

Urban morphology and ecosystem services: a  
historico-geographical study of fringe belts and urban green  
spaces in Birmingham, UK

by

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## **Abstract**

Cities have tended to be treated by ecologists as essentially physical entities unconnected to the concerns of historical geographers. In contrast, urban morphologists have tended to focus on how urban physical expressions of culture have changed over time: such an approach has stimulated research on the characteristics and planning of the form of cities that has been largely divorced from concerns about ecosystem services. This is somewhat paradoxical in light of the significant areas of most cities that are vegetated and the increasing evidence of the value to society of these green spaces. This thesis examines the connection between urban morphological research on the fringe-belt concept, as developed by M. R. G. Conzen and others, and the character and distribution within cities of major areas of green space. The principal focus is on how green spaces within fringe belts that are embedded within cities (for example, parks, allotment gardens, golf courses, and land attached to educational and medical institutions) have changed over time, especially during the past 100 years. Detailed studies of fringe-belt sites in Birmingham reveal a decline in green space over time but maturation of surviving green space towards mature wood-grassland. Comparisons are made with residential areas.

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# Chapter 1. Introduction

## 1.1 Urban morphology and ecology

This thesis addresses aspects of the relationship between urban morphology and ecology. In the early parts of the thesis this relationship is addressed in general terms, ranging broadly across the disciplines. The core and concluding parts of the thesis are concerned with developing the interconnection of much more limited aspects of each field.

Urban morphology and ecology are two fields of research that have hitherto been almost entirely separate from one another. This separation is an example of a much wider tendency for disciplines to function largely in isolation from one another (Gibbons *et al.*, 1994). In the case of urban morphology and ecology, the separateness is partly a reflection of broader differences of affiliation, urban morphology having been pursued largely within the social sciences and humanities, and ecology within the life and environmental sciences.

Urban morphology is widely understood among its researchers to be the study of urban form, embracing such topics as the configuration of urban areas and intra-urban patterns of streets, building types and land use. It is much concerned with the historical development of the physical form of cities (Conzen, 1960) and has links with urban design and planning (Barke, 2015; Kropf, 2009).

Ecology may be described as the scientific study of the process of determining organisms' abundance, distribution and interactions, the flow of energy and materials

through organisms and associated environmental interactions (Gaston, 2010). It entails measurement of a variety of variables that define or determine organism abundance and behaviour (McIntyre *et al.*, 2000, p. 5).

Therefore, the approaches of ecologists and urban morphologists almost inevitably differ substantially. Studies of ecology have hitherto been largely ahistorical and almost entirely acultural. Cities have often been treated by physical geographers as essentially physical entities with minimal links to the concerns of historical geographers. Researchers in the field of ecology have been mainly schooled in biological science and, to a lesser extent, environmental science. Urban morphologists in contrast have mainly been trained as human geographers, architects and, to a lesser extent, historians and planners.

Ecology is central to the maintenance of environmental quality (Escobedo *et al.*, 2011) — that is, the extent to which a place sustains a diverse ecological community and sustains human communities — in urban as well as rural contexts. Trees, for example, provide shade (Gomez-Baggethun and Barton, 2013), cooling, and reduce air pollution (Leichenko, 2011, p.165). Urban green space contributes to several sustainable development goals (SDGs), including good health and well-being (3<sup>rd</sup> SDG), sustainable cities and communities (11<sup>th</sup> SDG), climate action (13<sup>th</sup> SDG), and life on land (15<sup>th</sup> SDG).

Key concerns of urban morphologists have been how urban physical expressions of culture have been maintained or changed over time. This is notably the case with research that has adopted Conzenian or Muratorian approaches (Caniggia and Maffei,

2001; Conzen, 1960). These and other approaches have stimulated research on urban form that has been largely divorced from concerns about ecology (Kropf, 2009; Whitehand, 1994). For example, vegetation tends to have a comparatively small part to play in the recognition of urban morphological regions, which are fundamental units in the work of many urban morphologists, in spite of the fact that urban spaces are often designed to accommodate vegetation (Johnston, 2015).

However, there has been recognition that an understanding of urban ecology requires methods that draw on several disciplines, and arguably ecologists tend to have a more constructive and positive attitude to interdisciplinary research than has characterized much of science (Gaston, 2010). Studies of urban ecology need inputs from social science, as urban spaces are, by definition, strongly shaped by human activities (Alberti *et al.*, 2003; Grove *et al.*, 2006; Hope *et al.*, 2003; Kinzig *et al.*, 2005; McIntyre *et al.*, 2000).

There are gaps between urban morphology and ecology that need filling at all geographical scales, from the most local (individual plots of land) to the national and international (for example, how urban areas in different parts of the world compare). In recognizing the nature and basis of these gaps and eventually addressing them, it is necessary to consider the principal characteristics of these two fields of knowledge within the spectrum of the sciences, social sciences and humanities.

## **1.2 Urban morphology**

Central to urban morphology is a concern with built environment relationships and how these have developed over time: urban form as a cultural expression, especially

urban form viewed historically, is central to much of the published research in urban morphology (especially the work of the Conzenian ‘school’ (Whitehand, 2014, p.95). Conzen’s method involves analysing and synthesizing the characteristics of urban form in terms of historical processes (Conzen, 1960). Based especially on fieldwork and documentary and cartographic records, specially-designed maps are produced that recognize and highlight urban landscape units, ranging from “morphotopes” (which are the smallest units) to “morphological regions” (Conzen, 1988, p. 259). Urban morphologists aim to explain and delimit urban forms, seeking to distinguish characteristics that are significant in their development (Conzen, *et al.*, 2012).

Urban morphology is one of the basic academic disciplines that should underpin the practice of urban design (Whitehand, 2005). An important part of urban design is the creation of urban form (Kropf, 1993). Kropf considers the essential elements of urban structure and bridges the divide between urban form and urban design (Kropf, 1993). Larkham employs practical applications of morphological analysis in planning and urban design (Larkham, 2005).

The evidence of cultural impacts on urban design becomes one of many significant indicators for implementation in urban planning (Kropf, 2009). For example, the evidence of the historical value of heritage sites is a crucial issue in carrying out a conservation plan (Chen and Wang, 2013). This is just one illustration of how aspects of different disciplines have been brought into urban morphology. Urban morphology uncovers, through fieldwork and scholarly research, relatedness in spaces and persistence through time of elements of the built environment which, because of their

significance over space and in time, become culturally important. This tendency for the heritage value of urban form to increase as long as the urban form remains unchanged should be distinguished from the propensity for ecological value to change over time towards climax ecosystems.

### **1.3 Ecology**

Urban ecology is the integrated study of biotic and abiotic components of ecosystems (Shulenberger *et al.*, 2008). The term ‘ecosystem’ is used by Tirri *et al.* (1998) to refer to “a functional entity or unit formed locally by all the organisms and their physical (abiotic) environment interacting with each other” (Tirri *et al.*, 1998; Wallace, 2007, p. 237). This definition is close to that of Wallace (2007) who defines the ecosystem as encompassing elements of both abiotic and biotic environments (Wallace, 2007). The biotic (i.e. living things, such as plants, humans and animals) and the abiotic (i.e. environmental states, and flows of water, energy, nutrients, etc) interact. For example, trees take in carbon dioxide and release oxygen, which is essential to human life: hence, the protection of forests and grasslands is a basic requirement (Bixby *et al.*, 2015; Wallace, 2007). The human requirement for contact with nature may even be built into the human condition as a fundamental trait, called ‘biophilia’ by naturalist E.O.Wilson (Wilson, 1986).

Ecology uncovers — through fieldwork, laboratory experiments, and computational modelling — relatedness in space and evolving persistence through time of elements of natural systems, which, because of their significance over space and in time, store natural capital or deliver ecosystem services. Unlike built environment, the

natural tendency of ecological systems is to change (in form and function) over time towards so-called 'climax' ecosystems, which then persist in a dynamical balance with their environment (Wallace, 2007, p.235).

The idea of 'ecology' as a description of complex systems, containing strong positive and negative feedbacks, is so persuasive it has been adopted as a description of other (human) complex systems: hence, 'political ecology' (Evans, 2005, p.16), and 'industrial ecology' (Van *et al*, 2013). In what follows, the term ecology is reserved for the study of systems of nature, and the word 'system' is used to describe entirely human complex systems (Wallace, 2007, p.236).

#### **1.4 The relationship between urban morphology and ecology: previous work**

Despite the almost entirely separate development of urban morphology and urban ecology hitherto, there have been a small number of studies that have come close to bridging certain of the gaps between the two fields. For example, Hopkins has explored the ecological significance of the zones that are recognized by urban morphologists (Hopkins, 2012), and Evans has underlined the relevance to both fields of urban political systems (Evans, 2003). These studies indicate that urban ecology and urban morphology are usefully complementary lenses through which to study cities.

Whitehand's findings about changes over time in house types and their surrounding environments (including green spaces) reveal that the subject matters of urban morphology and ecology are closely interrelated (Whitehand and Morton, 2003, p.838). For instance, an urban zone with a high incidence of green space partly reflects the fact that the character and occupation of the individual sites of which that zone is composed

have become rooted in the mental maps of those able to influence change. However, unfortunately, too few planners see individual sites as integrated parts of the historical and ecological development of the city as a whole (Whitehand, 2005, p.19).

Previous research has underlined the importance of bringing an ecosystem approach into the planning process (Ecosystem Knowledge Network, 2012). In clarifying the links between urban form and ecology, Hopkins (2012) has demonstrated that parts of Birmingham, UK have been subject to less major disturbance than other parts. He reveals the ecological value that has been derived from the demographic structure of the tree population in a particular urban fringe belt (Hopkins, 2012).

### **1.5 The relationship between ecology and urban morphology: research gaps**

The need to fill the gaps between ecology and urban morphology has been identified by a number of researchers: for example, to enhance quality of life (Chiesura, 2004), improve mental health (Barton, 2009), optimize provision for recreation (Willis and Whitby, 1985, p.160), and improve historical and spatial awareness (Conzen, 1966, pp.59-61). This thesis will focus on one of the major gaps between urban morphology and urban ecology, namely that between the historical development of urban form and the nature, significance and distribution of various types of green space. The principal concern will be the different types of green space (such as parks, golf courses and allotment gardens) associated with fringe belts (Conzen, 1969, p. 125).

Among the most striking fringe belts are those that formed around medieval towns, especially associated with town walls, and, in Great Britain in particular, those that came into existence at the end of the 19th century and the beginning of the 20th century

(Whitehand, 2005). Since each fringe belt tends to mark a lengthy period when there was a slump in house building, land uses that tend to require large amounts of space, such as schools and sports grounds, are able to acquire sites when there is little demand for land for housebuilding. Birmingham's Edwardian fringe belt has for many decades been embedded within the growing urban area and has become a potentially important element in planning (Hopkins, 2012) and, as will be argued later in this thesis, in urban ecology. The fringe-belt concept provides a frame of reference for depicting, explaining, and comparing the physical structure and historical development of urban landscapes (Conzen *et al.*, 2012). Although each fringe belt is a product of human culture specific to a time and place, the fringe belt concept provides a frame of reference that is distinct from historical Grand Narratives, a frame that is directly linked to the physical space that is the site of urban ecology investigation.

## **1.6 Ecosystem services**

The term 'ecosystem services' began to be used in the scientific literature in the 1970s (Gómez-Baggethun *et. al.*, 2009, p.1209). It is important in this thesis not least because of the link it affords between ecology and applied aspects of urban morphology.

Ecosystem services are the benefits people obtain either directly or indirectly from ecological systems (Kaplan, 1993; Millennium Ecosystem Assessment, 2005a; Nassauer *et al.*, 2009; Tzoulas *et al.*, 2007). This definition will also be used in this thesis. Green spaces often hold spiritual, iconic, social, and economic values and meanings. These meanings underpin diverse ethical worldviews, in many respects parallel to the cultural meanings ascribed to the built environment. The values of green space we now often

group into ecosystem services: provisioning (e.g., timber, firewood), regulating (e.g., carbon sequestration, mitigation of floods and air pollution), supporting (e.g., soil formation, nutrient cycling), and cultural (e.g., aesthetics, heritage, spiritual well-being). Urban green spaces offer multiple ecosystem services (ES). Some of these provisioning and cultural benefits are direct. It is important to note for the discussion to follow that direct biodiversity provisioning and regulating ecosystem services are much greater for mature trees than for young saplings or monoculture grass (NEA, 2011, chapter 10). Many green spaces provide recreational opportunities and have been shown to influence human activity, health and recreation (Kaplan, 1993, 2007; Nassauer *et al.*, 2009; Neuenschwander *et al.*, 2014; Tzoulas *et al.*, 2007). They play a potentially key role culturally and socially. This is particularly the case for young people and children, many of whom prefer to use green spaces for recreation (Każmierczak, 2013). In addition, urban green spaces provide opportunities for social integration because they are places where people can meet formally and informally (Maas *et al.*, 2009).

There are also indirect regulating benefits of green spaces. For example, their vegetation has an effect on the urban microclimate and contributes to mitigating urban heat islands. This increases the attractiveness and amenity value of the urban public environment (Kleerekoper *et al.* 2012; Neuenschwander *et al.*, 2014). Urban green spaces tend to be heterogeneous and provide a variety of niches for biodiversity (Marzluff and Rodewald, 2008; Neuenschwander *et al.*, 2014; Yli-Pelkonen and Niemälä, 2005).

There are also somewhat different definitions of ecosystem services. For instance, Wallace points out that the definition of ecosystem services specified in the Millennium

Ecosystem Assessment (MEA) mainly concentrated on the narrower meaning of ecosystem services derived from natural elements. The narrow meaning is used throughout that MEA document (Wallace, 2007). Another example is that of Binning (2001) who defines ecosystem services as “one of the means by which ecosystem goods are produced, rather than as the goods and services themselves” (Binning *et al.*, 2001; Wallace, 2007, p.244). It is also acknowledged that in the ecological and related economic literature the term 'services' is sometimes used to include both goods and services. By estimating and accounting for the economic value of ecosystem services, social costs or benefits that otherwise would remain hidden can potentially be revealed. The term ‘natural capital’ (Costanza *et al.*, 1997, p.253) encapsulates a framework that recognises the distinction between goods and services, and between stocks and flows of natural capital.

Despite the popularity of urban green spaces and many of the features with which they are associated, and their potentially significant role in urban sustainability (Neuenschwander *et al.*, 2014; Swanwick *et al.*, 2003), recent urban expansion in numerous places is resulting in a decrease in access to these important parts of urban areas (Boyko and Cooper, 2011, Di Giulio *et al.*, 2009; Jaeger *et al.*, 2010). This thesis will focus on change in the amount and distribution of green space over time and consider how an urban morphological viewpoint helps in the interpretation of such change.

The fact that ecosystem services are the benefits provided to humans by ecosystems is the basic underpinning of the relationship between these two concepts (MEA, 2005b). Ecosystem services are generated as a side-effect of ecosystem functioning and often

require other inputs (for example, human labour, monetary capital, and fabricated goods) in order to be fully realised (Edens and Hein, 2013, p. 43). Ecosystem services are increasingly promoted as a means of documenting the values humans place on ecosystems and evaluating benefits derived from natural resources (Costanza *et al.*, 1997). However, it is also recognised that the intrinsic value and the use-value of nature are not identical, the former being presumed much greater than the latter. Clarifying these definitions can help link ecological perceptions and urban morphological interpretations when elements of an ecosystem are converted into maps.

### **1.7 Research aims: the historical geography of urban form, especially in relation to ecosystem services**

A contribution will be made in the thesis to filling the major research gap between the historical development of urban form and the nature and distribution of different types of green space. The principal focus on fringe belts will include a detailed study of part of Birmingham.

As discussed above, ecosystem services are often categorised as provisioning services, regulating services, cultural services and supporting services. Regulating services can be defined as the benefits obtained from the regulation of the environment such that it remains conducive to human society. They include water regulation, air regulation, flood regulation and disease regulation (MEA, 2005a). Disease regulation is now rare in Birmingham. Increased flooding due to removal of front garden green space could be a significant loss of ecosystem service in Birmingham.

Instead of concentrating on the physical forms and changes of these ecosystems (the

physical changes of trees and grass), the method of analysing how the changes of the ecosystem occurred is to compare and contrast with the total amount of trees and grass in different categories of land use evident in each historical period. This method of analysis accords with the urban morphological method of fieldwork and analysing historical, topographical maps. Water, another crucial ecosystem, exists in abundance in the area to be studied. Water stocks and flows occur in the canals, reservoir and an ornamental lake.

Cultural services consist of “the nonmaterial benefits people obtain from ecosystems through reflection, cognitive development, recreation, spiritual enrichment and aesthetic experiences, including: aesthetic enjoyment, recreation and spiritual fulfillment” (MEA, 2005a, p. 40). Cultural services are most easily identified in the ecosystems regularly inhabited or visited by people. For instance, the green spaces in the parks and golf courses provide recreational and aesthetic experiences.

Supporting services include soil formation, photosynthesis and primary production, nutrient cycling and water cycling (MEA, 2005b). In the south-western part of the Edwardian fringe belt of Birmingham, water cycling, soil formation and photosynthesis are likely to be main supporting services: they are particularly provided by the abundant trees and canals. The water cycle associated with canals and the reservoir in the sample area is also important for living organisms. By understanding how the ecosystem services are influenced by the ecosystems, part of the thesis will consider the types of ecosystem services that could be offered by changes to green spaces.

## **Chapter 2. The changing significance of green space**

Having established some of the aspects of urban morphology and urban ecology with which this thesis is concerned, consideration now turns to some of the gaps that are apparent between urban morphology and knowledge of different types of urban green space. This requires a broader consideration of current knowledge of the characteristics of urban green space. This is provided in this chapter in the form of a review of the findings of research relating to urban green space at the UK national scale and, finally, within Birmingham.

Fuller and Gaston have studied the extent of green space provision in European cities. They have revealed the extent to which city area and population density are related to urban green space coverage (Fuller and Gaston, 2009).

Green space (excluding domestic gardens) accounts for 14% of urban areas nationally. However, this percentage varies greatly between individual cities, and needs explanation. In Birmingham, the proportion of green space is 33.7% (not including domestic gardens and land associated with water bodies, roads and railways) (Gaston, 2010).

Increases in total tree stocks in the UK between 1900 and 2010 tended to be largest in the most intensely urbanized areas (Díaz-Porrás *et al.*, 2014). A decrease in national tree stocks occurred after the Second World War, following a period when national and regional tree stocks had been static. This decrease was associated with urban expansion. Infrequent government censuses of trees in towns (Britt. and Johnston, 2008) are now

complemented by an increasing number of local censuses using the iTree framework (I-Tree, 2013) and by a national census of urban tree canopy cover ( Doick *et al.*, 2017).

The increases in the trees in urban Sheffield were more marked in areas with the most green space from 1900 to 2010 (Díaz-Porrás *et al.*, 2014). It is particularly important to preserve larger areas of urban green space to protect the largest and oldest trees — these make contributions disproportionately to other ecosystem services and carbon storage. Maintaining urban tree stocks and associated ecosystem service provision needs continued investment in urban tree planting programmes. This needs to be combined with other measures: for example, revisions to tree retention orders in order to conserve these trees when they mature (Altman and Low, 1992). Planning a resilient and sustainable urban forest that takes account of climatic change and human population pressures requires ‘future thinking’ that weighs up the risks of plausible future scenarios (Hale *et al.*, 2015, p.4600).

## **2.1 Categories of land use**

### *Public parks and their environmental value*

There are 27,000 parks covering 121, 953 ha located in the 100 most deprived areas of the UK, according to the Urban Parks Forum’s public park assessment (UK National Ecosystem Assessment, 2011, p.374). Public parks have been the focus of various studies of urban biodiversity, with a major theme being that parks constitute the biggest continuous areas of green space in urban areas and are crucial contributors to the environment (Kinzig *et al.*, 2005; Leichenko, 2011; Nowak *et al.*, 2010).

For many centuries, there have been city dwellers who have attempted to compensate for the relatively small amounts of natural greenery within their cities by creating space for nature to thrive in the form of parks and gardens (Altman and Low, 1992; Johnston, 2015; Kazmierczak, 2013; Kellert, 2012). Increasingly, urban green space is seen as an integral and essential part of cities, providing a range of services to both the people and the wildlife living in urban areas (Beatley, 2016; James *et al.*, 2009).

The formation of public parks in the UK, frequently as a result of gifts by major landowners, was especially concentrated in a period of a little over half a century before the First World War. The large areas of green space, especially trees and grassland, are major features of fringe belts originating at that time. Originating as many did as extensive, mostly landscaped, private parks of wealthy families, they brought into cities extensive quasi-rural green spaces.

#### *'Semi-natural' habitats*

A relatively small number of 'semi-natural' habitats have, for a variety of reasons, survived within British cities. Their survival in recent decades has often been aided by their designation, and therefore to an extent protection, as Sites of Local Importance for Nature Conservation (SLINCs). The partial survival of one such site has occurred in south-west Birmingham (Evans, 2003, p.221).

The ecological assessment of such sites in the development control process and their designation in strategic planning has been explored in terms of the national and local policy framework. The site in south-west Birmingham, often referred to as 'Vincent

Drive', constituted part of one of the largest remaining 'semi-natural' habitats in Birmingham (Evans, 2003, p.221). It illustrates how ecological knowledge is formulated within and influences practical urban regeneration, environmental consultancy, sustainable development, and community use (Evans, 2003, p.65). In the words of a planning consultant, "In Selly Oak you've got the issue of allotments, you've got nature conservation, you've got trees, you've got canals, you've got new roads and the wider objectives of what the council are trying to achieve. You've got a site of fifty acres, and it's all about a balancing act (Town planning consultant/author, Sainsbury's Selly Oak EIA, 18<sup>th</sup> May 2001)" (Evans, 2003, p.235).

### *Golf courses*

Golf courses are one of a number of types of green space whose creation in England and Wales has been shown to have an inverse relation to housebuilding. Golf courses on average cover 60-80 ha, almost all of which is given over to green space and blue space (i.e. water) ranging from very highly managed short sward grass greens and fairways, through lightly managed long sword 'rough', to unmanaged 'wild' areas of woodland, dune, or peatland, which can comprise up to 50% of the area of an average golf course (Dobbs and Potter, 2016, p.899). Frequently created at or near to the urban fringe during a housebuilding slump, many have become embedded in the built-up area during a subsequent boom in housebuilding (Whitehand, 1994).

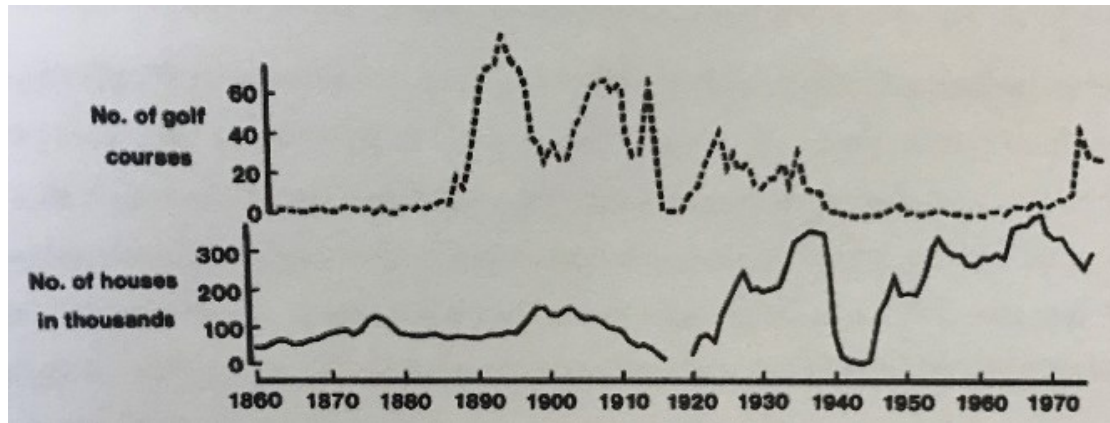


Figure 2.1. Number of golf courses created in England and Wales in relation to fluctuations in housebuilding, c.1860-1975. Source: Housebuilding-Mitchell and Deane, 1962, p.239; Department of the Environment, 1971, p.7; 1975, p.3; 1978, p.24. Golf courses-compiled by S.T. Delaney from *The Golfing Annual 1888/9-1909/10*, vols 1-21, and *The Golfer's Handbook 1902-77*, vols 1-74. Reproduced from Whitehand, 1994, p.8.

### *Allotments*

“The name ‘allotment’ comes from the days when the landless village dole was ‘allotted.’ This was collectively a small, compact block of land divided into individual rented plots of five acres to a quarter acre or less. Fuel could be gathered, cows pastured, or vegetables and bread-corn grown.” (Thorpe, 1975a, p.169). Allotments were therefore at one time linked to the stigma of charity and the economic motive (Thorpe, 1975b). In modern times, allotments have been associated with war-time emergency and austerity. Most recently, they have been part of the popularity of ‘back to the land’ self-sufficiency and environmentalism (Library of Birmingham, 1908, p.3; University of Birmingham, 1976). In the UK they are now more valued for a broad range of ecosystem services that they provide rather than food provision alone (Scott *et al.*, 2018).

The varying demands on allotments as a source of food supply have been major factors in their fluctuating physical extent as a feature of urban form. One of the earliest

distribution maps is of Birmingham in 1830. This reveals a zone of allotments around much of what was the urban fringe of the city at that time. These allotments had largely been redeveloped by 1886 in the course of major house-building activity (Axinte, 2015, p.18).

As part of the preparation of a government Departmental Committee of Enquiry into Allotments (The Thorpe Report), Harry Thorpe and his colleagues chronicled much of the history of allotments in the UK, including the sharp rises and falls in their numbers associated with the two world wars (Thorpe *et al.*, 1977). After the end of the First World War, the need for allotments for food rapidly diminished. However, during the 1920s and early 1930s, economic depression created unemployment and reduced earnings, and this was a stimulus for the use of allotments not only as a source of food but also for exercise and social interaction. With the advent of rationing in the UK at the beginning of the Second World War, large areas of land were converted into allotments and there was widespread digging up of lawns and other parts of private gardens for the growing of vegetables. Much of this land reverted to its previous use in the course of the early post-war years (Library of Birmingham, 2016; Berry and Wall, 2016).

A potentially important influence on the character of allotments as green space in the post-war period was the Thorpe report. This proposed a considerable revision of the concept of allotments, recommending that they be remodelled as 'leisure gardens'. This idea involved significant rethinking of these areas of land with regard to the ecosystem services they provide, entailing not only changes for the cultivators of these plots but also major changes of visual experience for those viewing them from outside. The

leisure garden model was developed at Russell Road in south-west Birmingham (Thorpe, 1973, p.13). But wider adoption of the leisure garden model has been slow.

## **2.2 Physical extent of urban green space**

The physical extent of urban green space can be considered the basis of its ecological, soil, microclimate, water and air quality functions, and provisioning and regulating services (Berkowitz *et al.*, 2003; Breuste *et al.*, 1998; Marzluff *et al.*, 2001). The composition, location, spatial configuration and structure of urban green spaces will influence their ecological structure and function (Pauleit and Duhme, 2000; Turner *et al.*, 2005). The ecosystem services provided by urban green spaces are associated with the physical attributes of these spaces (de Groot *et al.*, 2002). They have a key role in maintaining viable wildlife populations and human health (Maas *et al.*, 2006; Tzoulas *et al.*, 2007). Urban green spaces have a role in both reducing the impact of cities on climate and in 'climate-proofing' cities (Gill *et al.*, 2007). In comparison with carbon dioxide emissions in cities, the green area plays a small role in sequestering carbon (Donovan *et al.*, 2005; McPherson, 1998; Nowak, 1994). Green spaces in urban areas might decrease energy consumption and thereby also carbon dioxide emissions by decreasing the requirement for heating in the winter and air conditioning in the summer (Jo and McPherson, 2001; McPherson, 1994).

The three-dimensional extent of urban green space is as important as the two-dimensional extent marked on a map, because regulating such aspects as shading (Richards and Edwards, 2017) and air pollution removal (Pugh *et al.*, 2012) are strongly influenced by the height and spread of tree canopies. Moreover, because tree canopies

spread out, the projected area of green space does not define an exclusive land use, but rather often overlays other land uses (for example, pavements and roads) (Doick *et al.*, 2017; Richards and Edwards, 2017).

## **Chapter 3. Benefits and management of green space**

### **3.1 Benefits**

#### *Experience of urban green space*

Urban green spaces have a significant function within cities in bringing people into interaction with nature and in contact with each other (Beatley, 2016; James *et al*, 2009). Proximity to nature brings many advantages, for example by diminishing stress and anti-social and criminal behaviour (Wolf and Flora, 2010). There are also some direct physical health advantages, besides the psychological benefits of interaction with nature, for instance helping to reduce obesity and increase longevity. Urban green space aids social contact and brings people together: it reduces anti-social behaviour, for instance aggression (Newton, 2007). An increased proportion of observable vegetation is believed to be effective in reducing negative psychological symptoms and helping to increase residents' rating of urban scenery. Greener surroundings are associated with fewer crimes and are thought to induce mental vitality (Kuo and Sullivan, 2001).

The aesthetic value of urban green spaces has been drawn attention to by many authors, and studies reporting the preferences of urban dwellers for built-up areas containing green spaces are similarly numerous (Appleton, 1996; Hartig and Staats, 2006; James *et al*, 2009; Regan and Horn, 2005; Staats and Hartig, 2004; Wilson, 1993). Thompson (2004) has pointed out how green spaces continue to provide various means of presenting current beliefs, cultures and values in urban societies.

Urban vegetation offers both ecosystem services in urban areas and pleasing entertainment for residents (Tyrvaïnen and Miettinen, 2000). It reduces greenhouse gases, cleans water (Chiesura, 2004), filters wind (Nowak and Crane, 2002), and purifies air (Nowak, 2006). Green façades and green roofs help amplify natural sounds and reduce noise (Veisten *et al.*, 2012). “Urban trees can mitigate the heat-island effect, which can save energy in air conditioning and cutting the carbon footprint” (Akbari *et al.*, 2001, p.295).

Perhaps not surprisingly, there is a close connection between aesthetic and health aspects of urban green spaces and the cultural backgrounds of the communities that use them (Thompson, 2004; Tzoulas, 2006). It has long been evident that different value systems and relationships with nature are associated with different cultures. Urban green spaces play an important role in helping to improve local character and identity, but the relationships involved sometimes vary a good deal within the same city. To understand the use of green spaces by different cultural groups in urban societies, it is necessary to develop suitable management systems (Johnston and Shimada, 2003).

#### *Economic value of urban green space*

“Luttik (2000) found that having a view of a park or water was associated with increased house prices, in a study of 3,000 house purchases in the Netherlands. There is, therefore, a hedonic value to urban green infrastructure through house valuations, and this is the method the UK National Ecosystem Assessment (NEA, 2011) used for urban ecosystem services. Even though the contribution made by urban green space to

ecosystem services and to health experiences is difficult to value” (de Groot *et al.*, 2002; Kaplan, 1993, p.193; and Kaplan, 2007; Luttik, 2000; Takano *et al.*, 2002; Tzoulas *et al.*, 2007; Ulrich, 1984), there remains a requirement for quantitative and economic evaluations (Lambert, 2007; McPherson, 1998; Neilan, 2008; Tyrvaainen, 2001) in order to inform land-use decision-making in urban areas. Traditional valuation techniques, such as Contingent Valuation and Cost Benefit Analysis, have limitations for evaluating the social and ecological functions of urban green spaces.

Therefore, new valuation techniques may be required. The UK’s 2011 National Ecosystem Assessment used “hedonic pricing” to estimate the value of public urban green space; that is, they investigated the premiums that people were prepared to pay for houses in areas of higher environmental quality (NEA, 2011).

#### *Benefits of access to green space*

The advantages of access to green spaces have been widely documented (Fuller, 2009), including those relating to social cohesion (Coley, *et al.* 1997; Sanders and Timmeren, 2017) and provision of ecosystem services (Gilbert, 1989). Benefits of Urban Green Space (BUGS) was a European project aiming at improving a method to assess the influence of green space and settlement patterns on urban environmental quality and social well-being and to formulate suggestions for green spaces to act as an urban planning tool in urban design strategies (De Ridder *et al.*, 2004).

Measuring and comprehending urban residents’ exposure to sights of green spaces has turned into a significant and much required task for making quality-of-life

assessments; for example, Coley *et al.* (1997) showed that more social interaction took place in green spaces containing trees than in “spaces devoid of nature”.

### **3.2 Protection by city councils and developers**

The increasing evidence of the impact of trees on visual amenity, historicity and nature conservation value (Holzinger *et al.*, 2013, p.27), and in helping to improve air quality and soften building lines, is having an effect on the policies of local authorities in the UK. For example, Birmingham City Council, like most other British local authorities, conserves trees through “tree preservation orders, planning conditions and conservation legislation” (Holzinger *et al.*, 2013, p.90). And developers are expected to prioritize the natural features on development sites and attach importance to the retention of trees. Such planning regulations do not ensure the maintenance of urban trees and green places in the face of all other drivers of change: at the time of writing street trees in Sheffield have become a highly contested facet of the urban fabric (Newham, 2017).

