development and/or restructuring of the development pattern
- a range of planning contexts, from plan-led to development-led
- the wishes of local authority partners
- coincidence with individual land use and/or transport zones in the LUTM used by SOLUTIONS.

The study areas are briefly described below. They vary greatly in scale across the three city regions in order to accord with LUTM zone size (thus potentially allowing statistical comparisons) and reflect context – from 5-10,000 population, or roughly equivalent to one neighbourhood, in Cambridge, to 60-80,000 in London. This variation has necessitated different approaches being adopted in the case study cities.

Cambridge

- Northstowe – proposed new town of 20-25,000 people to the north-west of Cambridge, within easy commuting distance, designed to take the pressure off the rapidly growing city – mainly occupying a former airfield, and adjacent to two existing villages. Proxy survey area: Bar Hill (an existing exurb with a local centre).
- Cambridge Southern Fringe – mixed age development along two southern radials, based around Trumpington village and Addenbrookes hospital – very varied population – some facilities locally and the shortest average trip distance of any survey area.
- Cambridge East – proposed major urban extension, close in to the city, on existing airport site – plans for a new cultural quarter – proxy survey area just to the south: Cherry Hinton – with the highest share of non-motorised trips of any survey area.

Figure 2 *The Cambridge study areas*

London

- West Barking – established suburb of mixed age, mainly early to mid twentieth century, including Barking town centre – the poorest area studied, with the highest proportion of social housing and the lowest car ownership – under-going planned regeneration as part of the Thames Gateway.
- Broxbourne – linked 'exurban' settlements to the north of London of varied age including late twentieth century, strung out along the A10, cutting through the green belt – socially mixed population with very high car ownership and the highest car dependence of any study area – current plans relatively short-term and based on infill.
- South Harrow – archetypical, well-established suburb – early development around tube stations and later (mid century) low density semi-detatched filling in all around – mixed population, some very affluent, with strong Asian minority – plan largely based on pockets of higher density renewal.

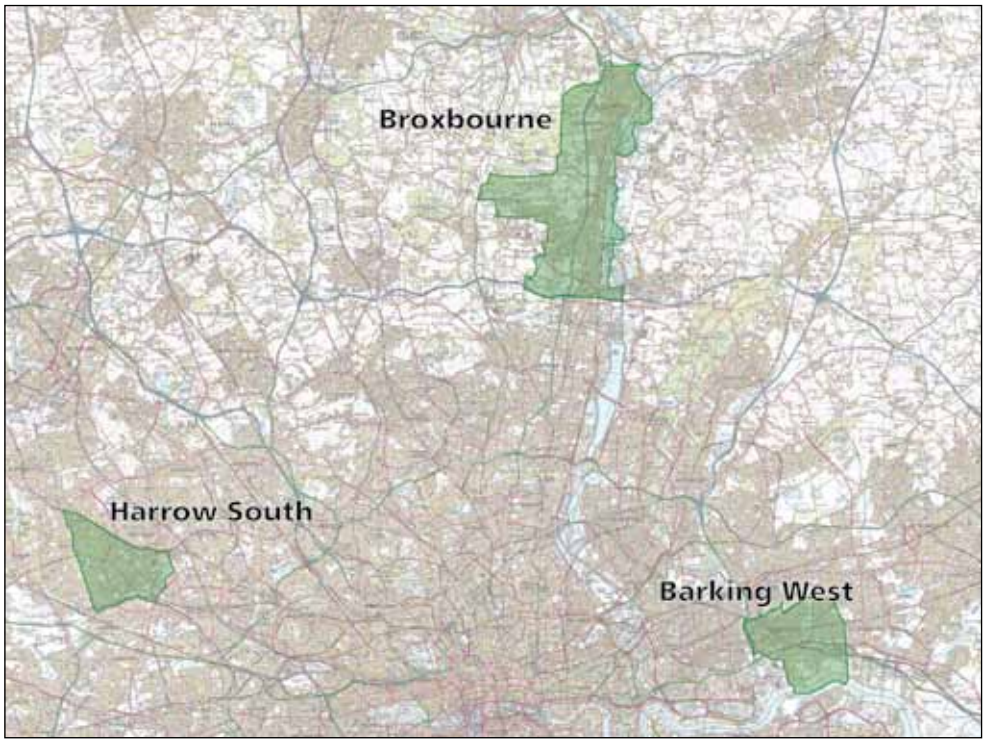

Figure 3
The three London study areas

Tyne and Wear

- Newcastle Great Park – major urban extension to the north of the city, straddling the A1 trunk road, partially built – relatively rich with high car ownership.
- Backworth and Shiremoor – urban fringe area with sporadic pattern of development including old mining villages, council estates and more recent private-ownership estates – mixed population, relatively deprived but quite high car ownership.
- Scotswood – partly nineteenth century terraces, partly early twentieth century suburb – very substantial areas demolished, some rebuilding to a long term regeneration plan – poor population, high deprivation.

Overview

The original hope was to study one established suburb, one urban extension and one new settlement in each city region and this is reflected in the choice of the three Cambridge study areas (see Table 1). In the event it was not possible to achieve this – for the reasons explained above – in the other city regions. Scotswood was a late choice and is excluded from the analysis here for two reasons: it can only marginally be classified as 'suburban' rather than 'inner urban'; and we do not have data about resident behaviour that is available in the other areas. Nevertheless across the remaining eight areas there are striking contrasts and parallels, and together they present a good test of alternative design strategies.

Figure 4 *The Tyne and Wear study areas*

Locational settings	**City regions**		
	London	Cambridge	Tyne and Wear
New settlement		Northstowe	
Major urban extension		Cambridge East	Newcastle Great Park
Urban fringe	Broxbourne	Cambridge Southern Fringe	Backworth and Shiremoor
Established suburb	West Barking Harrow South		Scotswood

Table 1 *Study areas and their locational settings*

3. The SOLUTIONS household survey

All the eight remaining local design study areas are paralleled by household surveys, the results of which are reported on the SOLUTIONS website under the title *Active travel patterns and neighbourhood accessibility*. Except for the two Cambridge study areas noted above (where nearby localities provide an insight into possible behaviour in proposed settlements) the survey provides direct insight into local behaviour. It also included four other neighbourhoods, one a new town to the north of Newcastle, the other three an older suburb, an urban extension and a commuter town in the Bristol area.

The survey captured responses from 1600 households at a response rate of about 30%. Comparing the results with those from the National Travel Survey, the survey covered 45 % of total household trips, and shows a good match with the NTS where the two surveys coincide in terms of trip purpose. The survey areas vary widely in spatial characteristics and in social mix, giving a fair representation of current suburban/exurban behaviour.

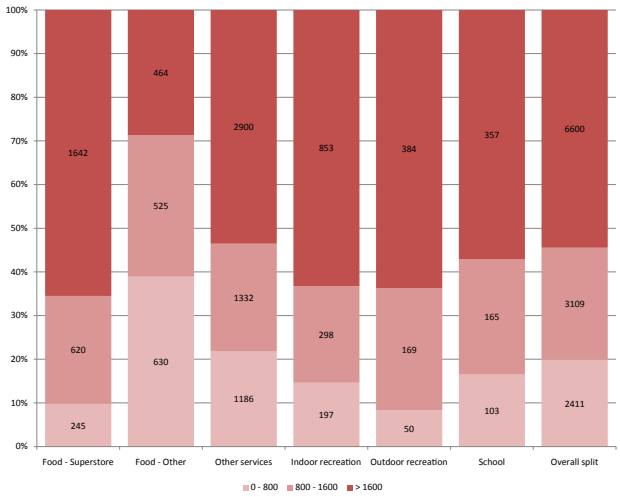

Figure 5 *Trip distance bands by facility type*

One general finding of this research is the alarming degree to which most of the suburbs and exurbs surveyed are not offering adequate local services locally, and are therefore highly car dependent. The first chart shows the proportion of trips made for different purposes that are within 800 metres (circa two thirds of trips on foot) and 1600 metres (circa one third of trips on foot). The second chart shows the proportion of active travel trips by distance band for all purposes studied. The implications of this paucity of local facilities for levels of active travel, for social exclusion and for emissions are evident and re-emphasize the need for suburban sustainability retrofit.

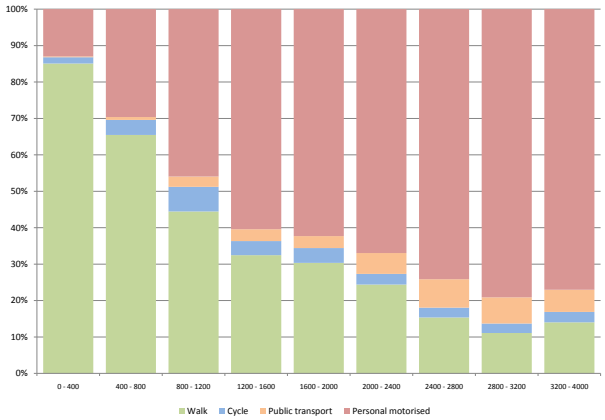

Figure 6 *Modal split by distance band for all trips*

Figures 5 and 6 sum the results across all twelve survey areas. This is not entirely a fair picture. An important finding is that the behaviour of residents in the different suburbs and exurbs varies very significantly (see figure 7). There is no standard pattern of car dependence. The level of personal motorised transport use varies from 36% to 82%, while conversely active travel varies from 62% of trips to 18%. Four of the original 12, Cherry Hinton, Trumpington, Filton Avenue and Barking, stand out as having higher levels of walking and cycling than the norm. Analysis of the data – both socio-economic and spatial – reveals some of the reasons. The first two are in Cambridge city, where facilities (including one superstore apiece) are reasonably close and there is a distinctive culture of cycling, not reflected in the other areas. Filton Avenue in Bristol has no such culture, but the most convenient disposition of facilities of the set. Barking study area is unusual in having quite long trip lengths but high levels of walking. This reflects on one hand the relative poverty of the area, and lower car ownership, and on the other, poor levels of local facilities. Many people in Barking have no choice but to walk well over a mile to get to vital facilities.

At the other end of the spectrum is Broxbourne. The surveyed area in Broxbourne is an area of suburban sprawl (a legitimate term in this case), lacking focus and poorly related to the main urban area. It shares with two of the other areas surveyed (Bradley Stoke and Cramlington) a layout based on the assumption of full motorization.

The factors which stand out as critical in determining the level of active travel and car use are distance to facilities and levels of car ownership. The latter accounts for much of the variation between households, but – because high car ownership is now widespread even by those on modest incomes – it does not generally account for the variations

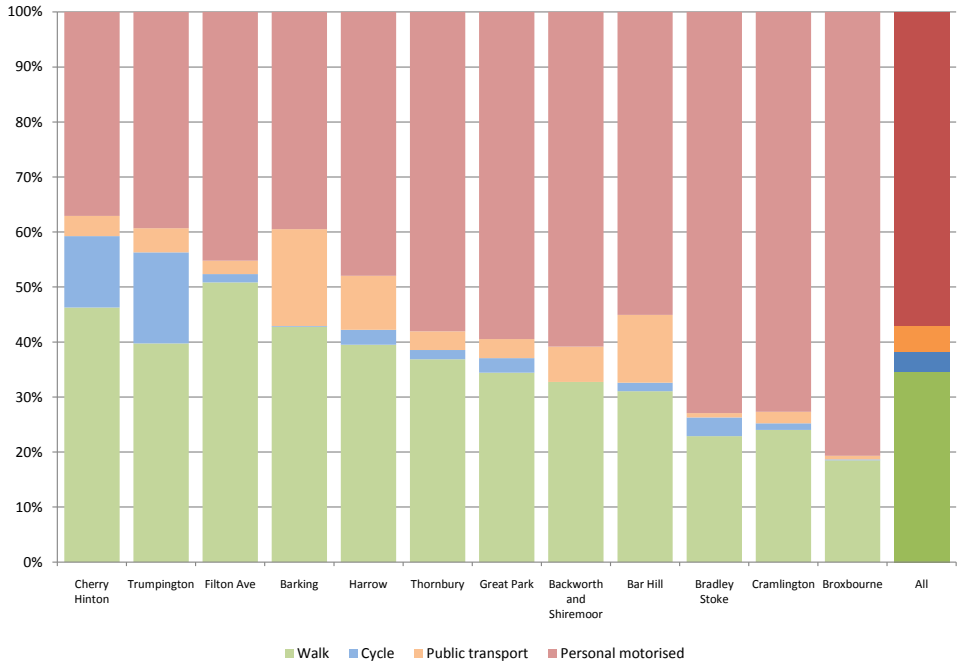

Figure 7 *Modal split in each study area in rank order of active travel*

between places (the exception is Barking West, as noted above). By–an-large people in all areas rely on their closest facility, so the actual location of facilities (superstores, other food shops, convenience services, schools) in relation to homes is very important. Together these trips account for 94% of the trips reported. There is a different pattern for recreation and leisure trips (the remaining 6%) – both to facilities like pubs, clubs and restaurants, and playing fields, parks, woods. In these cases facilities tend to have specialised characteristics and often people do not choose the closest.

Across different neighbourhoods and different social groups there is a surprising degree of consistency of behaviour in relation to the distance people are prepared to walk, and their choice of mode according to distance. For example respondents in two suburbs of Bristol, one with very high car use and the other relatively low, the difference in modal choice is not because one community is willing to walk much further than the other, but because the number of facilities within easy walking distance is very different.

It is also note-worthy that the variation in facility provision is not due primarily to the factor most commonly highlighted in the literature – i.e. density. Figure 8 relates gross density of the residential area surveyed (excluding extraneous zones) with the level of active travel, and demonstrates the weak relationship. The age of the area, urban form and street pattern are much more significant. Neighbourhoods that have an integrated and interlinked form, and a permeable street pattern, perform the 'best'. Those based on segregated site development and tree, or cul-de-sac layouts, perform the 'worst'. This conclusion is consistent with (and goes further than) other recent studies in America (Lee and Moudon 2008).

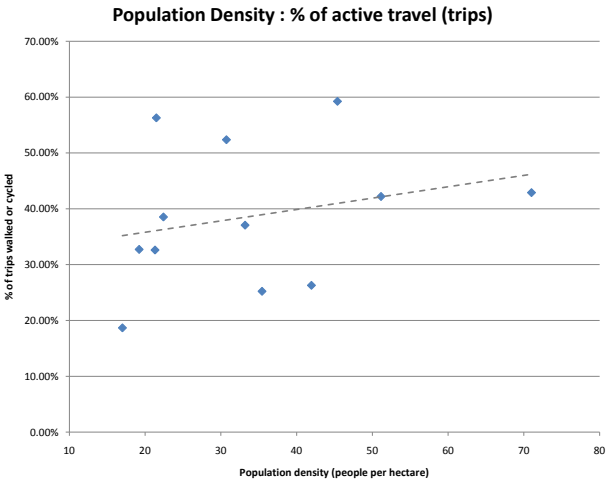

Figure 8 *Scatter diagram of neighbourhood density against percentage of active travel*

There are clear lessons from the empirical study. Local urban form is important. If neighbourhoods can be planned so that facilities are viable locally and accessible by foot – within certain distance thresholds – then there will be more active travel, a more socially inclusive environment and greater opportunity for people to cut car use and carbon emissions. The potential contribution of local trip making is not marginal – 45% of trips were captured by the survey, and that did not include all trips that could be local (for example visiting other people's homes). This belief, underpinned by the results of the household survey, is central to the evaluation of alternative long-term designs for the study areas.

4. Neighbourhood design archetypes

Four basic archetypes, representing contrasting neighbourhood forms, have been selected from study of current and traditional practice in the UK. They are derived from distinctions drawn by Barton in Sustainable Communities (2000) and amplified by Barton, Grant and Guise in Shaping Neighbourhoods (2003). Three are promoted by various advocates as good models of neighbourhood form: the neighbourhood unit or cell, the high density neighbourhood cluster, and the linear township. One is based on prevailing practice in the late twentieth century: car-oriented campus and cul-de-sac development, which we have called "pods". In order to clarify their distinct characteristics, the archetypes are described in this section in their pure form. Later, when they are applied to real situations, some distortion of the pure form is often inevitable.

The archetypes once applied give rise to a series of development scenarios. Each archetype can be used to describe existing forms as well as proposed forms, and derives from a different development or design philosophy.

"PODS": use-segregated, car-oriented, campus and cul-de-sac developments

This pattern of use-segregated dispersal is typical of many outer city areas developed in the last 40 years. Particular sites are developed independently for different purposes, with no attempt at neighbourhood planning. They are campus-style developments, of very varied sizes, with buildings typically surrounded by car parks and landscaping. Each pod is separately accessed by cul-de-sac or loop-road off the main road system, so that there is no or limited direct connection between them. They may be business parks, retail parks, schools universities, hospitals, or industrial estates. Residential areas may also be pods – limited access estates, lacking local facilities, gated if affluent.

This form is the most versatile, in that it can be found in the widest range of scales and sizes. Single pods can be anything from 1ha, say a small residential development of 20 houses, to 500ha, a large business park campus. Since the pods are designed as independent developments, they can be found as one-offs, e.g. infill development, or spread over a wide edge-of-city area, offering many of the activities of a town, but without the spatial integration or pedestrian accessibility that makes a town function.

The structure of land ownership and the hierarchy of road systems tend to shape the pattern of pod development (see Figure 10). Within that context market forces play a very strong role. Attributes such as size, density, use, access and building type, are market led. Socially driven agendas such as provision of public open space, community facilities, quality of the public realm are only addressed where regulation dictates or local planning places constraints.

