Practical Guidance

Residential developments and trees

A guide for planners and developers

January 2019

WOODLAND TRUST

Countryside Properties

Incorporating trees into residential developments

With more than 80% of the UK's population living in towns and cities, it is critical Local Planning Authorities and developers step forward to ensure they are healthy, happy and productive places for people to be. These communities need to be multi-faceted and resilient to the challenges posed by climate change, an ageing population, the obesity crisis and increasing budgetary constraints.

The importance of trees and green space in delivering high quality places to live, work and spend leisure time is now widely recognised. These vital areas can be taken for granted but add significant value to the development in terms of social, economic and environmental benefits. Integrating trees and green spaces into developments early on in the design process minimises costs and maximises the benefits they can provide.

Environmental benefits

Reducing flooding

The high proportion of impenetrable surfaces in urban areas increases the speed and volume of water runoff which can quickly overwhelm drains. Urban flooding as a result of drainage systems being overwhelmed is estimated to be costing £270 million a year[1] and is only going to rise with increasing frequency and magnitude of storm events. Poor quality water is also a significant problem in urban areas which leads to detrimental impacts on wildlife and water-based leisure and recreation activities. This in turn leads to higher treatment costs.

Woods and trees should form an integral part of all Sustainable Urban Drainage Systems (SUDS).

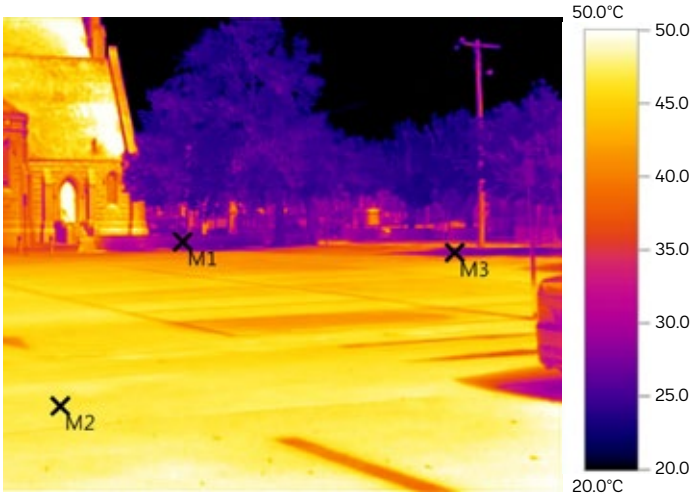
- Planting trees can slow the flow of water and reduce surface water runoff by up to 62% compared to asphalt[2,3].
- Trees intercept water as it falls, which is then directly evaporated back into the atmosphere. Roots help the infiltration of water into the soil, lowering the risk of surface water flooding. The average volume of water removed by urban trees was 6.24 m^3/tree/year[4], or 0.48 6.24 m^3/tree/year averaged over six UK urban areas[5], leading to a significant reduction in pressure on drainage systems.
- Isolated single trees (for example urban street trees) use much more water because of their larger canopy and greater exposure.
- Individual tree canopies can intercept as much as 79% of a 20mm, 24-hour rainfall event under optimum, full leaf conditions[2].
- A single young tree planted in a small pit over an impermeable asphalt surface can reduce runoff by around 60%, even during winter when not in leaf[6].
- Tree roots can increase infiltration rates in compacted soils by 63%, and in severely compacted soils by 153%.
- Trees can help diffuse pollution and by reducing the amount of water running into drains in turn help reduce the quantity of water that needs treating[7,8].
- Integrating SUDS and tree pit design can have a significant effect on 'slowing the flow'. Adequate soil volumes provided within hard surfaces can retain substantial volumes of water within the soil matrix, reducing inundation and providing slow release back into natural or engineered drainage systems.

Improved air quality

Poor air quality can have adverse impacts on people's health, especially those with heart and lung conditions, including asthma. In the UK alone, air pollution is estimated to have an effect equivalent to 29,000 deaths a year and is expected to reduce the life expectancy of everyone in the UK by six months on average, at a cost of £16 billion per year[9]. Trees are effective at mitigating the effects of air pollution by trapping particulate matter on leaf surfaces and directly absorbing gasses[10,11]. Trees can remove the pollutants which cause greatest concern: particulate matter (PM), oxides of nitrogen, sulphur dioxide and ground-level ozone. Pollution removal values per unit of canopy cover in eight UK urban areas were estimated at between 5.1 to 12.2g/m^2/year (median 9.6 g/m^2/year), providing a total monetary value per year from £281,495 (Torbay) to £126,100,000 (London)[12].

