Trees or turf?
Best value in managing urban green space

Prepared for the Woodland Trust by Land Use Consultants

May 2011
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Executive Summary

This report is an update of ‘Urban Woodland and Grassland, Comparative Management Costs’ produced by the National Urban Forestry Unit in 1998. The main purpose of that report was to provide objective comparisons of the costs of maintaining a number of different grassland regimes with the cost of maintaining different types of woodland. In so doing it was hoped to encourage the creation of more woodland and the planting of more trees, by showing that the management of woodland could be markedly cheaper than maintaining some types of grassland.

This report updates the cost comparisons in the original document, but also looks a little more deeply into the benefits of planting woodland and trees, particularly in the light of increasing awareness of the effect of climate change on our society and environment.

It does so by providing a summary of information and research which looks at the range of factors influenced by trees and woodlands, such as:

- Cleaner air, better health
- Improved shelter and protective shade
- Flood alleviation
- Biodiversity
- A more attractive landscape
- A stimulus to inward investment
- A focus for community action

The same nine regimes were chosen as in the original study, as it was felt they provide a good range of the types of regime that would or could be applicable to urban or suburban areas. The regimes are:

- Amenity grassland 10 per cent mown by hand
- Amenity grassland 50 per cent mown by hand
- Amenity grassland 100 per cent gang mown
- Meadow grassland
- Rough grassland
- Complex mixed woodland planting
- Woodland in managed green space
- Pioneer style woodland
- Naturally colonising woodland

Each was placed on a 1 hectare site 200m by 50 with a path suitable for each regime running through the middle, so simulating an area of open space accessible to users.
Maintenance costs for each of the regimes covered maintenance of the vegetation as well as the path and information signs, and were broken down into three successive phases:

- Years 1-4: Establishment phase
- Years 5-9: Post establishment phase
- Years 10-50: Long term management phase

Path maintenance, establishing and maintaining signs and collecting litter continues at a regular rate and cost for the woodland and grassland regimes, depending on the level of public access.

The results of the study revealed that:

- Naturally colonising woodland and pioneer style woodland can be considerably cheaper to maintain than all types of grassland;
- Maintenance costs of managing woodland in managed green spaces are more expensive during the establishment phase than informal woodland but are still less than the maintenance of amenity grassland;
- Complex mixed woodland planting are the most expensive of the woodland types to establish but these are still less than the cost of maintaining amenity grassland. However, the long term cost of managing complex woodland does rise above those for amenity grassland.

A summary of the average annual maintenance costs for each landscape type are provided in the table below.

<table>
<thead>
<tr>
<th>Regime</th>
<th>Average annual costs (£/ha)</th>
<th>Years 1-9</th>
<th>Years 10-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amenity grassland 50 per cent mown by hand</td>
<td>£2,280</td>
<td>£2,280</td>
<td></td>
</tr>
<tr>
<td>Amenity grassland 10 per cent mown by hand</td>
<td>£1,750</td>
<td>£1,750</td>
<td></td>
</tr>
<tr>
<td>Amenity grassland 100 per cent gang mown</td>
<td>£1,620</td>
<td>£1,620</td>
<td></td>
</tr>
<tr>
<td>Complex mixed woodland planting</td>
<td>£1,425</td>
<td>£2,750</td>
<td></td>
</tr>
<tr>
<td>Woodland in managed green space</td>
<td>£1,065</td>
<td>£1,050</td>
<td></td>
</tr>
<tr>
<td>Meadow grassland</td>
<td>£710</td>
<td>£710</td>
<td></td>
</tr>
<tr>
<td>Rough grassland</td>
<td>£580</td>
<td>£580</td>
<td></td>
</tr>
<tr>
<td>Pioneer style woodland</td>
<td>£250</td>
<td>£400</td>
<td></td>
</tr>
<tr>
<td>Naturally colonising woodland</td>
<td>£200</td>
<td>£350</td>
<td></td>
</tr>
</tbody>
</table>

The benefits of woodland in the urban environment are far reaching with the potential economic savings just one motive for establishing tree communities. Research has shown that trees can also improve the health and wellbeing of users and surrounding communities, increase biodiversity and aid in the mitigation of effects of climate change.

It should be noted that woodland planting may not be appropriate in all locations and careful consideration should be given on a site-by-site basis to ensure the impacts of establishing woodland are fully understood. It is also important that the right species of trees are planted in the right place.
1 Introduction

BACKGROUND

1.1 Woodland is one of the UK’s finest assets and fulfils a valuable role in the urban environment benefiting biodiversity, health and wellbeing of the local community, and mitigating the effects of climate change. Specific benefits of woodland planting include:

- Cleaner air
- Improved shelter and protective shade
- Biodiversity
- A more attractive landscape
- A stimulus to inward investment
- A focus for community action

1.2 In 1996, the National Urban Forestry Unit commissioned Land Use Consultants (LUC) to produce a report to assess the relative resource requirements for managing woodland and grasslands to demonstrate that some woodland could be cheaper to maintain than some types of grassland.

1.3 The resulting report ‘Urban Woodland and Grassland, Comparative Management Costs’ assessed four different woodland types, typical of those that might be suitable for urban or urban fringe locations and three grassland. The results of this study revealed the following:

- Naturally colonising woodland and pioneer style planted woodland can be considerably cheaper than grassland to maintain;
- Woodland within managed green space (i.e. where there is a greater degree of public access and a tidier woodland is required) are on average similar to the costs of maintaining rough grassland and meadows;
- The maintenance costs of complex mixed woodland plantings increase above the cost of maintaining rough and meadow grassland but can still be lower than for fully maintaining amenity grassland.

PURPOSE OF THE CURRENT STUDY

1.4 In 2011 The Woodland Trust commissioned LUC to review the original study to:

- Objectively re-assess the cost comparison of managing woodland landscapes over the traditional grassland spaces;
- Provide a summary of the benefits of woodland within the urban environments.

STRUCTURE OF THIS REPORT

1.5 The remainder of this report is set out in the following sections:

Section 2: brings together the results of other studies on the benefits of woodland within the urban environment;

Section 3: describes the woodland and grassland regimes considered in this study;

Section 4: provides a comparison of resource requirements for management of woodland and grasslands.
2 Benefits of woodland

KEY ISSUES

2.1 This section provides a brief summary of the many and varied benefits of trees and woodland and also points out circumstances where it may not be appropriate to plant trees and woodland.

2.2 Today, 80 per cent of the population live in urban areas and trees have an essential role in making towns and cities cleaner, healthier and more prosperous. Green space in towns can deliver significant benefits to the environment, society and public health. Trees, woods and forests are likely to be cost effective ways to combat climate change and the government has stated a commitment to encourage more woodland and trees in appropriate places.

2.3 Climate change has very significant implications for towns and cities because it is here that people and property are concentrated and also because of the particular properties of the urban environment itself. The buildings’ mass and hard surfaces absorb heat during the day and then release it overnight so producing an ‘urban heat island’. Impervious surfaces, which can exceed 70 per cent in urban centres and high density residential areas, increase surface water run-off and hence increases the risk of flooding. These factors amplify the effects of climate change where the prediction of higher temperatures will strengthen the heat island affect and of more and stronger rainfall will magnify surface water run-off.

2.4 Trees and woodland improve air quality and living near woodland encourages physical exercise and lowers mental stress. Trees protect people from extreme weather; they provide shade and cooling of cities, reducing the heat island effect by significant amounts. They intercept rain and improve the capacity for absorption of water through the ground, helping to mitigate surface water flooding. They act as reserves of biodiversity; they provide food and opportunities for recreation.

2.5 In addition, it will be possible in some areas to grow wood to use as a fuel, using coppicing techniques. Wood fuel is carbon neutral and provides a sustainable alternative to burning fossil fuels.

2.6 The Woodland Trust has highlighted that the UK is one of the least wooded countries in Europe with only 4 per cent native woodland cover. They estimate that at least twice as many native trees and woods are needed for the sake of wildlife and people, to combat climate change and improve the environment.