Figure 9 Pods

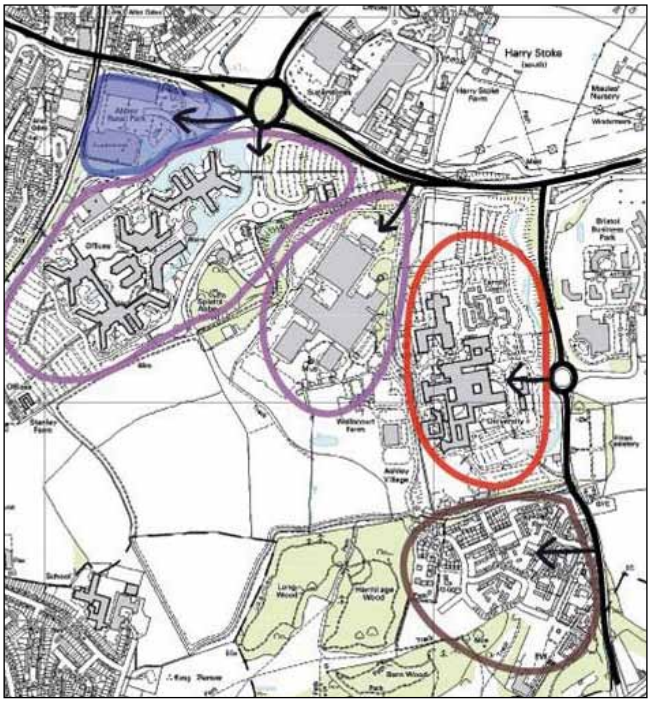

Figure 10 Large pods in North Bristol

"Cells": neighbourhood units, locally self-sufficient

The cell archetype is very different in that it stems from community design principles rather than engineering or market principles. The "neighbourhood unit" was the term used in the mid-twentieth century, especially by the British new towns movement, to signify a distinct, bounded,

residential area with a local centre (the 'nucleus' of the cell). The size range, as illustrated in new and expanded towns is 4-10,000 people, and is defined by walkable distance. Many outer city estates, especially mid century council estates, adopted this model. It can also be equated with village communities, and like a traditional village it should be centred on some local shops, a school, pub, church and community centre. It still provides the common image of a "neighbourhood".

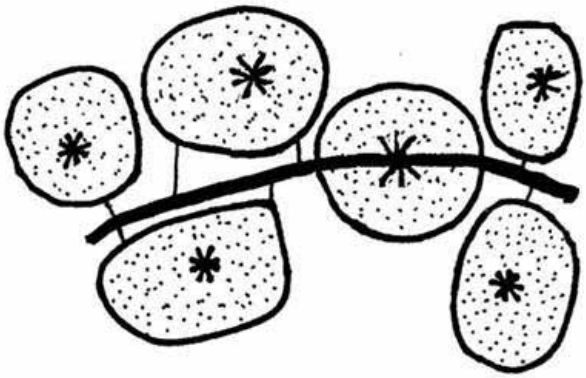

Figure 11 Cells

Cell neighbourhoods come in a variety of forms. The normal image is of a 'closed cell' (Barton, 2000), with main roads, industrial areas, open space and playing fields defining a distinct boundary, giving it a separate identity from adjacent areas. Such neighbourhoods may sit astride a main distributor road ('on-line') or lie to one side, with limited access ('off-line'). The latter are distinguished from simple pods by their mixed-use character.

The on-line neighbourhoods are more integrated than the off-line with the rest of the town, with the potential for more direct bus services and a local centre able to benefit from passing trade. In many actual situations an on-line cell is not physically separated from surrounding localities: permeability is greater, so although there is a clear core area its edge is fuzzy. This may be called an 'open cell'. It can be equated with the 'transit oriented developments' (TODS) of American planning, where a main public transport stop provides the focus for a cluster of local facilities and medium density housing within the low density suburban sprawl.

The cell neighbourhood is more restricted in size range than pods, and normally much bigger. Its scale is given on the one hand by the need to support local services, and on the other by the distance that is walkable.

The design parameters vary according to context. For example a neighbourhood based on a secondary school will be larger (say 8,000 people) than one only supporting a primary school (say 4,000 people). The accessibility standard used by designers (the distance from edge to centre) conventionally varies from 400 to 800 metres. Density, too, can vary. Early designs for last century, aspiring to the 'garden city' image, were low density. Better accessibility and environmental sustainability can be achieved when density is graded with higher densities towards the centre.

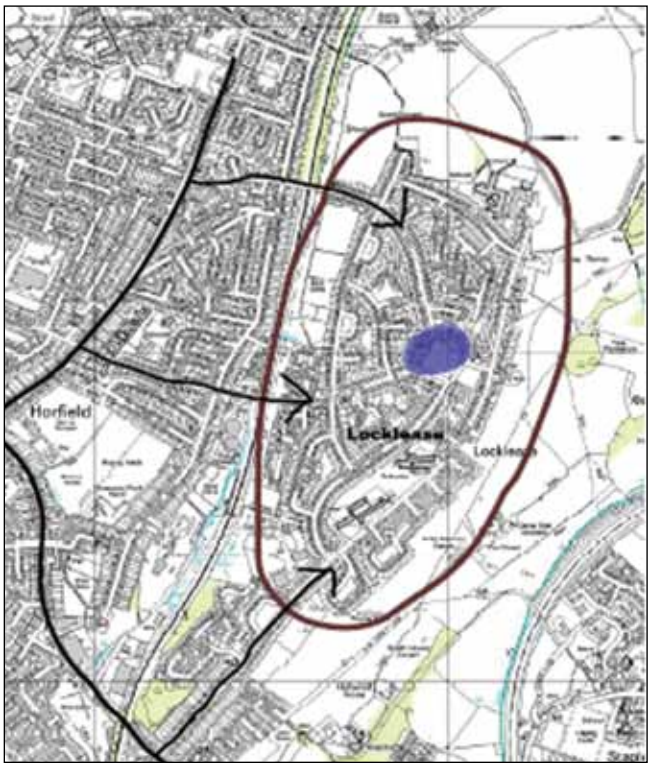

Figure 12 Mid century neighbourhood cell in north Bristol

"Clusters": a group of interlocking neighbourhoods

The cluster is a further development of the 'fuzzy' open cell model. But unlike the separate cell neighbourhoods, these neighbourhoods are clustered and interpenetrating within a wider urban district or township that provides higher level services. They form part of the urban continuum of the town. Each neighbourhood has its own local centre but is also tributary to a district centre serving the whole cluster of, maybe, 30,000 people – sufficient to support a good range of services and jobs. This model has been powerfully advocated by the Urban Task Force (1999) as a means of achieving inclusive, sustainable, less car-dependent suburbs. It relies for its viability on much higher densities, so that there are sufficient people to support both local and district centres within a walkable distance – say 300-400 metres maximum to the nearest local centre and 900-1200 maximum to the district centre.

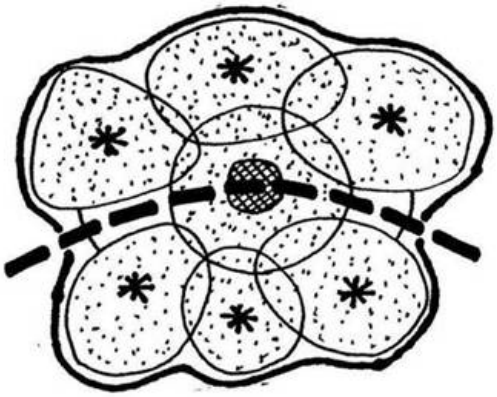

Figure 13 Clusters

This archetype does not currently exist in outer city areas. It is evident in some inner cities (see Figure 14), though always in a rather distorted form, and frequently suffering from declining population. The idealised pattern of 6 tributary cells and a hub would make seven cells of 4000 totalling 28,000. Density is graded with higher densities towards the centre of each open cell. The district cell has the highest densities, matching those of the local centres at its periphery but grading even higher towards the core. In the interstices between the cells, lower density uses such as schools and green open space are sited.

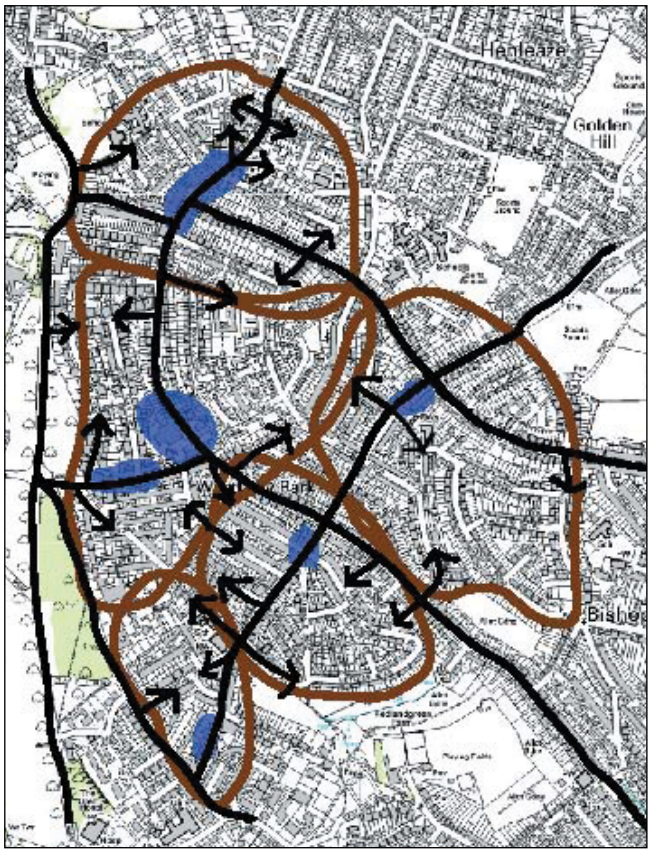

Figure 14 Cluster of overlapping neighbourhoods in north Bristol

"Linear Townships": linked neighbourhoods along a high street spine

The linear form is evident in many older suburban areas where development occurred along main radials well served by tram or bus. In this archetype the neighbourhoods may merge into each other and rather than being centred on a local centre, they are bounded by the 'uniting seam' of the high street. Some older high streets have declined because of falling hinterland population, congested streets and lack of parking, though others (such as those studied in South Harrow) are thriving.

The historic linear form has been adapted and re-defined in some new/expanded town designs – for example Peterborough – and advocated as a sustainable model because it aims to maximise public transport efficiency and the coherence of the green network (e.g. Tjallingii, 1995; Barton, 2000). The form is based on the supposition that for many purposes city (rather than local) trips are critical, and the structure of the town reflects that.

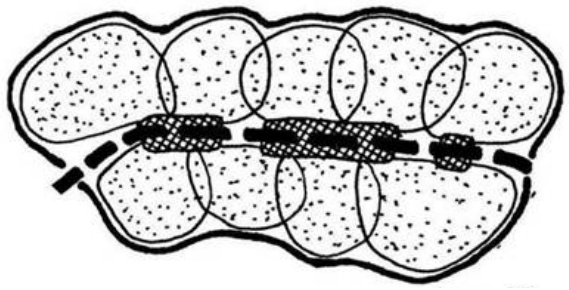

Figure 15 Linear

Density is graded with increasing densities towards a central public transport corridor and around transport interchange nodes (see Figure 7.16). Mixed use is found in these higher densities. Facilities are located on the central road corridor with some freedom of position. The lowest density is represented by a linear accessible open space should run alongside the township. This open land could also contain a parallel non-congested road bypassing the main central road but giving intermediate access to it. The central road will have the local traffic slowed down by the good access to shops and facilities.

As an urban continuum the form could contain populations of between 20,000 to 40,000, covering some 1 to 3 km. The linear form is not continuously even but characteristically displays a series of fuzzy neighbourhoods – the boundaries of which are dynamic in time. The diagram shows a 'single strand' of development but can also be developed as 'double strand' along two parallel transport routes. There are high levels of permeability (particularly for non-motorised movement) between neighbourhoods.

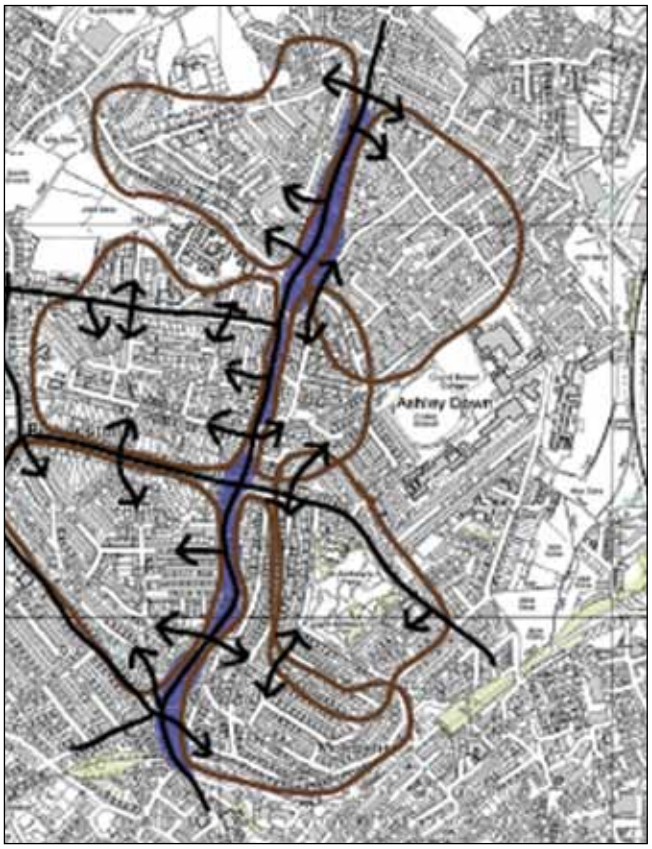

Figure 16 Linear township along a main radial, with neighbourhoods either side of the high street, in north Bristol

Applying the archetypes

The typology described above enables the planner to analyse the form of settlements at meso level: i.e. above the level of streets and blocks but below the scale of overall urban form. Abstracting to this level is important in order to understand the internal structure of the town and city. It is of course inevitable that some areas do not fall neatly into one of the four archetypes. Especially in suburbia there are areas of 'sprawl' that lack focus or shape. Equally there are areas which do not conform to the archetype but hint at it. There are many failed linear districts, for example, with a strong radial spine route but lacking the facilities that the local population in theory justifies. Having identified such a failed township it is then a question of why has it failed, and how could its apparent potential be realised.

The map of Hayes (London) in Figure 17 illustrates the application of the typology at a broad scale. The dominant features are the linked linear townships that have grown up along main roads – either historic radial arterial roads or streets giving access to an important station. To some extent these linear townships are paralleled by linked green spaces to their rear. There are no nucleated clusters of neighbourhoods, nor are there any planned neighbourhood cells. But there are many examples of pods – normally more recent development. Some are simply long cul-de-sacs, and may be part of a larger form. Others are whole industrial or residential estates with limited access points.

Once the basic forms are recognised, they can be used to trigger forward plans. In Hays the strength and importance of the linear townships is such that they need to be sustained and enhanced - despite their focus on main traffic arteries which compromise environmental quality. The parallel green spaces could be evaluated for the opportunity to intensify and grow into real neighbourhoods, and thus extend the proportion of the population with good levels of accessibility to facilities. There are other areas, often of more recent development, and including some pods, which look like potential cells. They were not designed as such, and currently lack adequate local facilities, but have the kind of layout and size that might make evolution into a cell feasible, given some renewal and new development. The isolation of the pods could be gradually reduced as development opportunities present themselves.

The Hays example covers a wide area. The map and diagrams of the Southern fringe of Cambridge in Figure 18 illustrate the application of the archetype analysis at a more local level. The main neighbourhood, Trumpington, is an on-line cell made up of a series of pods (mostly residential). The rest of the area is dominated by pods – including the huge hospital of Addenbrookes (to the right). It is clear that a key part of any planning strategy would be to increase permeability/connectivity, thereby shortening trip lengths and increasing potential pedestrian catchment for facilities.

Figure 17 Analysis of local urban form in Hays, West London (Green corridors, blue linear townships, red-pink pods analized through the route network pattern)

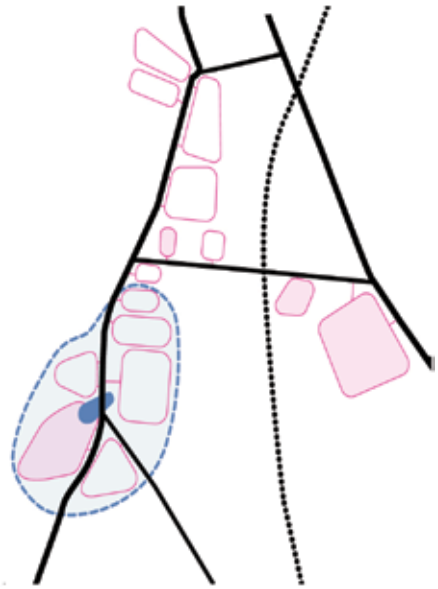

Figure 18 *The study area and local form analysis Cambridge Southern Fringe*
(Note the Trumpington neighbourhood cell with internal pods, and the huge pod of Addenbrookes Hospital to the east).

Key

Hollow red	- residential pods
Filled red	- commercial and institutional pods
Blue	- retail centre
Dotted blue	- online neighbourhood cell

5. Designing a new settlement

NORTHSTOWE

We now turn from principle to application. This section, focusing on the design of a new settlement, is intended to illustrate and clarify the nature of the archetypes, while at the same time shedding light on the question of the sustainability of a new town. The archetypes, in application, become scenarios for possible development patterns. Northstowe is ideal for this because it is the simplest case study – on a relatively straightforward, level site which can allow the archetypes to be expressed with minimum distortion. The typical advantages and disadvantages of each can therefore emerge clearly.