Planting in areas of high pollutant concentration – such as along roads and at traffic junctions – will have the greatest benefit[13]. A single tree alone has been estimated to reduce PM concentration by 15-20[14], while a line of young silver birch roadside trees resulted in over 50% reductions in PM levels within the row of terraced houses screened from the road[15]. Tree species do however differ in their ability to remove pollutants depending on leaf properties such as hair and wax cover[16]. The Woodland Trust report on Urban Air Quality has more details on which species to choose[17].

An additional benefit of integrated planting in highway and junction design is improved traffic flow, reducing the amount of idling traffic and therefore associated pollution hotspots.



City of Greater Geelong

Mitigating the urban heat island

The urban heat island effect is caused by hard surfaces of structures such as buildings and roads absorbing heat during the day and releasing it at night, coupled with energy released by human activity. There can be as much as a 9°C difference between residential centres and the surrounding area, which can contribute to heat-related stress, a cause of premature death.

Increasing tree cover in urban areas can help mitigate the urban heat island: through direct shading, by reducing ambient air temperature through the cooling effect of water evaporation from the soil via plant leaves, and because they do not absorb as much heat as built surfaces. A study in Manchester found that shade from street trees reduced surface temperatures by an average of 12°C; concrete surfaces shaded permanently by a bank of trees were cooled by up to 20°C in the summer, although there was no effect on air temperatures[18]. The shading provided by trees can also reduce energy use for heating and cooling buildings. Trees can therefore play an important role in urban climate change strategies[19].

Reducing noise

According to the World Health Organisation, after air pollution[20], noise is the second largest environmental health risk in Western Europe. Major roads, railways, airports and industrial areas can all be sources of considerable noise, and in an urban environment noise reflected off hard surfaces can be amplified. Using a barrier can increase the distance between the noise and the receiver[21]. Natural barriers provide a more aesthetic alternative to artificial ones made of concrete or wood. Trees can reduce surrounding noise through a combination of reflection and absorption of sound, although the effects are modest (typically 2-4 dB)[22,23,24]. Larger leaved trees are more effective than smaller leaved ones with low shrubs and hedges also providing good sound barriers[25]. The denser a natural barrier and the closer it is to the source of the noise, the more effective it will be at lessening the impact[26]. A 15m wide tree belt has been shown to provide noise reduction equivalent to a 1-2m high thin concrete wall[27].

Biodiversity

Natural spaces such as parks, gardens and woodland within urban areas can support a range of wildlife, and urban trees in particular support rich and biodiverse communities[28]. Trees and hedges within urban areas provide important connectivity between isolated pockets of fragmented habitats, mitigating the negative effects of urbanisation for species such as bats[29]. Urban trees also provide food resources, shelter and nest sites for wildlife that inhabit urban areas.

Victoria Bankes Price/WTML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Social value

Health and wellbeing

The provision of green space can benefit both physical and mental health, reduce health inequalities and reduce the wider costs of health care. The role that green space can play in helping to tackle public health issues and deliver wide-ranging benefits to people's health and wellbeing is widely acknowledged[10,30,31]. An estimated £34.2 billion worth of wellbeing benefits (including to physical and mental health) per year are delivered by frequent use of parks and green spaces[32]. To lead a healthy, active lifestyle, individuals must have access to an environment which provides opportunities for healthy living where they want to spend time[33].

Reducing health care costs

The costs to the NHS of treating overweight and obese patients together with related health problems are estimated to have reached £4.2 billion by 2007 in direct costs and £15.8 billion in indirect impacts – such as to the wider economy[34]. The costs of mental health issues in terms of health and social care are increasing; estimated as reaching £12 billion a year in England with a wider economic impact of £63 billion per year[35].

A number of studies have emphasised the savings to the NHS from increasing activity and exercise among individuals. Research by the Department for Culture, Media and Sport has suggested that an increase in adult physical activity by 10% would benefit England by £500 million per year[36]. A report to the Forestry Commission suggested a saving of £1.44 billion in health care costs could be achieved with a reduction of just 1% in sedentary behaviour[37] while Natural England estimated that access to quality green space could save around £2.1 billion in health care costs[38]. Studies have also highlighted specific benefits to physical and mental health.

