PUTTING A VALUE ON THE URBAN FOREST

Burton-upon-Trent
Tree Project

EXECUTIVE SUMMARY

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Individual trees and woodlands in towns, including street and garden trees, trees in open spaces, woodlands and hedgerows make up the urban forest. Urban forests provide a wide variety of benefits to communities and the local economy, such as cleaner air, resilience to climate change, enhanced biodiversity and a more attractive place to live.

This study aimed to investigate the benefits delivered by the urban forest in a Staffordshire town. It is hoped that this study – a first for Staffordshire – will inspire other communities to explore their urban forests.

The study area was Burton upon Trent in East Staffordshire, which lies within The National Forest. The study used a methodology called i-Tree Eco, which has been used both in the UK and internationally to evaluate the benefits of urban forests, assigning financial values where appropriate. The study was based on a survey of 250 randomised plots, stratified against deprivation data. Plots of 0.04 hectares (400m2) were surveyed by trained volunteers in August -September 2016.

Survey data was entered into i-Tree Eco software to establish a quantitative baseline of the structure and value of Burton's urban forest for setting objectives and monitoring progress.

KEY FINDINGS FROM THE STUDY:

- The replacement cost of Burton's urban forest is **£54.2 million** – i.e. what it would cost to replace the trees with others that are structurally identical in the same locations.
- The amenity value of Burton's urban forest has an estimated value of **£1,126 million** – i.e what is considered to be the asset value of the whole stock to the community.
- Carbon storage has an estimated value of **£1.23 million** with the urban forest storing 19,800 tonnes of carbon.
- The estimated value of carbon sequestration is **£44,800** per year or 722 tonnes, through the long term storage of atmospheric carbon dioxide.
- The estimated value of avoided runoff is **£21,700** per year or 23,700 m^3.
- Pollution removal has an estimated value of **£48,800** per year or 23 tonnes of pollutants per year.

The study found that tree cover in Burton is relatively low at 9.4%, compared to other towns and cities that have completed i-Tree surveys (ranging from 11.4% - 17% for other UK locations). The town is also dominated by younger trees with relatively few large mature trees. The number of species is considered to be low, with 50 species recorded. The three most common species were Beech, Hawthorn and Sycamore.

The results of the survey suggest there is considerable scope to develop and enhance Burton's urban forest and increase the benefits it provides to the town's communities, economy and environment. The report outlines eight aims to achieve this and offers recommendations on how they could be achieved.

KEY MANAGEMENT AIMS:

1. Increase overall tree cover
2. Develop a more diverse age structure to address the dominance of younger trees
3. Improve species diversity of the urban forest to increase resilience
4. Enhance biodiversity
5. Enhance the sense of place and amenity value
6. Increase the contribution of the urban forest to public health outcomes
7. Increase the contribution of the urban forest to the local economy and maximise opportunities from new developments
8. Increase the contribution of the urban forest to climate change resilience and mitigation

To conserve and enhance Burton's urban forest the implementation plan identifies the key next steps to achieve these aims. Four priority zones are outlined where planting will provide particular benefit to communities together with a range of actions for new planting and measures to protect the existing tree stock both within the priority zones and the wider area.

Due to the predominantly urban nature the study area it is likely to be challenging to establish tree cover. A modest target of 1% increase in tree cover has therefore been set for the whole project area for this initial period to reflect the challenges. However it is important that this is reviewed and that a long term strategy is maintained to increase tree cover across the town. Burton may then rightly achieve the aspiration to be recognised as the capital of The National Forest.

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Mapping was produced by **Shona Frost, Staffordshire County Council.**

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INTRODUCTION

IMPORTANCE OF URBAN FORESTS

FIGURE 1
Benefits of the urban forest

Individual trees and woodlands in towns, including street and garden trees, trees in open spaces, woodlands and hedgerows make up the urban forest. Urban forests provide a wide variety of benefits to communities and the local economy which can often go unnoticed or are undervalued. Some of the benefits of urban forests are summarised in Figure 1.

Carbon storage and sequestration

As trees grow they capture atmospheric carbon, reducing this greenhouse gas in the atmosphere and helping to create resilience to climate change

Aesthetic

Trees can improve the visual amenity through screening and greening developments and providing diversity and a distinctive sense of place

Energy savings

Tree canopies can provide shading in summer and also offer wind protection and insulation in winter

AIMS OF THE STUDY

The aim of the study was to investigate the benefits delivered by the urban forest in a Staffordshire town, and where possible to estimate the financial value of these benefits. The study used a recognised survey and analysis methodology called i-Tree Eco, which has been used in towns and cities in the UK and internationally. Using the outcomes of the i-Tree survey and existing data, a further aim was to develop an implementation plan to identify how the urban forest could be developed to maximise its benefits to society.

The information and recommendations resulting from the project can be used by a range of stakeholders including planners, highway authorities, conservation groups, community groups and the National Forest Company to steer planting and woodland management to the areas which need it most.

It is hoped that this study – the first of its kind in Staffordshire – will act as a pilot for other areas, inspiring other communities to look at the benefits their urban forests could provide.

THE STUDY AREA
BURTON UPON TRENT

Burton is situated within the River Trent corridor and this has shaped the settlement pattern through its floodplain. Also known as the `Washlands' the floodplain dominates the centre of the town and provides a unique feature and valued recreation resource for residents. Surveys carried out on behalf of East Staffordshire Council show that the majority of residents value Burton's greenspaces but not all use them.

