CHAPTER 5
Density and Other Policy Objectives

INTRODUCTION

5.1 This chapter examines the way in which the use of density in planning interacts with other policy objectives and measures. It is based on an extensive review of the literature dealing with the environmental and societal effects of density standards. The relationships examined are, in turn, those of density with:

- the pattern of settlements and travel between them;
- energy demand;
- social attitudes;
- bio-diversity; and
- design quality.

This review forms the background to the more detailed explorations in Chapter 6 and 7, of how density control relates to two specific considerations:

- built form; and
- the demand for urban land.

GENERAL RELATIONSHIPS BETWEEN DENSITY AND OTHER CONTROLS

5.3 Residential density measures the extent to which land is occupied either by people or by some physical unit of accommodation, such as dwellings, habitable rooms, bedrooms or floorspace. Recent debate has focused on the need for a composite measure which takes account of the total number of persons who will live and/or work in the area[1]. It is a useful measure of the residential envelope and the basic characteristics of the development contained therein[2], and it sometimes serves as a measure of the dynamic interaction that may be expected in an area[3].

The research findings presented in this Chapter suggest that:

On Settlement Patterns and Travel Demand

- *in theory, higher densities can mean more opportunity for local interrelationships and less motorised travel demand;*
- *in practice there is evidence that travel by all modes was lowest in areas with a density of over 50ppha but;*
- *more research is needed on how much difference density makes, as a part of the total mix of variables.*

On Energy

- *density and built form influence the use of energy for heating and service provision;*
- *high densities and compact forms of development offer an opportunity to incorporate energy efficient distribution systems, such as CHP/DH; and*
- *high rise forms of development use more energy for access and service provision.*

On Social Aspects

- *perceptions of residential density do not always match the measured reality, but higher densities tend to have negative connotations;*

On Bio-Diversity

- *urban sites often exhibit a wide range of habitats and complex species; and*
- *site coverage is likely to be more important than density in determining the impact of development.*

On Design Quality

the relationship between design quality and density is not very direct.

5.4 The density of non-residential development is usually expressed as the ratio of the floorspace (net or gross) to the site area (net or gross). It is used widely to promote redevelopment, to facilitate the regrouping of buildings and the rearrangement of street patterns, to secure 'good' environmental conditions for buildings, to prevent over-development, and to balance the conflicting claims of land use activities, access and parking with the capacity of adjoining streets and public transport. Although building volume controls are widely used throughout the world, they are only occasionally specified in the development plans now being prepared by local planning authorities in England. Until recently the London Boroughs used plot ratio to control building bulk and height. Unitary Development Plan Inspectors are now recommending that plot ratio policies should be deleted from the plans[4] on the grounds that these standards are too inflexible and restrictive in the light of the provision of Section 54A of the 1990 Planning Act.

5.5 Density is a complex variable which continues to figure prominently in debates on urban form, patterns of sustainable urban development, environmental health, crime and vandalism, travel patterns, and the quality of life in towns and cities. There is sufficient evidence to confirm that residential density, built form and layout interact with a wide range of environmental and societal variables. Although the precise nature of many of these relationships has still to be established, they clearly play an important role in determining residents' perceptions of their quality of life and local housing priorities[5].

5.6 A comprehensive approach to the planning, location and design of residential areas is required to ensure that important goals are not overlooked or pre-empted. For example, a balance needs to be struck between the principles governing wind control and passive solar access and other equally important performance criteria, such as privacy, noise reduction, emergency access and crime prevention. The use of extensive urban tree planting to provide shelter can result in a wide range of benefits such as carbon sequestration, dust filtration, improved air quality, enhanced biodiversity, improved levels of outdoor comfort, additional recreation/education potential, renewable energy cropping and job creation.

5.7 The importance that is now attached to sustainable development poses fundamental questions about the location, scale, density, form and layout of new development. These issues have assumed particular importance in the light of current projections that an additional 4.4 million households may have to be accommodated in England during the period 1991-2016. Government policy envisages that much of this accommodation can be provided by raising densities, by house conversions, the conversion of empty office blocks into flats and the use of compact energy-efficient forms of development, such as terraced housing and low-rise blocks of flats. This approach will reduce the need to travel, encourage the use of public transport and minimise the development of green field sites.

SETTLEMENT SIZE, LAND USE, DENSITY AND TRAVEL DEMAND

5.8 Recent research highlights the relationship between settlement size, range of facilities, density, urban form, travel demand, journey length and modal choice[6]. A settlement's size, population density and range of facilities will influence the extent of its catchment area and thus the number and distance of the journeys it attracts. In principle, larger denser settlements can moderate travel demand by:

- increasing the number and range of services and employment within the area;

- concentrating movement patterns in a way that favours public transport; and

- reducing the average distance to locations of high movement demand, especially town centres.