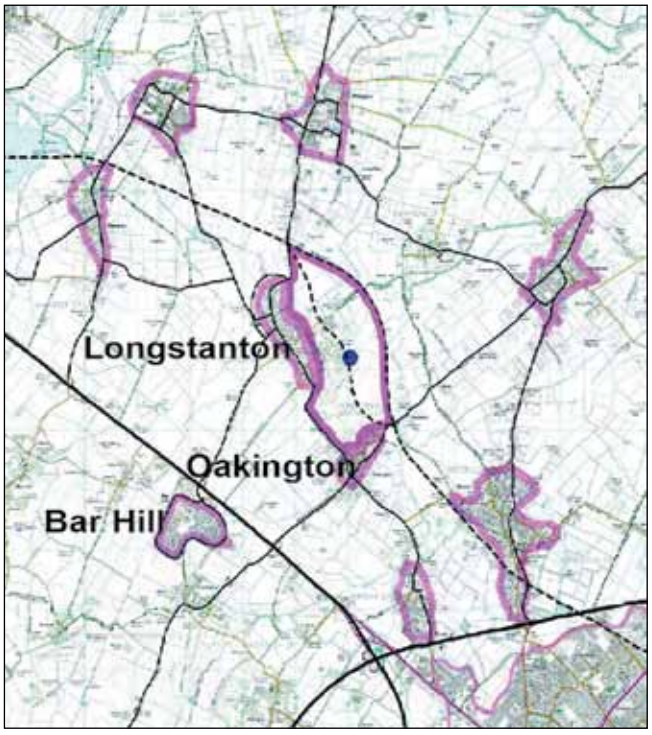

Figure 19 *Northstowe with surrounding villages and Cambridge to the south-east*

Northstowe, Cambridgeshire is particularly appropriate because it has been held up as a test bed for the idea of eco-towns. Lessons which emerge may well have application beyond the specific case. Northstowe is a new settlement to be built largely on open land. It allows further clarification of the nature of the archetypes. It is nine kilometres to the North East of Cambridge, adjacent to the existing villages of Longstanton and Oakington. The main justification for the location is the potential to reuse a brownfield site (an airfield) and to serve the settlement by a new guided busway on an old railway line linking to Cambridge. The site has a capacity of up to 10,000 dwellings. English Partnerships and Gallaher submitted an outline planning application in December 2007 for 9,500 new homes, a town centre, employment areas and schools to create a community of up to 24,000 people. Detailed planning applications were submitted for road links and improvements. The Cambridgeshire guided busway has since won grant and commenced construction.

In order to find a settlement which might give insight into future travel behaviour in Northstowe, we had to look beyond the adjacent villages. The household survey included the Cambridgeshire 'exurb' of Bar Hill, as a rough proxy. Bar Hill exhibited an unusual pattern of travel to 'local' facilities. Convenience trips were dominated by the huge local superstore: food trips were relatively short, as were primary school trips. However, many trips had to be much longer than average in order to reach facilities – mainly in Cambridge. The modal split was overall low for active travel (33%), high for public transport (19%) and average for private vehicle use (47%). The conclusion is that Bar Hill currently is not large enough to support a full range of local facilities, forcing longer distance travel. Bus services do, however, capture a quite large proportion of the longer trips because of the focus on one key destination: Cambridge city centre. This pattern of trips at Bar Hill could well indicate the future trip pattern at a partially completed Northstowe.

The new settlement of Cambourne (see Figure 7.20), also in the Cambridge hinterland, provides further insight. In some ways Cambourne is comparable to, and a direct precursor of, Northstowe. Research into the attitudes and behaviour of residents and local stakeholders are revealing (Platt, 2007). Most consider the settlement is overall a success, liked for the quality of its environment and its social milieu. But in relation to sustainability it has failed in several ways. First: the intended balance of jobs and people has not so far materialised; only 21% of people consulted thought the settlement was economically thriving. Second: the dominant pattern of out commuting has resulted in high car dependence (81%) by comparison both with Cambridge itself (42%) and with the rest of South Cambridgeshire District (78%). Third: the lack of a secondary school means reliance on bussing and reduction in local integration. Fourth: the lack of one strong centre compromises the ability of the settlement to offer town-level services.

Figure 20 Cambourne masterplan

Cambourne was designed as three linked 'villages' or neighbourhood cells, attractive in themselves. But the population of each cell is not sufficient to support many services. Even when combined it takes many years for key catchment thresholds to be reached, and meanwhile residents adopt habits of travel out of settlement, with consequent high car dependence.

The evidence from both Bar Hill and Cambourne is that new settlements do not easily establish themselves as towns, with a full range of facilities and work opportunities, restricting the options for residents. Longer distances are likely to be car based and overall car use high unless good and convenient bus services can be established. If we are to believe that Northstowe will be different from this, then the reasons will need to be compelling.

Applying the archetypes to Northstowe

Each of the archetypes was applied to the site in as consistent a way as feasible. The process of design was experimental – searching for good solutions that maximised the benefits while minimizing the disbenefits of the archetype. A number of features were held constant, so that the comparison between archetypes depended as far as possible on form.

- All scenarios protected valued environmental assets and ensured as good residential access to greenspace as the archetype allows.
- Public transport services were held constant. A high quality guided bus service (as planned in reality) was assumed through the length of the site.
- Commercial and retail facilities were optimally located in relation to the form and dominant transport modes.
- One secondary schools was located in a convenient central position for bus and bike access, normally adjacent to greenspace.
- Primary schools were provided in proportion to population (one per 4,000 people) and distributed as evenly as possible, always close to greenspace.

The pods archetype is market-led, so the whole new town area was allocated for development except for green buffers around the existing villages (figure 21). Each pod was treated as separate development parcel, with a specific land use. Pods varied in size according to context, and density was left to the market (a moderate average density was assumed for calculation purposes). Retail and business pods were located at either end of the development to catch trade from neighbouring settlements and be more accessible to the main road system. Being car-oriented they were low density. Social facilities, including the secondary school, were located centrally, as a planning requirement. Each pod was provided with direct vehicle access off the main distributor roads. The planning authority also required an extra pedestrian connection between adjacent pods to increase permeability.

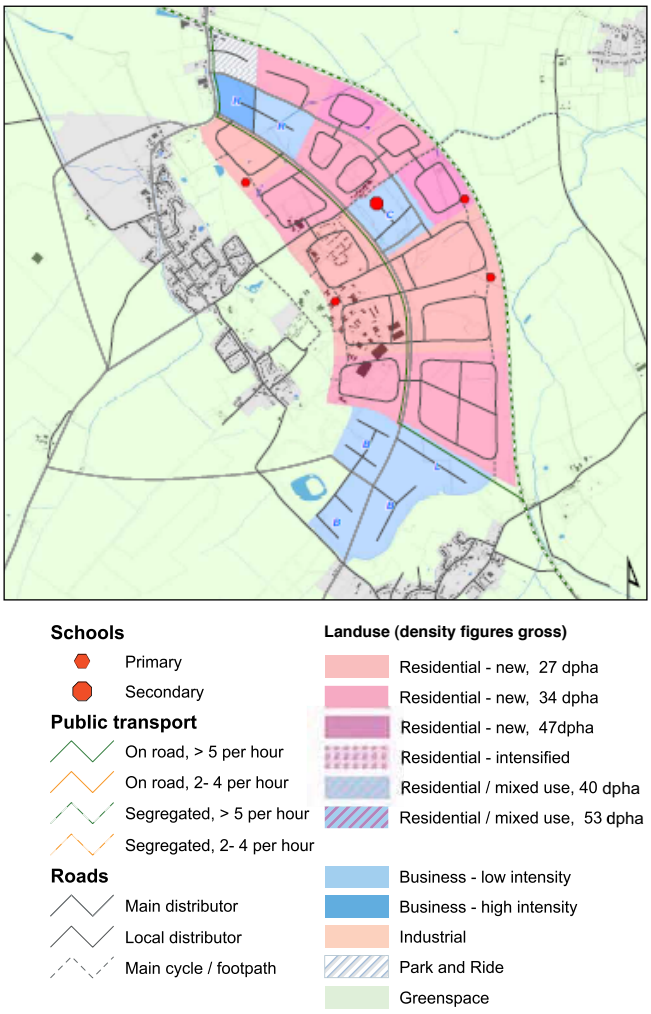

Figure 21 Northstowe: the 'Pods' scenario (key applies to all)

Cell, cluster and linear forms all create intentional neighbourhoods (figures 22, 23, 24). A number of design features are shared between them. The local centres and

town centre are all compact, mixed use and pedestrian-friendly. They include retail, business, social and leisure uses, plus higher density housing – flats over other uses. Residential densities are graded from high in the core areas to moderate on the fringe, so as to maximise pedestrian accessibility while providing housing choice. The residential areas include other uses such as primary schools, playgrounds surgeries workshops, small parks. The densities quoted are therefore gross not net.

The street networks are based in all three cases on a 100 metre grid, adjusted to suit the situation. Every second or third street is a distributer road (i.e. a through traffic route). The other streets are all traffic calmed, designed for cycling and pedestrian priority and having the character of home-zones.

The key differences are in terms of shape. Each cell is designed to fall within the 5,000-10,000 population range, and with maximum radius of 800m along the streets. As the diagram illustrates, there are three distinct neighbourhood cells in the Northstowe design. The cluster is designed with a town centre and six sub-centres, two of which are within the old village of Longstanton, integrating them into the town. The cluster has a maximum radius, along the street network, of 1,500 metres. The rationale of the linear design is public transport accessibility: there is a maximum depth (along the streets) of 600 metres, and some freedom of location for businesses and facilities to locate anywhere along the high street (figure 23).

Comparing feasibility

The pods model can be adapted to fit the Northstowe site without problem. The form is flexible and can react to changing market pressures over a period of years. Stakeholders considered that this scenario would have a fair chance of attracting car-based retail and business park activity. But it was also clear that it ran counter to current policy guidelines. The neighbourhood cells model was also relatively straightforward to apply: three linked cells along the guided busway, maintaining the separation (locally desired) from the existing villages. They could be constructed sequentially. The only major reservation concerned the viability of retail centres in each cell, with limited catchment population. The linear township overcomes this problem by developing the site as one settlement rather than three. The site lends itself to this linear model, and the official proposals are not dissimilar. Stakeholders considered the linear option to be feasible and acceptable. The cluster model is more problematic. It solves the catchment problems by integrating neighbourhoods into a nucleated town with a strong mixed use heart. But the form requires absorption of the adjacent village of Longstanton into the design. In the abstract this makes good sense, but stakeholders considered it was unacceptable because of the loss of village identity.

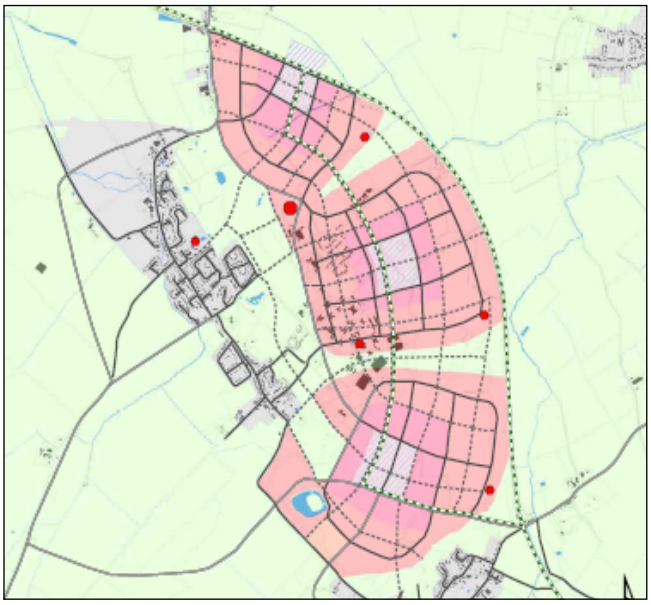

Figure 22 *Northstowe: 'Cells' scenario*

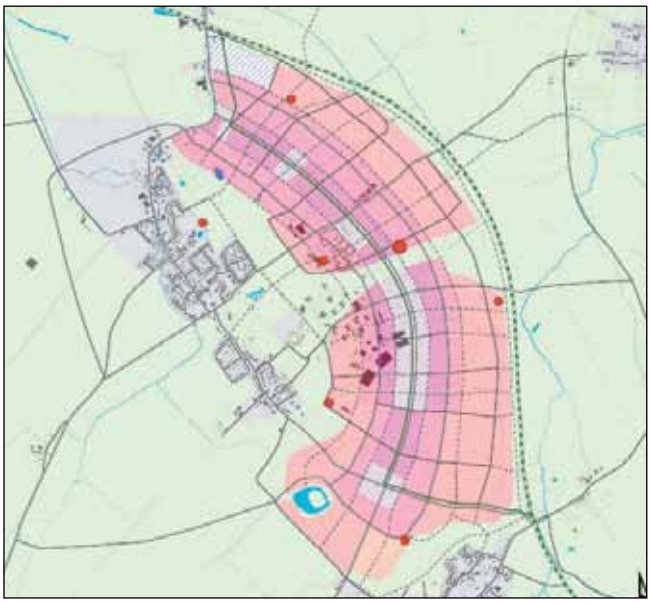

Figure 23 *Northstowe: 'Linear' scenario*

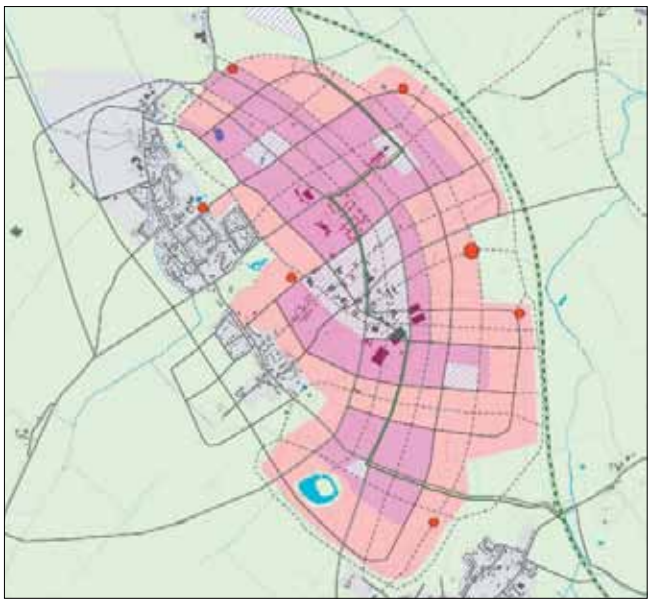

Figure 24 *Northstowe 'Cluster' scenario*

Comparing sustainability

The sustainability performance was estimated. The scale of change proposed is large. The existing population of 2,900 increases to between 17,000 (the pods scenario) and 24,000 (the cluster scenario) with the other midway between and similar to official plans. The difference is accounted for different densities, reflecting different transport priorities. The cluster option is thus about 40% more efficient in its use of land; other things being equal it could provide for a longer period of development. There is also a large differential in terms of accessibility. This is to be expected when the archetypes can be more-or-less fully realised, as at Northstowe. The cluster scenario was the best for retail access; linear was by far the best for public transport; linear and cluster both performed reasonably well for school access; cells and linear were best for open space access. Overall the linear option was clearly preferable in terms of accessibility, and therefore also in terms of social inclusion and physical activity. The pods option, despite being designed with some pedestrian permeability, performed worst on every count. While accessibility, given certain assumptions, is a matter of metrics, viability of services is more a matter of judgement. While linear gives the best chance of supporting good quality public transport, the viability of local retail services might be best in the cluster model (it gives the highest pedestrian catchments). But the separation of services into a number of smaller centres in both the cells and cluster could be a recipe for failure according to stakeholders. It is quite likely that the main cluster centre would pre-empt the growth of the sub-centres, thereby undermining the logic of the design. The pods version, while scoring badly in terms of local pedestrian accessibility, is designed with the catchment of neighbourhood villages in mind, and might therefore be the most commercially successful.

Location

The question of location raises a more fundamental issue relating to the function of the new settlement. With a prospective population of 20-25,000 it is intended to be a town with a good degree of autonomy, offering services and jobs to its people. The problem, as noted in relation to Cambourne, is that the population grows to that level over many years, and initially critical catchment thresholds are not achievable. A cursory acquaintance with the geography of towns, however, leads to the realisation that successful towns are at the hub of the transport networks, have a hinterland of tributary villages, and the potential to attract commercial and institutional investment, thus jobs, on a scale commensurate with population.

Northstowe as currently conceived does not appear to match the pre-requisites for a sustainable town: it is three kilometres from the main road system; while it does have one high quality public transport link, this will only cater for a minority of longer distance trips; it is poorly connected some of the surrounding villages. If it is to be a town not an exurb with high car dependence it will need a special attraction (such as a part of Cambridge University). The surrounding villages could also help: those within easy cycling distance have a population of 20,000 (2001 Census). If well connected so as to experience the gravitational attraction of the new town, they could provide a head-start for many services.

Table 2 Comparative performance of Northstowe scenarios, once the town is complete

CRITERIA	PODS	CELLS	CLUSTER	LINEAR
Efficiency in use of open land				
Accessibility to local services				
Accessibility to schools				
Access to public transport				
Access to open space				
Level of active travel				
Local transport carbon emissions				
Likely retail viability				
Political acceptability				
Market feasibility (overall)				

Grading the scheme against sustainability criteria		
	EXCELLENT	The criterion is fully satisfied
	GOOD	The criterion is generally satisfied
	NEGOTIABLE	Success depends on further work and negotiation
	PROBLEMATICAL	Not likely to be satisfactorily fulfilled without major reassessment
	UNACCEPTABLE	The criterion cannot be satisfied

Conclusions

- The location and land allocation of Northstowe tend to undermine the aspiration to make it into a town
- the potential of nearby villages to help seed and grow town-level services depends on the quality of street connection, including safe bike routes and bus services
- current travel patterns of settlements at Bar Hill and Cambourne suggest Northstowe will experience high car dependence and high out commuting
- indications from the earlier Cambridge Futures LUT modelling suggest the guided busway will only be able to capture a small proportion of that tidal commuting
- in relation to the specific site, its shape has effectively pre-determined the most efficient neighbourhood for which in this case is linear. The merits or otherwise of the four forms are summarised in the chart below (see Table 3)
- both the linear and the cluster models (or some hybrid) can work effectively as new town forms, given the appropriate context. The cells archetype has certain strengths but is more problematic overall because of the focus on 'neighbourhood' not 'town'.
- The pods model is unacceptable in relation to sustainability criteria.