Burton is firmly identified as a brewing town and this has influenced the architecture and character of the town. Many Victorian terraces around the periphery of the town centre have remained more or less intact with no significant post-war clearance / redevelopment schemes taking place for new housing and roads. There has only been modest clearance of Victorian industrial buildings for other uses such as housing and employment uses, so Burton has retained much of its cohesive historic character and form. However, in some areas housing stock is in poor condition associated with pockets of deprivation, economic inactivity and socio-economic problems. The layout of these areas generally has a hard urban form with little soft landscaping, trees and open space.

Burton upon Trent is generally regarded as a moderately densely-developed town, with relatively little green space remaining within it's built up areas and few roadside trees in the town. As the largest town within The National Forest, Burton is a key part of the Forest. This has had, and will continue to have, a profound effect on the town, facilitating the creation of large areas of new publicly accessible woodland within and on the edge of the town.

Burton is set to grow significantly; between 2012-2031 approximately 7000 new homes are proposed on brown and greenfield land, putting pressure on Burton's important green spaces.

Assessing the value of Burton's urban forest will enable the Council and other stakeholders to have a better understanding of the benefits trees provide. This will allow for more informed decisions for future management. The strong connection with The National Forest provides greater potential opportunities to take forward the recommendations from this report.

METHODOLOGY

The study area covered 2,851 hectares and followed the town boundary plus adjacent housing and strategic urban extension allocations identified by East Staffordshire Borough Council.

The area was stratified using the English Indices of Deprivation which measures the risk of premature death and impairment of quality of life through poor physical or mental health. This provided a framework to relate how the urban forest can contribute to regenerating and improving social and economic influences.

250 plots were randomly selected for survey, representing 0.35% of the survey area. The number of plots allocated to each stratified area was in proportion to the size of each stratum. Following this methodology ensured that both public and private land ownership were included, with a balance of plots for each stratum.

Burton's trees were surveyed by volunteers in August and September 2016. Access restrictions prevented all the allocated plots being surveyed with 247 of the target 250 plots being completed. This equated to 32 plots in the most deprived stratum, 66 plots in the above average deprivation stratum, 71 plots in the average deprivation stratum, 73 plots in the below average deprivation stratum, and 5 plots in the most deprived stratum being completed, shown in Figure 2.

Each plot covered 0.04 ha (400m^2) and in line with the i-Tree methodology, the following was recorded:

- **The type of land use e.g. park, residential**
- **The different types of ground cover present in the plot e.g. grass, tarmac**
- **The percentage of the plot:**
  - **Covered by trees[1]**
  - **Covered by hedges**
  - **That could have trees planted in it**
- **Information about trees**
  - **The number of trees and their species**
  - **The size of the trees including height, canopy spread and girth of trunk**
  - **The health of the trees including the fullness of the canopy**
  - **The amount of light exposure the canopy receives**
  - **The amount of impermeable surface (e.g. tarmac) under the tree**
  - **The distance of trees from the nearest building**
- **Information about shrubs with a trunk girth less than 7 cm (species, size and dimensions of shrubs recorded).**

Further details on the i-Tree Eco methodology can be found at:

www.itreetools.org/resources/manuals.php

[1] For the purpose of the project trees with a diameter at breast height (DBH) of 7cm or greater were classified as trees and were surveyed fully. Trees with a DBH less than 7cm were included in the shrub listing.

All the volunteers were provided training in small groups on the i-Tree methodology and loaned all equipment needed for surveying. Access request letters and general information on the project were provided to the volunteers to offer to residents when requesting access permission. Vicki Lui, Staffordshire Wildlife Trust and Lawrence Oates, Burton Conservation Volunteers provided support to volunteers throughout the project.

The project was publicised through local newsletters and stakeholder websites with some direct mailing to Parish Councils, housing associations and large businesses to raise awareness of the project.

National data sets were used to map Burton's air quality, flooding, health and mortality rates.

Data was entered into i-Tree Eco software and used to measure:

URBAN FOREST STRUCTURE

Number of trees, species composition, age and size class distributions, tree health, and a land-use classification.

POLLUTION REDUCTION

Amount of pollution removed by the urban forest (pollution removal was calculated for ozone, sulphur dioxide, nitrogen dioxide, carbon monoxide and particulate matter <2.5 microns). The financial cost is calculated upon the UK Social Damage Costs for NOx (£14,646 per tonne) and SOx (£1,956 per tonne) only.

CARBON

Total carbon stored (calculated by estimating the trees biomass) and net carbon annually sequestered by the urban forest using the 2016 carbon value of £62 per tonne.

AVOIDED RUNOFF

Yearly avoided runoff attributed to trees, (based upon £0.9141, the standard Severn Trent Water Sewerage volumetric charge).

VALUES

- The Replacement value of the forest (this calculation is based on valuation procedures of the Council of Tree and Landscape Appraisers[2] using tree species, diameter, condition and location information).
- The amenity value (calculated at the CAVAT Quick Method valuation[3], and is intended to consider the stock as a whole to estimate the asset value of these amenity trees for management purposes). It is calculated using a Unit Value Factor of £15.88, and a Community Tree Index (CTI) factor of 100%[4]), as well as the estimated economic value for many of the ecosystem services provision.