Benefits to physical health

- Based on a nationally representative annual survey carried out over six consecutive years, it was estimated that English adults make 1.23 billion 'active visits' to the natural environment per year[39]. Active visits lasting 30 minutes or more (which would contribute to the recommended weekly physical activity guidelines) were associated with an estimated 109,164 Quality Adjusted Life Years, with a total social value of £2.18 billion.
- Irrespective of income or social group, the closer people live to green space the more likely they are to be physically active and have a lower tendency to be overweight or obese[40].
- Improving the quality of outdoor space with trees can increase physical activity such as walking and cycling. Physical activity in green spaces has a greater positive impact compared to activities in alternative environments[41].
- Green space can have a positive effect on physical health conditions such as obesity, heart disease, circulatory and respiratory diseases and asthma through encouraging activity and reducing air pollution[42]. Spending time within sight of trees and walking in a natural environment were associated with lowered blood pressure and lower stress levels[43].
- Having a high amount of green space within walking distance was correlated with lower BMI scores in children[44].
- Urban tree canopy cover, independent of green space access, has been associated with health benefits in Californian residents, including reduction in obesity, type 2 diabetes, high blood pressure and asthma[45].

Benefits to mental health and wellbeing

- Increased physical activity has been linked to an improvement in mental wellbeing[46] and a delay in the effects of dementia[47].
- Access to green space improves people's mental health as does the view of a natural environment[48]. Contact with nature was also found to have had a relaxing effect on Alzheimer's patients[49].
- A greater percentage of green space in the living environment has been linked with lower stress levels,

objectively measured by levels and diurnal patterns of cortisol secretion and controlling for demographic and socioeconomic variables[50].

- Children with a more natural space nearby have higher levels of psychological wellbeing[51].
- The symptoms of ADHD in children improved in those children that had taken part in outdoor activities[52].
- Access to the natural environment benefited people living with dementia through increasing awareness and attention as well as reducing stress and improving social interaction[40]. Further evidence showed the potential of woodland visits to improve verbal expression and stimulate memory as well as enhancing wellbeing[53].
- As individual visits to urban green space increased, significantly fewer individuals reported stress-related illnesses[54].

Reducing health inequalities

Health inequalities, the health gap between communities with differing economic conditions, are influenced by the wider environment[55]. Access to green space is not equally distributed across the population[56]. More affluent areas and people in higher socioeconomic groups have larger amounts and greater access to green space compared to more deprived areas[57]. Inclusion of existing and creation of new green space can help reduce these inequalities. In those areas where there are a greater proportion of green spaces, income-related health inequalities are lower.

Community benefits, amenity and recreation value

- Around 83% more individuals use green spaces for activity compared to bare sites[58].
- Urban greenspaces are being increasingly utilised, with an estimated 1.46 billion visits made by people living in towns or cities in 2015/6 compared to 1.16 in 2009/10[59].
- Encouraging the use of outside space and maintaining its quality can deter crime and anti-social behaviour. Open green space and widely spaced trees are perceived more positively than dense vegetation[60].
- The presence of trees indicated a more cared for neighbourhood, and street trees were associated with a decreased incidence of crime[61].
- For a public housing development in Chicago with approximately 5,700 residents, the rate of violent and property crimes were lower for apartment buildings with greener surroundings[60].
- Trees can play a significant aesthetic role helping integrate new developments into existing ones and creating a local identity[10].
- A poor quality local environment can have a negative impact on the quality of life of those communities[62].
- Children prefer to play in natural areas but these are increasingly being lost. These green areas are proven to increase activity levels, enhance creativity and help physical development as well as increase social skills[30].

Road safety

Trees can create an environment in which road and hazard awareness of road users is improved. Trees along roads help motorists judge their speed more effectively and can be used as part of traffic calming measures[63]. Trees can be used as a means of making local access and residential roads visually distinct from main roads (see below). Research from New Zealand shows this approach reduced speeds on the local roads. There was a 36% reduction in crashes in the area and an 86% reduction in crash costs[64].

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Education

Learning outdoors has a number of benefits for child development, boosting confidence and self-esteem and helping with team building[65]. Children who are connected with nature are more likely to engage with nature as adults[66]. Views of a natural environment are also important, increasing children's concentration, improving academic results and decreasing time off due to illness[30].

