Forest Research

Urban health and health inequalities and the role of urban forestry in Britain: A review

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Contents

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Executive summary

This literature review explores urban health issues and health inequalities and **identifies the links between trees, woods and forests (TWF) and health in urban populations**. It outlines current gaps in research and identifies potential opportunities for the Forestry Commission in England, Scotland and Wales to focus on health and well-being in urban areas.

The review highlights difficulties associated with defining terms such as urban and deprivation. Research gathered for this review does not always distinguish between green space and TWF making it sometimes difficult to identify specific issues related to urban forests. However the definition of urban forestry is broad and includes all tree stands and individual trees in urban areas; many green spaces will include these so we use the terms interchangeably, to a certain extent, in this report.

Green space and TWF are now referred to in a number of health strategies in England, Scotland and Wales which is important for organisations such as the Forestry Commission (FC) which seek to promote the use and enjoyment of TWF for health. FC in each country forestry strategy emphasises the important role TWF can play in improving individuals and communities health and well-being.

The causes of **urban health inequalities** are associated primarily with:

- Socio-economic status/income/poverty/deprivation levels
- Unemployment, incapacity/worklessness
- Skills and educational level/attainment
- Housing conditions/tenure
- Social mobility and life chances.

Health inequalities can be entrenched particularly in some areas such as parts of North west and North east England, the south Wales valleys and in parts of the central belt of Scotland. The recent National Equality Panel report highlights that inequalities in earnings and income are high in Britain and that there are deep seated differences in economic outcomes between social groups. The Marmot Review set up by the government to strategically review health inequalities importantly **identifies a role for TWF/green space in reducing health inequalities**. This includes acknowledging the importance of green infrastructure for urban healthy living and encouraging physical activity for recreation and active travel. It suggests the need for investment in quality green space **particularly street trees in deprived areas** and advocates that the health system should promote contact with nature.

Empirical research (from 93 peer reviewed papers) reviewed in this report identifies the **key health benefits** of urban TWF/green space as:

- Long and short term physical benefits associated with obesity, life expectancy, heart rate and blood pressure
- Attention and cognitive benefits associated with restoration, mood and self esteem
- Physical activity benefits associated with the use of TWF
- Self reported benefits in terms of health and life satisfaction
- Community cohesion benefits through social contact fostered by TWF.

Theory and empirical work suggests **four major mechanisms** for explaining the relationship between green space and health:

- **Physical action**: Filtering pollutants, reducing heat or noise etc.
- **Physical activity**: Encouraging physical exercise
- **Social support**: Providing a space that promotes social interaction and inclusion, reducing social annoyances and crime
- **Restoration**: Reducing stress and restoring cognitive function and capacity to function with the demands of life.

Key messages from this review suggest:

- Evidence that green space promotes health by **encouraging exercise is not consistent.** This is potentially due to a range of factors such the quality of green spaces, concerns by some groups about personal safety, and confidence in accessing such spaces.
- There is stronger and more consistent evidence for the **restorative benefits of green space and the facilitation of social contact through green space use** to explain the relationship between green space and health.
- Little understanding of the components of urban forests that promote health.
- Some evidence that **proximity, size and amount of green space influence physical and mental health outcomes.**
- Urban forests **immediately around homes and workplaces** are important for health outcomes.
- Sense of **safety is linked to enclosure, maintenance, and presence of others/authorities.**
- Green space in **children's learning environments can provide significant developmental benefits**.

In reviewing the evidence from research undertaken to date we suggest that an urban forestry approach to targeting urban health inequalities could focus on the:

- **restorative benefits** of urban forests particularly those in immediate residential surroundings
- **social support** mechanisms for the health benefits of TWF.

Two target groups that could especially benefit from a focus on urban forestry and health are **children and poor communities**.

The location of trees in relation to walking destinations, e.g. **providing attractive and shady connections between homes and destinations**, are potentially most important when considering physical activity. **Visibility of urban forests and trees** from home and work are **important for the restorative role of urban forests**. Because positive social interaction is important the characteristics of urban forests that **promote a sense of safety and inclusion, such as good maintenance, staff presence and led activities,** should be considered.

While parks and woods are important, **urban forests in streets and around residences are vital** and highlight a need to move beyond a specific focus on increased presence and closer proximity to deal with issues of accessibility.

Opportunities for the FC could include **working in partnership** with organisations that have specific experience of and links to the two target groups. A focus on the **quality of spaces and their accessibility** is important as these are complex issues in urban deprived areas. Ensuring urban forests are part of **urban regeneration approaches** is important as well as the remediation of brownfield and underused land to create woodlands in urban areas. **Targeted grants and targeting specific groups** and areas can provide a range of opportunities for encouraging people to utilise urban forests for health. **Community activities and outreach** will be important if hard to reach groups, are a priority for engagement; as they need support in accessing and benefiting from TWF.

An overarching outcome of this review is the **value of providing everyday, very local urban forests**. Promoting health benefits of urban forests is less about providing large-scale grand spaces, and more about providing places where people have easy and routine access (including simple visual access) to urban forests and where they feel at ease. It is also important to understand more about how people living in poor communities understand and negotiate the relationships between TWF, green space and health.

Therefore the key message of this review is to highlight the importance of:

Nearby trees and woods for restoration and social contact

1. Introduction

This report is a result of a scoping review of urban health inequalities and the role that trees, woods and forests (TWF) might play in reducing, mitigating and alleviating some of the health problems faced by urban populations. The health of the United Kingdom (UK) population is a key issue for the UK government and the devolved administrations. Particular concerns have increased in the past ten to fifteen years due to rises in conditions such as obesity, type 2 diabetes and a lack of physical activity; with many people leading increasingly sedentary lives. Promoting, facilitating and encouraging healthy lifestyles and healthy behaviour are a key focus of current government health promotion and policies.

The objectives of the review were to:

- Identify key urban health issues and health inequalities
- Examine the role of TWF in urban areas
- Explore the links between TWF and health/health inequalities in urban populations
- Identify gaps in research that will provide clearer evidence of the links between urban forestry and health
- Identify potential opportunities for the Forestry Commission to focus on health and well-being in urban areas.

Over 80% of the UK population is urban based; many people travel to the countryside, woodlands, green space and to the coast and waterways as part of their leisure activities. There has been some debate about whether urban populations have poorer health than those who live in rural areas, this issue is made complicated by the different ways in which urban/rural is defined and the collection of health and demographic data at different geographical levels. While there is an increasing body of research concerning the health benefits of nature much of the research about the links between nature/green space and health do not distinguish between different types of green space or focus on urban areas or urban health inequalities. This review has been produced to explore some of these gaps.

In this report we outline the methods used for the review, and illustrate the health and forestry policies of relevance; particularly identifying where health policies mention TWF or nature more broadly and where forestry policies mention people's health. We then discuss current health and health inequality issues before talking about the increasing importance of TWF in urban areas and identifying the links between TWF and urban health. Gaps in current knowledge and understanding are outlined suggesting where more evidence is needed. We conclude by identifying potential opportunities for the Forestry Commission to encourage use and enjoyment of urban TWF for health benefits.

2. Methodology

2.1 Methods used

The methods used in this scoping review included a literature review of research exploring the links between health and nature, and documentary analysis methods to identify relevant current strategies and policy documents. We focused primarily on the salutogenic (e.g. positive) aspects of how TWF can contribute to people's health rather than focus on issues of environmental health which have been dominated by a focus on toxic environmental effects on health e.g. through pollution.

2.1.1 Documentary analysis

Strategies and policy documents for the UK and the devolved administrations were gathered through web based searches of primarily government based websites and focused on search terms of:

- Health
- Health inequalities
- Interventions to reduce inequalities (if health/well-being was identified as a focus for the intervention)
- Regeneration
- Forestry
- Green space and nature.

2.1.2 Literature review

The review of literature focused on empirical investigations of the relationship between urban green space and health; published in peer reviewed journals. Studies were included where they dealt with green space in an urban setting (or in general terms that could be linked to urban settings) and where research participants were from an urban or general population.

Studies were identified through a search of online data bases including Web of Science, CAB Abstracts, Current Content, Scopus, Academic Search Premier (EBSCO), Expanded Academic ASAP (Gale), MedLine, PsychInfo PubMed. Search terms included:

> Health inequality terms: Health, mental health, mortality, life expectancy, physical activity, obesity, well-being, health inequality, socio-economic, women, ethnicity, poverty, deprivation.
>
> Environment terms: Green space, forests, woods, woodlands, urban forestry, trees, public open space, parks.

In addition, reference lists of recent reviews of green space and health (Tzoulas et al., 2007; Verlarde et al., 2007; Maller et al., 2008; Davies and Deaville, 2008; Strife and Downey, 2009) were examined to identify studies meeting search criteria.

2.1.3 Definition of terms

This section provides definitions for health, health inequality, a healthy city, and urban areas that guide the focus of this review.

Health

The World Health Organisation (WHO) defines **health** as 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (WHO, 1946).

Health inequalities can be defined as differences in health status or in the distribution of health determinants between different population groups (WHO, 2009). They are the result of 'a complex system operating at global, national and local levels which shapes the way society, at national and local level, organises its affairs and embodies different forms of social position and hierarchy. The place people occupy on the social hierarchy affects their level of exposure to health-damaging factors, their vulnerability to ill health, and the consequences of ill health' (Marmot, 2009: 14).

WHO have defined a **healthy city** (cited in Land use Consultants, 2007: 12) as 'one that is continually creating and improving the physical and social environment and expanding the community resources that enable people to mutually support each other in performing all the function of life and in developing to their maximum potential'.

Urban

There are difficulties associated with a single definition of what is **urban and rural**. In England and Wales the rural/urban definition was introduced in 2004 (see Appendix A: Map 1). Census Output Areas with populations over 10,000 are classed as urban, within this settlements are identified as urban sparse and urban less sparse (National Statistics, 2009).

In England there is also a Local Authority classification for when data is only available for larger geographies and this is divided into:
Major urban – over 100,00 population
Large urban – over 50,000
Other urban – over 37,000

In Scotland 'large urban areas' are classed as settlements with a population over 125,000 and other urban areas with 10,000-125,000 population size (SG, 2009a). Map 2 (Appendix A) shows urban areas in Scotland.

Urban Forestry

A definition of urban forestry is given in Section 5.2

Appendix D (Figure 7) shows how green infrastructure and ecosystem services can aid in turning urban spaces into quality places.

Deprivation

'Deprivation takes many different forms in every known society. People can be said to be deprived if they lack the types of diet, clothing, housing, household facilities and fuel and environmental, educational, working and social conditions, activities and facilities which are customary, or at least widely encouraged and approved, in the societies to which they belong'. (Townsend, 1987: p.126)

The indices of deprivation in each country covers key domains and these are used to assess levels of deprivation in Britain.

For example:
Scottish Index of Multiple Deprivation (IMD) has 7 domains – income, employment, health, education, skills and training, housing, crime and geographic access.
Welsh IMD has 8 domains – income, employment, education, health, access to services, housing, environment and community safety.
English IMD 2007 has the domains of employment, health and disability, education, skills and training, barriers to housing and services, living environment and crime (Office for National Statistics, undated).

Maps 1 and 2 (Appendix A) show that in Wales and Scotland urban areas are concentrated in specific places such as the central belt of Scotland and in a small area of the east coast. In Wales urban areas are concentrated in south Wales with a strip across the top of north Wales. In England however urban areas are much more widely dispersed and larger than in Wales or Scotland.

3. The policy context: health and forestry policies

This section outlines some of the key current health policies with a focus on identifying when green space or the natural environment is mentioned in relation to health and well-being. Forestry policies are outlined that explicitly mention health and well-being. What this section illustrates is that the Forestry Commission in each country has become increasingly aware of the potential for TWF to contribute to people's health and well-being. In the health sector the natural environment is mentioned more rarely, although there has been some increase over the past 2-3 years in references to nature. The NHS Forest (logo below) was launched at Alder Hey Children's Hospital in October 2009. The NHS Forest is a partnership project[1] with the aim of establishing 1.3 million trees (one for every employee in the NHS) planted at hundreds of sites across the UK. The project aims to work closely with the health sector and gain support and increase understanding in this sector about the potential links between health and nature.

NHS FOREST
growing forests for health

www.nhsforest.org

3.1 Health policies

Health policies differ for England, Scotland and Wales and illustrate the key health issues in each country. However across all the countries there is increasing recognition that health is not the sole responsibility of governments, it is an issue for all sectors and people in society. This has sometimes led to a particular focus on individual behaviour change without a broader recognition of the wider societal and organisational structures that influence or impede change. Therefore partnerships have become increasingly important in the delivery of health. Health promotion and the integration of services are leading to the development of new strategies and campaigns to encourage people to lead healthier lifestyles. Prevention of ill health is becoming increasingly important. The Wanless report 'Securing good health for the whole population' (2003) outlined the need for a more co-ordinated and sustained effort to improve health and well-being and acted

[1] Including the Campaign for Greener Healthcare, Forestry Commission, Woodland Trust, Natural England.

as a catalyst for a range of health strategy documents. In recent years the natural environment and green spaces have been named in health strategies and policies with an acknowledgement that these areas can be beneficial to health and well-being.

3.1.1 General health

The 'Health challenge England' (DoH, 2006: 33) report outlines the next steps that needed to be taken as a result of the 'Choosing health' white paper. Improving health and tackling health inequalities are key issues:

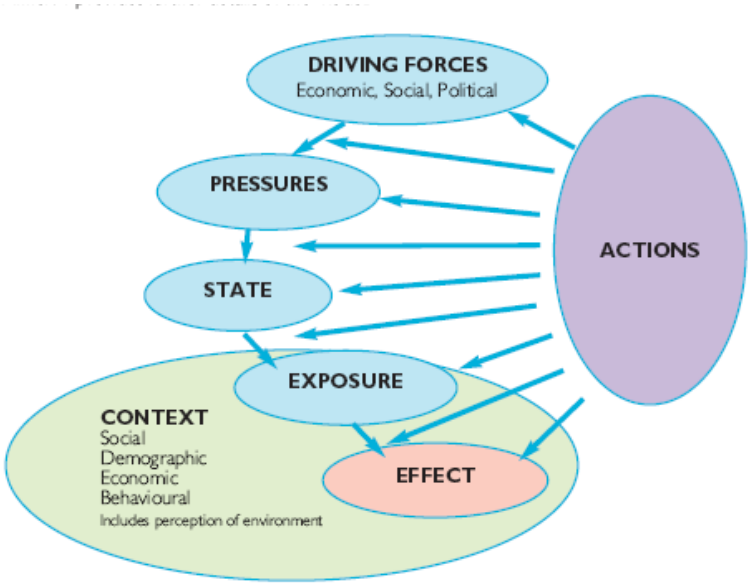
> *'Today, government, society and individuals are engaged in a new dialogue. Together we need to stand up to the health challenges we all face. After all, health does not belong to the Government, but to people. For this reason alone we must always put them at the heart of improving health and tackling inequalities'.*

The 'Be active, be healthy' strategy in England (DoH, 2009a) which wants to promote healthy lifestyles identifies the natural environment as an important setting for health and physical activity. It also suggests that the natural environment is a factor in helping to reduce stress, has a restorative effect on adults and can enhance well-being.

'Designed for life' (Welsh Assembly Government, 2005a) is a ten year vision to create world class health and social care in Wales. In 2009, the Welsh Assembly Government (WAG) brought out a consultation document called 'Our healthy future' (WAG, 2009a), the aims are to improve quality and length of life and promote good health on equal terms for everyone in Wales. The 'Well-being in Wales' (WAG) 2002a) report outlines that the natural and built environments are both relevant to health, with the natural environment providing opportunities for leisure and recreation as well as being a source of jobs, income and a key part of the tourism industry.

'Good places better health' (Scottish Government (SG), 2008a) is an implementation plan for cross cutting public health with a focus on nurturing positive health. The plan provides a model (Figure 1) as a basis for creating a strategy to inform policy and action in complex situations. This modified model can take into consideration contextual and wider issues which influence whether a good environment leads to positive health and well-being or if poor environments have a negative impact.

Figure 1: Modified DPSEEA model (SG, 2008a).



3.1.2 Physical activity

In 2004 the Department of Health (DoH, 2004, a and b) produced the 'Choosing health' white paper and a report entitled 'At least five a week'. These documents brought together evidence of the links between physical activity and health. They highlighted that physical activity can contribute to the prevention and management of over 20 conditions and diseases including coronary heart disease, diabetes, cancer, positive mental health and weight management (DoH, 2005). The 'Five a week' report recommends that people undertake 30 minutes of moderate intensity exercise on at least five days of the week to improve their health. The recommendation is higher for children, at 60 minutes of moderate intensity exercise every day (DoH, 2004a and b).

The 'Healthy and active lifestyles' report in Wales (WAG, 2002b) provided a framework for action and argued for national and local partnerships to encourage activity, provide good information to health professionals and remove barriers to being active. The government strategy on sport and physical activity was published in 2005 and 'Climbing higher: next steps' builds on this (WAG, 2006a). It mentions the natural environment and states that work will take place through outdoor specialists such as Forestry Commission Wales (FCW), (WAG, 2006a) to help enable people to be active outdoors.

The 'Let's make Scotland more active' strategy was published in 2003 (SG, 2003a) and focuses on an integrated and multi-sectoral approach to improving health. A Physical Activity and Health Alliance has been set up which is a collaboration between NHS Health

Scotland and the Scottish Government to support practitioners in implementing the strategy.

3.1.3 Mental health and well-being

There is still no single universally agreed definition of mental health. The DoH (2009b: 10) suggests that 'it is more than the absence or management of mental health problems; it is the foundation for well-being and effective functioning for individuals and their communities'. Stigma still surrounds mental ill health and people can be reluctant to admit problems or seek help. 'New Horizons' (DoH, 2009b) is a consultation document which tries to move towards a shared vision for mental health. The document states that access to green space and getting involved in outdoor activities in these spaces may reduce stress (particularly in children) and promote well-being. The association between physical activity and mental health is seen as increasingly significant in the UK in health policies (Whitelaw et al., 2008). The recent strategy for children and young people's health, 'Healthy lives, brighter futures' (Department of Health and Department for Children, Schools and Families, 2009: 40) states that 'even small amounts of green space are shown to have qualities that facilitate relaxation and recovery from mental fatigue and stress, particularly for those with symptoms of attention deficit hyperactivity disorder'.

The Future Vision Coalition is made up of a number of organisations[2] and has recently set out a vision for mental health in England which will contribute to the 'New Horizons' consultation (2009). Mind (the National Association for Mental Health in England and Wales) produced a report on 'Ecotherapy'[3] in 2007 and advocates this type of approach as a treatment option stating that those suffering from mental distress frequently get involved in physical activity such as walking, gardening and exercise to help lift their mood, reduce stress and raise self esteem.

'Towards a mentally flourishing Scotland' is a new action plan for mental health improvement (SG, 2009b). The plan focuses on promotion of well-being and acknowledges that 'the quality of the physical environment, proper access to nature and green space and access to cultural experiences have an important role to play in shaping the mental state of individuals' (SG, 2009b: 25). This document and the report 'Delivering healthier communities in London' (Land Use Consultants, 2007) both talk about the importance of green spaces as 'escape' facilities. It can be argued that this is particularly important in urban areas where green spaces have been described as the

[2] Mind, Royal College of Psychiatrists, Mental Health Foundation, Mental Health Network, Local Government Association, ADASS (adult social services), ADCS (children's services), Rethink, Sainsbury Centre for Mental Health.

[3] Ecotherapy is contact with nature through a range of activities such as a conservation or horticultural programme that can lead to mental, physical and social well-being for participants or patients.

'lungs of the city' (Konijnendijk, 2008) and where woods 'give you [people] a country feeling within the city' (O'Brien, 2006: 542).

The UK Government commissioned Foresight to review mental capital and well-being; in one of its reports on the effect of the physical environment on mental well-being - exposure and access to nature was raised (Cooper et al., 2009). The report mentions studies such as those identified in section 6 of this report, it covers the importance of access to nature in terms of restoration, social relations, feelings of neighbourhood safety, and opportunities to be active.

3.1.4 Social bonds

Mental health Wales run by Hafal, a charity focusing on people with mental illness, talks about how people's social life can have an important effect on their mental health and how maintaining a social life can play a significant role in recovery from mental illness (Hafal, 2009). The charity suggests that physical and mental activities provide opportunities to form social bonds and can provide a distraction from problems. Repeating activities can lead to more social activity, for example those who have been involved in the 'Walking the way to health' initiative talked about the importance of the social contact they gained and reduced sense of isolation from being involved in the regular walks (Dawson et al., 2006). Increased social capital may lead to improved health behaviours. There is debate amongst academics and policy makers about how participation in community and civic life and the creation of social capital can aid in reducing health inequalities (NHS Development Agency, 2004). However most health policies and strategies do not mention the potential role of green space as a collective community space in which organised events and activities might bring people together and contribute to social capital.