5.9 The provision of employment, services and recreational facilities also plays an important role in determining travel patterns. There is a clear trend towards the provision of large-scale facilities, (e.g. shopping centres, new hospitals, leisure and theme parks, industrial and high-technology parks). The implications for transport sustainability are profound. Journey lengths have increased and access is often only possible by car. The suppliers of these services and facilities favour peripheral greenfield sites with good car accessibility. Current Government policy, however, favours central locations, within large urban areas, which afford good access to public transport[7].

5.10 So, although density is only one of the influences, there are a number of ways in which it can affect travel patterns:

- by widening the range of opportunities for local personal contacts and activities which can be maintained without the use of motorised transport;

- by widening the range of local services which can be supported, thereby reducing the need to travel long distances for those services;

- by reducing the average distance between journey origin and destination, and hence reducing the need to travel and increasing the practicability of using non-motorised transport;

- by providing a larger catchment for public transport services and thereby improving the viability of public transport operation; and

- by discouraging car ownership and use as a result of limited road space for parking and driving.

5.11 The relationship between settlement size, density and travel is both complex and difficult to interpret, because there is no clear relationship between the distance travelled by all modes and size of settlement. It is possible to identify a number of general trends using data from the last three U.K. national travel surveys:

- the relationship between population density and travel distance has remained consistent between 1985/86 and 1992/94;

- the total distance travelled by all modes was lowest in areas with a density of over 20 persons per acre (50 persons per hectare);

- the total distance travelled by all modes was lowest in towns with a population of 250,000 and over; and

- the distance travelled by all modes increased as density decreased.

5.12 The energy used for personal travel reflects the trip purpose, modal choice, fuel 2 efficiency of vehicles, and settlement size, form and density. The importance of these variables is determined by the interaction of socio-economic/behavioural variables such as income, age and life-cycle as well as the existence of alternative modes of public and private transport[4]. Recent studies have examined the effects of settlement size, form and density on travel patterns and fuel consumption.

In the U.K. the most consistent set of variables are the physical ones, principally density and amount of open space, but the social and economic factors are also important in the individual towns and cities[3]. However, substantial variations in energy use in transport have been found within towns and cities, so the scale of analysis becomes important. These variations reflect the distribution of existing housing and facilities and decisions on the location of new housing and facilities.

Mixed land uses and concepts of self-containment are important in reducing energy consumption in transport, but local jobs and facilities must also be suitable for local people, otherwise long-distance, energy-intensive movements will be made. It should be remembered that the vast majority of trips do not use much energy. About 20% of motorised trips account for 61% of energy consumption rising to 72% in urban areas.

Further research is needed on the effects of household size and income, and settlement size, form, density and land-use pattern on travel patterns. Particular attention should be paid to the nature, extent and purpose of non-work trips.

5.13 The relationship between urban form, density and travel underpins the case for raising residential densities. The advantages of compact forms of urban development (e.g. terraced housing and low rise blocks of flats) include reduced travel, fuel consumption and CO emissions, energy saving, the prevention of further urban sprawl and the prospect of securing the provision of affordable housing. Compact forms of development can be promoted regardless of settlement size, location (e.g. inner city and urban fringe) and density.

For example, attempts are being made in the USA to promote suburbs which are either pedestrian or public transport orientated. These developments are characterised by mixed uses, higher densities and a more interconnected pattern of streets[10]. Recourse to the literature, however, confirms that there is considerable uncertainty about the equity and efficiency implications of 'low' and 'high'-density development[11]. It is important to ensure that sustainable forms of development, regardless of density, are environmentally and socially just[12]. At this junction it is difficult to predict the impact of continued advances in telecommunications upon the future size and form of settlements, travel patterns, congestion and pollution. Evidence from the USA confirms that, whilst commuting has been reduced in some areas, only 5 – 10% of the work force is able and willing to substitute telecommuting for all or part of their daily journey to work[13].