Economic value to development

Provision of green space has both direct and indirect benefits to developments[67]. Good quality green space can enhance their appearance and improve people's perceptions of an area[25]. Several studies have also shown investing in green space and tree planting increases property and land values and encourages further investment[68]. Others indicate buyers are willing to pay more for views of trees and the natural environment[10,69,70]. The additional benefits of, for example, trees in mitigating air pollution and storing carbon should also be included in an economic consideration of green spaces[67].

Direct benefits

- A CABE review showed that properties in environments landscaped with trees or close to green space had a range of price increases up to 30%[71].
- The economic value of the benefits of urban woodland was estimated at £39 billion or £130,000 per hectare[67].
- A study in north west England found a natural view added 18% to a property's value[35].
- A London case study found a 1% increase in green space was associated with a 0.5% increase in the average house price[72].
- Well managed nearby green space was estimated to increase property values between 2.6-11.3%[6].
- A number of evaluation methods exist for trees[25,73]:
  - The Helliwell method calculates the amenity value of trees and woods.

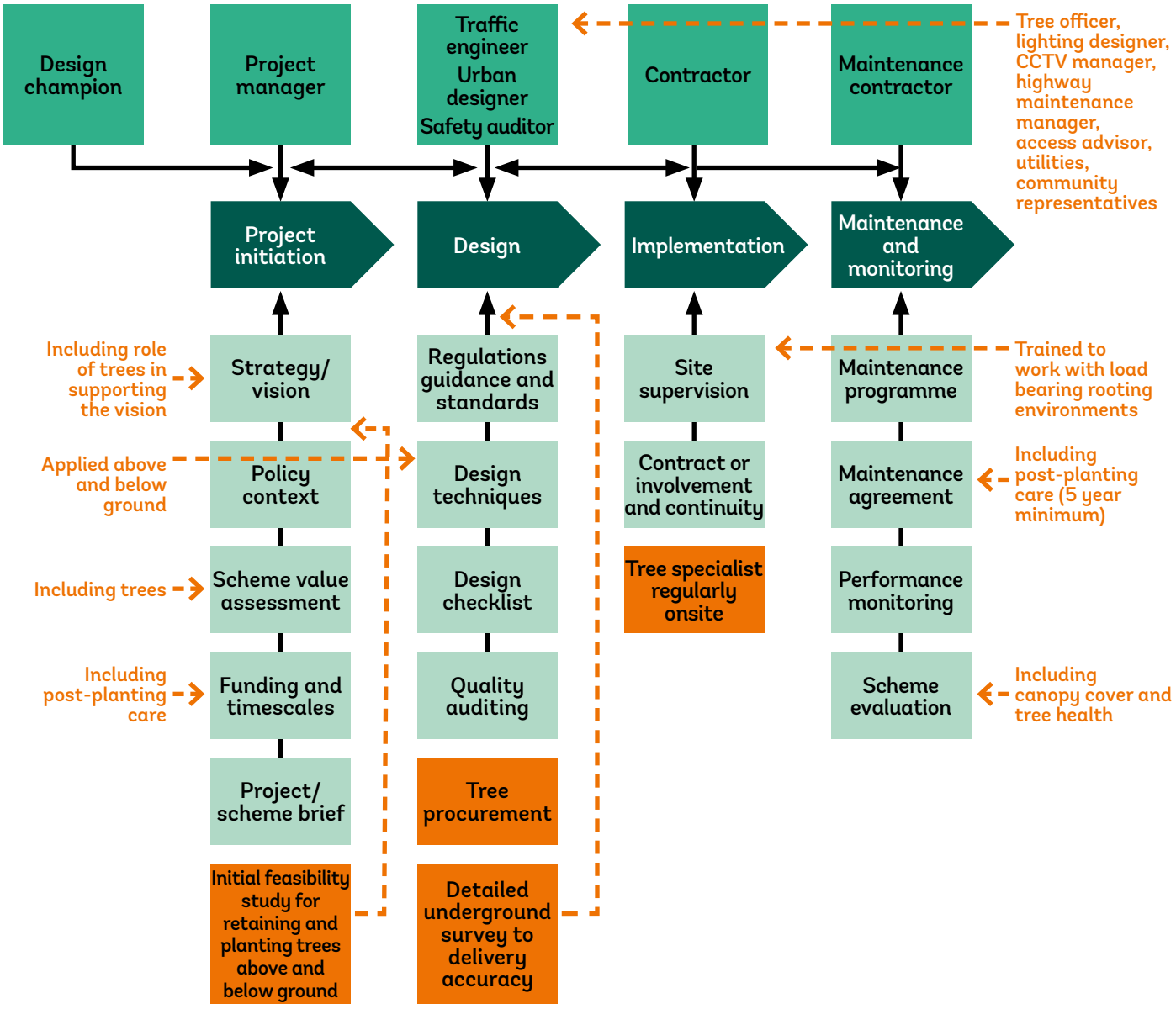
Summary of the average annual maintenance costs for each landscape type from the Woodland Trust *Trees or Turf?* Report (2011)