3.1.5 Healthy lifestyle campaigns

Broad social marketing campaigns to encourage people to change behaviour and lead healthier lifestyles include 'Health challenge Wales' which aims to encourage individuals and organisations to adopt healthier lifestyles. Information is provided for individuals on keeping fit and there is a link to the FCW website. There is also information about mental health. In England the DoH in 2009 launched the 'Change4Life' campaign (logo below), with a focus on encouraging families to eat well and be more active it provides information on exercising and eating, and a chance to find out what is happening in people's local areas. 'Muckin4life' from the Department of the Environment, Food and Rural Affairs (DEFRA) is part of the 'Change4life' campaign and encourages people to get involved in fun, free and healthy environmental voluntary activities (DEFRA, 2009).

www.nhs.uk/Change4life

3.2 Forestry Policies

The Forestry Commission in all three countries recognises the role that TWF can potentially play in the enhancement of the population's health and well-being. This is evident in the inclusion of health objectives, activities and related indicators in all three country strategies.

3.2.1 England

The Government's 'A strategy for England's trees, woods and forests' (DEFRA, 2007) was launched in June 2007 with five aims, one of which is 'Quality of life'. This strategy is translated into action through the 'Delivery plan 2008-2012' (Forestry Commission and Natural England, 2008) and under the 'Quality of life' aim, clear attention is given to health and well-being through the objective: 'recreation, enjoyment and healthy lifestyles'. This objective is aimed at increasing 'the use of TWF for recreation and physical activity, promoting healthier lifestyles, enjoyment and a greater understanding of the natural environment' (Forestry Commission and Natural England, 2008: 29). Specific health-related activities are:

- Develop and test a new way to monitor and evaluate the quality of experience provided by new or improved woodlands and their impact on local quality of life
- Support innovative partnership projects and joint ventures that extend the range of opportunities for both informal and more active sport and recreation in both public and private woodland
- Further develop the Forestry Commission's role as a provider of high-quality recreation, natural play and leisure experiences to a wide audience for the benefit of their health, well-being and personal development (Forestry Commission and Natural England, 2008: 30).

It is also reported that under this objective there will be action to 'promote and support tree planting and the creation of accessible woodland in identified 'priority areas' (Forestry Commission and Natural England, 2008: 30). These priority areas are defined as being within 4km of priority populations' defined as those:

a) Within the most deprived 40% of England (based on the Index of Multiple Deprivation)
b) Within a growth area (based on the map of growth areas from the Department for Communities and Local Government).

The caveat being that only those populations which are located within an urban settlement of >10,000 population are included. It is clear that Forestry Commission England (FCE) is focusing its afforestation efforts on urban populations and in particular, those in the most deprived 40% of the country.

3.2.2 Scotland

Of the three countries, Scotland's forestry policies and strategies place the greatest emphasis on health and well-being. The Scottish Government's forestry strategy was published in 2006 and one of the strategy's three main outcomes against which forestry benefits will be delivered is through 'improved health and well-being of people and their communities' (SG, 2006: 8). The three main outcomes have seven key themes, one of which is 'access and health'. Forestry Commission Scotland (FCS) translate the Scottish Government strategy into an implementation plan every three years and in the 2009-2012 plan (FCS, 2009a: 5) it is observed that 'woodlands have particular potential as a health resource'. There are numerous activities listed in both the strategy and implementation plan that will be undertaken under the 'access and health' theme in order to:

- Contribute to health improvement and narrowing the health gap in Scotland by increasing the number of people who visit woodlands and the outdoors
- Make access to woodlands easier for all sectors of society
- Use woodland access to help physical and mental health in Scotland
- Provide a greater range of ways for people to enjoy woodlands (FCS, 2009a: 29).

The strategy has 62 indicators, 8 of which are for 'access and health':

- Proportion of the population with accessible woodland greater than 2 hectares within 500 metres of their home
- Proportion of the population with accessible woodland greater than 20 hectares within 4 kilometres of their home
- Proportion of adults (16 years +) who visited woodland in previous 12 months
- Number of visits to national forests
- Number and length of core paths in woodlands
- Proportion of visitors satisfied with woodland provision
- Proportion of people who used woodland, forest or tree covered parks for exercise at least twice per week in the last four weeks
- Number of 'volunteer days' associated with woodland activity (Scottish Government, 2006: 41).

However, beyond these broad forestry policy documents, FCS also has its own, dedicated 'Woods for health strategy', which sets out ways in which FCS can support more people in Scotland to live longer, healthier more fulfilled lives and how FCS 'can help to reduce inequalities of opportunity through specific actions' (FCS, 2009b: 6). Importantly, it explicitly acknowledges health inequalities and the role TWF can play in overcoming these and states that 'helping to narrow this inequality is one of our main objectives' (FCS 2009b: 5). Inevitably, much of the scope of the work programme resulting from this strategy will therefore have an urban focus (FCS, 2008: 6).

3.2.3 Wales

'Woodlands for Wales: The Welsh Assembly Government's strategy for woodlands and trees' has four strategic themes, one of which is 'woodlands for people' (WAG, 2009b: 8). Under this headline theme outcome ten is particularly relevant: 'more people live healthier lives as a result of their use and enjoyment of woodlands' (WAG, 2009b: 9). The WAG intends to achieve outcome ten through the following actions:

- Encourage the development and promotion of woodland access throughout Wales with suitable infrastructure and well managed woodlands which feel safe and welcoming
- Support tree planting to improve the landscape and provide opportunities to use green space for outdoor recreation, taking account of local needs.
- Support communities to identify local access and recreation needs
- Encourage joint working with providers of health, education and social care services to promote the use of woodlands by people of all ages, appropriate to their physical and mental health needs
- Look for opportunities where woodlands could contribute to volunteering initiatives that encourage physical good health and social inclusion (WAG, 2009b: 33).

Related success indicators include: recreation – amount and range of recreational activity taking place in woodlands and accessibility – proportion of population with accessible woodland close to where they live (WAG, 2009b: 55). Health is also mentioned with reference to the core theme of 'Welsh woodlands and trees' under outcome six: 'urban woodlands and trees deliver a full range of benefits' (WAG, 2009b: 9). This outcome is about using TWF to enhance the quality of life for those people living in urban areas, improving access to urban woodlands, working with local authorities to increase urban tree planting and woodland management, ensuring trees are taken into account in planning guidance, and promoting 'the contribution that urban woodlands and trees could make to other policy agendas, including those which concern…health, social welfare…' (WAG, 2009b: 23). The success indicator for this is 'area of urban woodland and number of urban trees outside woodland' (WAG, 2009b: 54). In the Welsh Strategy, therefore, there is an explicit acknowledgement of the potential contribution TWF could play in the urban health agenda. Forestry Commission Wales (FCW, 2009a) translated the Woodlands for Wales' strategy into their own Corporate Plan, 'Our purpose and direction'. Here they state that they want to encourage people to make more and better use of woodlands because of the health and well-being benefits such use brings and that they want to ensure everyone has an equal opportunity to enjoy woodlands, 'including people from the most disadvantaged communities' (FCW, 2009a: 19).
Five relevant performance targets are:

- Number of adults that have visited a woodland for recreation in the last 12 months

- Proportion of woodland visits which provide high quality experiences
- Proportion of adults that have forest or woodland they can get to easily without a car or other transport
- Percentage of the population that live within 500m of accessible woodland of 2 hectares plus
- Percentage of population that live within 4km of accessible woodland of 20 hectares plus (FCW, 2009a: 36).

3.2.4 Access Standards

All three countries share in common their use of access related performance indicators for their health and well-being objectives, so it is worth briefly outlining relevant standards. The access performance indicators are drawn from access standards as suggested by Natural England, and the Woodland Trust and Forestry Commission. Natural England (2009) has developed the 'Accessible Natural Greenspace Standard' (ANGSt) which sets benchmarks for access to green space for people living in towns and cities as follows:

- an accessible natural green space of at least 2 hectares in size, no more than 300 metres (5 minutes walk from home)
- at least one accessible 20 hectare site within two kilometres of home
- one accessible 100 hectare site within five kilometres of home
- one accessible 500 hectare site within ten kilometres of home
- statutory Local Nature Reserves at a minimum level of one hectare per thousand population.

This standard is concerned with promoting and recognising the role of green space and nature in improving quality of life in the urban context. The Countryside Council for Wales have adopted an almost identical standard in their 'Greenspace Toolkit' (CCW, 2006: 2). The Woodland Trust's 'Woodland Access Standard' (WASt) builds on the ANGSt, establishing aspirations for woodlands in particular (Woodland Trust, 2004: 15):

- that no person should live more than 500m from at least one area of accessible woodland of no less than 2ha in size and,
- that there should also be at least one area of accessible woodland of no less than 20ha within 4km of people's homes.

3.2.5 Planning Policies

Beyond forest-specific policy, other forestry and woodland relevant government documentation exists in the form of planning policy guidance and advice, a summary of which can be viewed in Appendix F.

4. Urban health and health inequalities

4.1 Current health concerns

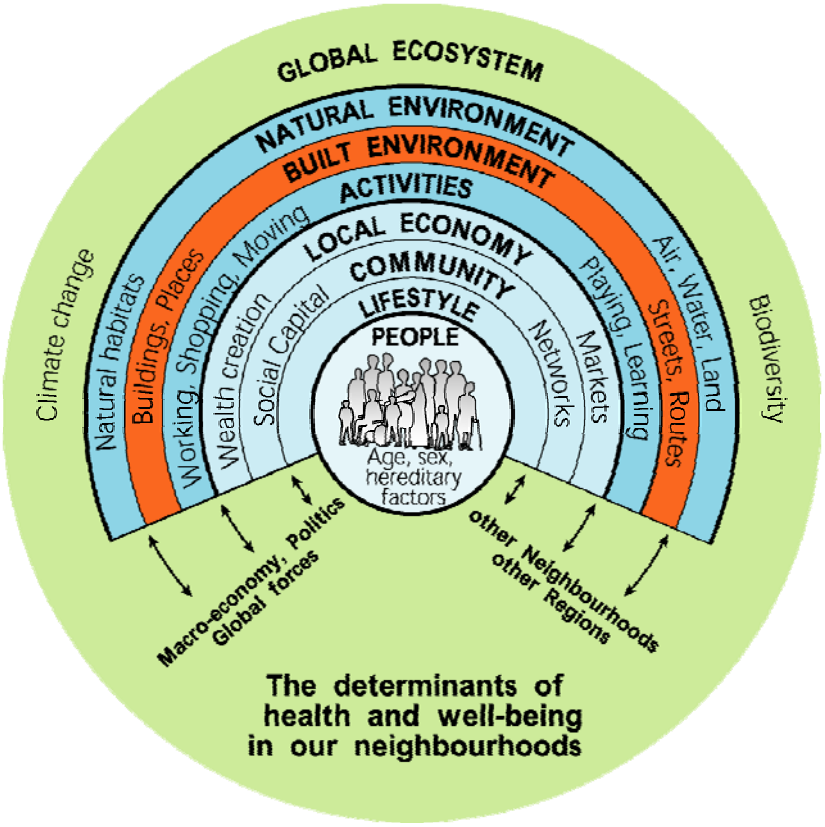
Health is an important issue and there is much discussion in government and in the media about key health issues and the costs of running the National Health Service (NHS). In the past 15 - 20 years growing concerns have been raised about increases in obesity, type 2 diabetes and the sedentary lifestyles that many people are leading, as well as rates of binge drinking and smoking. There is also major concern from the World Health Organisation (WHO) about mental ill health. It is estimated that 1 in 4 people will experience a mental health problem at some point in their lives (The Future Vision Coalition, 2009). An example of the growing costs of some of these health problems in England is outlined in Table 1. England, Scotland and Wales all run health surveys where data is gathered on the health of the respective populations. The key factors explored to assess trends over time include cardio vascular disease, stroke, type 2 diabetes, obesity, psychological well-being, alcohol, smoking and physical activity levels, and mortality rates. The determinants of health have been outlined by Barton and Grant (Figure 2) which highlights the complex social, environmental and economic conditions that influence the health of individuals and populations.

Table 1: Costs of health problems in England (taken from 'Health, place and nature' by the Sustainable Development Commission, 2008).

Health problem	Health and social care	Wider Economy	Total
Mental ill health	12 billion per annum	64 billion per annum	76 billion
Obesity	1 billion per annum	2.3 billion per annum	3.7 billion
Diabetes	1.3 billion per annum	Unknown	1.3 billion

As mentioned in the introduction to this review there is debate about whether people are healthier in rural or urban areas. According to Hay et al. (undated) in Scotland's rural areas there is less unemployment, generally less deprivation, better life expectancy and better self reported health. However the assumption that rural areas are healthier is open to question (Wales Centre for Health, 2007), made complex by the difficulties of defining what is urban and what is rural and the fact that deprivation can be masked in rural areas with heterogeneous populations. A number of studies suggest that rural environments contribute better to mental well-being than urban ones (Cooper et al., 2009). Depression, psychiatric morbidity, alcohol and drug dependence have been found to be higher in urban areas in a range of studies (cited in Cooper et al., 2009: 13).

Figure 2: Social determinants of health (developed by Barton and Grant, 2006).



4.2 Health inequalities

The definition of health inequalities outlined in Section 2, as differences in health status between different population groups, highlights that this is a complex issue. There is increasing interest in health over the life course. Health inequalities often originate in childhood if people face poorer economic circumstances in degraded environments. Poverty and deprivation disadvantage people giving them fewer opportunities (National Equality Panel, 2010). These disadvantages affect people's health and well-being and their economic and educational prospects which in turn affect health (WAG, 2002a). Levels of deprivation for the population as a whole are higher in urban areas than elsewhere and inner city wards tend as a whole to have higher levels of deprivation than those in outer cities (Dorsett, 1998). Figure 6 (Appendix C) shows deprivation across the UK with a scale from the 20% most deprived to the 20% least deprived. It highlights that the most deprived areas are in south Wales, London, the West Midlands, parts of the North West and North East of England and in the central belt of Scotland.

Health inequalities are a particular challenge in Scotland as can be seen from Table 2. Wales also has challenges, a report (WAG, 2005) outlined that it had mortality rates

amongst the worst in Western Europe. Health inequalities are measured typically by mortality and morbidity rates.

Life expectancy highlights some of the inequality differences in various parts of Britain with Scotland facing particular challenges for both men and women, with over ten years difference between the lowest and highest level of life expectancy (Table 2). In Table 2 it can be seen that 8 out of 10 (for men) and 6 out of 10 (for women) areas with the lowest life expectancy are in Scotland. The majority of places with the lowest life expectancy are urban areas.

Table 2: Life expectancy at birth by local areas in the UK 2004-06 (National Statistics, 2007)

Rank	Lowest life expectancy at birth - men		Lowest life expectancy at birth - women	
432	Glasgow City	70.5	Glasgow City	77.0
431	West Dunbartonshire	71.8	West Dunbartonshire	77.7
430	Inverclyde	72.2	Inverclyde	77.8
429	Eilean Siar (Isle of Lewis)	73.0	East Ayrshire	78.2
428	Manchester	73.0	North Lanarkshire	78.2
427	North Lanarkshire	73.0	Liverpool	78.3
426	Clackmananshire	73.2	Hartlepool	78.3
425	Blackpool	73.3	Halton	78.4
424	Renfrewshire	73.4	Renfrewshire	78.4
423	Dundee City	73.5	Manchester	78.6
Highest life expectancy at birth - men			**Highest life expectancy at birth women**	
1	Kensington and Chelsea	83.3	Kensington and Chelsea	87.2
2	East Dorest	81.4	East Dorset	84.7
3	Hart	80.7	Christchurch	84.4
4	Rutland	80.6	Rochford	84.3
5	Elmbridge	80.4	South Cambridgeshire	84.2
6	Christchurch	80.3	Epson and Ewell	84.2
7	Wokingham	80.3	New Forest	84.1
8	South Norfolk	80.2	East Cambridgeshire	84.1
9	Westminster	80.2	Rutland	84.0
10	Guildford	80.1	Hart	84.0

A National Obesity Observatory was set up in 2007 to provide a central source of evidence on obesity as increases have been significant in the past 15 years for those of all ages, sex and socio-economic status. Current levels of overweight and obesity are outlined in Table 3 with some differences between the countries. Table 3 also shows that men and women in Scotland appear to be undertaking more physical activity than those in England and Wales.

Table 3: Percentages of men and women who are physically active, and overweight and obese (National Statistics, 2003; Scottish Public Health Observatory, 2008).

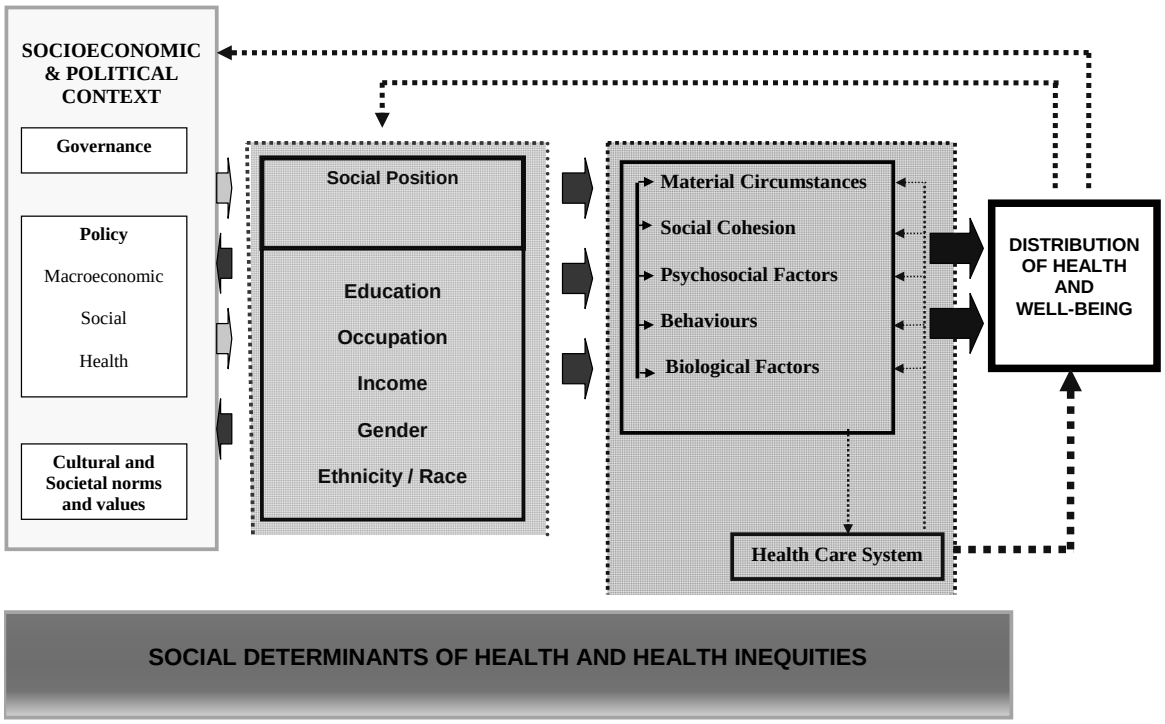
	England	Scotland	Wales
Men - obesity and overweight	65.4	65	60
Women – obesity and overweight	55.5	60	48
Men – physical activity	37	42	36
Women – physical activity	24	30	23

In England between 1995 and 2003 obesity among children age 2-10 rose from 9.9% to 13.7%. It was also found that obesity was higher among children living in inner city areas (National Statistics, 2006). Girls and boys with two obese parents are ten times more likely to be obese than girls and boys with no obese parents. Obesity in women is lower (in England) in households where the main reference person is in a managerial or professional role. According to Bajekal and Osbourne (2006: 50) 'it has long been known that obesity prevalence in adulthood is inversely related to socio-economic status in women but not in men'. Stroke and ischaemic heart disease (reported heart attack or angina) for men and women is higher in households were the main reference person is employed in semi-routine or routine occupations.

The model in Figure 3 highlights the key forces that drive distribution of health and well-being that can lead to health inequalities. What the health surveys across Britain highlight is that for the data collected on factors related to health for some of the major categories, prevalence of a disease or type of behaviour increases as household income decreases and there are differences across socio-economic groups. For example in England the prevalence of diabetes has increased for both men and women and the disease shows some variation by socio-economic status. Cardio vascular disease and stroke increase as household income decreases. This relationship also holds for psychological well-being, smoking, alcohol consumption and to a certain extent for obesity levels, particularly for women (National Statistics, 2003). Binge drinking is a particular issue amongst young people and those in northern parts of England, and is more common in men from households with lower income or those living in deprived areas (National Statistics, 2003).

Child poverty is an important issue for the government which wants to eradicate it by 2020. In 2008, the government created the 'Take up taskforce' to advise how local services can reduce child poverty by aiding poor families to access tax credits and benefits they are entitled to (Department for Children, School and Families, 2009).

Figure 3: Commission on the social determinants of health conceptual framework (taken from Marmot, 2009).