6. Major urban extensions

The SOLUTIONS research examined two areas where major urban extensions have been planned by the local authorities: Newcastle Great Park and Cambridge East. Newcastle Great Park is already being developed in an edge of city location. It is a relatively straightforward scheme along conventional lines. Cambridge East remains on the drawing board, pending closure of the airport, and is close in to the city. The surveys of existing residents (or nearby residents in the Cambridge case) reveal very different patterns of behaviour. The Newcastle residents are among the most car dependent, while those in Cambridge were among the least car dependent. Each is examined below in turn, highlighting some of the key design choices and their implications.

NEWCASTLE GREAT PARK

"Newcastle Great Park" is a major urban extension of about 5 square kilometres, to the North of Newcastle. Significant development has already occurred but the majority of the land is still green fields. The site straddles the A1 trunk road, with the core of the site to the West. It is about 2.5 km from the nearest Metro station at Kingston Parl. The whole area benefits from closeness to Newcastle Airport, making it a desirable location for commerce and housing.

Like Northstowe, Great Park offered the opportunity of fresh thinking about neighbourhood design. SOLUTIONS used it as a context for testing the alternative scenarios, also taking further the issue of location and site choice. The main existing developments within the Great Park were incorporated in all designs. However, the researchers allowed themselves some flexibility at the margins in order to articulate the archetypes more fully.

Designing the scenarios

Official plans for whole site were (at the time of the research) not available as an integrated masterplan. The approach of the local authority was more about pragmatic incrementalism. The emerging pattern of development is at much higher average densities than the older suburbs, but continues the tradition of use-segregated car-based campus development, with limited permeability between sites. One benefit is the ease of managing the development process, parcel by parcel, pod by pod (see Figure 7.28). The original intentions were to construct a high quality public transport route to serve the new development; this good intention has so far been frustrated by implementation problems. For the research exercise we assumed a modest bus service commensurate with the population easily accessible to it.

The research explored all the other three scenarios, but here looks just at the most successful. The linear scenario (figure 27) is much more complex than the current strategy. It requires the careful integration of new development with the old, including the improvement of the potential public transport spine down to the Metro station at Kingston Park. Kingston Park becomes the main hub of activity, where residents transfer onto the regional rail system, implying eventually the comprehensive redevelopment of the retail sheds near the station into a pedestrian-friendly district centre. Optimisation of the linear form would also mean redefining the boundaries of the Great Park development area so as to reflect the logic of the form better. The linear scenario uses land considerably more efficiently than the current plan, without sacrificing access to open space, and therefore could cater for a higher eventual population.

Figure 25 *Newcastle Great Park – baseline environmental assets*

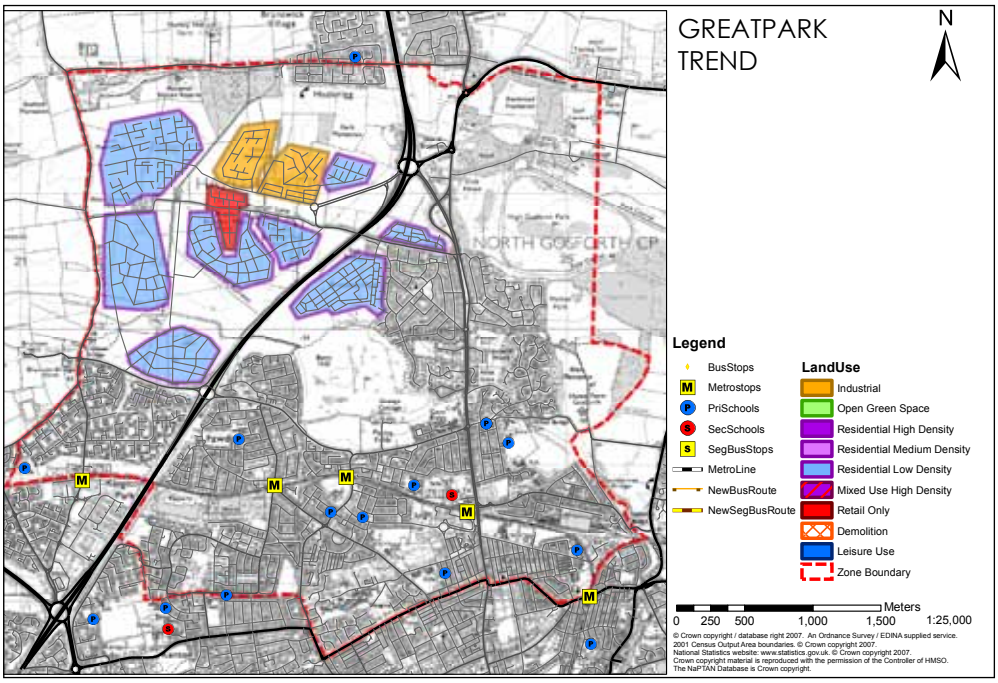

Figure 26 *Great Park: current planning proposals – equivalent to a PODS scenario*

Comparative performance

The comparison between the official plan (akin to the pods archetype) and the linear scenario reinforces the lessons of the Northstowe case study. The contrast in terms of accessibility and social inclusion is stark. The majority of households in the pods option would be beyond the accessibility thresholds for public transport, schools and retail centres. The effect would be to perpetuate the pattern of high car dependency and low levels of active travel.

Conversely the linear option (figure 27) succeeds in achieving excellent accessibility to public transport, schools and local centres. If the behaviour of future residents mirrored those surveyed in terms of their modal choice in respect of distance, then much higher levels of active travel and much greater social inclusion would be achieved. However, this assumes that the development could be completed in a reasonable timescale. Current rates of growth of Great Park do not give grounds for confidence, and it might well be that the linear plan is still-born, failing to realise its potential.

The main disadvantage of the linear – as with other scenarios – for Newcastle Great Park is reliance on major capital investment in the public transport link. Even with such a link residents would have to transfer onto the sub-regional rail system in order to reach major centres. This journey break would be associated with a time penalty, compromising public transport competitiveness. So the question arises as to why the Great Park area was selected for a major urban extension in the first place. In principle there is a better alternative. The Metro between Kingston Park and the Airport has three stations with development potential, and a parallel dual carriageway, presenting an apparently superior opportunity. The scheme illustrated is a linked series of neighbourhood cells, creating the "beads on a string" model (figure 28).

The string of cells in the alternative development zone along the Metro also performs well in theory. It has the huge advantage of being tied directly into the existing sub regional rail network; it therefore has much better opportunity of achieving its goals. Presuming the stations were the trigger for local facility provision, then pedestrian access would be good; distances by car and van to other parts of the conurbation are comparable to the Great Park, but longer trips by public transport would not require change from bus to train, thus would be much more attractive

Stakeholders represented at the workshop came from a wide range of organisations. They assessed the pods scenario to be easy to programme and implement because of the separate sites available. But they considered it to be problematic in terms of sustainability and creating an attractive living environment. The linear option was considered to be far preferable from the sustainability and life-style perspectives, and probably feasible – the only reservation being the incursion into what had long been considered a green buffer. This factor was critical in relation to the alternative location. Public and political concern over the loss of green open land between the city and the airport made the beads-on-a-string option unacceptable at the present time. However, stakeholders saw some distinctive advantages: the reinforcement of the viability of the existing Metro system, and the potential provision of local services for what are currently rather scattered small communities.

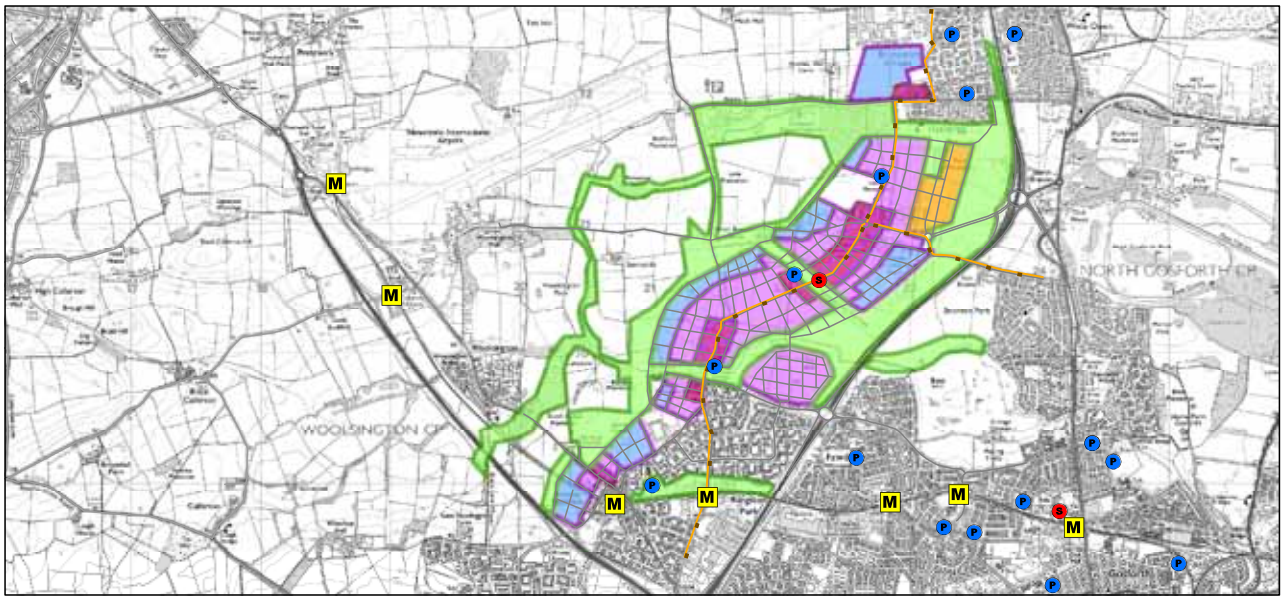

Figure 27 *Great Park linear scenario (above).*
Figure 28 *Newcastle major growth: alternative location – string of neighbourhood cells (below).*

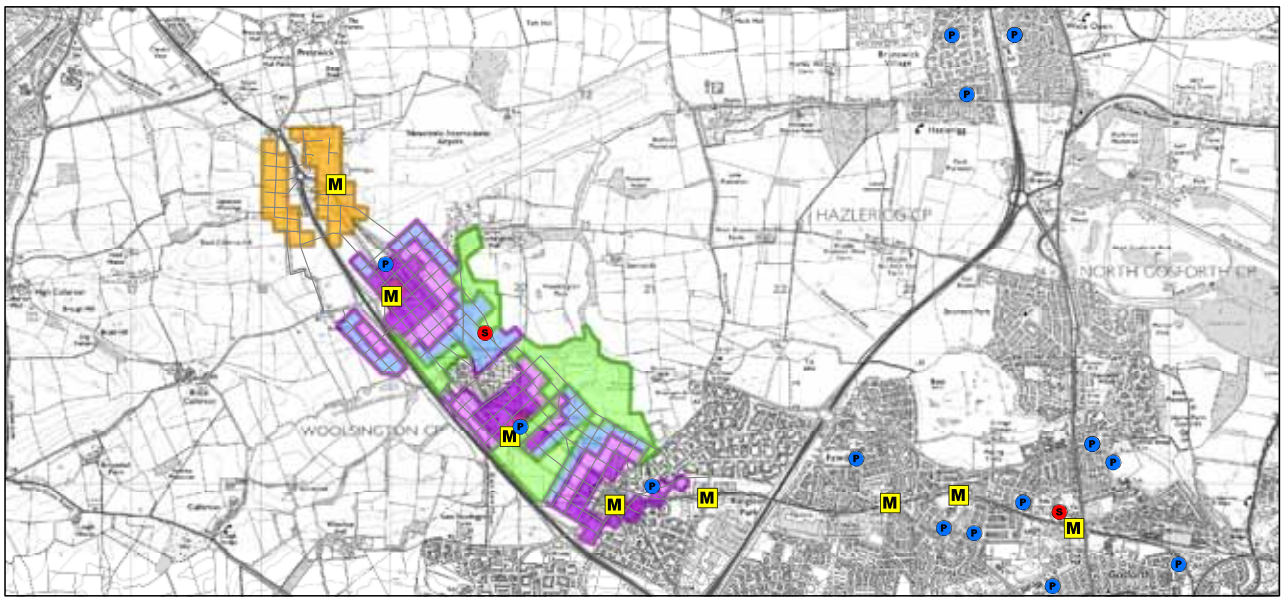

Table 3 (overpage) summarizes the evaluation of the three options.

Decisions on the location and disposition of land released for Newcastle Great Park were not, evidently, taken on the basis of optimum urban form or sustainable development (see Table 4). The reasons perhaps had more to do with minimum environmental constraint, political and land ownership factors. The result is a scheme which is in its early stages very car dependent. There is no reason to believe this will change as development proceeds. Newcastle Great Park is likely to compound problems of physical inactivity, social exclusion and high levels of greenhouse emissions, and fail to give opportunity for the sustainable lifestyles which are an objective of the planning system.

CRITERIA	Newcastle Great Park		Metro Stations
	PODS	LINEAR	CELLS
Efficiency in use of open land			
Accessibility to local services			
Accessibility to schools			
Access to public transport			
Access to open space			
Level of active travel			
Local transport carbon emissions			
Stakeholders assessment of desirability			
Political acceptability			
Market feasibility			

Table 3 Evaluation of the three options presented above (key same as table 3).

CAMBRIDGE EAST

The second example of a major urban extension is more in-town than out-of-town. Unlike Newcastle Great Park the development of Cambridge East remains uncertain. The current user of most of the site is Cambridge Airport, and there is as yet no firm plan for its relocation. The aspiration of the City is for a high density compact development including a major cultural centre, served by high quality public transport routes.

The area of the Cambridge East site is nearly 4 square kilometres. It lies within the 5 km threshold distance of the city centre, which can be used to define a nucleated town (Barton et al., 1995). Major roads surround it, and there are existing suburbs immediately to the West and South, both of which are rather isolated from the main built up area and have modest levels of local facilities.

The contribution of this case study is to illustrate the range of workable options that can exist when the development area is sufficiently large and well-related to existing development. It also illustrates the exploratory nature of the design process – showing how stakeholder involvement helped to improve the interpretation of the archetypes.

Figure 29 Basic context map of the Cambridge East study area

Designing the scenarios

All the scenarios are physically possible and include some shared elements: a main high quality public transport route, a new cultural/leisure centre (often in association with shops and offices), and a green corridor towards the South of the site. The first set of scenarios were criticised by stakeholders as not adequately achieving the ambitions of the community. They were subsequently revised to take account of the criticisms. The linear design, for example, was completely re-orientated from radial to orbital – in order to avoid excessive congestion and an unpleasant core environment along the radial and create the opportunity for better integration of the parts of the city.

The pods scenario segregates uses onto discreet development sites, using clues from the existing pattern of fields, runways and boundaries to provide some logic. The main commercial and leisure activities are grouped along the arterial road. Footpath links are provided between pods. As with other study areas, the pods scenario is easy to adapt to site conditions and flexible in implementation. Stakeholders considered that it was highly marketable, but from the viewpoint of national and local policy and local politics it was unacceptable.

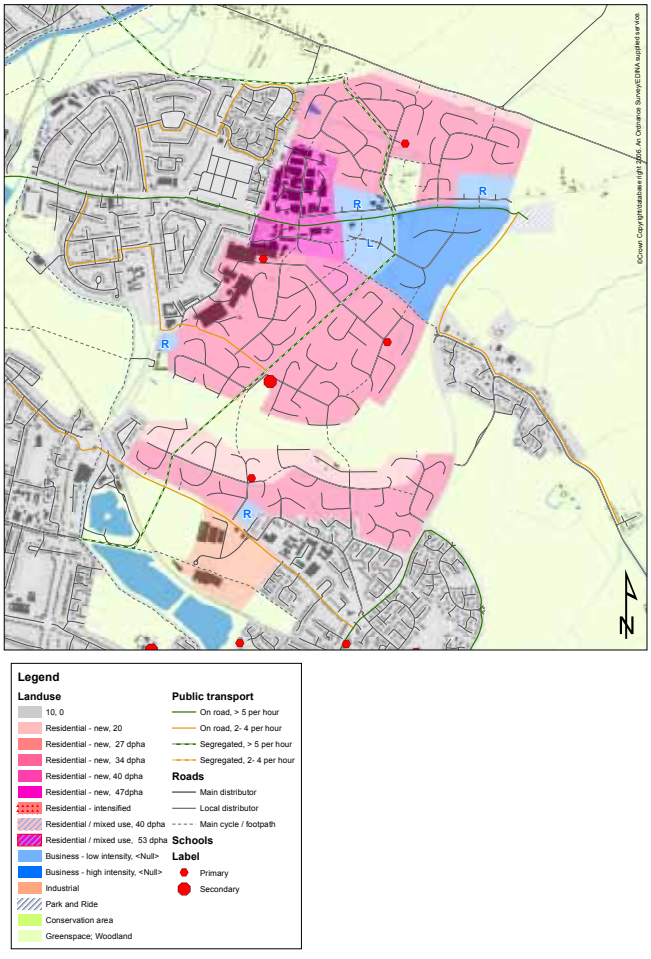

Figure 30 *Cambridge East pods scenario (legend applies to all scenarios)*

The cells scenario involved three new neighbourhoods, and one strengthened neighbourhood, with the central cell providing an opportunity for the cultural centre. Two of the cells implied further development outside the site boundary. The cells were considered reasonably flexible in implementation, because they could be developed sequentially as demand merited. However, stakeholders were unhappy about the potential viability and attractiveness of the main commercial/cultural centre because – in line with the requirements of the archetype – it was 'buried' in the heart of a cell.