2.7 Demands on land are increasing due to population growth and increased expectations; it is predicted that there will be a significant increase in the

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1 Woodland Trust ‘Greening the concrete jungle’
2 CJC Consulting with Willis, Ken (January 2009) ‘The Value and Benefits Arising from Trees and Woodland in the UK’, School of Architecture Planning and Landscape University of Newcastle upon Tyne.
3 Defra Website http://ukclimateprojections.defra.gov.uk DEFRA Website (2011)
demand for land for housing, recreation, transport, food, water and energy. Urban trees whether in private gardens, schools hospital or in parks and streets, are under increasing threat from development. Tree cover is also deteriorating in many areas with concerns over tree safety and insurance claims.

2.8 In the face of these demands there is an increasing awareness of the need to understand the true economic and environmental value of green space (including woodland) in particular the value provided by natural systems and the costs associated with their degradation. The support that the natural environment provides is not always visible and includes mitigating climate change and improving public health. The Government has issued a discussion paper which is the forerunner of a White Paper on the Natural Environment due to be issued in 2011. It poses questions like ‘what do we need to do to embed the true value of all our natural resources in decision making at all levels’.

2.9 The Government has stated that although deficit reduction and economic recovery are their top priorities, they also know that we can no longer afford the cost to our economy and quality of life which arise from a degraded natural environments.

2.10 The current economic climate with its reductions in public spending means that the public sector is under increasing financial pressure, and as these are the bodies responsible for planning, planting and maintaining the majority of publicly accessible urban green space and its grass, shrub or tree components, it is inevitable that the trend of the last 30 years or so for more cost effective ways of managing green space will intensify. Public open spaces are required to have maintenance costs that are as low as possible. However many of the benefits of open space have been shown to decline where they are poorly maintained and unattractive and studies have shown that instead of being a benefit they have a negative impact.

2.11 To succeed in generating investment in trees and green space it will be important to convince planners, councillors, landowners and land managers of the benefits of landscape to their short-term cost programme. In the current financial climate the benefits of the long-term economics of green space does not address the financial constraints of the times.

2.12 Therefore it is essential that the long term benefits of trees and woodland are understood and valued arguing a whole–system approach in order to inform short term planning and design. Woodland could be promoted as insurance or security against flooding and heat island effects in towns.

2.13 However, there are also social and cultural dimensions to urban green space. It has to meet a range of recreational needs, and open grassed land is valued for many activities including sports and as venues for events which cannot be

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6 Christine Whitehead. Professor in housing at London School of Economics, at the LI’s ‘Why Invest in Landscape?’ debate on 21 March
carried out in woodland. Compared to woodland it is easier to see the use being made of turf and hence the perceived value of grass as a resource.

2.14 Studies have shown that people generally prefer a mix of open areas and trees rather than dense tree cover. Urban wildness of the type associated with natural regeneration, scrub woodland or areas going back to nature are perceived by most people to be associated with neglect, dereliction and as an environment that is threatening with opportunities for crime.\(^7\)

2.15 Whilst not necessarily cheaper to maintain, the maintenance of grassed areas is simpler to instruct than the maintenance of woodland. The openness of grassed areas also makes it easier to monitor for security.

2.16 Particular challenges of urban woodland are its susceptibility to fly tipping and other anti-social behaviour; initiatives like the Defra supported 'Big Tree Plant' are engendering community involvement in planting and wardening. The Big Tree Plant aims to encourage people and communities to plant more trees in urban and residential areas. The five year campaign will encourage local community groups to plant and care for trees in their neighbourhood, particularly in areas that do not have many. The Big Tree Plant partnership brings together civil society partners and conservation organisations, working with Defra and the Forestry Commission.

2.17 In summary, while woodland and trees may offer many benefits to society and the environment, careful planning needs to be undertaken to ensure that they are planted in the right place, are the right type of woodland or tree, and the long term impact of their existence and maintenance have been considered.

**POLICY CONTEXT**

2.18 The following summarises the current policies relevant to establishing and or maintaining or expanding tree cover, particularly in connection with combating climate change and improving the environment.

2.19 One of the objectives of Planning Policy Statement: Planning and Climate Change Supplement to PPS1 is that planning authorities should prepare spatial strategies which ‘conserve and enhance biodiversity, recognising that the distribution of habitat and species will be affected by climate change’. In selecting which areas should be developed they should consider any effect on the capacity of biodiversity to adapt to climate change and the contribution that existing or new green infrastructure could make to urban cooling, sustainable drainage systems, and conserving and enhancing biodiversity.

2.20 Climate change Defra UK. Because of the scale of climate change the government is developing an integrated climate change adaption and mitigation strategy. Climate change mitigation means limiting the extent of future climate change by reducing greenhouse gas emissions now and in the future. It can also mean removing carbon dioxide from the atmosphere, for example by planting more trees. Defra states that trees, woods and forests are cost effective ways to combat climate change and that they provide many

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other benefits too. Defra states that it wants to see a major increase in woodland creation, the planting of the right tree in the right place and a greater level of sustainable forest management in England.8

2.21 **Defra** state that woodland planted in England over the past 90 years currently removes about 3 million tonnes of CO₂ a year from the atmosphere. However, this effect is expected to decline as many of the coniferous forests planted between the 1950s and 1980s mature and are harvested (and then replanted). The wood harvested from forests can also contribute to climate change mitigation through substituting for fossil fuels, directly (as woodfuel), and indirectly when timber and wood products are used to replace materials with high embedded energy. The independent Read Report: “Combating climate change - a role for UK forests”, identified woodland creation as a cost effective mitigation option. It has the potential to provide additional reduction of 15 Million tonnes of CO₂ per year by the 2050s if UK woodland cover were increased from 12 per cent to 16 per cent over that period. The Forestry Commission, working with Defra, the private sector and civil society, have established the **Woodland Carbon Task Force** to facilitate an increase in the rate of woodland planting to help mitigate climate change.

2.22 The **Woodland Carbon Task Force** is running a two year programme with 5 projects. This is part of the Forestry Commission’s work to increase tree planting and woodland management in England. They are working towards establishing the conditions for a step change in rates of woodland creation and greater uptake of sustainable woodland management in England underpinned by private finance. To do this they are bringing together a team called the “Woodland Carbon Task Force” with leading roles for business, civil society, and landowners.

2.23 The **Forestry Commission** state that England is one of the least wooded countries in Europe and while many woods are well managed, much of it is fragmented and undermanaged. Over the past ten years woodland planting rates in England declined from about 5,000ha per year to about 2,000ha per year.

2.24 They state that this situation does not reflect the potential of the forestry sector to grow and help cut carbon emissions, support new green jobs and provide many other benefits such as flood management, helping wildlife cope with climate change and enabling people to get involved in their local landscape.

2.25 The Forestry Commission website quotes an independent review of evidence published in 2009, “Combating Climate Change – a Role for UK Forests” (the Read Report) shows how the planting of 23,500ha of woodland per year in the UK could provide significant carbon savings in the 2050’s. Supply and demand of woodfuel from lower quality material can help unlock the resource from undermanaged woods and promote sustainable woodland management.

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2.26 The Forestry Commission argue that increasing planting rates and woodland management in England will depend on creating conditions which stimulate private investment in forestry. There are major opportunities for private finance associated with demonstrating corporate social responsibility and achieving objectives for reducing greenhouse gases.

2.27 The Climate Change Act 2008. This Act introduced a binding reduction target requiring the UK to reduce its emissions by at least 80 per cent by 2050 against 1990 levels. It also introduced a long-term framework for managing emissions through a system of national carbon budgets: caps on the total quantity of greenhouse gases permitted in the UK over a specified time. Each carbon budget covers a five year period, with the first three carbon budgets running from 2008 to 2012, 2013-2017 and 2018-2022. During these periods, emissions must be reduced (from 1990 levels) by 22 per cent, 28 per cent and 34 per cent respectively. More information on carbon budgets is available on DECC’s website. The UK also has European and International obligations to reduce greenhouse gas emissions.

2.28 The UK Climate Projections (UKCP09) gives climate information for the UK up to the end of this century. Projections of future changes to our climate are provided, based on simulations from climate models. The purpose of providing information on the possible future climate is to help those needing to plan how they will adapt to help society and the natural environment to cope with a changing climate.9

THE VALUE AND BENEFITS FROM TREES AND WOODLAND IN THE UK

2.29 In an effort to demonstrate economic reasons for planting or maintaining woodland, the Woodland Trust commissioned CJC Consulting with Willis (2009)10, to assess the contribution that woodland makes to our lives.