Urban ecosystems play an essential role in creating a sense of place: urban inhabitants develop affective connections to the ecological sites of their cities (Altman and Low, 1992). Urban green spaces offer multiple opportunities for cognitive development, improved mental health and physical exercise. For instance, allotment gardens are frequently used to contribute to local ecological knowledge and environmental education (Elmqvist *et al.*, 2013).

Well-designed grass in recreation areas presents an attractive boundary and fulfils particular design purposes (Hough, 2004, p.16). When people make lifestyle choices,

they show preference for interesting, pleasant and changing landscapes. Opportunities for entertainment are also highly-valued. Places with both peaceful and noisy areas, such as spaces for recreation and designed gardens, are considered more interesting than those places that do not have entertainment areas. Cities benefit from having clear boundaries and identified areas because they emphasize the characteristics of the cities' balance of society, commerce and environment (Hough, 2004, p.18).

The importance of trees and shrubs in providing ecosystem services in urban areas relates to the fact that these woody plants contain a significant proportion of urban biomass (Davies *et al.*, 2011; Díaz-Porras, Gaston and Evans, 2014; Roy *et al.*, 2012). The advantages accruing from urban vegetation involve a series of cultural services as well as improvements to human well-being and health (Fuller *et al.*, 2007; Maas *et al.* 2006; Ulrich 1986; Kuo and Sullivan 2001). In addition, urban green space offers several regulating services, such as reductions in air pollution (Donovan *et al.*, 2005; Pugh *et al.*, 2012), “flood risk” (Stovin *et al.*, 2008), “the urban heat island effect” (Hall *et al.*, 2012; Lindberg and Grimmond, 2011), and “noise pollution” (Islam *et al.* 2012). Large, mature trees are especially important in the provision of urban ecosystem services (National Ecosystem Assessment, 2011, section 10.4.1), so strategic planning is necessary if delivery of ecosystem services is to be well maintained (Hale *et al.*, 2015; TDAG, 2012). In North America, tree preservation orders have succeeded in preserving urban trees where they have been assisted by adequate investment in enforcement and management (Díaz-Porras, Gaston and Evans, 2014; Landry and Pu, 2010).

Tree conservation orders in the UK are generally concerned only with trees that

have high amenity value. The meaning of ‘amenity value’ is not defined precisely, but it is strongly related to the visual impact of trees, their prominence, rarity and size (Department for Communities and Local Government, 2012; Díaz-Porras, Gaston and Evans, 2014). Tree preservation orders are less likely to be placed on trees in places with small green spaces because in such areas there is greater likelihood of damage to infrastructure and the blocking of light. Tree preservation orders may be granted for these trees in consideration of their future instead of focusing only on their current amenity value. Reducing mortality rates of trees can add to the advantages of urban tree planting programmes by increasing the representation of particular species (Díaz-Porras, Gaston and Evans, 2014).

Public parks are significant sites of multiple ecosystem services in UK cities (National Ecosystem Assessment, 2011). However, the governance of UK public parks is relatively weak, such that they are often poorly maintained and under threat of closure (Communities and Local Government Committee, 2017), leading to widely-supported calls for statutory protection.

The enhancement of green areas has the potential to mitigate the adverse effects of urbanization in a sustainable way, making cities more attractive to live in, and preserving ecosystem services in the face of urban sprawl (De Ridder *et al.*, 2004).

#### *Recognition of urban green spaces as a vital urban habitat*

The UK Biodiversity Action Plan (UK BAP), published in 1994 was a response of the UK Government to the Convention on Biological Diversity (CBD). The UK BAP

provided British biological resources for conservation. National reports, to be published every three- to five-years, explained how the UK BAP was making contributions to the major biodiversity loss by the CBD (JNCC, 1994).

In the BAP, recreation grounds, parks and other open green spaces are recognized as vital parts of the urban habitat, which support a city's flora. A city's parkland makes contributions to the background capacity of the city by supporting wildlife (Holzinger *et al.*, 2013, p.90). The importance of urban green space was reiterated and reinforced in the UK National Ecosystem Assessment (2011, ch.10) and by the establishment of a Natural Capital Pioneer project in Greater Manchester (Urban Pioneer, 2017).

### **3.3 Management**

Being aware of the long-term dynamics of urban vegetation is significant in making decisions about the provision of key resources for ecosystem services and improving their management (Hale *et al.*, 2015). Unfortunately, such studies are rare because of the paucity of suitable historical data (Díaz-Porras *et al.*, 2014).

#### *Management of urban green space in Europe*

The management of urban green space varies considerably. It requires the collaboration of several disciplines working at different spatial scales. Structures and mechanisms governing green space maintenance and management vary across Europe (Werquin *et al.*, 2005). General responsibility for urban green space seldom rests with national agencies, ministries or departments concerned with the environment or city planning (Carmona and De Magalhaes, 2004). Urban vegetation is often the remit of

regional or municipal authorities (Niemelä, 1999) or dependent on the resources of private property owners (for example, in the case of numerous grounds and gardens).

Various schemes have been proposed and implemented to differing degrees across Europe, involving ecological networks (Opdam *et al.*, 2006; Sandström *et al.*, 2006), urban forests (Konijnendijk, 2000), green fingers or wedges (Jim and Chen, 2003), greenways (Walmsley, 2006), green infrastructure (Sandström, 2002), green belts and green hearts (Kühn, 2003), and ecological frameworks (Kazmierczak and James, 2008).

Each of these arrangements reflects a subtly different perspective on urban vegetation, for instance emphasizing the population of woody plants (urban forest - Konijnendijk, 2000; Donovan *et al.*, 2005; I-Tree, 2013), the connectivity of urban green spaces (green fingers/green wedges - Jim and Chen, 2003; Walmsley, 2006), or the ecosystem services provided (green infrastructure - Sandström *et al.*, 2006).

Urban form is the result of economic, political, and societal change, and is a sustainable, replicable process (Hough, 2004). Green space is an integral aspect of urban form, but is often treated as something external to, and unconnected with, the built urban form. Only when green space is considered in the context of the surrounding built environment can ecosystem services be properly quantified (Hale *et al.*, 2015; Owen *et al.*, 2003; Pugh *et al.*, 2012).

### *Governance of urban green space in the UK*

Green space governance and management are commonly a local authority responsibility (Britt and Johnston, 2008). Carmona and De Magalhaes (2004) pointed out

that the way that urban green space management and governance responsibilities are coordinated is more important than their distribution among different geographical departments. They also recognized that significant problems arose in the coordination of restrictions arising from existing non-statutory and statutory effective communication and powers amongst departments (Carmona and De Magalhaes, 2004).

It is important for city councils to promote tree management plans to ensure the long-term amenity of their areas (TDAG, 2012). They are responsible for the management of parks and landscape development services throughout their areas. In the case of Birmingham, it has been pointed out that the supply of and demand for the main environmental services need to be examined further (Holzinger *et al.*, 2013). There is a requirement for a strategy that is fully “endorsed by the local community as well as the city council” (Holzinger *et al.*, 2013, p.3).

Numerous planning policies have addressed the idea of green belts (Ward, 2004, p.55) and the relationship between green belts and housing (Gunn, 2007), and there has been some discussion of green wedges (Lemes de Oliveira, 2014). Planning policy documents dealing with the subject of urban green space more generally have been much fewer. However, the development of ideas relating to urban green space more generally (the ‘green movement’) has attracted a good deal of attention (Ward, 2004, p.195). This includes the international development of green organizations (McCormick, 1993).

This chapter has begun to explore the contributions and advantages of urban green spaces - which can be classified into physical health, aesthetic enjoyment, and

economic and social contributions - and highlights the need for their effective management. These findings have implications for the concept of fringe belts which is discussed in more detail in Chapter 4. Considerable knowledge has been gained in recent years about the role of fringe belts, including their importance in relation to the distribution of green spaces, although connecting to ecosystem function and form has been less developed. Chapters 5 to 7 utilize a case study in Birmingham.

## **Chapter 4. Fringe belts**

Previous chapters have reviewed in broad terms, the relationship between urban morphology and ecosystem services, before focusing more specifically on green space and its benefits and management. In this chapter, there are two principal aims. The first is to summarize aspects of fringe-belt research from which the present research springs. Special attention is given to historical aspects of fringe belts and their relation to green space. The second is to introduce a major fringe belt in Birmingham within which a detailed study will be undertaken, focusing on the land use, types of surface and, in particular, the green space in one part of that fringe belt. This will also include consideration of the methods of analysis to be used and salient findings on the historical development of the land use of the part of that fringe belt that is to be subjected to detailed analysis of types of surface in subsequent chapters.

### **4.1 The origins of the fringe-belt concept**

Fringe belts were first identified by Louis (1936), particularly with regard to their relationship to former fortification zones around cities. The fringe-belt concept was subsequently developed in much greater depth and breadth by Conzen (1960). The majority of research has been on fringe belts that developed spontaneously in association with various obstacles to urban growth, both over space and time. The most notable of these have been major lengthy slumps in house building activity (Barke, 1974, 1976; Whitehand, 1967, 1972a, b).

## 4.2 Fringe belts and fluctuations in urban growth

Fringe belts have become recognized over several recent decades as zones of predominantly extensive land use that have formed at the fringe of an urban area during a period of very slow outward residential growth (Whitehand and Morton, 2003, p.819). A hiatus tends to occur when the demand for land from house builders is very low and land is relatively cheap (Whitehand, 1994). The cycles of urban area expansion have substantial morphological significance (Barke, 1974). A fringe belt is heterogeneous in its plan, building structures, and land utilization (Whitehand and Morton, 2003, p.819). Institutions, public utilities, recreational areas and allotment gardens are characteristic of its varied land uses. It is very different in character from a residential area – different both in its buildings and in its spaces. When residential growth resumes, the previous slump in house building leaves evidence within the urban area as the fringe belt becomes embedded (Whitehand and Morton, 2003; Larkham and Jones, 1991). House builders at this point tend to acquire sites beyond the fringe belt rather than develop sites within it. Therefore, from the urban morphologists' perspective, a fringe belt is particularly a product of substantial variations over time in the speed with which a city grows outward. It comes into existence during a period of slow growth associated with a slump in house building or geographical obstacles to housing development. When embedded within an urban area it becomes a potentially significant consideration in planning (Hopkins, 2012).

Urban transformation and growth are in many areas creating major problems for the comprehension and management of urban landscapes (Adams *et al.*, 2015). Urban

morphology provides a significant part of the groundwork for meeting these challenges. The fringe-belt concept provides a framework for explaining the physical structure and historical development of urban landscapes (Conzen *et al.*, 2012).

The model of historical fringe belts, innovation and building cycles has been shown to have wide relevance. Examples of studies include those of medieval fringe belts (for example, Conzen, 1960), the fringe belts of Falkirk (Barke, 1974) and the Edwardian fringe belt of Birmingham (Scott, 2013; Whitehand and Morton, 2003, 2004, 2006). Birmingham's Edwardian fringe belt comprises a zone marking the edge of the built-up area between about 1910 and the early 1920s.

Whitehand and Morton (2004, p.276) identify three main characteristics of fringe belts. These are: first, a low-density road network, with few radial roads (that is, running across the fringe belt), and hence low permeability for the movement of vehicles outward from the city centre; secondly, a high proportion of large and well-vegetated plots, a good many of which contain institutional buildings, often of architectural note; thirdly, the tendency to have morphologically distinct sub-areas. These characteristics are relevant in varying degree to the understanding, appreciation and planning of urban green space.

#### **4.3 Relationship between historical aspects of fringe belts and public green space**

Margaritis and Kang (2016) consider both “radial” cities (Leicester, Sheffield, Nottingham, Coventry) and “linear” cities (Bournemouth, Southampton, Blackpool, Brighton) in terms of land use and morphological characteristics. Great changes took place, particularly after the Second World War, in the urban structure of most major

British cities. Over much the same period, public green spaces in British cities have become more actively considered (Margaritis and Kang, 2016, p.175).

The green spaces of fringe belts are part of a long fringe-belt tradition, which has deep historical roots in many cities and cultures (Whitehand, 1996). According to Whitehand (1996), they tend to separate zones of housing that have distinct physical characteristics. These distinct characteristics include differences in the amount and arrangement of green space. A notable example of this in British cities is the contrast between the high-density areas of terraced housing of the Victorian and Edwardian periods and the semi-detached housing of the garden suburbs of the inter-war years.

In post-war Britain, green belts, which have become a major feature of planning, have certain affinities with fringe belts. However, though the two types of belts have commonalities, notably in regard to the significance of green space, their statutory role is quite distinct, and rarely have the challenges that fringe belts present for planning been noted.

#### **4.4 Birmingham's Edwardian fringe belt**

Figure 4.1 shows the extent of Birmingham's Edwardian fringe belt in 1995, and the types of surfaces within it. Soft surfaces are vegetated. Hard surfaces include roads, pavements and buildings. Areas of water are mainly reservoirs and lakes. Transitional surfaces are mainly 'brownfield' sites. They are surfaces in previously developed areas that have been cleared, but not redeveloped: they may be in a very early stage of being colonised by plant species (Hopkins, 2004, p. 103). Much of this intermediate category is a result of industrial clearance. It is a potentially important resource for wildlife. The

Edwardian fringe belt comprises 1903 ha, of which 1009 ha (53%) is soft (i.e. vegetated)  
(The area is calculated based upon the NERC Urban Regeneration and Environment (URGENT) programme study undertaken by Whitehand and Morton).

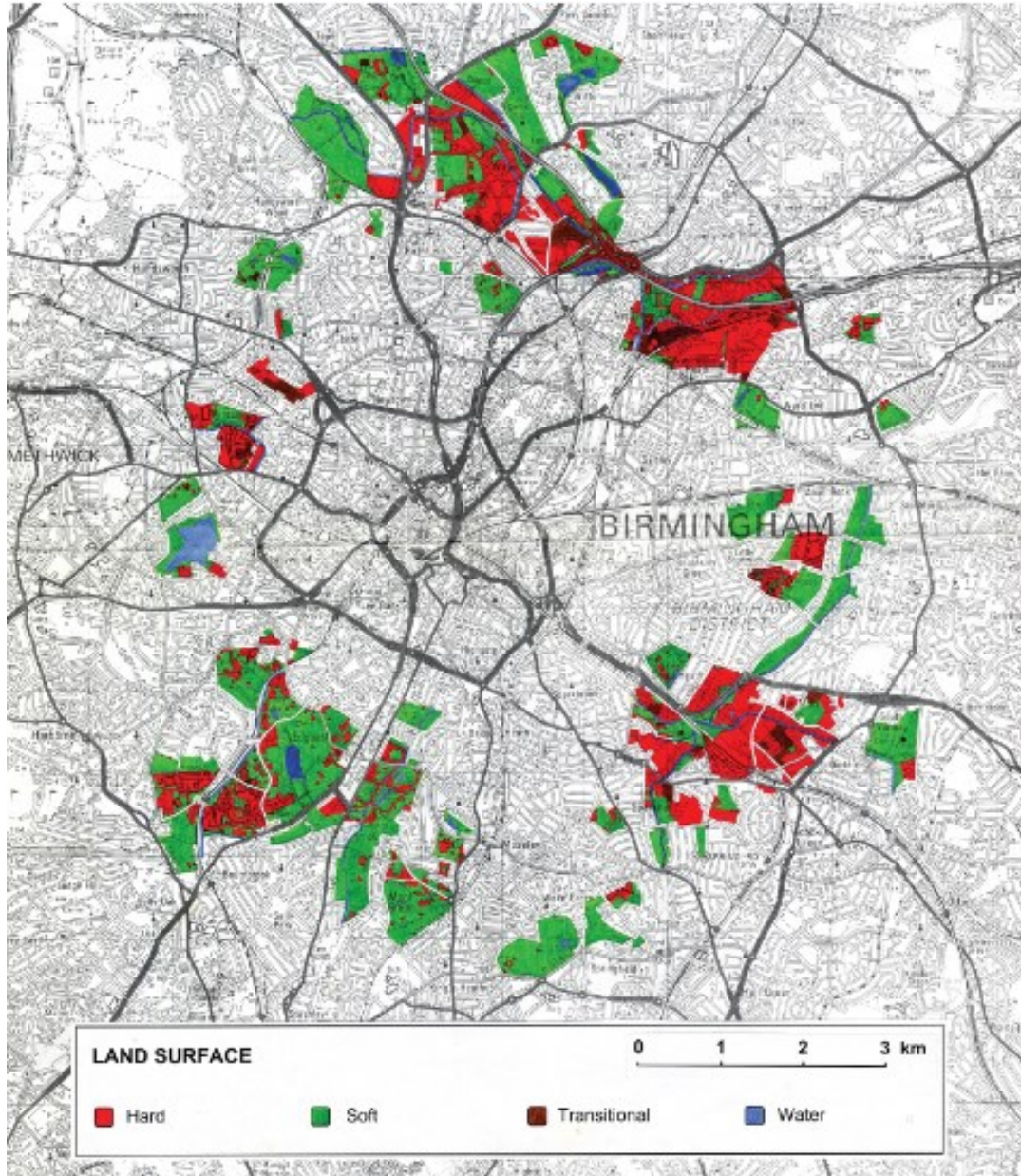


Figure 4.1. Hard and soft surfaces in Birmingham's Edwardian fringe belt in 1995. Source: NERC image of 1995 and part of the Urban Regeneration and Environment (URGENT) programme study undertaken by Whitehand and Morton.

Green space within the city of Birmingham may be classified in a number of different ways. For example, public open space in Birmingham occupies 3132 ha (BCC,

1993; BCC, 1997). The Birmingham Nature Conservation Strategy uses the data contained in the EcoRecord database to produce a quantification of green space based upon habitat types (BCC, 1993; BCC, 1997; Jarvis, 1996). The total area of the habitats identified is 6212 ha. However, this does not include private gardens.

Birmingham's Edwardian fringe belt was so named because it underwent its most formative phase between the late nineteenth century and the early 1920s, including the major slump in house building between 1910 and the early 1920s. Figure 4.1 shows types of surface as they were in 1995. Fringe-belt sites that were at some point in their history lost to housing ('alienated', to use Conzen's (1969) term) are omitted (Whitehand and Morton, 2004, p.275).

The preliminary ecological findings of previous work, notably the URGENT programme, suggested the value of vegetated wildlife corridors. However, there is a lack of agreement on what exactly constitutes a corridor, which is a problem when considering rivers such as those found running through the Edwardian fringe belt (Whitehand and Morton, 2004).

In relation to fringe belts, it is evident that much depends on the orientation of major potential obstacles to movement by road and foot, such as rivers, canals and railways. In south-west Birmingham, the canal and, running adjacent to it, the railway, are aligned in the same direction as outward urban growth rather than transverse to it. There is therefore little evidence of these obstacles to urban growth acting as fixation lines (Conzen, 1969, p.125). This is in marked contrast to the case of the River Kelvin in Glasgow, which formed a marked fixation line in relation to a fringe belt

characterized by patterns of land use and green space with marked similarities to those of the area to be examined in detail in south-west Birmingham.

Figure 4.2 is based upon a specific morphological study of the Edwardian fringe belt of Birmingham, which is also in the part of the NERC URGENT programme undertaken by Whitehand and Morton. It shows the areas occupied by various types of land use in Birmingham's Edwardian fringe belt between 1886 and 1995.

In 1886-88, unaltered open land is the biggest land-use category. It reflects the fact that much of the area that was to become Birmingham's Edwardian fringe belt was still rural. Examples of the characteristic extensive land uses already within the fringe belt include parks at Small Heath (opened in 1879) and Cannon Hill (opened in 1873), country houses at Perry Hall and Edgbaston Hall, institutions including Birmingham cemetery in Witton (opened in 1859), and utilities such as the sewage works at Nechells (opened in 1877) (Hopkins, 2004).

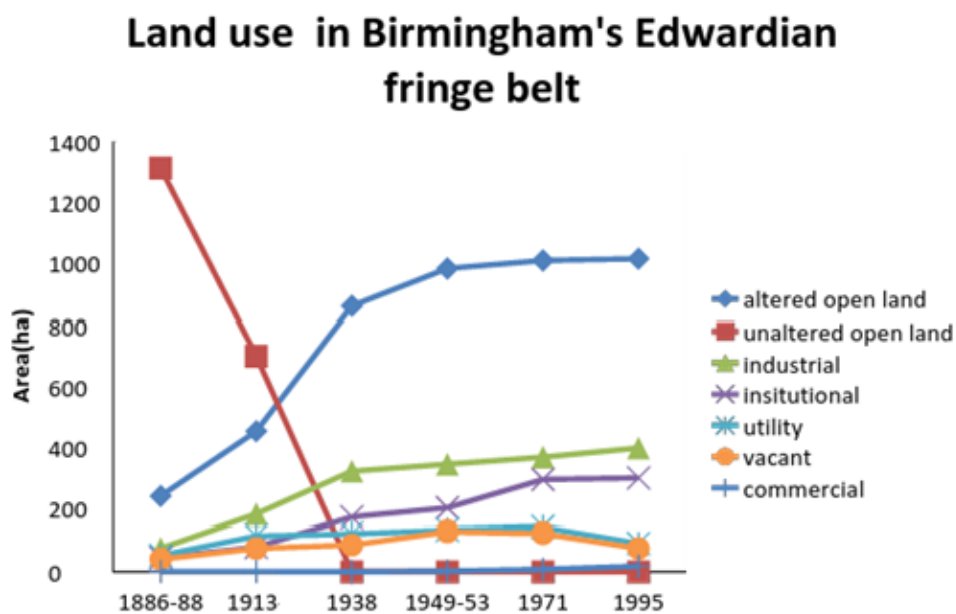


Figure 4.2. Land use in Birmingham's Edwardian fringe belt, 1886-1995. Source: NERC image of 1995 and part of the Urban Regeneration and Environment (URGENT) programme study undertaken by Whitehand and Morton.

By 1913, about one-half of the unaltered open land in 1886-88 had been converted to other land uses. These included the Edgbaston campus of the University of Birmingham (which began to take shape in 1900), Moseley Golf Club (opened in 1892) and Perry Park crematorium (opened in 1903) (Hopkins, 2004). Unaltered open land continued to decrease rapidly in the inter-war years. By 1938, the amount of such land had reduced to zero.

By 1938, expansion of institutional uses included the King Edward's School and the building of the Queen Elizabeth Hospital adjacent to the University of Birmingham campus and the growth of the East Birmingham hospital site at Yardley. New hospitals and clinics occupied substantial villas at Moor Green. Further urban open spaces were created in Edgbaston and along the River Cole Valley. Allotments also occupied significant amounts of land, for instance at Perry Barr and Little Bromwich. In the latter suburb, a greyhound racing stadium was opened in 1928 (Hopkins, 2004). Edgbaston Hall was converted into a club house for a golf course that occupied practically all the land attached to this former country house.

By the end of the 1930s, the Edwardian fringe belt had been entirely embedded within the built-up area (Hopkins, 2004, p.70). Some land uses had by this time begun to be changed to other uses associated with existing fringe-belt uses (Hopkins, 2004, p.70).

#### **4.5 Analytical methods**

The spatial disaggregation of ecosystem services aids visualization of the distribution and patterns of significant ecological landscape elements and their relationship to other aspects (Bateman *et al.*, 1999; Eade and Moran, 1996; Troy and

Wilson, 2006). The fact that the size and shape of the area of influence of an ecosystem service tends to vary according to the type of service is a complication. It is likely to be related to hydrological connectivity in the case of water-related services, whereas in relation to recreation and social amenities the key factor is “distance” (Troy and Wilson, 2006, p.435).

A GIS-based study has helped to visualize a broad range of quantitative, spatial and statistical data in the form of 2D maps (Batty and Hudson-Smith, 2005). GIS-based study is associated with an attribute table, which can be utilized for analytical purposes.

ArcGIS has been widely used. Like computer-based methods more generally, it has undergone major developments. Urban architects and planners have utilized not only 2D-based geographic information systems (GIS) in analyzing different spaces, but also 3D visualization in drawing and designing (Adams, 2013; Batty, 2001; Morar *et al.*, 2014; Shiode 2001).

Conzen (1960) advised against a retrogressive approach, pointing out the difficulty of being aware of *processes* by dealing with relics. He used an evolutionary perspective arguing that features that had been eliminated were as significant as those that continue to exist. He adopted a method that was largely cartographic, employing a series of maps for townscape analysis and historical development. In the case of his study of Alnwick, he mainly used published maps and plans to establish and record much of the process of residential development (Conzen, 1960, pp. 53-4, Tables II and III). In a similar way, he tabulated the land-use composition (residential, institutional, and commercial and industrial) of the various periods of growth of the built-up area of Alnwick (Conzen,

1960. p.90, Table VIII).

Technical advances in the digital era allow applications of Conzen's approach in ways that are far less labour intensive. Harley (1968) argues that analysis of the evidence on early paper maps is required, including to assess the accuracy and completeness of the data (Harley, 1968, p.63). Based upon Harley's evaluation of early paper maps, Heuvel (2006) made the distinction between paper maps and digital maps (Heuvel, 2006, p.114). The paper map, once finished, is static and unchangeable, while the digital one can be more flexible and transformed repeatedly. A map made by ArcGIS can be readily modified (Kamel *et al.*, 2011).

There are a number of basic steps by which different ecosystem elements have been created and converted into maps in the present case. First there is the creation of shapefiles and their categorization into different elements of the ecosystem, such as water, trees and grass. Their projection needs to be defined to ensure that these newly created shapefiles are chosen as the British National Coordinate. Then, these polygons are traced with the use of different types of sources, for instance, aerial images obtained from the NERC. The additional documents used include Google Earth images, and Ordnance Survey (OS) plans to ensure that the boundaries of buildings are accurate. Polygons are traced after the completion of the fieldwork and the investigation for each detailed category of land use.

The basic rules of interpreting elements of an ecosystem in a map are slightly different for buildings. The actual buildings may be obstructed by shade created by trees or other buildings presented in the aerial images. It is therefore necessary to use other

sources to confirm that the shape of buildings is correct. Other items (trees, grass and water) do not generally have the problem of being obstructed by shade and can be drawn based purely on the aerial images.

### *Georeferencing*

1) *Production of georeferencing.* Owing to the sources of maps in 1945 being overlapped and provided in a ‘tiled’ form, they were combined into one file using Photoshop. All the TIFF images require the georeferencing process to put them into the correct coordinate system (British National Grid).

2) *Preparation of the georeferencing.* Two data sets are needed:

(a) a verified and co-ordinate map; (b) the image to be georeferenced. To align the raster with control points, a distinct point (a spot on the map that will not have changed in the last 10 years, such as the University Clock Tower or a road corner) is selected on the georeferencing map and the exact same point is then selected on the verified base map.

The georeferencing map is then automatically moved to the correct position. However, the size of the image is considerably smaller than that of the base map. Therefore, more control points are necessary to ‘warp’ the georeferencing map so that it is aligned with the base map.

The greater the number of control points, the greater is the accuracy. To minimize errors, georeference data is needed at the highest resolution and largest scale. Ideally there should be at least one link near each corner of the raster dataset (i.e. the point for

1945) and a few others to produce the best results. Generally, the greater the overlap between the raster dataset and the target data, the better the alignment that results.

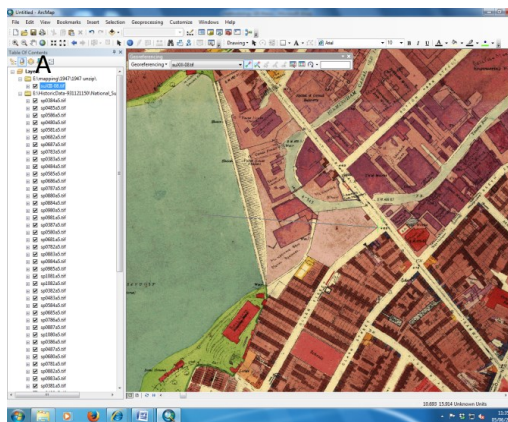


Figure A) Point in 1947 tiff image

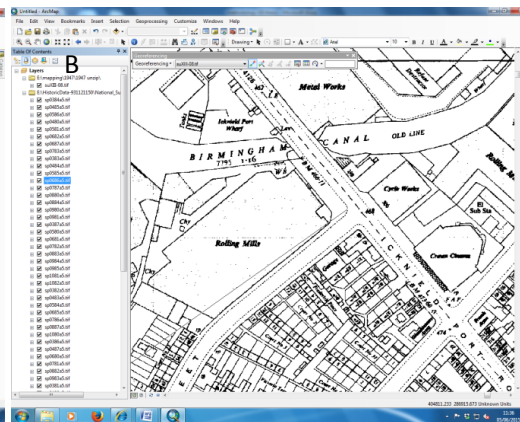


Figure B) Same control point in the base map

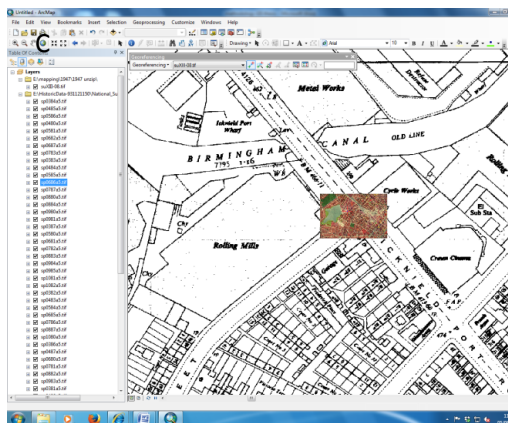


Figure C) Georeferenced image in place

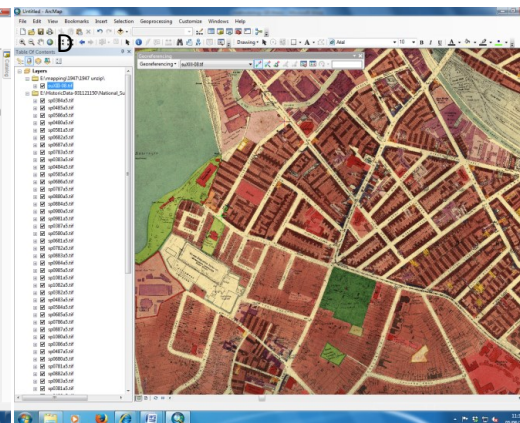


Figure D) Choice of the second point in the layer

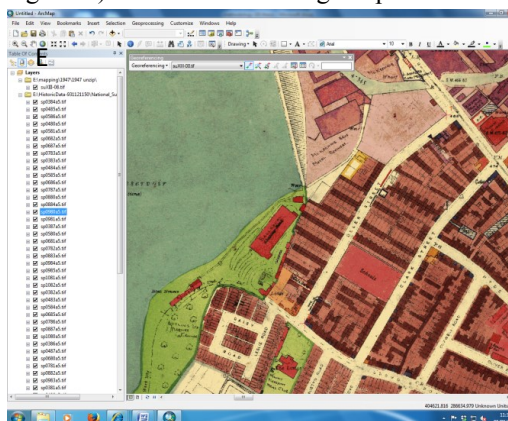


Figure E) Relocate the same point

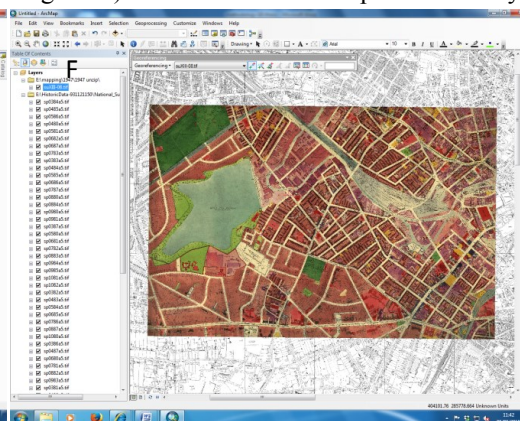


Figure F) Warped Georeference map

### *Production of shapefile*

A new feature class is created and the coordinate system is defined using the

‘define projection tool’ in the British National Grid. This process is done for every map in different periods, for instance, 1945, 1995 etc.