4.2.1 What causes health inequalities and why do they persist?

The 'Focus on health' report (Bajekal and Osbourne, 2006) brings together data for the UK from a range of surveys. What the report reveals is that health inequalities occur due to differences in key factors such as:

- Socio-economic status/income/poverty/deprivation levels
- Unemployment, incapacity/worklessness
- Skills and educational level/attainment
- Housing conditions/tenure
- Social mobility/life chances and opportunities.

Mortality, morbidity and mental health follow 'a social gradient' (Bajekal and Osbourne, 2006). The higher people are on the social hierarchy the lower their risk of ill health and premature death. There is variation in self reported 'good health' for this hierarchy with 82% in higher managerial or professional occupations reporting good health and 66% for those in routine occupations but only 50% for long term unemployed or those who have never worked. England and Scotland have higher rates of self reported good health than Wales and Northern Ireland; however there is substantial variation in England and a north/south divide with lower rates of good health in the north. Females tend to report lower rates of good health than males for all ethnic groups.

In terms of mental health all neurotic disorders (including depression, anxiety, and obsessive compulsive disorders) are more common in women. Those with a neurotic disorder are more likely to be in unskilled occupations, to lack formal qualifications, to be economically inactive and to rent from local authorities and housing associations. The 'Focus on health' report states that unemployment, poor housing and poverty can be important factors in mental disorders and affect/impede recovery. Also, mental disorders can result in social and financial hardship by affecting people's ability to continue their work and maintain social relationships.

The report also states that the impact of deprived housing on health is well documented and strongly linked to income. It suggests that the social and physical characteristics of the surrounding areas are also vital in maintaining good health. The fact that 'poor quality accommodation is often situated in impoverished surroundings with few local amenities contributes further to making vulnerable individuals housebound' (Bajekal and Osbourne, 2006: 14). Those who live in social housing (self-) report lower levels of good health: 57% compared to owner occupiers at 75%.

Bartley et al. (1998: 3) in trying to explain why health inequalities persist in Britain even when income levels and life expectancy has risen over recent years cite the distribution of income as being important saying a more 'equal distribution of income seems to produce higher life expectancy'. According to Marmot (2009 and 2010) the gap between rich and poor in the UK is greater than in three quarters of the OECD (Organisation for Economic Co-operation and Development) countries. Bartley et al. argue (1998: 8) that personal identify may be a significant factor and it is worth quoting them in full as they state:

> *'what resources does each social form make available to individuals from which they may shape an identity they can live with. These considerations are most acute in the literature on disability but they may turn out to be crucial for health inequality research as a whole. Future research may well set out to discover how action is shaped by narratives people construct to make sense of their own encounters with inequality. One strategy which has been well described in the literature on illness behaviour is that known as normalisation; rather than bear the threat to self esteem inherent in an admission of a problem many will skilfully find ways to deny it. Improved understanding of an important source of the persistence of health inequality may well lie in the sensitive analysis of such strategies of denying the existence of subordination'*.

Poorer people also have greater need for health care, jobs, housing, education and transport, however they often have the least access to important life chances and resources and this has become known as the 'inverse care law'. When there are not

enough jobs for everyone the labour market keeps out those least able or willing to hold onto employment; and these are often men and women with poor health and poor skills. Once out of work people have few opportunities to break back into work as the duration of being on benefits (such as Job Seekers Allowance or Incapacity Benefit – which is being replaced by a new Employment and Support Allowance) grows and their lack of recent work experience starts to count against them (Osmond, 2008). Differences also persist between socio-economic groups in terms of risky behaviour which also potentially contributes to the explanation of why social health inequalities persist.

Williams (cited Osmond, 2008: 13) outlines an argument made by Richard Wilkinson who suggests that as identified above the distribution of wealth and the impact of relative deprivation is important. He suggests that in wealthy societies the impact of economic inequality on health seems to be partly through its effect on social cohesion 'the more economically unequal the society the more society or social order breaks down which in turn leads to a wide range of negative physical and mental health consequences'. Lack of social mobility often due to educational inequalities can also impact on health and a key focus of government is on trying to build people's capabilities so they can obtain better jobs in the future and provide fairer chances for people to fulfil their potential (Cabinet Office, 2008).

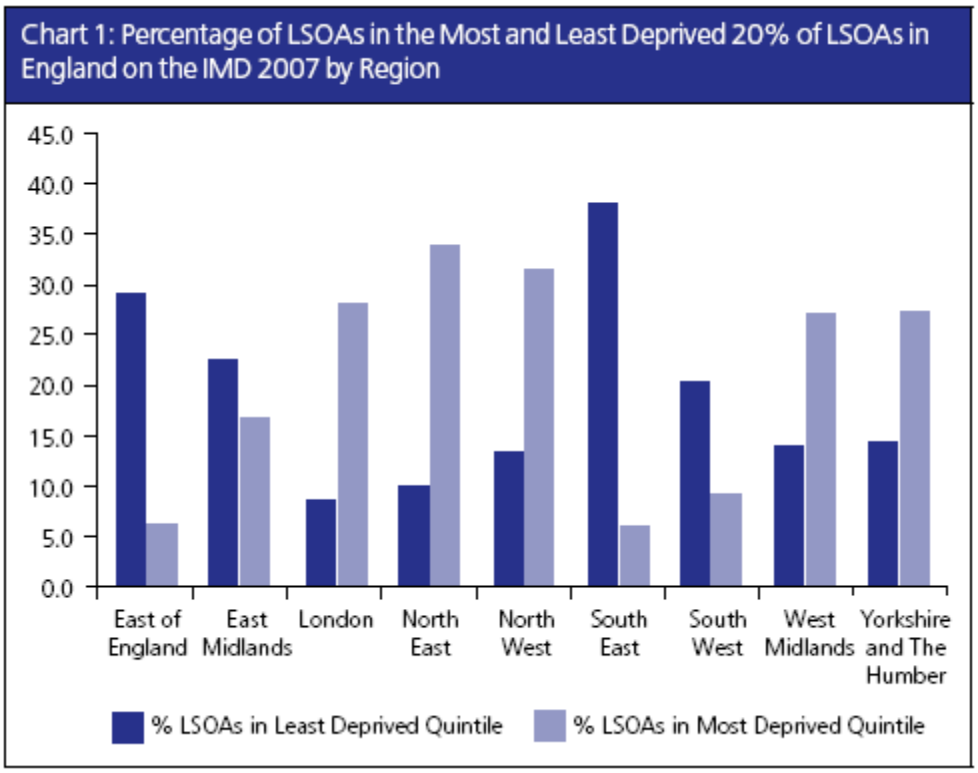


Figure 4: Percentages of most and least deprived areas in England (taken from Department of Communities and Local Government, 2007).

Figure 4 shows the North East and North West have the greatest percentage of deprived Lower layer super output areas in England.

Ethnic differences

In terms of ethnicity, some differences have been identified for particular groups. For example the Health Survey for England in 2004 found that Bangladeshi, Pakistani men and women and Black Caribbean women were more likely to self report bad or very bad health than the general population (Sproston and Mindell, 2006). Diabetes was more prevalent in Bangladeshi men and Pakistani and Indian men and women. Mean BMI (body mass index) was lower for Chinese, Bangladeshi and Pakistani men than the general population; however it was higher for Black Caribbean and Black African women. Apart from Irish men and women and Black Caribbean men participation in physical activity was lower in minority groups than in the general population. Black and minority ethnic groups are more likely in Britain to live in major cities, particularly inner cities (apart from London where there are more in the outer city). Pakistani and Bangladeshi people according to Dorsett (1998) are most likely to live in deprived areas.

4.2.2 What has and is being been done to address health inequalities?

In 2008, Professor Marmot was asked to advise the Secretary of State for Health on the future of a health inequalities strategy for England post 2010 (Marmot, 2009). The first phase report highlights that although life expectancy has increased the gradient in life expectancy between different social groups persists. The final report suggests that understanding of the social determinants of ill health has improved and there is better evidence of:

- Cumulative effect of disadvantage over life course. Economic advantage and disadvantage reinforce themselves across the life cycle, and often on to the next generation (National Equality Panel, 2010:1)
- The way early childhood impacts on health and disadvantage over the life course
- Role of mental well-being in shaping physical health and in contributing to life chances
- Biological mechanisms which direct/indirectly link stress and people's level of control over their lives to negative health outcomes (Marmont, 2010).

Since the 'Black' report (Department of Health and Social Security, 1980) and the 'Health Divide' (Whitehead, 1988) report outlined the issues of health inequality in the 1980s, policy makers have developed a range of broad interventions that act on the social determinants of health such as creating a minimum wage, investing in education, promoting work and flexible working and investing in neighbourhoods through schemes such as 'Neighbourhood renewal' which aims to tackle deprivation (Department for Communities and Local Government, undated). The 'New Deal for Communities was a major area based intervention to tackle deprivation in 39 of the most deprived areas in England the majority of which are in urban areas (Beatty et al., 2009).

In Wales 'Heads of the valleys' is a 15 year regeneration programme and strategy to tackle the causes of economic inactivity. The Valleys is the largest long lasting regeneration region in the UK in which there are issues of unemployment, high levels of morbidity, poor housing and low levels of workforce skills (Osmond, 2008). One of the key themes of the strategy is the need for an attractive and well used natural, historic and built environment. In Scotland £95 million of European funding is being used to create 129 projects across Scotland to develop the workforce and regenerate communities. Training and skills development will be an important part of the programme (SG, 2009c). The current recession in the UK will probably slow or delay progress that has been made in trying to reduce the gap between the rich and poor and reduce childhood poverty.

4.2.3 Is there an identified role for urban woodlands and green space?

In the Marmot (2009) review, task groups have been created to identify new evidence where action is likely to be most effective in reducing health inequalities. Two task groups are particularly relevant to this current scoping review: the 'built environment', and 'sustainable development'. The 'built environment' task group states that green infrastructure enables urban healthy living and encourages physical activity. The task group suggests a park or supervised play area should be within a four minute walk of every family home, it should be of good design and family friendly. The importance of green infrastructure in promoting active travel is also highlighted as a way of promoting public health. Community allotments and gardens are also outlined as important, particularly for older people.

The 'sustainable development' task group talk about the importance of investment in quality green space, especially in deprived areas and that this should include a tree planting programme for residential streets. The group explicitly states that the health system should promote contact with the natural environment, recognise the benefits of this and promote it in communities as well as on the NHS estate. General Practitioner referrals to green gyms[4], blue gyms[5] and health walks are advocated, with NICE (National Institute for Clinical Excellence) being called on to evaluate the effectiveness of these approaches. Marmot (2009:32) also argues that 'by increasing access to green space from every home and taking action to make public space in deprived areas less threatening, harmful and stressful the improvement for those in disadvantaged areas is likely to be proportionately greater than for others'. A key policy recommendation by Marmot (2010) is to improve quality green spaces available across the social gradient.

[4] Green gyms run by the British Trust for Conservation Volunteers aim to increase fitness and well-being through practical voluntary conservation activities.

[5] Blue Gyms aim to encourage use of the sea, lakes, canals and rivers. The Blue gym project is being piloted in South West England through Natural England, the Environment Agency, Department of Health and the Peninsula Medical School.

5. Trees, woods and forests in urban areas

5.1 The history of the urban forestry concept

There is a long tradition of provision of public green space in Europe. This can be traced back to the 19th century when significant efforts were made to increase public green space as a result of industrialisation and the increase in urban populations as it was believed that urban green space could contribute to the health and well-being of the largely working class urban population (Konijnendijk et al., 2006: 97). However, for many decades different types and areas of urban green space were managed and designed independently of each other and more integrated approaches did not emerge until much later (Konijnendijk et al., 2006: 97). Urban forestry is an integrated approach.

Significant socio-economic changes in the post-industrial, developed world (in particular urbanisation) have demanded structural change in the forestry sector. As the populations of towns and cities have grown, a phenomenon has been experienced which Konijnendijk (2003: 174) refers to as 'the dramatic 'urbanisation' of the forest', with a 'growing part of the forest resource…[coming] under urban influence, both directly (i.e. becoming incorporated into the interface or located at the interface with urban areas) and indirectly (as urban uses and values have also come to dominate more remote forest areas)'.

In recognition of these changes, the urban forestry concept originated in the 1960s in North America and 'not only dealt with city trees or with single trees or with single tree management, but also with tree management in the entire area influenced by and utilised by the urban population' (Randrup et al. 2005: 12). The concept was initially met with some resistance from both foresters (who did not see the management of single trees or small urban green areas as part of their role) and those who had traditionally managed urban parks and trees (who did not welcome the prospect of foresters interfering in what they perceived as their domain) (Konijnendijk et al., 2006: 97).

Nonetheless, it gradually gained more support from both sides and in the 1980s the term urban forest was first introduced in the UK (Konijnendijk et al., 2006: 97). Following from this, the Forest of London project was the first city-wide urban forestry project in Britain, aimed at using 'tree planting and management as a tool for social, economic and ecological regeneration' (Randrup et al., 2005: 13). Other similar 'Forest of …' projects ensued over the coming years and twelve Community Forests were established near metropolitan areas in England to provide environmental, social and economic benefits to urban communities and to work with them to achieve this

(Konijnendijk et al., 2006: 98-9; Randrup et al., 2005: 13). Many benefits have been attributed to urban forestry and in recent times there has been a growing interest in the health and well-being aspects of these benefits which we will discuss further in sections 6 and 7.

5.2 Defining urban forestry

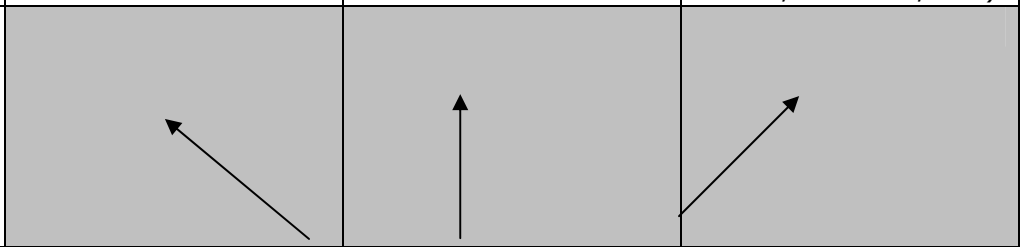
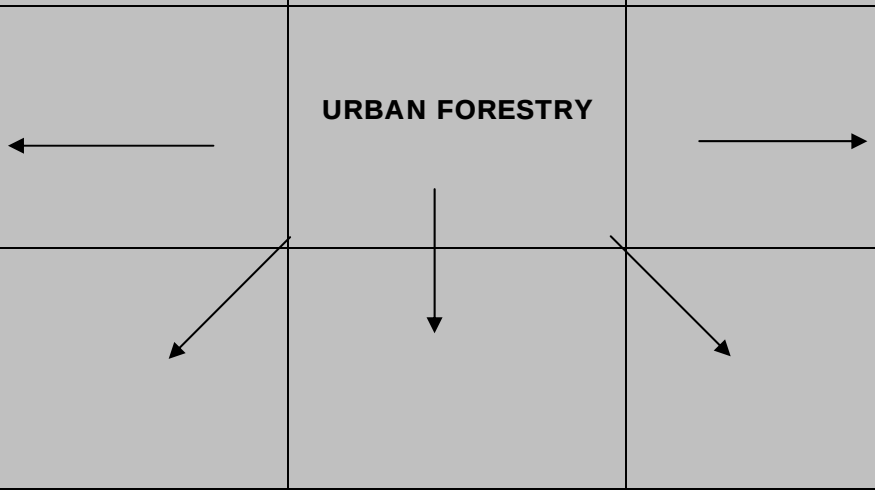
Urban forestry has been defined in many ways and is a contested concept. It can be viewed narrowly as simply referring to woodland in or near urban areas. At the other end of the spectrum, according to Konijnendijk et al. (2006: 94), urban forestry as a concept should be viewed as much more encompassing than this: 'Urban forestry…looks at urban greensapce from an integrative perspective, considering individual green space elements as part of an integral whole. [It] focuses on urban green space comprising of tree stands as well as individual trees. It is multidisciplinary and does not only involve foresters.'

In a Forestry Commission urban forests handbook, urban forests were defined as 'trees grown in and close to urban areas for their value in the landscape, for recreation, and including trees in streets, avenues, urban parks, on land reclaimed from previous industrial use, as well as those in urban woodlands and gardens' (Hibberd quoted in Randrup et al., 2005: 14). Randrup et al., (2005: 18) have developed an urban forestry matrix which usefully captures this integrative scope (Table 4).

Randrup et al. (2005: 15) also go further in aiding our understanding of the concept of urban forestry, defining it in the following terms:

- It is integrative, incorporating different elements or urban green structures into a whole (i.e. the urban forest)
- It is strategic, aimed at developing longer-term policies and plans for urban tree resources, connecting to different sectors, agendas and programmes
- It is aimed at delivering multiple benefits, stressing the economic, environmental and socio-cultural goods and services urban forests can provide
- It is multidisciplinary and aiming to become interdisciplinary, involving experts from natural as well as social sciences
- It is participatory, targeted at developing partnerships between all stakeholders.

Table 4: Urban forest matrix (Randrup et al. 2005: 18)

	The urban forest		
	Individual trees		**Urban woods and woodland** (forests and other wooded land, e.g. natural forests and plantations, small woods, orchards, etc.)
	Street and roadside trees	Trees in parks, private yards, cemeteries, on derelict land, fruit trees etc.	
Form, function, design, policies and planning			
Technical approaches (e.g. selection of plant material, establishment methods)			
Management			

5.3 The Forestry Commission and urban forestry

The public forest estate in Britain has relatively limited coverage in urban areas, as illustrated by Map 4 (Appendix B). Therefore, the Forestry Commission has had to adopt various strategies to further the urban woodlands and health agenda. Increasingly, targeted grants have been provided to promote urban woodland-related activities and management and as Konijnendijk (2003: 181) observes, Britain has issued an afforestation policy which gives urban areas 'the highest priority'. Woodland grant schemes thus favour urban settings. The FC in all three countries has been working progressively more in partnership with other agencies and woodland owners to develop projects and initiatives aimed at urban TWF and urban communities. Indeed, the majority of projects and initiatives that the FC leads or is involved in, and which focus on health, well-being and social benefit, are located in urban and peri-urban woodlands or

on 'honey-pot' FC sites (some of the larger public forests with good recreational facilities).

5.3.1 England

Forestry Commission England (FCE) has developed several projects aimed at demonstrating the benefits TWF's can have on health and well-being. For example, the Chopwell Wood Health Project aimed to explore whether TWF had a positive impact on people's health and well-being and raised awareness of the health benefits of woods. It included guided walks, GP referrals to certain activities and school visits. Similarly, the Capital woodlands project sought 'to raise appreciation of London's woodlands and increase public benefits and participation by undertaking access, biodiversity, community and training work both in six flagship woodlands and throughout the capital' (Capital Woodlands, 2009). This project was a three-year London Biodiversity Partnership initiative running from 2006 to 2009 and supported by the Heritage Lottery Fund. The lead partner was Trees for Cities, with other partners including the FCE, British Trust for Conservation Volunteers, various London Boroughs, Peabody Trust, Natural England and the Greater London Authority. Trees for Cities also have urban tree planting programmes in Bristol, Leeds, Greater Manchester, Reading, Brighton, the Midlands, Sheffield and Nottingham, as well as some international projects (Trees for Cities, 2009). The Capital woodlands project included work to empower local communities and to enable the woodlands to become celebrated as an invaluable natural resource (Capital Woodlands, 2009). This is an example of the FCE working in partnership on a project where the main focus was not on public forest estate woodlands in order to further the urban woodland agenda.

Another partnership venture that FCE have been engaged with as a core partner is a major regeneration scheme in the Northwest of England called the Newlands project, which is reclaiming large areas of brownfield, derelict land to help create community woodlands. This is a £59 million project; it was initiated in 2003 and has continued to evolve since then. Although there is a strong emphasis on economic outcomes and regeneration, the project also concerns itself with environmental and social outcomes and the health and well-being benefits to be gained from urban woodland:

> '*What in many cases was 'no-go' land has been successfully reclaimed for the local community thanks to the work of Newlands. Through regeneration of these sites, Newlands helps to restore pride and encourage community cohesion. Good quality environments encourage people out of their homes and into public spaces where they interact and build social relationships. Healthier living is designed in, by both informal and formal means. Cycle paths, sports equipment and footpaths along with open spaces provide plenty of opportunities for people to get active'* (Newlands, 2009: 9).

FCE has also been involved in various 'Active England' projects. The Active England programme began in 2003 with £94.8 million funding from Sport England and the Big Lottery with a central aim of increasing participation in physical activity and sport in England (O'Brien and Morris, 2009: 3). As part of this, five, three-year woodland-based projects were developed in 2005/6 with various other partners, three located on specific sites within the public forest estate and two within Community Forests where activities took place across a range of sites. The focus was on specific target groups that had been identified as being under-represented in sport, including women and girls, the disabled, black and minority ethnic (BME) groups, those under 16 years of age, those aged over 45, and people on low income (O'Brien and Morris, 2009). Work undertaken within the different projects included the development of programmes of facilitated access such as cycle rides and health walks, infrastructure improvements and community outreach work.