2.30 The review made the case for woodland based on sound evidence. The report identifies the range of different benefits that woodland deliver and provides estimates of the value of the benefits provided. The study made an assessment of the reliability and relevance of the evidence. Although the scope of the report does not include commercial benefits from timber production and excludes the role of woodland in relation to water quality and flood alleviation which has been the subject of another report11, it details themes where woodland makes a contribution which include:

- Leisure and recreation
- Health including pollution absorption
- Landscape value and visual amenity
- Regeneration

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9 The UK Climate Projections are based on a new methodology designed by the Met Office, which allows a measure of the uncertainty in future climate projections to be included in the information. UKCP09 is funded by the Department for the Environment, Food and Rural Affairs (Defra).
10 CJC Consulting with Willis, Ken (January 2009) ‘The Value and Benefits Arising from Trees and Woodland in the UK’, School of Architecture Planning and Landscape University of Newcastle Upon Tyne.
11 Woodland Trust (2010) Trees and Flooding
• Green House Gas mitigation
• Education and community benefits
• Biodiversity

**Leisure and recreation**

2.31 The report concluded that woodland is an important leisure resource. Benefits from accessible woodland in Great Britain were estimated to be £392m per year in 2003. Woodland is valuable both very close to where people live and where it provides higher quality recreational experiences which may involve more extensive travel. Interestingly, an evaluation of the Community Woodland Supplement found that residents near woodland were more interested in trees in their locality for reasons other than access, such as visual amenity.\(^\text{12}\)

**Health**

2.32 Health can be enhanced by woodland in three ways:

• by improving air quality thus reducing the incidence of respiratory disease;
• by providing an increased opportunity to take physical activity thus reducing the incidence of a number of other diseases;
• by relieving psychological stress.

2.33 The layered canopy structure of trees which has evolved to maximise exposure of the leaf surfaces to light and to absorb carbon dioxide for photosynthesis means that they provide a far larger surface area than the land areas they cover. This area is between two and twelve times greater.\(^\text{13}\)

**Air quality**

2.34 Trees improve air quality by absorbing pollutant gasses such as nitrogen dioxide (NO\(_2\)) Sulphur dioxide (SO\(_2\)) and ozone (O\(_3\)). Trees capture particulate matter such as dust, traffic emissions, pollen and smoke on the leaf and bark surfaces by both electrostatic attraction and direct interception on the rough surfaces. Like all green plants, trees take in carbon dioxide (CO\(_2\)) from the atmosphere and water and minerals from the soil and through photosynthesis manufacture all the substances for growth. In the process they release oxygen (O\(_2\)) into the air, and remove carbon dioxide and incorporate the carbon into their structures.

2.35 The health benefits from reduced air pollution are thought to be proportionately greater per unit area in urban woodland than large blocks of forest located at a distance from urban areas. Woods which are located close to sources of pollution capture more pollutants therefore urban trees and small urban woods are particularly effective in capturing air borne pollutants.\(^\text{14}\) More research is needed as this has mostly concentrated on

\(^{12}\) Crabtree et al. (2001) ‘Economic Evaluation of the Community Woodland Scheme’ Report to the Forestry Commission Macaulay Land Use Research Institute, Aberdeen
woodland in areas greater than 2ha and this is thought to underestimate the total benefits as there will be additional benefits from trees and smaller woods especially in urban areas which could be substantial.  

**Effect of Woodland on increased physical activity.**

2.36 Studies have shown that the likelihood of using the open space increased with increasing levels of access and those with good access to large, attractive open space were 50 per cent more likely to achieve high levels of walking. The link between increased physical activity and better health has been shown in many studies. Further work is needed on alternative physical exercise opportunities available locally e.g. distance to the wood, attractiveness of the wood as opposed to alternatives say walking in a suburban street and any concerns about safety.

**Psychological benefits**

2.37 Trees are known to produce psychological benefits in terms of improving medical recovery rates. There is also some evidence that woodland can be therapeutic in reducing anxiety and stress. However studies have also found that certain types of wooded areas, particularly those which are enclosed, dark and dense are intimidating and hence will increase anxiety.

2.38 In relation to mental health, a study in 2006 found that dissatisfaction with local greenspace was one factor that significantly reduced mental health and vitality. It is the greenspace close to where people live that is most important to their health and their propensity to psychiatric morbidity.

2.39 Many schemes have been developed in recent years which encourage people to become more active, and those schemes which are most cost effective in health terms are those which induce sedentary people to increase their levels of activity.

2.40 The most useful woodland is that which is very close to where people live and can be incorporated into their daily lives (in terms of frequent use). The quality of green space close to people’s homes in urban areas is also an important determinant of their psychological health and vitality.

**Landscape value and visual amenity**

2.41 There is evidence that urban trees and urban greening provide significant benefit to residents. Coskeran (1999)\(^\text{16}\) studied the value to residents of urban parks in Northampton. His valuation technique revealed that the equivalent monetary value of parks to Northampton residents was greater than current spend on maintaining parks, and also that the parks differentially benefited lower income groups in the town.

2.42 There is some evidence to suggest that there is a preference among the public for a diverse mix of trees and open space rather than denser woodland


\(^{16}\) Coskeran, T. (1999) An Application of the Contingent Valuation Method to an Excludable Good, the Case of Northampton’s Parks. PHD Thesis University of Warwick Coventry
cover. A study in a 2008 by Bullock\textsuperscript{17} was a detailed attempt to value individual attributes of urban green space (including trees and woods). The preferences of respondents were for well-maintained areas with good facilities (paths, seating, trails, playgrounds etc.). There were preferences for mixed open areas and trees but generally not for more wooded areas unless these were areas that the residents were familiar with. This could be interpreted as a concern for personal safety in woodland, especially among female respondents. The study strongly supports the benefits from scattered trees in mixed open areas.

2.43 The CJC report concludes that amenity benefits from woodland in the landscape, both near where people live and whilst they are travelling or away from home, provides an important public benefit. The report cites studies that show that people prefer natural looking forests and they value organic irregular shaped woodland in the landscape and a diversity of species in woodland. Other studies have shown that average respondents preferred small woodland comprising randomly spaced broadleaved trees of varying height interspersed with open-space. The studies are hard to generalise from as the context of woodland is important.

2.44 Nationwide studies in England indicate that people are willing to pay a higher price for a house with a view of woodland. However some types of woodland, dense conifers for example, can have negative effect.

2.45 The establishment of green spaces in urban areas is known to have a positive impact on neighbouring house prices. A number studies have estimated the impact of various urban attributes on property prices and in Tyneside, Powe et al (1995)\textsuperscript{18} found that being within 500m of deciduous trees added 8 per cent to property values and being within 500m of a large open space added about 6 per cent.

Regeneration

2.46 The role of trees in the regeneration of rural and urban areas including rehabilitation of industrial and derelict land has proved an effective way of both land remediation and regeneration of urban communities facing poor social and environmental conditions. The precise contribution of trees is difficult to measure as they are part of a larger process. However woodland creation has been an important element in the work of the Land Restoration Trust partnership (comprising the Forestry Commission, English Partnerships, Groundwork and the Environment Agency) which aims to deliver community led regeneration of previously derelict or underused land.

2.47 An indication of benefits comes from an evaluation by Selman et al (2003) of a Capital Modernisation Fund investment on part-brown field, part agricultural land in three community forest areas of the UK. It indicated that though there were high costs to set the project up due to difficult social and physical conditions of £10,000 per hectare for community woodland, the report anticipates that the projects’ annual public benefit eventually deriving from the

\textsuperscript{17} Bullock (2008) Valuing Urban Green Space :hypothetical alternatives and the status quo. Journal of Environmental Planning and Management 51 15-35
project would exceed £4,000/ha/year. However there were also some long
term management costs which might need to be addressed for maintaining
some of the more difficult sites.

2.48 The CJC report concludes that public benefits from large scale regeneration
involving tree planting on derelict and industrial land are difficult to assess but
generally positive. Careful targeting of sites is important in relation to public
benefits to maximise value for money.

2.49 Forestry as a rural development mechanism has disadvantages because of its
long timescale and uneven income flow. Value for money of schemes is
debatable because timber prices have declined and land prices increased.