DENSITY AND ENERGY DEMAND

5.14 Energy demand is of course not only associated with travel. Energy production, distribution and consumption interact with town and country planning at a variety of spatial scales ranging from individual buildings, neighbourhoods, towns and regions. Clearly, there is a link between settlement size, urban form, land use distribution, density, layout and the pattern of heat load. In so far as density is an arbiter of built form, layout, settlement size, occupancy levels and intensity of use, it is a surrogate measure of the potential demand for energy and, to a lesser extent, energy supply networks. For example, the location of a 24-hour heavy user of heat can provide the incentive for installing the main distribution pipework along the route between producer and user. This in turn will attract other developments which wish to 'tap' into the network. Combined Heat and Power/District Heating (CHP/DH) can increase the overall efficiency of fuel use from an average of 38% to between 80-90%, but so far only limited progress has been made on the establishment of urban-scale CHP/DH systems in the U.K.

5.15 There is little research on the relationship between urban form, density and energy consumption[14]. The evidence to hand confirms that these variables influence local microclimate which, in turn, influences the energy consumed for space heating and air-conditioning. Location within a settlement is also a key factor in determining energy consumption. Houses in exposed urban-edge locations may use 20% more energy for space heating than similar buildings in more sheltered central locations. Compact high-density areas use less energy than that used in low-density areas with a similar population. High-density layouts can also facilitate thermal exchanges between buildings, thus helping to retain warmth[15]. Changes to urban form can facilitate the adoption of energy-efficiency measures as well as influencing the choice of transport mode[16].

5.16 The energy-efficiency performance of new development will reflect the interaction of the following factors:

- location of the site;
- topographical and landscape features;
- site orientation and location of the development;
- the local microclimate (e.g. prevailing wind direction, the temperature of air flow around buildings, and the incidence of driving rain);
- the scale and land-use mix of the development;

- layout configuration;
- the density, design, form and height of buildings;
- proposed landscaping treatment; and
- the use of building forms and materials that minimise the spectrum of energy loss.

5.17 It is readily apparent that the planning and design requirements of passive solar energy and wind control will impose constraints on the road layout and the size, form, height and orientation of buildings[17]. The cost and marketability implications of such planning and design requirements may also entail a review of the prevailing density standards because these will determine the profitability of any housing proposal.

5.18 Buildings account for 42% of the energy consumed, and 47% of CO emissions in the U.K[18]. Housing consumes over 28% of the energy supplied to final users in the U.K.(16) The end-use energy efficiency of the 24.2 million dwellings and 1.7 million industrial, commercial and public service buildings reflects their age, design, condition, degree of insulation and ventilation, and patterns of occupation and use. The energy they currently consume could be reduced, with a commensurate reduction in CO emissions, using proven technologies with a payback period of 5 years. This could either reduce or postpone otherwise necessary capital investment to augment the future supply of energy. As around 1% annually is added to the U.K.[19] building stock in the form of new buildings, there is an opportunity to conserve energy in the remodelling, renovation and regeneration of our towns and cities[20]. Density policy, though less critical than other design standards, ought clearly to be consistent with the objectives for energy use and conservation.

SOCIAL ASPECTS OF DENSITY

5.19 Population density does not shed much light on the complex divisions of urban population and society. Socio-economic groupings (SEGs) provide a useful indicator and/or predictor of people's life-chances, health and well-being, and their ability to participate in job and housing markets. Family structure will often determine the occupancy of dwellings irrespective of their layout and density arrangements. Age, gender, ethnic and cultural differences also influence the ways in which different groups perceive their local residential environments and the effects of density upon them[21].

5.20 The major social divisions in urban population result in a complex residential pattern, including the segregation of different population groups. These patterns reflect the interaction of occupation, income, life style and life cycle[22]. In essence, they represent the trade-offs of individuals, households and groups who possess the financial resources to satisfy their locational preferences. Some will prefer to trade-off spacious low-density housing in suburban and rural locations for other highly valued attributes such as the environmental quality and high social status of a central area mews cottage and the convenience and low travel costs of an inner city terrace. In general, there will be social benefits if the population density is high enough to support a wide range of locally-accessible services. This will assume particular importance in those areas where the households lack the purchasing power and physical ability to travel widely in pursuit of market choice.

5.21 Various studies have confirmed that residents' perception of density does not represent the outcome of empirical calculation. Densities are perceived as low by residents if they include open spaces, low height to space ratios, low artificial light levels, low traffic levels, private gardens and entrances, the absence of non-residential uses nearby, and social homogeneity 23. The apparent simplicity of residential density as a measure of quality is deceptive. It is too general and unreliable a relationship to figure in the rationale for using density to control development. Different densities, layouts and housing types may all stimulate residents' dissatisfaction due to the existence of other uncontrollable phenomena, such as child density.