Targeted Woodland Improvement Grants (WIG) have also been used in England to support Forest Schools in East Anglia and the West Midlands, and a WIG in the West Midlands targeted health by providing grants to create projects that would encourage people to use woods to improve their health and well-being.

5.3.2 Scotland

In Scotland there are numerous examples of initiatives that demonstrate FCS's commitment to utilising forests to improve health in urban areas. For example, the Khush Dil (happy heart) initiative was established in central Scotland to encourage BME groups (who reside mainly in the large conurbations) to use woodlands for their health, and the Branching Out project offers people, experiencing mental health problems in the Greater Glasgow area, conservation and green space activity on referral.

However, the Woodlands in and Around Towns (WIAT) Programme 'provides the core focus for FCS work on improving quality of life in towns and cities' (FCS, 2008: 3; Frost, 2009). The first phase of this initiative ran from April 2005 to March 2008 with £30 million capital investment in over 110 urban woods across Scotland. The second phase was launched in May 2008 and will run until March 2011 with £24 million funding. It is concerned with contributing to the health and well-being outcomes of the Scottish Forestry Strategy (FCS, 2008: 8) and the aims of the programme are to: bring neglected urban woodland into sustainable management; create new woodland and; work with local communities to help them use their local woodland. The programme concentrates only on woodland or woodland creation within 1km of settlements with a population of over 2,000 people and within these zones, deprived areas are prioritised. The justification for such a strong concentration on urban woodlands is given as: 'most people in Scotland live in towns and cities. It therefore makes sense to focus some resources for woodlands for people in these areas' (FCS, 2008: 7). The programme is also contributing to green networks.

Targeted grants for woodland creation and management are available through the Scottish Rural Development Programme (SRDP) and additional contributions are available for woodland creation of at least 1ha in WIAT areas as an incentive. Funds are also available through the WIAT challenge fund and the Forestry for People challenge fund. The WIAT Challenge fund focuses on projects to bring neglected 'woodland into active management by supporting woodland planning, management, and recreation in WIAT woodlands' (FCS, 2008: 14). This is complemented by the Forestry for People funding programme which is aimed at encouraging local involvement in woodland projects for community strengthening, health and learning. In terms of the public forest estate, the intention is to purchase woodland and areas for woodland creation within the WIAT area. Furthermore, FCS is looking to develop 'partnerships to manage urban woodland owned by others' (FCS, 2008: 15).

A national network of WIAT demonstration sites, covering the four city regions of Scotland, is currently being developed (FCS National Committee, 2009: 3). The idea behind this is to establish a network of sites which will provide a strategic focus for the targeting of future resources and to develop exemplars of sustainable forest urban management that demonstrate the array of benefits which can be delivered through the WIAT programme. As well as meeting the existing WIAT woodland criteria as described above, in choosing the sites use will also be made of a tool developed by FCS called 'SIFT' – Social outcomes through Investment in Forestry Tool, which is being employed to help enable the prioritisation of areas for the delivery of FCS's social policies and programmes. This tool uses Geographic Information System (GIS) spatial datasets to assess the social benefits from woodland creation or management proposals in terms of: improved health and well-being; woodland to benefit people from deprived areas; more use of woodland for access and recreation; more woodland-based outdoor education (all ages); more woodland-based outdoor education (Secondary); and more woodland-based outdoor education (Primary) (FCS, 2009c).

5.3.3 Wales

In Wales, an example of a prominent FCW initiative that was undertaken to contribute to the health agenda was Cydcoed, which ran over two phases, 2001-2004 and 2003-2008. It was an £18 million pound programme and was funded through the EU Objective 1 programme and the Welsh Assembly Government (FCW, 2009b). Cydcoed 'was aimed at, but not exclusive to, two key areas: communities classified by the Wales Index of Multiple Deprivation as being the most deprived and; communities where the population has no access to community green space for relaxation and exercise' (Forest Research, Social and Economic Research Group, 2008a: 1). The Cycoed programme gave grants to 163 community groups to assist with community forestry initiatives and an evaluation of the programme concluded that the Cydcoed project woodlands helped increase regular physical activity (Forest Research, Social and Economic Research Group, 2008a: 3). Some of the reported outcomes of the programme included using woodlands to: create

new employment opportunities; enhance social capital and empower communities; promote conservation, recreation and education 'as well as improving more than 37,500 hectares of Welsh woodland and creating a further 227 hectares of new woodland' (FCW, 2009b).

FCW were also a partner in the Treegeneration initiative, an urban forestry pilot project which ran from 2003 to 2008 (FCW, 2009c: 5). The project focused on the counties of Flintshire and Wrexham in north-east Wales and was aimed at determining the scope for a national urban forestry initiative (Forest Research, Social and Economic Research Group, 2008b). Through the initiative, advice, practical help, support and awareness raising activities were undertaken, accompanied by the provision of grant aid of up to 75% of costs for community groups, schools, environmental groups, individuals and up to 50% for businesses carrying out tree planting schemes and associated community development (FCW, 2009: 5). In total, Treegeneration supported 27 planting schemes in urban sites with a total grant aid expenditure of £115,342 (70% of the total cost of the schemes, which was £164,205) (FCW, 2009c: 5). The main outputs from the initiative were: 30 hectares of woodland creation; 59,300 native trees planted; 308 non-native trees planted and; 2,200 people involved in tree planting' which, among other things, contributed to improved access to trees and woodlands for some urban communities (FCW, 2009c: 6).

As previously mentioned in section 4.2.2, the 'Heads of the Valleys' is a 15-year regeneration programme backed by the Welsh Assembly and developed in partnership with five local authorities (Thomas and Pitcher, 2008: 1). As the largest landowner in the designated area, FCW is an active partner (FCW, 2009d). The £500 million programme began in 2006 and covers some of the industrialised valleys in South Wales where many deprived communities reside (WAG, 2006b). It is fundamentally about encouraging people to move into the area and decrease the numbers leaving but there are five priority themes, one of which is aimed at securing 'a well educated, skilled and healthier population' (FCW, 2009d; Thomas and Pitcher, 2008: 2). In the summer of 2009, FCW appointed a Heads of the Valleys project officer, 'responsible for promoting the importance of forests and trees to the regeneration project' and finding 'new ways of putting trees and woodlands into the urban landscape' (FCW, 2009d).

5.4 Accessibility of urban green space and TWF

Despite the benefits of urban green space and woodland, many people do not have easy access to such areas, either in physical terms due to distance from home, lack of roads etc., or because of other barriers. For example, a park or wood may be close to where people live but if it is considered unsafe then it is not accessible: 'a wood that a healthy man finds easy to use may be out of the question for a mother with toddlers, a lone woman, old people or those who have mobility problems' (The Woodland Trust. 2004: 14). Evidence suggests that the benefits gained from green space and woodlands are

unevenly distributed throughout society and some groups, such as those living in deprived areas see little of these benefits (Weldon et al., 2007: 2). For example, 'The Comedia and Demos report found that elderly people, ethnic minorities, women and people with disabilities were under represented as users of parks and such findings are applicable to woodlands' (Scotland and Northern Ireland Forum for Environmental Research. 2005: 90).

On the one hand, this can be attributed to the existing quantity and location of green space and woodland. As the Royal Commission on Environmental Pollution (2007) argue, green spaces need to either be well serviced by public transport or be cited close to where people live since in many cases people will only travel short distances to green space, which is particularly true of the distances that children (especially unaccompanied) travel.

As previously mentioned in section 3.2.4, Natural England has developed an access standard for green space. Barbosa et al. (2007) confirm that meeting this standard is a problem in at least some urban areas through their research on Sheffield, which found that 'a worrying proportion of Sheffield households fail the government's access targets' with only 36.5% of urban households achieving the Natural England standard (Barbosa et al. 2007: 194; Barbosa et al. 2007: 190). Also previously mentioned is The Woodland Trust access standard for woodland which is documented in 'Space for people: targeting action for woodland access' (The Woodland Trust. 2004). In formulating this standard, an inventory of accessible woodland was undertaken in partnership with the Forestry Commission and the Northern Ireland Environment and Heritage Service, known as the 'Woods for People' project, which is ongoing. The results of the first phase of this work are shown in Table 5. This project has found that there is not enough woodland cover in the UK to meet either the social or biodiversity requirements of the country (The Woodland Trust. 2004: 4).

The Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) undertook a research project titled, 'Investigating environmental justice in Scotland: links between measures of environmental quality and social deprivation' (2005). This study found that in urban Scotland, the percentage of the population living within 600m of woodland greater than 2 hectare in size was lowest in the most deprived sectors (deciles 1-3) of urban society, (at 54.8, 57.1 and 53.4 percent respectively), and highest in the least deprived sectors (deciles 7-10 at 60.4, 59.5, 62.9 and 65.1), with deciles 4-6 falling in between (SNIFFER, 2005: p.93). However, the results were more encouraging in terms of *new* woodland with decile 1 (the most deprived) gaining most in terms of woodland creation, with 18.1% of the decile 1 urban population living within 600m of new woodland (SNIFFER, 2005: 94). This suggests that the problem of a lack of woodlands in deprived areas has been recognised in Scotland and is beginning to be addressed.

Table 5: Permissively accessible woodland as a proportion of woodland area by Country and Government Office regions (The Woodland Trust, 2004: 8)

Country/Government Office region		Woodland area*	Publicly accessible woodland (permissive)	
			Woods for People dataset**	% of woodland area
Country	**Area (ha)**	**Area (ha)**	**Area (ha)**	
England	13,295,236	1,059,771	488,240	46
Northern Ireland	1,431,496	115,192	82,385	72
Scotland	8,023,384	1,339,736	813,074	61
Wales	2,122,450	281,171	149,741	53
Region				
East Midlands	1,581,477	74,443	35,503	48
Eastern	1,957,502	117,004	56,707	48
London	159,472	6,074	4,300	71
North East	867,642	104,460	97,427	93
North West	1,491,831	94,314	50,936	54
South East	1,941,293	267,756	94,573	35
South West	2,439,224	213,612	72,165	34
West Midlands	1,300,380	88,667	28,557	32
Yorkshire and the Humber	1,556,415	93,398	48,072	51

* Woodland area taken from national Inventory of Woodland and Trees (Great Britain) and the Ordnance Survey Woodland Vector maps (Northern Ireland)

** Woods for People research, Woodland Grant Scheme (Walkers Welcome). Forestry Commission Estate, Woodland Trust sites

Although there are issues with levels of green space and woodland, barriers to their access go beyond their abundance or the distance they are from people's homes. The Urban Green Spaces Task Force reports that there are 5 main social barriers: '(i) poor condition of facilities (ii) other undesirable users (iii) concerns about dogs and dog mess (iv) safety and other psychological issues and (v) environmental quality issues such as litter, graffiti and vandalism' (Royal Commission on Environmental Pollution, 2007).

Surprisingly, Barbosa et al. (2007: 194) found that in Sheffield the least affluent and elderly appeared to have the greatest access to green space. However, they also admitted that their study only took into account distance to public green space and did not consider quality of green space or investigate actual usage, yet these factors are of equal importance. For example, a study of Melbourne, Australia by Crawford et al. (2008: 891) found that public open spaces in the highest socioeconomic neighbourhoods tended to have more features and amenities that would encourage usage, such as paths, lighting, signage etc. than those in lower socioeconomic neighbourhoods. However, as

Weldon et al. (2007: 7) argue there is also a need to engage with local communities and hard to reach groups to improve their usage of these areas and encourage them to reap the benefits woodland and green space can provide.

Greenspace Scotland has commissioned survey work to investigate the public usage of green space in urban areas in Scotland. In their 2009 survey, 63% reported that they used their local green space once a week or more often and at the other end of the scale, 19% visited green space six times a year or less (Progressive Partnership, 2009: 5). It was also found that the elderly were less likely to use green space than those who were younger and that those respondents living in the most deprived areas were less likely to use green space on a regular (at least weekly) basis then those in more affluent areas (Progressive Partnership, 2009: 5). However, when asked if they considered it important to have green spaces in their local area, all respondents agreed that it was, confirming that green space is seen as a key component in the urban landscape and in urban communities (Progressive Partnership, 2009: 26).

To give us some idea of the numbers of people visiting woodlands in the UK, especially in urban areas we can look to the FC household-based public opinion of forestry survey which is undertaken every two years. The results for 2009 show that 77% of respondents in the UK said that they had visited forests or woodlands in the last few years for recreational purposes (Forestry Commission, 2009: 22). Of those that had visited forests or woodland, 64% reported that they had visited woodlands in and around towns compared with 86% that had visited woodlands in the countryside, with 48% stating that they had visited both (Forestry Commission, 2009: 26). 'This pattern is similar to previous years, although the proportion of respondents reporting visiting woodlands in and around towns is significantly higher than it was in 2005 (64% in 2009 in comparison with 52% in 2005)' (Forestry Commission, 2009: 26). Thus, it seems people are more likely to visit woodland in the countryside but the likelihood of them visiting urban woodland is increasing.

6. Links between urban forestry and health

6.1 Health benefits of urban forestry

Research examining the health benefits of access to green space is extensive, and a comprehensive review has become near impossible. While it is difficult to provide a high level of evidence for all health outcomes investigated, the number and relative consistency of studies is persuasive. This section reviews a broad range of studies in this field, summarising key findings and gaps in knowledge. There have been several recent reviews that share common ground with the current review (Tzoulas et al., 2007; Davies and Deaville, 2008; Maller et al., 2008), but these have been concerned with green space or nature in general, and do not include the many studies published in the past 2-3 years. Here the relationship between green space and health is assessed with particular attention to the relationship between urban forests and human health.

93 empirical journal articles were identified examining some aspect of the relationship between urban forests and health. These are briefly summarised in Table 6 and outlined in more detail in appendix E.

Table 6: Summary of review of literature regarding health benefits of green space

Health indicator category	Examples of indicators	Number of studies	Research strategies	Overall findings
Long-term physical health benefits	Mortality, obesity, recovery from surgery	14	Cross-sectional (7), epidemiological (5), quasi-experiment (1), longitudinal (1)	Positive association
Short-term physical health benefits	Heart rate, blood pressure, muscle tension	7	Experiment (7)	Positive association
Long-term self-reported health indicators	Self-reported health or stress, attentional capacity, well-being	28	Cross-sectional (25 – 16 quantitative, 9 qualitative), longitudinal (2), quasi-experiment (1),	Mixed findings
Short-term attentional and cognitive function indicators	Directed attention, mood state, self esteem	10	Experiment (5), Cross-sectional (4)	Positive association
Physical activity	Distance, size and quality of green space and physical activity	22	Cross-sectional (22)	Mixed findings
Community cohesion	Social interaction, crime statistics, feelings of safety	12	Cross-sectional (12)	Mostly positive association

6.1.1 Long-term physical health indicators

A small number of studies have provided evidence of long term physical health benefits of urban green space (Appendix E, Table E1). The health indicators included here are ones that have relatively stable physical characteristics, which can be independently observed and are likely to be of particular interest from a public health perspective. These include mortality and life expectancy (e.g. Takano et al., 2002a; Hu et al., 2008), obesity (e.g. Ellaway et al., 2005; Mujahid et al., 2008), prevalence of asthma (Lovasi et al., 2008) and recovery from surgery (Ulrich, 1984).

Work in this field makes use of independently observed presence of green space defined in a general way, often simply the presence/absence of green space within a neighbourhood. Several studies draw on geographical information to calculate distance from any green space or percentage of green space in a neighbourhood. Only one study (Lovasi et al., 2008) deals specifically with the relationship between street trees and health outcomes.

A few studies use whole population epidemiological approaches, but the majority use cross-sectional designs. This reflects the practical and ethical constraints on using experimental designs to test questions of long-term health. Only one study Hartig et al., 2007) was found using a longitudinal design.

Each study examining long-term physical health benefits reports a positive association with green space. No studies were found to report negative or no association. A recent study by Maas et al (2009a) is particularly valuable since it draws on records of General Practitioners to examine relationships between green space and multiple disease clusters. They found the relationship was strongest for mental health indicators.
Taken together, the studies provide a persuasive picture yet the body of work is limited by:

- Little replication of studies of the same health indicators across different geographical areas.
- Little attention is given to issues of quality and access to green space, or to types of green space (for example distinguishing between playing fields and woodlands).
- Urban forest elements such as street trees are generally not included in green space definitions.
- Little use of longitudinal studies to enable better understanding of the cause and effect relationships between green space and long-term physical health indicators. These studies are complex and expensive but could provide significant insights into casual relationships regarding urban health.

6.1.2 Short-term physical health indicators

A number of studies have observed short-term physiological responses to exposure to nature (Appendix E, Table E2). Health indicators typically include heart rate and blood

pressure (e.g. Pretty et al., 2005) and muscle tension (e.g. Chang et al., 2008). Usually these studies are laboratory based and use an experimental design. Nature is presented in simulated form, using photographs, video or computer simulations (e.g. Ulrich et al 1991). A smaller number of studies compare responses to different types of actual environments (e.g. Gathright et al., 2006; Hartig et al., 2003a).

Studies use a range of physiological measures, but present a consistent pattern of results. Observing or exercising in more natural environments is associated with lower heart rate, blood pressure and other physiological stress indicators. There are some challenges in generalising from these studies to urban forest contexts. The studies often compare urban and 'natural' scenes. This makes it difficult to determine whether TWF in urban contexts will also provide similar benefits. The study by Parsons et al. (1998) is particularly helpful in its comparison of scenes with different levels of nature/artefact. Their findings demonstrate that driving in urban areas with higher levels of nature can result in better short-term health outcomes. The ecological validity of the laboratory studies may be low, although Gathright et al. (2006) note the challenges of making physiological observations in the field, but their findings are nevertheless consistent with the laboratory studies.

In summary, research on short-term physical health indicators provides persuasive evidence of health benefits. At the same time, the body of work would be strengthened by:

- Further field-based experiments.
- Specific studies to determine health benefits of urban forests, particularly the presence of street trees.

6.1.3 Self-reported long-term health indicators

Many studies have examined self-reported health benefits in relation to urban green space (Appendix E, Table E3). These health indicators are relatively stable ones that depend on participants' (or their parents' or teachers') subjective observations, examples include self-reported health (e.g. Mitchell and Popham, 2007) and stress (e.g. Grahn and Stigdotter, 2003), longer-term attentional capacity (e.g. Kuo, 2001), and well-being (e.g. Kaplan, 2001). The majority of these studies use cross-sectional designs. Most use structured self-report quantitative approaches to measuring health benefits; others use more qualitative explorations of these relationships.

Quantitative studies tend to characterise green space in simple ways, based on abstract quantification of presence or distance from green space. For example, Maas et al. (2005) based analysis on percentage of green space in a 1km and 3km radius. As noted earlier, this means that issues of access and quality of green space are not always taken into consideration, and some elements of urban forests are excluded, especially street trees.

Kuo (2001) and Wells (2000) provide important exceptions here since they deal with areas of green space in immediate residential surroundings.

In contrast, qualitative studies provide insights to a wider range of more specific interactions with green space. For example, some studies focus on interactions with a specific woodland (e.g. O'Brien, 2006), or participation in a particular programme of activities within green spaces (e.g. Milligan and Bingley, 2007). This offers strength in enabling better understanding of the specific elements of urban forests that contribute to experience, but also presents challenges to generalisation of results.

Quantitative studies almost all report health benefits associated with access to urban green space. There is only a single exception to this. Sugiyama et al. (2008) examined the relationship between quality of neighbourhood open space and life satisfaction and self-reported health. Their study dealt only with older residents of Britain. While they found a positive association for life satisfaction, they found no association for health. There is potential that satisfaction with life can/might have an impact on people's health.

Qualitative studies provide a more complex picture. Milligan and Bingley (2007) make it clear that woodlands can be scary places as well as restorative environments. A number of studies highlight that while many people report significant health benefits from access to urban forests, these benefits depend on management of safety, user conflict, leadership and governance issues (O'Brien 2005; O'Brien and Snowdon 2007; Kingsley 2009). The quantitative work by Mitchell and Popham (2007) also provides a more nuanced perspective. They found that while in general a higher proportion of green space in an area was associated with better health, this relationship varied with urbanity and level of income deprivation within an area. For example, they found that in lower income suburbs a higher proportion of green space was actually associated with lower self-reported health. Mitchell and Popham suggest this points to the importance of access and quality of green space in determining benefits for health.

Overall, this area of research presents considerable evidence regarding the health benefits of urban forests. However:

- Almost all studies use a cross-sectional strategy, only Nordh et al. (2009a) and Wells (2000) uses a longitudinal design.
- Few studies integrate qualitative and quantitative indicators. Multidisciplinary research (e.g. Kessel et al., 2009) could provide significant benefits for understanding the role of green space, and particularly urban forests, in the health of urban communities.

6.1.4 Attention and cognitive function indicators

A number of studies examine attentional and cognitive function benefits associated with short-term exposure to nature (Appendix E, Table E4). The majority of these examine

attentional capacity, operationalised as symptoms of attention deficit disorder (e.g. Kuo and Taylor, 2004) or directed attention performance (e.g. digit span recall tasks used in studies by Cimprich and Ronis, 2003). Other studies consider benefits for mood and self esteem.