2.50 Projects have to be assessed on their regional context and long-term success
depends to a large degree on the extent on which tourism is stimulated and
local residents derive amenity and access benefits from the woods.

**Green House Gas mitigation**

2.51 Trees sequester carbon during growth and in unharvested regenerating
forests the carbon balance including soil carbon continues to be positive over
a long time period. Sequestration in trees contributes over half of all the
measured environmental benefits from the British forest stock.

2.52 New planting is most effective in reducing greenhouse gas emissions where
the wood substitutes for fossil fuels.

2.53 There are limits to the potential of forestry to reduce net emissions because
of competition for land. More research is needed to establish whether
woodland creation can be a cost effective policy mechanism for GHG
mitigation.

**Education and Community Benefits**

2.54 Woods are increasingly being used as a space for educational and community
activities. Communities can benefit from a link to their local woods through
ownership management or as a member of partnership with other bodies.
Large numbers of people have been involved in tree planting to create
woodland and derive benefits from doing so.

2.55 Woodland can provide a flexible social space for those with a wide range of
groups, including the mentally ill, disaffected youth and those with learning
disabilities.

**Biodiversity**

2.56 The CJC report found that there were several problems with the estimation
of biodiversity values. Although many people enjoy seeing nature when
visiting woodland this element was difficult to separate from visual amenity
and other forms of recreation experience. That said, the studies the report
reviewed revealed a sizable willingness to pay on the part of the public for
biodiversity and its improvement.

**Location**

2.57 The CJC found that benefits to people of green space and woodland
(primarily from recreational access landscape and health) are highest close to
where they live, work and spend their recreation time. People value green
space although trees are only one element in a wider demand for open space and other recreational facilities. It says that policies focussed on benefits to people would have trees in streets and open space in urban and peri-urban locations as a priority. Planting of woodland in rural areas where the major output is a contribution to biodiversity provides limited justification in terms of benefit.

**Climate Change**

2.58 Even the more conservative projections of climate change predict that we can anticipate hotter, drier summers and warmer, wetter winters with rainfall becoming more intense. There will be more severe extreme weather events such as heat waves and severe flooding. 19

2.59 Climate change has very significant implications for towns and cities in part because it is here that people and property are concentrated and also because the particular properties of the urban environment itself.

2.60 The buildings mass and hard surfaces absorb heat during the day and then release it overnight so producing an ‘urban heat island’. On some days there is a difference of as much as 10° C between central London and its surrounding suburbs.

2.61 As the proportion of surfaces on which rain falls and are impervious surfaces can exceed 70 per cent in urban centres and high density residential areas, a high proportion of any falling rainwater runs off directly into drainage systems and rivers, rapidly increasing their levels and the potential for flooding.

2.62 Both these factors amplify the effects of climate change, higher temperatures will strengthen the heat island and increased and more intense rainfall will magnify surface water run-off and hence the potential for flooding.

2.63 The environmental services provided by trees become critically important in a changing climate. Trees provide shade so reduce the amount of heat reaching hard surfaces and the most effective way to reduce urban temperatures and the effect of the heat island is increased canopy cover. Trees also reduce the ambient temperature through evaporative cooling. 20

2.64 It is during droughts that provision of shade becomes increasingly important in managing high temperatures. The cooling effect of tree canopy is greatest in broadleaved and mixed forests. The potential of forests to provide cool shelter was studied by Renaud and Rebetz 21 and they comment that forested parks could provide an important source of relief during heat waves.

2.65 Climate change will have an impact on biodiversity, hotter summers and wetter winters will mean that some tree species will be able to extend their

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range northward in the UK and some may decline in the hotter drier south east. For example shallow rooting trees like beech trees (*Fagus sylvatica*), may be disadvantaged by increased severity and regularity of summer drought and may decline. Some introduced tree species may start to produce viable seed and become too widespread for example False acacia (*Robinia pseudoacacia*) and Tree of Heaven (*Ailanthus altissima*). Woodland will also be affected by storms and milder winters may foster greater survival of insect pests.\(^{22}\)

2.66 There are also hazards associated with trees themselves including subsidence, wind throw, and ozone precursors\(^{23}\) which may be aggravated by climate change and appropriate strategies and guidance will be needed to develop management strategies so they can be managed effectively\(^{24}\).

2.67 A major factor in the level of management and intervention needed to maintain and manage trees and woodland is the suitability of both to the sites they occupy, i.e. the right tree or woodland needs to be in the right place.

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\(^{23}\) Some trees produce volatile organic compound which can react with pollutant like nitrogen oxides to form ozone although their contribution is small in high temperatures in urban areas it can exacerbate smog. Although the total benefits of trees far outweigh the possible consequences of volatile organic compound emissions.

**Table 2.1: The right tree in the right place**

Checklist of headline considerations when planting trees or woodland

- **Local character**: check if there is a history in the area for the use of particular species that could be reflected in the planned planting.

- **Work with nature**: in natural areas, employ stock of locally native origin. Best of all, work with natural colonisation.

- **Great trees of the future**: where the setting allows, take opportunities to plant large species of trees with a long lifespan.

- **Accessibility**: new trees and woodland are most needed where they can provide people with access to nature and natural landscapes in areas presently lacking in such areas.

- **Infrastructure**: consider existing and future infrastructure requirements – do not plant too close to over/underground infrastructure. Consider root barriers for street trees.

- **Highways**: meet the statutory requirement to maintain a clear route along roads (consider heights of buses, HGVs, cars, cycles and horses).

- **Preserving existing habitats**: shade cast by trees, and their demands on soil, water and nutrients, mean that they can kill or damage valuable wildlife habitats such as wetlands, waterways and water bodies, heathlands, flower rich grasslands and brownfields, so check for existing habitat value.\(^25\)

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3 Woodland and grassland types

3.1 While the previous section discussed the potential benefits of planting and maintaining trees and woodland, this section looks at the comparative costs of maintaining a number of different woodland and grassland types.

3.2 To provide a common base for the cost comparison, each of the woodland or grassland regimes is based on a notional model of a 1ha site, 200m x 50m in size, with a single path 130 metres long and 1.5 metres wide. Interpretation boards are located at either end of the path.

3.3 For the pioneer style woodland, woodland in managed green space and complex mixed woodland planting, maintenance costs are calculated from the first year establishment but exclude any planting costs, while for naturally colonising woodland maintenance costs are assumed to include initial work required to cater for public access as well as ongoing maintenance. Grasslands are assumed to be established and undergoing routine annual maintenance.

3.4 Each regime contains the operations that would be needed to maintain not only the vegetation but also footpaths and sign boards, and to collect litter to an appropriately tidy standard over a 50-year period. This period has been split into three, corresponding to the initial establishment of the woodland (years 1-4), post establishment (years 5-9) and long term maintenance (years 10-50).

NATURALLY COLONISING WOODLAND

3.5 In naturally colonising woodland, little short term maintenance is required, apart from opening up rides, maintaining a simple path and signage. Paths are assumed to be formed through habitual use, possibly reinforced by occasional mowing.

3.6 Long term maintenance requirements are very dependent on local site conditions and on the type of woodland required. On derelict sites with poor soil cover the naturally colonising tree cover may not be adequate and further planting may be required. An allowance for this has been assumed in our costings.

3.7 As such sites develop, the long term maintenance may be restricted to keeping paths open and sign boards in good condition, allowing thinning and regeneration of trees to occur naturally with little or no outside influence. There is a possibility that with no deliberate thinning, the woodland develop a dense thicket structure with little or no access away from the paths, or that self thinning will occur as trees mature.

3.8 On richer soils where natural colonisation is more productive and the resultant sapling density is higher, or where the desired final structure of the woodland is of well shaped mature trees with a clear open understorey, thinning and selected felling and planned replanting may be essential. Where thinning is included we have assumed that it starts at 10 years and continues at 10 to 15 year intervals.
3.9 Our cost estimates consider both situations, i.e. with and without thinning.

3.10 However, regardless of the thinning regime, public access and safety have to be considered. Provision is therefore made for safety inspections, after 30 years when trees are becoming large, of trees close to public paths, and subsequent safety work.

**PIONEER STYLE WOODLAND**

3.11 Pioneer style woodland tends to be in informal surroundings, derelict or reclaimed land for example and are meant to be planted versions of the naturally colonising woodland.

