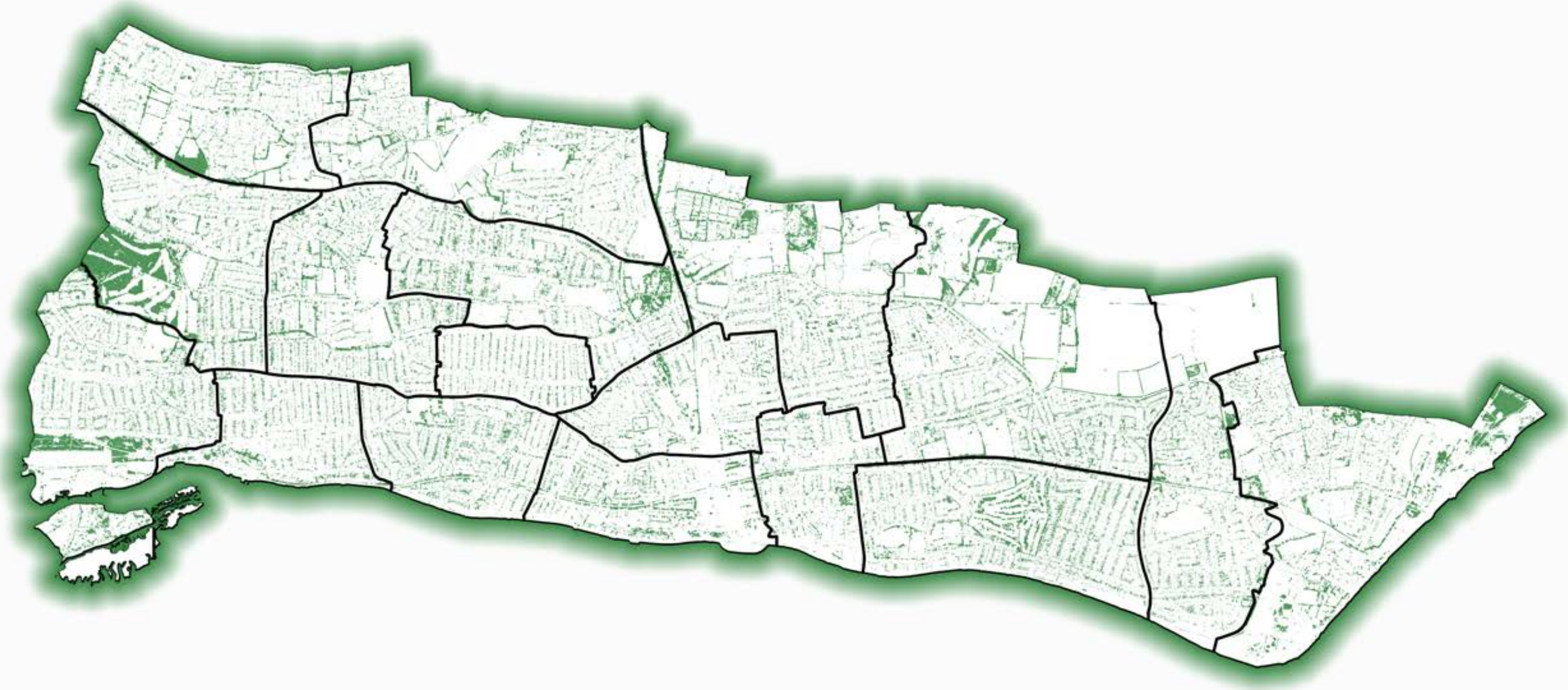

Southend-on-Sea Borough Council

Tree Canopy Cover Assessment

October 2019

Canopy Cover Explained

Tree canopy cover, which is often also referred to as canopy cover and urban canopy cover, can be defined as the area of leaves, branches, and stems of trees covering the ground when viewed from above.

Canopy cover is a two-dimensional metric, indicating the spread of tree cover across an area. Quantifying the spatial extent of the urban forest is one of the first steps in managing this important resource and helps to answer the fundamental questions: ‘What canopy cover have we got?’ and ‘Where is it?’

Measuring canopy cover has helped city planners, urban foresters, mayors and communities to see trees and forests in a new way, focusing attention on green infrastructure as a key component of community planning, sustainability and resilience. It is an easy-to-understand concept that is useful in communicating messages about our urban forests with both the public and policy makers.