These studies have been conducted across a range of locations or types of green space, both simulated (e.g. Hartig et al., 1996) and actual environments (e.g. Bodin and Hartig, 2003). A number examine effects of exposure in typical urban forest settings (e.g. view to trees; time spent in a neighbourhood park; visit to urban arboretum) and demonstrate benefits are obtained in such settings. Together these studies present very solid evidence that exposure to green space, including urban forests, provides benefits for cognitive function.

6.1.5 Physical activity

Physical activity has been positioned as both a health indicator and a mechanism for explaining the health benefits of time in natural environments (Maas et al., 2008). A large number of studies (most published since 2008) have considered whether access to green space, particularly in urban settings, leads to higher levels of physical activity. Many of these are summarised in Appendix E, Table E5, but this is unlikely to be comprehensive.

This body of literature has developed rapidly in very recent years, and is increasingly focused on understanding the particular characteristics of green spaces that support physical activity. Seven studies have examined the importance of distance from green space, and findings are varied. Three studies reported that physical activity increased with proximity to green space (Giles-Corti et al., 2005; Neuvonen et al., 2007; Sugiyama et al., 2009a), while others found no association or that the relationship varied with age or gender (Foster et el., 2004; Lackey and Kaczynski, 2009; Kaczynski et al., 2009). Five studies examined the relationship between density or number of green spaces and physical activity, and again reported mixed results. Other characteristics investigated included size, quality, accessibility, restorative qualities and attractiveness of green space. These studies report positive associations with physical activity indicators, but the small number of studies makes generalisation difficult. Tilt (2009) was one of very few studies to consider the association between street trees and physical activity.

The evidence for the relationship between green space and physical activity is quite mixed, and demonstrates some of the complexities in social relationships to green space. The presence of green space alone is not sufficient to explain physical activity (Maas et al., 2008; Cochrane et al., 2009). As previously mentioned in section 5.4, other environmental characteristics need to be taken into consideration including quality and accessibility. Factors such as gender, age and perceptions of safety are also important.

6.1.6 Community cohesion

Social contact fostered by green space has also been posed as a mechanism explaining the health benefits of green space (Mass et al., 2009b). A number of studies explore this relationship (Appendix E, Table E6), using both qualitative and quantitative approaches to examine impacts on diverse indicators of quality of community.

Almost all the quantitative studies have been undertaken in highly urbanised, often deprived contexts. In many of these studies, green space indicators have generally relied on trained observation of nearby vegetation in residential areas (e.g. Kuo et al., 1998). Some have used larger scale indicators such percentage of green space within 1km and 3km radius of residence (e.g. Maas et al., 2009b). Westphal (2003) took a very different approach and examined interactions with an urban greening programme.

While the majority of studies report positive associations, several also note the complexity of this relationship. Benefits may not be experienced equally by all social groups (Ravencroft and Markwell, 2000). Governance and leadership can be important for harnessing community benefits (Westphal, 2003). In very urban areas, the relationship may be complicated by sense of safety, and enclosing vegetation may contribute negatively to community interaction (Maas et al., 2009c).

6.2 Urban forest and urban health inequalities

While there is a considerable amount of support for the relationship between green space and health, little of this provides insight to the role of urban forests in socially deprived settings. However, there is increasing recognition of the importance of this question. This is reflected in a small number of recent articles (most notably Mitchell and Popham, 2008), comments (Hartig, 2008; Woo et al., 2008), and in a review by Strife and Downey (2009). The latter review focuses on developing a research agenda for issues of childhood development.

Some studies have specifically targeted urban deprived communities. These demonstrate green space can provide benefits for such communities. These represent research across a number of health indicators. Kuo (2001) and Wells (2000) both investigated the impact of green space on children's cognitive function, focusing on children living in highly urban, deprived settings. Both studies showed that amount of vegetation near to residence (including street trees and trees and shrubs around apartment buildings) were associated with significant benefits for children's cognitive function. Quite a few studies have examined community cohesion or childhood development benefits of green space in deprived urban contexts (Coley et al., 1997; Kuo et al., 1998; Taylor et al., 1998; Kuo and Sullivan, 2001a and b; Westphal, 2003). All reported positive associations, although Westphal (2003) found this depended on governance and leadership. Cochrane et al. (2009) examined physical activity in a relatively deprived urban area of England. They found a positive association between physical activity and green space.

While many of the studies reviewed noted socio-economic conditions of neighbourhoods or individuals, this was primarily as a factor to be controlled in testing the relationship between green space and health (e.g. Takano et al., 2002b; Grahn and Stiggsdotter, 2003). Most report a positive association that is still evident once socio-economic status is controlled. While a minor element of these studies, these works demonstrate that benefits of green space can be experienced in deprived urban communities. Landry and Chakraborty (2009) explored the spatial distribution of street trees and issues of equity in Florida, USA. Their results indicate a significantly lower proportion of tree cover in neighbourhoods containing a higher proportion of African Americans, renters and low income residents.

Some studies provide greater insight to the relationship between green space, health and health inequality, and are considered here in more detail. A series of cross-sectional studies have explored whether a positive association between green space and health can be found for people living in areas with higher or lower urbanity, and people of higher or lower socio-economic status; the findings are mixed.

Maas et al. (2006) considered this relationship for self-reported health, while Maas et al. (2009a) analysed health outcomes in terms of a range of disease clusters reported by General Practitioners. Both studies found that the relationship was strongest in slightly urban areas, and less strong for very urban areas. Both studies also showed that the relationship between green space and health was strongest for people from lower socio-economic groups. These findings are also consistent with earlier, exploratory research from the same group (de Vries et al., 2003). The authors conclude that people from deprived settings are more sensitive to the amount of green space in their immediate locality.

Harlan et al. (2006) did not directly consider the health of urban populations, but modelled vulnerability to heat stress of neighbourhoods in Phoenix. Arizona. They found that people from lower socio-economic and ethnic minority groups were more likely to live in neighbourhoods with greater exposure to heat stress, and have fewer social and economic resources to help them manage this.

Mitchell and Popham (2007) examined the relationship between green space and self-reported health. They used data for the whole of the UK, drawn from the 2001 census, and analysed the findings by urban, suburban and rural residence. They found that in general a higher proportion of green space was associated with better health but this relationship varied with a combination of deprivation and urbanity. For urban areas, greater amounts of green space were linked to better health for people from both high and low income categories. This relationship was less straightforward for people living in suburban areas. In these areas, among low-income groups, higher amounts of green space were actually associated with poorer self-reported health. For high income groups,

there was no association between amount of green space and health. These relationships may relate to presence of a garden, issues of quality as well as quantity of green space. So while Mitchell and Popham's work confirms that green space can provide health benefits for deprived urban communities, the benefits for deprived suburban communities are less clear.

These four studies focus primarily on the relationship between green space and health, and examine whether benefits can be observed for people of different socio-economic status and urbanity. In effect, these studies position socio-economic status as a factor that moderates the relationship between green space and health. Mitchell and Popham (2008) considered the same three factors, but conceptualised the relationship between them quite differently. They were primarily concerned with health inequalities. They examined the causal relationship between socio-economic deprivation and poor health, and considered how green space moderated the relationship between these two variables.

Mitchell and Popham (2008) assessed mortality data for all English residents younger than retirement age. They investigated health inequalities (the difference between mortality for people with different degrees of income deprivation). They found that for some causes of mortality, this inequality was smaller for the greenest neighbourhoods. This pattern was found for 'mortality by all causes', and 'mortality by circulatory disease'. No association was found for 'mortality by lung cancer' or 'intentional self-harm'. They concluded that there is evidence of the moderating effect of green space on the relationship between income deprivation and health. It should be noted that this analysis was for the whole of England. The relationship was not described for urban residents specifically. This is significant given findings that the association between green space and health differs for different levels of urbanity (de Vries et al., 2003; Maas et al., 2006; Mitchell and Popham, 2007).

A final study examining the relationship between socio-economic status, health and green space conceptualises the relationship between the variables in yet another way. Van Lenthe et al. (2005) were interested in educational differences in physical activity. They predicted that people living in more deprived areas would be less physically active, and that this relationship would be mediated by neighbourhood characteristics including general attractiveness and levels of safety. This contrasts with Mitchell and Popham's framework in a significant way. Rather than viewing green space as a factor which moderates the relationship between socio-economic status and health, van Lenthe et al. (2005) position green space as the mechanism by which inequalities of activity are created. People living in socio-economically deprived areas are assumed to have less access to quality green space, and thus are less likely to be physically active. The researchers actually found little support for this model. They found that socio-economic differences in physical activity were not consistent. People with higher educational levels

did tend to walk more for leisure, but there were no differences in walking for transport to shops or work. In addition, they found that the neighbourhood characteristics did not mediate the relationship between socio-economic status and physical activity where it existed. This is perhaps not surprising given the complex relationships between socio-economic status and access to quality TWF/green space (Mitchell and Popham, 2008).

In summary, a relatively small number of studies provide insight to the relationship between TWF/green space and urban health inequalities. Taken as a whole, the evidence that green space provides benefits for human health is overwhelming. A number of studies demonstrate some benefits are evident in deprived urban communities (Coley et al., 1997; Kuo et al., 1998; Taylor et al., 1998; Kuo, 2001; Kuo and Sullivan, 2001a, 2001b; Wells, 2003; Westphal, 2003). Several studies indicate that economically deprived communities may in fact be particularly sensitive to the amount and quality of green space near their residence and benefit significantly from its presence (de Vries et al., 2003; Maas et al., 2006; Mitchell and Popham, 2007; 2008). While an extremely promising area of research, existing knowledge is limited in many ways:

- Theoretical models describing the relationship between green space and health inequalities are inconsistent and often unclear.
- The most theoretically clear and comprehensive study to date (Mitchell and Popham, 2008) uses national level data and does not examine the relationship between variables within urban areas specifically.
- All of the key studies noted here base observations of green space on land use data that excludes important components of urban forests, particularly street trees.
- To date, these studies have considered only a limited range of health outcomes.
- To date only cross-sectional approaches have been used to investigate this relationship. Longitudinal research and multi-disciplinary studies are likely to provide further insights.

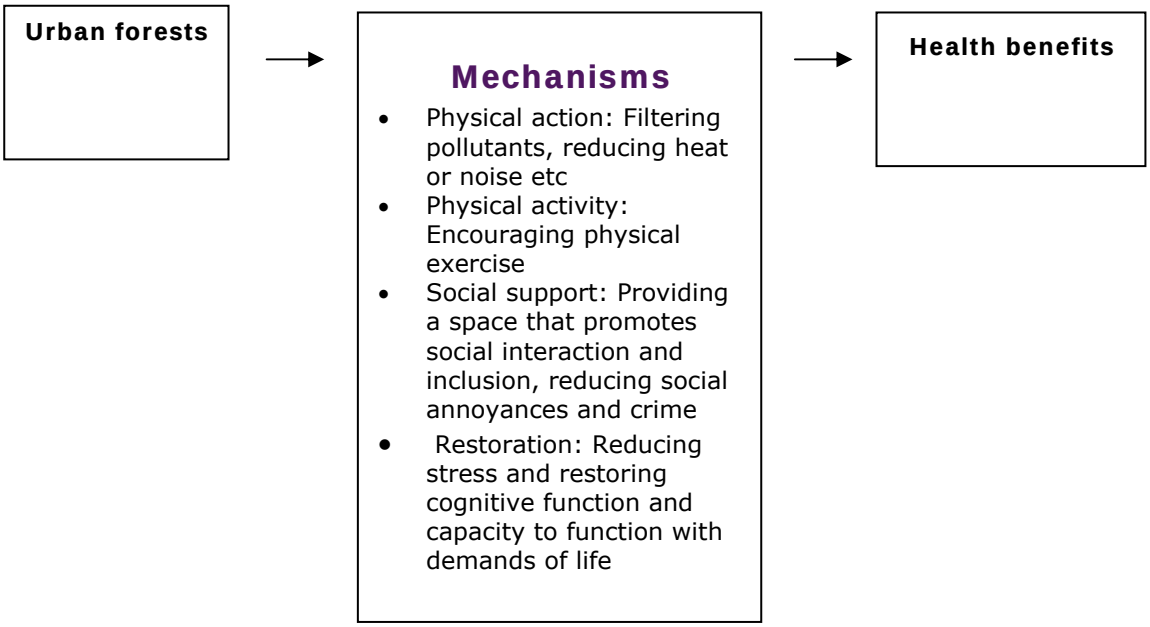
7. What is known about where urban forestry may contribute most positively to urban health?

There is some evidence that urban forests can help reduce urban health inequalities. However, to date there has been little attempt to synthesise and interpret the practical implications of this work for urban forest policy and planning. In this section we review empirical research to identify challenges and opportunities for forest agencies seeking to make a positive contribution to reducing urban health inequalities.

7.1 What is the relative importance of mechanisms explaining the relationship between green space and health?

There are several major explanations for how green space positively influences health. The most commonly noted mechanisms posited are outlined in Figure 5.

Figure 5: Mechanisms hypothesised to explain health benefits of access to green space (van den Berg et al. 2007; Maas et al 2008; Mitchell and Popham 2008).



Understanding the importance of these mechanisms can guide policy and programme design, assisting planners in focusing on elements that will make the greatest difference. There is evidence that health benefits of green space are linked to physical characteristics of urban forests. For example, Lovasi et al. (2008) suggest that links

between street trees and prevalence of asthma is most likely explained by reduced air pollution. Harlan et al. (2006) demonstrated the ways that green space reduces temperature in urban areas, and so provides a physical mechanism for health benefits through reduced heat stress. While these mechanisms are important, the body of evidence regarding other mechanisms is significant. Many of the observed benefits of green space, for example improved attention (e.g. Kuo and Taylor 2004; Berman et al., 2008) cannot easily be explained by these physical mechanisms.

A number of theories have sought to account for the restorative impact of green spaces (Hartig et al., 2003a). Attention restoration theory is the dominant account. This theory suggests that more natural environments often place less cognitive demands on humans; softly fascinating elements of nature (for example leaves and water) allow undirected, effortless attention, providing scope for restoration of cognitive capacity for more focused or directed attention (Berman et al., 2008). Other accounts suggest humans are better adapted to cope with more natural environments, and that this leads to lower levels of stress in natural environments (Pretty et al., 2005). Studies based on these theories provide a significant body of evidence for health benefits of green space (Tennessen and Cimprich, 1995; Hartig et al., 1996; Parsons et al., 1998; Bodin and Hartig, 2003; Cimprich and Ronis, 2003; Kuo and Taylor, 2004; Berman et al., 2008; Pretty et al., 2005; Gathright et al., 2006; Morita et al., 2007; Chang et al., 2008). These emphasise that the mere presence of near by green space can provide significant benefits in urban settings. This is particularly evident in studies which show that the presence of trees and grass in residential areas, or relative greenness of view from the windows of residential homes can be associated with significant benefits (e.g. Kuo, 2001; Kuo and Sullivan, 2001a).

A large number of studies have investigated whether access to green space increases physical activity. Findings are quite inconsistent (e.g. Foster et el., 2004; Giles-Corti et al., 2005; Neuvonen et al., 2007; Sugiyama et al., 2009a; Lackey and Kczynski, 2009; Kaczynski et al., 2009). Giles-Corti and Donovan (2002) note that simply increasing green space is not sufficient to increase physical activity. Work by Ball et al. (2009) confirms the importance of personal, social and environmental determinants of walking. A number of researchers have pointed to the social factors – such as sense of safety – that may undermine the capacity of green space to encourage physical activity. For example, Cochrane et al. (2009) conducted research in an English region and found that safety issues significantly influenced walking activity in deprived areas. Other researchers have demonstrated that health benefits occur with or without physical activity. For example Korpela and Ylen (2007) found that people who had spent time just being in or relaxing in a natural favourite place more often reported feeling much better than those who had been involved in some form of activity in green space. Together these studies suggest that encouragement of physical activity cannot be considered the primary mechanism for explaining how green space provides benefits for health. Maas et

al. (2008) explicitly set out to test this mechanism. They found green space is not related to physical activity and so does not explain the relationship between green space and health.

In a separate study, Maas et al. (2009b) examined social contact as a possible mechanism for health benefits of green space. They hypothesised that presence of green space facilitates greater positive social interaction, and that the resulting social support might promote better health outcomes. They found greater support for this pathway. Among other findings, they report that shortage of social support partially mediated the relationship between green space in a 1km radius and number of health complaints. They found that self-reported loneliness partially mediated the relationship between green space and self reported health, number of health complaints and self-rated propensity for psychiatric morbidity. And finally, that a self-reported shortage of social support fully mediated the relationship between green space and self-rated propensity for psychiatric morbidity. This is consistent with a wider body of work demonstrating a link between green space and social interaction (e.g Coley et al 1997; Kuo, 2001; Kuo and Sullivan, 2001a).

While some studies have set out to test the strength of evidence for particular mechanisms, it is unlikely that a single account is sufficient. It is also likely that the relative importance of mechanisms is different for different health outcomes. Work by Sugiyama et al. (2009c) provides some insight into this. These researchers did not consider the full range of mechanisms described here, but did consider the relative importance of physical activity (walking), social coherence and social interaction for explaining physical and mental health benefits of green space. They found that recreational walking provided a better account of physical health benefits of greenness, while mental health was only partly explained by recreational walking and social coherence. Since they could not explain all the variance in health outcomes, Sugiyama et al. (2009c) concluded that researchers also need to consider the restorative effects of environments. Mechanisms are likely to be strongly interrelated (van den Berg et al., 2007). For example, people may walk together for social contact as well as exercise and choose to walk in a park because it is quieter. In such a situation, the restorative qualities of green space, physical exercise, social contact, and the filtering capacity of green space become inseparable.

In summary there is greater evidence for restorative and social support mechanisms for explaining the relationship between green space and health, and less consistent evidence for physical activity. The relationship between these mechanisms is complex. At a most basic level, this suggests that policy and planning responses should not focus on a single means for encouraging health benefits of urban forests. Programmes should not for example, solely focus on encouraging physical exercise in urban forests since there is least consistent evidence for this mechanism. Therefore programmes should seek to

provide access to nearby urban forests (including simple visual access to urban forest around homes and workplaces) and promote development of urban forests that foster positive social contact.

Given the complexity of mechanisms, there is a need to understand what kinds of environments promote restoration, physical activity and social interaction, as well as the kinds of interventions and social contexts that support use and health benefits of TWF/green space. The remainder of this section deals with these issues.

7.2 What aspects of urban forests contribute most to promoting health benefits?

How can urban forests be designed to maximise health benefits? While there is a significant body of work on health benefits of green space, this question has not been adequately explored. Evidence on the health benefits of green space generally takes a coarse approach to comparing environments. Studies often simply compare responses to photographs of 'urban' and 'natural' environments with little comment on the specific components of such environments (Verlade et al., 2007). Other studies examine health benefits in relation to simple measures such as percentage of green space in an area. These approaches often exclude much of the urban forest such as street trees or very small woodlands (Maas et al., 2009).

Relatively little is known about specific characteristics of urban forests that support health benefits. What is known can be drawn from two major sources. There are some studies that compare health benefits of different types of urban environments. Verlade et al. (2007) reviewed a number of studies to clarify the relationship between landscape attributes and health outcomes. A relatively small number of studies drew on different forms of urban green space. We draw on this work, supplemented by a number of studies that examine health benefits of green space with regard to characteristics such as proximity and size. There is also a body of research that examines the restorative potential of environments (e.g. Nordh et al., 2009b). While these studies do not measure actual health outcomes, they evaluate the perceived capacity of environments for restoration.

In reviewing this literature it is important to bear in mind the multidimensional nature of urban forests (Bedimo-Ring et al., 2005). Each mechanism considered in section 7.1 points to different components of urban forests that may be significant for health. For example, location of urban forests relative to polluting sources (e.g. traffic) and density of trees might be particularly important in filtering toxins. Location of trees in relation to walking destinations (for example, providing attractive and shady connections between homes and destinations) are perhaps most important when considering physical activity mechanisms. Visibility of urban forests from home and work may be most important in

considering restorative role of urban forests (Nordh et al., 2009a). Both theoretical and empirical work also points to particular environmental characteristics that support restoration. These include the presence of gently fascinating elements such as moving leaves, designs that are both extensive (allowing exploration) and coherent (allowing way-finding), environments that enclose, providing a sense of 'being away', and environments that are compatible with individual purposes (Kaplan, 1991). Finally, since positive social interaction should also be considered a mechanism for health benefits, characteristics of urban forests that promote a sense of safety and inclusion should also be considered. In this section we examine empirical studies on the green space-health relationship to determine whether it provides guidance on the design of urban forests with regard to forest components, issues of proximity and size, and safety.