Regime	Average annual costs (£/ha)	
	Years 1–9	Years 10–50
Amenity grassland 50% mown by hand	£2,280	£2,280
Amenity grassland 10% mown by hand	£1,750	£1,750
Amenity grassland 100% gang mown	£1,620	£1,620
Complex mixed woodland planting	£1,425	£2,750
Woodland in managed green space	£1,065	£1,050
Meadow grassland	£710	£710
Rough grassland	£580	£580
Pioneer style woodland	£250	£400
Naturally colonising woodland	£200	£350

Intergrating trees into the LTN1/08 design process, flow, inputs and outputs

This four-step approach of initiation, design, implementation and maintenance and monitoring can be applied to new developments. The titles refer to roles rather than to professional backgrounds; one person may fill several roles.

Courtesy of Trees and Design Action Group



- The Council of Tree and Landscape Appraisers (CTLA) uses an economic model to create a value of trees.
- Capital Asset Value for Amenity Trees (CAVAT) along with the value of a tree incorporates an element designed to record its social value.

Other indirect economic benefits

- Trees reduce the maintenance costs of green space[74].
- Green infrastructure can make an area more attractive to visitors and through this, add value to the local economy by increasing inward investment and increasing land and property values[10].
- An economic valuation of green infrastructure can support the case for its inclusion into developments[25].

Factors to consider when incorporating trees

The Trees and Design Action Group (TDAG) publication *Trees in Hard Landscapes: a Guide for Delivery Checklist*, has a list of headline considerations when incorporating trees and green space into development[63]. Adapted from the Department for Transport's Local Transport Note 1/08 Traffic Management and Streetscape the orange annotations (see above) demonstrate how to integrate trees into the design and implementation process.

Design[63,74,75]

- Incorporating new and existing trees at the early stages of development plans is essential.
- Refer to any relevant local strategies applying to trees and green space. If a particular species has been used in an area historically, then that could be reflected in the planned planting.
- Using existing mature trees when planning and designing developments can save money on planting and add immediate impact. Where the setting allows, take opportunities to plant large species of trees with a long lifespan.
- Studies have shown that people generally prefer a mix of open areas and trees rather than dense tree cover.
- In high density housing, space along boundaries, paths and in areas of public space can be used to accommodate roots and canopy growth.
- Community involvement in the creation of green infrastructure can help ensure its success and increase its value to communities through a sense of ownership.
- New trees and woodland are most needed where they can provide people with access to nature and natural landscapes in areas presently lacking such an opportunity.