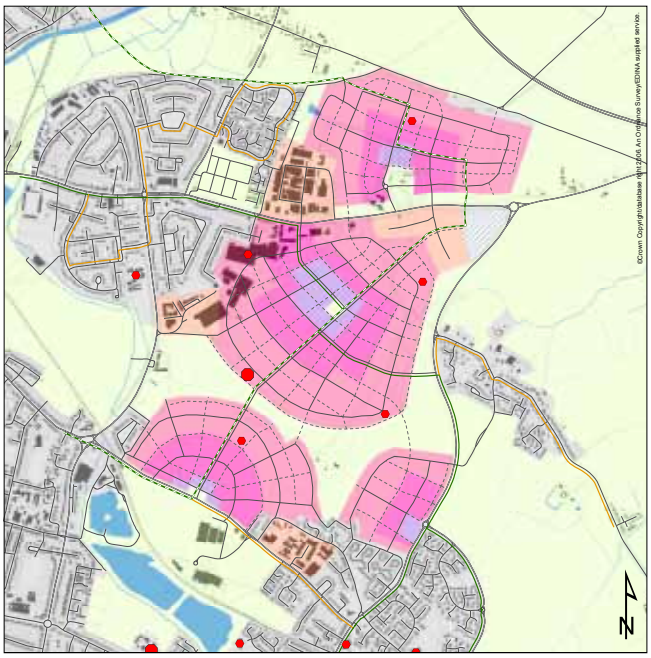

Figure 31 *Cambridge East cells scenario*

The cluster form involved a more radical approach (see Figure 32). In order to achieve the compact cluster township it proved necessary to incorporate an adjacent residential area. This had the advantage, appreciated by stakeholders, of improving services in the existing (rather deprived and isolated) suburb, and encouraging its gradual regeneration. The sheer extent of the cluster also meant pushing the green corridor further south than shown on official plans. However, stakeholders felt that in general the cluster was consistent with policy and created a marketable higher-density environment. The local centres potentially give attractive social foci within the development, and the cultural centre was much more likely to be successful than in the cells model. However, it was recognised that the local centres risk failure because their populations are at the bottom end of the range (c.4000) and they are not far from the dominant centre (7-800m). Across all the case studies, this was the cluster design that was most likely to achieve the aspirations of the Urban Task Force (1999).

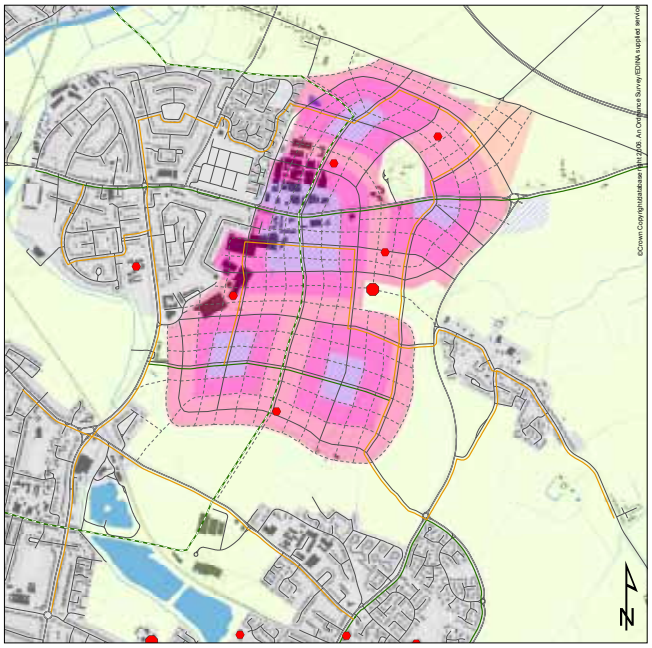

Figure 32 *Cambridge East cluster scenario*

The final linear design, after stakeholder comments, involved both orbital and radial elements, showing the adaptability of the form. It relates well to the spatial opportunities of the site and of all the options makes best use of the proposed guided busway round the city. It also connected up the rather isolated southern neighbourhood (Cherry Hinton), creating a new (much needed) bus-priority radial in the process. The Cultural Centre appeared viable, but some local centres, it was thought, might suffer from being swamped by the main centre as in the cluster scenario.

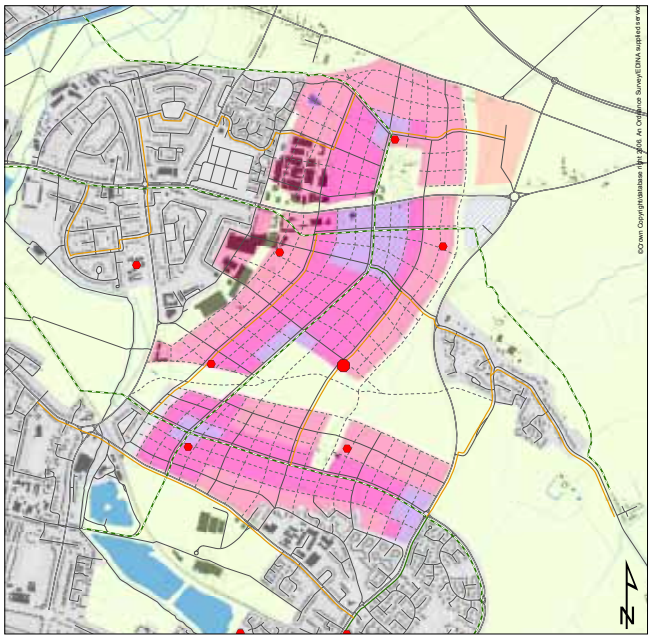

Figure 33 *Cambridge East Linear scenario*

Comparative performance

All four scenarios improve on the current situation as experienced by the adjacent localities. This is an indication that the location is, as might be expected, appropriate for an urban extension. But the difference between pods and the other three scenarios is marked as illustrated in Table 4. If optimally designed, cell, cluster and linear can all, on this relatively unconstrained large site, achieve potentially good levels of accessibility. The weakness of the cell model is that the cultural centre may get 'lost' within the cell, and not be perceived as a city-wide facility by investors. The weakness of both cluster and linear models is the uncertain viability of the smaller centres.

Conclusions: Major urban extensions

Newcastle Great Park and Cambridge East provide contrasting evidence on major urban extensions. While the Great Park example throws up fundamental questions about location, form and current development policy, the Cambridge East proposal demonstrates the potential for a new sustainable suburb fully integrated into the city.

Location

- On the basis of these two case studies and the previous review of Northstowe, it is vital to give due weight to the question of location.
- Cambridge East offers a good example: close tied into the city, helping to integrate existing disparate parts, accessible to the city centre by bike and potentially able to support substantially improved public transport.
- Newcastle Great Park is of course much further out from the city centre, but, even given that, the chosen location fails to maximise the potential for efficient public transport connection to the rest of the city, thereby compromising sustainability.

Site allocation

- In any general location, the exact boundaries of the allocated development site can prejudice the spatial options available. Rather than basing allocation simply on the absence of environmental constraints and/or the accidents of historical boundaries, allocation should take proper account of optimum form and the relationship to existing neighbourhoods.
- Whereas in Cambridge East the allocation allows the development of a wide range of spatial options, in Newcastle Great Park one scenario (cluster) required a very different land allocation: the best (linear) scenario also implied a revised boundary, though on a much more modest scale. In Northstowe the shape of the site more or less determined the optimal form.

Urban form

- The four archetypes on test perform differently in different contexts. For major urban extensions, where the eventual population merits it, the two archetypes with the inherently greater scale – cluster and linear - have the potential to deliver the best outcomes. Where development zones are smaller, the cell is more practicable.
- The pods archetype, while the pragmatic answer in Newcastle Great Park, compromises social inclusion, active travel and carbon efficiency. This applies in Cambridge East too. With very careful planning in an optimum location (such as Cambridge East) it can still be an improvement on the existing situation. But careful planning and pod development are not natural partners.
- The cell model offers a flexible design approach, practical in many situations, such as the beads-on a string design for north east Newcastle. It does not easily support the development of a walkable, high quality district centre. The creation of a cultural centre in Cambridge East, (and of a town centre in Northstowe) was considered problematic.
- The Cluster model is much less easy to integrate into the prescribed land allocations. It was physically precluded in Newcastle Great Park, and politically excluded in Northstowe. Where it could be achieved, in a context where there is sufficient space and high density is appropriate, as in Cambridge East, it can provide a sound basis for planning, helping to integrate a declining estate and provide good accessibility.
- Linear townships are easier than clusters to fit into the prevailing framework. In Great Park the linear option tied the new development into the existing development and offered excellent local accessibility. In Cambridge it offered a viable alternative to the cluster. In Northstowe it was the obvious solution.

CRITERIA	PODS	CELLS	CLUSTER	LINEAR
Efficiency in use of open land				
Accessibility to local services				
Accessibility to schools				
Access to public transport				
Access to open space				
Level of active travel				
Local transport carbon emissions				
Attractiveness of main centre				
Viability of smaller centres				
Development feasibility				
Political acceptability				

Table 4 Evaluation of alternative Cambridge East scenarios (key same as table 3)

7. Urban fringe development

While some areas on the urban periphery have in the past experienced, or are in the present experiencing, planned, large scale, urban extensions, many areas develop much more incrementally. Progressive accretions occur in a relatively disjointed fashion. Forward planning for sustainability, in this situation, is often about retrofitting some urban form logic to a disparate pattern.

The three case studies examined here exhibit a wide range of conditions. The area of Backworth and Shiremoor, north of Newcastle, has a complex patchwork of urban development and rural residue; Cambridge southern fringe has rather more coherence, and is more closely tied to the city; Broxbourne is a broad ribbon of development along a main London arterial road, slicing through the green belt. All three have many examples of pods, limiting urban continuity; and all three have some weak or failed neighbourhoods (in varied forms) – either lacking critical mass to support key facilities, or undermined by social change.

BACKWORTH and SHIREMOOR

The area of Backworth and Shiremoor, on the north-east edge of Newcastle, has experienced sporadic state and market-led development. It lacks any coherent form; however, the planning authority is now attempting to impose some order by concentrating development around the two Metro stations, which give access to the wider city region. Despite the potential represented by the Metro, the actual form of new development has been more in the (now traditional) form of pods.

The disaggregated character of the area is partly due to its industrial past. In that context the old village of Backworth (see Figure 34) has an attractive air, while Shiremoor is an aging council estate with high levels of deprivation and a low level of facilities. Despite the new superstore at one of the stations, the population remain largely dependent on going by car to other more favoured sectors of the city. Poor spatial arrangement is fostering this car-dependent lifestyle. Thus what this area experiences is an unfortunate combination of social exclusion, carbon-intensive travel patterns and, for many people within it, unhealthy life-styles.

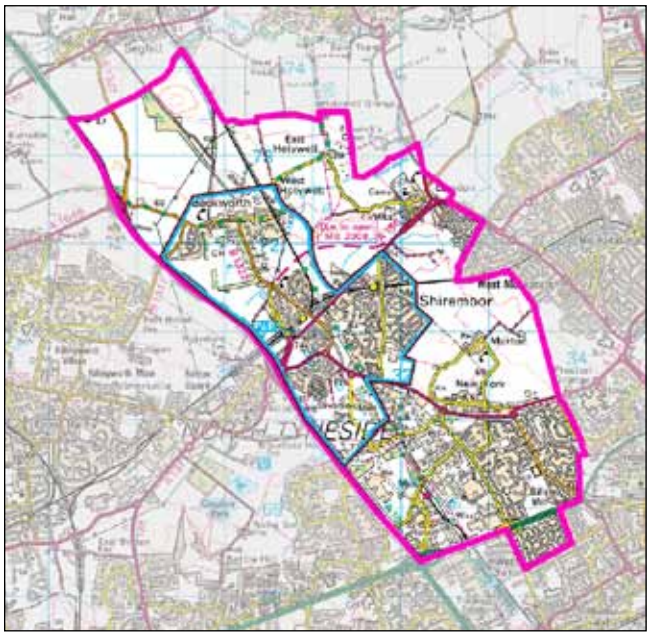

Figure 34 *Backworth and Shiremoor study area*

Future strategy

SOLUTIONS explored cell-based, cluster and linear options involving major greenfield development and new public transport infrastructure. What was striking was that all required the retrofit of the existing localities, with more modest infill development, in very similar fashion. So rather than examining the full schemes, which would necessarily be very long term, we will concentrate here on some of the issues raised by retrofit.

The key opportunities are presented by the Metro stations, as foci of activity. Given continuing market pressure in the area, the most logical shorter-term strategy investigated by the SOLUTIONS project is to develop integrated neighbourhood cells around local centres at the two stations. The existing planning strategy has been pursuing this in terms of the location of development, but not in terms of form or layout.

Around the western station, which has a superstore already as the core of a local centre, the difficulty is the dominance of provision for motorised traffic, and hence the segmentation of the potential neighbourhood into a series of non-communicating pods.

The layout of very recent developments has compounded rather than eased these problems. The diagrams in figure 35 show a simplified version of current reality, and the alternative emphasis on pedestrian and cycling desire lines.

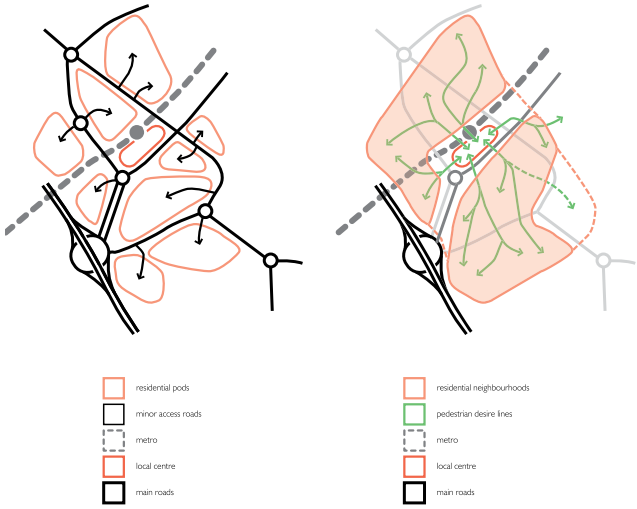

Figure 35 Retrofit at Backworth – diagrammatic representation of the current 'pods' approach in part of the study area, and the alternative principle of pedestrian connectivity

The implementation of an integrated neighbourhood scheme would be awkward, expensive and controversial. New high quality, safe pedestrian and cycling connections linking between pods and leading towards the station and superstore are difficult to incorporate into the existing pattern and could on occasion require compulsory purchase and even demolition.

The eastern station is at the heart of Shiremoor, but the retail and service facilties there are poor, the environment uninviting. The station is a key attractor for the wider area so it makes sense as the centre. The issue is how to promote renaissance of Shiremoor as a whole, to reinvigorate it socially, economically and environmentally. To have a chance of success any strategy needs a radical approach to the estate. This could include redevelopment and intensification near the station, improved connectivity to the new residential area to the north, and new linked development to the east aiming to diversify the social milieu and bring money into the area. Public ownership of land and buildings in Shiremoor could assist this process: if affordable housing in the inner zone was redeveloped at twice the density, then new private housing could pay for the renewal of the social housing stock. Again, in terms of implementation, this strategy would clearly be difficult, especially in the context of the current (2009) weak market conditions.

Backworth and Shiremoor illustrate a pattern of disaggregated car-based urban fringe development that is not uncommon across the country. It is possible to devise short and long term plans which integrate the development pattern and work towards sustainable urban form. But the difficulties of implementation are immense, requiring costly physical change and political commitment in the face of likely opposition.

CAMBRIDGE SOUTHERN FRINGE

The Southern Fringe of Cambridge shares key features with Backworth and Shiremoor. It has evolved over many years as a series of separate developments – old village core, a huge teaching hospital, council estate, industry, market housing – often on the basis of the 'pod' pattern. But there the similarity ends. These developments have happened within a clear planning framework based on the compact city model and preserving greenspace continuity around and through the city. In recent years further growth has been planned as part of the compact expansion of the city, with detailed plans and on-going discussions with key land owners.

The SOLUTIONS project stood apart from this work and explored the theoretical options for development, and the validity of the neighbourhood archetypes. It took the local authority plan horizon of 2016, together with the approved land allocations, as its starting point, but also raised questions about longer term pressures and options. (Note that since the SOLUTIONS work on the Southern Fringe, the actual situation has progressed).