7.2.1 Components of the urban forest

While few studies give specific consideration to the health benefits of urban forests, it is clear that trees in parklands, woodlands, streets and around homes and workplaces are important for human health (Coley et al., 1997; O'Campo et al., 2009; Tilt, 2009). Nordh et al. (2009a) showed that trees play a role in enabling a sense of 'being away' in a city, blocking out views of concrete and buildings and facilitating experience of a more nature-dominated environment. Despite this, few studies provide insight to specific characteristics of trees or woodlands that might contribute to restorative/health benefits. One study was identified considering health relationships with specific tree characteristics. Lohr and Pearson-Mims (2006) examined physiological health indicators while viewing different types of trees. They found a positive response to trees with a denser canopy, and with spreading rather than rounded or conical form.

To understand the components of urban forests that contribute to health, it may be necessary to draw on wider literature, for example in regard to landscape preferences. For example Staats et al. (1997) examined pleasure associated with forest landscapes of different density and accessibility (with and without paths). They found evidence of greater pleasure where a path was present. Numerous studies have found that people prefer forests that are relatively open with traversable ground cover (Kaplan and Kaplan, 1989) though this is not always the case (Williams and Cary, 2002). A full review of this literature is beyond the scope of this study. Literature on the relationship between urban forests and safety may also provide insight to physical components that contribute to health outcomes. Maas et al. (2009c) examined sense of safety in relation to Dutch green space. They distinguished between open green space (grass areas, coastal areas) and closed green space (forests, woodlands). They found that in general the percentage of green space in the immediate living area was positively related to sense of safety. This was not however the case for the most highly urban areas, where enclosed green space was associated with reduced sense of safety. The issue of safety in urban forests is explored in section 7.2.3, but once again, a full review of this literature is beyond the scope of the present study.

Verlade et al. (2007) reviewed the information available and concluded that in considering the specific landscape characteristics that contribute to health, 'the greener the better'. They conclude this field of study has not to date provided much guidance as to what kinds of greenery will be of greatest health benefit. Many questions might be posed. Does density of trees and shrubs make a difference in regard to restorative value? Does management of trees (e.g. pruning, hedging) make a difference? Does species (or perhaps plant traits or cultural association of plants) matter in promoting health benefits? Following Lohr and Pearson-Mims (2006) work, does tree form or size make a difference? Are some colours of foliage more beneficial than others?

Research on components of urban forest that contribute to health is also limited by a focus on visual characteristics of urban forest. The experience of sound in urban settings (and the relationship between vegetation and sound) is also an important consideration. Irvine et al. (2009) report there is not a lot of work on sound and environmental experience in parks. They measured sound (objectively and subjectively) in three Sheffield parks. They found that the type of sound was more important than volume in predicting positive or negative experience. In particular, birds made a positive contribution to experience, and they noted the interaction between the kind of vegetation in parks (especially the presence of shrubs) and the experience of bird songs. The importance of sensory experience for health benefits of woodlands is also evident in some qualitative studies, for example O'Brien and Murray (2007).

7.2.2 Size, amount and proximity of urban forests

Do larger woodland areas promote greater health benefits? There is some possibility this is the case. Giles-Corti and others (2005) found that size of nearby green space helps to predict physical activity of residents. Forest Research's Active England evaluation (O'Brien and Morris, 2009) found that people stayed longer at the larger sites where there were facilities. At the same time, both theory and empirical work suggests large woodlands are not essential for some health benefits. Attention restoration theory (Kaplan 1992) suggests that restorative environments are characterised by 'extent', which enables exploration. While extent may be associated with size, extent can be achieved in other ways. For example, landscape 'rooms' provide extent by allowing exploration, as does miniaturisation in landscapes (Kaplan 1992). In line with this Nordh et al. (2009b) demonstrate that even small parks can have a high perceived restorative value.

Does amount or density of green space matter for health benefits? There is more empirical insight to this issue. Many studies of the relationship between green space and health demonstrate a positive relationship between health outcomes and percentage of green space in a neighbourhood. A positive association between increased amounts of green space has been shown for multiple disease clusters (e.g. Maas et al., 2009) and self-reported health (e.g. Mitchell and Popham, 2007). The relationship between

amount of green space and physical activity is less clear. Kaczynski et al. (2009) found that each additional hectare of park area within 1km of a home increased the odds that residents would participate in 150 minutes or more per week of neighbourhood-based moderate-to-strenuous physical activity. Consistent with this, Neuvonene et al. (2007) found increased likelihood of recreational visits to green space in Helsinki in neighbourhoods with greater amounts of green space. Other studies found no such association (Maas et al., 2008: Ball et al., 2007).

Several studies have examined the relationship between proximity of green space and health benefits. Findings are somewhat mixed. Grahn and Stigsdotter (2003) found that proximity factors - including distance to public open green spaces and presence of garden or green yard around residence - were important in predicting health outcomes. De Vries et al. (2003) found that nearby green space was in general positively associated with self-reported health, but did not find support for the hypothesis that green space within 1km from home would be more beneficial than green space within 3km of home. Giles-Corti et al. (2005) showed that proximity of green space was positively associated with walking levels. Other studies have found no such association between proximity and physical activity (e.g. Foster et al., 2004; Maas et al., 2008). A number of studies have shown greater use of green space when it is more proximate (Maat and de Vries, 2006; Neilsen and Hansen, 2007; Neuvonene et al., 2007; Ward Thompson et al., 2008). The importance of proximity is strengthened by the clear evidence that even views of nature can provide health benefits (Ulrich, 1984; Tennessen and Cimprich, 1995; Kaplan, 2001; Kuo and Sullivan, 2001a; Hartig et al., 2003a).

In general, there is some evidence that size, amount and proximity of green space are positively associated with some physical and mental health indicators. The relationship with physical activity is less clear. Findings regarding proximity and health are complicated by issues of access, quality and awareness of TWF/green space.

Several studies - mostly those concerned with predicting physical activity - have noted that perceived indicators of green space proximity are not always consistent with objective indicators of proximity. Lackey and Kaczynski (2009) found poor agreement regarding perceived and objective proximity of local parks. People who used parks for physical activity were more likely to be accurate in their beliefs, as were people who had more parks in their area, or whose closest park had more features such as a playground or wooded area. Some studies have suggested that perceived proximity of green space is a better predictor of physical activity (Tilt et al., 2007; Reis et al., 2009). But Lackey and Kaczynski (2009) found there was no strong relationship between physical activity and either measure, while Tucker et al. (2009) found positive associations with both measures.

It is important to bear in mind that access to green space and urban forests is not facilitated only by distance. Kessel et al. (2009) conducted multidisciplinary research into residents' interactions with the Thames Chase Community Forest. They observed physical proximity of residents to green space in both 1990 and 2003. On average, distance from the forest to homes reduced by 162m. However the reduction was greater for people from less deprived areas. Ethnographic work showed that access to the forest was more complex than proximity. Residents' access to the forest depended partly on their personal identity, particularly whether they could imagine themselves using the forest. This sense of access seemed to be related to the diversity of ideas about 'proper' use of the forest, and manners associated with certain activities in the forest. Accessibility of urban forests is also very likely related to feelings of safety.

This body of research generally indicates that closer proximity of green space promotes better health outcomes. The relationship is not simple however, with access depending on safety and sense of identity. Two things stand out with regard to policy and planning for urban forests. First, in planning for health benefits of urban forests, decision-makers need to need to think about the whole of urban forests. While parkland and woodland are important, urban forests in streets and around residences are vital. Policy should promote all components of urban forests, including street trees. Second, policies need to go beyond merely facilitating increased presence and closer proximity to urban forests; they need to deal with accessibility of urban forests, considering the physical and social factors that contribute to awareness, access and sense of safety in urban forests.

7.2.3 Safety and urban forests

Sense of safety is a recurring theme in many studies examining the relationship between green space and health, particularly in urban settings. There is some evidence that urban forests and green space more generally contribute positively to sense of safety. Most persuasively, Kuo and Sullivan found that amount of green (generally trees and grass) in neighbourhoods was negatively associated with levels of police crime reports (2001a) and reported level of violence and aggression (2001b). Leslie and Cerin (2008) examined perceived aesthetics and greenery of neighbourhood and found a positive association with a number of dimensions of satisfaction with neighbourhoods, including sense of safety. Kuo et al. (1998) studied sense of safety in urban public housing estates and found that sense of safety was positively associated with amount of green around apartments. It appears however, that this is not always the case. Maas et al.'s (2009c) work on green space and sense of safety has already been noted. In the most urban areas they found that enclosed green space was associated with reduced sense of safety.

What characteristics of urban forests contribute to a sense of safety or lack of safety? Maas et al. (2009) suggest enclosure is an important characteristic. This is reflected in other studies. Milligan and Bingley (2007) found that some forest formations were linked to greater anxiety. These included densely wooded paths, narrow paths and overhanging

trees that shut out sunlight. Maintenance also plays a role. O'Brien (2006) interviewed residents about Peabody Hill Wood in London. She reports how residents quickly raised issues of safety in woods, with children often viewing playing in the street to be safer than playing in woods. Participants raised concern with visibility in the woods, but also were concerned to see higher levels of maintenance: removing rubbish, improving lighting, cutting back shrubs and trees. Similarly, Agyemang et al. (2007) found that dissatisfaction with green space is (unsurprisingly) correlated with experience of crime, nuisance from noise, evidence of drugs use and graffiti. Sense of safety also appears linked to strategies that increase presence of others and authority. In the Peabody Hill study, residents sought provision of nature trails and interpretation, involving schools, and providing CCTV surveillance (O'Brien, 2006). In a separate study O'Brien and Morris (2009) found that an official presence, for example of a ranger, can promote feelings of safety, as well as staff or volunteer led activities such as health walks.

It is also important to recognise that sense of safety is not completely dependent on physical attributes of urban forests. Some groups of people may feel less safe in urban forests than others. Several studies suggest women are more likely to feel unsafe in parks and woodland (Krenichyn, 2004; O'Brien, 2006; Foster et al., 2004). Interestingly, Maas et al. (2009c) found that women felt safer in green areas than did men. Older people may also feel less safe (Day, 2008; Cutts et al., 2009). People who as children spent more time in woodlands may also feel more confident in safe in these areas as adults (Ward Thompson et al. 2008). Similarly, sense of safety in woodland is not a simple given for these groups, but is actively negotiated. People may act in ways to increase their sense of safety and so enhance access to woodlands. Both Krenichyn (2004) and O'Brien (2006) noted that women use strategies to promote sense of safety such as visiting woods in the company of people or with dogs. The link between company, sense of safety and health benefits of urban forests is made explicit in the work of Staats and Hartig (2004). They demonstrated that sense of safety plays a mediating role in restorative benefits of forests. People with company in forest environments often felt a stronger sense of safety, and this was linked to restoration.

Research suggests that sense of safety in urban forests can be considered a necessary prerequisite to harnessing health benefits. But it is important to note the potential for a 'trade off' between urban forest characteristics that promote sense of safety and characteristics that promote restorative experience. For example, while high levels of maintenance may increase sense of safety, this may also reduce the sense of being away that promotes restorative experience. Similarly, a strong sense of the presence of others may promote sense of safety but in some cases diminish restorative value (Staats and Hartig, 2004). Bearing in mind the social differences evident in the ways people experience safety in urban forests, it seems critical to provide a wide range of urban forests, catering to different levels of comfort with enclosure and 'naturalness'.

8. Health benefits of urban forestry for particular groups

Urban health inequalities are often particularly evident among some social groups, including women, older and younger people, and those from ethnic minority groups. This section considers current understanding of the relationship between green space and health for selected types of people. Evidence in many cases is limited or non-existent. We consider evidence regarding health benefits of green spaces for these social groups, identify particular barriers these groups face in accessing health benefits of green space, and examine evaluations of green space-related interventions established to improve health.

8.1 Poor urban communities

We have already considered whether green space provides particular health benefits for those living in deprived urban communities. We concluded this is a promising area of work, with some evidence that green space can help reduce health inequalities, but also note significant limitations with the current state of knowledge. Building on this, we examine research that provides insights to factors that might promote or discourage health benefits of green space for these communities.

Only a small number of studies were identified that specifically considered access to green space in the context of health benefits for poor communities, but these provide considerable insight to the challenges involved. Work by Pinder et al. (2009) explored perceptions of health in relation to Thames Chase Forest. They found that potential to access health benefits may be reduced through imposition of professional ideals of 'proper use' of green spaces. For example, residents may feel alienated by views expressed by professionals or lay leaders of programmes that some uses of forests are inappropriate. Examples noted were laughter directed at people using a laptop in a forest, or reading a newspaper in the car park. They also noted issues associated with interventions to promote walking in the forest. There appeared to be professional expectations regarding how and when people should exercise in forests that indicated little appreciation of the experience and role of walking in deprived communities. One medical practitioner commented: 'poor people don't walk for pleasure; they walk because they have to'. These observations resonate with work by Cattell et al. (2008). These researchers observed interactions with a wide range of public open spaces in relation to access and health. The value of parks for recreation was discussed by many participants, but so too were streets and markets and private 'public' spaces like front drives. Their findings highlight the value of places that contribute to basic human needs of feeling at ease or 'at home'. This is linked to memories of familiar places, places of escape and places of social interaction, including that simple recognition of other regular users. Cattell et al. (2008) show how this sense of ease related to familiarity with

spaces, regular use, positive perceptions of areas, feeling comfortable with fellow users, and endurance of space over time. Some places like the market were particularly important for allowing interactions between people from different ethnic groups.

Some studies report interventions to actively involve residents of deprived urban communities in restoration of urban woodlands and green spaces. O'Brien (2006) reports on the difficulty of involving adults in a Peabody Hill woodland clearance and tree-planting day in London. While the day attracted a number of participants, these were mostly children and adults from outside the neighbourhood. It was not clear why it was so difficult to attract local adults. O'Brien speculates this might have related to negative attitudes to the wood, lack of publicity or a lack of sense of responsibility for the woodland; and an expectation that the authorities would take care of any issues. Westphal (2003) examined participation in urban greening projects, seeking to understand how these projects contributed to health-related outcomes such as empowerment of participants. While there was evidence of empowerment in some projects, this was not found for all projects. Community-based urban greening projects were sometimes characterised by exclusion of some residents from decision making and loss of access to open space by some people. Westphal described projects where plantings failed because of conflicts over land use (for example, whether a play park or garden should be established), or where project leaders used gardens to establish private benefits from projects. Westphal (2003: 137) concludes that the presence of an empowering leader, 'openness of project process and overall history of the block were important to achieving empowerment outcomes'. Community forestry projects need a clear understanding of the goals of local residents (including diversity of goals), and the level of involvement required in the project to provide desired outcomes. It is important to be realistic about potential benefits, and to pay attention to the process of establishing and guiding projects and watching out for disempowering participants and leaders.

This review is once again limited to studies that consider health related outcomes. Wider research into engagement of urban communities in greening, access to parks and woodlands will likely provide further insight. In general however, the research indicates that green space can provide significant health benefits for people living in deprived urban communities, but simple provision of urban forests is unlikely to be sufficient.

8.2 People with mental health challenges

The evidence for health benefits of green space is strongest with regard to mental health indicators. Sugiyama et al. (2009c) found that perceived neighbourhood greenness was more strongly linked to mental than physical health, while Maas et al. (2009a) found the relationship with nearby green space was stronger for anxiety disorder and depression than for other disease clusters. This means there may be particular value in planning

green space to promote health outcomes for those living with particular mental health issues.

Some studies evaluate forest-related interventions designed to promote health outcomes for people with depression or anxiety disorders. Townsend (2006) evaluated the impacts of participation in civic environmentalism (e.g. involvement in tree planting days) for people suffering from depression. She concluded that there are significant benefits, but not just for mental health. She also described a range of factors that can make it difficult for people suffering from depression to get involved in such activities. These include shyness, a fear of being stereotyped (for example as a 'greenie'), the relative openness and accessibility of groups, lack of recognition of health benefits, lack of awareness of groups and how to get involved, busy lifestyles/lack of availability, and practical issues such as lack of transport and childcare. This suggests greater access might be facilitated through diversity training among group leaders, greater promotion of health benefits of forest activities among support groups and medical practitioners, and provision of practical support.

Nordh et al. (2009a) examined a forest-based rehabilitation project for people suffering from depression and anxiety disorders. A ten week programme was conducted in a forest a small distance from a Swedish town. The programme involved a range of forest-based activities including making inventories of cultural artefacts and natural flora and fauna, training in using maps and compass and walking in forest. The daily programme was guided by ecologically expert staff with health education training and involved a small group of 24 participants. The researchers measured health outcomes using both quantitative and qualitative indicators. Quantitative indicators (e.g. quality of life and symptoms of illness) did not provide strong evidence of benefits. Participants qualitative reflections on the programme were more encouraging suggesting many felt they had benefited from the experience. The programme was not without complications however, and Nordh et al. (2009a) note some of the issues in designing forest-based interventions for people with mental health issues. There were significant differences in physical capacity of participants, which led to some people being frustrated by the pace of the programme and the difficulty of tasks. There was an initial tendency for the group to focus discussion on negative experiences regarding health, and this only diminished toward the end of the project. Most felt the project needed to be longer, and post involvement interviews with eight people indicated they were disappointed that the programme did not lead to new opportunities. Finally some exercises within the programme (e.g. an individual mapping exercise which required participants to think about future plans) provoked anxiety. This study highlights the need for a high level of professional skill in designing urban forest programmes for people with mental illnesses.

8.3 Older people

Day (2008) argues that the quality of the local environment may disproportionately affect older people. Evidence regarding health and green space is consistent with these claims. Several studies (de Vries et al., 2003; Maas et al., 2006; 2009) found that the link between nearby green space and health was particularly pronounced among older people. Researchers suggest this may be because older people spend more time at home, so that near by green space is important. Similarly, Kaczynski et al. (2009) found that the relationship between nearby green space and physical activity is stronger in younger (18-34) and older (55+) age groups.

Some studies provide insights into the needs of elderly people regarding urban forests/green space. Day (2008) noted that natural environments can be a great motivator to activity among elderly people, but that these needed to have good paths, free from obstacles and include resting places. Jorgenson and Anthopolou (2007) found that fears about personal security in urban woodland were particularly strong among elderly people. Compared with younger age groups, the elderly tended to be more enthusiastic about interventions to reduce risks. These included physical changes that would help with frailty (seating, unobstructed paths, physical access) as well as increased proximity to activity of other people, which the authors suggested might relate to sense of safety in urban woodlands. This study also shows ways that people act to improve their personal sense of safety in urban woodlands. For example older women said they were more likely to visit the woodland with company, that they preferred to have a mobile phone on site and wanted more maps and information. Jorgenson and Anthopolou (2007) recommend that health outcomes for elderly people can be enhanced through the practical physical changes noted earlier as well as provision of 'health walks' and ensuring bus timetables are well planned to enable elderly people to access to them.

Studies of physical activity among elderly people also provide some guidance on the design of parks and open spaces that support walking. Several of these point to the role of urban forests in meeting these needs. Takano et al. (2002a) use the idea of 'walkable green spaces' to promote physical activity for elderly people. These are described as greenery filled areas with good paths within easy distance from homes. Sugiyama and Ward Thompson (2008) studied walking activities of older people in Britain. They found that walking increased where open space was more pleasant, free of nuisances, had good paths and good facilities such as seating. Borst et al. (2008) found a positive association with both parks and trees along routes and walking among elderly. Curiously a study using a different methodology (Borst et al., 2009) found that presence of vegetation and parks reduced the likelihood of elderly people selecting a particular walking route. They suggested that the reason for this is not clear but may relate to concealed paths, fear or crime, or poor quality paths.

8.4 Women

There is some indication that women may especially gain health benefits from access to green space. Kaczynski et al. (2009) found that the relationship between nearby green space and physical activity is stronger for women than men. De Vries et al. (2003) and Maas et al. (2006) found the link between nearby green space and heath was especially strong for 'housewives' and concluded this may be because this cohort spend a lot of time in the residential environment. Taylor et al. (2001) examined the relationship between self-discipline and proportion of green views out of residential windows. They found there was a significant effect for girls but not for boys. The authors suggest this may relate to the relative mobility of boys and girls. Girls may be more sensitive to green space immediately around their residence if they are more restricted in movement across the larger neighbourhood.

Krenichyn (2004; 2006) examined women's physical activity in an urban park, considering the ways in which the park supported or inhibited activities for women. Some physical characteristics of parks were particularly valued for exercise. These included varying topography, provision of toilets and drinking fountains, presence of nearby nature, proximity and convenience of access. Woodland areas were valued, as were low impact surfaces and sense of exploration, but they also raised concerns about safety. She found women had multiple reasons for exercising in parks; companionship was an important motivation. This included a sense of familiarity arising through passing people regularly. This assisted in developing a sense of community, and sometimes leading to deeper connections. Parks facilitated encouragement to exercise through seeing others exercising, especially people similar to oneself, and through verbal encouragement from others. She found that conflicting roles (as mother, wife, worker etc.) can constrain women's access to parks, but also showed how some find ways to negotiate these constraints. For example, some women used multi-tasking strategies, for example exercising while spending time with kids. As reported by other researchers (Foster et al., 2004; O'Brien, 2005) issues of safety were important to women. Companionship was an important way of negotiating concerns about safety.