3.12 The emphasis is on a relatively limited range of suitable and hardy indigenous species, planted at a small size (60-90 or 90-120cm) and at 2m centres. Good establishment is a priority: a weed free zone is maintained around each tree for the first three years using herbicides. Paths are simple, and have been assumed to be formed through public use, with some additional mowing.

3.13 Pioneer style woodland is designed to simulate natural woodland, being of simple design, using species which will allow evolution and change over the years. Management, if required at all, is easier and cheaper than in the more intricate complex mixed woodland planting because of the bold, simple blocks of species. Our costings therefore consider situations where some thinning is carried out and also where no thinning is needed. Work needed to maintain paths, access and safety are included regardless of the thinning regime.

**WOODLAND WITHIN MANAGED GREEN SPACE**

3.14 Woodland in managed green space is based on the principles of the pioneer style woodland with similar species, planting and establishment procedures, but because they are located in urban parks, allowances have to be made for greater public use.

3.15 During establishment, for example, a weed free zone is maintained around each tree but in addition, vegetation growing outside the weed free zone is strimmed to maintain a tidy appearance. Paths have hard surfaces, and litter picking is increased to cater for the higher numbers of users.

3.16 Over the long term, thinning would be required to produce woodland with a clear understorey which appears safe to users. Although the level and degree of thinning would vary from site to site, we assume that it starts at year 10, continues on a 10 year cycle, initially taking out 25 per cent of trees, falling to 15 per cent at 50 years. The potential costs of safety inspections and work resulting from them are also included.

3.17 To provide for a sustainable, mixed age woodland, we have assumed that planned establishment of new trees, probably naturally generating from the existing trees, would take place over 25 per cent of the woodland area after 40 years.

3.18 Regular maintenance of paths and signs and litter collections (20 per year) will take place, with the cost of replacement of paths and signs being spread over the whole 50 year period.
COMPLEX MIXED WOODLAND PLANTING

3.19 Complex mixed woodland planting is where a diversity of tree and shrub species have been planted at close spacing and at different sizes to provide a rapid visual effect, often close to residential areas.

3.20 Maintenance is governed by the need for thinning and coppicing to compensate for the initial close planting spacing and to realise the more complicated design intentions. Relatively heavy public use of the areas also needs to be catered for. Paths are assumed to be hard surface. Litter generation and hence collection have also been assumed to be relatively high.

3.21 Long term management for the complex mixed woodland planting includes periodic thinning at 10, 15, 20, 25, 35 and 45 years. Provision is also made after 30 years for safety inspections of trees close to public paths, and subsequent safety work. Replanting in 1/4 ha blocks has also been assumed to provide mixed age woodland.

AMENITY GRASSLAND

3.22 Amenity grassland is cut around 15 times a year, mainly with gang mowers but using pedestrian mowers and/or strimmers for path edges, banks and obstructions. To give some idea of the variation in cost of mowing using a tractor drawn gang mower and of using pedestrian mowers, two scenarios have been considered: one with 10 per cent of the total area mowed using pedestrian mowers and another where 50 per cent of the site is uneven or in small patches where a pedestrian mower is required.

3.23 For both situations, it has been assumed that the site also undergoes spiking, fertilising and other operations to maintain a healthy sward. Provision is also made for 15 collections per year of litter generated by users.

ROUGH GRASSLAND

3.24 Rough grassland is cut twice a year with the arisings left. The path layout and number of obstructions has been assumed to be the same as for the amenity grassland but as public use tends to be lower than for amenity grassland, litter generation and hence gathering is assumed to be at a lower level, 10 times a year as opposed to 15 for amenity grass. However an allowance has been made to compensate for the greater difficulty of collecting litter from long grass.

MEADOW GRASSLAND

3.25 Meadow grassland differs from rough grassland in that only one cut is made per year, but the arisings are removed to reduce the soil fertility and hence to encourage a wider range of grassland species.

COMPARING COSTS

3.26 Cost rates for the various operations were found from a number of sources, to provide a range of values. Sources included contractors’ rates, published material and an analysis of work rates, hourly labour costs, overheads and machinery costs.
When assessing the results of this study, it should be noted that quoted costs for any task can vary markedly from one contractor to another. Even for grass mowing where the operations are well defined and work rates are similar from site to site, variations can reflect the relative areas of expertise of different contractors, or be dependent on the make-up of the site. In our comparisons we have averaged rates from a number of sources, ignoring those rates which show a marked variation from a number of broadly similar results.

Costs for woodland maintenance, particularly for those tasks involving tree felling or other tasks generating large amounts of arisings, can vary considerably from one site to another depending on the ease of disposing of those arisings. Prices will be far lower where arisings can be disposed of on site, or where access to roads allows the arisings to be removed easily.

In addition the tasks needed to manage woodland, both in the short and long term can vary considerably according to growing conditions, location and on the type of woodland required. Thinning in particular is an expensive operation and may be needed in areas where natural regeneration e.g. of sycamore and ash, would produce a thicket woodland which may be unsuitable for public access, but it may not be necessary on sites with poor soil.

Hence the findings of this study can be used as a guide to relative costs but should not be assumed to be an accurate reflection of the prices that would be quoted for every site.
4 Comparison of resource requirements for management of woodland and grassland

4.1 This section compares the costs of managing and maintaining the four different woodland types and the three grassland types over a 50 year period which is broken down into three successive phases:

- Years 1-4: Establishment phase
- Years 5-9: Post establishment phase
- Years 10-50: Long term management phase

4.2 Path maintenance, establishing and maintaining signs and collecting litter continues at a regular rate and cost for the woodland and grassland regimes, depending on the level of public access.

PHASING OF WOODLAND MANAGEMENT

4.3 Woodland management needs to respond to each of the phases as follows:

- establishment of new woodland or initial preparation of naturally colonising woodland;

- a post-establishment phase when the trees have been established, and canopies have closed to an extent, inhibiting weed growth. This period, between 5 and 10 years after the woodland has been established is the cheapest period for those woodland where thinning is required;

- a period from about 10 to 30 years when, if required, thinning takes place to provide more space for selected trees to grow. After 30 years, thinning can continue, but new planting is established, or natural regeneration is managed in part of the woodland to establish a mixed age woodland community.

4.4 It is assumed that after 50 years, maintenance will have reached a relatively steady state, with rotational planting, establishment, thinning and felling operations.

4.5 The management of all publicly accessible woodland will need to consider the safety of users, particularly as trees become larger. Allowances should be made for safety inspections, particularly along paths and at entrances, and for any work required to make the woodland tree safe.

4.6 Compared to naturally colonising and pioneer style woodland, the management intensity is greater for woodland in managed green space and complex woodland plantings throughout the 50 year period predominantly due to ongoing thinning of densely planted trees.

4.7 Naturally colonising woodland and pioneer style woodland, thinning and regeneration may be allowed to occur naturally, with management of only those areas close to paths.

4.8 Safety work applies to all woodland. However safety inspections are limited to trees along the footpath for naturally colonising and pioneer style woodland as access is usually restricted to these routes. For woodland where
visitor pressure is greatest (i.e. woodland within managed green space and complex mixed woodland plantings) safety inspections will be need to respond accordingly with a greater of number of trees being surveyed.

**PHASING OF GRASSLAND MANAGEMENT**

4.9 The maintenance requirements of grasslands are more consistent than compared with woodland with the required maintenance regimes for each type being carried out each year.

4.10 Amenity grasslands require the greatest resource requirements through the need for regular mowing to maintain a short even sward free of litter and other detritus.

**AVERAGE COSTS OF MANAGING WOODLAND AND GRASSLAND BY PHASE**

4.11 Figure 4.1 provides an overview of the average costs of managing each landscape type over each of the three phases. The management costs of each landscape type are discussed in the paragraphs below.