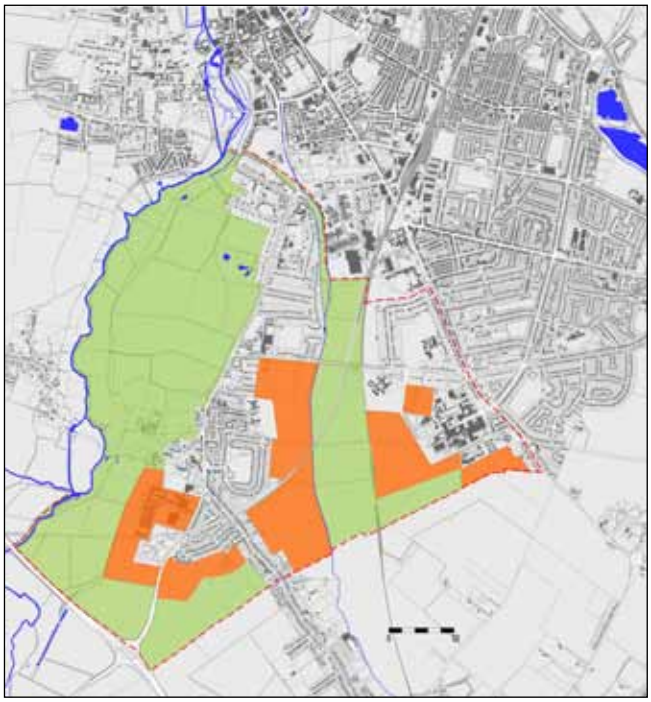

Figure 36 Cambridge Southern Fringe – development areas: the pattern reinforces the existing structure of development while safeguarding green corridors

The Southern Fringe consists of two main parts: Trumpington and Addenbrookes. Trumpington includes the original village and subsequent suburban accretions, and lies on a main radial, south from the city centre see Figure 34. There are some limited local facilities and a large superstore at its heart. The population of the study area is 6,550 (2001 Census), predominantly in Trumpington. Total employees amount to 10,200, mainly at Addenbrookes, which is one

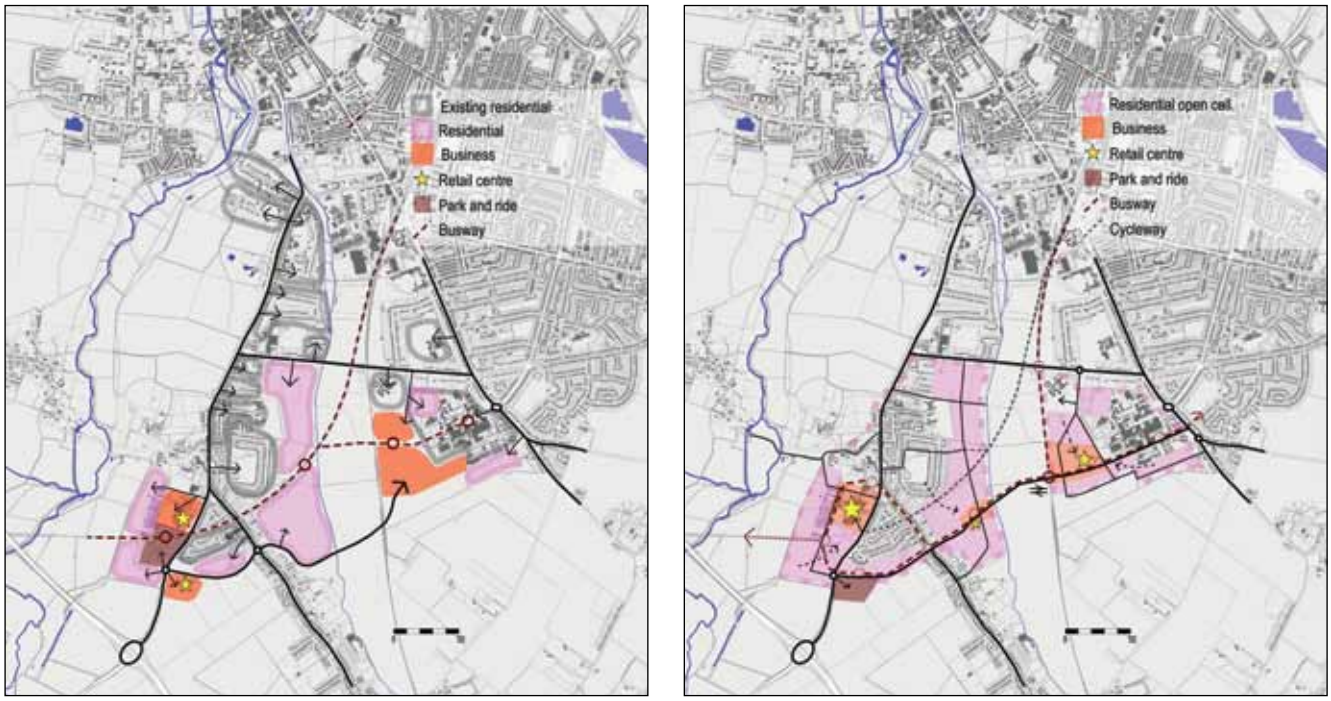

Figure 37 *Cambridge Southern Fringe: pods and cells options: spot the difference! The apparently small variations result in different outcomes*

of the largest medical research centres and hospitals in the country. After the city centre, it is the largest trip generator in Cambridge.

The form of development was illustrated earlier in Figure 18. Trumpington is a neighbourhood cell with several significant pods incorporated. The household survey of Trumpington reveals that despite the apparent limitations of the local centre, the local area provides most of the 'local' services that people need: this includes food shopping (both superstore and other), non-food retail services and outdoor recreation provision; the median distance for these activities range from 739m to 1245m, and are the lowest of all the localities studied. Schools and indoor leisure activities are a different matter, with some of the longest median lengths (3.9 and 2.9 km respectively). Nevertheless the generally short distances result in a high proportion of non-motorised trips (57%) and modest levels of car dependence (39%). Cycling is a significant mode.

Design strategy: pods versus cells

This section picks out two of many design variants tested to illustrate the critical choices being made on the form of development within a set land allocation. It makes the point that land allocation by itself (often the main focus of local planning debate) is not enough: a clear spatial framework is needed. The two sketches in Figure 37 illustrate pod and cell development respectively. Both include the planned guided busway from the heart of the city.

The pods archetype can be applied quite straightforwardly to the allocated land. Each site can be separately accessed and ascribed a particular use. The outcome is in accord with the hopes and preferences of market and institutional interests – the house-builders who have bought up the allocated land and the hospital (Addenbrookes), where further development of medical research and related business use is planned.

Whilst there is some limited pedestrian permeability, vehicle routes would not be connected. The most startling example of this is the new road across to Addenbrookes. Overall, the pods scenario is feasible in the short run and adaptable in the long run. It did not, however, satisfy the stakeholder group. They considered that the lack of permeability between new and old development – inherent in the pods model – was unacceptable and against both national and local policy statements.

The cells archetype proved more difficult to apply. Cells are designed around the principle of pedestrian access to a local centre. In Trumpington it proved difficult to meet the criteria for accessibility due to the inherited pattern of development. The illustration therefore shows a new centre on the busway within the main new residential area. It also shows streets linking previously separate enclaves, tying the locality together. The most radical proposal, however, is in respect of Addenbrookes. Rather than yet further increasing employment on the site (exacerbating an already bad commuting/access problem) the neighbourhood principle suggests diversifying activity: creating a mixed

use neighbourhood with residential and local service development complementing the huge employment and regional service centre. The research and business development proposed by the hospital authorities is instead located in the redeveloped high density core of Trumpington, enabling a stronger district centre to be created there.

The cell development of Trumpington won favour from stakeholders, and in many ways mirrored what the City is demanding. There were reservations, though, about whether the new local centre on the busway would be viable, since its potential catchment area is not ideally situated and Trumpington centre is quite close. If it failed, then the proportion of people accessing facilities by car would go up.

The Addenbrookes mixed use proposal met with sharp hostility from stakeholders. The interdependence of hospital and research activities was considered the overriding factor. The pods version was being promoted by the institution and was completely accepted by the City, despite the increased concentration of employment trips.

The current plans for land release on the Cambridge Southern Fringe are part of an overall strategy of compaction, concentrating development in and around the city. In the study area it is apparent that this compaction could go much further without destroying the parallel principle of green wedges. So a set of long term scenarios was developed as part of SOLUTIONS. The linear intensification scenario illustrated was one of these. Given the very congested nature of the Trumpington radial, the practicality and sustainability of the scenario would rest of the ability to create good bike and bus priority along the length of the radial. This highlights a potential flaw in linearity. But if major modal transfer were to eb achieved, then the linear option provides improved accessibility, and total traffic (across the city and hinterland) would be reduced by comparison with more decentralised options. Stakeholders, however, disliked this option because of the loss of green areas perceived as vital cultural assets.

Table 5 *Evaluation of Cambridge East scenarios*

Cambridge East Local assessment criteria			2031				
			Baseline	Pod	Cell	Cluster	Linear
1.	Development of previously undeveloped greenfield land ha per 1000pop.		n/a	4.8	2.6	3.1	2.7
2.	Transport emissions & energy average distance to exit km		n/a	2.1	1.9	1.9	1.9
3.	Accessibility to facilities % pop. with access to facilities:	primary schools	29	49	70	67	68
		secondary schools	2.0	30	46	67	61
		local shops	49	72	89	81	90
3.	Access to local public transport % pop. with access to public transport:	good	0	39	75	73	77
		mediocre awaitingnewdata	73	20	14	77	74
5.	Average distance to nearest open space km		n/a	1.3	0.8	0.8	0.4
6.	Trips by walk or cycle awaiting strategic and empirical data		tbc	tbc	tbc	tbc	tbc
7.	Vitality of retail services (Pop.withinretailcatchment),passingtradeawaiting strategicdata,stakeholderassessmentyettobeadded		(6,200)	(19,400)	(28,500)	(26,900)	(29,800)
8.	Public and political acceptability		n/a				
9.	Market and institutional feasibility		n/a				
10.	Physical practicality and robustness		na/				

1. Greenfield land
Most of the site is currently Cambridge Airport, thus brown field land. So all the metrics here are good. Cells, cluster and linear all achieve near optimal use of land. Pods could be improved by raising densities and better design, although by its nature will not perform as well as the others.

2. Transport emissions
Although pods are, as expected, rather less efficient in terms of vehicle trip length to the edge of the study area, the variation from the other scenarios is not very large (10%). All scenarios are reasonably efficient.

Grading the scheme against criteria		
	EXCELLENT	The criterion is fully satisfied
	GOOD	The criterion is generally satisfied
	NEGOTIABLE	Success depends on further work and negotiation
	PROBLEMATICAL	Not likely to be satisfactorily fulfilled without major reassessment
	UNACCEPTABLE	The criterion can not be satisfied
	Cells without colour are awaiting further data at this this interim stage.	

BROXBOURNE

Broxbourne, north of London, is a corridor of suburban development along the original line of the A10, with sacrosanct green belt to either side. Its development options are hemmed in not only by the protection of open land, but by the railway and flood-land to the east and the new A10 to the West. The benefit of the railway, giving excellent services to inner London, is reduced by the location of stations at the edge, not the centre of the linear band. On one latitude, the town spreads over the A10 to the west in a series of public and private housing estates. This western sprawl was the area chosen for the household survey.

The retail centres serving this extensive borough fall into three categories: the district centres of Hoddesdon, Cheshunt and Waltham Cross; the out-of-town centre of Brookfield; and a series of smaller, declining retail clusters, mainly along the old spine road, which now barely qualify as local centres. Current access to facilities and travel behaviour in Broxbourne, on the basis of the survey, is the least sustainable and most socially inequitable of all the 12 areas. Its level of car dependence is 81%, compared with the average of 57% and the least dependent 37% (Cherry Hinton, in Cambridge). This reflects the relative paucity of facilities within easy walking distance of the western sprawl: median trip length is 2.8 km, compared with the average of 1.7 and the lowest of 0.9 km (Trumpington).

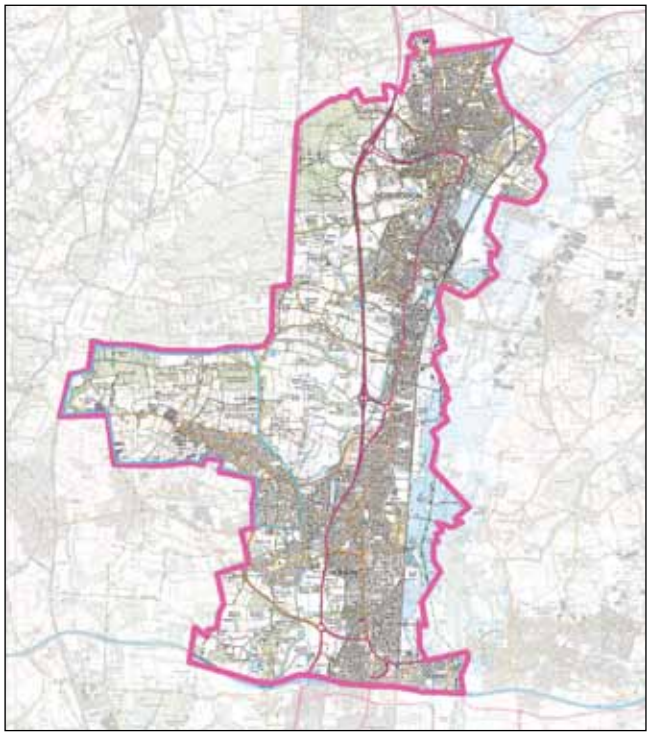

Figure 38 *The Broxbourne study area, with the M25 in the south*

Failed linearity, cell potential

Broxbourne provides an object lesson in urban form. Its original rationale followed the logic of ribbon development and public transport services, and led to the single strand linear pattern. But now most of the band is poorly provided for. The lesser centres along what might have been a thriving high street have declined. An analysis of population helps to explain. In an era of high mobility the minimum population normally needed to support a local centre (defined as having a supermarket and/or a range of small food shops; a newsagent and chemist; plus, until recently, a post office) is 4-5,000. As household size has declined, populations living within the 800m pedshed of the local centres along the spine road have fallen down to or below the this catchment number. At the same time the Brookfield retail park has attracted people away, offering superior choice and convenience. The local and district centres that remain successful, such as Cheshunt, have higher catchment populations – around 8,000.

The map of bus service quality demonstrates the degree to which linearity has in this case failed (figure 39). Only the green zones have a good bus service. The vast majority of the population has either no accessible services (the uncoloured zones) or a poor service less than every half hour (coloured red). The nature of the trip patterns, the culture of the residents, as well as falling catchment populations, have all conspired to make Broxbourne a very car dependent settlement.

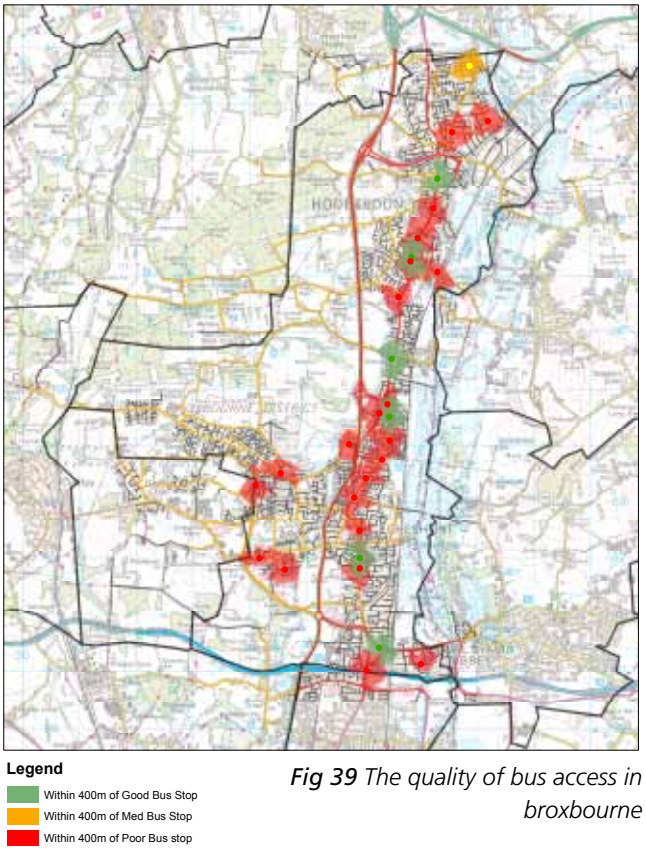

Fig 39 *The quality of bus access in broxbourne*

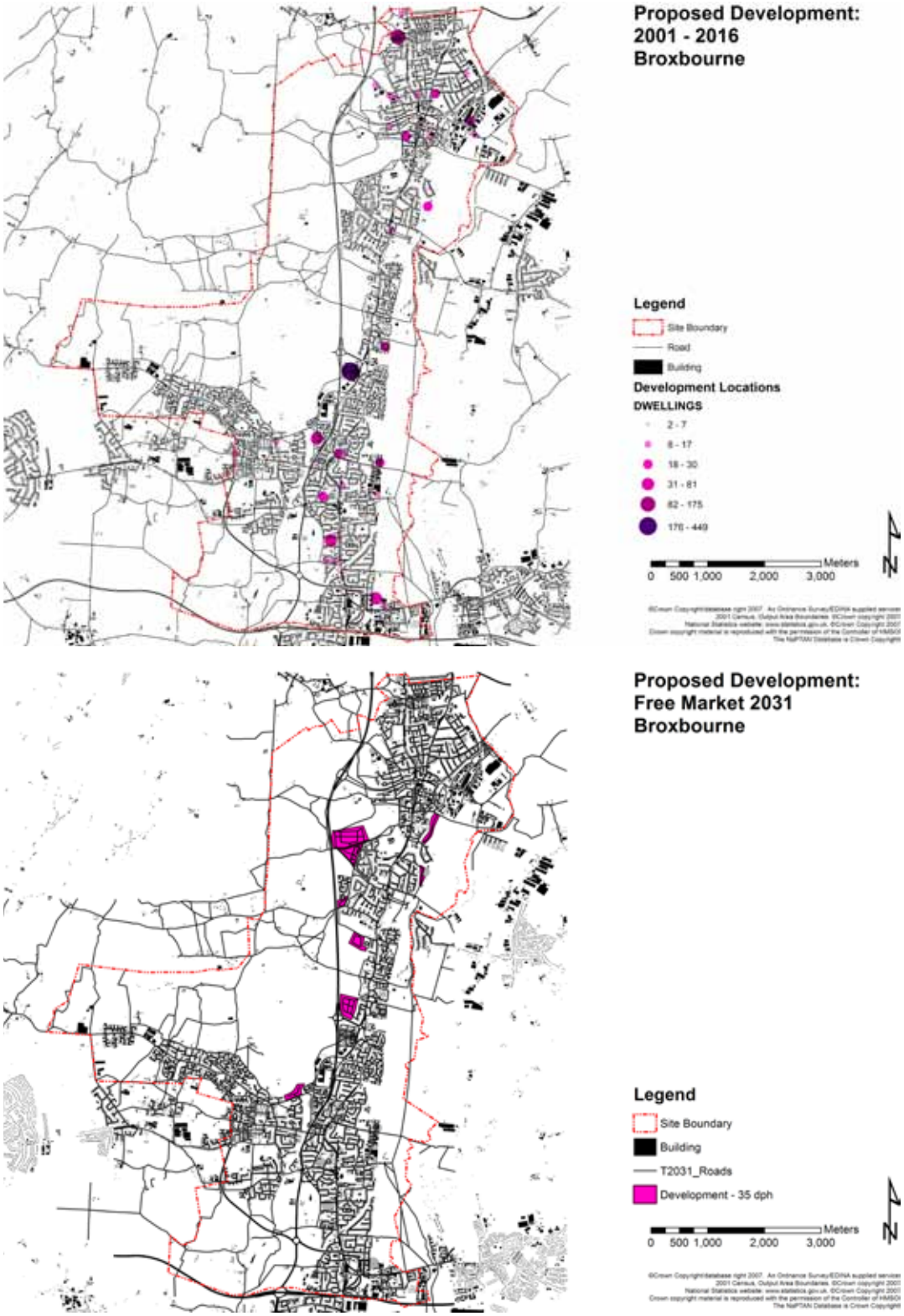

Figure 40
2001 - 2016 and 2031 trend map

Current local authority policy is to reinforce the linear band, partly in order to avoid impinging on the green belt. However, the locations where infill or renewal is occurring are not generally around the declining local centres, but on the fringe of the band, often in the form of pods. Ironically these new small developments are at a much higher density than the older areas, so the highest density is furthest from the services – exactly the reverse of linear township theory.