We identified one evaluation of an environmental intervention to assist health outcomes for women. Cimprich and Ronis (2003) examined attention performance in women recovering from breast cancer. They used a prescribed intervention where women were provided with instructions on actions to undertake at home. This involved spending 120 minutes per week (preferably 30 minutes four times week) spent in activities such as viewing nature out a window, visiting urban nature sites and so on. They found significant attentional benefits for women participating in these activities.

8.5 Children

There is some indication that green space provides particular benefits for children, but the evidence regarding this is not consistent. Maas et al. (2006; 2009) found that youth particularly benefit from access to green space, but de Vries et al. (2003) did not find any particular sensitivity among this cohort.

Some research indicates that childhood experience of urban forests may have a lasting impact on adult experiences. Ward Thompson et al. (2008) found that childhood time spent in woodlands was critical to the likelihood of adult time spent in woodlands. Similarly, Bingley and Milligan (2004) interviewed young adults about their experiences of woodland and found that childhood experience of woodlands was important to feeling confident there. Unstructured play in woodlands was particularly important. They also found that young adults who had picked up on parent's anxieties about woodlands tended to be more anxious about woodlands.

Children's access to urban forests is likely to be constrained by a range of factors, but we found relatively little consideration of this within the green space-health literature. Both Milligan and Bingley (2007) and O'Brien and Murray (2007) note that children can be initially uncomfortable in natural environments if they have little past experience. Both papers found that anxiety of woodlands was sometimes expressed in disgust at touching elements of woodlands such as leaves and bark. Milligan and Bingley (2007) reports that young people with these fears tended to get over these anxieties quickly when given opportunity to play or work with natural elements. Strife and Downes (2009: 113) reviewed existing literature on children's access to green space, particularly in deprived areas, and concluded that, 'youth access is less about proximity and availability of local green space and more about access to safe outdoor spaces, community trust, and the ability to travel to far-away and pristine natural settings'.

Some studies have examined the capacity of children's learning environments to support health outcomes for children. O'Brien and Murray (2007) assessed Forest Schools in Britain. These are classes for children that are conducted predominantly in woods. Forest Schools are structured in a range of ways, but typically children attend for one day a week for an extended period of time (2-12 months). Drawing on observations of teachers and parents, they demonstrated significant developmental benefits for children. Mårtensson et al. (2009) examined the relationship between green space in pre-school play areas and attention deficit disorder. She surveyed a range of pre-schools and characterised these with regard to total outdoor areas accessible in pre-school, proportion of area containing shrubbery, trees or hilly terrain, and fraction of free sky above play areas. She found lower prevalence of attention deficit disorder symptoms among children whose pre-schools had more 'green' characteristics.

8.6 Other social processes that may assist in providing health benefits

Others studies provide insight to social programmes and processes that may support health benefits of urban forests. O'Brien et al. (2008) studied environmental volunteers and found that they gained many well-being benefits from their activities such as physical and mental well-being, being outdoors, and gaining meaning and satisfaction from undertaking activities that can benefit the environment and others. Volunteers also faced barriers to participation. These included difficulty finding out about opportunities to get involved, costs such as travel, poor capacity among some groups to manage large numbers of volunteers, lack of transport, lack of confidence to get involved and poor understanding of what was involved in volunteering.

Lamb et al. (2002) compared health outcomes of prescribed lay-led health walks, comparing these with health outcomes where patients were merely advised to increase exercise. People who were prescribed participation in health walks were more likely to have increased levels of exercise than the comparison group. There were no significant differences in other health outcomes of the groups.

In summary, there is some evidence that urban forests can be of particular benefit to people from more deprived urban communities, with poor mental, younger and older people, and women. However, there are also clear challenges in ensuring access to urban forests and facilitating supportive experiences for these cohorts.

9. Key messages and gaps in knowledge

Some key messages and general research gaps are clear from this review. Better understanding is needed of the interrelationships between mechanisms that lead to health benefits from urban forests, and the relative importance of mechanisms under particular circumstances. In the present context, there is a need to develop better understanding of the mechanisms at play in deprived urban communities. While it is helpful to understand this relationship through a lens of cause and effect, it is also important to understand more about how people living in these circumstances understand and negotiate the relationships between TWF, green space and health (see for example Day, 2008). Table 7 outlines key messages and gaps in knowledge.

Table 7: Key messages and research gaps

Key messages	• Evidence that **green space promotes health by encouraging exercise is not consistent** • There is stronger and more consistent evidence for **restorative and social contact pathways** for the relationship between green space and health • Little understanding of the **components of urban forests that promote health** • Some evidence that **proximity, size and amount** of green space **influences physical and mental health** outcomes • Urban forests **immediately around homes and workplaces are important** for health outcomes • **Access is influenced** by factors such as **awareness, comfort/ease** in urban forests, and sense of safety • Sense of **safety is linked to enclosure, maintenance**, and presence of others/authorities • People **vary in levels of confidence** in using urban forests • **Nearby urban forests** can provide particular health benefits for **elderly, children, people with mental health issues,** and for people living in deprived communities • Professional and lay norms for **'proper' use** of urban forests **may discourage use** among some groups of people • High levels of **skill are needed to design** and lead urban forest interventions for people with special needs • `**Walkability'** of urban forests is especially important for the elderly • Green space in **children's learning environments can provide significant developmental benefits** • Issues of **governance and leadership are important in planning** urban forestry interventions for deprived communities

	• **Intervention programmes** may assist people with specific needs to harness health benefits of urban forests • There are opportunities to plan some urban forests and parks to **support access needs of the elderly and women.** • Plan for urban **forests in and around schools and pre-schools** • **Support educational programmes** that improve forest access for children.
Research gaps	• Clarify the relative importance of green space- health mechanisms in deprived urban communities • Explore residents' understandings of the relationship between urban forests and health • Explore how density, management, and plant selection influence health benefits of urban forests • Identify how sound, smell and touch contribute to health benefits of urban forest • Multi-disciplinary studies can clarify the relationship between proximity, access and health benefits of urban forests • What urban forestry interventions promote health in deprived urban neighbourhoods, and among people with mental health issues? • How do people living in deprived neighbourhoods act to promote a sense of safety in urban forests? • What institutional arrangements most effectively promote health-benefits of urban forests? • Greater understanding of the urban forest interventions that may promote health benefits for particular cohorts • Longitudinal research to understand the causal relationships between green space and health • Research on the importance of street trees to health and well-being • Replication of health issue studies across different regions • Develop a clear theoretical model for relationship between health inequality and green space • Does purpose of visit to urban forests matter to health outcomes? 'In the forest' and 'of the forest' activities e.g. activities that are specific to forests or those where the forest is incidental to the activity.

10. Opportunities for the Forestry Commission

This review outlines key messages and research gaps associated with the role of TWF and urban health and health inequalities. A range of potential opportunities and challenges for the FC in England, Scotland and Wales are raised in this section by the findings of this review. Key groups that could potentially be targeted, if focusing on health inequalities and urban forestry, include children and poor communities.

10.1 Opportunities

10.1.1 Forests as part of urban regeneration agendas

The Newlands Project mentioned in section 5.3.1 provides evidence of a Regional Development Agency (North West RDA) recognising, with significant funding, that an attractive environment can encourage inward business investment. The Heads of the Valleys Regeneration Strategy in Wales, mentioned in sections 4 and 5, also sees the need for an attractive and well used natural environment to assist economic regeneration. Positioning urban forestry as part of regeneration approaches is therefore already taking place in some areas and should be widely publicised and promoted in other urban regeneration projects.

10.1.2 Brownfield restoration and remediation

Restoration and remediation of derelict, underused and contaminated land can be an important part of regeneration approaches and provide opportunities for the creation of woodlands in urban/peri urban areas or deprived areas that were once more industrially focused. The opportunities are for the creation of new woodlands nearer to centres of population.

10.1.3 Partnerships

The public forest estate is not always situated near to urban populations and therefore partnership working is crucial to operating in more urban environments. The FC already works with a variety of partners and has agreements and memorandums of understanding with a range of organisations. Current partners include Local Authorities, Charities and voluntary sector organisations (e.g. British Trust for Conservation Volunteers, Groundwork, Kennel Club), other government and statutory bodies (e.g. Natural England, Scottish Natural Heritage, Regional Development Agencies), and private sector organisations (e.g. Sport Glasgow, United Utilities). Given the challenge of working with deprived urban communities there is an opportunity to partner with organisations already skilled in working with children and poor communities. Partners skilled in these areas can provide a better understanding of how best to engage people

living in deprived neighbourhoods and how best to support and facilitate community based projects. Working with ethnically diverse communities will be an important consideration. This may entail increased working with the third sector including social enterprises.

10.1.4 Targeted grants

The Woodlands In and Around Town initiative in Scotland, Cydcoed in Wales and the West Midlands Health Woodland Improvement Grant (WIG), and Forest School WIGs in the West Midlands and East Anglia illustrate how FCS, FCW and FCE are and have been using grants to promote health and well-being and encourage people into woodlands to benefit their health in urban areas. Targeted grants that have health objectives such as encouraging greater physical activity and mental relaxation are an important approach.

10.1.5 Community activities and outreach

Community engagement and outreach work could potentially contribute to addressing health inequalities. Qualitative research on people's experiences and use of woodlands and green space have identified more of the complicated nature of use by identifying when people experience barriers to accessing these spaces. Research by O'Brien and Morris (2009) illustrates that for certain hard to reach groups 'led' and 'supported' activities are important for them to feel able to engage with, make use of and enjoy woodlands. Volunteering approaches provide opportunities for this as activities are led by volunteers or representatives of organisations and sometimes include help with transport to particular sites.

Structured programmes can be valuable for helping people harness health benefits of urban forests. However more clarity about relative merits of programmes that have been utilised is needed.

10.1.6 Green infrastructure

Championing the role of trees as part of green infrastructure is crucial, and already taking place, to provide opportunities to promote and encourage active travel and to advocate the importance of trees near to people's homes, including street trees.

10.1.7 Targeting specific groups and areas

This review suggests that particular attention could be paid to children and deprived urban communities, if focusing on health inequalities and urban forestry. Providing urban forest access for people living in more deprived urban communities is pragmatic since it enables a geographically located response that can be aligned with boundaries of local authorities. It is also likely to provide benefits for people from other cohorts of interest since such neighbourhoods often have a higher proportion of residents who are elderly, very young, have poor mental health or are from ethnic minorities. While evidence regarding health benefits of green space for children is somewhat mixed, the evidence of

developmental and long term impact for children suggest investment in this cohort will be especially valuable. Encouraging confidence and ease in urban forests early in life is likely to set a path for more positive restoration experiences later in life. Promoting positive cognitive development in children and so increased capacity to deal with life challenges will potentially have a significant and long term impact on wider communities. Forest School and other education approaches are important means of engaging with children and young people.

10.2 Challenges

There are challenges of working across different sectors and working in, and developing new partnerships as good contacts, networks and time are needed to develop trust and opportunities. The re-organisation of government bodies and agencies can have a real impact on developed networks as key contacts may move to different posts. For example Primary Care Trusts were re-organised in 2005 from over 300 to approximately 150 in England.

A challenge is that the public forest estate is not primarily located in urban areas and working across land tenure and with other organisations and individuals who own TWF will be important. Finding out who owns TWF can be difficult and time consuming.

Helping urban deprived communities to adapt to climate change is a challenge and there is an important role for TWF in reducing temperatures in urban areas, providing shade and in being a means of engaging with local communities to encourage involvement in shaping and using local spaces and in exploring how different behaviours have an impact on the environment.

11. Conclusions

This review draws primarily on empirical research regarding the relationship between health and TWF/green space in urban areas. There are, of course, other areas of research that could be brought to bear on this analysis. This includes significant bodies of research regarding landscape preferences, on community participation in land management, safety and access to urban forests. These areas of research may provide more specific insights to some of the issues identified and considered in this report.

Despite this, the research reviewed here indicates there is a clear opportunity to make a positive contribution to urban health and urban health inequality thorough an urban forestry focus and this is already happening through various projects and programmes. Urban forestry strategies could support the restorative and social support mechanisms for health benefits, rather than primarily encouraging physical activity in urban environments. Strategies should ensure provision of urban forests, including street trees, very close to residences, and provision of woodlands and parks that are socially inclusive.

An overarching outcome of this review is the value of providing everyday, very local urban forests. Promoting the health benefits of urban forests is less about providing large-scale grand spaces, and more about providing places where people have easy and routine access (including simple visual access) to urban forests and where they feel at ease.

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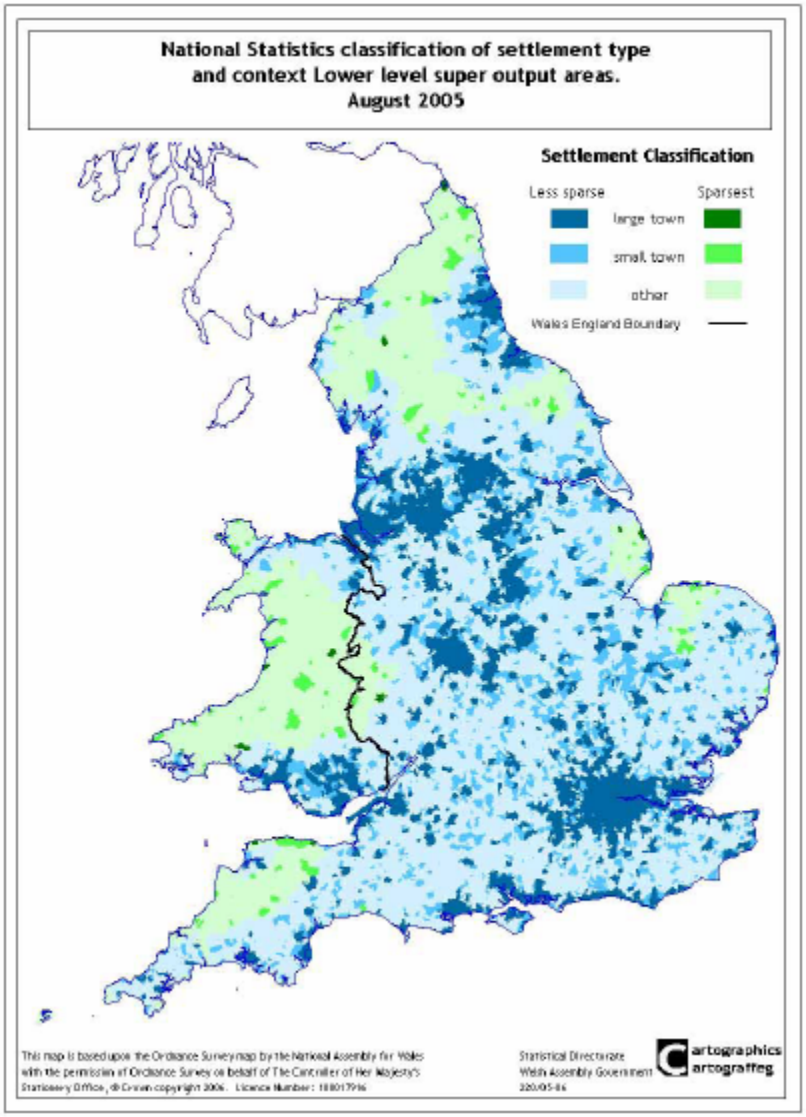
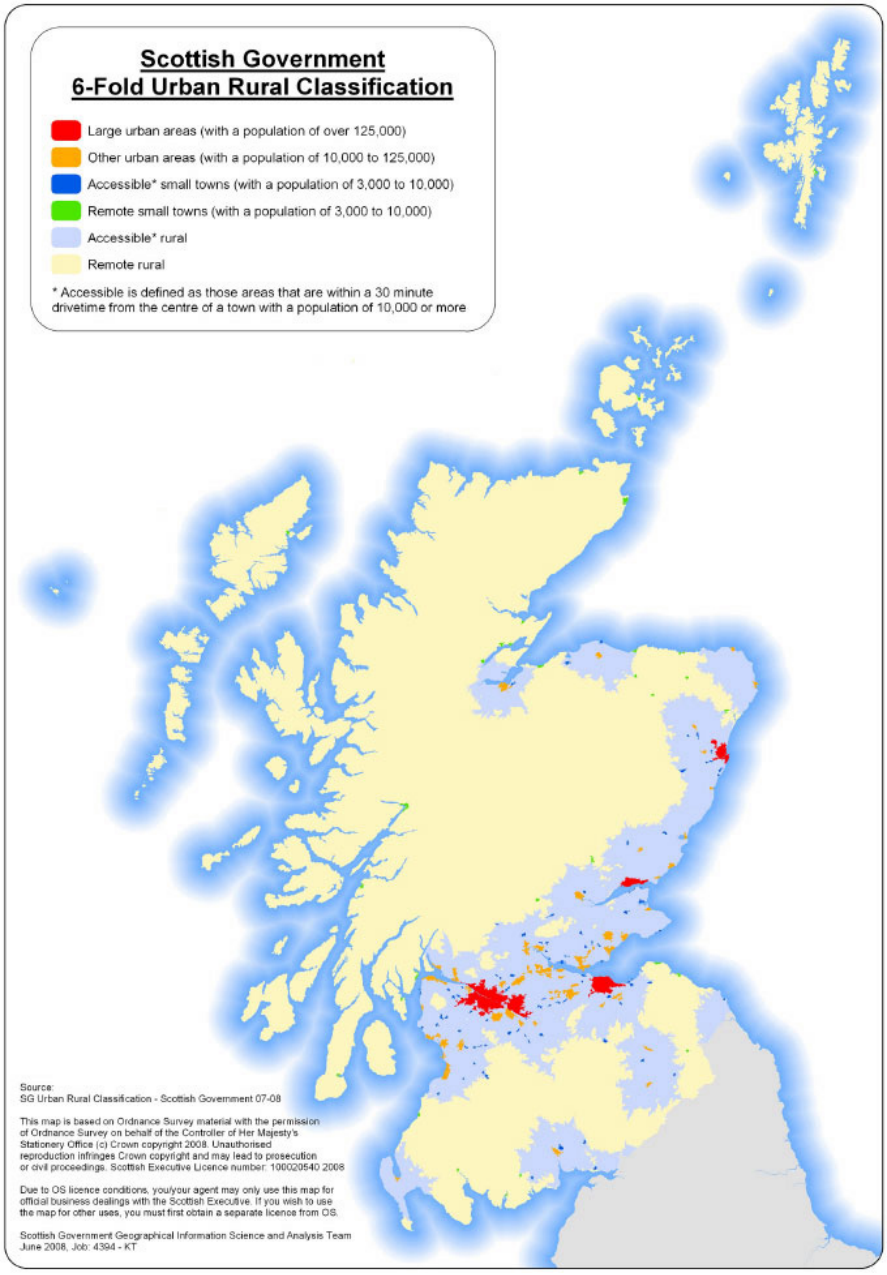
Appendices

Appendix A

Map 1: Urban and rural areas in England and Wales (National Statistics, 2008).

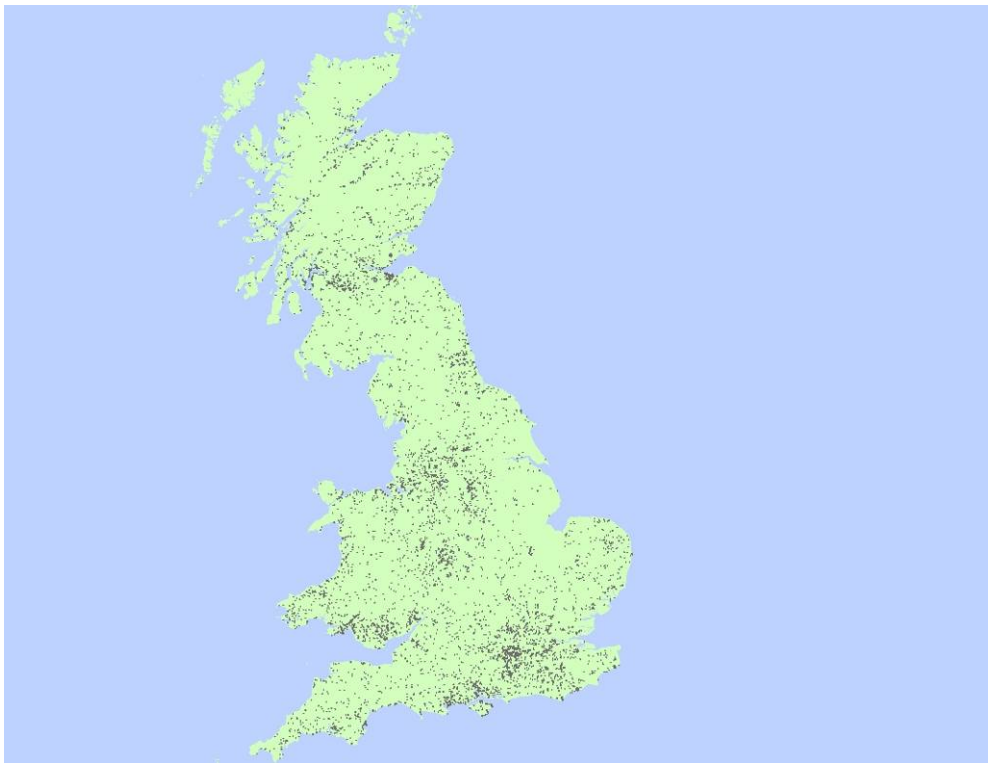


Map 2: Urban and rural classification in Scotland (SG, 2009a).