[2] CTLA: Council of Tree and Landscape Appraisers version 9, as incorporated into i-Tree Eco v6.02

[3] CAVAT: Capital Asset Value for Amenity Trees, see www.cavattv.org for further details. The Quick Method (QM) has been adopted for the purposes of this study. QM calculates a base value for each tree (trunk size multiplied by CAVAT Unit Value Factor) and adjusts it according to the Community Tree Index (an adjustment based on location), crown size and condition, and life expectancy. The QM value for each tree is summed and extrapolated for the full assessment area.

[4] The CTI factor is a means to reflect in the tree stock's asset value the relative population density of the local area and thus the relative number of those potentially able to benefit from the local authority trees. CTI bands vary from 100% to 250% for densely populated inner city areas. Burton as a low density area has been calculated at 100%.

DATA LIMITATIONS

Taken as a whole, this report presents a statistically robust picture of Burton's urban forest in 2016. There is, however, potential that any one of the strata may have an under or over-representation of the number of trees or species, age class, etc., due to the limited amount of data collected at the stratum-level.

In particular, the least deprived area covers less than 2% of the survey area. As the number of survey plots was proportional to the area of each stratum data is limited for this stratum. Similarly it is likely there will be other species present in Burton which were not identified during the field campaign.

This report should be used as an indication only for generalised information on tree distribution, age and species within any of the individual strata. Where detailed information for an area is required further survey work should be carried out.

i-Tree Eco only quantifies certain benefits of trees, as detailed in this report. Other benefits provided including the effect trees have on noise pollution, their role in reducing building energy consumption and secondary effects of pollutants such as acid rain have not been considered as part of this project.

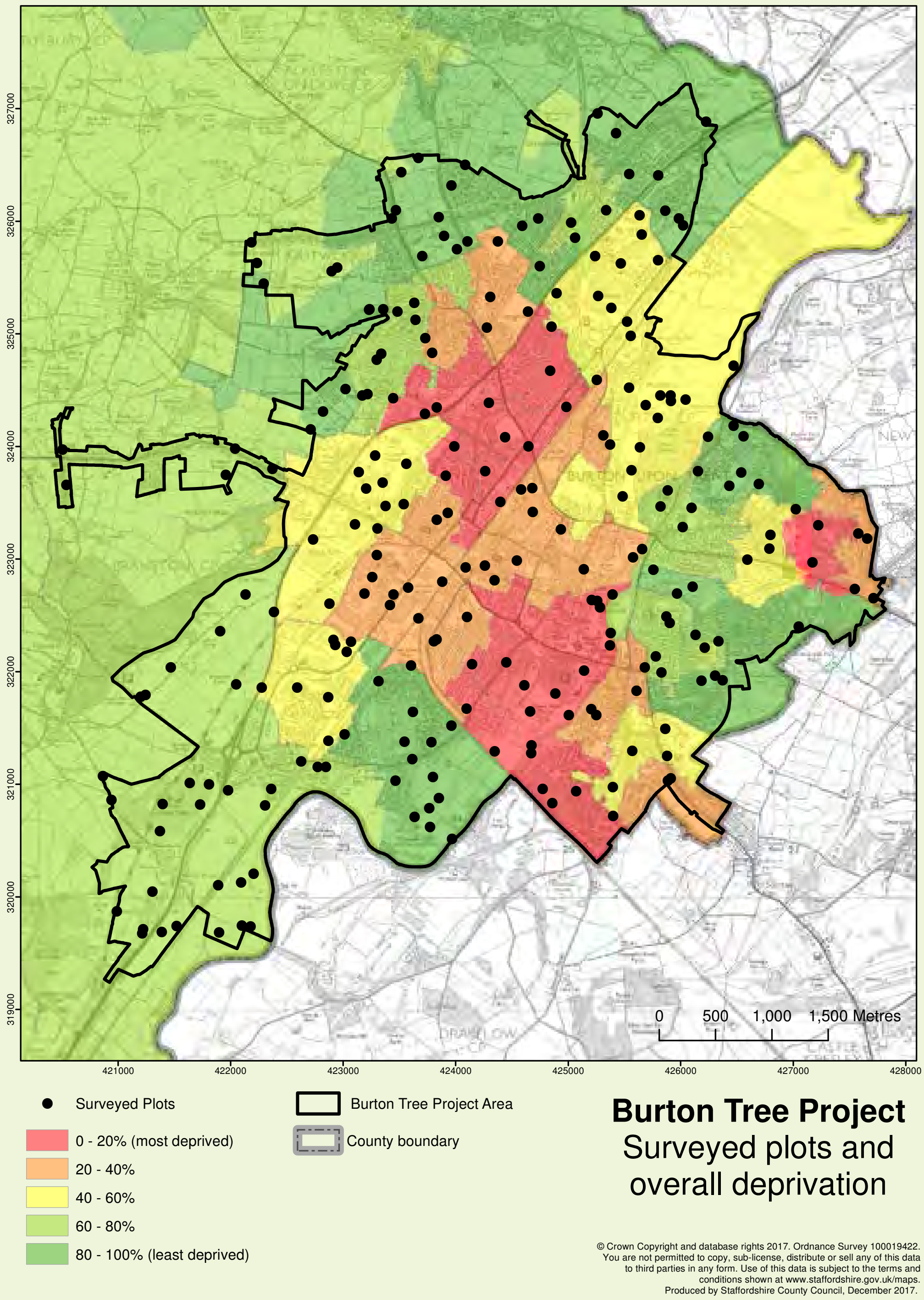


FIGURE 2

THE SURVEY AREA AND SAMPLE PLOTS

RESULTS/ ANALYSIS

It is estimated Burton has a tree cover of 9.4%, equating to a population of 102,400 trees.