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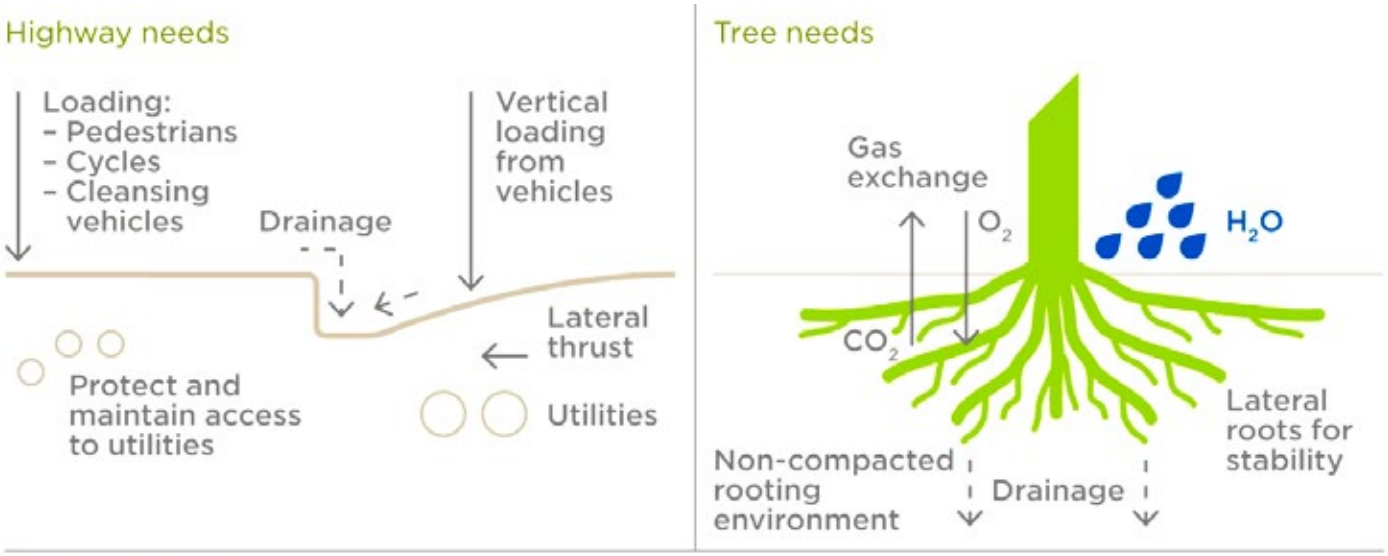
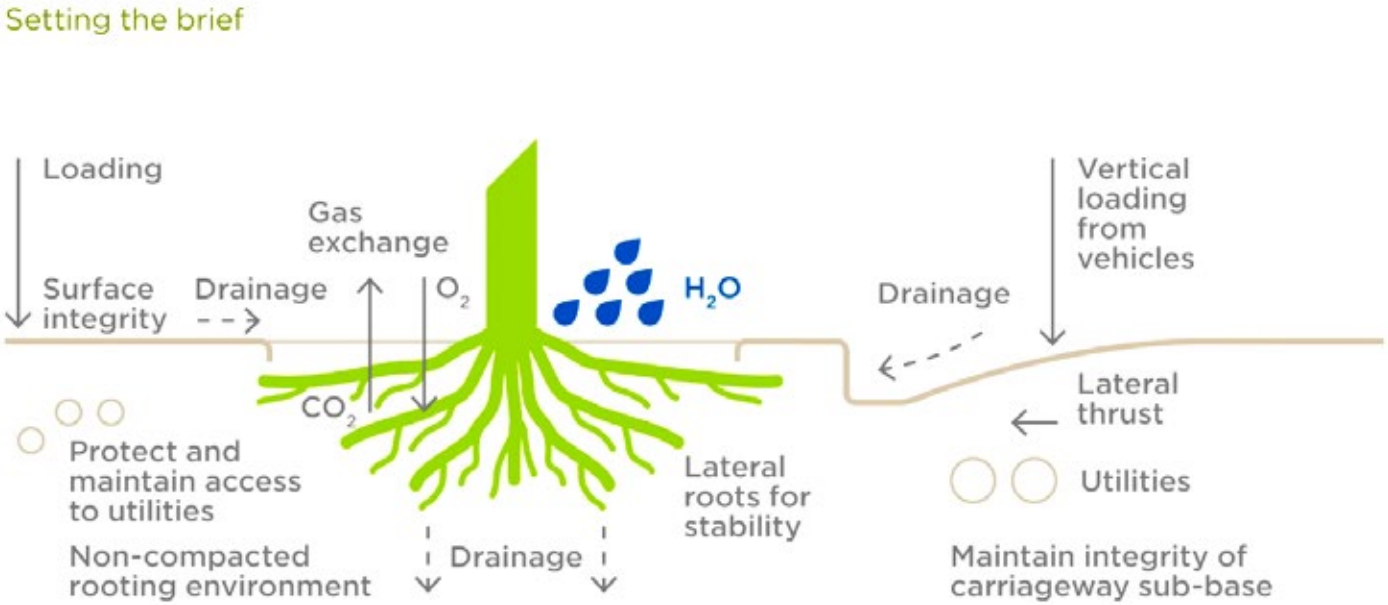
- Check for existing habitat value and preserve and incorporate existing habitats such as wetlands, waterways and water bodies, heathlands, flower rich grasslands and biodiverse brownfield sites.
- The location of the tree relative to buildings should be considered in terms of the desired local climate moderating effect required. A tree planted to the west of a building will provide cooling in the summer and limited impact in the winter, whereas a tree planted to the south will have little effect in the summer but cause unwanted cooling in winter which is undesirable in temperate Europe[5].