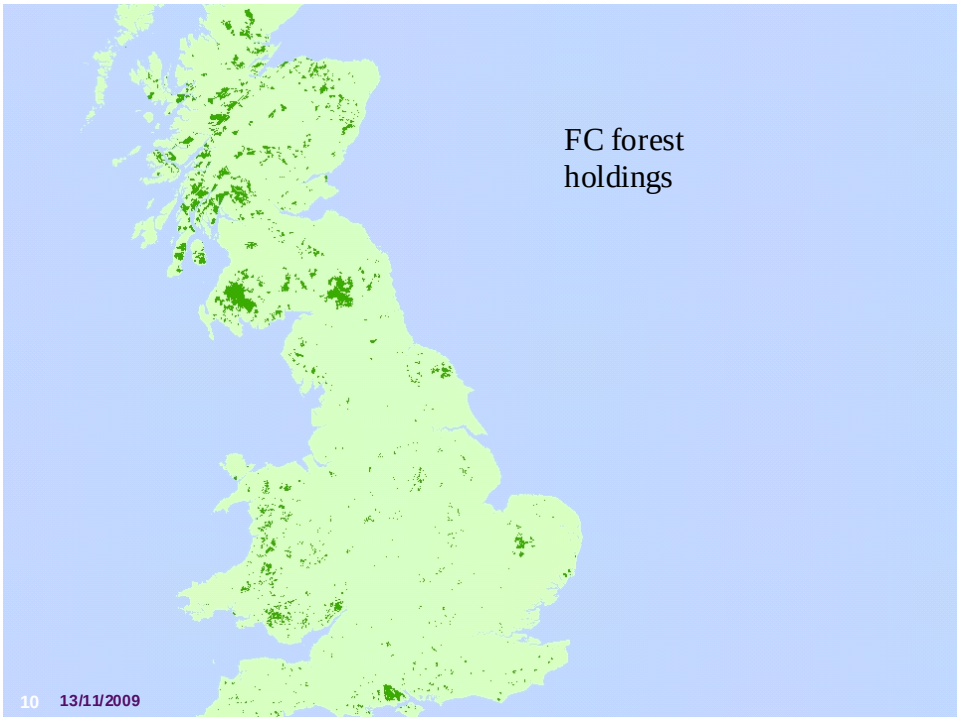


Appendix B

Map 3: Urban woodlands in Britain

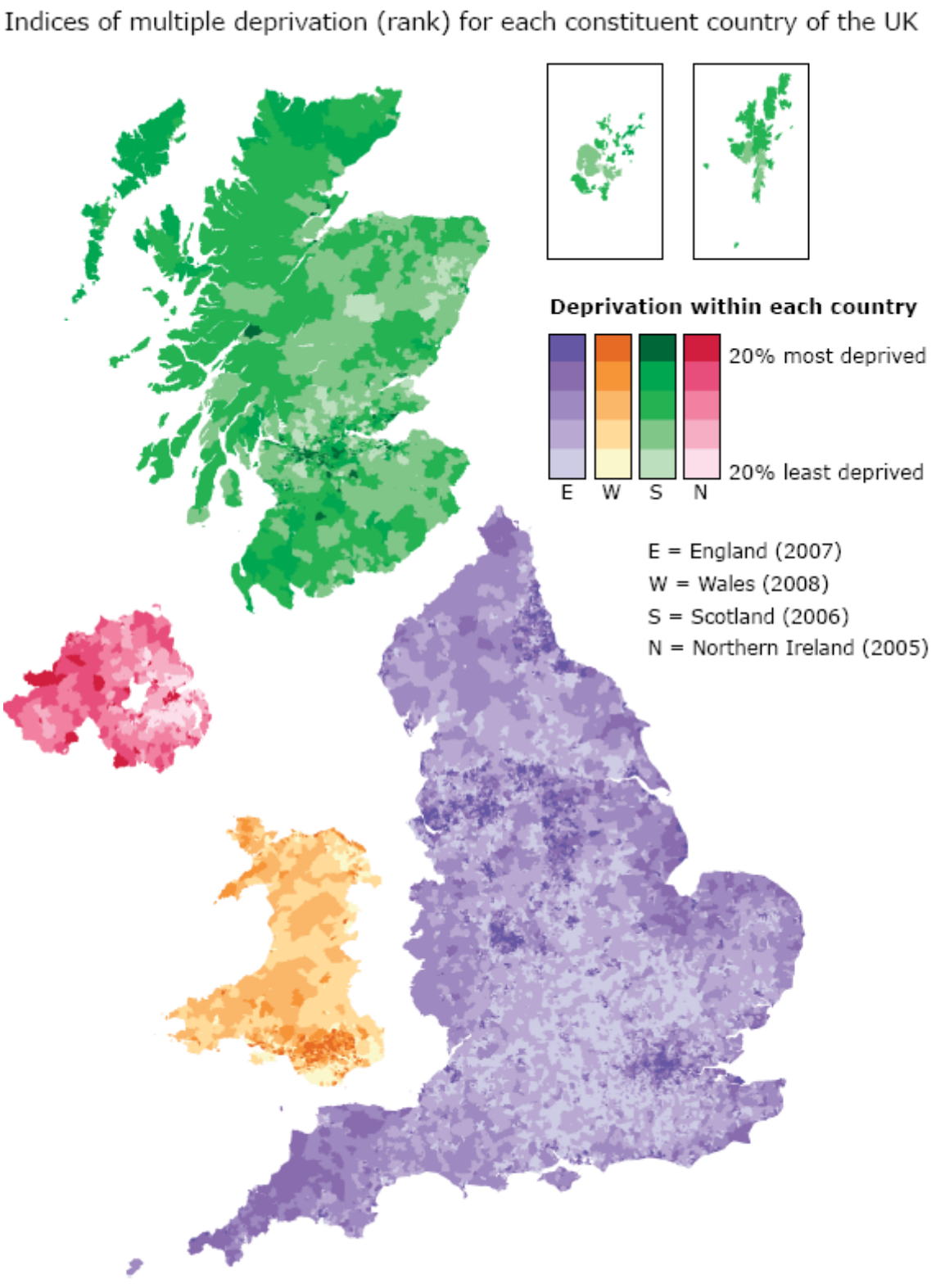


Map 4: The public forest estate in Britain



Appendix C

Figure 6: Indices of multiple deprivation. Office of National Statistics (date)



Appendix D

Figure 7: Turning urban areas into quality places. Taken from 'No charge' publication (Natural England, 2009)

No charge? Valuing the natural environment 16

Appendix E

Table E1 Summary of evidence for impact of urban forests on long-term physical health indicators.

Health indicator	Empirical studies	Type of investigation	Green space indicators
Multiple disease clusters	Maas et al. (2009)	Cross-sectional	Land use data; percentage of green space within 1km and 3km radius of residence
Mortality/Life expectancy	Takano, Nakamura et al. (2002)	Epidemiological	Self-reported access to walkable green streets and spaces
	Takano, Fu, et al. (2002)	Epidemiological	Proportion of ward land area of parks, gardens, green space
	Hu et al. (2008)	Epidemiological	Distance from green space based on satellite imagery
Obesity/Body Mass Index	Ellaway et al (2005)	Cross-sectional	'Greenery' rating of neighbourhood by trained observers
	Nielsen and Hansen (2007)	Cross-sectional	Self-reported distance to green areas (parks, urban greenery, water bodies)
	Tilt et al. (2007)	Cross-sectional	'Greenness' of neighbourhood based on normalised vegetation difference index
	Bell et al. (2008)	Cross-sectional	Distance from green space based on satellite imagery
	Mujahid et al. (2008)	Cross-sectional	Neighbourhood level self-report quality of walking environment and aesthetic quality
Metabolic Syndrome	Dengel et al. (2009)	Cross-sectional	Map based distance from park
Recovery from surgery	Ulrich (1984)	Quasi-experiment	Vegetation visible from window
Thermal comfort (vulnerability to heat stress)	Harlan et al. (2006)	Epidemiological	Neighbourhood amount of open space, vegetation density
Asthma prevalence	Lovasi et al. (2007)	Epidemiological	Street tree density
Use of antidepressants	Hartig et al. (2007)	Longitudinal (across seasons), national scale	Seasonal constraints on outdoor activities

Table E2 Summary of evidence for impact of urban forests on short-term physical health indicators.

Health indicator	Empirical studies	Type of investigation	Green space indicators
Heart rate and Autonomic Nervous System activity	Gathright et al. (2006)	Experiment	Tree compared with tower climbing
Heart period, muscle tension, blood pressure correlate	Ulrich et al. (1991)	Experiment	Exposure to photographs of natural (vegetation or water) or urban (streetscapes)
Blood pressure	Pretty et al (2005)	Experiment	Exposure to simulated pictures of pleasant/unpleasant urban and rural scenes (while exercising)
Muscle tension, brain activity, blood circulation to periphery	Chang et al. (2008)	Experiment	Exposure to natural scenes varying in restorative qualities
Cardiac inter-beat interval	Laumann et al. (2003)	Experiment	Exposure to videos of natural and urban environments
Blood pressure	Hartig et al. (2003)	Experiment	Sitting in room with tree view compared with viewless room
Blood pressure, ANS activity	Parsons et al. (1998)	Experiment	Exposure to nature and artefact dominated simulated scenery while driving

Table E3 Summary of evidence for impact of urban forests on long-term self-reported health indicators.

Health indicator	Empirical studies	Type of investigation	Green space indicators
Self-reported health	Maas (2005)	Cross-sectional	Percentage of green space in 1 and 3 km radius
	De Vries et al. (2003)	Cross-sectional	Neighbourhood percentage of green space
	Mitchell and Popham (2007)	Cross-sectional	Proportion of green-space in area
	Angyemag et al. (2007)	Cross-sectional	Neighbourhood level dissatisfaction with green space
	Sugiyama, Leslie et al. (2008)	Cross-sectional	Perceived greenness of neighbourhood
Stress-related illnesses	Grahn and Stigdotter (2003)	Cross-sectional	Self-reported distance from green space and access to garden.
	Korpela and Ylēn (2007)	Cross-sectional	Frequency of visits to favourite natural place
	Hansmann et al. (2007)	Cross-sectional	Visit to urban forest and city park in Zurich
	Nordh et al. (2009)	Longitudinal	Participation in forest activities (evaluation)
Attentional capacity; life functioning	Kuo (2001)	Cross-sectional	'Greenness' rating of residential area by trained observers
Attention deficit disorder evaluation	Wells (2000)	Longitudinal –	Extent of green space visible from home rated by residents (before/after house move)
	Mårtensson et al. (2009)	Cross-sectional	Pre-school play areas characterised by total outdoor areas accessible in pre-school; proportion of area containing shrubbery, trees or hilly terrain; fraction of free sky above play areas.
Concentration, impulse inhibition	Taylor et al. (2002)	Quasi-experiment	Extent of green space visible from home rated by residents
No. of sick days in last month, Satisfaction with Life	Sugiyama, Ward Thompson et al. (2008)	Cross-sectional	Self-reported quality of Neighbourhood Open Space
Indicators of crisis rehabilitation	Ottosson and Grahn (2008)	Cross-sectional	Self-reported activities in natural settings (yard, park, neighbourhood)
Well-being and mental health (Quantitative measures)	Kaplan (2001)	Cross-sectional	Self-rated similarity of photograph with area around own home (nature, landscape, cars)
	Leslie and Cerin (2008)	Cross-sectional	Perceived aesthetics and greenery
	Lafortezza et al. (2009)	Cross-sectional	Visit to green space characterised by time of year, location.
	Smyth et al. (2008)	Cross-sectional	City scale green area/capita
Well-being and mental health (Qualitative measures)	Townsend (2006)	Cross-sectional	Participation in woodland management
	O'Brien (2006)	Cross-sectional	Various interactions with local woodland
	O'Brien and Murray (2007)	Cross-sectional	Participation in Forest School (UK)
	Kinglsey et al. (2009)	Cross-sectional	Indigenous people's connections to country

	O'Brien (2005)	Cross-sectional	Various interactions with local woodlands
	Milligan and Bingley (2007)	Cross-sectional	Participation in woodland based activities
	O'Brien and Snowdon (2007)	Cross-sectional	Participation in Chopwell Wood Health Project
	Cattell et al. (2008)	Cross-sectional	Various interactions with local open spaces
	O'Camp et al. (2009)	Cross-sectional	Cluster of 'green area and natural environment' concepts including parks, trees

Table E4 Summary of evidence for impact of urban forests on short-term attentional and cognitive function health indicators.

Health indicator	**Empirical studies**	**Type of investigation**	**Green space indicators**
Symptoms of Attention-Deficit/Hyperactivity Disorder	Kuo and Taylor (2004) Taylor et al. (2001)	Cross-sectional	Activity in 'mostly natural area – a park, a farm, green backyard or neighbourhood space'
Directed attention performance; Mood or emotion	Berman et al. (2008)	Experiment	(S1) Walk in arboretum compared with walk in down town area; (S2) viewing pictures of nature or urban settings
	Bodin and Hartig (2003)	Experiment	Running through marked parkland or urban (residential/commercial) routes
	Hartig et al. (1996)	Experiment	Photographs of urban and parkland settings
Directed attention	Tennessen and Cimprich (1995)	Cross-sectional	Dormitories with and without view to nature
	Cimprich and Ronis (2003)	Experiment	Home-based programme involving 120 mins weekly exposure to natural environment (e.g. visit to scenic spot, window with view of trees or garden)
Mood	Morita et al. (2007)	Cross-sectional	Walk in Tokyo University Forest
Mood state	Gathright et al. (2006)	Experimental	Tree compared with tower climbing
Self esteem and mood	Pretty et al. (2005)	Cross-sectional	Participation in green exercise activities in varied UK countryside

Table E5 Summary of evidence for impact of urban forests on physical activity

Empirical studies	**Green space indicators**	**Physical activity indicator**	**Findings**
Foster et al. (2004)	Perceived distance to local park	Any and minutes of walking in last month	Positive association males only
Evanson et al. (2005)	Before and after construction of walking trail	Time spent in physical activity	No significant change
Giles-Corti et al. (2005)	Distance from, attractiveness and size of public open space	Self-reported and observe use of public open space	Positive association
Van Lenthe et al. (2005)	Quality of green facilities	Time per week walking/cycling	No association

Ball et al. (2007)	Density of POS	Time walking for leisure and transport	No association
De Vries, et al. (2007)	Proportion of green space in neighbourhood	Moderate physical activity	No association
Neuvonen et al. (2007)	Amount and distance to green space	Time since last nature-based recreation	Positive association
Borst et al (2008)	Neighbourhood level ratings of attractiveness of streets (partly predicted by presence of trees, parks)	Walking behaviour	Positive association
Kemperman and Timmermans (2008)	Green space accessibility indicator	Duration, type and location of physical activity	Positive association
Sugiyama and Ward Thompson (2008)	Range of characteristics of neighbourhood open space	Level of walking activity	Positive association with pleasantness of open space, good paths and facilities
Maas et al. (2008)	Amount of green space within 1km and 3km radius of residence	Time in physical activity; whether met recommended 30 mins	No association
Pate et al. (2008)	Number of parks	Time in physical activity	Positive association
Witten et al. (2008)	Neighbourhood travel time to park	Time in physical activity	No association
Borst et al. (2009)	Characteristics of preferred route including presence of park and trees	Preferred walking route	Elderly people less like to walk a route through parks
Cochrane et al. (2009)	Proximity of physical activity spaces	Self-reported physical activity	Positive association, but green space not sufficient explanation
Hug et al. (2009)	Restorative quality of indoor and outdoor exercise environments	Exercise frequency	Positive association
Kaczynski et al. (2009)	Number, size and distance from park	Self-reported moderate to strenuous activity	Association varied with gender and age
Lackey and Kaczynski (2009)	Perceived and objective proximity to parks	Park-based physical activity	No association
Sugiyama et al. (2009)	Perceived distances to nearest outdoor recreational facility	Self-reported number of days took part in mod-vigorous physical activity	Positive association
Ries et al. (2009)	Map based park availability and self-reported park availability and quality	Accelerometer measure of activity; reported park use.	Positive association with perceived but not objective measures of park availability
Tilt (2009)	Perceived level of vegetation in neighbourhood	Self-reported frequency of walking to range of locations including parks	Positive association
Tucker et al. (2009)	Percentage park space;	Previous day physical activity	No association

Table E6 Summary of evidence for impact of urban forests on community

Empirical studies	Green space indicators	Community indicator	Findings
Coley et al. (1997)	Presence of trees	Use of common space	Positive association
Kuo et al. (1998)	Amount of trees and grass in residential common space	Use of common space and neighbourhood social ties, sense of safety	Positive associations
Kweon and Sullivan (1998)	Use of common green spaces	Social ties and strength of community	Positive associations
Taylor et al. (1998	Amount of vegetation in residential areas	Childhood play activities	Positive association with play, creative play
Ravencroft and Markwell (2000)	Parks	Accessibility to minority youth	High access but localised and uneven and does not imply integration
Kuo and Sullivan (2001a)	Apartment block scale observation of level of nearby vegetation	Police crime reports	Positive association
Kuo and Sullivan (2001b)	Apartment block scale observation of level of nearby vegetation	Resident reports of aggressive behaviour	Positive association
Westphal (2003)	Participation in urban greening programme	Empowerment of participants	Association depends on governance and leadership of project
Sullican, Kuo and Depooter (2004)	Greenness of common spaces rated by trained observer	Social activity in common spaces	Positive association
Seeland et al. (2009)	Reported environments where friends are made	Number of friends, friendships across cultures	Positive association, but varies with age, gender, % of immigrants in area
Maas, Dillen et al. (2009)	Percentage of green within 1, 3 km radius of residence	Feelings of loneliness, perceived social support, health	Positive association
Maas, Spreeuwenberg et al. (2009)	Comparison of urban and rural areas	Feelings of safety	Positive association except in very urban areas

Appendix F

Planning policies related to urban green space, TWF and health

In England, *Planning Policy Guidance 17: Planning for open space, sport and recreation* recognises the importance of green space for the improvement of air quality (Department for Communities and Local Government, 1991). Woodland and forests are also included in the definition of 'open space' used here and as such the benefits of open space (and therefore woodland and forests) for health and well-being are explicitly stated: 'well planned and maintained open spaces and good quality sports and recreation facilities can play a major part in improving people's sense of well being in the place they live'; 'open spaces, sports and recreational facilities have a vital role to play in promoting healthy living and preventing illness' (Department for Communities and Local Government, 1991). The policy guidance also asserts that, 'local authorities should encourage the creation of sports and recreational facilities in…areas of managed countryside, such as country parks, community forests, and agricultural show grounds' (Department for Communities and Local Government, 1991).

Likewise, in Scotland the health benefits of green- and open- space are referred to in some planning polices. For example, *National Planning Policy Guidance (NPPG) 14* on natural heritage observes that 'Good provision for open-air recreation and access to the natural heritage…benefits the nation indirectly through less quantifiable benefits in terms of health and quality of life' (SG, 1999). Also relevant, NPPG 11 on *Sport, Physical Recreation and Open Space* 'describes the role of the planning system in making provision for sports and physical recreation and protecting and enhancing open space' (SG, 1996). *Planning Advice Note 65: Planning and Open Space* goes further, stating that, 'Open spaces (the definition of which includes forest and woodland) are important for our quality of life. They provide the setting for a wide range of social interactions and pursuits that support personal and community well-being...Open space provides opportunities for sport and recreation, helping to promote active and healthy lifestyles…' (SG, 2008b)

Similarly, in Wales, *Technical Advice Note 16: Sport, Recreation and Open Space* initially sets the document in context, detailing the fact that the Welsh Assembly Government's *Environment Strategy for Wales:*

> states that every community should have a high quality, well planned and maintained built environment which provides access to green spaces and areas for recreation, and supports biodiversity. It recognises that poor quality environments with poorly maintained buildings, public spaces and lack of parks and green spaces can have a detrimental effect on our quality of life, and on our health and well-being. It also recognises that local environmental quality is often poorer in

> our more deprived areas…[and] focuses on improving the built and natural environment, including encouraging the provision and retention of green spaces in urban areas' (Welsh Assembly Government 2009b: 4).

It goes on to assert that: 'Playing fields and green spaces…can…offer health and well-being benefits and opportunities for community engagement' (Welsh Assembly Government 2009b: 14). It further notes that community woodlands, as well as other areas and spaces, 'can provide opportunities for children to interact and gain the social, health and well-being benefits which come from opportunities for active, physical play' (Welsh Assembly Government 2009b: 18).