Urban forests have a structural and functional value. The structural value is the cost of replacing a tree with a similar tree. The functional value, is a calculation of the variety of environmental functions they can perform.

For Burton these are estimated at:

STRUCTURAL VALUES:

- The cost to replace a tree with a similar tree in the same location is estimated at **£54.2 million.**
- The contribution to the public as an amenity tree is estimated at **£1,126 million.**
- Carbon Storage is the amount of carbon held in the woody part of the vegetation and is estimated at **£1.23 million** (19,800 tonnes).

FUNCTIONAL VALUES:

- Carbon Sequestration is the amount of carbon dioxide removed from the air by plants and is estimated at **£44,800** per year (722 tonnes/year of carbon).
- Avoided Runoff is calculated based on rainfall interception by vegetation. Although tree leaves, branches and bark may intercept rainfall, only rainfall intercepted by leaves is accounted for in the analysis, equating to **£21,700** per year (23,700 m3/year).
- Pollution Removal is calculated using local pollution data and is estimated to be **£48,800** per year (23 tonnes/year).

Note: Costs are correct at the time of analysis (February 2017); valuations are subject to market conditions and may change in the future.

Pollution removal and avoided runoff estimates are reported for trees and shrubs. All other ecosystem services are reported for trees.

THE THREE MOST COMMON SPECIES ARE BEECH, HAWTHORN AND SYCAMORE

These three species account for 33% of the tree population. The top 11 species are summarised in Figure 3 with a full species list included in Appendix I (note the majority of the Beech were identified in one plot and could therefore be showing an over representation of Beech distribution across Burton).

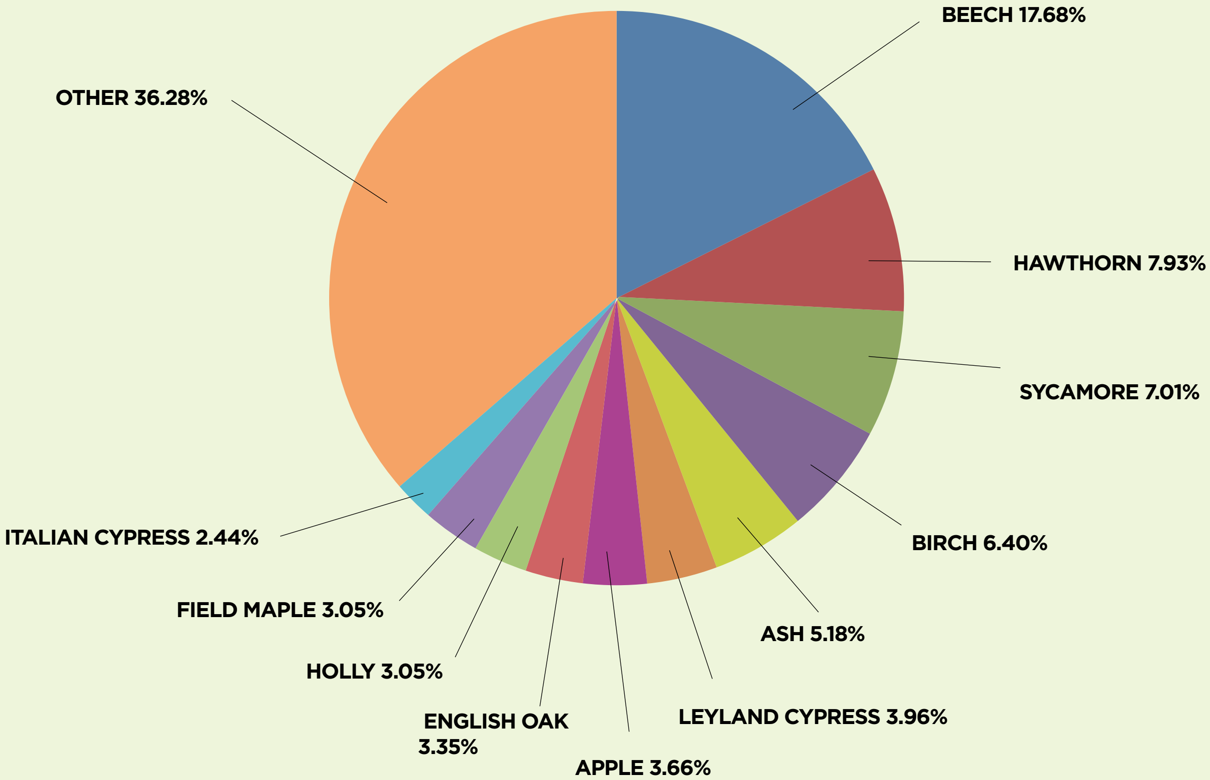


FIGURE 3

SPECIES MIX, SHOWING THE TOP 11 MOST COMMON SPECIES IN BURTON'S URBAN FOREST

Burton is dominated by younger trees with 40% having a diameter at breast height of (DBH) of less than 15 cm and 52% being between 15-49 cm (77% of the population had a DBH of less than 30 cm). This is detailed in Figure 4.