We extended the current policy to 2031, looking for the most likely renewal opportunities. This did not solve the situation. Because of the predicted continued fall in household size, total population remained similar, and the catchment zones were not strengthened. It is evident therefore, that current policies for Broxbourne are failing – and will fail in the future – to deliver 'sustainable communities'. The reasons are, first, that development

is highly constrained by green belt policy, not allowing settlements to breathe; second, that any new development proposals, following the path of least resistance, are normally of higher density in less accessible locations, undermining any principle of restructuring a sustainable town form.

One interesting alternative was tried: creating a new cell neighbourhood around the Brookfield retail park. This capitalized on the availability of greenbelt land, otherwise unconstrained by environmental assets, close to the out-of-town centre. The intention was that the retail sheds would be redeveloped at a much higher density to create a mixed use, pedestrian-friendly town centre for the Borough (see Figure 41). This idea was floated by our local authority partners. The scheme shown integrates the new neighbourhood with the existing development and provides excellent access to local facilities. However, it suffers from being some distance from the rail stations. Unless it could support a transformation in connecting bus services the likelihood is that it would not overcome the current high levels of car dependence. Commuting by car would remain the norm and affect the levels of car ownership and use.

Figure 41 *A new cell neighbourhood and town centre for Broxbourne*

Conclusions: the difficulties of retrofit

The three areas of mixed urban edge examined here, around three cities of very different scales, illustrate the dangers of generalization. Suburbs such as Trumpington, part of a city where the tradition of cycling enables a relatively high proportion of active travel, emerge as having the potential to become more locally self-supporting in terms of services. At the other extreme Broxbourne is very car reliant, and while strategies can be devised to encourage local service provision, the location in the rural fringe around the conurbation makes real improvement (in terms of sustainability) difficult. In between is Backworth and Shiremoor: this area is currently closer to Broxbourne in terms of behaviour, but the public transport infrastructure is in place to allow, with good planning, progressive improvement towards a more healthy urban environment. Having recognised the sharp contrasts, however, there are many similar features:

- All three urban fringe areas have developed, within broad planning guidelines, in a disaggregated way. In two out of the three cases this is being perpetuated by recent planning decisions based on the pod model of urban form,
- not only has this led to higher car dependence but also poorer residents are more likely to experience social exclusion and unhealthy life-styles; this is particularly the case in Shiremoor and parts of Broxbourne.
- New fringe development can be employed to overcome the problems of the current pattern of development, creating adequate catchment populations to support better services, and forging a permeable environment where at present it is atomised.
- Public transport infrastructure is often critical to success in moving towards more sustainable patterns: Backworth/Shiremore has it already in place; Cambridge is planning it; Broxbourne has yet to plan it.
- In terms of future urban forms, the most easily implemented scenarios – based on pods – perform poorly in terms of social inclusion, healthy active travel and land use efficiency, and should be discounted.
- However, the instincts of market and institutional forces are still to retain single-use pods. Addenbrookes is an example of business parks, science parks, hospital and educational campuses across the country. In some situations, as at Addenbrookes, there are clear operational benefits from agglomeration, but this does not equate to separation. Firm action needs to be taken by central and local government to integrate these functions into the town.
- The cells archetype proved an appropriate basis for forward planning in all three case studies: in each case the best scenarios were on-line cells around an existing focus of activity which could be strengthened.
- In the long run the linear structure shows most promise in the case of Trumpington and is the logical form for Broxbourne when and if redevelopment is feasible and public transport services are upgraded. If Backworth/Shiremoor were to benefit from a new tram line, then linear also performed well in that situation.
- The cluster model is difficult to implement in edge-of-town suburban retrofit. Current densities do not support the form, and current spatial forms tend to cut across and inhibit large scale township structures.

8. The evaluation of established suburbs

Current trends in South Harrow and West Barking

As explained in section 2, the main purpose of the London case studies was to look at the local impacts of broader strategies. The scale of the study areas in West Barking and South Harrow was large – both in excess of 60,000 population. Nevertheless there are implications for local urban form , explored below.

West Barking is a relatively poor area, with the lowest car ownership of any of the suburbs studied. It has a mixed urban/suburban feel, with the eastern parts dominated by low density council estates. It is now part of the Thames Gateway initiative and considerable redevelopment has occurred in and around the town centre of Barking. The ageing suburbs in its hinterland, however, show signs of decay, with falling populations and dying local centres.

Barking town centre, provides an excellent array of services, but elsewhere the traditional shopping streets and parades are of poor quality, forcing people to travel further afield for most services. The decline of services is due to the combination of a relatively poor population, with high incidence of multiple deprivation, and falling household size. Car ownership is relatively low. In compensation the bus services are overall better than Harrow (though 30% of people are effectively disenfranchised, over 400m to any service), and Barking exhibits the highest bus use of any of the SOLUTIONS study areas. People in Barking are also prepared to walk further to access facilities than any other SOLUTIONS local study area. This is not so much a matter of choice as of necessity.

Harrow South is more affluent – a mixed population in terms of class and ethnicity. Much of it is classic low density suburbia, a series of mainly private sector interlinked estates, with a scatter of open spaces and strong district centres tied to tube stations.

Current form and behaviour

Harrow might (pejoratively) be called 'sprawl'. In some ways this is fair, because low density urban development simply spreads in a kind of flux across the space, with form rather ill-defined. Nevertheless, there are patterns within the flux. In Harrow, the traditional high streets that developed along major bus routes on either side of stations form the core of linear townships, providing a fair level of accessibility to the residential hinterland. The greenspace which – in the theoretical model – parallels the high street, does not exist. And the efficiency of the form is compromised by barriers (e.g. railways) and inappropriate pod development.

In comparison to the twelve areas surveyed, Harrow is slightly above average in the proportion of walking and using public transport. Access to public transport is good for over half the population, but a third suffer poor or non-existent services. Car dependency is 48% (average is 57%). Median trip length is just shorter than average at 1600m (one mile). Behaviour is thus reasonably typical of suburbs.

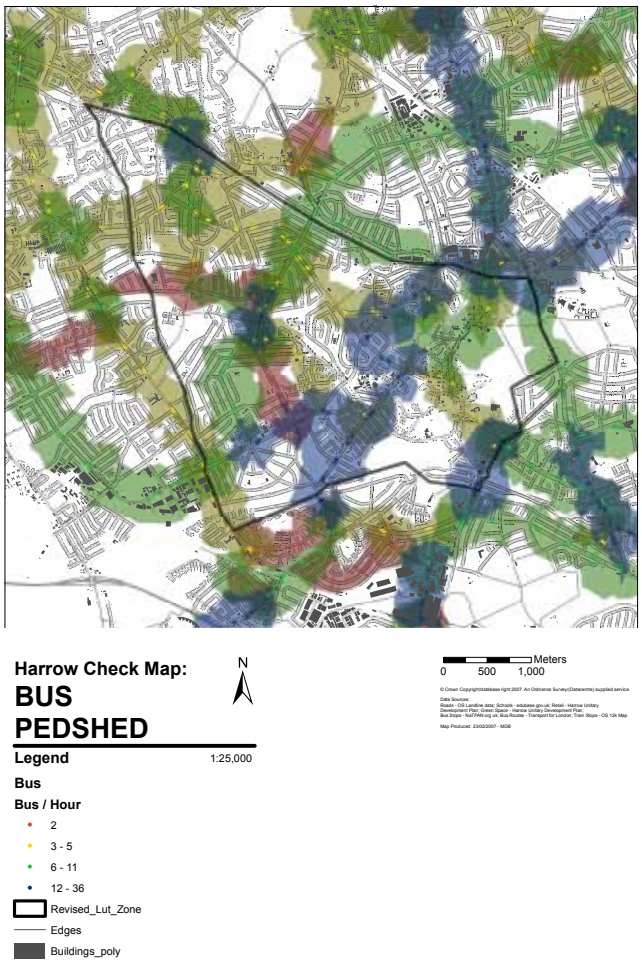

Figure 42 *The quality of bus access in South Harrow*

The inadequacy of local services means that trip lengths are longer at 2100m. The low incomes of many households, however, means reliance on foot and bus is greater than Harrow, and car dependence lower at 39%. People are generally walking further than in any other study area to access key facilities. While this may benefit health for some, for others it is a symptom of exclusion.

Assessing the trends

As explained elsewhere, the main thrust of current policy in London is urban intensification. Policy-makers are, with some success, shifting the metropolis away from progressive decentralisation towards centralisation, inspired by the rhetoric of the compact city advocates, the need to promote regeneration and the desire to safeguard open country.

The question arises as to whether the trend scenario will result in the kind of spatial change advocated in the London Plan and government guidance (e.g. PPS13). The compact city principles espoused look for an increasing focus of development around high PTAL nodes (public transport accessibility). The proportion of households accessible to town centres and public transport services should therefore be improving. However, the GIS analysis of the two study areas revealed only marginal change, sometimes positive, sometimes negative. It appears that the process of intensification is rather random in its impact.

The explanation lies in the way new development is happening. The pattern of development is determined in part by the investor-led process of gradual renewal, and in part by major land release of brownfield or greenfield sites through the planning system. The former was assessed by examining current trends. The LPAs predicted the projects likely in the period to 2016. The pressure for renewal was greatest in Harrow, with densification led by the market occurring on a diversity of sites. In Barking the rate of change was slower, with more public sector involvement. In Broxbourne most of the sites identified were small scale infill, normally on the fringes of the developed areas, not at the core. The conclusion is that gradual renewal tends to result in a rather sporadic pattern of intensification.

The only major land release in the two areas was at Barking. Here, as part of the Thames Gateway initiative, there is massive redevelopment near the town centre, and at least in prospect, the construction of 10,000+ dwellings at Barking Riverside. At the time of study (2007) the former was happening apace. At the time of writing (2009) the latter was in doubt because to the withdrawal of funding for the essential Docklands Light Railway (DLR) extension.

Figure 43 *Intensification in Harrow*

Figure 44 *Proposed development at Barking Reach*

Elsewhere in Barking, in the declining suburbs, there is very limited new development planned. The predictable result will be a continued fall in population levels, further closure of local facilities, and reduced accessibility for the relatively poor residents.

The model output provided valuable insight into the degree to which the trend, as planned and forecast, would actually materialise. In the case of both Harrow and Broxbourne the model predicted a shortage of housing vis-à-vis population. In other words the pressure for accommodation would be greater than the amount provided. This is in accord with general perceptions that housing is in short supply in London, and consequently house prices are high. The situation though, was different in Barking West. There the model predicted a surplus of housing supply over demand with consequent high vacancy. Given the role of Barking and Dagenham Borough in the London housing market – with the cheapest housing on offer – this is not surprising. None-the-less the local stakeholders were much more bullish. They pointed (in 2007) to the current market enthusiasm for building in and near Barking town centre, and the low vacancy rate, which was at odds with the expectations of the model.

Strategies for sustainability

South Harrow is in many ways a typical suburb, so it is relevant to consider what might be the basis for a really significant transfer of trips (in the categories studied here) away from the car. Currently the threshold for 50% active travel is around 800m, and for 75% active travel it is 400m. This contrasts sharply with the equivalent figures in Cambridge (both areas) of c. 2,500m and 600m. There is clearly a difference in culture – part of which is about cycling. If Harrow could improve its active travel propensity to the level of Cambridge, then there would be a significant shift in overall modal split. Safe, convenient cycle routes are a prerequisite.

In South Harrow the main element of the optimum land use strategy is to reinforce the existing linear concentrations. They provide a good level of service and the majority of the population are within the 800m threshold. In line with the London Plan, progressive intensification should be encouraged close to the high streets, while there should be no intensification at the periphery. In order to work, this gradual land use change will need to be partnered by transport change: improving linkage and shortening trip lengths for pedestrians and cyclists, constraining car use whilst giving buses priority. Accessible greenspace is another important issue, implying a radical approach to forging new open spaces in deprived locations.

A general impact of greater intensification identified by local concern, in Harrow, was in relation to congestion. While the number of car trips per household should go down as accessibility improves, it is very unlikely to go down by as much as the increase in the number of households. Greater congestion leads to higher environmental impact. This is the paradox of the compact city strategy. The only way to escape this paradox is through a systematic, comprehensive strategy of priority for pedestrians, cyclists and public transport, reducing the road space available for traffic, enhancing the accessibility of both local and city facilities by means other than private car. This strategy is not easy to implement successfully. However, such strategies have been pursued with conspicuous success in a number of European cities (PRP 2008).

For South Harrow, the LUTM predicted continuing strong demand. The proposal locally was therefore to re-emphasise the high PTAL pattern already in the London Plan, gently increasing housing densities within the orbit of the shopping centres and stations. This was considered practical along the main high streets, but more problematic in the stable suburban hinterland. New guidelines would be needed encouraging 'infill' above, between and behind houses. Stakeholders considered that this might be unacceptable politically because of replacement of family housing by apartments. An alternative compact city scheme which overcame this problem involved concentrating very high density development close to Harrow town centre, with its excellent public transport services. Those wanting apartments would benefit from very good accessibility, while the low density suburbs would retain their exclusivity. In practice, a combination of these two strategies might be appropriate. Together, they demonstrate the potential for considerable intensification, far beyond current plans. The benefits of the compact city scenario were clear. The proportion of the population served well by public transport and local services increases. In South Harrow, for example, the proportions rise from 50% to 60% for good quality public transport, and from 64% to 70% for access to local shopping centres.

In Barking local stakeholders felt that with the right policy context development could happen much faster than the trend. On that basis the SOLUTIONS local design team devised an ambitious strategy, focussing most new development beyond 2016 on tube stations. It was considered practical in core areas to double or even triple current low densities, given the high level of public land ownership and the potential to cross-subsidise new social housing from the profit on market housing. In effect the scenario was for a series of open cells or TODS (transport-orientated developments). Existing failing local centres next to the stations would become more viable, and potentially provide a good level of service where at present it is poor. Stakeholders were enthusiastic, recognising the attractiveness of this strategy in terms of social inclusion and regeneration. However doubts were expressed about marketability and political will.

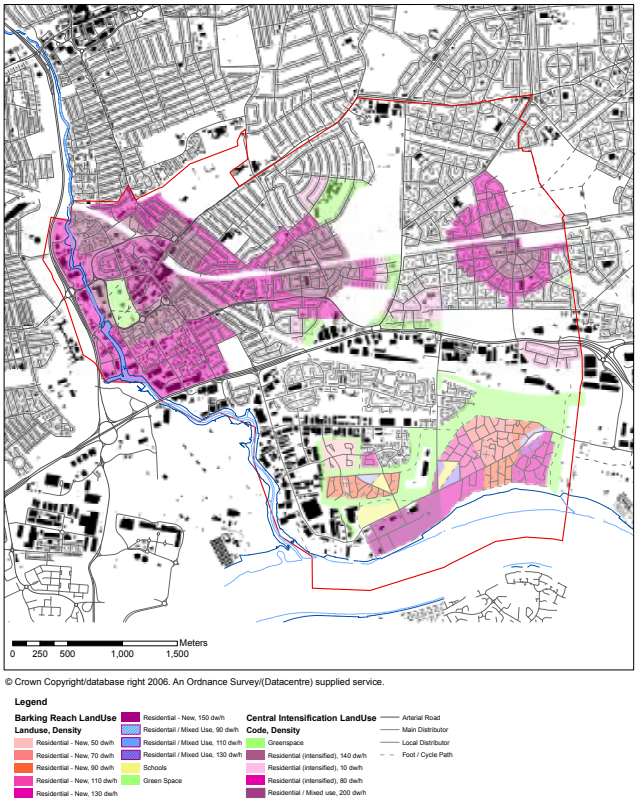

Figure 45 *Scenario applying the compact city principle to Barking West*

Conclusion

The structure of the older suburbs in London is complex, with historical patterns layered over each other so that underlying forms are confused. This is particularly the case with Barking West. A strong and relatively high density town centre dominates failed local high streets and a poorly served hinterland sliced across by major railways and roads that impede connectivity. The solution most favoured by the design team and local stakeholders was redevelopment around the stations to increase density and diversify population so as to be able to support new local centres. This would create a series of open cells or TODs (transit-oriented developments) embedded in the existing community and improving accessibility. This was considered physically practical because of Local authority land ownership, but even before the collapse of the housing market (2008-10) the market demand for this option was in doubt.