**Figure 4.1: Average maintenance costs**

<table>
<thead>
<tr>
<th>Landscape Type</th>
<th>Years 1-4 (£/ha)</th>
<th>Years 5-9 (£/ha)</th>
<th>Years 10-50 (£/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amenity grassland 50%...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amenity grassland 10%...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex mixed woodland...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amenity grassland 100%...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woodland in managed green...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meadow grassland...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rough grassland...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pioneer style woodland...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naturally colonising woodland...</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Years 1-4: Establishment phase**

4.12 Table 4.1 below indicates the average costs of managing the differing woodland and grasslands types during the first four years of operation.
### Table 4.1: Average annual maintenance costs years 1-4

<table>
<thead>
<tr>
<th>Regime</th>
<th>Average annual costs (£/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amenity grassland 50 per cent mown by hand</td>
<td>£2,280</td>
</tr>
<tr>
<td>Amenity grassland 10 per cent mown by hand</td>
<td>£1,750</td>
</tr>
<tr>
<td>Complex mixed woodland planting</td>
<td>£1,650</td>
</tr>
<tr>
<td>Amenity grassland 100 per cent gang mown</td>
<td>£1,620</td>
</tr>
<tr>
<td>Woodland in managed green space</td>
<td>£1,500</td>
</tr>
<tr>
<td>Meadow grassland</td>
<td>£710</td>
</tr>
<tr>
<td>Rough grassland</td>
<td>£580</td>
</tr>
<tr>
<td>Pioneer style woodland</td>
<td>£310</td>
</tr>
<tr>
<td>Naturally colonising woodland</td>
<td>£90</td>
</tr>
</tbody>
</table>

4.13 Amenity grasslands where large areas of hand mowing are required are the most expensive landscape types to manage during this period.

4.14 Complex mixed woodland plantings are the most expensive woodland and are marginally more expensive than amenity grassland areas where the entire site can be mown using a tractor towed gang mower.

4.15 Woodland in planted in urban parks, mainly through the cost of weed control and litter collection, are more expensive in their first four years of existence than either pioneer style or naturally colonising woodland and more expensive than maintaining rough or meadow grassland.

4.16 Pioneer style woodland, designed to be easy to establish inexpensive to maintain, are certainly the cheapest woodland to establish and are also cheaper to maintain than the grasslands considered.

4.17 Pioneer woodland is more expensive in the first four years. Naturally colonising woodland is the lowest cost of all woodland and grassland regimes.

### Years 5 to 9: Post establishment

4.18 The average costs for managing woodland and grasslands during the post establishment phase are listed in Table 4.2.

### Table 4.2: Average annual maintenance cost years 5-9

<table>
<thead>
<tr>
<th>Regime</th>
<th>Average annual costs (£/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amenity grassland 50 per cent mown by hand</td>
<td>£2,280</td>
</tr>
<tr>
<td>Amenity grassland 10 per cent mown by hand</td>
<td>£1,750</td>
</tr>
<tr>
<td>Amenity grassland 100 per cent gang mown</td>
<td>£1,620</td>
</tr>
<tr>
<td>Complex mixed woodland planting</td>
<td>£1,200</td>
</tr>
<tr>
<td>Meadow grassland</td>
<td>£710</td>
</tr>
<tr>
<td>Woodland in managed green space</td>
<td>£630</td>
</tr>
<tr>
<td>Rough grassland</td>
<td>£580</td>
</tr>
<tr>
<td>Pioneer style woodland</td>
<td>£190</td>
</tr>
<tr>
<td>Naturally colonising woodland</td>
<td>£110</td>
</tr>
</tbody>
</table>

4.19 During this phase complex mixed woodland planting and woodland planted in managed green space are cheaper than amenity grassland, with woodland planted in managed green space similar or slightly lower in cost to rough and
meadow grassland. However both are more expensive than pioneer style and naturally colonising woodland. The bulk of the expenses in both these woodland types result from a higher level of safety inspections, path maintenance and litter clearance to cater for increased public access.

10 to 50 years: Long term management phase

4.20 Table 4.3 below indicates the costs associated with the management of woodland and grasslands during the long term management phase.

4.21 As the woodland matures and trees become larger, maintenance costs rise to reflect costs of thinning and replanting, and safety work. During this period the cost of maintaining complex mixed woodland, with their high planting densities, complicated design and subsequent need for thinning, can, in the years when thinning takes place, rise above the cost of maintaining even amenity grassland mown with a pedestrian mower. Woodland in managed green space cost more than rough grassland and meadow grassland but less than amenity grassland.

Table 4.3: Average annual maintenance costs years 10-50

<table>
<thead>
<tr>
<th>Regime</th>
<th>Average annual costs (£/ha) Years 10-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex mixed woodland planting</td>
<td>£2,750</td>
</tr>
<tr>
<td>Amenity grassland 50 per cent mown by hand</td>
<td>£2,280</td>
</tr>
<tr>
<td>Amenity grassland 10 per cent mown by hand</td>
<td>£1,750</td>
</tr>
<tr>
<td>Amenity grassland 100 per cent gang mown</td>
<td>£1,620</td>
</tr>
<tr>
<td>Woodland in managed green space</td>
<td>£1,050</td>
</tr>
<tr>
<td>Meadow grassland</td>
<td>£710</td>
</tr>
<tr>
<td>Rough grassland</td>
<td>£580</td>
</tr>
<tr>
<td>Pioneer style woodland</td>
<td>£400</td>
</tr>
<tr>
<td>Naturally colonising woodland</td>
<td>£350</td>
</tr>
</tbody>
</table>

Average annual costs

4.22 Amalgamating the costs into average annual costs for short term maintenance (the first nine years) and long term maintenance (10 to 50 years), shows that for the regimes considered:

- the average annual costs for maintaining informal woodland with low public access, naturally colonising and pioneer style woodland, are lower than for all types of grassland. If thinning is needed, then the long term maintenance costs of both woodland types are increased but are still similar to the costs of maintaining rough and meadow grassland, and are considerably lower than for amenity grassland;

- where public access is increased, and the woodland is maintained in a relatively tidy state, (i.e. woodland in managed green space), the average annual maintenance costs can be slightly higher than both rough grassland and meadow grassland, but still lower than amenity grassland;

- increasing the density and complexity of planting, as in complex mixed woodland planting, increases both the short and long term average annual maintenance costs. However our figures indicate that the average cost of maintaining complex mixed woodland planting during the first
nine years are still slightly lower than the cost of maintaining amenity grassland, whether using gang mowers or pedestrian mowers.

4.23 However the costs for amenity grassland assume that the grass is not only mown but is regularly fertilised, scarified etc. and has path edges cut. If the mowing alone is considered then the average cost for largely gang mown amenity grassland is approximately £700 per year per hectare, lower than short and long term maintenance of complex mixed woodland planting and slightly lower than for short term maintenance of woodland within managed green space.

Table 4.4: Average annual maintenance costs years 1-9 and 10-50

<table>
<thead>
<tr>
<th>Regime</th>
<th>Average annual costs (£/ha)</th>
<th>Years 1-9</th>
<th>Years 10-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amenity grassland 50 per cent mown by hand</td>
<td>£2,280</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amenity grassland 10 per cent mown by hand</td>
<td>£1,750</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amenity grassland 100 per cent gang mown</td>
<td>£1,620</td>
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<td>Complex mixed woodland planting</td>
<td>£1,425</td>
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<td>£2,750</td>
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<tr>
<td>Woodland in managed green space</td>
<td>£1,065</td>
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<td>£1,050</td>
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<tr>
<td>Meadow grassland</td>
<td>£710</td>
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<td></td>
</tr>
<tr>
<td>Rough grassland</td>
<td>£580</td>
<td></td>
<td>£580</td>
</tr>
<tr>
<td>Pioneer style woodland</td>
<td>£250</td>
<td></td>
<td>£400</td>
</tr>
<tr>
<td>Naturally colonising woodland</td>
<td>£200</td>
<td></td>
<td>£350</td>
</tr>
</tbody>
</table>

ASSUMPTIONS AND EXCLUSIONS

4.24 These figures do not consider the provision of wardens or interpretation facilities other than signboards. Potential annual costs for a full-time warden would be:

- Salary                     £20,000
- Overheads (e.g. National Insurance, pensions etc.) £6,000
- Vehicle (depreciation and running costs) £10,000
- Equipment (depreciation and running costs) £2,000
- Total                      £38,000

4.25 However small sites of one hectare or less rarely require a full time warden and if wardening were provided it would probably be as part of a much larger round. In areas of amenity grass the priority might be encouraging dog owners to clean up after their dogs, in other less formal areas; duties would be more concerned with interpretation of the site. Hence the cost of wardening for each of the seven regimes discussed above would be a proportion of £38,000, but the extent of that proportion is difficult to predict without setting each site in a wider context.