Understanding the extent of the tree canopy cover in the borough of Southend-on-Sea and its relationship with other indicators is a first step in ‘measuring to manage’ the urban forest. This appreciated asset (part of Southend’s Natural Capital) can now be improved and maintained using this study and its data, with resources targeted to the areas that need it most.

The Authors

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This assessment was carried out by Treeconomics

Contents

Executive Summary

Trees are arguably the single most important component of Green Infrastructure (the mosaic of parks, street trees and all other 'green assets' found in urban areas), yet are often overlooked and undervalued. In particular, trees are important because they enhance and improve the urban environment by providing a wide range of benefits (or ecosystem services) at relatively little cost. There is a growing body of research which demonstrates that trees improve our health and well-being. Trees provide a 'sense of place', moderate extremes of high temperature in urban areas, improve air quality and act as a carbon sink[1].

Aerial imagery for each ward in the borough of Southend was used to calculate the canopy cover (Figure 1 illustrates the area of study). The results provide a snapshot of the current tree canopy cover (Table 1) and a baseline to allow for comparison with any future tree canopy surveys. The study also compared tree canopy cover with relevant statistics from the Office for National Statistics (ONS) and reviewed other available sources of geographical data on human health, well-being and societal factors (including crime rates, social deprivation and life expectancy) to observe if there were any correlations with tree canopy cover.

Highlights of the report are:

The overall canopy cover of the borough of Southend is estimated at 12%
In comparison with other studies[2], the canopy cover is below the average (17%) estimated in the 320 towns and cities surveyed in the UK. In comparison with London, Southend is below the average of 21% canopy cover. However, in general it can be said that coastal towns have lower canopy covers. A baseline study of canopy cover in the UK found that 20 out of 30 coastal towns had a canopy cover below 10% and the average canopy cover was 13.7%.

The relationship between Tree Cover and Social Indicators, demonstrated that areas with increased tree cover also score higher for community wellbeing in areas such as, Life Expectancy, Lower Crime Rate and correlates with Higher House Prices.

It is suggested that Southend could reasonably aspire to a canopy cover of 15% by 2050 subject to the production of a fully costed and resourced action plan, and in alignment with the average for coastal towns in the UK.

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1 Further details are provided in later sections of this report

2 Comparable studies can be accessed at www.urbantreecover.org

Canopy cover by ward area figures and a selection of total canopy cover in UK cities are provided in Tables 1 and 2.

Canopy cover estimates across Southend range from just 8.5% in Westborough Ward to 23.3% in Belfairs ward. Canopy cover in Southend is lower than the national average of 17% within cities, and also below the London average, which is 21%.

Ward	Tree Canopy Cover (%)
Belfairs	23.3
Prittlewell	14.4
West Leigh	14.4
Thorpe	13.1
St. Luke's	12.7
Blenheim	12.7
Shoeburyness	12.3
Chalkwell	12.0
Eastwood Park	12.0
Southchurch	11.0
St Laurence	10.0
Milton	10.0
Leigh	9.7
Kursaal	9.4
Victoria	9.0
West Shoebury	8.6
Westborough	8.5
Borough of Southend Average	**11.95**

Table 1: Tree Canopy Cover by Ward within the administrative area of the borough of Southend

Figure 1: Ward map of Southend

City/District	% Tree cover	Source
Royal Tunbridge Wells	33.7	i-Tree Canopy Survey 2016
Dover	29.2	i-Tree Canopy Survey 2016
Winchester	27.4	i-Tree Canopy Survey 2016
Telford	25.2	i-Tree Canopy Survey 2016
Birmingham	23.0	i-Tree Canopy Survey 2012
London	21.9	i-Tree Eco Sample Project 2015
Oxford	21.4	i-Tree Canopy Survey 2015
Plymouth	18.5	i-Tree Canopy Survey 2017
Newcastle	18.1	i-Tree Canopy Survey 2018
Edinburgh	17.0	i-Tree Eco Sample Survey 2012
Ealing	16.9	i-Tree Eco Sample Survey 2018
Eastbourne	15.9	i-Tree Canopy Survey 2011
Manchester	15.5	Red Rose Forest survey 2007
Glasgow	15.0	i-Tree Eco Sample Survey 2014
Bristol	14.0	Bristol Tree Survey 2009
Southend	12.0	Southend Canopy Survey 2019
Torbay	12.0	i-Tree Eco Sample Survey 2011

Table 2: A selection of urban towns and cities throughout the UK and their estimated canopy cover

1. Introduction

1.1 Background

Measuring tree canopy provides the means to help city planners, urban foresters and communities consider trees and forests as distinct elements of green infrastructure, as a key component of community planning, sustainability and resilience.