Harrow has a less confused structure. The area is typified by a series of linear townships, centred on thriving high streets around tube stations and bus routes. However, a third of the population experiences poor access to the high streets, bus services and greenspace. The recent trend of site-by-site intensification is occurring in a haphazard way, and not correcting the imbalance. Future policy should be based on reinforcing the linear townships, with graded densities, forging new connections to reduce barriers to active travel and extend the accessible zones. Extra greenspace is difficult given the existing development, but a critical priority.

The main overall conclusions from the London local studies are as follows:

- The current London trend, involving a rather haphazard pattern of intensification, is not expected to lead to the hoped-for improvements in local accessibility and active travel, and therefore needs urgent review.
- A strategy of carefully planned concentration within London suburbs is feasible in some areas and could lead to significant improvement in accessibility and related aspects of social inclusion, but at the expense of environmental quality, due to congestion, unless radical local transport measures are pursued on a comprehensive basis.

9. Comparing the archetypes

This section reviews the evidence in relation to the strengths and weaknesses of each archetype. It draws on findings from all the scenarios devised for the study areas - including some not reported earlier. The broader implications and recommendations in terms of policy and design are dealt with in the final chapter.

As a reminder, the key evaluation criteria are:

- spatial feasibility – assessed through exploratory design exercises
- sustainability – especially in terms of household accessibility to facilities and public transport – assessed through GIS analysis of alternative scenarios
- market and political acceptability – assessed primarily through stakeholder workshops.

There is thus a combination of quantitative and qualitative assessment. In all cases the raw results are carefully evaluated by the researchers to take account of the diversity of context and try to ensure consistency. The conclusions are eventually a matter of judgement on the base of the evidence available.

Pods

Despite government guidance to the contrary, it is clear that pods – use-segregated, car-based campus and cul-de-sac development at modest densities – remain one of the dominant forms of suburban development. Four out of the nine study areas fall into this category. This is perhaps predictable in areas such as Backworth/Shiremoor and Broxbourne lacking long term plans. In these situations sites coming forward through planned or market initiative are often small and most easily developed as separate enclaves. It is more surprising in the case of major urban extensions such as Newcastle Great Park.

The essential advantage of pods is their ease of implementation. Individual land owners can bring forward sites without the complications of over-arching plans or the necessity to collaborate with neighbours. Pods are flexible in terms of spatial arrangement and timing. Sites identified for development can happen in any order, with no fixed timetable. In some ways the traditional approach of planning authorities has reinforced this: land release for housing often occurs on a site by site basis, rather than through analysis of spatial dynamics and neighbourhood form. Pods are what tend to occur if there is inertia in the system – if LPAs are reactive not proactive.

The sustainability of pods is a different matter. In all the cases where they were occurring, or explored through design, scenarios based on pods performed badly. Accessibility to local centres, schools, major green space and public transport was normally worst on all counts. This was due to the lack of permeability, lower average densities and (sometimes) poor location. Note that the research process did not treat the pod archetype as a "paper tiger". The design scenarios assumed extra connectivity for pedestrians and cyclists over vehicles. But this did not compensate for the lack of an integrated overall pattern.

By-an-large the stakeholders consulted through the workshop agreed that pods were not sustainable or desirable. In most study areas pods were voted as the worst option. There was one notable exception, however, which highlights an interesting point. The view of stakeholders consulted about the Cambridge Southern Fringe seemed at first sight contradictory. They were strongly opposed to pods in the Trumpington neighbourhood (which had been promoted by developers), but strongly in favour in relation to Addenbrookes – the huge hospital and medical research centre. In the latter case institutional pressures – the needs of the organisation – took precedence over concerns about poor connectivity and over-concentration of employment/ service activity. The issue therefore is how the benefits of agglomeration can be obtained while at the same time avoiding campus-style pods and creating a permeable, integrated urban environment.

In conclusion, then, pods have occurred and are occurring because they are easy to conceive, design and develop. They are the most feasible form in terms of market preference and can be adapted to almost any spatial opportunity. But they are also the least sustainable: they create an environment that compromises accessibility and health, reducing active travel, increasing car use and trip length.

Cells

The idea of neighbourhoods as distinct units or cells, popularised by the British New Towns, is evident in practice when looking at the pattern of twentieth century development in many of the study areas. But there is generally less enthusiasm in the forward plans studied – except for Trumpington, in Cambridge Southern Fringe. This may be a reaction to the experience of some outlying council estates, designed as neighbourhood units, which have become concentrations of relative deprivation (for example, the Shiremoor estate in Newcastle). The apparent lack of enthusiasm for cells, however does not imply they are not feasible. Exploratory scenarios show they are physically viable options in all the urban edge locations, and often the most easy to implement if the pods option is excluded. This was not the case in older suburbs. The main uncertainty about neighbourhood cells is the degree to which they can successfully support a good range of local services.

Stakeholders, including commercial interests, were often concerned about this. For example it was suggested in the case of Northstowe that the cells option spilt retail demand in an unhelpful way: no cell by itself would be able to support sufficient services and if the central cell established dominance then the others would be neutered.

Putting such uncertainties to one side, cells sometimes performed well in terms of providing an accessible environment. They also have the advantage of forming an easily recognised, identifiable, neighbourhood. But their main advantage, in a number of cases, was their adaptability to different situations, and their ability potentially to transform an unsatisfactory fragmented urban structure. Examples are given below:

- Cambridge East: extending the tail end of an existing outlying estate so as to generate a new local centre
- Trumpington, Cambridge: peripheral expansion of an existing cell neighbourhood to increase catchment population and improve the local centre
- Shiremoor, Newcastle: extend and socially diversify the old council estate so as to generate more local demand, with core area redevelopment around the station
- Broxbourne: create a new neighbourhood around an existing out-of-town retail park, encouraging the latter to redevelop as a pedestrian-friendly, mixed use centre.

In each of these cases a key factor in the scenario was linkage. The neighbourhood centre was not hidden away in the secret heart of a residential enclave but visible, public, on display. To remain vital and viable as populations evolve the centre needs passing trade. At Shiremoor people within and without the neighbourhood would be drawn by the Metro station, or pass on the main road. Both Cambridge examples are also on main city distributors.

Such cells can be seen as permanent features in the urban structure. But they can also be designed so that they could evolve into parts of larger forms – clusters or linear townships. The cell was the logical model for Trumpington (South Cambridge) for the medium term, however in the long run the possibility of linear development along the whole Trumpington radial, with much improved reliable bus services, could alter its character. Equivalently the revived Shiremoor cell could be seen as a staging post on the way to a whole cluster of interlocking neighbourhoods providing higher level services at the core. The key to leaving such long term options open is contingency planning.

Clusters

Integrated clusters of neighbourhoods, advocated by the Urban Task Force, rely on high average densities and compact form if they are to succeed. In the nine study areas there are no examples of such clusters, either existing or proposed. Across the country as a whole the same is largely true. Most of the major urban extensions in the pipeline are either large neighbourhood cells, linear townships, or some hybrid design. The question arises why this should be?

In part it is certainly due to spatial difficulties – there is often not the physical space for a nucleated new town in the land allocated. Exploratory cluster designs for Northstowe, Cambridge Southern Fringe, and Newcastle Great Park all illustrate the difficulty of realising the archetype within existing physical structures and allocated development land. By contrast, however, the schemes designed for Cambridge East and Blackworth/Shiremoor showed promise. Both involved integrating existing neighbourhoods into the scheme, with potential benefits in terms of regeneration, providing more social diversity and improved access to services. In some situations, too, changed land release policies could have permitted clusters to develop. This was the case at Newcastle Great Park and Northstowe. In both situations the actual planned allocation seemed to the researchers to relate more to land ownership and/or brownfield definitions than to settlement planning.

The situation in suburban London is rather different. In both Barking and Harrow there is more of an urban continuum, with peaks of activity in town and district centres around stations, which might on first consideration lend themselves to cluster development. But in neither situation is the cluster archetype a viable option. Harrow South has partial linear townships which should shape future policy. The favoured scenario for Barking West could echo this by developing around stations, moving towards an open on-line cell model. But the practicality of this restructuring is doubtful.

In those situations where clusters were possible there was significant distortion in order to fit reality. Nevertheless accessibility analysis showed that in principle cluster could be as effective as any other form. The uncertainty was similar to that reported for cells: how viable would the smaller local centre be in competition with a dominant district centre offering a much wide range and quality. The catchment population for each local centre is not normally more than 4,000, which is marginal in itself. Compound that by the fact that some people in that catchment will be less than 1000m from the main centre (a distance that we know many are willing to walk to food and other retail outlets), and you have a risky situation. In addition is it difficult to design a cluster so that every centre is likely to have a frequent bus service and passing motorised trade. Even in the case of East Cambridge, the best formed cluster, the uncertainties in this respect outweigh the certainties.
However, before dismissing clusters it is important to note other pros and cons:

- Clusters are more efficient in their use of land than either cells or linear townships. This of course is a function of higher average densities,
- clusters provide poorer access to major greenspace than

either cells or linear townships,

- stakeholders views about the desirability of clusters varied according to context. Where the impact on adjacent neighbourhoods was perceived as benign (e.g. Cambridge East) then cluster was in favour; where it was perceived as invasive (Northstowe) or compromising vital green lungs (Backworth/Shiremoor) it was disliked.

The evidence from SOLUTIONS casts doubt on the merits of advocating the cluster as a general solution to sustainable suburbia – as for example in the high profile Urban Task Force report (1999). Its relevance in most situations is doubtful. Its sheer size and complex structure makes it difficult to integrate. Another key problem is that the cluster relies for its excellent level of local accessibility on viable sub-centres, but might well in practice fail to sustain them in competition with the main centre. By comparison with cells or linear forms the sub centres are relatively close to the main centre. It might cease to be a cluster and become a large mono-centred neighbourhood, with some fringe households beyond easy walking distance of the centre, while others at the heart are distant from major open space.

Linear

Linear townships centred on a tram or trolley-bus spine were a feature of industrial towns and cities, but the late twentieth century suburbs followed an altogether different pattern. Looking across the nine study areas, linearity is strongly observable only in the earlier places: West Harrrow, with several thriving high streets, often related to tube stations; Scotswood, with one long intermittent high street on the line of Hadrian's Wall; Broxbourne, with a series of often decayed small shopping centres strung out along the old A10.

The starting point for applying linear townships in future planning is the potential for reinforcing and extending traditional linear patterns without simply exacerbating the congestion often associated with high street spines. In Harrow South a good case could be made. Public transport services are good, there is the possibility of rebalancing the use of road space and there are opportunities for gradual intensification close to the stations and the high streets through the process of renewal. Local stakeholders believed it could be successful and desirable. However, Broxbourne was rather different. The key difference is the poor quality of public transport and local facilities and very high levels of car dependence. Intensification along the original A10 spine would result in more vehicle trips, with the associated social, economic and environmental disadvantages. It is, if you like, 'too far gone'. It is difficult to see that situation changing unless economic fundamentals change first.

The application of linear designs to the urban fringe, urban extension and new town study areas is generally feasible. Physical practicality depends on the land allocated for development. In the case of Northstowe the allocation exactly suits a linear township. The scale of proposed release in Cambridge East permits an elegant linear design, even though it was not conceived for that. The area of Newcastle Great Park also allows linearity – though in this case the optimum design would require a shift in land released. In Backworth/Shiremoor there is an attractive long-term linear opportunity (not currently reflected in land allocation) but the linear scheme may not properly address the existing problems – rather the linear option could evolve from the best medium term option, which is a cell scenario. This process of evolution, from one form to another, could also apply in Cambridge Southern Fringe (Trumpington) and the major redevelopment area within Scotswood.

In most cases linear found favour with stakeholders. It was considered first or first equal in six out of eight assessments. The reasons for this varied: sometimes because it tended to integrate urban areas rather than segregate, thus thought to encourage local facilities; sometimes because it was perceived as reinforcing public transport. In two cases it was thoroughly disliked: one where the logical long term linear option invaded greenspace which was considered sacrosanct; the other where the scenario was expected to result in an unpleasant environment along an already very congested radial. In this latter case the SOLUTIONS team then devised an alternative scheme which avoided that problem.

The most striking result of the research is perhaps the performance of linear schemes against sustainability criteria. Taking an overall view, linear would appear to perform best or best equal in most cases. A key factor is its efficiency in relation to public transport operation and accessibility – so long as the linear concentration is well interconnected to prime transport routes. It also generally performs well in access to local facilities, schools and major greenspace. It is average (with cells) in its use of land. The classic disadvantages of linear – excessive multi-use and congestion on spine routes, and longer trips – do not for the most part appear significant when the linear designs essentially occupy the same terrain as competing schemes. The spine road problem is sometimes solved by parallel segregated roads (as exist in Newcastle Great Park and Cambridge East final scheme). What is vital is that the main high street is not also a key city distributor, or if it is, there is space to widen it to boulevard standard. Overall, then, linear townships have been found to be widely applicable, generally the more sustainable forms tested, and often liked by stakeholders.

10. Conclusions

This report has attempted to summarise the findings of a very complex research project so that clear lessons are learnt, and implications for practice can be spelt out. The six conclusions below deal with general principles for the planning process that emerge from the research.

The significance of different local urban forms for key sustainability indicators of accessibility, social inclusion and active travel is considerable.

While the general conclusion of the SOLUTIONS strategic studies is that different broad land use and transport strategies make only very modest differences to sustainability outcomes over the period to 2031, this does not imply that spatial strategies at the more local level are similar. The major regional studies could not attempt to explore local variation. A fundamental principle is: the smaller the area under consideration the greater the potential for major change and significant variation in impact. The research on neighbourhood accessibility (section 3) demonstrates the current significance of local urban structure for behaviour. This report as a whole illustrates the potential for more sustainable forms to be planned for the future.

The optimum neighbourhood form depends on context. Linear was the most consistent in its performance, but cells and clusters are best in certain situations. Pods were never appropriate

There is no one answer to what is the most sustainable form of settlements. It depends on context. Of the four archetypes studied, one – "use-segregated dispersal" – was consistently rejected in all places – both by local stakeholders and by technical evaluation. The other forms – neighbourhood cells, clusters and linear – all performed well in specific locations. Cells were sometimes the most practical solution in edge of city locations where critical mass could be achieved based on existing, poorly structured or sporadic development. Clusters only appeared practical where a major urban extension, well related to the city, offered significant space. Linear forms proved the most adaptable, and frequently the most efficient, linking into historic linear patterns and justifying good quality new public transport services.

The research shows that in many cases the question of sustainable neighbourhood form - i.e. the structure that provides the best opportunities for social inclusion and healthy lifestyles, and the least environmental impact - has not been closely considered, or given due weight, in the planning decision-making process

Land for new development is frequently released or permitted on the basis of factors which have little to do with sound and sustainable neighbourhood structure. Of the eight study areas, five exhibit unsustainable location and/or form of proposed new development, while four were generally sustainable. Valid sustainable forms have often been precluded because of previous decisions on location and land release. The reasons for this have not been systematically examined in this research, but the incidental evidence from stakeholders and reports strongly suggests the following factors can undermine good decision making:

- The favouring of brownfield sites for development, even when poorly located
- Ownership of land by influential and powerful companies or government bodies
- The process of searching for housing sites to fulfil targets for specific end-dates
- Local political desire to minimize opposition

The location of new settlements is critical and should not be strongly influenced by either vested interest (i.e. land ownership) or politics.

Small new towns, lacking their own economic raison d'être, and cut off from the mother city, are not normally sustainable from the transport viewpoint. Evidence from the Cambridge city region indicates that the sustainability of new settlements is profoundly affected by their location, scale and nature. This is illustrated by empirical evidence of unsustainable travel behaviour in the new settlements of Cambourne and Bar Hill, and analysis of the proposed new town of Northstowe. Evaluation of the Newcastle Great Park development in Tyne and Wear, and evidence from the sustainability appraisals of proposed eco-towns, reinforce the conclusion.

New land for development should be released on the basis of sustainable settlement form, not vested interest or political considerations.

Irrespective of the general location, the research reveals there is frequently mismatch between the land released for development and the optimum form of development.

Land release is often seen in the UK as dependent on land ownership or minimum opposition rather than the best way for a town to grow. This is illustrated by Newcastle Great Park, Backworth, Trumpington and Broxbourne. In each case potentially desirable patterns were precluded by the prior site decisions.

Good practice in sustainable suburban development is a matter of recognising the importance of relatively simple (and initially desirable) principles and not compromising them.

The Cambridge East case study provides an example, so far, of principles have been logically followed through.

- The location is excellent, closely linked into the city, helping link and integrate currently rather disparate development.
- The development boundaries offer the possibility of a range of different neighbourhood forms: cluster, linear and cell. Masterplanning processes will be able to explore the strengths and weaknesses of each before decisions are made.
- The development is planned to include a new mixed use centre which will be at the heart of the extension, linked into the existing town by high quality public transport.
- The principle of the green wedge is fundamental, while it's exact location is to some extent flexible, and it can provide a logic to open space and green infrastructure provision.
- Residential densities are sufficiantly high to support a good range of viable facilities. Our own studies suggest that within the high average density a diversity of dwelling types (and therefore household types) can be accomodated.

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