- 1) The SEARCH tool is used to find how to create a shapefile
- 2) The ‘Create Feature Class’ comes out to name a shapefile
- 3) Define the projection
- 4) Edit Feature with the use of EDITOR TOOL to draw a polygon

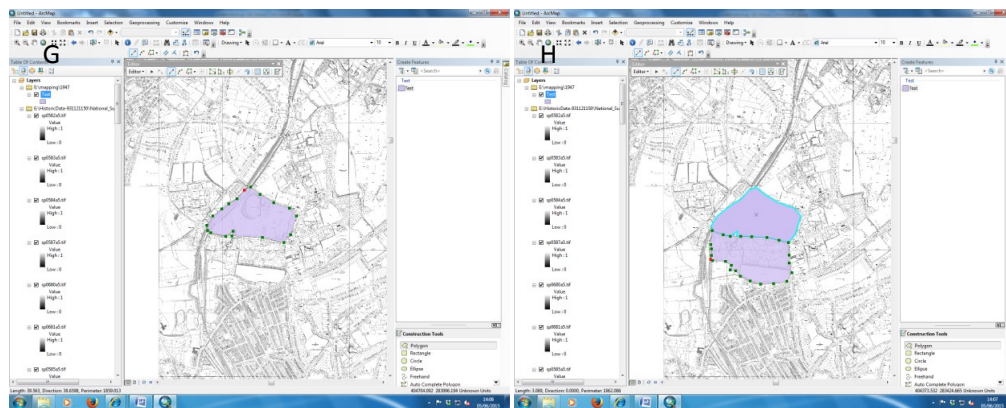


Figure G) A polygon is being drawn

Figure H) A completed polygon

#### 4.6 Land-use change in the south-western section of Birmingham’s Edwardian fringe belt

A number of different sources make it possible to map broad categories of fringe-belt land use in approximately 1945, 1995 and 2015. These include OS plans surveyed just before the Second World War, an aerial photographic survey in 1945, the *Cities Revealed* high-resolution aerial photographic database surveyed in 1995 (available from the Natural Environment Research Council) and Google Earth Imagery of 2015. OS plans surveyed just before the First World War (but published just after the war) are insufficient alone to allow comparable land-use mapping for c. 1915, although in conjunction with other sources, they do allow inferences to be drawn about some aspects of types of surface at that time.

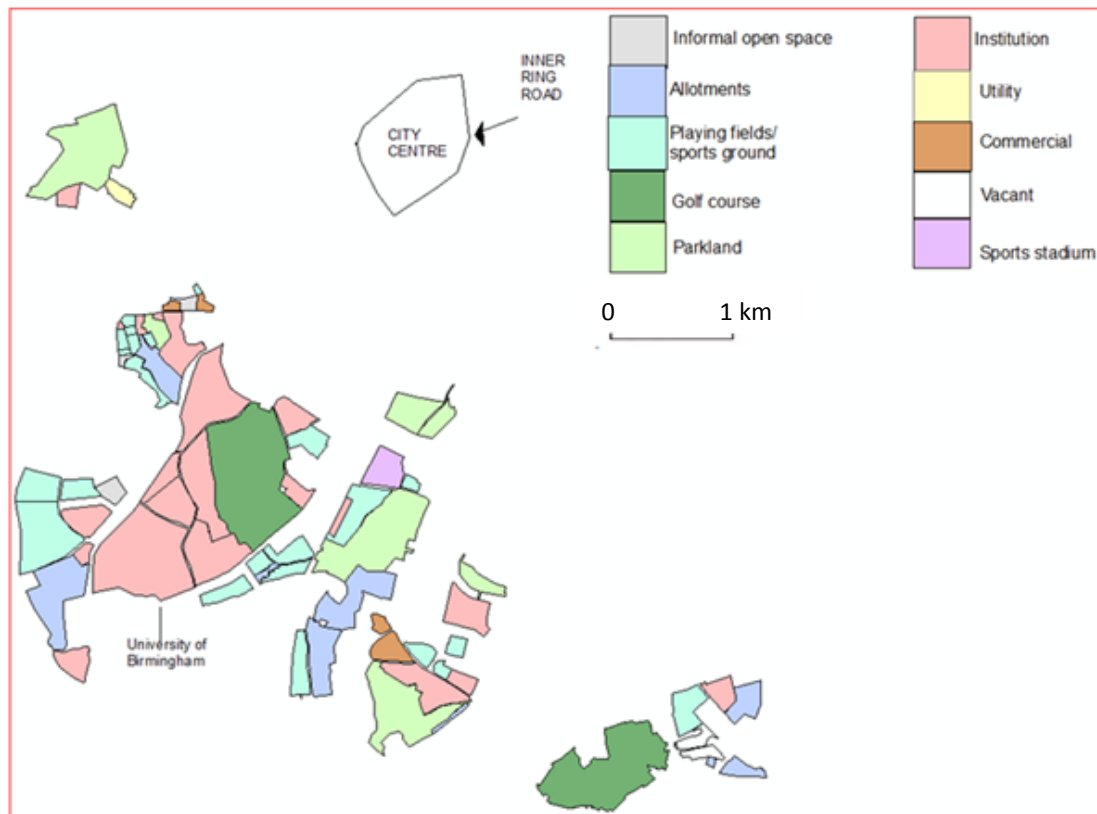


Figure 4.3. Land use in the south-western quarter of Birmingham's Edwardian fringe belt in 1945. Sources: OS plan, 1945 and aerial photograph, 1945.

By 1945 (Figure 4.3) the Edwardian fringe belt had been embedded in the built-up area for 10 to 20 years, in places longer. Its land-use character had become established. This map is largely based on a combination of OS plans at a scale of 25 inches to a mile (about 40 cm per km) and aerial photographs. The largest areas were occupied by institutions, parkland and golf courses, so providing the principal criterion for the selection of sample fringe-belt sites in Chapter 5.

50 years on, in 1995, the general pattern of land use superficially remains quite similar to that in 1945, as would be expected given the tendency of fringe belts to persist through time (Conzen, 1960). However, there had been a sizable increase in the amount of informal open space and, more obviously, in the amount of land occupied by institutions (Figure 4.4). Table 4.1 shows various land uses and their gain or loss of land

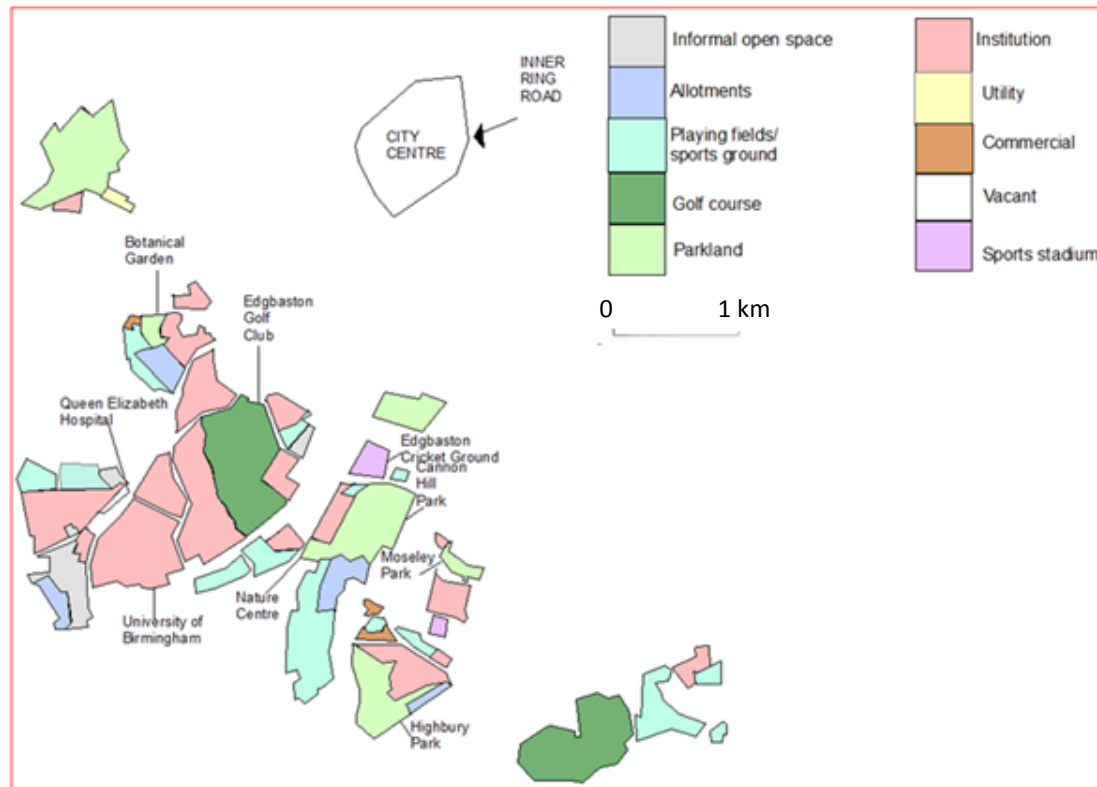


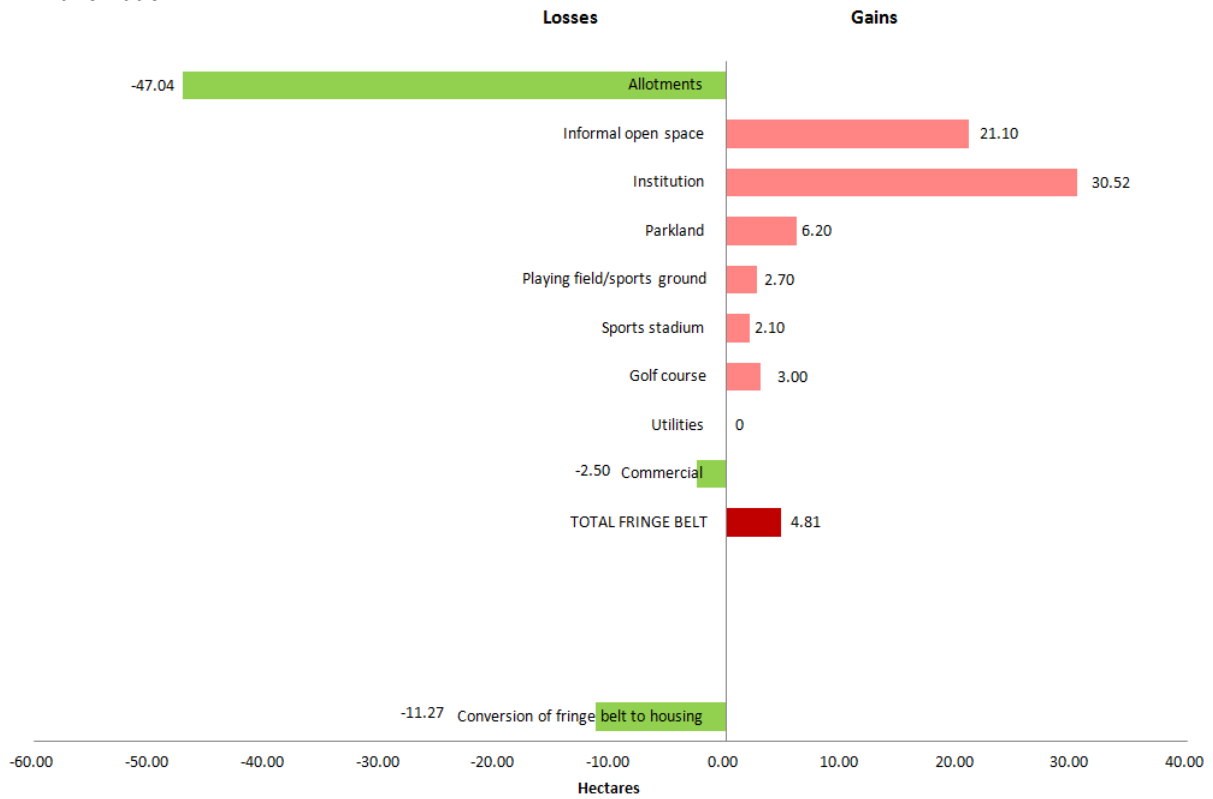
Figure 4.4. Land use in the south-western quarter of Birmingham's Edwardian fringe belt in 1995. Source: NERC aerial photograph, 1995.

between 1945 and 1995. The largest decline was in the amount of land occupied by allotments: consisting in 1945 of eight separate sites occupying in total 68.4 ha, by 1995 the number of sites had declined to four and the total area to 21.4 ha. This reflected the conversion to other uses, notably housing and tree-covered grass, of land that had been converted to allotments during and at the end of the Second World War to meet the food shortages at that time. There was a large increase in the amount of land occupied by institutions and also an increase in the amount of land that was informal open space.

The total amount of fringe-belt land lost ('alienated') in the 1945-1995 period was 11.27 ha: this acquisition of fringe-belt land for housing occurred during the house-building boom of the 1960s. Some conversion of land to housing at this stage in the development of a fringe belt, namely in the house-building boom following its

embedment in the built-up area, is broadly consistent with the findings of previous research on fringe belts in Glasgow (Whitehand, 1972a, p. 217), though Barke (1990, p. 294) reveals different findings in the much smaller settlement of Falkirk.

Table 4.1. Land-use change in the south-western section of Birmingham’s Edwardian fringe belt, 1945-1995



Comparison of 2015 with 1995 (Figure 4.5 and Table 4.2) reveals that the most striking feature is the minimal amount of change except for the decline in the amount of informal open space. It is a slower rate of change than was recorded between 1948 and 1995 in the Edwardian fringe belt more generally in a previous study (Whitehand and Morton, 2003).

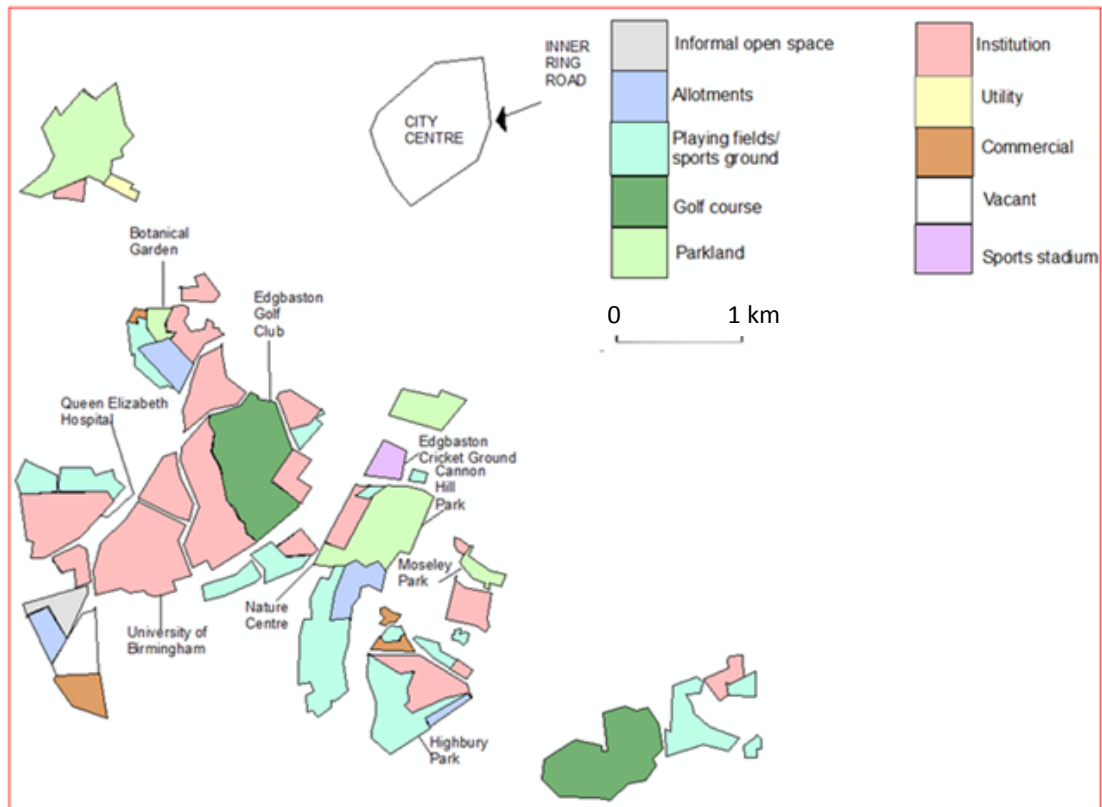
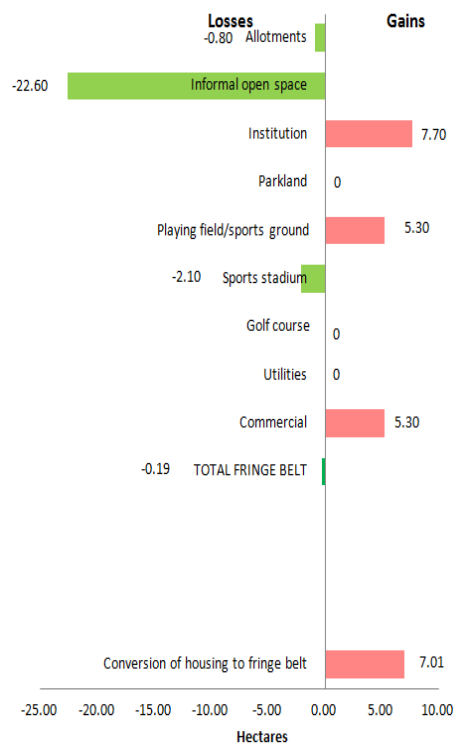


Figure 4.5. Land use in the south-western quarter of Birmingham’s Edwardian fringe belt in 2015. Source: OS plans in 2015 and aerial photograph in 2015.

Table 4.2. Land-use change in the south-western section of Birmingham’s Edwardian fringe belt, 1995-2015.



## Chapter 5. The micro scale

In this chapter, ideas introduced in broad terms in Chapter 3 and considered further in relation to Birmingham's Edwardian fringe belt in Chapter 4 are investigated at the scale of individual fringe-belt sites.

In moving to the micro scale, this chapter focuses on a variety of types of land use associated with fringe belts that began to develop in the late-nineteenth century and further evolved in the course of the twentieth and twenty-first centuries. An introduction is provided to each fringe-belt site, followed by quantification of change over time, focusing successively on the years 1915, 1945, 1995 and 2015. In particular attention is given to the change from grass to trees and changes in the total amount and distribution of hard and soft surfaces. Both these changes have implications for the delivery of ecosystem services.



Figure 5.1. 9 fringe-belt sites in 2015 1.University of Birmingham 2.Edgbaston Golf course 3.Queen Elizabeth Hospital 4.Cannon Hill Park 5.Highbury Park 6.Battery site 7.Priory Tennis Club 8.Tally Ho Grounds 9. Birmingham Botanical Gardens. Sources: OS plans surveyed in 2015, Google Earth Image, 2015.

The 9 fringe-belt sites were chosen in consideration of their representativeness of the south-western section of Birmingham's Edwardian fringe belt. The University of Birmingham and the Queen Elizabeth Hospital are major institutions referred to in Chapter 4. The Battery site includes a mixture of informal open space, vacant land, and land occupied by allotments. Representative of other major occupiers of space are Edgbaston Golf Club, two parks (Cannon Hill Park and Highbury Park), a more specialized 'parkland' (Birmingham Botanical Gardens) and two sports clubs/playing fields (Edgbaston Priory Tennis Club and the Tally Ho Grounds). The relative sizes and shapes of these sites in 2015 are shown in Figure 5.1. The micro-scale analysis of a variety of aspects of these sites is designed to shed light on the theoretical framework outlined in previous chapters.

The aspects examined include alterations in green spaces in the context of changes of land ownership (for example, private ownership or being opened to public access), the heritage of sites, and conservation practices. Formations and changes within the sites may favour the incorporation of key green spaces into the urban fabric with variable levels of modification or associated with other urban developments, with, in turn, implications for the quantity and quality of ecosystem service provision.

At a more detailed level, this chapter has two main aims. The first is to introduce the historical backgrounds and land-use changes of the individual sites. This also entails consideration of the role played by property ownership, notably relating to the estates of

rich families. Issues of fundraising and heritage concerning country houses and principal buildings are also discussed.

The second aim is to present and discuss maps of the types of surface, notably soft and hard surfaces, on the sites. A particular concern in this respect is changes of green space distribution over time, including variations over time and space in the pace of change.

There are two main types of change. The first relates to changes in the form of urban ecosystems, especially those relating to how trees, grass and water have changed. These are essentially changes in the soft-surface canopy. The second is the connection of ecosystems to human attributes. Many of the outcomes relate to hard surface changes. These require consideration in varying respects, including for their heritage value.

In the case of each site, the following aspects are considered: first, the main visual (or landscape) characteristics of the site, particularly viewed historically; secondly, the specific change of green spaces distribution (including grass and tree-covered grass, hard and soft surfaces) from 1915 to 2015. The main sources used to ascertain physical changes to the sites were Ordnance Survey plans, aerial photographs and satellite images. The factors underlying the changes are explored, including changes of land use related to the planning system, and changes of ownership and site occupation.

## **5.1 The University of Birmingham**

The University of Birmingham grew out of Birmingham Medical School, which began in 1825 in Birmingham's inner fringe belt. In 1900, the 6th Baron Calthorpe donated 25 acres (10.1 ha) of his estate to allow the relocation of the University to Edgbaston (Hoyte and Filmer-Sankey, 2012). Such a shift of institutional location from an inner fringe belt to the rural-urban fringe has been noted in previous research (Whitehand, 1972a, p.215).

The layout and buildings of the new campus were designed by architects E. Ingress Bell and Aston Webb, who already had national reputations. The design consisted of a semi-circle of buildings radiating out from a detached campanile based upon the Torre del Mangia in Siena (University of Birmingham, 2012). The campus was opened on 7 July 1909 by King Edward VII. Thus land donor, architect, and opening ceremony were commensurate with the perceived status of this development.

Hoyte and Filmer-Sankey (2012) remind us of the extension of the campus to the north to the design of Birmingham architect William Haywood, in the late 1920s. He introduced a tree-lined avenue extending from the original entrance on University Road to a new one on a realigned road to the north. However, the piers, lodges and gates on the road to the north, Pritchatts Road, were the only buildings constructed (Hoyte and Filmer-Sankey, 2012).



Figure 5.2. The University under construction in 1902 (University of Birmingham, 2012).

There are historical pictures and records to illustrate how the early buildings as well as surrounding green spaces appeared in the past (Figures 5.2 and 5.3A). There was a marked contrast between the largely grass covered campus and buildings in 1909 and the much less grass covered site of 2015 (Figure 5.3B).

The southern university campus of 1909 was striking in three respects: (i) the topographic re-modelling giving rise to straight contour lines; (ii) the large areas of lawns and playing fields; and (iii) the almost total absence of mature trees. Areas where woody shrubs or trees may have been newly planted are evident and there appear to be tree shelters for newly-planted saplings along the driveway inside the South Gate. By 2015 (Figure 5.3B), the abundance of mature trees is evident.

An aerial photograph of the central and northern parts of the university campus in 1948 (Figure 5.4) shows a landscape returning to urban parkland after its 're-setting' to engineered grassland during the construction of the main university buildings. Geometrical green infrastructure features dominate, particularly the avenue of trees

leading north from the tower and the bank of trees/shrubs separating the main buildings from the playing fields to the south.



Figure 5.3. The South Gate of the University of Birmingham. (A) in 1909 (University of Birmingham, 2012). Areas of new planting of shrubs/trees are evident. What appear to be tree shelters to protect saplings are shown bordering the driveway inside the South Gate. (B) in 2015 (author's photograph).



Figure 5.4. View of the University of Birmingham and parts of the fringe belt to its immediate north east in 1948 (University of Birmingham, 2012). The bank of shrubs/young trees in the foreground corresponds to the main area of new planting beginning to be evident in figure 5.3A.

#### *Types of surface in 1915, 1945, 1995 and 2015*

At the beginning of the 20th century, the new University campus was still at the urban fringe. Indeed, even at the end of the Second World War, parts of the campus and areas adjacent to it had an almost rural-urban fringe appearance (Figure 5.4), although the main edge of the urban area had already moved farther out by the 1930s. In 1915, the large majority of the University's site was covered by grass, and in 1945, grass still predominated (Figure 5.5). However, by 1995 grass cover had decreased to only about one-half of the surface area, and there was a further decrease by 2015 (cf. Hoyte and Filmer-Sankey, 2012).

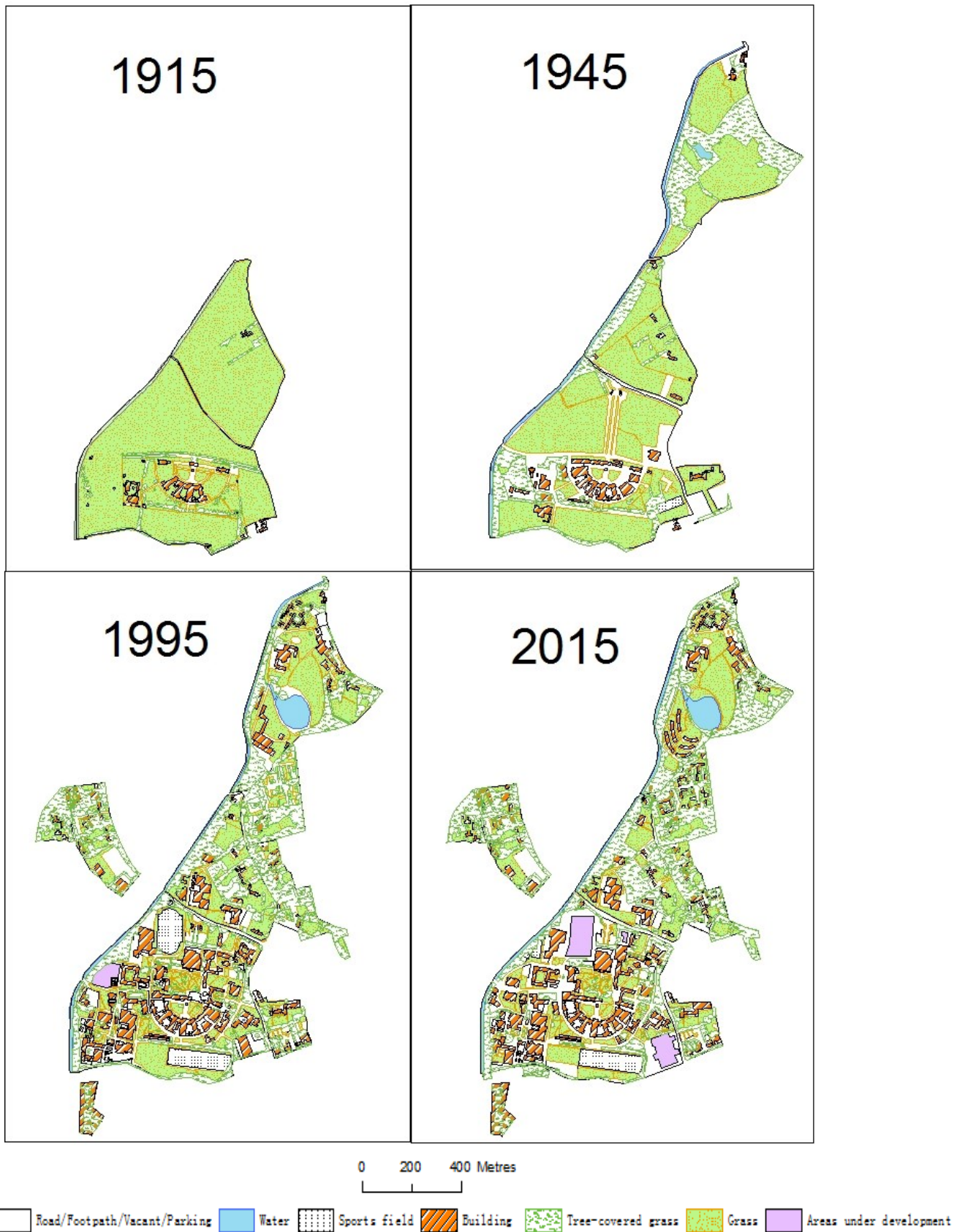


Figure 5.5. Types of surface in 1915, 1945, 1995, and 2015 in the University of Birmingham. Sources: OS plans of 1915, 1945, 1995 and 2015, Aerial photograph, 1945, Natural Environment Research Council (NERC) image of 1995, Google Earth Image of 2015.

In contrast to the decline in the amount of grass over the 100-year period up to 2015, the relative amount of tree-covered grass grew considerably. There is little doubt that the trend for tree-covered grass to actually increase in the University of Birmingham in the second half of the 20<sup>th</sup> century is indicative of an actual increase in tree numbers. As well as the maturation of the planting evident in Figures 5.3 and 5.4, the twentieth-century increase in tree cover reinstated the ‘parkland’ from which the university was ‘carved out’ by substantial earthworks and tree removal. The character of this prior parkland is indicated by the landscape outside the University grounds shown in the top of Figure 5.4.

More striking is the trend for increasing amounts of hard surface. This includes not only buildings (Figure 5.6), but many other hard surfaces, notably tarmac. Substantial land acquisitions have increased the total area of the University by approximately one-half compared with 1915. The northern acquisition, ‘the vale’, was developed in the mid-twentieth century into student accommodation in a parkland setting with an extended water feature. The eastern and western acquisitions, retain large areas of green space and, in the case of the eastern acquisitions, much of the character of nineteenth century very large detached domestic housing. The original university land has undergone considerable building in-fill, including removal of much of the tree-lined northern entrance avenue.

From the standpoint of design, the treatment of green space on the University site has varied over time. The long-term tendency on the greater part of the main compass has been to adopt a formal approach. There is virtually no informal green space. This is

in contrast to the informality of most of the gardens of former residential areas, most of which were acquired by the University fairly early in the post-war period. Here, a good deal of the informality of the gardens characteristic of large Edwardian residences has been retained. Where the formal green-space designs have survived—for example, the tree-lined avenues—they are scarcely recognizable. The arrangement of lawns and paths associated with the earlier buildings are an exception.

In many ways, the development of the site of the University of Birmingham over time can be viewed as a series of morphological periods. And these apply as much to green spaces as to built form. In the Edwardian period the character and disposition of green space, essentially grass and a few trees, was very largely subordinated to the grand, monumental, planned semi-circle of buildings, focal tower and the geometry of the internal roads and footpaths. In the inter-war period, the wider landscape of grass had as its axis the grand tree-lined avenue: this was the period much more than any other when green space was prominent in the planning of major sites. This avenue was truncated and separated from its gateway in early post-war decades when, as elsewhere in fashionable town planning, the ring road became prominent. Then and subsequently, particularly recently, green space considerations have largely been subordinated to the various locational and spatial needs of individual new buildings. It is worth noting that the University is, at time of writing, undertaking a major landscaping effort (the Green Heart project) motivated, to some extent, by the recognition of the value of Haywood's vision for a northern gateway into the University.

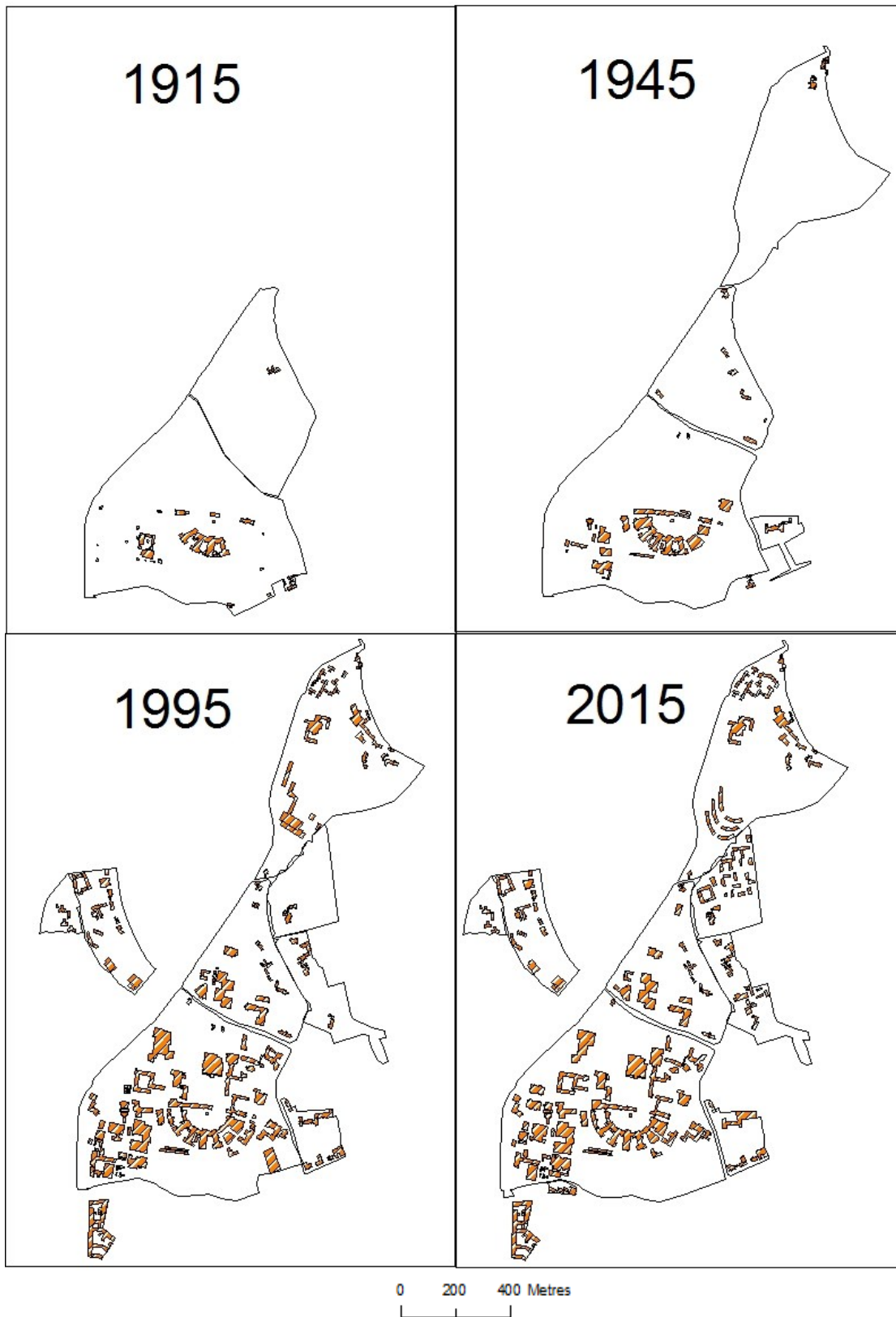


Figure 5.6. Buildings in 1915, 1945, 1995 and 2015 in the University of Birmingham. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995, Google Earth Image of 2015.