5.22 There are two main schools of thought about the effects of design, density and layout on the behaviour and social relationships of groups and individuals. The first maintains that the physical

environment created by the modern architectural movement is largely responsible for a wide range of social problems[24]. Some kinds of spatial configurations facilitate interaction whereas other forms of neighbourhood design mitigate against human encounters[25]. Housing satisfaction studies confirmed that density, layout, built form and human behaviour are sometimes linked. The response to densities of over 120ppa (296pph) and high levels of occupancy varies according to the culture and social situation as well as demographic factors such as age and stage of family life-cycle. For example, a high-rise block of flats can provide the setting for a thriving community or a full-scale riot against the police.

5.23 The second school of thought maintains that physical space is a contingent factor which is largely determined by the social position, values and inspirations of households and individuals. Social relationships, which often reflect class, gender and ethnic origins, are thought to be the main causal mechanisms governing behaviour and social change. This has led to social analysis of density. Attention has focused on intensity of occupation and overcrowding. Relative success in the competitive struggle for accommodation makes it possible to live in areas which are not crowded. Relative failure, on the other hand, can result in overcrowding, unwelcome social interactions and anti-social behaviour. There are many different views on the nature and effects of overcrowding[26]. It is the combination of social deprivation and high density overcrowding which is most clearly associated with pathological behaviour patterns.

5.24 Since the 1920s social scientists have tried to establish a causal link between density and various indicators of social pathology, (e.g. alienation, public disorder, social conflict, physical aggression, crime, morbidity, mental illness and impaired child development). Some argue that public housing estates are increasingly associated with deprivation, and that they are being used as 'holding areas' for problem families[27]. Public housing brings together the disenfranchised and most deprived members of the community. High-rise, high-density estates magnify this situation both functionally and symbolically.

5.25 In recent years there has been an increase in the number of housing satisfaction surveys undertaken by social landlords. The Department issued guidance on the future conduct of such surveys in 1993[28]. Earlier surveys of local authority estates found that residents, especially housewives, appreciated 'good' design and layout, high-quality landscape, a sense of spaciousness, attractive views and a variety of house types and built forms. The main complaints included the drab institutional appearance of some estates, poor standards of workmanship and maintenance, lack of security, noise, lack of privacy and the inadequate open spaces and play areas[29]. One particular cause of complaint concerned the high child density in some flatted estates. Problems arose because the play areas attracted large numbers of children resulting in noise, disturbance, damage and vandalism. A recent survey of private sector flat conversions carried out in London found that many of the occupants wanted to move. The main complaints included poor materials and workmanship, small cramped rooms (especially the kitchens), sound transmission, inadequate storage space, traffic noise, the problem of on-street parking, vandalism and crime[30].

5.26 It was during the 19th century that attention was first focused on the relationship between the social organisation of space and the incidence of crime. From this time on crime was deemed to be an urban phenomenon. The findings of recent national and local crime surveys confirm that certain areas (e.g. unpopular council estates located in the inner city and the periphery of conurbations) experienced above average levels of crime and criminal activity. It would appear that council tenants are more vulnerable to property crime than homeowners. Although some links have been established between crime levels and a range of societal and environmental variables, it is nevertheless the case that outwardly similar residential estates can exhibit very different crime profiles[31]. It would appear that high child densities are also associated with high rates of crime in some areas. One study concluded that criminal activity was linked to housing allocation policies, tenure and social stigma rather than the layout, density and built form of residential estates[32].

5.27 There is sufficient evidence to confirm that the fear of crime is an important determinant of people's use of space and recreational/ entertainment facilities. A recent quality of life study has found that residents in Cheshire perceive a direct relationship between housing and crime, especially in those districts where there is widespread crime and drug taking. The fear of crime clearly inhibits their everyday behaviour, especially after dark, and hence reduces their quality of life"[13].

DENSITY AND BIODIVERSITY

5.28 The Government is firmly committed to upholding the principles laid down in the Convention on Biological Diversity which was ratified at Rio de Janeiro in June 1992. Article 2 of this Convention defines biodiversity as:

"The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems"[14].

The above definition identifies three distinct levels of biodiversity, namely diversity between and within ecosystems and habitats, diversity of species, and genetic variations within individual species.

5.29 Urban areas are remarkably heterogeneous, both in terms of their land-use history and current practices of open space management. This results in a wide range of different habitats and complex species groups in different urban areas. Age of site has been shown to be related to the numbers of small mammal and ruderal ("weedy") plant species found on urban sites. There is also a significant correlation between site age and invertebrate species. The most likely explanations for the importance of age are twofold. Firstly, in the cases of ruderal plant species, and small mammals, the longer a site remains vacant, the more time there is available for different species to colonise it and for populations to develop – the same situation may also hold true with invertebrate groups. Secondly, there are many relict sites in British cities which are "relics" from the pre-urban situation i.e. the so-called encapsulated countryside. Examples include ancient woodlands and old heathland areas. These sites may support a historical reservoir of so-called relict species, especially certain plants and invertebrates, which are relatively poor at colonising newer urban habitats. This accounts for the higher species numbers found in such settings. Therefore, determining whether or not there has been continuity with the rural past, and whether or not this is reflected in the species presently found on the site, is a critical factor.