4.26 Our analysis of maintenance costs has been based on an arbitrary site, 1 ha in area. For smaller sites, quantities are smaller and hence the overall cost lower, but not necessarily in proportion, i.e. not half the cost for half the size. This is because all cost rates for operations include components for preparing for the work as well as carrying out the operation. For smaller sites, the
preparation time for a particular operation would be the same as on a larger site, but with less time doing the work.

4.27 This means that cost rates per unit area tend to increase with decreasing size of site. However, the effect is more marked with faster operations, e.g. if the cost rate of gang mowing 1m² on a 1ha site is 100 per cent, then for a 0.25ha site, the cost rate increases to 135 per cent and for a 2ha site it decreases to 94 per cent of the cost for a 1ha site.

4.28 However the reduction in cost rates with increasing size of site is less pronounced for slower operations, e.g. strimming or woodland operations. The cost rate for strimming a 0.25ha site is only 2 per cent higher than the equivalent rate for a 1ha site.

4.29 While there may be little variation in the way amenity grassland is maintained, woodland management is far more site specific, particularly for long term management. Thinning for example may start from 10-15 years from establishment and the level of thinning may also vary from woodland to woodland. Hence the findings based on the regimes used for this study may not cover all situations, but they do reflect a broad range of situations between low and high maintenance grassland and woodland regimes.
Appendix I

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[http://www.decc.gov.uk](http://www.decc.gov.uk) DECC website 2011


**Trees for cities** [http://www.treesforcities.org/Biodiversity and Trees for Cities](http://www.treesforcities.org/Biodiversity and Trees for Cities)

**UKCP09** The UK Climate Projections are based on a new methodology designed by the Met Office, which allows a measure of the uncertainty in future climate projections to be included in the information. UKCP09 is funded by the Department for the Environment, Food and Rural Affairs (Defra).

**Whitehead,** C. Professor in housing at London School of Economics, at the LI’s ‘Why Invest in Landscape?’ debate on 21 March 2011.


**Sources of rates**


Carillion 2005. ‘PSA Schedule of Rates for Landscape Management’. TSO, Norwich


Land Use Consultants (contract prices)

Forestry Commission (2011). Thames Chase Community Forest (woodland and grassland management costs)
Appendix 2

Details of maintenance regimes
Description:

Woodland often found on neglected and derelict sites, with pioneer species such as birch and alder colonising naturally from seed. Management consists of establishing and maintaining safe public access, usually on footworn paths, and promoting healthy woodland through natural colonisation, additional planting and thinning where required.

Tree types: Pioneer species only
Tree species: e.g. alder, birch, willow, wild gean, ash and sycamore
### Maintenance operations

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fell trees to create entrance (5 assumed)</td>
<td>1x</td>
</tr>
<tr>
<td>• Clear shrubs and lower branches to create a clear entrance</td>
<td>1x</td>
</tr>
<tr>
<td>• Rotational clearance of shrubs and lower branches from entrance</td>
<td>1x per year after 6 years</td>
</tr>
<tr>
<td>• Fell trees as necessary to create path access (5 assumed)</td>
<td>1x</td>
</tr>
<tr>
<td>• Initial clearance of shrubs and lower branches from path area</td>
<td>1x</td>
</tr>
<tr>
<td>• Clear shrubs and lower branches from path sides (10 per cent of the path are per year)</td>
<td>1x year after 6 years</td>
</tr>
<tr>
<td>• Establishment to improve tree density, assumed to be needed on 20 per cent of the site</td>
<td>1x from year 5, with establishment operations as per pioneer woodland</td>
</tr>
<tr>
<td>• Thinning woodland</td>
<td>Depending on growth rates, possibly once in the first 10 years, removing some 25 per cent of the tree numbers, thereafter on 5 - 10 year intervals removing 25 per cent of the remaining trees, this proportion decreasing to 10-15 per cent after 5 or so thinnings</td>
</tr>
<tr>
<td>• Respacing of naturally colonising trees after 30 years to promote mixed age woodland</td>
<td>25 per cent of area per 10 years after 30 years</td>
</tr>
<tr>
<td>• Safety inspection when trees are larger, after 30 years, assuming 10 per cent of trees are in locations which require inspection</td>
<td>1x per year after 30 years</td>
</tr>
<tr>
<td>• Pruning and tree work resulting from safety inspection, assuming 5 per cent of trees require safety work</td>
<td>1x per year after 30 years</td>
</tr>
<tr>
<td>• Flail path and remove arisings</td>
<td>1x per year</td>
</tr>
<tr>
<td>• Flail path edges, removing arisings</td>
<td>1x per 2 years</td>
</tr>
<tr>
<td>• Clear bushes and lower branches from path sides over 10 per cent of the area</td>
<td>1x per year</td>
</tr>
<tr>
<td>• Scavenge litter from all areas</td>
<td>4x per year</td>
</tr>
<tr>
<td>• Inspect and maintain sign boards</td>
<td>3x per year</td>
</tr>
</tbody>
</table>
Description:

A robust and relatively informal woodland, designed for rapid establishment of pioneer and hardy indigenous species. Transplants (20-120cm) are planted in 1 metre diameter weed free circles which are kept weed free for the first 3 years of establishment.

**Tree types:** Pioneer species only  
**Tree species:** e.g. alder, birch, willow, wild gean, ash and appropriate shrubs (including nitrogen fixers)  
**Spacing:** 2m centres  
**No. trees/ha:** 2,500  
**Size:** transplants (20-120)
<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Weed control in 1m diameter circle around trees, using herbicide</td>
<td>2x per year for the initial 3 years of establishment</td>
</tr>
<tr>
<td>• “Beat up”, assuming replacement of 10 per cent of the planted trees</td>
<td>1x in the 2nd year</td>
</tr>
<tr>
<td>• Thinning woodland</td>
<td>Depending on growth rates, possibly once in the first 10 years, removing some 25 per cent of the tree numbers, thereafter on 5 - 10 year intervals removing 25 per cent of the remaining trees, this proportion decreasing to 10-15 per cent after 5 or so thinnings</td>
</tr>
<tr>
<td>• Establishment of new planting after 30 years to promote mixed age woodland</td>
<td>25 per cent of area per 10 years after 30 years</td>
</tr>
<tr>
<td>• Safety inspection when trees are larger, after 30 years, assuming 10 per cent of trees are in locations which require inspection</td>
<td>1x per year after 30 years</td>
</tr>
<tr>
<td>• Pruning and tree work resulting from safety inspection, assuming 5 per cent of trees require safety work</td>
<td>1x per year after 30 years</td>
</tr>
<tr>
<td>• Flail path and remove arisings</td>
<td>1x per year</td>
</tr>
<tr>
<td>• Flail path edges, removing arisings</td>
<td>1x per 2 years</td>
</tr>
<tr>
<td>• Clear bushes and lower branches from path sides over 10 per cent of the area</td>
<td>1x per year</td>
</tr>
<tr>
<td>• Scavenge litter from all areas</td>
<td>6x per year</td>
</tr>
<tr>
<td>• Inspect and maintain sign boards</td>
<td>3x per year</td>
</tr>
</tbody>
</table>
WOODLAND WITHIN MANAGED GREEN SPACE

Description:

A robust and relatively informal woodland similar in concept to the pioneer woodland but planted in urban parks and hence catering for greater public access. The woodland is designed for rapid establishment of pioneer and hardy indigenous species, but is also kept tidy by strimming vegetation between the trees and by collecting litter more frequently. Transplants (20-120cm) are planted in 1 metre diameter weed free circles which are kept weed free for the first 4 years of establishment.