## 5.2 The Queen Elizabeth Hospital

As in the case of the University, the development of a site for the Queen Elizabeth Hospital in the growing Edwardian fringe belt was related to expansion of facilities existing in the inner fringe belt. Those existing facilities were at the Queen's and General hospitals. The idea of expanding them on their existing sites was investigated after the First World War. However, the idea was rejected in 1922 in favour of establishing a further medical centre adjacent to the University of Birmingham. Also similarly to the University, the donation of land by a major landowner was a significant factor — in this case W.A. Cadbury. Previous studies have drawn attention to the interrelationships between different types of occupancy of fringe-belt sites (Barke, 1974). The outward relocation of the main city hospital in Glasgow to a site adjacent to the university in that city was a notable earlier similar development.

The estimated cost of the new building was £ 1,000,000. This amount was to be mainly dedicated to the hospital and the remainder was for the Medical School of the University. The plan for the additional 600-bed hospital centre was finalized in 1929. The growing population of Birmingham and the desirability of combining the scientific advances occurring at the University with access to clinical services were key factors (University Hospital Birmingham, 2012).

Construction followed the placing of the foundation stone by the Prince of Wales in 1934. As in the case of the University, the central building was designed by a London architect with a national reputation — Thomas Arthur Lodge. The central hospital building contained 740 beds for regular patients with a further 100 beds for paying

patients. It was designed as a modern centre for health care, which provided cutting-edge services for the people of south Birmingham and surrounding areas. It was initially financed by payments and donations for private treatment. It was recognized as a voluntary hospital. However, this arrangement ended when the National Health Service was introduced. When the formal opening ceremony was performed, the complex of buildings consisted of Nuffield House nurses' home, the Vincent Medical Block and the Cadbury Surgical Block.

During the war, the number of in-patients at the hospital increased significantly, with local inhabitants being treated along with battle casualties, both military and civilian. The number of patients was often more than double the number for which the accommodation was designed.

The Queen Elizabeth School of Nursing was opened to provide additional trained nurses for the institutions of Birmingham United Hospitals in the 1950s. In the late 1960s, the improvement of the west side of the Queen Elizabeth Hospital site had been completed (University Hospitals Birmingham, 2012).

Edgbaston had become the home of most of Birmingham's most eminent doctors in the 19th century but it was not until the mid-20th century that it became the most important medical centre in Birmingham with the opening of the Queen Elizabeth Hospital and the University Medical School in 1938-9 (Clifford *et al.*, 1997).

*Types of surface in 1915, 1945, 1995 and 2015*

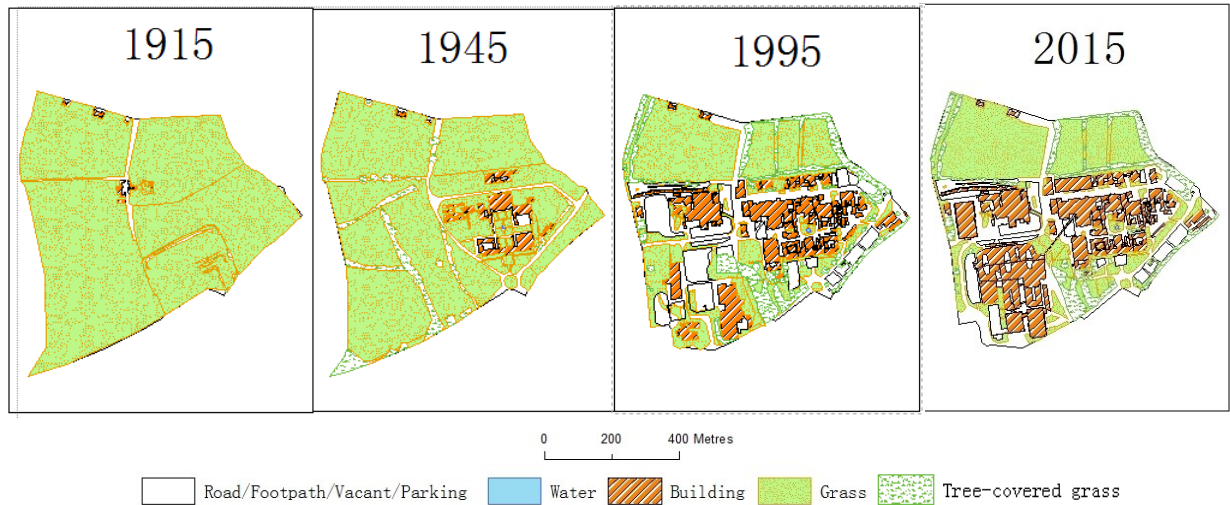


Figure 5.7. Types of surface in 1915, 1945, 1995, and 2015 in the Queen Elizabeth Hospital. Sources: plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

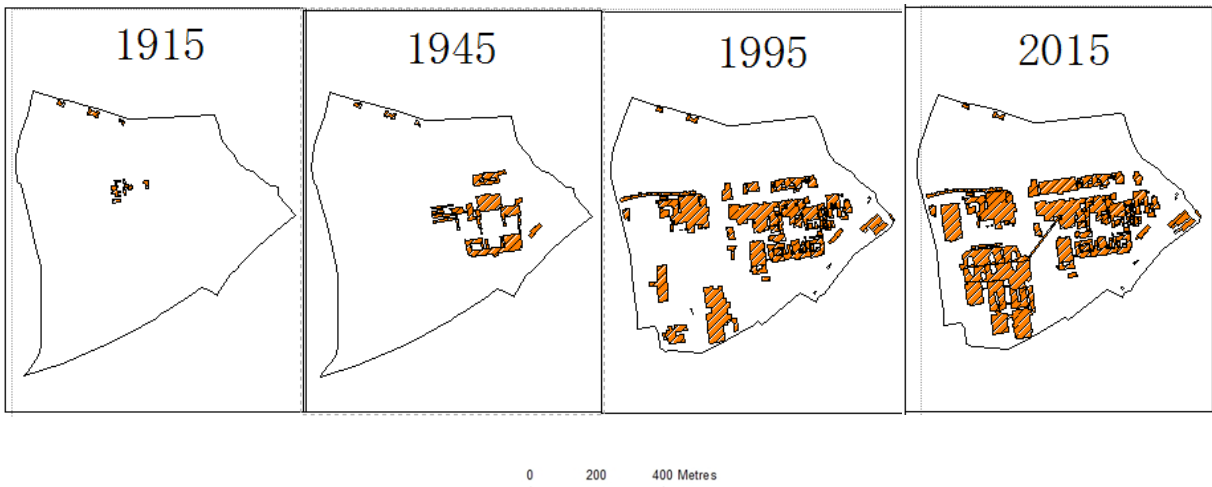


Figure 5.8. Buildings in 1915, 1945, 1995 and 2015 in the Queen Elizabeth Hospital. Sources: plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

The greenfield site of 1915 already contained the basic road layout that has been retained throughout a subsequent century of intense development on the 37 ha site (Figure 5.7). Lines of trees and woodland areas had appeared by 1945 only to have been largely felled by 1995. Changes to the character of the green spaces, which include the

site of a Roman fort, were fairly small scale between 1995 and 2015. The main change was the creation of buildings on previously vacant lots. Building was restricted to south of the east-west road that crossed the hospital site by 1945 (Figure 5.8). The green space to the north of the site, largely comprised of grass, has continued largely unchanged. There is little evidence of increases in woody shrubs and trees.

### **5.3 The Battery site**

The Battery site was named after the Birmingham Battery Company, which manufactured metal at the southern extremity of the site, occupying buildings there between the 1870s and the 1980s. However, the majority of the site was occupied by grass, tree-covered grass and allotments throughout its urban history (Figure 5.9). It was owned throughout that history by the Gibbins family who, like several other wealthy families owning fringe-belt sites in south-west Birmingham, were nonconformist in their religious beliefs. The site has undergone more land-use change than any of the other sample fringe-belt sites.

These major land-use changes have particularly involved changes in the amount and character of green space. They need to be viewed especially in relation to three factors: first, the major national fluctuations over the past 100 years in the amounts of land occupied by allotments: secondly, the significant extent of an area of 'semi-natural' habitat (in this case a SLINC); and thirdly, the close proximity of the University of Birmingham and the Queen Elizabeth Hospital. All of these factors had a bearing on the degree of pressure for the construction of buildings and other hard surfaces. A fourth

factor, the expansion of the retail area of Selly Oak, was beginning to exert an influence on the Battery site when the field and archival work involved in the study of this site was completed in 2015.

#### *Types of surface in 1915, 1945, 1995 and 2015*

The main changes in land use were large increases in allotment coverage associated with the two world wars, followed by major decreases since the late 1940s. With a significant area designated as a SLINC, the Battery site was, until the beginning of this century, one of the most ecologically significant of the fringe-belt sites selected for consideration in this study. However, following a very extended planning debate, a significant part of the SLINC was taken over for additional building for medical purposes adjacent to the site of the Queen Elizabeth Hospital.

The area occupied by allotments declined from 18.9 hectares to 2.2 hectares between 1945 and 2015 by a combination of disuse and deliberate land-use change. The north-western extremity of the site was alienated when some of the allotments were replaced by residential development. On the whole, the changes over time in the amount of land used for allotments have been consistent with the pattern of national changes outlined in Chapter 2.

In the early 2000s, conversion of open land to buildings occurred on the northern part of the site for expansion of the nearby hospital (Figure 5.10). Soon afterwards a major road was constructed across the site. This bisects the site approximately south-west to north-east, breaking up what was previously a continuous green space.

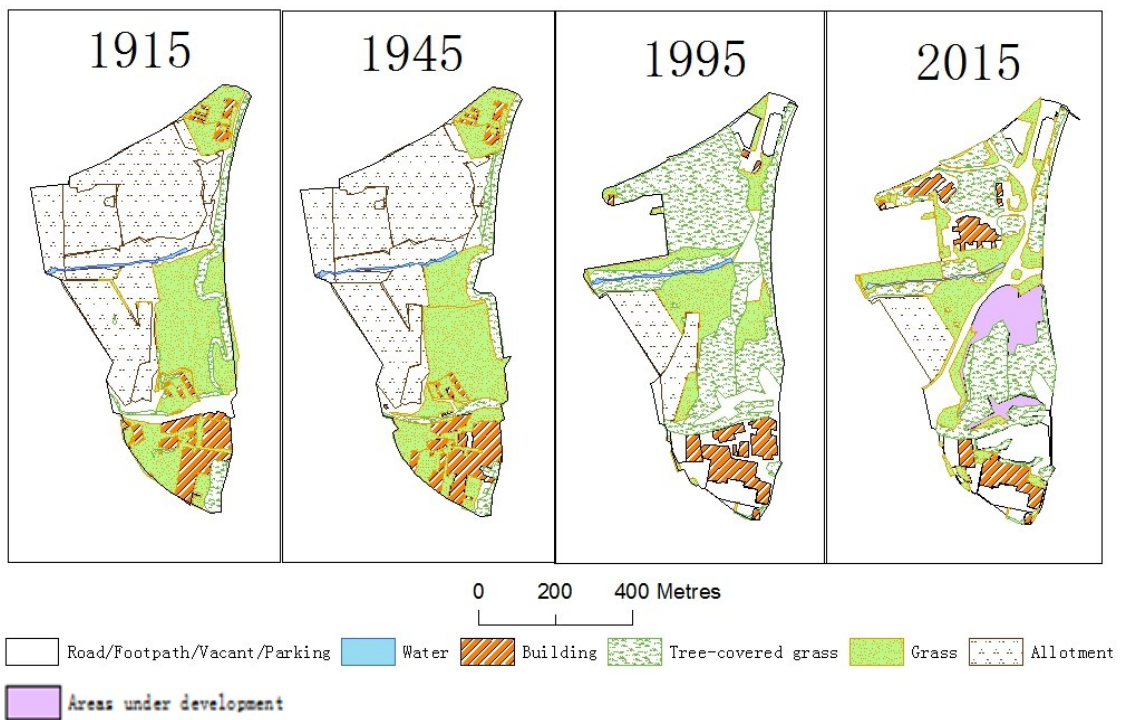


Figure 5.9. Types of surface in 1915, 1945, 1995, and 2015 on the Battery Site. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

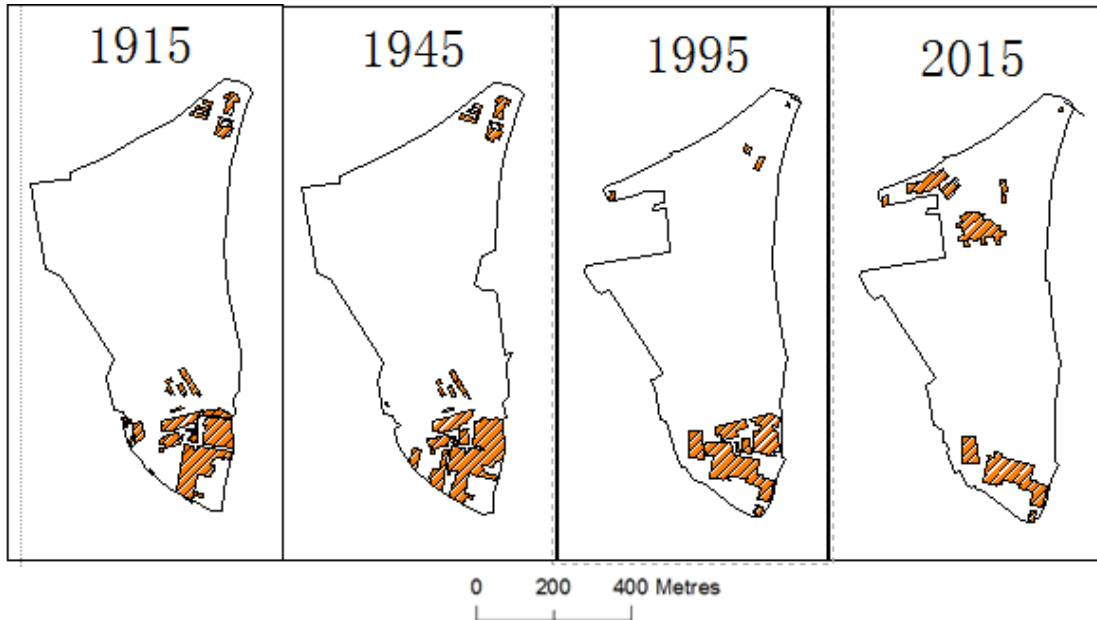


Figure 5.10. Buildings in 1915, 1945, 1995 and 2015 on the Battery Site. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

## 5.4 Edgbaston Golf Club

The site of what is now Edgbaston Golf Club was a country park of the Calthorpe family until the 1930s, when it was leased to the golf club. Edgbaston golf course is of sufficient historical importance to be a concern for English Heritage. Edgbaston Hall is listed as grade II. It became the clubhouse of Edgbaston Golf Club in 1936. In 1937, the clubhouse was opened by Neville Chamberlain, who was then Prime Minister. While this may be seen as a reflection of the importance of the site, more influential was probably the fact that he was a Member of Parliament for the Edgbaston constituency. A tract along the park's north-east side included Park Mount, an early-nineteenth century villa. Edgbaston Hall suffered damage from bombing in the Second World War and was not fully reopened until 1950 (Historic England, 2007a).

The National Heritage List for England entry for Edgbaston Hall (NHLE, n.d.) describes some principal features of the urban ecology: including approximately 12 ha across the northern part of the park. There are several lines of silver birch that run towards Edgbaston Hall and that divide not only the managed grass of the fairways, but also the various greens. The main feature of the west side of the park is the large expanse of water. The lake's north-eastern fringes are almost screened by trees (Historic England, 2007b).

The Great Pool is approximately 12.5 ha (Figure 5.13), and is fed by the Chad Brook. It is retained by a brick-walled, causeway-like dam at its south end. Since the lake's water level was lowered in the course of the twentieth century, the dam has

become more important. The north end of the lake was drained to create the thirteenth fairway of the golf course. It then reached its present form (4.5 ha).

The golf course is registered by English Heritage under ‘the Historic Buildings and Ancient Monuments Act 1953’ with ‘the Register of Historic Parks and Gardens’ for particular historic awareness (Historic England, 2007a). The parkland landscape from which the golf course developed is attributed to Lancelot ‘Capability’ Brown (c.1716-1783). Some features of the Georgian parkland, including a number of veteran trees, remain (NHLE, n.d.). It is thus in several respects, particularly the extent of its lake and various characteristics of its very extensive surviving green space, arguably one of the most distinctive of the fringe-belt sites within the south-western portion of Birmingham’s Edwardian fringe belt.

#### *Types of surface in 1915, 1945, 1995 and 2015*

In 1915, the majority of the golf course site was parkland covered by grass (cf Figure 5.4 which is a view towards the golf course, top right). Grass remained predominant until 1945, and there were only a few buildings (Figure 5.11). By 1995, however, grass surface coverage had declined to 27.6 ha, as the pattern of fairways became established, and there was a slight further decline by 2015.

Though the grass coverage decreased between 1945 and 2015, the decline was minimal compared with that of most of the sample of fringe-belt sites. The amount of tree-covered grass grew significantly. The trend towards tree-covered grass on the golf course is indicative of an increase in total tree numbers. The smaller patches of tree

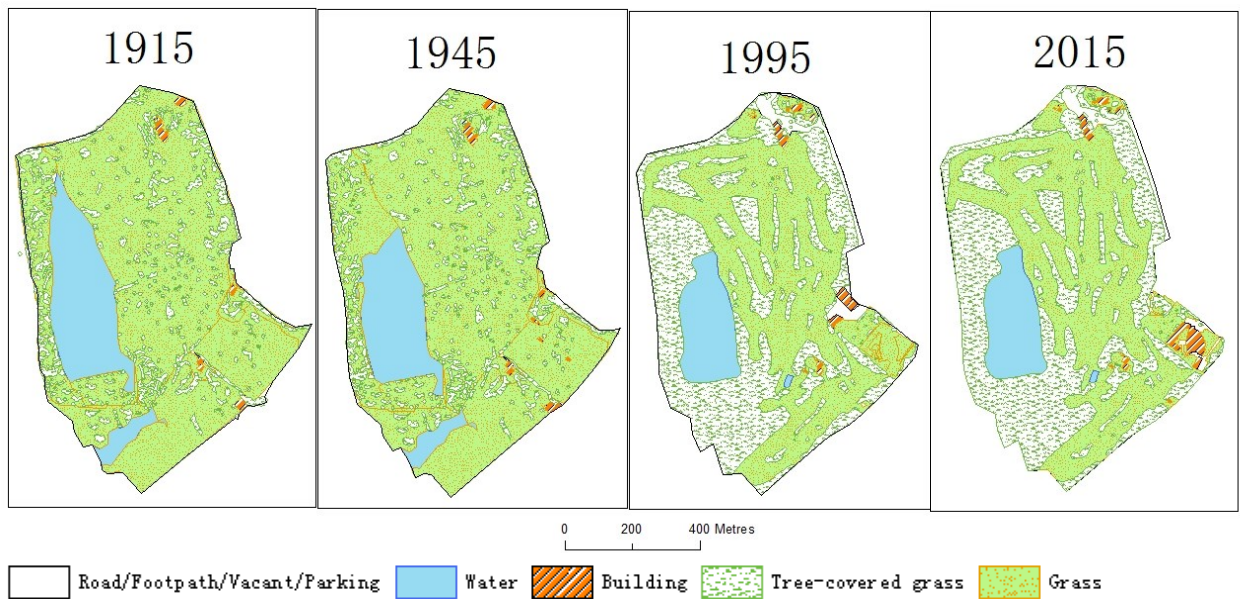


Figure 5.11. Types of surface in 1915, 1945, 1995, and 2015 in Edgbaston Golf Course. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

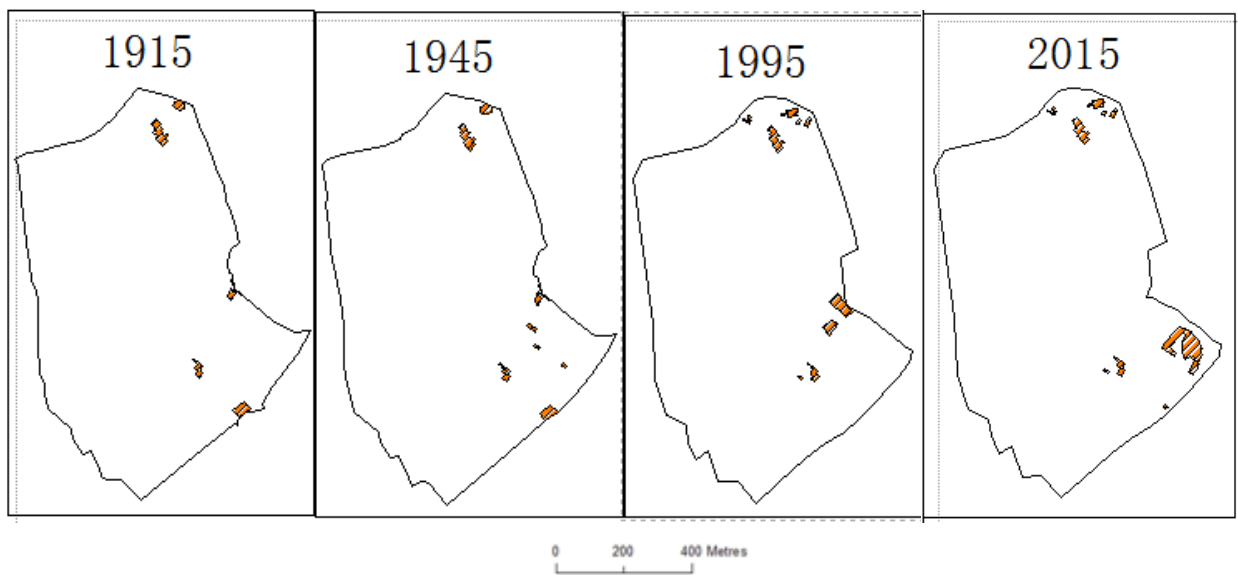


Figure 5.12. Buildings in 1915, 1945, 1995, and 2015; on the Golf course. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

covered grass, which are often linear, provide designed obstacles as part of the golf course and visual interest for the players. The large area of trees to the west of the site is mainly dense beech. This provides a notable ‘aesthetic’ ecosystem service for both members and non-members of the golf club, and is also a visual amenity for visitors to

the University of Birmingham's Winterbourne House.

The small additions to the amount of hard surface included not only buildings but also other hard surfaces, particularly tarmac and, after 1945, other vacant spaces. Only a few hard surfaces existed before 1945. Soft surfaces in total declined by 3 ha between 1945 and 2015. Some grass was replaced by new buildings and other vacant surfaces and grounds. Buildings still cover only a tiny fraction of the site (Figure 5.12).

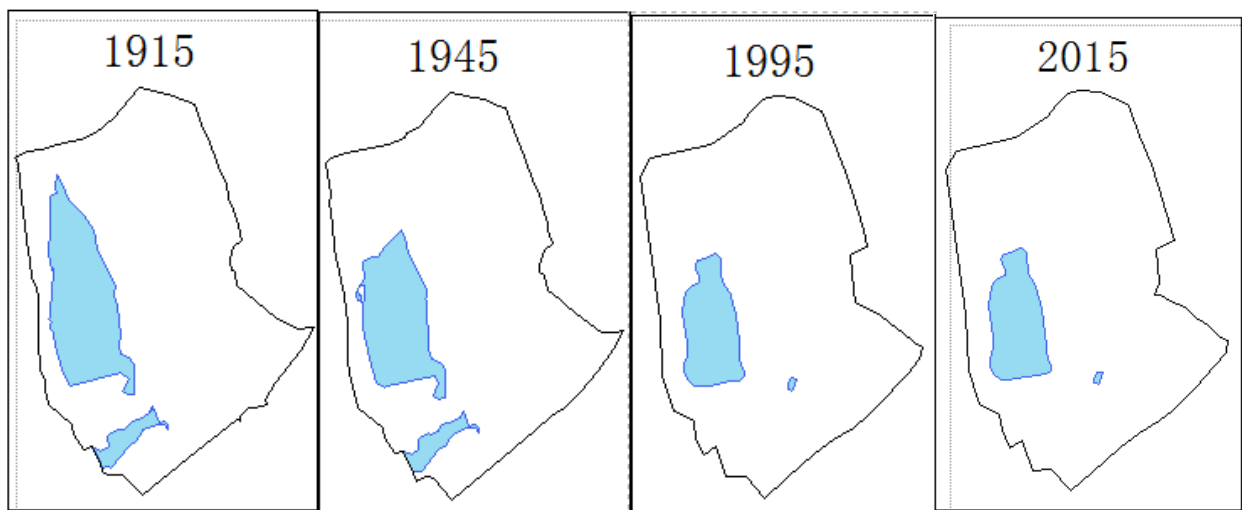


Figure 5.13. Water in 1915, 1945, 1995, and 2015 in the Golf course. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

## 5.5 Birmingham Botanical Gardens

In the early 19th century, botanical gardens were established in considerable numbers in England as a consequence of a growing middle-class interest in gardening and botany. In 1829, the Birmingham Botanical Gardens (BBG) was laid out for the Birmingham Botanical and Horticultural Society (Historic England, 1999; Slater, 2002, p.40). Much of the history of the buildings and spaces of the site has been investigated in largely unpublished work by Ian Nex, on which the present study of this site is heavily reliant.

Table 5.1 the periods of the development of the BBG. Source: based on unpublished drawings by Ian Nex.

1 Loudon's vision	1830-1832
2 The Cameron years	1831-1847
3 Victorian reality	1848-1899
4 Botanical or zoological	1900-1939
5 Mirror, mirror on the wall what is the future for us all	2004 to infinity

*Loudon's vision 1830-1832*

John Claudius Loudon (1783-1843) designed the original layout of the BBG, which included a proposal for a 200-foot (c. 60 m) diameter annular glasshouse. A 100-foot (c. 30 m) water tower was to supply various fountains. There were three fountains around the glasshouse, two at different positions on a line to the far point of the pentagonal grounds where a 160-foot (c. 50 m) jet would play (Figure 5.14).

At the bottom of the illustration of Loudon's vision (Figure 5.14), in the centre, there is a large pond with the 160 foot jet and waterwheel. Beyond that is a building that

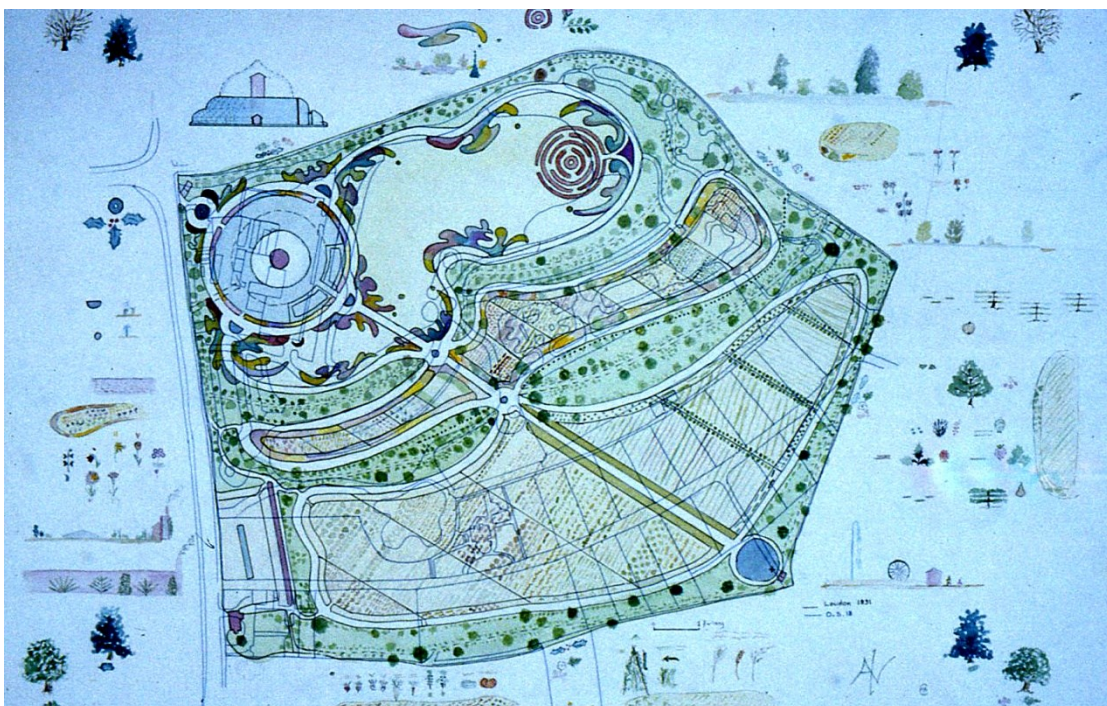


Figure 5.14. Loudon's vision 1830-1832. Source: unpublished drawing by Ian Nex.

was to contain the first public water closets in Birmingham. This included separate areas for ladies and gentlemen next to each other. On either side of the area that comprised the original site of the Edgbaston Archery and Lawn Tennis Club, are two areas containing 3.25 acres of vegetables and cereals. With the exception of the provisioning services of the vegetables and cereals, the emphasis in the Loudon design is on what would now be described as cultural ecosystem services of outdoor open space and prepared sports fields for exercise, and various planning for education and visual pleasure.

#### *The Cameron years 1831-1847*

By 1831, the BBG proponents had raised approximately £2,000 capital. Unfortunately well over £1,000 was needed to buy the remaining 15 years lease from the previous owner. This meant that they could not build Loudon's envisaged annular



Figure 5.15. The Cameron years 1831-1847. Source: unpublished drawing by Ian Nex. Compromises to original Loudon design are apparent.

glasshouse. The first curator, David Cameron (1831-1847) designed an oval conservatory with lean-to houses on either side, which was built in 1832 (Figure 5.15). This was to house tender plants. The gardens were considered by the Society to be a scientific institution at this time (Nex, 2017).

### *Victorian reality 1848-1899*

The large dark area at the south of the map in Figure 5.16 is an area that the Society returned to the Calthorpe Estate due to financial problems. There was disagreement within the administrative committee on whether scientific or ornamental criteria should prevail in the design and management of the gardens. The latter view prevailed and major changes were instigated.



Figure 5.16. Victorian reality 1848-1899. Source: unpublished drawing by Ian Nex.

*Types of surface in 1915, 1945, 1995 and 2015*

Hand drawings by Loudon illustrated the historical change to the BBG up to 1899. For the period since then it is possible to recognize the main types of surface present at various dates by using the same sources used for the other sample fringe-belt sites.