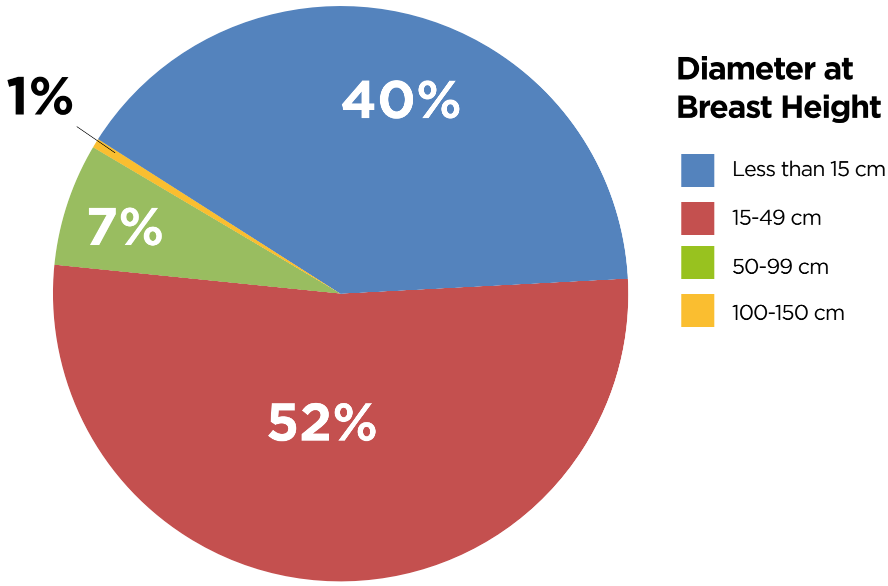


FIGURE 4

DISTRIBUTION OF TREES BY SIZE CLASS (DIAMETER AT BREAST HEIGHT)

The tree population and associated benefits for each of the stratified categories is summarised below and in Tables 1 and 2 and Figures 5, 6 and 7. The 'least deprived area' represents less than 2% of the study area, therefore the data collected in this area is limited and has not been included in the summary.

- Tree density is remarkably similar between the strata, ranging from 34 to 41 trees per ha. Average DBH is small (typically 24 cm) and approximately equal across the strata, as is height – ranging only 8 to 12 m.
- Tree density and average tree height is highest in the 'above average deprivation area'. A consequence of the disproportionately high numbers of common beech reported in this stratum, relative to the other areas (this is due to one of the plots in this stratum being located within a beech plantation).
- The Structural and Functional values are greatest in the 'most deprived area' due to the relatively higher number of large stature trees (oak and sycamore) and trees with a high total leaf area (such as willow spp.) relative to the other strata
- Leaf area per hectare is second highest in the 'average deprivation area'. This area also has the lowest carbon sequestration rate; this is due to the low frequency of large stature long lived trees in this stratum, relative to the size and population distributions of the other strata.
- Carbon storage was second highest in the 'below average deprivation area' although the structural values in terms of carbon sequestration, avoided runoff and pollution removal is lower in comparison to the other stratum. This is due to the relatively low numbers of large stature trees (oak spp., sycamore or beech) relative to the other strata.
- There is no clear correlation between the level of deprivation and any of the urban forest characteristics.

These results emphasise the role that different species and the age structure has in influencing the functional and structural values provided. In particular, i-Tree Eco demonstrates that it is both size (stature) of a tree species and the relative contribution of each species to the total population of the urban forest that are critical in the current delivery of ecosystem services. I-Tree Eco terms this 'Importance Value'. The importance value (IV) of each of the tree species recorded in the field campaign is provided in Appendix 1.

An i-Tree Eco study presents a snapshot-in-time of an urban forest – its composition and condition etc. at the time of the survey. This is especially true of IV which highlights those species of greatest importance now. IV is a useful tool in risk analysis, for example to help understand the impact of a particular pest or disease. It can also be useful in planning.

A species with a high IV and a high percentage presence in the urban forest may be important now but is less important, especially in the longer term, than a species with a high IV for a relatively low population. Planting more of the latter will more substantially bolster ecosystem service delivery. Oak, lime and beech are frequently represented in the most valuable trees in an urban forest (as reported in other i-Tree Eco surveys), however this pattern does not bear out in Burton with beech, sycamore and ash having the highest IV values.