Barrell Tree Consultancy

Key points for success with trees in hard landscapes

Courtesy of Trees and Design Action Group





Maintenance[74,75]

- Making provision for maintenance and incorporating it into management plans can highlight any issues that can be dealt with at the design stage.
- The benefits of open space can decline if they are poorly maintained.
- Planning for their long term existence should ensure the right tree for the right place.
- Selection of the right species is crucial:
  - Choosing native trees will mean a wide variety of wildlife species will benefit.
  - Tree species selection is also important in avoiding complaints about trees, for example honeydew landing on cars parked under trees, which is a secretion produced by tree aphids that feed on lime.
- Consider existing and future infrastructure requirements and position trees appropriately to allow sufficient space for them to grow and prevent conflicts with underground utilities.
- Providing appropriate surfacing around the root can prevent future issues.
- Allow adequate spacing between the tree and the path to avoid obstruction.

Victoria Bankes Price

- Knowing the final canopy height of a tree species and suitable location can prevent the problem of shading and the obstruction of lighting and meet the statutory requirement to maintain a clear route along roads.

Ancient woodland

The guidance within this paper should always be considered after the existing ecological conditions have been assessed on site. The Woodland Trust is primarily concerned with the protection and enhancement of ancient woodland. In England ancient woodland is land that has been continuously wooded since 1600. It is recorded on the ancient woodland inventory[76]. The inventory generally only records woodlands over two hectares in size but smaller woodlands can be added: the inventory is provisional so even if the woodland is not recorded as ancient, map evidence and site surveys may prove that it is.

Ancient woodland is impossible to replicate because many of the species that make up ancient woodland are long-lived and slow growing, do not respond positively to any disturbance and the conditions in which the woodlands formed no longer exist. Furthermore, it is often wrongly assumed that development can only have an impact on ancient woodland if there is direct loss to the wood. Development adjacent to woodland can cause indirect effects such as changes to drainage, increase in pollution risk, impacts on tree roots and changes to noise and lighting – all of which can have a deleterious effect on the woodland ecosystem. These should be refused in accordance with the National Planning Policy Framework[77]. Development near ancient woodland should be treated in accordance with Natural England's Standing Advice[78]. Bespoke buffering schemes should be considered on a case by case basis. The Woodland Trust has produced two useful guides on development adjacent to ancient woodland to assist in considering the impacts of different schemes[79,80].

Ancient and veteran trees are special because of their great size, age or condition. Retaining these trees will enhance the value of any development. They will add a unique quality, giving it a sense of place or an air of respectable antiquity, creating character and distinction which will be appreciated by potential owners and their families. The impact upon ancient and notable trees must also be considered as part of the development process. The Woodland Trust has produced a useful guide[81].

Standards and benchmarks

- Accessible Natural Green Space Standard[83]

  Developed by Natural England this provides local authorities with a guide as to what constitutes accessible green space. It recommends the distance people should live from certain types of green spaces and the size of the green spaces in conjunction with distance to homes. All people should have accessible natural green space:

  - Of at least two hectares in size, no more than 300m (five minutes' walk) from home.
  - At least one accessible 20 hectare site within 2km of home.
  - One accessible 100 hectare site within 5km of home.
  - One accessible 500 hectare site within 10km of home.
  - A minimum of one hectare of statutory local nature reserves per 1,000 people.

- Woodland Access Standard[84]

  To complement the Accessible Natural Green Space Standard, the Woodland Trust's Woodland Access Standard aspires:

  - That no person should live more than 500m from at least one area of accessible woodland of no less than 2ha in size.
  - That there should also be at least one area of accessible woodland of no less than 20ha within 4km (8km round trip) of people's homes.

If you have any questions or would like to find out more about how to incorporate trees into residential developments email governmentaffairs@woodlandtrust.org.uk.

References and further reading

Environmental benefits

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