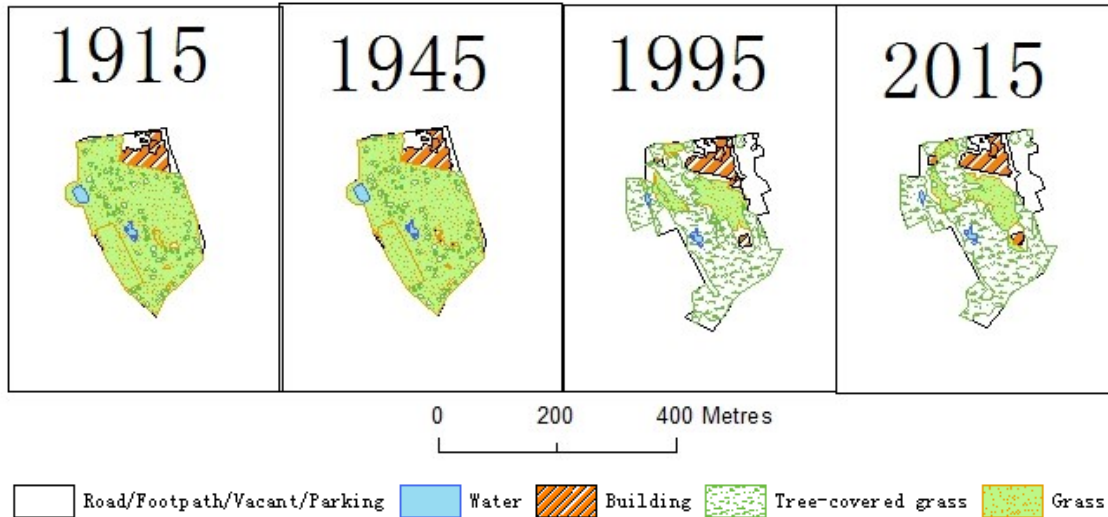


Figure 5.17. Types of surface in 1915, 1945, 1995, and 2015 in Botanic Gardens. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

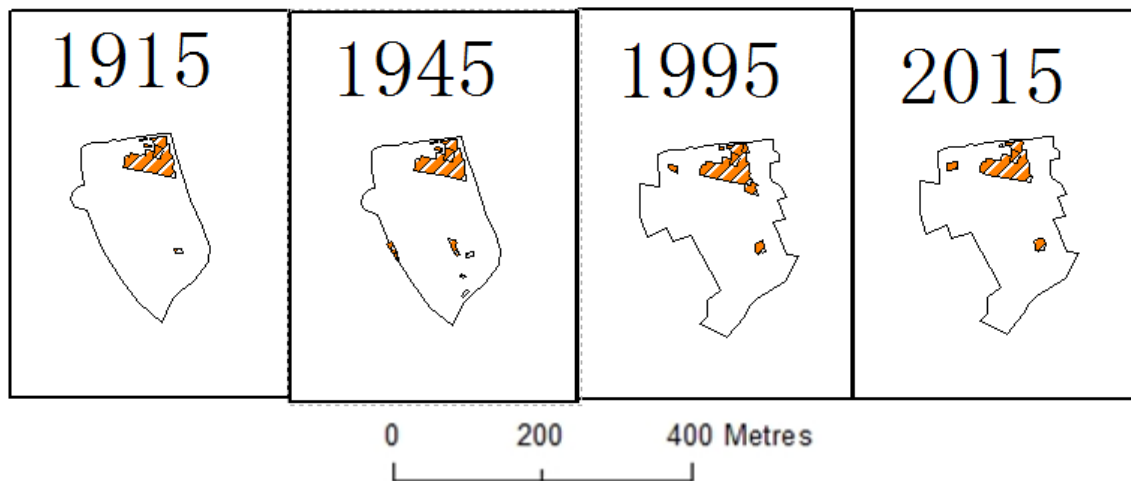


Figure 5.18. Building in 1915, 1945, 1995, and 2015 in Botanic Gardens. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

The most striking characteristic of the BBG land is the changing pattern of surfaces (Figure 5.17). The north-east corner, after 1945, has more hard surface coverage

especially in 1995, including parking and vacant areas; and the green space has been developed farther to the south. From an ecological standpoint, the decreases in the benefits of the ecosystem are a matter of concern. For instance, from 1915 to 2015, the soft surface areas have decreased by approximately 11%, though the proportion of buildings has remained steady (Figure 5.18).

### 5.6 Highbury Park

Highbury Park comprises what were three private estates: Henburys, Uffculme and Highbury. These were gifted to the City of Birmingham. The history of the Highbury Park has been the subject of research by historian Phillada Ballard (2009) and it is upon this that the present consideration of its development heavily relies (Ballard, 2009).

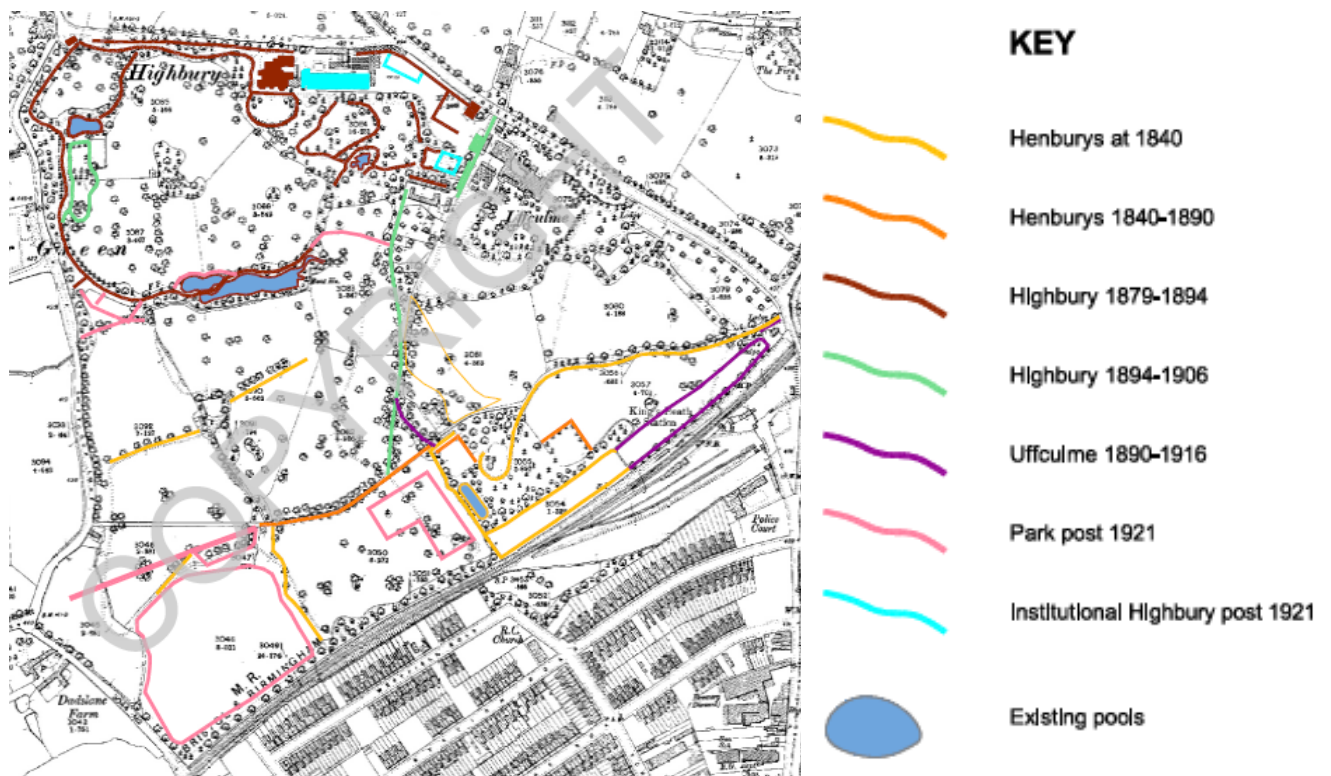


Figure 5.19. Development of the Highbury estate from 1840 to post-1921. Source: Ballard (2009)

Ballard has shown on an Ordnance Survey plan the dates when phases in the

development of what is now Highbury Park occurred (Figure 5.19). Henbury's was a small rural estate from 1760 to 1892. The first phase of landscaping occurred up to 1840, and a second phase between 1840 and 1894. The house was extended in 1876 by G.F. Lyndon and then reduced in size in 1894. The eastern portion of Henbury's house was opened to the public in 1921 and demolished in 1965.

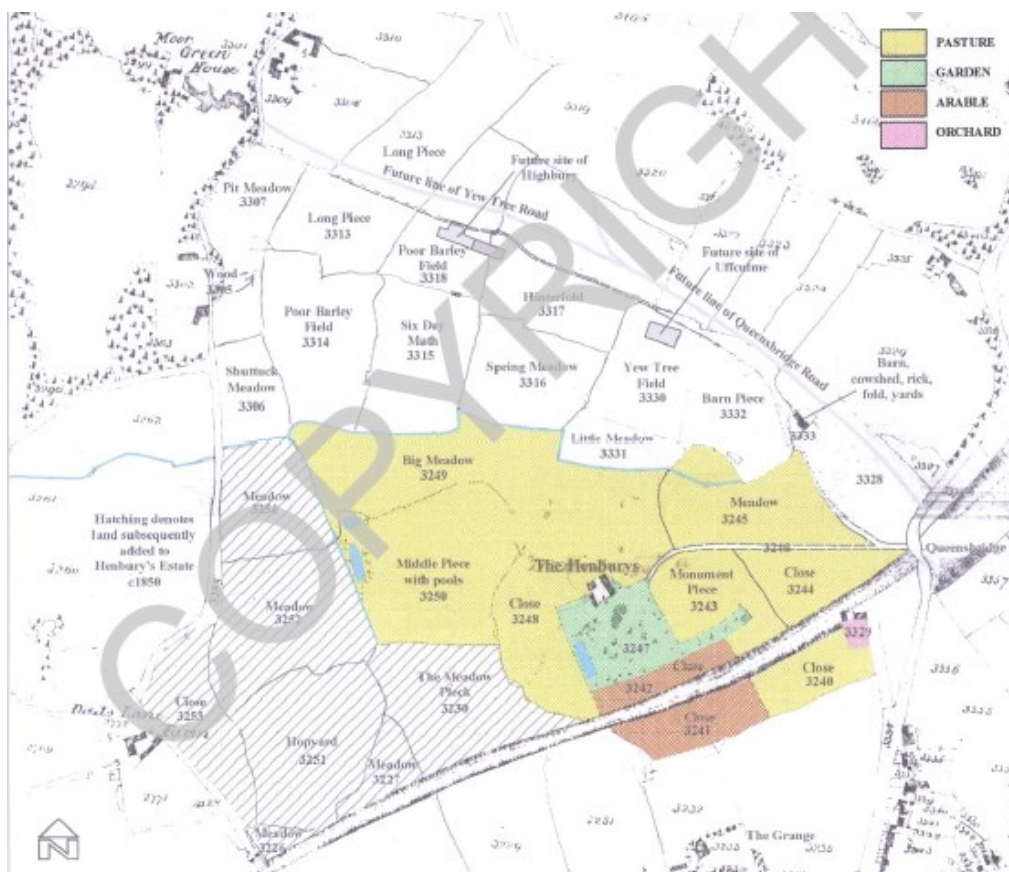


Figure 5.20. Henbury's Estate in 1840, based on a map of King's Norton in 1840, showing the field names and land use. Land subsequently added to Henburys and the future sites of the Highbury and Uffculme Estates are also shown. Source: Ballard (2009)

Uffculme was built by Richard Cadbury in 1890 on former agricultural land. He bought 13 acres of land, most of it located to the south of the recently extended Queensbridge Road and then enlarged it southwards to the northern boundary of Henbury's (Figure 5.20). The Uffculme estate was given to the City of Birmingham by

Barrow Cadbury in 1918.

Joseph Chamberlain established Highbury as a family home in 1878. In 1915, it was converted to institutional use. Many buildings were added, particularly in 1919, including Chamberlain House, which was demolished in 1984.

The development of the Highbury Estate consisted of two phases, the first ending in 1893 and the second in 1921, when the Highbury Trustees leased 15 acres of the Highbury grounds to the City of Birmingham Parks Department for use as a public park. The other 16 acres of land remained part of Highbury's private grounds until 1953. In 1923, the grounds of Highbury were part of the Uffculme estate. 42 acres (17 ha) of the Henbury's western part in 1923 were added to the Highbury Park, purchased by the Birmingham Civic Society and donated to the City of Birmingham. The Society donated an additional 3 acres (1.2 ha) of land adjoining Highbury in the following year. After 1933, the land from The Henburys, Uffculme and Highbury became known widely as Highbury Park.

The land of Highbury Park has had different functions over time. For instance, in the 1830s, the park included botanical gardens designed by J.C. Loudon. The botanical gardens were opened to the public in 1832. During the First World War, Highbury was a military hospital; the glasshouses were used as wards, operating theatres and workshops. Many of these glass houses were demolished in the 1920s. In 1951, Highbury Park was still being used for gardens. In 1967, the planting range was extended, and the site was used for the Midland Rose Centre. In 1971, the General Purposes Committee of

Birmingham added a very small amount of land. The site was designated as a Grade II site by English Heritage.

*Types of surface in 1915, 1945, 1995 and 2015*

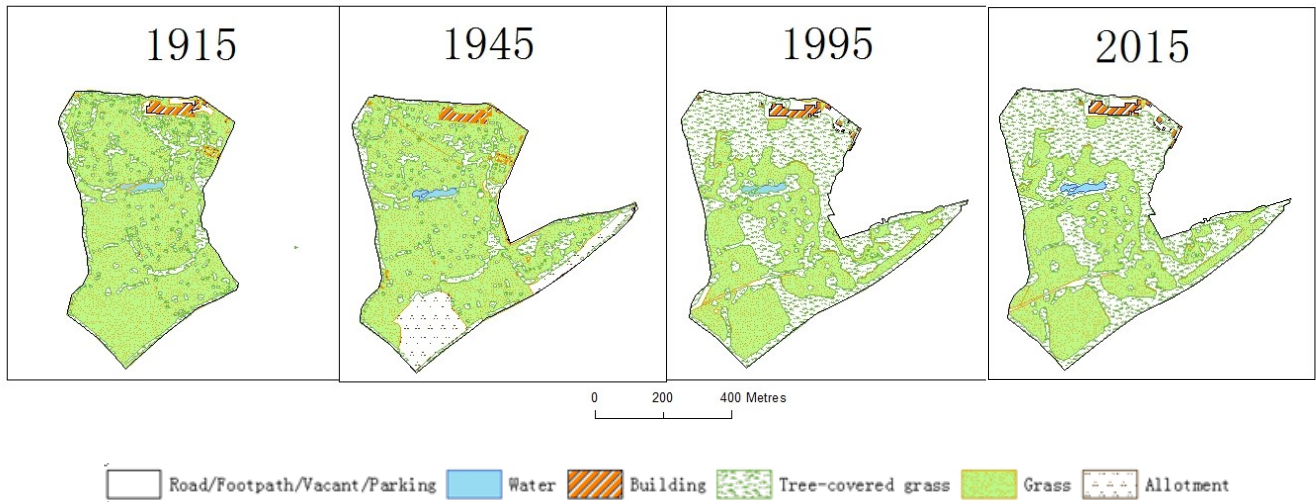


Figure 5.21. Types of surface in 1915, 1945, 1995, and 2015 in Highbury Park. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

After a significant enlargement between 1915 and 1945 the size of the site of Highbury Park remained almost unchanged through to the present. The large majority of the site in 1915 was grass and trees, but in the 1940s allotments replaced some of the spaces dedicated to grass and trees as part of a national large-scale change of use relating to the demand for vegetables during and following the Second World War. By 1995, these allotment areas had been restored to trees and grass and their area had not changed significantly by 2015 (Figure 5.21).

The trend towards increasing the intermingling of trees and grass in Highbury Park led to an increase in tree numbers. Since there were already trees marked in the grassy areas in the OS plans of 1915 and 1945 (Figure 5.21), the conversion of grassland to

trees-covered grass may indicate a reduction in arboricultural management, particularly at the northern end of the Park. One would expect the species richness to increase as 'weeds' encroached on areas previously maintained as grass monocultures. Air pollution regulating services would have been increased by the conversion of grass to tree-covered grass because of the increase in leaf surface area (cf. Donovan *et al.*, 2005, p.6730). The additional woody biomass would increase carbon capture by the site, although this can only ever be a very small offset to local anthropogenic emissions (Donovan *et al.* 2005, p.6731).

The increase in the area of soft surfaces between 1915 and 1945 was entirely accounted for by the increase in the size of the site. The main buildings remained largely unchanged between 1915 and 1945. Between 1945 and 2015, there was a small reduction in coverage by grass and trees as the areas occupied by roads, parking spaces and buildings were increased. Most of the building demolition and construction was in the period from 1945 to 1995.

### **5.7 Cannon Hill Park**

The Cannon Hill property, comprising about 57 acres (about 24ha), formed part of the extensive Birmingham estates owned by Miss Louisa Ann Ryland. She gifted Cannon Hill to Birmingham City Corporation, and it was opened to the public as a park on 1 September 1873. In 1897, Sir John Holder gifted a further 7 acres (c 3ha) to the City. Cannon Hill House itself remained in the ownership of Miss Ryland until 1907, when the Corporation bought it from the trustees of the late Miss Ryland. This pattern of public park creation, as in Highbury Park, was a major characteristic of fringe-belt

creation in Britain in the last one-third of the nineteenth century, especially during slumps in house building (Whitehand, 1981, p.135).

After the First World War, usage of the Cannon Hill Park included a cycle rally, and a yearly vehicle rally and various dancing events (Historic England, 2013). Hence, from the perspective of the current study, the park provided cultural ecosystem services. After the Second World War, Cannon Hill Park was considered as Birmingham’s premier open public park. In 2013, parts of it were let for commercial use, but it remains municipal property.

*Types of surface in 1915, 1945, 1995 and 2015*

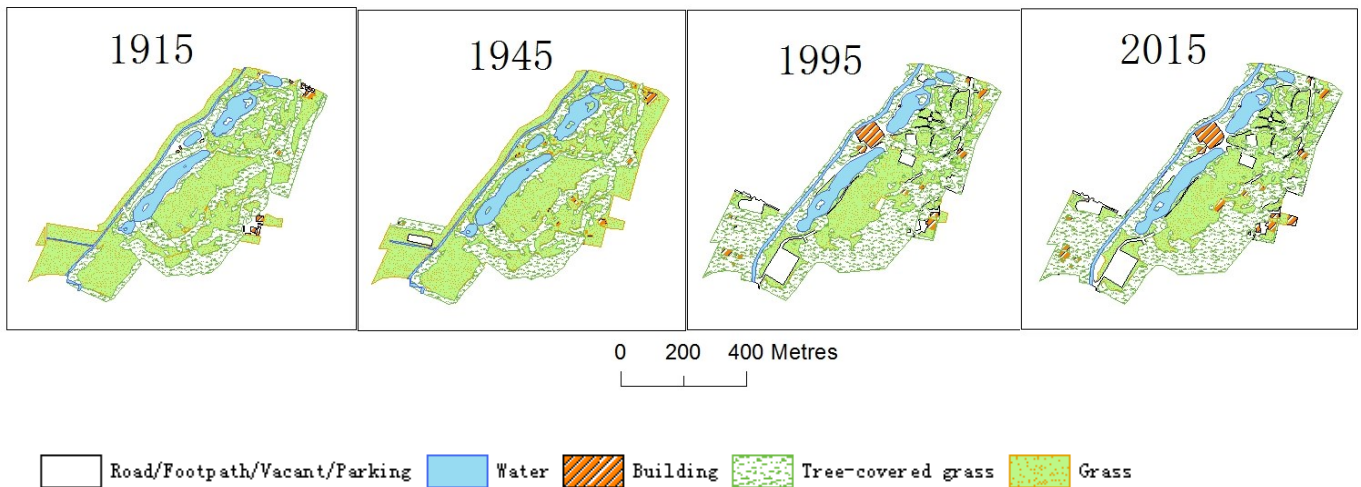


Figure 5.22. Types of surface in 1915, 1945, 1995, and 2015 in Cannon Hill Park. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

Unlike the boundary of Highbury Park, which changed after 1945, the extensive area of Cannon Hill Park remained unchanged. In 1915, the large majority of the park was covered by grass and this cover still dominated in 1945. There were few buildings before 1995. The surface area of grass coverage had declined to 7 ha by 1995 and was

approximately that size in 2015. Replacements of grass were by buildings (Figure 5.22), vacant surfaces and roads. Like Highbury Park and most other public parks that were designed in Britain in the nineteenth century, Cannon Hill Park was designed essentially as an informal open space. However, somewhat more straight lines have been introduced than at both Highbury Park and Edgbaston Golf Course. This is perhaps unsurprising in light of the fact that it is the closest to Birmingham city centre of the major public parks. The increase in tree canopy cover is clear in Figure 5.22, indicative of tree maturation, or decreasing arboricultural management, or both. Increased tree canopy cover and tree average age enhances provisioning and regulating ecosystem services (Chapter 1.6), perhaps at a small cost to cultural ecosystem services, since observation would suggest that recreational use is greater for open parkland than for closed canopy thickets in parks.

### **5.8 Priory Tennis Club**

Like several other fringe-belt sites in south-west Birmingham, Priory Tennis Club underwent its development with the support of Calthorpe Estate (Cannadine, 1980). The main transformation consisted of the change from the existing grassy areas to buildings (including the club house, opened in 1926) and tennis courts. A large amount of the green space (41%) was converted into the tennis courts (30%) and buildings (11%) over the study period.

As is evident in Figure 6.23, the number of tennis courts has increased gradually. The first four courts were built in 1888 (Cole, 1875). Prior to 1915, the coverage of sports fields was only 7% (Figure 5.23). Between 1920 and 1926, the number of courts

increased to 21 (Cole, 1875), increasing further to 23 by 1964 (Cole, 1875). This is reflected in Figure 5.23, which shows an increase in space occupied by ‘sports fields’ (almost entirely tennis courts) in the northern part of the site between 1915 and 1945 and in the north-western part between 1945 and 1995 (Figure 5.23).

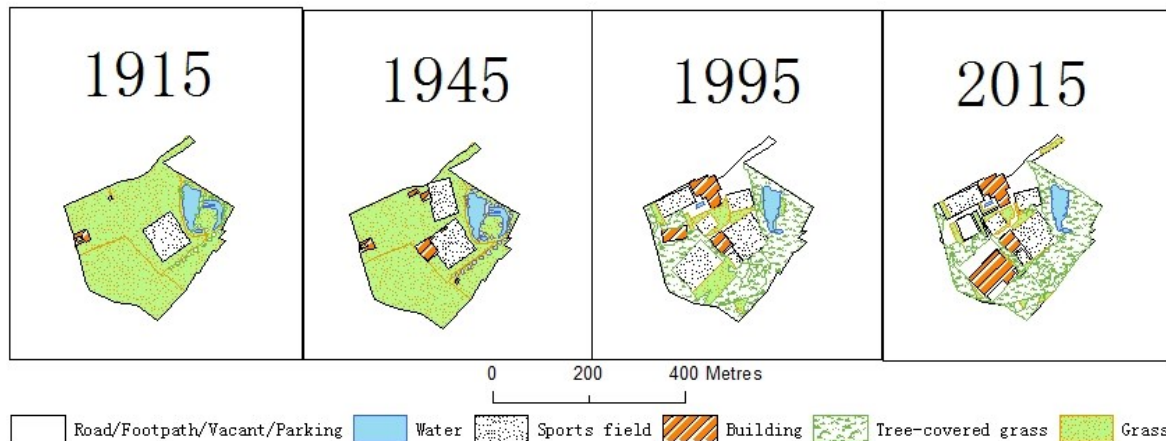


Figure 5.23. Types of surface in 1915, 1945, 1995, and 2015 in Priory Tennis Club. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

In addition to the increasing number of tennis courts since 1915, the number of buildings has also increased. In total, 11% of green space was converted into buildings after 1915, with the clubhouse opening in 1926 (Cole, 1875). The area covered by buildings increased by 0.5 ha (Figure 5.23). In June 2012, a new six-court indoor tennis centre was opened (Cole, 1875). Part of the south-west area of the site had been developed with buildings by 2015. These new developments have been funded by a £12 million building programme (Cole, 1875). From 1915 to 2015, the topography of the site has remained the same, but the types of surface have changed dramatically (Figure 5.23). As for the golf club and the South Birmingham parks, tree canopy cover has increased, bringing with it enhancements in biodiversity, and regulating ecosystem services.

## 5.9 Tally Ho Grounds

Judging by the Ordnance Survey plan surveyed in 1887, the site of Tally Ho Grounds was still farmland at that time. By the time of the Ordnance Survey plan that was surveyed in 1914, the Tally Ho Grounds already existed and included a ‘tennis ground’ and ‘bowling green’, although the Edwardian Mill farmhouse remained on the site. During the inter-war years the site, leased from the Calthorpe Estate, was already embedded in the built-up area. As in the case of a number of such sites, by the time that a housebuilding boom was developing in the 1960s more extensive development seemed a logical outcome. There ensued between the early 1970s and the early 2000s discussions of over 20 more intensive potential developments, many of which gave rise

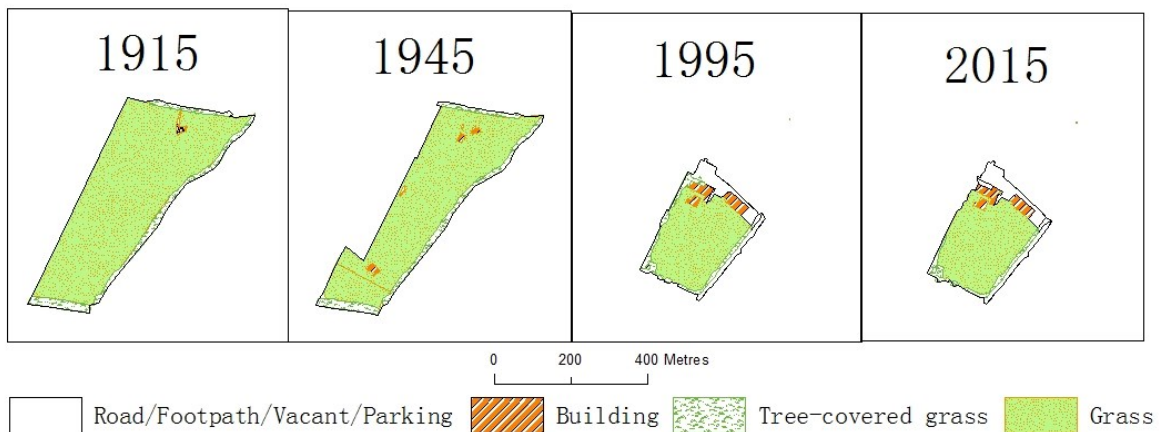


Figure 5.24. Types of surface in 1915, 1945, 1995, and 2015 in Tally Ho Grounds. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

to actual planning applications. In 1982 the tennis club decided that the increased ground rent required by the Calthorpe Estate was too great to sustain, and an agreement was entered into with the Priory Tennis Club whereby members transferred to that club (personal communication from long-term Tally Ho member, M. F. Tanner). Thereafter, a series of planning applications or discussions of potential planning applications ensued

for increasingly intensive redevelopments of parts of the site (Whitehand and Morton, 2004, pp.280-281). In the course of these lengthy discussions large parts of the Tally Ho Grounds remained practically derelict. Ultimately the northern part of the site became alienated from the fringe belt and was occupied by a multi-storey apartment block.

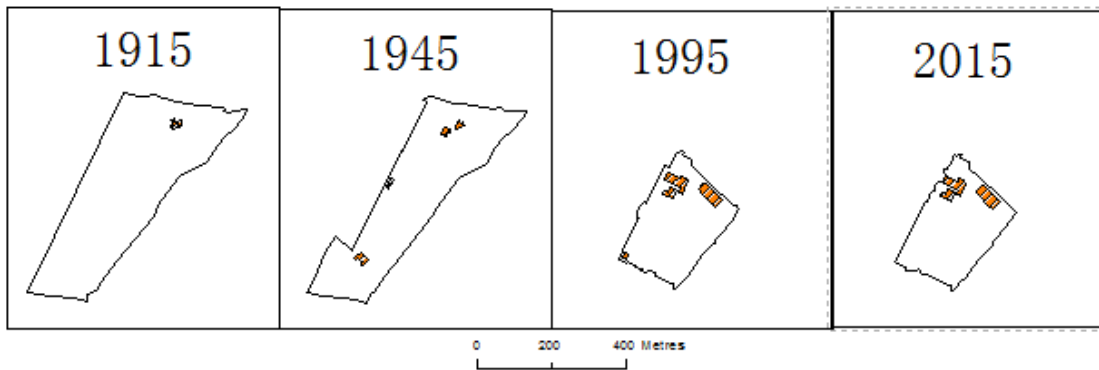


Figure 5.25. Buildings in 1915, 1945, 1995, and 2015 in the Tally Ho Grounds. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

The salient changes in terms of types of surface during the course of the history of the site are shown in Figures 5.24 and 5.25. Only small areas of the site were covered by buildings until the latter part of the twentieth century. The large majority of the site was — and remains — grass covered, including narrow fringing borders of tree-covered grass just inside three of the boundaries. The Tally Ho site now contains the only substantial grass-roofed building in the Edwardian fringe belt in south-west Birmingham. Building to support a grass or green roof is more expensive than conventional roofing, demonstrating the value attached to green space in this area.

### 5.10 Comparison of fringe-belt sites

Figures 5.26-5.29 show for all the fringe-belt sites the changes over time in the percentages of the sites that were covered by buildings, other hard surfaces, soft surfaces and water. As shown in Figure 5.26, the percentages of sites covered by

buildings in the Battery Site, Birmingham Botanic Gardens, Cannon Hill Park and Edgbaston Golf Course changed very little. However, there was a steep rise in the percentage of building coverage in the other five fringe-belt sites. There was little change in the percentage of other hard surfaces in the Edgbaston Golf Course and Highbury Park sites, whereas there was a steep rise in this percentage in the other seven fringe-belt sites after 1945 (Figure 5.27). The percentage of soft surface has remained almost unchanged in both Edgbaston Golf Course and Highbury Park. In contrast, there has been a gradual decrease in the percentage of soft surface in Cannon Hill Park and a marked decrease in the other five fringe-belt sites (Figure 5.28). Edgbaston Golf Course is the only site to have had a significant decrease in its area of water between 1915 and 1995, although this was followed by a slight increase, 1995-2015.

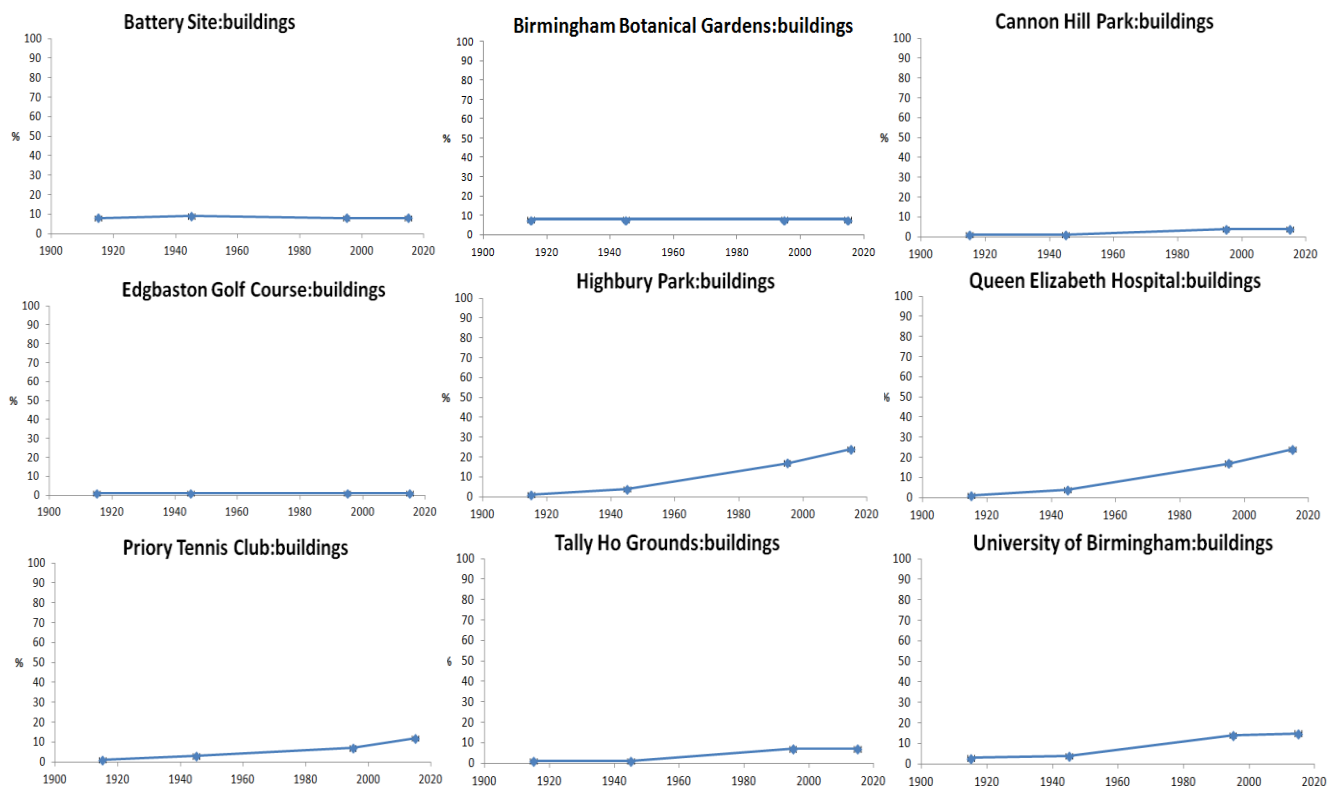


Figure 5.26. Percentage of buildings over time on 9 fringe belt sites. Sources: OS plans surveyed in 1915, 1945, 1995 and 2015, NERC Image, 1995, Google Earth Image, 2015.