5.30 There are a number of ecological factors which determine the potential biodiversity of urban space[15] e.g.:

- structural diversity;
- age and history of the site;
- distance to other open spaces, to the urban centre and to the urban fringe;
- distance to water;
- the incidence of barren ground and dense vegetation; and
- regional and local climatic regions.

5.31 Studies have shown that within towns and cities there are identifiable species – area relationships which hold true for plant species, small mammals, amphibia, birds and reptiles. A key factor in these relationships is the availability of space for colonising and the size of the territorial areas of particular birds, mammals and insects. These species – area relationships need to be viewed with caution because other factors such as the dynamics of species groups and/or site age, may be more significant in determining local biodiversity. It suffices here to list the main urban habitats and their contribution to biodiversity, namely:

- private garden: native and non-native plants: species densities often peak in the suburban zone;
- parks: a limited biodiversity due to intensive management; tree regeneration is rarely allowed; poor quality grassland; and

- vacant sites: ruderal types of vegetation; urban scrub (e.g. elder and sycamore).

5.32 Parks can contribute to urban biodivesity providing that more sensitive management measures are adopted. These could include for example: retention of dead-wood and dying trees, allowing some scrub incursion and plant succession, and a deliberate attempt to create natural habitats. More dense tree-planting could also be an option. To achieve some, or all, of these measures would require a degree of public education to secure acceptance of areas of "wilderness" within urban areas.

5.33 Larger towns and cities, by virtue of their heterogeneity, tend to support more vegetation types and plant species. The nature of the species groups varies according to the degree of urbanisation[16]. As one approaches the city centre, or alternatively as the size of open sites becomes smaller, so the range of ubiquitous and common species increases compared to those species which are restricted to particular habitat types. In other words, the nature of the actual species types varies according to the degree of urbanisation, and the effects of adverse factors such as traffic noise, trampling and other forms of human activity". The significance of these effects for particular species groups and different site sizes remains uncertain due to the lack of quantifiable data, and as a consequence no single factor can be used to "explain" biodiversity anywhere. Increasing the density of development (at least in terms of built footprint) will tend to reduce opportunities for bio-diversity. But the nature of the relationship will depend on the individual site.

5.34 There are a number of points to be considered:

- a distinction needs to be drawn between development coverage and density. Its bio-diversity will be lost regardless of the number of dwellings accommodated on the site. For example, high-density development in the corner of a site with ecological interest will be less damaging than low-density development over the whole site; and
- the nature of development and the use of space between buildings is important. Low-density development is just as capable of extinguishing opportunities for bio-diversity as high-density development if the space between buildings is covered in tarmac.

5.35 Hence, at the site-specific level, the relationships between bio-diversity and density are more to do with the location and site coverage of development and especially with the ecological character of the site than with density *per se*.

5.36 At the broader level we need to be concerned about the net change in bio-density. If development in rear gardens has a negative impact, this then needs to be compared with the impact on bio-diversity of development of the same number of houses or floorspace on, for example, a peripheral green field site, a redeveloped town centre site – or for that matter a converted office block.

DENSITY AND DESIGN QUALITY

5.37 Density is one of a number of design considerations which authorities are explicitly permitted to take into account in considering planning applications (DoE 1997[18]). However, its relationship with design and quality is less than direct and depends on factors other than density.

5.38 A recent recent study in London[19] which reviewed the environmental quality of 50 residential areas found that the majority of areas judged to be of above average quality were either above or below the density range recommended by LPAC and applied by many London Boroughs (125-250hrh). Indeed only 17% of the areas assessed as being above average quality were within this density range. One explanation for this, as our previous chapter's analysis of recent residential development suggests, is that the application of typical planning, road and parking standards tends to result in uniform dwellings and layouts which lack character and distinctiveness.

5.39 The London study concluded that quality reflected a range of design and management issues – the coherence of the street scene and the design of parking areas were important, but so too were

issues of safety, danger from traffic and maintenance. This tells us that while density is a consideration, it must be seen as part of a wider design briefing and urban management process and these factors tend to be more important than density per se.

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