TABLE 1

TREE DENSITY AND AVERAGE FOR EACH OF THE FOUR PROJECT STRATA

Stratum	Tree Density per ha	Average DBH (cm)	Average Height (m)
Below average deprivation	35	24	9
Average deprivation	34	18	8
Above average deprivation	41	24	12
Most deprived	37	24	9

TABLE 2

LEAF AREA, AND CARBON STORAGE SEQUESTRATION FOR EACH OF THE FOUR PROJECT STRATA

Stratum	Leaf Area per ha	Carbon Storage (kg/ha)	Carbon Sequestration (kg/ha/year)	Avoided Runoff (m3/ha/year)	Pollution Removal (kg/ha/ year)
Below average deprivation	3908	7084	274	7	4
Average deprivation	4075	6131	200	9	5
Above average deprivation	3355	5582	273	8.5	4.5
Most deprived	4298	12276	327	9	5

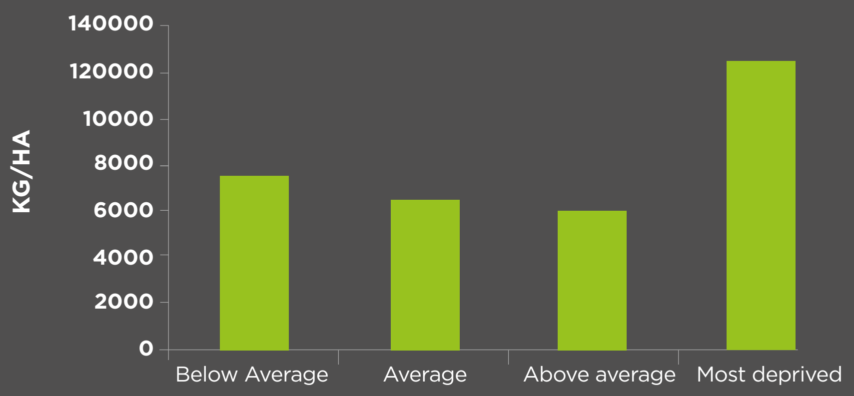


FIGURE 5
CARBON STORAGE BY DEPRIVATION CLASS

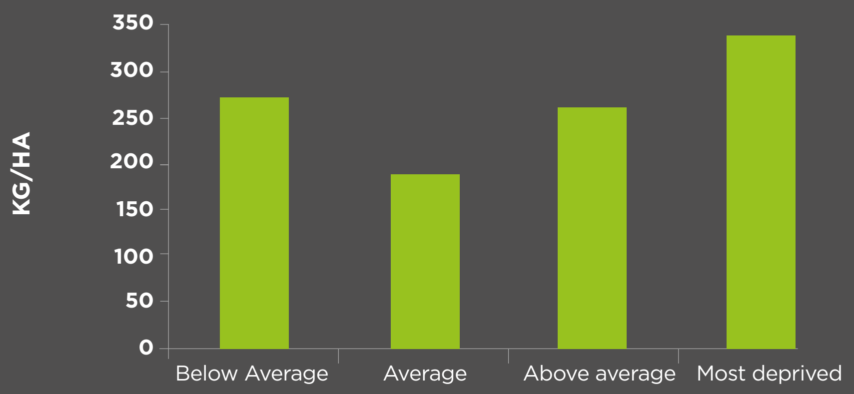


FIGURE 6
ANNUAL CARBON SEQUESTRATION BY DEPRIVATION CLASS

According to the CAVAT Quick Method valuation technique, the amenity value of Burton's urban forest is valued at £1,126 million. This figure is distinct to the Council of Tree and Landscape Appraisers (CTLA) valuation of £54.2 million.

The CTLA estimation is the cost to replace that tree with another structurally identical in that location, taking into consideration the species, condition and location factors. Unlike CTLA, CAVAT values trees based upon their contribution to the public as an amenity tree.

CAVAT addresses worth more so than value, it reveals trees as assets to be managed and maintained to grow their portfolio of worth. Figure 8 shows the ten most valuable trees in terms of amenity (CAVAT value) revealing sycamore, beech and willow have the highest value, reflecting the predominance of mature sycamore, beech and willow across the sample area.

The land-uses containing the highest proportion of trees according to amenity valuation are park, residential and vacant (Figure 9). The size of Burton's tree population on vacant land, therefore, represents a valuable asset that should be appropriately protected in planning policy and considered in planning decisions, where possible.

The CAVAT valuation also reveals the importance in terms of amenity valuation of public trees in parks, cemeteries and around multi-family residential/multiple separate housing unit areas and, therefore, the need to appropriately fund the management of this resource.