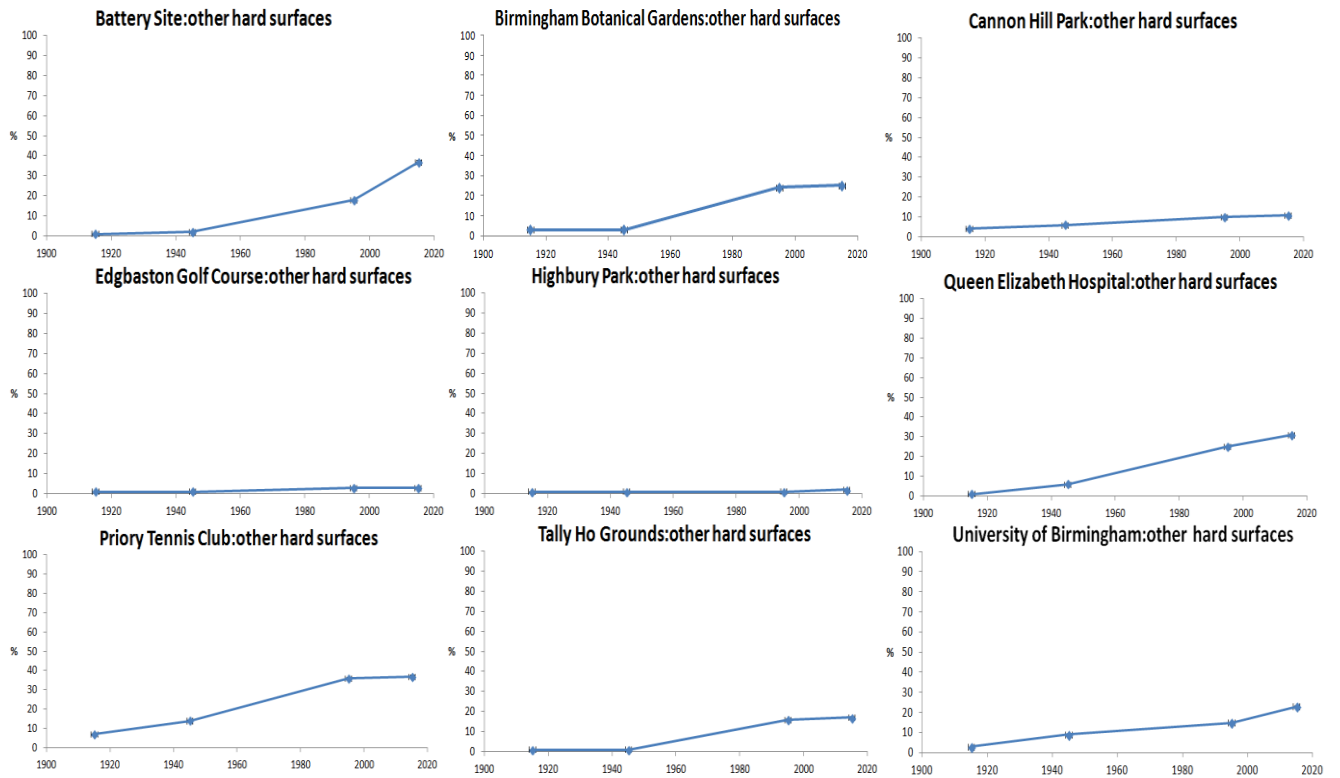


Figure 5.27. Percentage of other hard surfaces over time on 9 fringe belt sites. Sources: OS plans surveyed in 1915, 1945, 1995 and 2015, NERC Image, 1995, Google Earth Image, 2015.

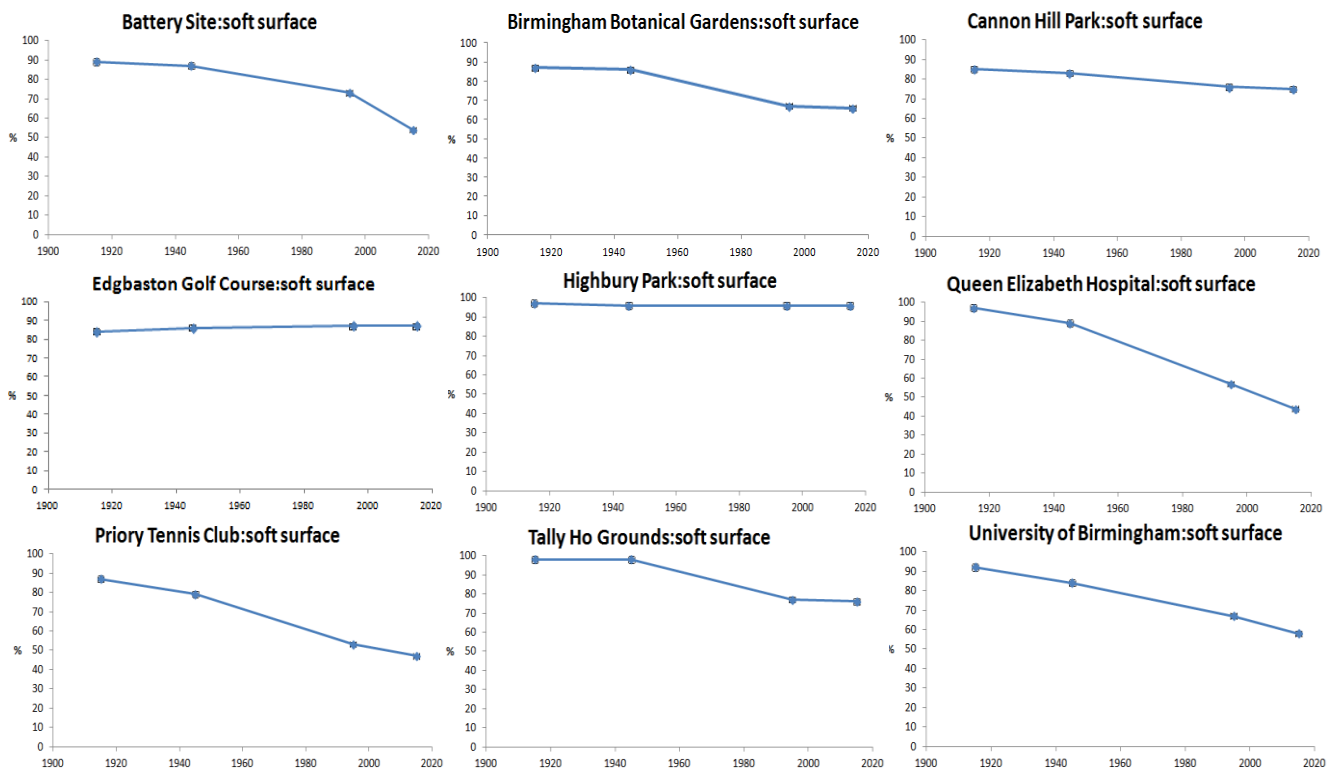


Figure 5.28. Percentage of soft surface over time on 9 fringe belt sites. Sources: OS plans surveyed in 1915, 1945, 1995 and 2015, NERC Image, 1995, Google Earth Image, 2015.

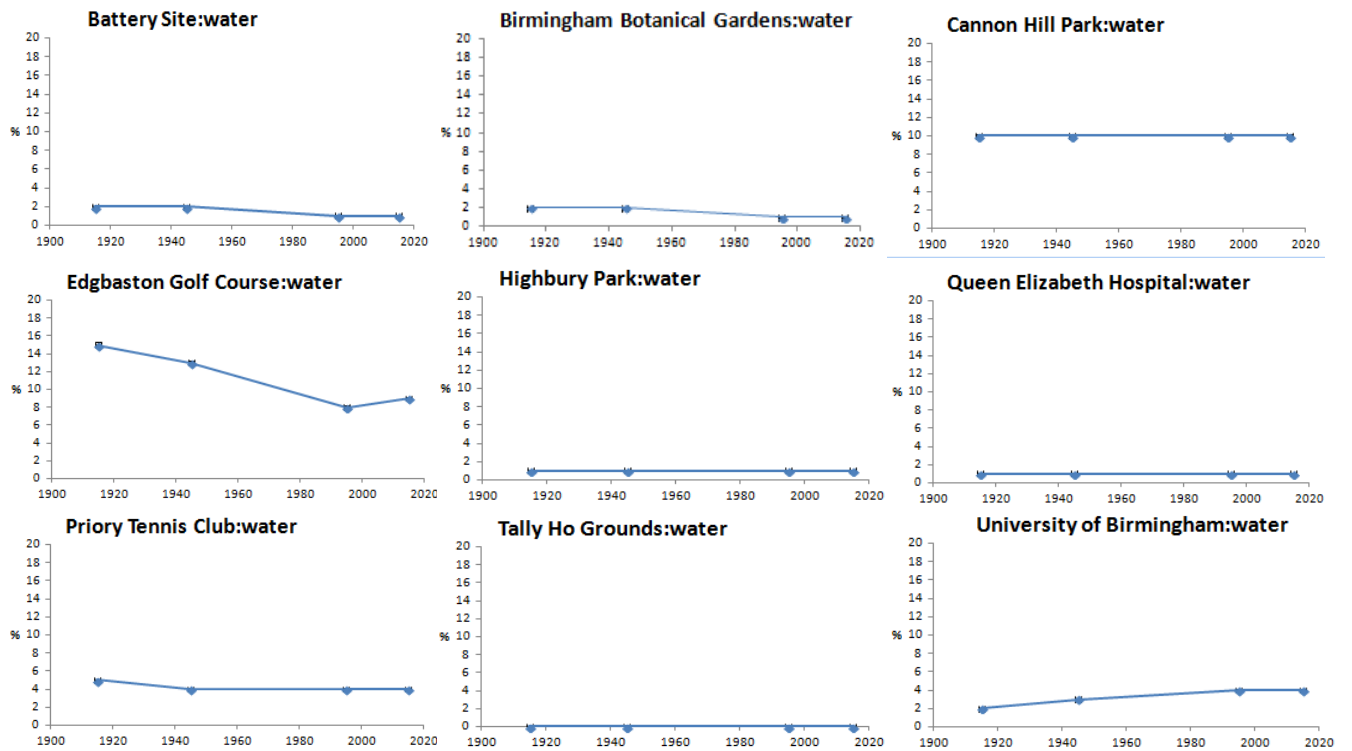


Figure 5.29. Percentage of water over time on 8 fringe belt sites. Sources: OS plans surveyed in 1915, 1945, 1995 and 2015, NERC Image, 1995, Google Earth Image, 2015.

The nine sites considered in this chapter were chosen to represent the major types of land use occurring in the south-western part of Birmingham’s Edwardian fringe belt. In all cases the land uses they represent have survived, though in varying ways, for over a century. Some have survived only partially, as parts became alienated for housing; some sites have expanded into adjacent sites, often incorporating what was previously private housing. In all cases the different types of surfaces of which the sites are made up have changed to some degree, nearly all having increased their amount of hard surface at least in small ways as they have become increasingly deeply embedded within the urban area. Standing somewhat in contrast to this, however, are the increases in tree-covered-grass evident in most sites, indicative of enhanced biodiversity and regulating ecosystem services albeit in smaller green areas. The process, inasmuch as it is evident from the analysis presented here, is of *intensification* of ecosystem service

provision as the landscape evolves from estate parkland to embedded fringe belt. It is not possible to deduce from this analysis whether the intensification leads to an overall increase or decrease in ecosystem service provision, but the present analysis does at least provide a historico-geographical perspective from which such hypotheses can be generated.

Just as the function of urban green infrastructure is highly dependent on its built-environment setting, it is evident from the consideration of fringe belts so far, both in more general terms and in the examination of individual sites in this chapter, that to understand the significance of fringe belts within the wider urban structure entails examination of that wider framework, especially its physical composition. The most extensive part of that framework is its residential areas, and it is to these that the next chapter is devoted.

## Chapter 6. Residential areas

In this chapter, an examination of the physical characteristics of residential areas contextualises the analysis of fringe belt sites in the previous chapter and provides the basis for a subsequent synthesis. First, previous work on residential areas is considered. This provides the background to an examination of 8 sample residential areas in south-west Birmingham: 3 closer to the city centre than the Edwardian Fringe Belt and 5 farther out.

The characteristics of the principal house types are considered in chronological order, summarizing the main types of change over time that previous work suggests they have undergone. In focusing subsequently on the 8 sample residential areas, particular attention is given to variations in the amount of change between 1915 and 2015.

### **6.1 Chronologies of change: studies of historical periods and types of residential development**

Much has been written about British house types (Whitehand *et al*, 2013, p.10), albeit comparatively little on the contributions that private gardens make as green spaces. In almost all of England, development from the burgage blind-back to the back-to-back to the back-wing terraced house (1875-1918) to the semi-detached house (1919-1945) can be interpreted as a progression. Each of these different house types has particular amounts of green space (or lack of green space) associated with it. The number of houses of the first two types that were constructed diminished to close to zero after c.1875. The back-wing terraced house was, broadly speaking, the

predominant type constructed between 1875 and the First World War, after which the semi-detached house predominated until the mid-1950s (Whitehand *et al.*, 2013, p.10).

### *Nineteenth-century house types*

The earliest form of nineteenth-century housing in England was based on an adaptation to an existing elongated and narrow plot type: the medieval burgage (Conzen, 1960). The house of the burgher was at the head of the plot, facing the street. Blind-backs were constructed piecemeal behind this building along the length of the plot. The related back-to-back house (Figure 6.1) was subsequently produced in various types of layout (Whitehand and Carr, 1999a, p.1662). Though it was produced in large numbers in Birmingham, there are almost no survivals of this house type in that city today. The back-wing terraced house superseded the back-to-back house. This was often

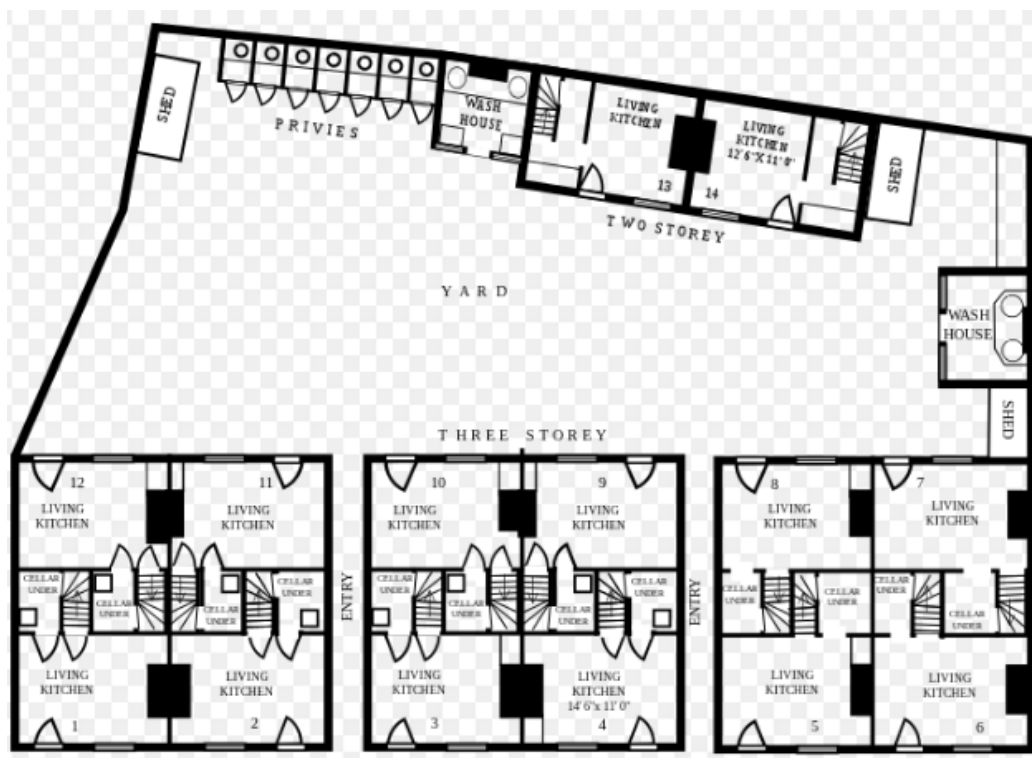


Figure 6.1. An example of back-to-back houses; source: photograph by Clem Rutter

referred to as the ‘bye-law terraced house’ and was reproduced in near-standard form in urban extensions throughout England. “The semi-detached house had antecedents in the pairs of back-wing houses that were built in increasing numbers in the late-Victorian and Edwardian period” (Whitehand *et al.*, 2013, p.10).

Negligible green space was characteristic of back-to-back housing (Whitehand *et al.*, 1999). The spaces that were not built on were almost entirely yards with hard, impermeable surfaces. Trees were almost entirely absent.

Following the Public Health Act of 1875, local authorities implemented various building regulations, including most notably those relating to the spacing of buildings. Late-Victorian back-wing terraced houses were by far the commonest attempt to comply with these regulations (Figure 6.2). Even the highest density examples of this type of layout tended to have a little soft surface, at least in the tiny garden at the rear of the houses. In the case of the lowest-density back-wing houses that were built in the Edwardian period, trees in the footpaths bordering the streets were not uncommon.



Figure 6.2. Late-Victorian back-wing terraced houses (photograph 1995; Ordnance Survey 25 Inch Plan revised 1914). Reproduced from Whitehand, 1996, p. 231).

### *The inter-war period*

The road patterns, building styles and architectural styles of the inter-war period are largely distinct from those in the period before the First World War. The year 1918 tends to be recognized as the beginning of a new morphological period (Whitehand and Carr, 1999c, p.231).

Semi-detached houses were the predominant house type constructed in England in the inter-war period and Birmingham was no exception (Whitehand and Carr, 1999c, p.230). A great change in national housing policy at the end of the First World War led to central and local government becoming involved in large-scale housing provision for the first time (Carr and Whitehand, 1996, p.279). Local-authority housing, widely known as 'council housing', consisted of a large proportion of short terraces, a terrace of four dwellings being the most widespread. The provision of green space, both grass and trees, was characteristic of the period in the housing provided both by private builders and local authorities (Whitehand and Carr, 1999b, p.483; Whitehand, 2001). During the inter-war period, in Birmingham, the numbers of council and privately-built houses constructed were broadly similar. The 1920s were dominated by council house building, but after the beginning of the 1930s, the pace of this building fell sharply (Carr and Whitehand, 1996, p.279). The construction of garages attached to or close to houses had already begun in areas of detached houses by the 1920s. By the end of the inter-war period such garage building was already occurring in areas of private-enterprise semi-detached houses. However, the inter-war period was one in which the provision of soft surfaces was on average significantly greater than in the period before the First

World War.

*The post-war period*

After the Second World War, high demand and the need for new housing led to sites being developed by local authorities and private developers both within existing urban areas and within and beyond the zone of inter-war suburbs. Flats were constructed in large numbers for the first time in major English cities, though the number of dwellings of this type constructed in Birmingham was still fewer than other types (Whitehand, 1996, p.279). Also evident on a significant scale in the late-1950s and 1960s was the ‘densification’ of more spacious existing areas of detached houses by the subdivision of gardens for the construction of additional houses (Whitehand and Carr, 1999a, p.1661).

*Factors influencing change*

The last quarter of the 19th century had presaged the demise of the compact city after 1918. In the inter-war period, builders embraced the garden-suburb ethos. This contributed to major changes to British cities (Whitehand and Carr, 1999b, p.498). Figure 6.3 shows the street pattern proposed for a housing estate in 1910 and the actual pattern implemented in that same area in 1928. The amount of space occupied by street surfaces in the actual layout of the inter-war period was only about 70 percent of that proposed in 1910 at the end of the Edwardian period. The ethos of the inter-war period, so obviously evident in the Tudor Walters Report, was one of spacious living. The early

post-war years in contrast re-introduced the idea of the compact city but in a very different form from its manifestations before the First World War.

The associated physical changes in different types of residential area associated with the changing fashions in terms of, for example, plot patterns and dwelling densities require analysis (Cherry, 1994).

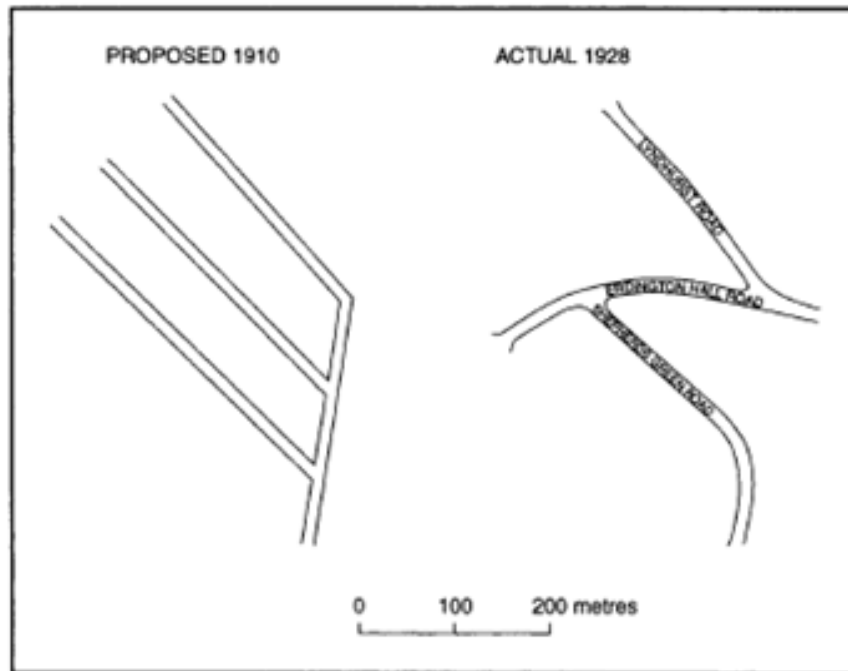


Figure 6.3. Proposed and actual street systems in part of the Gravelly Hill area, Birmingham. Sources: Lloyd George Finance (1909-10) Act, 1910, Ms plan (Birmingham Central Library); Ordnance Survey 1: 2500 plan, revised 1961/63; and local authority building records (Birmingham Central Library). Reproduced from Whitehand and Carr (2001, p.60).

### *The significance of green space*

Even the most cursory reconnaissance of the main types of residential area in British cities reveals major variations in the amount of green space. To examine these variations in detail and aid representative coverage, it is important as far as practicable to identify sample areas that are representative of the main types of residential area.

Previous studies have tended to focus on the physical form of architectural or other

changes to houses. There is a lack of knowledge of the back gardens of houses, and even the green spaces located in front of the houses and those located along the road have rarely been mapped systematically even for a single point in time.

To comprehend the morphological periods that have characterized British cities over the past 200 years, it is necessary to appreciate the social and economic context. In England, until the mid-19th century, “most working-class housing had involved communal sharing of not only the space in the vicinity of each dwelling but also basic services, such as latrines and water supply.” (Whitehand *et al.*, 2013, p.7). However, although such aspects as communal sharing of water supply have been explored, little attention has been given to cultural ecosystem services and the benefits that green spaces can bring.

Much attention has been drawn by urban morphologists to physical changes to buildings (Whitehand and Carr, 1999a; Larkham and Adams, 2017; Adams and Larkham, 2016). However, spatial analysis of green spaces has largely been undertaken by urban ecologists with little reference to the historical development of urban built form. Changes in the amounts and effects of roadside trees and front gardens have attracted little attention from urban morphologists. This gap in knowledge needs to be filled.

## **6.2 Analysis at the micro-scale of sample residential areas**

The eight sample residential areas in south-west Birmingham were selected to be, as far as practicable, representative of house types constructed in south-west Birmingham over the period of a little over 100 years between the mid-nineteenth

century and the early years after the Second World War (Figure 6.4). Most of them are fairly close to the Edwardian fringe belt, either closer to the city centre than the Edwardian fringe belt or a little farther out. Each is 250m by 250m in size. In terms of the principal house types of their original construction they are Early-Victorian detached, mid-to-late Victorian terrace, mainly Late-Victorian and Edwardian terrace, mainly Edwardian terrace, inter-war council, inter-war semi-detached, inter-war detached, and 1960s flats and terraces. Changes over time, concentrating principally on the various types of hard and soft surface, have been analyzed so as to provide the basis for comparison with the fringe-belt sites previously considered. Four cross-sections in



Figure 6.4. Eight 250m x 250m sample residential areas in the vicinity of the south-western part of Birmingham's Edwardian Fringe Belt. Samples are representative of (A) Early-Victorian detached; (B) Mid-to-Late Victorian terrace; (C) Mainly Late-Victorian and Edwardian terrace; (D) Mainly Edwardian terrace; (E) inter-war Council; (F) inter-war detached; (G) inter-war semi-detached; (H) Mainly 1960s flats and terraces. Source: OS plans of 1995.

time have been examined. The dates chosen (1915, 1945, 1995 and 2015) have been influenced principally by the availability of cartographic and photographic information. Not all sources used correspond exactly to these dates. In particular, Ordnance Survey plans surveyed just before the 1914-18 and 1939-1945 wars have been employed. The principal source for 1945 was an aerial photograph of that date, and for 1995, it was *Cities Revealed* high-resolution aerial photographic database, surveyed May 1995 (Geoinformation Group, Cambridge). The types of surface that it has been possible to identify for all four temporal cross-sections are buildings, roads/footpaths/vacant land/parking (collectively the hard surfaces) and grass and tree-covered grass (the soft surfaces).

Table 6.1. The main house types

<b>Periods</b>	<b>House types</b>
<b>Early Victorian</b>	<b>Detached</b>
<b>c. 1880 Mid-to-Late Victorian</b>	<b>Terraced</b>
<b>Mainly Late- Victorian and Edwardian</b>	<b>Terraced</b>
<b>Mainly Edwardian</b>	<b>Terraced</b>
<b>Inter-war</b>	<b>Council terraced</b>
<b>Inter-war</b>	<b>Semi-detached</b>
<b>Inter-war</b>	<b>Detached</b>
<b>Mainly 1960s</b>	<b>Terraced and Apartments</b>

### *Early-Victorian detached houses*

The area of Early-Victorian detached houses comprises a small part of an extensive area of the estate of the aristocratic Calthorpe family. The area was laid out in streets and plots and for the most part individual purchasers of plots commissioned houses to be architect built to various styles that were fashionable at the time. Roughly a century later, the broad distribution of plots and buildings as shown on the Ordnance Survey mid-twentieth-century plan had changed little. The dominant feature at each cross-section in time is the predominance of soft surfaces, initially mainly grass, but over time increasing amounts of tree-covered grass (Figure 6.5). However, by 1995 several of the original large plots had been subdivided and smaller detached houses

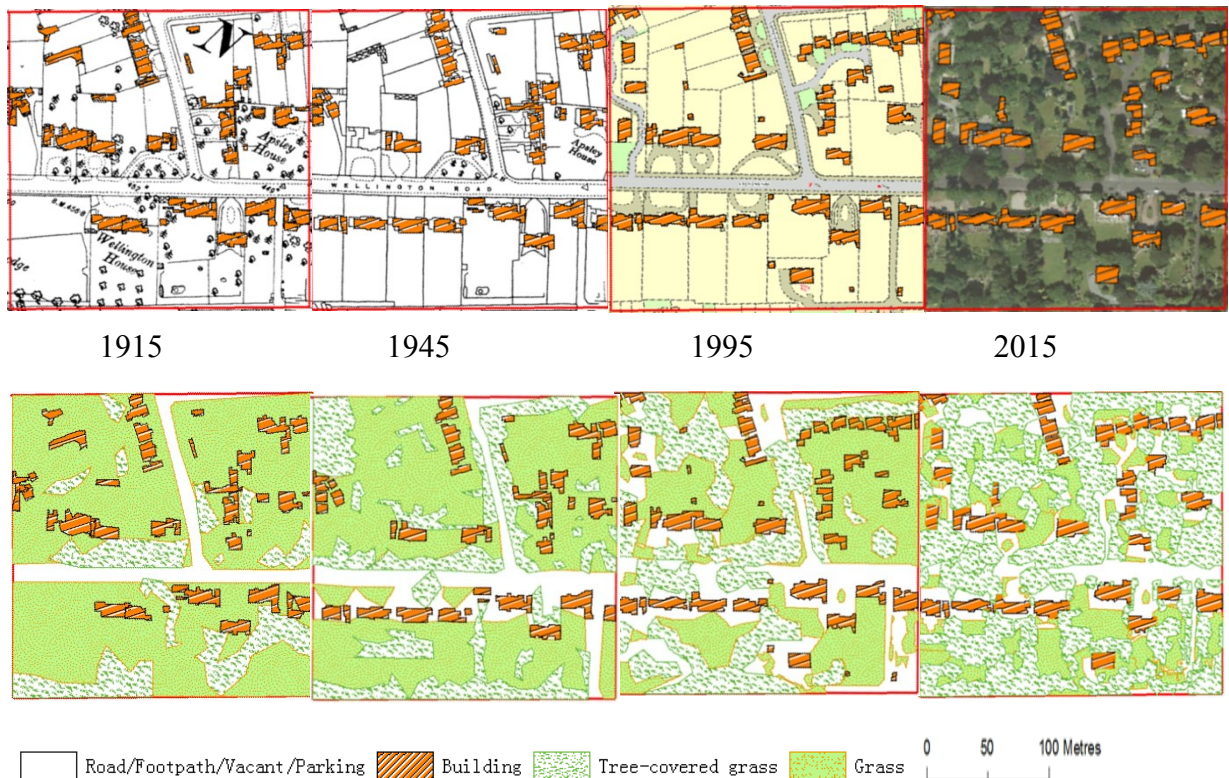


Figure 6.5. The distribution of buildings, grass and trees in an area of Early-Victorian detached houses in 1915, 1945, 1995 and 2015. Sources: OS plans of 1915, 1945, 1995 and 2015, Aerial photograph, 1945, NERC image of 1995, Google Earth Image of 2015.

constructed within the subdivisions. Because areas are calculated from maps, overlapping surfaces (for example, tree canopies overhanging buildings or tarmac) are not accounted for, so that the sum of hard and soft area equals the total surface area. The house style and size, as shown in Figure 6.6, is characteristic of a good deal of the wider area in which sample area is located. In this sample area the abundance of large woody plants appears to have increased fairly steadily since 1915.



Figure 6.6. 43 Wellington Road: (A) OS plan in 2015; (B) Front view of house; (C) Rear view of house (Source: a sold house from Rightmove)

### *Mid-to-Late Victorian terraced houses*

Nearly all the blind-back and back-to-back houses in Birmingham were demolished in the course of the redevelopment of much of inner Birmingham in the two decades after the Second World War. Many of the mid-to-late Victorian terraced houses were also demolished at that time. However, a number of areas of such housing still survive, and one of these, in the Sparkbrook area of inner Birmingham, is the second sample area. In virtually all respects it contrasts markedly with the sample area of early Victorian detached houses: in particular having large areas occupied by hard road



Figure 6.7. Distribution of buildings, grass and trees in an area of c.1880 Mid-to-Late Victorian terraced houses in 1915, 1945, 1995, 2015. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

surfaces and building footprints generally occupying more than half of the plots in which they are located (Figure 6.7). Where they exist, the front gardens are almost all too small to be decipherable at the scale of reproduction in Figure 6.7. A number of backward extensions of the original backwings were already evident in 1915. By 1995, there were many more small rear extensions, some extending to the rear boundary of their plots. However, tiny green spaces still survived in 2015 at the rear of about half of the plots, although by this time various types of hard surface had been added to these areas (Figure 6.7). Since street trees are totally absent, the public ecological value to be derived in this area is negligible (Figure 6.8).



Figure 6.8. 56 Wilton Road: (A) OS plan in 2015; (B) Front view of house; (C) Rear view of house (Source: a sold house from Rightmove)

*Mainly Late-Victorian and Edwardian terraced houses*

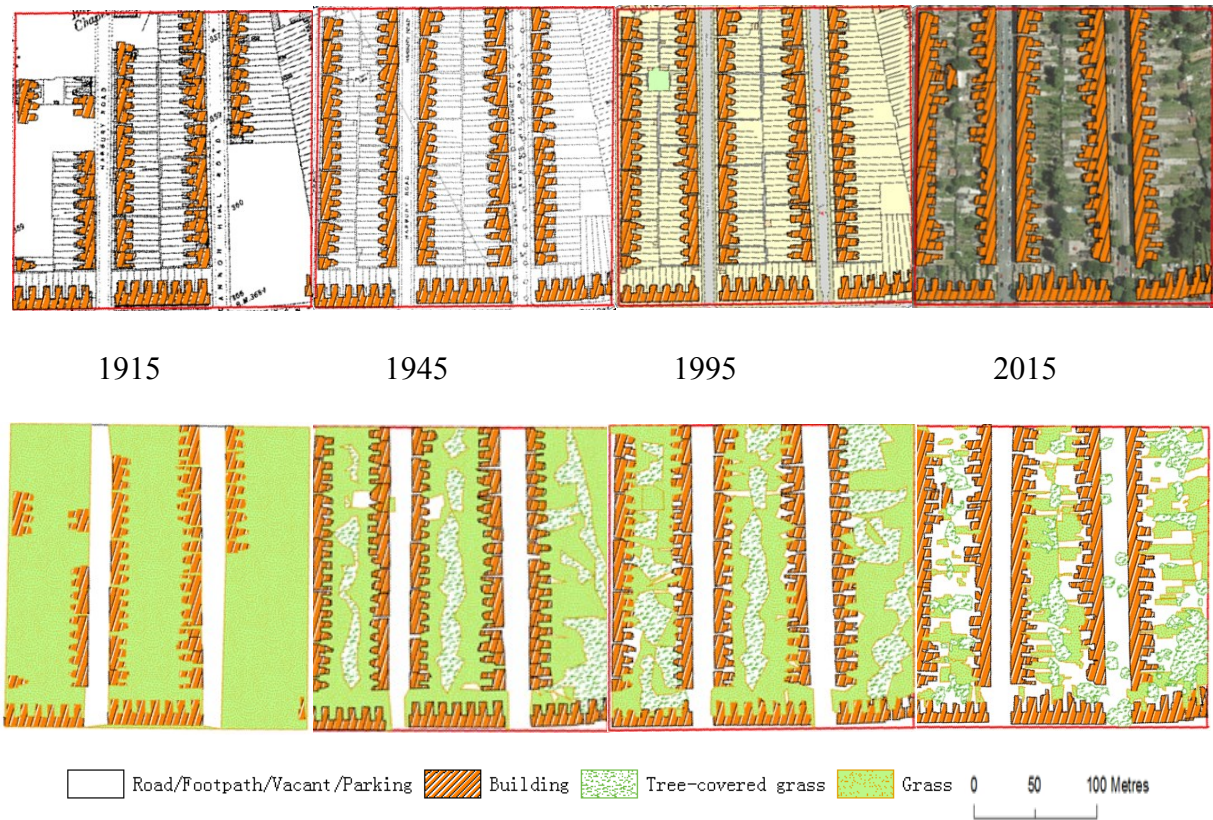


Figure 6.9. Distribution of buildings, grass and trees in an area of mainly Late-Victorian and Edwardian terraced houses in 1915, 1945, 1995, 2015. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

Though mostly slightly later in construction than the previous sample areas, this area has many of the same characteristics. This is consistent with the fact that, as far as small dwellings were concerned, in the period between the 1875 Public Health Act and the Tudor Walters Report of 1918 there were few changes in the predominant construction features. The most evident difference is the greater average length of the plots in this area (Figure 6.9). The same tendency for the amount of land covered by green space to diminish over time is evident. However, a higher proportion of soft surface has been retained in 2015 than in the previous sample area.