Tree types: Pioneer mainly
Tree species: e.g. alder, birch, willow, wild gean, ash and appropriate shrubs (including nitrogen fixers)
Spacing: 2m centres
No. trees/ha: 2,500
Size: transplants (20-120)
## Maintenance operations

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weed control in 1m diameter circle around trees, using herbicide</td>
<td>2x per year for the initial 3 years of establishment</td>
</tr>
<tr>
<td>Strim between trees</td>
<td>1x per year for first three years</td>
</tr>
<tr>
<td>Apply fertiliser to trees</td>
<td>1x, in second year of establishment</td>
</tr>
<tr>
<td>“Beat up”, assuming replacement of 10% of the planted trees</td>
<td>1x in the 2nd year</td>
</tr>
<tr>
<td>Thinning woodland</td>
<td>Depending on growth rates, possibly 1x in the first 10 years, removing some 25% of the tree numbers, thereafter on 5-10 year intervals removing 25% of the remaining trees, this proportion decreasing to 10-15% per cent after 5 or so thinnings</td>
</tr>
<tr>
<td>Establishment of new planting after 30 years to promote mixed age woodland</td>
<td>25% of area per 10 years after 30 years</td>
</tr>
<tr>
<td>Safety inspection when trees are larger, after 30 years, assuming 10% of trees are in locations which require inspection</td>
<td>1x per year after 30 years</td>
</tr>
<tr>
<td>Pruning and tree work resulting from safety inspection, assuming 5% of trees require safety inspection</td>
<td>1x per year after 30 years</td>
</tr>
<tr>
<td>Strim path edges</td>
<td>1x per year</td>
</tr>
<tr>
<td>Repair and maintain tar spray and chip path, assuming repair of 10% of path per year after 4 years</td>
<td>1x per year 4</td>
</tr>
<tr>
<td>Scavenge litter from all areas</td>
<td>20x per year</td>
</tr>
<tr>
<td>Inspect and maintain sign boards</td>
<td>6x per year</td>
</tr>
</tbody>
</table>
Description:

A densely planted woodland with an unusually varied assortment of tree species as well as shrubs providing an understorey and cover at the edges of the wood. The woodland is designed to provide a strong structure and visual impression soon after planting.

**Tree types:** A mixture of tree and shrub species, some fast growing nurse species to provide rapid cover, others slow growing to provide long term structure. Shrubs are planted to provide an understorey and at the woodland edges.

**Tree species:** e.g. poplar, alder, birch, willow, wild gean, oak, ash and appropriate shrubs.

**Spacing:** 1m centres for the trees, 0.5m centres for the shrubs.

**No. trees/ha:** 10,000

**Size:** transplants(20-120), staked standards and whips (120-250)
### Maintenance operations

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Weed control, using herbicide</td>
<td>2x per year for the initial 3 years of establishment</td>
</tr>
<tr>
<td>• Inspect ties, guards etc.</td>
<td>1x per year for first 3 years</td>
</tr>
<tr>
<td>• Remove guards, ties etc.</td>
<td>1x in the 4th year</td>
</tr>
<tr>
<td>• Supply and apply fertiliser</td>
<td>1x in the 2nd year</td>
</tr>
<tr>
<td>• Thinning woodland</td>
<td>Depending on growth rates, possibly 1x in the first 10 years, removing some 25 per cent of the tree numbers, thereafter on 5 - 10 year intervals removing 25 per cent of the remaining trees, this proportion decreasing to 10-15 per cent after 5 or so thinnings</td>
</tr>
<tr>
<td>• Felling to create space for replanting</td>
<td>25 per cent of area per 20 years after 40 years</td>
</tr>
<tr>
<td>• Replanting and establishment of new planting after 30 years to promote mixed age woodland</td>
<td>25 per cent of area per 20 years after 40 years</td>
</tr>
<tr>
<td>• Safety inspection when trees are larger, after 30 years, assuming 10 per cent of trees are in locations which require inspection</td>
<td>1x per year after 30 years</td>
</tr>
<tr>
<td>• Pruning and tree work resulting from safety inspection, assuming 5 per cent of trees require safety work</td>
<td>1x per year after 30 years</td>
</tr>
<tr>
<td>• Flail path edges, removing arisings</td>
<td>1x per 2 years</td>
</tr>
<tr>
<td>• Clear bushes and lower branches from path sides over 10 per cent of the area</td>
<td>1x per year</td>
</tr>
<tr>
<td>• Repair and maintain tar spray and chip path, assuming repair of 10 per cent of path per year after 4 years</td>
<td>1x per year after 4th year</td>
</tr>
<tr>
<td>• Scavenge litter from all areas</td>
<td>12x per year</td>
</tr>
<tr>
<td>• Inspect and maintain sign boards</td>
<td>6x per year</td>
</tr>
</tbody>
</table>
AMENITY GRASSLAND

Description:

A grassland typical of that found in many parks and recreation grounds. Large expanses are mown with a tractor driven or self propelled gang mower, while pedestrian mowers and strimmers are often used on more restricted areas, around flower beds and obstructions and on steep banks. Allowances are also made for operations such as fertilising, scarifying etc. to maintain a healthy sward. Public use is assumed to be relatively heavy, leading to frequent litter picking and a hard surface to the path.
**Maintenance operations**

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut grass with gang mower or pedestrian mower</td>
<td>15x per year</td>
</tr>
<tr>
<td>Strim around obstructions</td>
<td>15x per year</td>
</tr>
<tr>
<td>Spot treat noxious weeds</td>
<td>2x per year</td>
</tr>
<tr>
<td>Supply and apply fertiliser</td>
<td>1x per 3 years (or 1/3rd of area per year)</td>
</tr>
<tr>
<td>Harrow</td>
<td>1x per 5 years (or 1/5th of area per year)</td>
</tr>
<tr>
<td>Aerate using hollow tine</td>
<td>1x per 5 years (or 1/5th of area per year)</td>
</tr>
<tr>
<td>Spike</td>
<td>1x per 5 years (or 1/5th of area per year)</td>
</tr>
<tr>
<td>Trim path edges</td>
<td>15x per year</td>
</tr>
<tr>
<td>Scavenge grass areas for litter</td>
<td>15x per year</td>
</tr>
<tr>
<td>Sweep path</td>
<td>1x per 2 weeks in summer, 1x per 2 months in winter</td>
</tr>
<tr>
<td>Repair path (tar spray and chip), 10 per cent per year</td>
<td>1x per year</td>
</tr>
<tr>
<td>Inspect and maintain sign boards</td>
<td>6x per year</td>
</tr>
</tbody>
</table>
ROUGH GRASSLAND

Description:

An informal grassland suitable for country parks or less used areas of urban parks, particularly on poor soils where growth rates are relatively low. The grass is cut twice a year using a tractor drawn rotary mower or flail and the arisings are left. Path edges are trimmed and obstructions strimmed around. Public use is assumed to be lower than for amenity grass leading to a lower frequency of litter collection and a gravel path rather than one with a tarred surface.

Maintenance operations

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut grass with tractor drawn rotary or flail mower</td>
<td>2x per year</td>
</tr>
<tr>
<td>Strim around obstructions</td>
<td>2x per year</td>
</tr>
<tr>
<td>Spot treat noxious weeds</td>
<td>2x per year</td>
</tr>
<tr>
<td>Trim path edges</td>
<td>4x per year</td>
</tr>
<tr>
<td>Scavenge grass areas for litter</td>
<td>10x per year</td>
</tr>
<tr>
<td>Sweep path</td>
<td>6x per year</td>
</tr>
<tr>
<td>Repair path (hoggin), 10 per cent per year</td>
<td>1x per year</td>
</tr>
<tr>
<td>Inspect and maintain sign boards</td>
<td>6x year</td>
</tr>
</tbody>
</table>
MEADOW GRASSLAND

Description:

An informal grassland designed to promote the growth of a species rich sward for country parks or less used areas of urban parks. The grass is cut once a year using a forage harvester or cutter bar and baler so that the arisings are removed to reduce soil fertility and encourage the growth of less vigorous grasses and wild flowers. Path edges are trimmed and obstructions strimmed around. Public use is assumed to be lower than for amenity grass leading to a lower frequency of litter collection and a footworn or mown path rather than one with a tarred surface.

Maintenance operations

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut grass with forage harvester or cutter bar and baler</td>
<td>1x per year</td>
</tr>
<tr>
<td>Strim around obstructions</td>
<td>1x per year</td>
</tr>
<tr>
<td>Spot treat noxious weeds</td>
<td>2x per year</td>
</tr>
<tr>
<td>Trim path edges</td>
<td>4x per year</td>
</tr>
<tr>
<td>Scavenge grass areas for litter</td>
<td>10 x per year</td>
</tr>
<tr>
<td>Clean path</td>
<td>6x per year</td>
</tr>
<tr>
<td>Inspect and maintain sign boards</td>
<td>6x per year</td>
</tr>
</tbody>
</table>