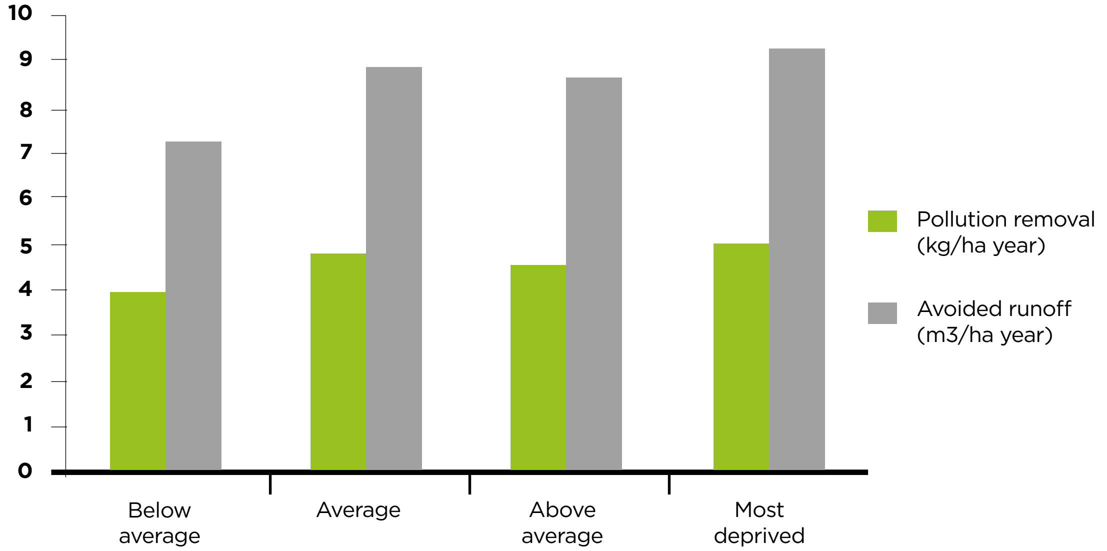


FIGURE 7

ANNUAL AIR POLLUTION REMOVAL AND AVOIDED RAINWATER RUNOFF IN EACH OF THE DEPRIVATION CLASSES

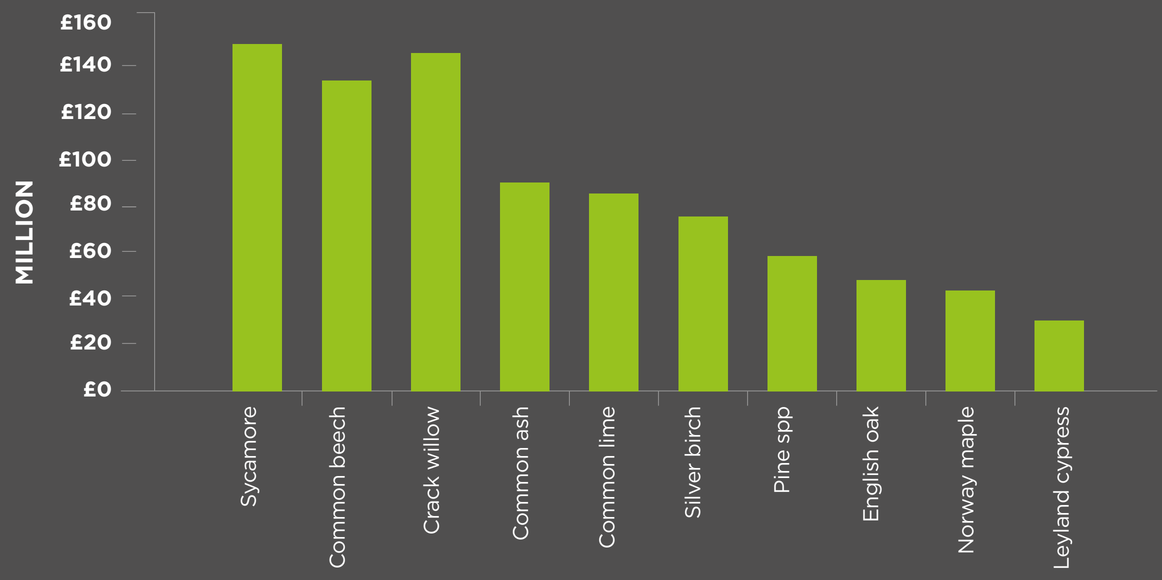


FIGURE 8

CAVAT VALUATION OF BURTON'S URBAN FOREST, BY SPECIES

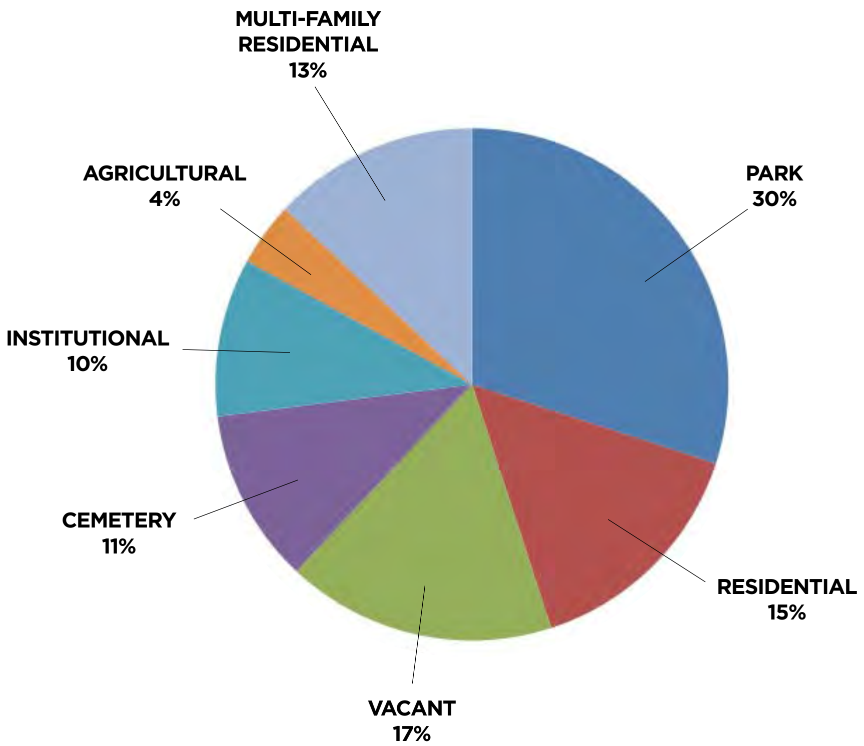
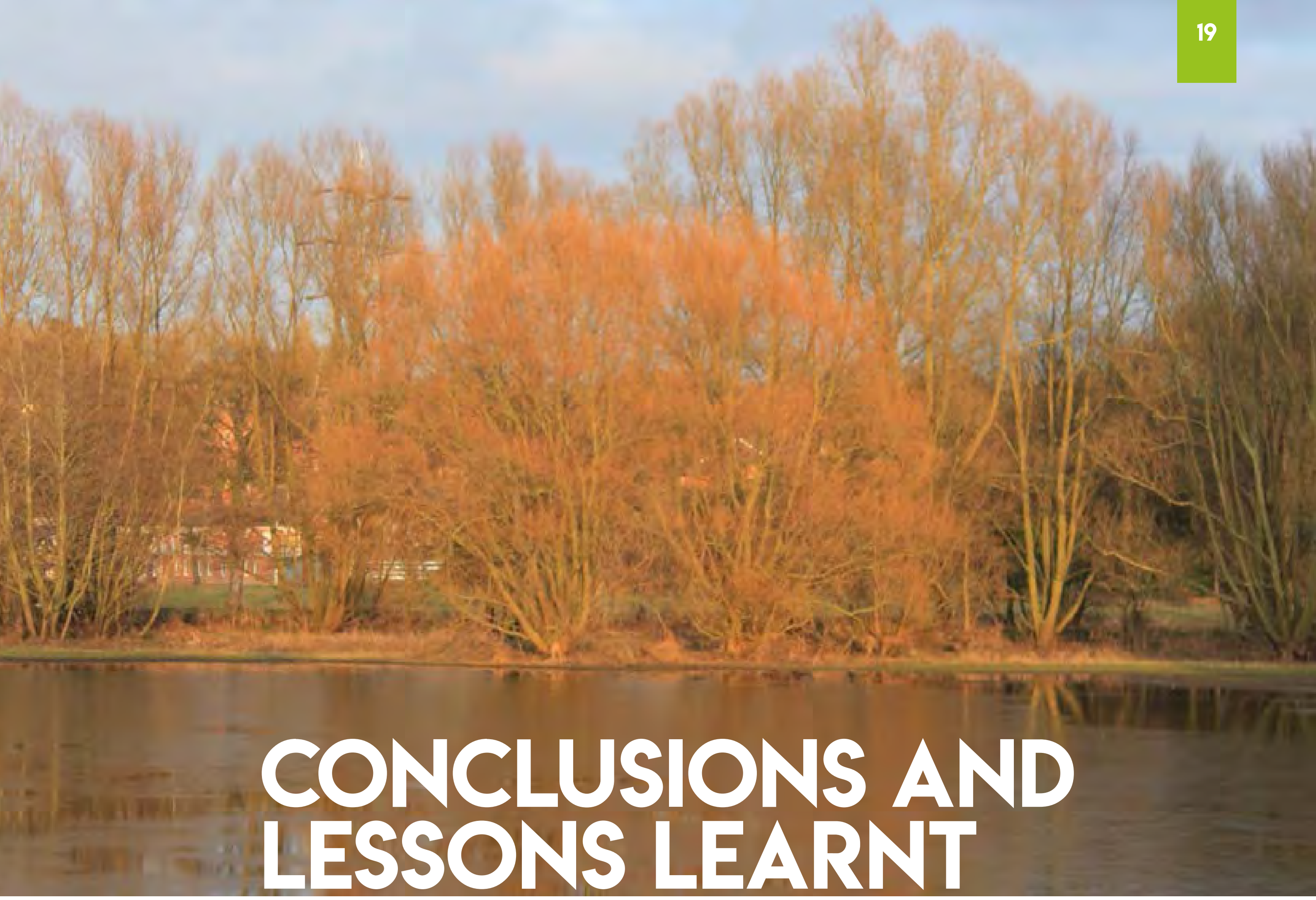


FIGURE 9

DISTRIBUTION OF TREES ACROSS THE LAND-USES ACCORDING TO THE CAVAT VALUATION



CONCLUSIONS AND LESSONS LEARNT

The study has provided a greater understanding of Burton's urban forest and the role it plays in maintaining a healthy environment for residents, visitors and wildlife. The relatively low numbers of trees identified during the survey indicates that there is considerable capacity to expand Burton's urban forest and the role this can have in environmental, social and economic improvement.

This project has been unique in applying a quantitative value for trees and linking this with environmental, health and deprivation data.

This data provides useful baseline information to direct planting to those areas where communities are likely to see the greatest benefit not only in terms of health and amenity, but also the potential positive outcomes in terms of reduction of crime and of investment.

Allocating quantitative values to tree and shrub populations are useful metrics to show the value of the urban forest. These values cannot be considered in isolation as the values have been applied considering a wide range of variables. Although some trees are better than others for the provision of some services, it is still important to maintain a diverse urban forest.

For example some of the best tree species for pollution and runoff reduction generally have a large leaf surface area. Although these species may be best for improving air quality and holding rainfall in the canopy a broad range of species should be considered to provide resilience to threats from disease and be suitable for the site aspect, soil and amenity.

Not all elements can have a quantitative value applied, this does not mean they are any less important when considering the right tree for the right place.