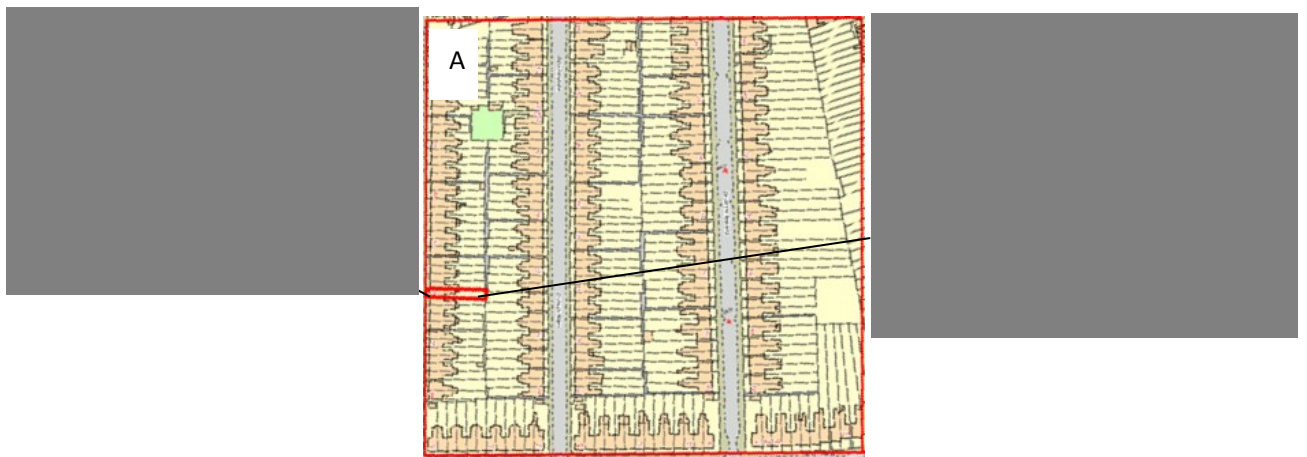


Figure 6.10. 60 Harbury Road: (A) OS plan in 2015; (B) Front view of house; (C) Rear view of house (Source: a sold house from Rightmove). Note front-garden shrubs and semi-mature trees in the back gardens.

#### *Mainly Edwardian terraced houses*

This sample area of mainly Edwardian terraced houses is slightly farther out than the Edwardian fringe belt and much farther out than the other residential areas so far considered. Its Edwardian origins reflect the fact that while the Edwardian Fringe Belt was still undergoing a strong formative phase, a scatter of initially separate peripheral settlements was already developing beyond the fringe belt. One of these was Selly Oak,

where this sample area is located. Despite its much more peripheral location than the sample areas so far considered, Figures 6.11 and 6.12 display many of the same characteristics as the comparable figures for the area of mainly Late Victorian and

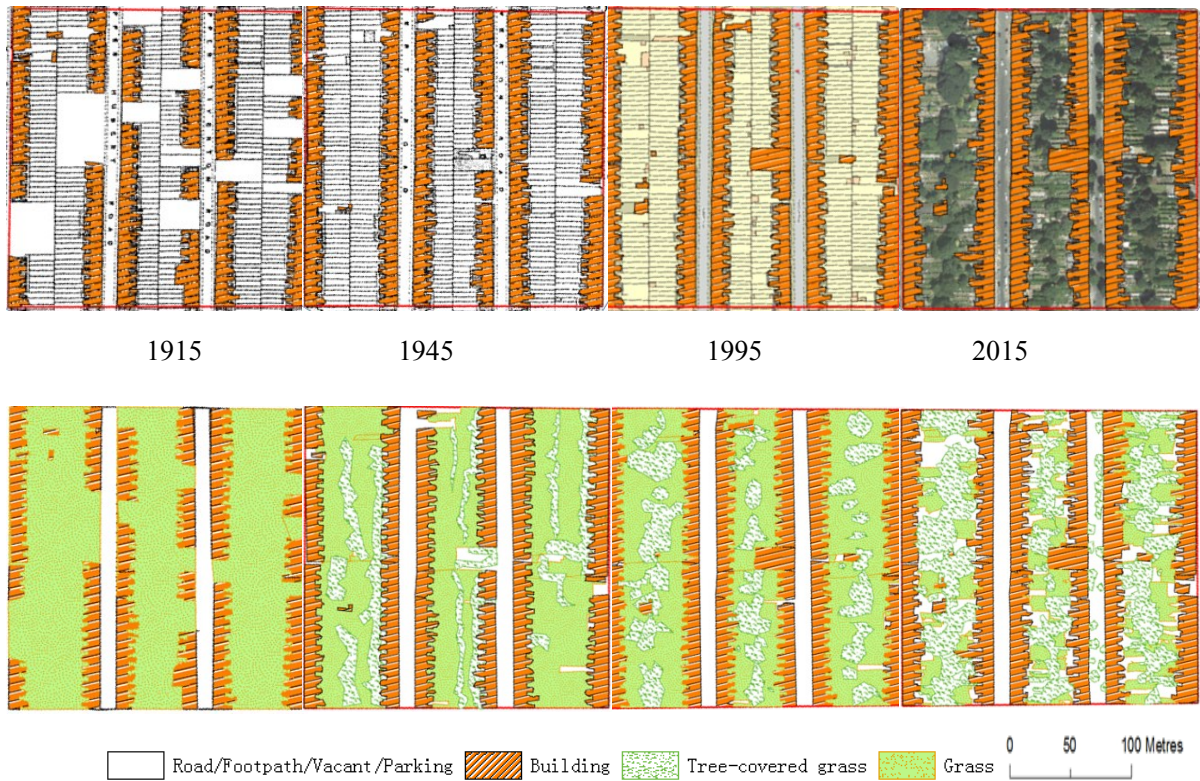


Figure 6.11. Distribution of buildings, grass and trees in an area of Edwardian terraced houses in 1915, 1945, 1995, 2015. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

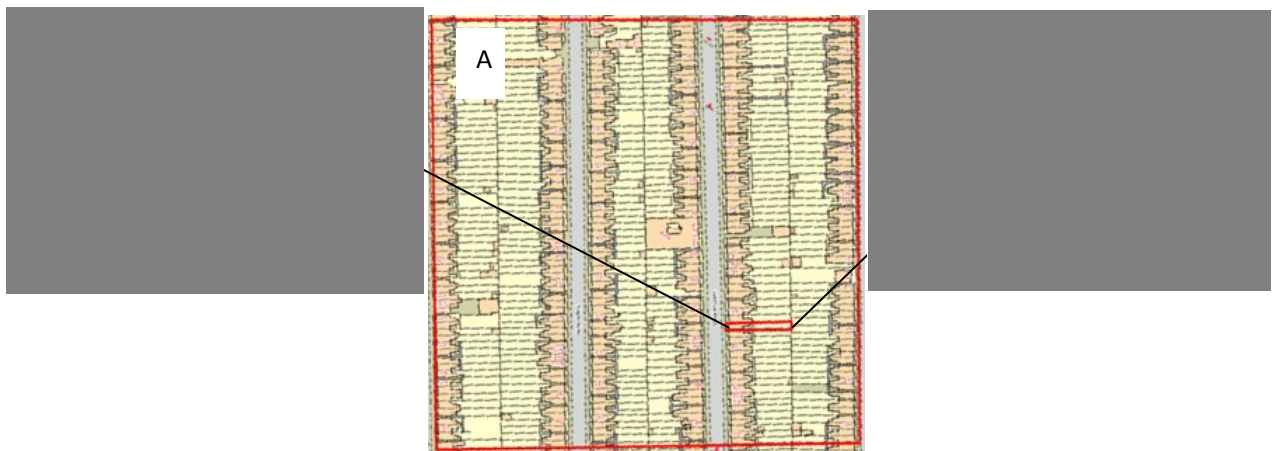


Figure 6.12. 299 Tiverton Road: (A) OS plan in 2015; (B) Front view of house; (C) Rear view of house (Source: a sold house from Rightmove). Note the presence of front-garden shrubs and indications of semi-mature back-garden trees at the edges of the back-garden view.

Edwardian houses, which is much closer to the city centre. However, a significantly larger amount of green space (both grass and tree-covered grass) is evident in the rear of the plots.

*Mainly inter-war Council terraced houses*

This area is comprised almost entirely of terraced houses built for the local authority in the inter-war period (Figure 6.13). Until recent decades, when a sizeable number were sold to their tenants, they were entirely let to people with quite limited financial means. The terraces are in units of four dwellings. In addition to the front door to each individual unit there is a central ‘tunnel’ providing access to the rear. The roads and plots are far more spacious than those in the residential areas previously considered,



Figure 6.13. Distribution of buildings, grass and trees in an area of inter-war Council terraced and semi-detached houses in 1915, 1945, 1995, 2015. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

with the one exception of the area of early-Victorian detached houses. Large amounts of green space have survived in the back gardens, as they have also in the very few inter-war semi-detached houses in the north-east corner of the area. This is almost certainly attributable to the fact that a large proportion of these houses were rented from the Council, which has exercised control over building extensions and the introduction of hard surfaces. However, there is a trend towards increasing amounts of hard surface, of which 108 Ashbrook road (Figure 6.14) is an extreme example.



Figure 6.14. 108 Ashbrook Road: (A) OS plan in 2015; (B) Front view of house; (C) Rear view of house. (Source: a sold house from Rightmove). Note the long front and rear garden spaces, now almost entirely given over to hard surface, although the rear-garden view shows extensive woody shrubs and mature trees outside the plot.

### *Inter-war semi-detached houses*

As in most English cities, semi-detached houses are the commonest inter-war house type. In Birmingham, unlike in most British cities, back lane vehicular access to the rear of the house plots (often to a garage) is quite common and is a characteristic of the selected area. As is generally the case in areas of semi-detached houses, the plots tend to be larger than those in areas of Victorian and Edwardian terraces. The curvilinearity of the roads is also a notable contrast to the rectilinear street patterns of

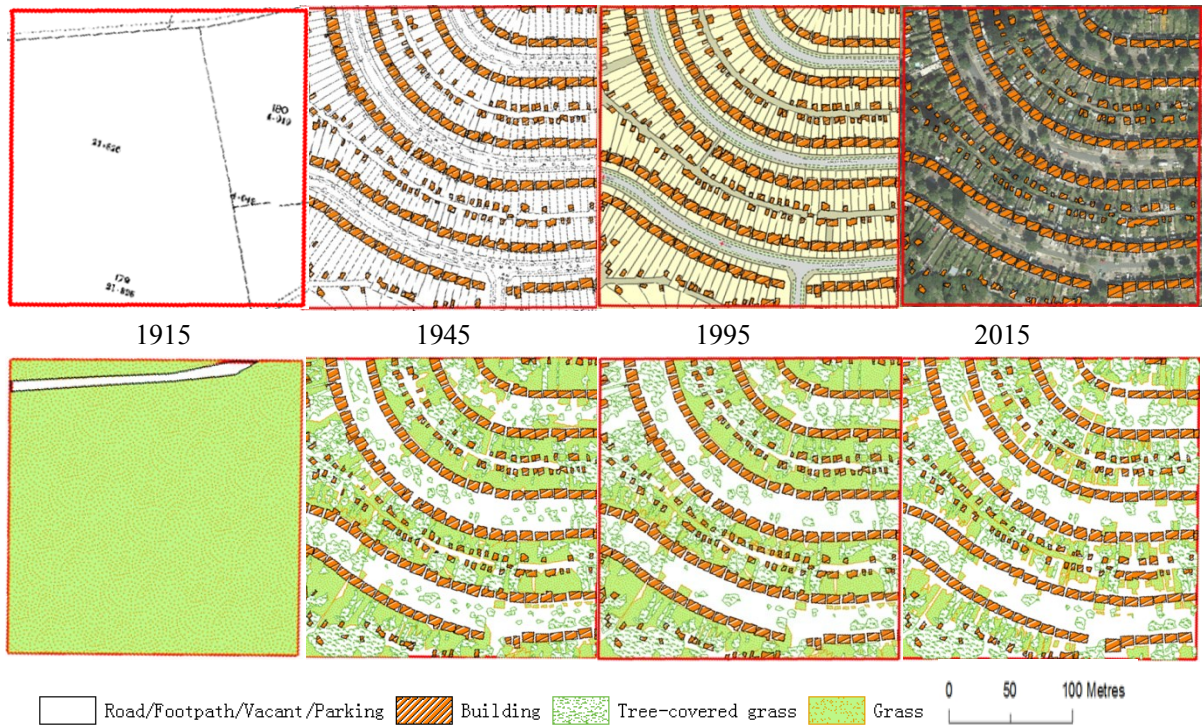


Figure 6.15. Distribution of buildings, grass and trees in an area of inter-war semi-detached houses in 1915, 1945, 1995, 2015. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

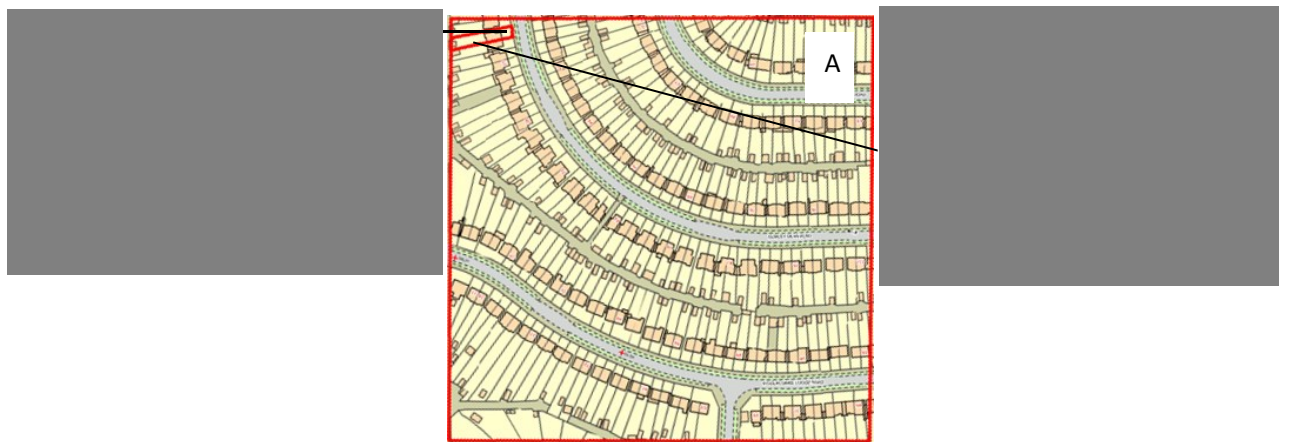


Figure 6.16. 21 Durley Dean Road: (A) OS plan in 2015; (B) Front view of house; (C) Rear view of house (Source: a sold house from Rightmove).

those areas (cf. Figures 6.9, 6.11 and 6.15). Another characteristic area of semi-detached houses more widely is the large amount of hard surface for car parking that has been added in recent years. What were in the 1930s, very largely front gardens predominantly characterized by grass and flower borders are now in many cases very largely,

sometimes entirely, hard surfaces (Figures 6.15 and 6.16). Amenity street trees are more evident in this housing type than in most others (cf. Figures 6.9, 6.11, 6.13 and 6.15).

*Inter-war detached houses*

The inter-war detached houses differ from the Early-Victorian detached houses (Figures 6.5 and 6.6) in several respects. Their plots are on average smaller, though larger than those of the inter-war semi-detached houses (Figures 6.15 and 6.16). Most have plain brick façades in contrast to the stuccoed façades of the Early-Victorian detached houses. Frequently, the houses have been extended and sizable parts of the front gardens have had hard surfaces added in recent decades (Figure 6.17). Figure 6.18 shows to an extreme degree both these changes, thereby significantly reducing the



Figure 6.17. Distribution of buildings, grass and trees in an area of inter-war detached houses in 1915, 1945, 1995, 2015. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.

ecosystem assets. However, as in this example, more generally rear gardens remain almost entirely as green spaces. There has been a marked increase in the amount of tree-covered grass in the rear gardens since the 1930s, many of the trees planted then, and subsequently, having matured by 1995. This change was even more evident by 2015.

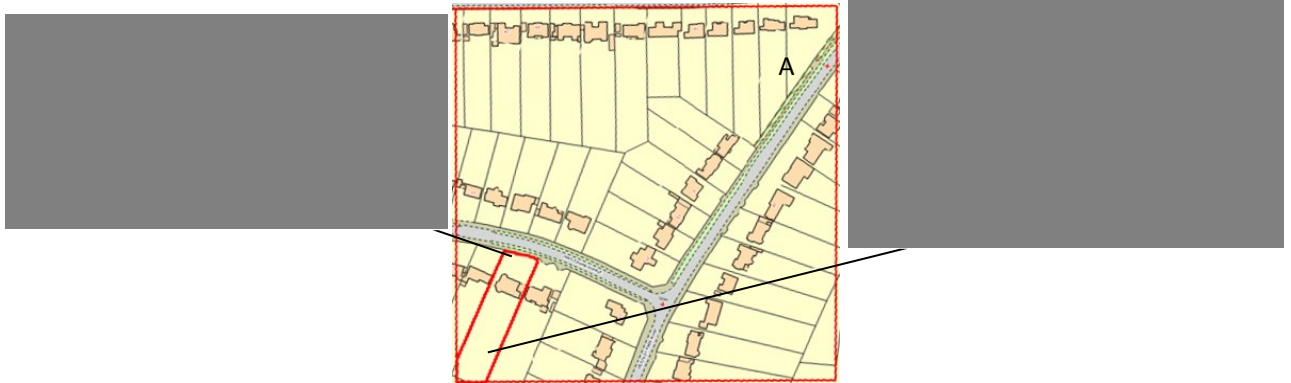


Figure 6.18. 8 Hintlesham Avenue: (A) OS plan in 2015; (B) Front view of house; (C) Rear view of house (Source: a sold house from Rightmove). Note the very large front garden, now given over to tarmac for car-parking, and the extensive rear garden, with semi- and mature trees and woody shrubs, predominantly restricted to plot boundaries (and, therefore, often blurring plot boundaries ecologically).

### *Terraced houses and apartments of the 1960s*

This sample area is an example of a type of development that occurred beyond the Edwardian Fringe Belt in relatively small patches of land that had remained as fields as late as the 1960s. It is largely comprised of terraced houses and apartments, although there are semi-detached houses in the southern parts of the area that are similar to types built in the 1930s (Figures 6.15 and 6.16). In the case of all the apartments, garage provision is in separate culs de sac behind the apartments. Most of the houses also have separate culs de sac of garages separate from the houses. If garage culs de sac are included, the length and amount of space devoted to roads is similar to that in the Mid-to-Late Victorian area. However, unlike in that area, the road pattern is curvilinear

rather than rectilinear and small green spaces are visible from the publicly accessible parts of the area.

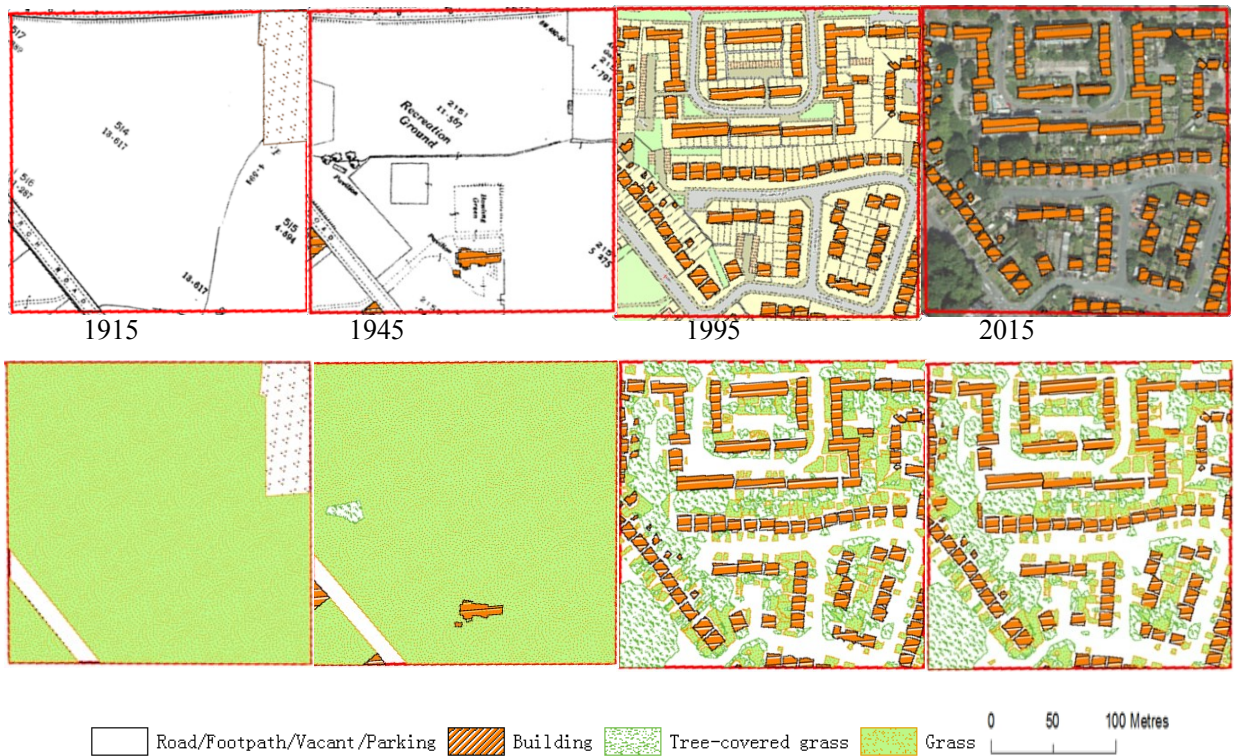


Figure 6.19. Distribution of buildings, grass and trees in an area of terraced houses and apartments of the 1960s, in 1915, 1945, 1995, 2015. Sources: OS plans of 1915, 1945, 1995 and 2015; Aerial photograph, 1945; NERC image of 1995; Google Earth Image of 2015.



Figure 6.20. 50 Fladbury Crescent and Apartment 120 Fladbury Crescent. (A) OS plan in 2015; (B) Front view of No. 120; (C) Front view of No.50; (D) Back view of No.50 (Source: a sold house from Rightmove)

*Changes in amounts of different types of surface over time*

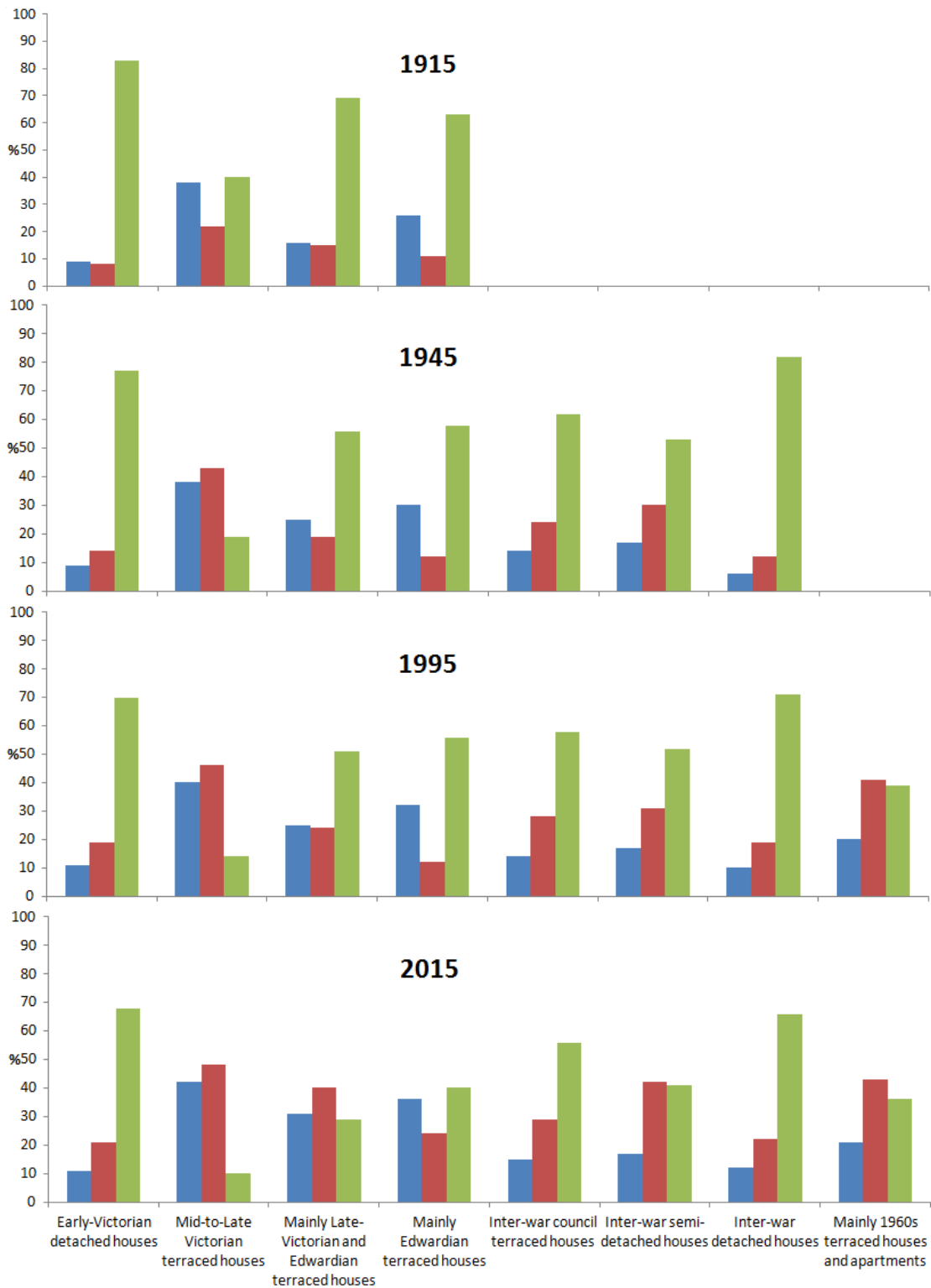


Figure 6.21. Percentage of different types of residential area covered by buildings, other hard surfaces and soft surfaces in 1915, 1945, 1995 and 2015. Sources: Google Earth image of 2015, aerial photograph 1945, OS plans of 1915, 1945, 1995 and 2015.

The percentages of each sample area occupied by different types of surface at each cross-section in time can be summarized diagrammatically (Figure 6.21). The main contrast in 1915 was between the detached houses and the three terraced types, the former having more than 80% of their areas covered by soft surfaces and the latter

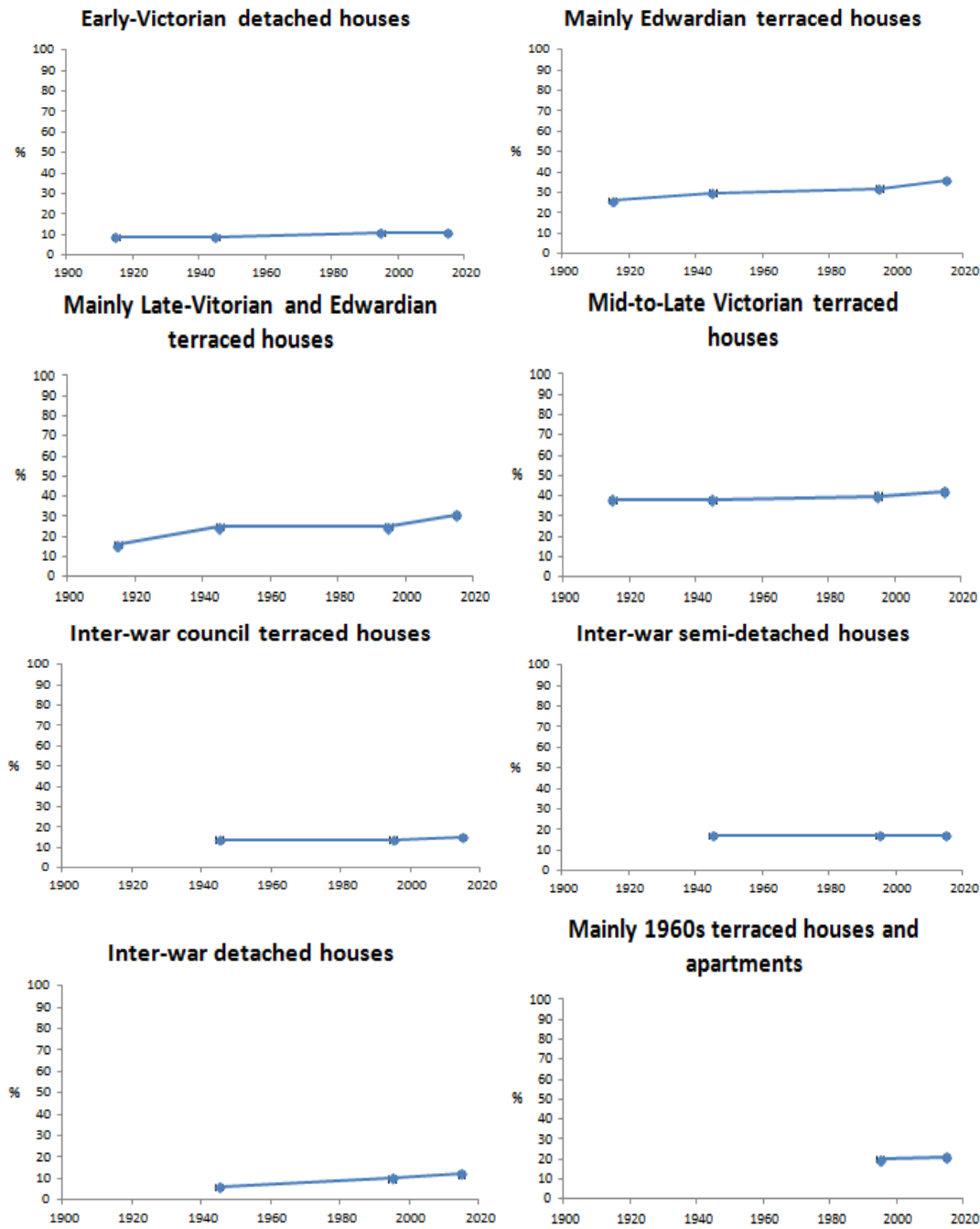


Figure 6.22. Percentage of area covered by buildings over time in 8 residential areas. Sources: OS plans surveyed in 1915, 1945, 1995 and 2015; NERC Image, 1995; Google Earth Image, 2015.

40-70%. All areas decreased their proportions of soft surfaces over time. By 2015, the percentage of soft surfaces in the area of Early-Victorian detached houses had decreased to 68% and in the area of inter-war detached houses to slightly lower. In other areas, the comparative percentage varied between 10% and 56%.

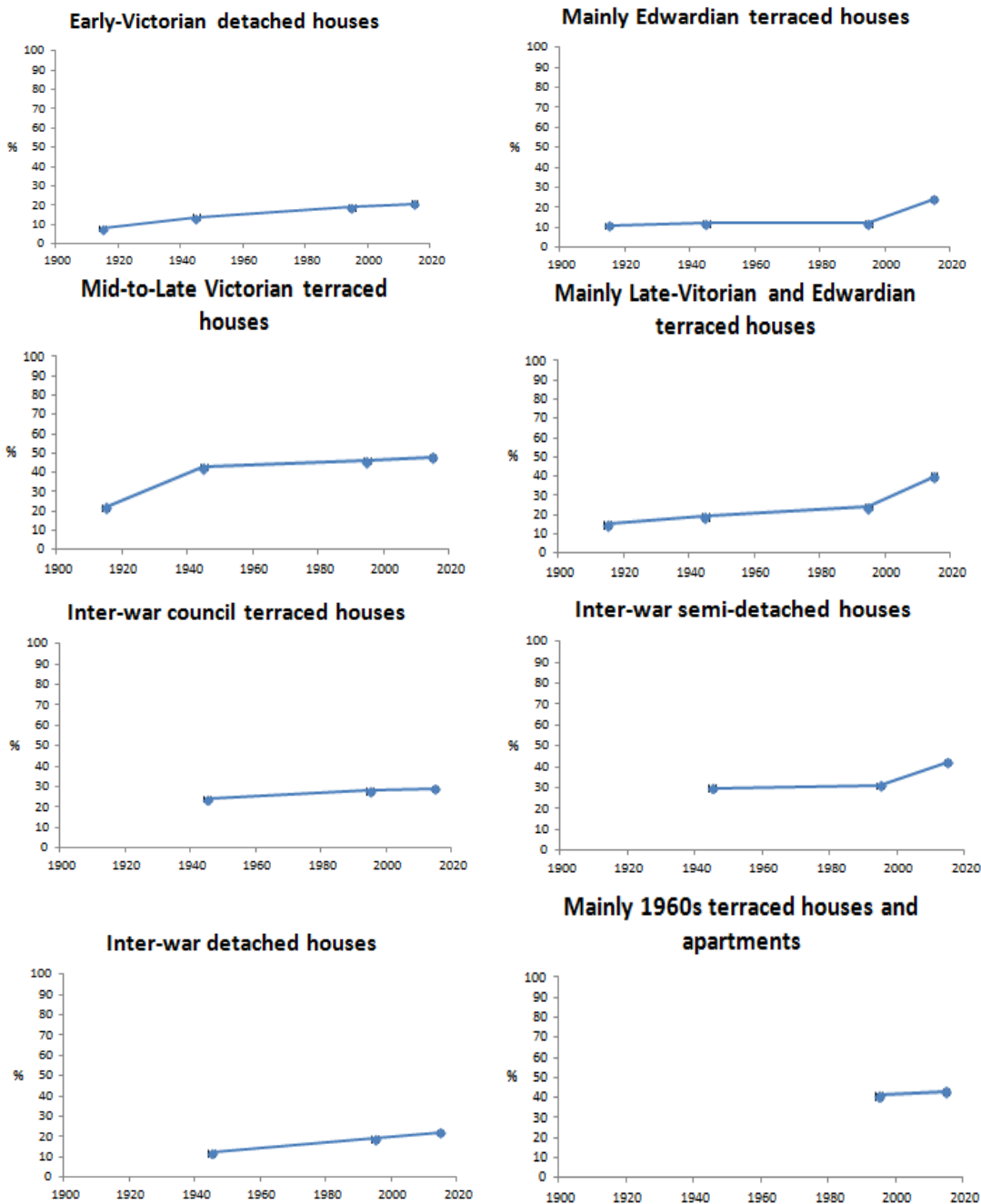


Figure 6.23. Percentage of other hard surface over time in 8 residential areas. Sources: OS plans surveyed in 1915, 1945, 1995 and 2015, NERC image, 1995, Google Earth Image, 2015.

The changes over time in the percentages of each residential area occupied by different types of surface are shown graphically in Figures 6.22 (buildings), 6.23 (other hard surfaces) and 6.24 (soft surfaces). There is an upward trend in the percentage of building coverage in all areas, although in the area of mainly inter-war council terraced

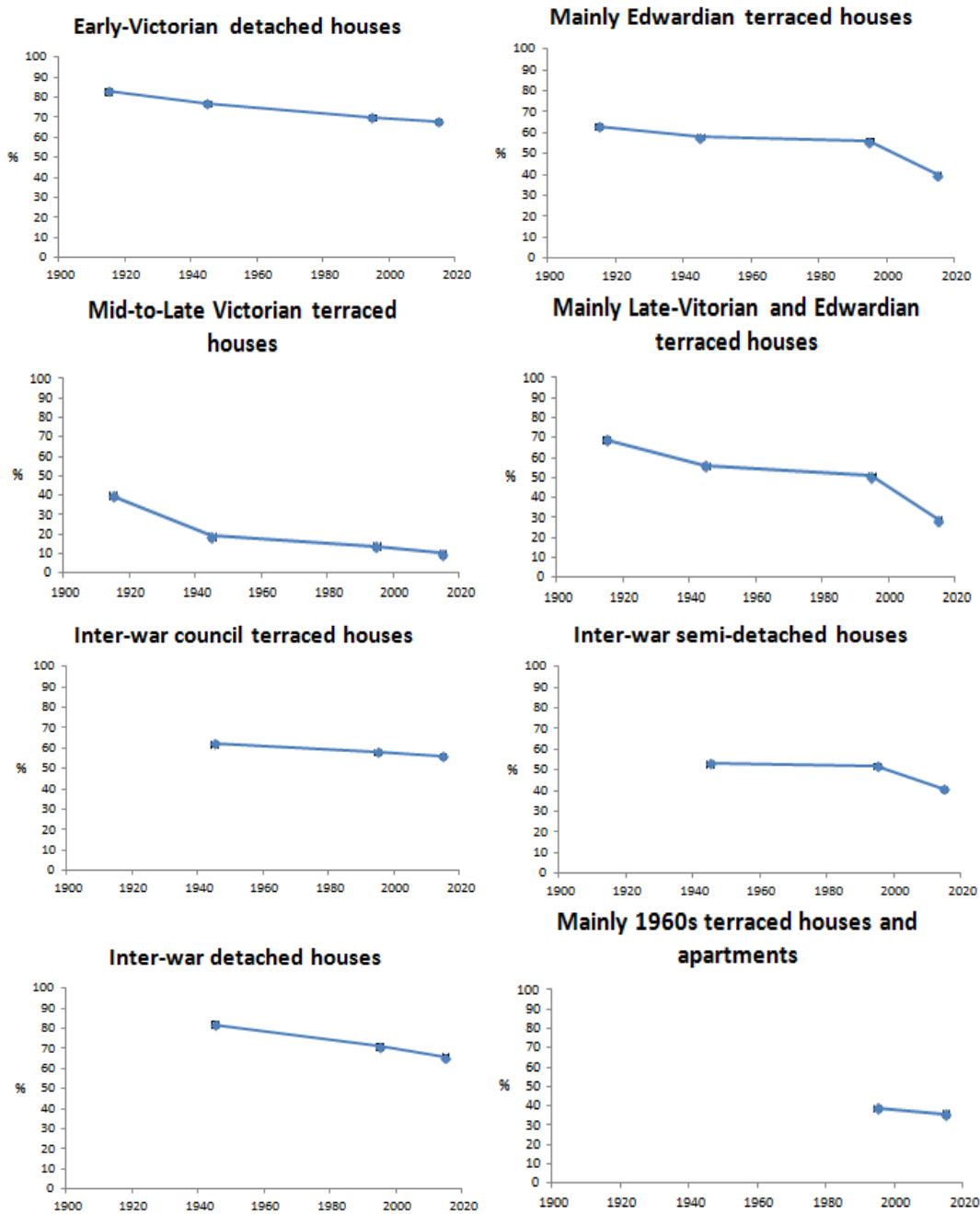


Figure 6.24. Percentage of soft surface over time in 8 residential areas. Sources: OS plans surveyed in 1915, 1945, 1995 and 2015. NERC Image, 1995, Google Earth Image, 2015

houses and the area of inter-war semi-detached houses it is slight. In the case of other hard surfaces, the upward trend is generally more pronounced. In the case of soft surfaces a decline in the percentage of the area covered is evident in all areas in all periods.

The findings of this chapter provide the basis for comparison with findings for the sample of fringe-belt sites. This comparison is undertaken in the next chapter.

## Chapter 7. Fringe-belt sites and residential areas

Despite the fact that fringe-belt studies have generally made a fundamental distinction between fringe belts and residential accretion, comparative examinations of the physical forms of these two types of urban areas have been relatively rare. In this chapter, a direct comparison is made of the samples of residential areas and fringe-belt sites in south-west Birmingham. Particular consideration is given to the configuration of plots, the changing character and distribution of green space, buildings and other hard surfaces, the influence on accessibility of different street patterns and forms of plot tenure, and variations in access to the benefits to be gained from green spaces.

### *Plot patterns*

The configurations of fringe-belt sites differ greatly from the plot patterns of residential areas. The contrast between the two types of plot in terms of size and shape

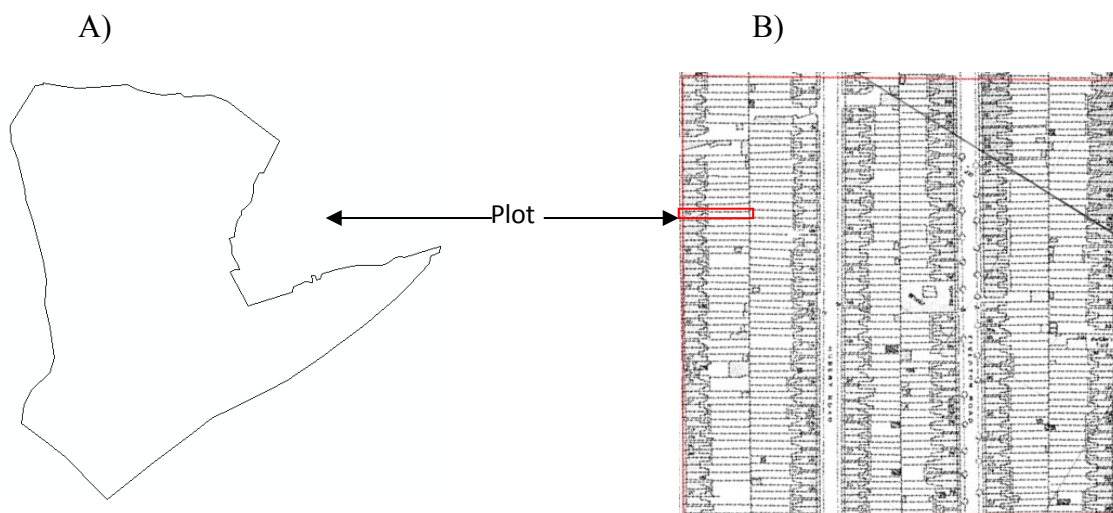


Figure 7.1. A) Example of fringe-belt site; and B) Example of residential area. Source: OS plans surveyed in 1945

is arguably one of the greatest contrasts in the layouts of cities, and south-west Birmingham is no exception. Figure 7.1 shows one of the most marked contrasts in that area.

Within south-west Birmingham, the plots within individual sample residential areas tend to be similar in shape and size: indeed within many areas, the plots are practically identical in these respects. The fringe-belt sites, in contrast, are highly variable in size and shape. In terms of their shapes over time, the fringe-belt sites tend to have changed somewhat more on average than the plots in the residential areas. This greater variability of the fringe-belt sites is to a major extent a reflection of the greater variation in the types of activity being undertaken within them, for example whether it be as containers of types of sporting activity or types of institution. It also relates to the extent to which the movements and accommodation of people need to be catered for. Heterogeneity is inherent in the very character of fringe-belt land and building uses. While it is also the case that no two houses and their gardens are identical, the range of practical possibilities for physical structures and the contents of any attached green spaces, particularly in private gardens, tend to be considerably less. Added to this source of difference there is the almost invariably significant difference between the ways in which fringe-belt sites and residential areas are maintained and, more often than not, brought into existence.

While much attention has been given to the conditions that favour the creation and continued existence of fringe belts, these belts are also different from residential areas in major ways that have, or should have, a bearing on their treatment in planning, not least

in relation to their role as green spaces. Even many of the privately-owned fringe-belt sites by virtue of the extent of their frontages onto public roads tend to provide greater ecosystem services than most residential areas.

### *Types of surfaces*

Graphs comparing the samples of fringe-belt sites and residential areas in respect of the median percentage of their areas covered by buildings, other hard surfaces and soft surfaces reveal the increasing amount of hard surface over time (Figures 7.2-7.4). Significant amounts of water exist only in the fringe-belt sites. However, the pressure on land, particularly related to the construction of other hard surfaces, is especially evident in the residential areas between 1995 and 2015. By far the most important component of this is the covering over of front gardens by hardstanding.

Between 1945 and 1995, the median percentage of other hard surfaces rose only slowly in residential areas, from about 17% to about 26%. However, in the case of the fringe-belt sites, there was major variability between sites, with very little increase in coverage in the case of Edgbaston Golf Course but an increase from about 14% to about 36% in the case of Priory Tennis Club.

Between 1995 and 2015, the median percentage of other hard surfaces in residential areas increased from about 26% to about 35%. The corresponding increase in the case of fringe-belt sites was from about 11% to about 20%. Variability between residential areas was small by comparison with that between fringe-belt sites during both 1945-95 and 1995-2015.

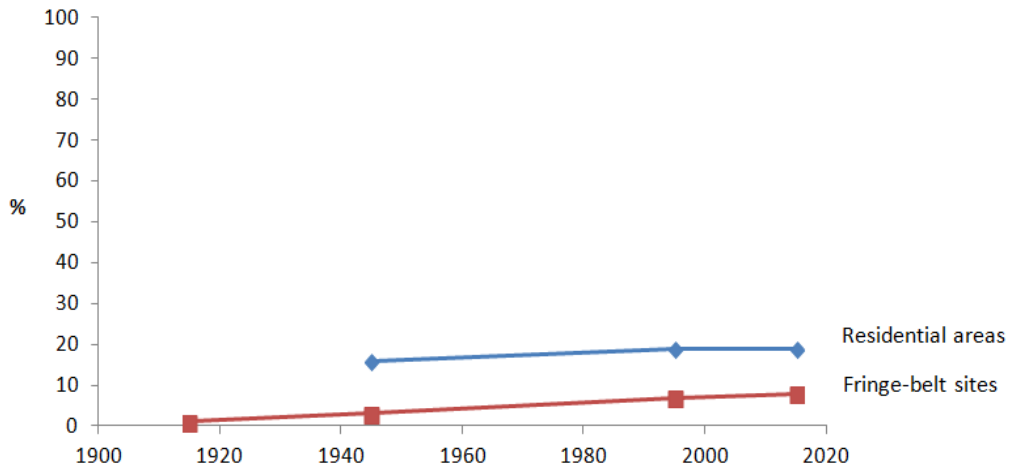


Figure 7.2. Median percentage of area covered by buildings in residential areas and fringe-belt sites

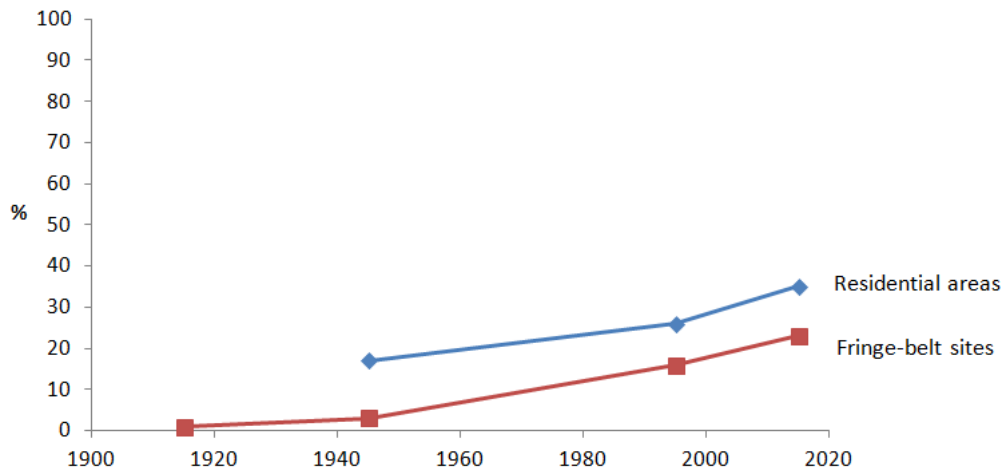


Figure 7.3. Median percentage of area covered by other hard surfaces in residential areas and fringe-belt sites

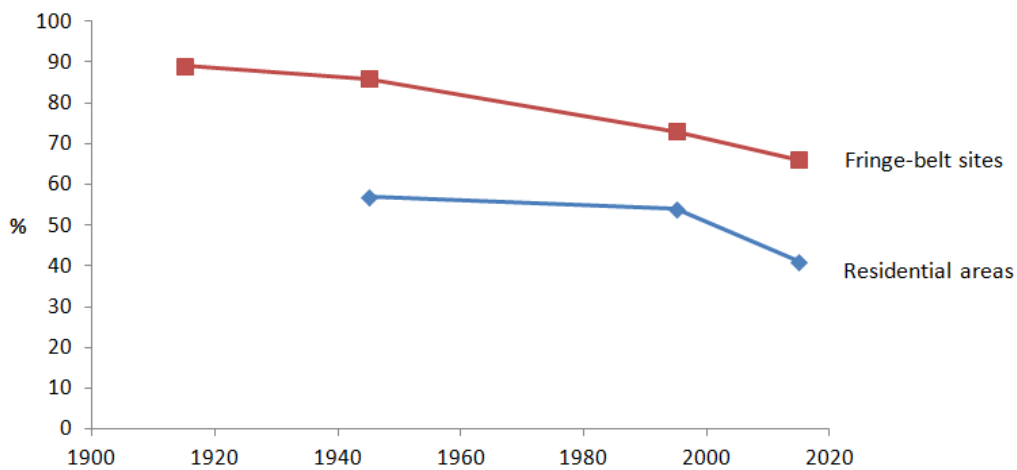


Figure 7.4. Median percentage of area covered by soft surfaces in residential areas and fringe-belt sites

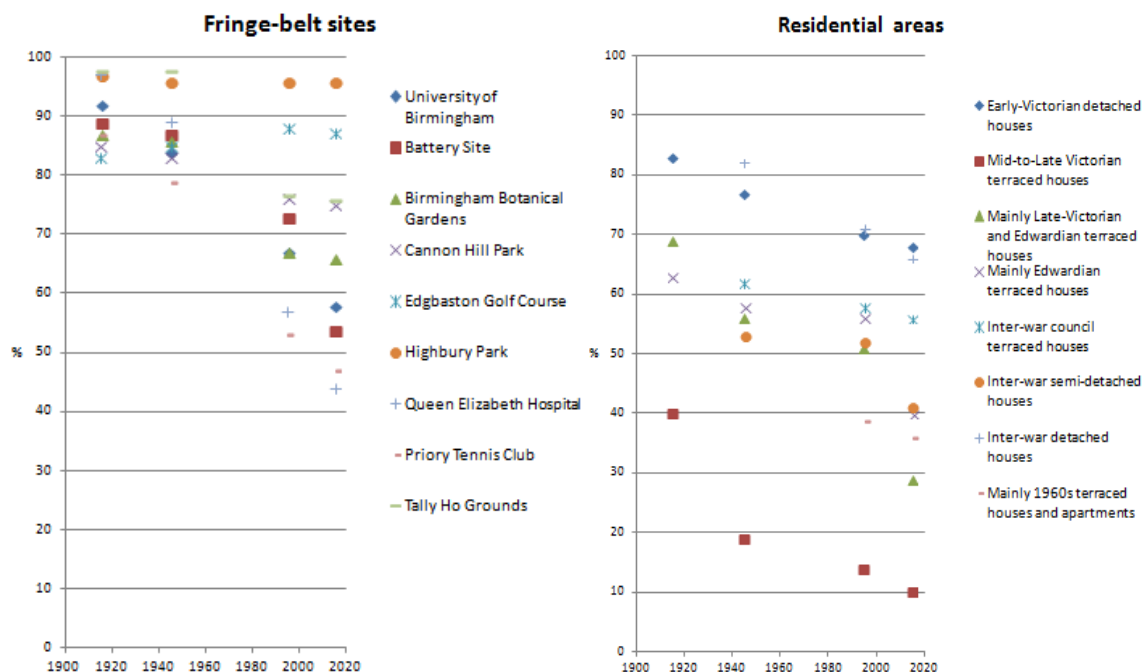


Figure 7.5. Percentage of soft surfaces in fringe-belt sites and residential areas, 1915-2015. Sources: OS plans, 1915, 1945, 1995, 2015; aerial photograph, 1945; NERC image, 1995; Google Earth image, 2015.

Figure 7.5 shows the change in the percentage of soft surface for each fringe-belt site and each residential area. Of the fringe-belt sites, Highbury Park had a very slight decrease in soft surface between 1915 and 2015, and Edgbaston Golf Course actually had a slight increase. At the other extreme, the decrease in the case of the Queen Elizabeth Hospital was from 97% to 44%. In the case of the residential areas the greatest decrease between 1915 and 2015 occurred in the area of mainly late-Victorian and Edwardian terraced houses (from about 68% to about 29%). The smallest decrease in any of the residential areas between 1915 and 2015 was in the area of inter-war council terraced houses.

Fringe-belt sites show either little change in their amounts of soft surface (e.g. Highbury Park and Edgbaston Golf Course) or accelerating loss. The pattern of loss can be described as exponential, with different time constants depending on the use of the

fringe-belt site. Residential sites, in contrast, have roughly linear trends (all with much the same gradients) in their loss of soft surface, though starting their existence with smaller amounts than the fringe-belt sites. Loss of soft surface in residential areas might therefore be seen as more predictable at least until such point as the soft surface area becomes very small.

### *Street patterns*

The streets have different alignments in the residential areas from those bordering the fringe-belt sites. For instance, the streets in the residential areas tend to follow regular patterns, rectilinear or curvilinear. However, in the case of streets bordering the fringe-belt sites their alignments are irregular, often having been strongly influenced by the pattern of rural roads that existed before urban development occurred (Figure 7.6).

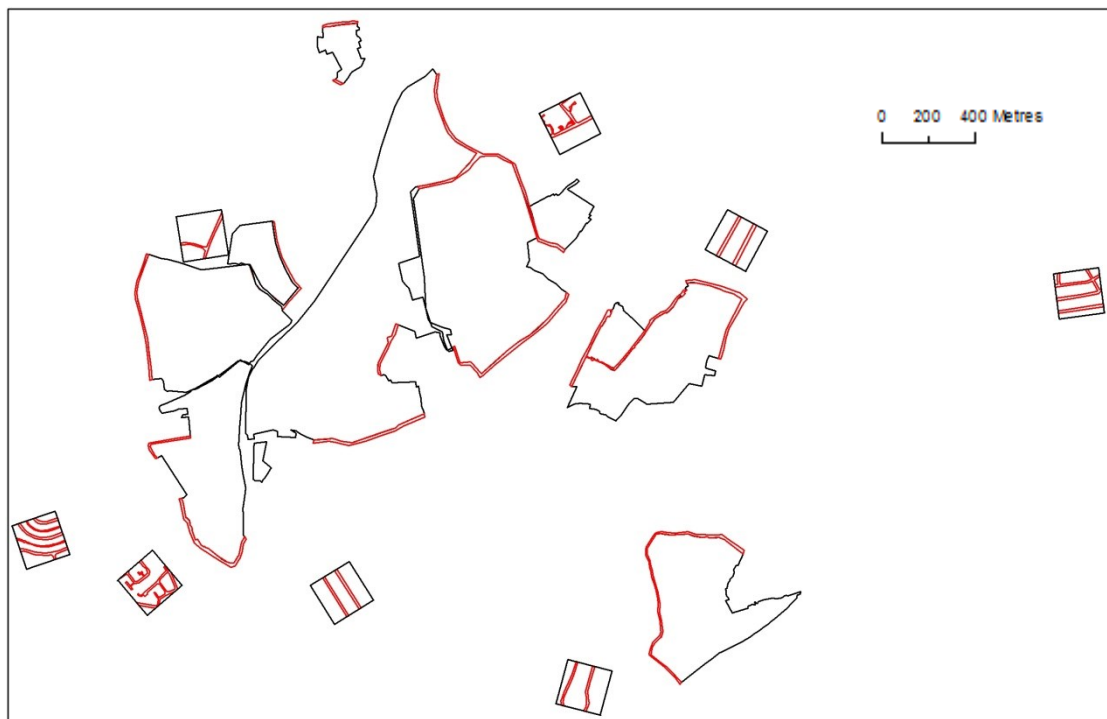


Figure 7.6. Generalized configurations of sample fringe-belt sites and sample residential areas. Public roads are shown in red.

### *Accessibility*

The ownership of the majority of residential plots, in south-west Birmingham at least, is private and, even where it is not, access to the green space of residential gardens is generally limited to the occupiers of the houses. Many fringe-belt sites in contrast are either publicly owned, notably public parks, or in some cases of private ownership, such as the University of Birmingham, effectively provide a considerable measure of access to, or at least views of, many of the green spaces.

However, in relation to intra-urban accessibility more generally, fringe belts tend to limit accessibility by vehicles, in that public roads across fringe belts tend to be much fewer than those through residential areas.

### *Property ownership*

Except for council houses, the ownership in the majority of the residential areas is private. Ownership of fringe-belt sites is much more often public. As the houses are individually owned, the back gardens of the houses cannot be accessed without permission of the owners. However, most of the fringe-belt sites effectively have public open access. Due to the differences in ownership and accessibility, different groups of people can benefit from accessing green spaces in different ways. The green space coverage in public institutions is more open and is thus beneficial for more people. In the residential areas, however, the green spaces in back gardens are specifically beneficial for private occupiers. A good example of this can be seen by comparing the

small private green space distribution in the back gardens of the houses with the large public open green spaces in Cannon Hill Park and Highbury Park.

## **Chapter 8. Conclusion**

One of the major features of Conzen's ground-breaking urban morphological studies of the 1960s, notably his study of the market town of Alnwick, was the distinction he recognized between the various types of urban physical regions. Of particular significance were the differences he recognized between the commercial core, successive residential accretions and the series of fringe belts that separated those regions. In relation to a major city, the present study has explored in detail part of a major fringe belt, particularly from the standpoint of its various types of spaces. It has done so in light of the tendency for Western urban morphologists to focus on built structures rather than the spaces in which these structures are located. In fact the attention given to urban green spaces will be new to the large majority of urban morphologists. Likewise the historico-geographical study of the urban morphological framework within which ecosystem services are provided will be unfamiliar to all but a very tiny minority of ecologists. While the detailed comparison over time of a section of fringe belt with the residential accretions on either side of it has dealt with many aspects that have become familiar to quite a number of urban morphologists over several recent decades, the attention devoted to green spaces in making those comparisons will be new to the very large majority of them. This final chapter summarizes, and refers very briefly to examples of, the main findings of the thesis.

In the early part of the thesis, a perspective was presented linking in broad terms aspects of urban morphology and ecosystem services. The main part of the thesis was

the adoption of this perspective in relation to the spatial framework of fringe belts and residential accretions in Birmingham, south-west Birmingham in particular.

Some of the findings that have been described can be seen as reaffirmations of previous work on fringe belts. Long-term survival of fringe-belt sites reflects the role of landowners at or near the time of embedment of their sites in the built-up area. Following on from that period of very influential decision taking, a notable feature in the south-west Birmingham study area was the process of expansion and contraction of sites in the Edwardian fringe belt while the fringe belt itself remained essentially intact.

However, the fact that fringe-belt sites lost soft surfaces and green spaces with a different time dynamic than residential areas, i.e., with fringe-belt green surface loss accelerating whilst residential area loss rates remained roughly constant, is a new finding. The ‘intensification’ of ecosystem services on fringe-belt sites into smaller but more mature urban wood-pasture landscapes is also new. In residential areas containing large detached houses, the tendency is more towards maturation of the whole garden space (albeit with some loss to impermeable surface for parking), whilst for more compact housing forms the maturation is most evident on plot borders, so that green infrastructure becomes largely interstitial to morphological units.

Despite these general results, there were considerable differences between fringe-belt sites. The most marketed difference was between the adjacent sites of Edgbaston Golf Club and the University of Birmingham. The University was also the most ‘aggressive’ of the occupiers of the sample of fringe-belt sites. Such differences are to some extent inherent in the nature of the land uses involved. Aspects particularly

evident in recent years in the case of the University of Birmingham were not just its expansion into adjacent sites, including a tennis club and many adjacent Edwardian residences set in very large gardens, but also its incorporation of entirely separate sites, including green spaces for sport many miles distant at the present urban fringe. There was also much wider activity by the University in the south Birmingham land and property market and the spread of the University's influence into neighbouring sites where it has not become a landowner but its students occupy purpose-built accommodation run by other organizations. It would be surprising if this city-scale activity has not in recent decades become characteristic of major institutions elsewhere. One might speculate that certain types of fringe-belt activity have intensified use and loss of soft surface 'built in' (i.e., vigorous expansion is planned), but the current analysis does not provide sufficient examples to be definitive.

The fact that built forms tend to conform to morphological periods is well known. Less evident hitherto has been awareness of the conformity of the amount and nature of green space to the same sequence of morphological periods generally associated with built forms. The University of Birmingham is an example. On the original 10ha site alone there are survivals today, albeit decimated to varying degree, of green spaces characteristic of the Edwardian and inter-war morphological periods. These were followed by morphological periods with only minimal green space presence: the late 1950s and 1960s when the first ring road and tower blocks were constructed, followed by the most recent periods of first repletion by individual structures and then redevelopment. In fact there was a sequence reminiscent of Conzen's burgrave cycle for

those sensitive to historical parallels. At the end of the cycle, green space was relatively small in extent. However, in the present study the University was the only one of nine fringe-belt sites to be at or near the end of the cycle. Future work might, therefore, fruitfully ask whether this ‘burgage cycle’ of fringe-belt in-filling always brings with it an intensification of ecosystem services in the form of mature wood-pasture and, if so, what implications this has for management of urban green infrastructure on decadal timescale.

Strongly related to the incidence of green space over time is the degree of formality with which green space has been configured. Again this has hitherto received little attention by urban morphologists. A number of significant considerations emerge from the sample sites investigated. The Priory Tennis Club and the Tally Ho Grounds were constrained by the straight lines of their sports areas. In the case of the University, its acquisition of both a country house park and later several large Edwardian residences were the basis for maintenance of essentially informal green spaces on the sites derived from these earlier land uses, including an ornamental lake in the case of the former. However, the green spaces of the former country house park have been increasingly subject to reductions in their designed informality as pressure has built up for the adding of further buildings for student accommodation. As on the main campus, where pressure has increased for conversion of playing fields for car parking, designed green-space informality has been reduced over time (Whitehand, 1991).

Where designed informal green space has survived to some extent, as for example in Edgbaston Golf Course, Highbury Park and Birmingham Botanical Gardens,

conservation has in recent years been a factor, particularly where the work of noteworthy landscape architects has been involved. The survival of green space with a significant natural history, as in a very small part of the Battery site, is rare.

What has been more difficult to assess in this study is the evolution of the ecological function of green space over time, a process that has no close equivalent in the case of built form. The assessment of ecological function in this thesis has been largely restricted to the well-established increase in biodiversity provisioning and enhancement of regulating ecosystem services that comes as trees mature. Edgbaston Golf Course is a notable case of such maturation at least in significant part. Only relatively few instances of natural tree maturation survive in the main University campus. It would be worth exploring in greater depth in future the implications for urban planning of the contrast in value-accrual between heritage built environment (for which value accrues when there is little or no change) and green infrastructure (for which value accrues through change towards 'climax' ecosystems).

The scope for further work extending from this thesis is considerable. No attempt has been made here to extend to an international scale of comparison, perhaps combining the use of ArcGIS and I-tree canopy. The use of big data models and analysis might also be explored. The present interdisciplinary approach also needs considering in relation to other disciplines. One of the other possible links is to psychological research, for example to examine the relationship between fringe-belt green space and health. Developing further the link to conservation planning is arguably one of the most potentially rewarding next steps.

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## Appendix

Median percentage of area covered by buildings in residential areas and fringe-belt sites

	1915	1945	1995	2015
8 residential areas		16	19	19
9 fringe belt sites	1	3	7	8

Median percentage of area covered by other hard surfaces in residential areas and fringe-belt sites

	1915	1945	1995	2015
8 residential areas		17	26	35
9 fringe belt sites	1	3	16	23

Median percentage of area covered by soft surfaces in residential areas and fringe-belt sites

	1915	1945	1995	2015
8 residential areas		57	54	41
9 fringe belt sites	89	86	73	66

Percentage of soft surfaces in fringe-belt sites and residential areas, 1915-2015.

9 Fringe-belt sites	1915	1945	1995	2015
University of Birmingham	92	84	67	58
Battery Site	89	87	73	54
Birmingham Botanical Gardens	87	86	67	66
Cannon Hill Park	85	83	76	75
Edgbaston Golf Course	83	85	88	87
Highbury Park	97	96	96	96
Queen Elizabeth Hospital	97	89	57	44
Priory Tennis Club	87	79	53	47
Tally Ho Grounds	98	98	77	76

8 Residential areas	1915	1945	1995	2015
Early-Victorian detached houses	83	77	70	68
Mid-to-Late Victorian terraced houses	40	19	14	10
Mainly Late-Victorian and Edwardian terraced houses	69	56	51	29
Mainly Edwardian terraced houses	63	58	56	40
Inter-war council terraced houses		62	58	56
Inter-war semi-detached houses		53	52	41
Inter-war detached houses		82	71	66
Mainly 1960s terraced houses and apartments			39	36