> *'Green Infrastructure is a strategically planned and delivered network comprising the broadest range of high quality green spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering those ecological services and quality of life benefits required by the communities it serves and needed to underpin sustainability. Its design and management should also respect and enhance the character and distinctiveness of an area with regard to habitats and landscape types.*
>
> *Green Infrastructure also encompasses river systems and coastal environments (these are sometimes referred to as Blue Infrastructure).*
>
> *Green Infrastructure includes established green spaces and new sites and should thread through and surround the built environment and connect the urban area to its wider rural hinterland. Consequently it needs to be delivered at all spatial scales from sub-regional to local neighbourhood levels, accommodating both accessible natural green spaces within local communities and often much larger sites in the urban fringe and wider countryside.'*
>
> *Natural England Green Infrastructure Guidance (2009).*

The importance of vegetation in urban areas has long been recognised (e.g. Oke, 1982, Huang et al., 1987, Nowak et al., 2010). Amongst other benefits, vegetation provides shading, evaporative cooling and rainwater interception (Gill et al., 2007). Tree canopy cover has a strong influence on a number of factors including energy demand, air quality and noise pollution, biodiversity, ameliorating high urban summer temperatures and human health and wellbeing (Davies et al., 2017).

Canopy cover assessments help to observe change over time at a relatively low cost in comparison to field surveys. Quantifying tree canopy cover has been identified by many authors (Britt and Johnston, 2008; Escobedo and Nowak, 2009; Schwab, 2009) to be one of the first steps in the management of the urban forest.

There is a growing body of international research and literature which supports the theory that overall, increasing tree cover in our towns and cities provides multiple benefits at little cost. For example, a study in Torbay found that for every £1 spent on an Oak tree, £4.96 was returned in benefits, taking into account all the costs on management and maintenance, whilst only being able to value just 2 of the associated benefits (pollution removal and carbon sequestration - Sunderland et al., 2012). A similar study in New York found that for every $1 spent on its street trees $5 were returned in benefits (Wells, 2012).

Trees and urban tree cover are also implicitly linked to other key concepts that are emphasised and highlighted within The National Planning Policy Framework (NPPF). Sustainability, ecosystem services and green infrastructure are all dependent on the significant contribution that trees in the urban forest make. Of the 16 sections in the NPPF trees are able to contribute to meeting the objectives of 11 of them. For example, increased tree cover can increase economic growth (Rolls and Sunderland, 2014) and prosperity as leafier environments improve consumer spending (Wolf, 2005). Additionally, businesses are prepared to pay greater ground rents associated with higher paid earners who are also more productive (Kaplan (1993), Wolf (1998), Laverne & Winson-Geideman (2003)), house prices increase and crime is reduced thereby "*Building a strong, competitive economy*", (Section 1 NPPF, paragraph 18). This is also directly linked to "*Ensuring the vitality of town centres*" (Section 2).

In addition:

- Supporting a prosperous rural economy
- Improving journey quality and encouraging use of alternative transport corridors
- Increasing property prices and reducing crime
- Improving the 'liveability' of urban areas, increasing happiness and reducing stress
- Providing habitat, increasing biodiversity and therefore recreational value

A full summary of how trees benefit local communities within the context of the National Planning Policy Framework is provided in Appendix III.

Note: Canopy cover is not to be confused with total leaf area, which seeks to estimate (all of the layers within a tree) canopy expressed as a volume. Total leaf area is normally expressed in cubic metres (m^3) or using leaf area index (LAI).

1.2 Aims and Objectives

This is a factual, evidence-based document which seeks to underpin the aspirational, ongoing aim of providing a positive argument to support policy development in favour of developing a robust, inter-connected urban forest network. The urban forest "*is the ecosystem containing all of the trees, plants and associated animals in the urban environment, both in and around the city*" (Sands, 2005). This report uses the term 'urban forest' when collectively referencing the urban trees of Southend.

The main objective of this report is to provide a snapshot of canopy cover in the borough of Southend. It is important to be able to measure this vital component of green infrastructure to ensure that it will be embedded and enhanced as part of the growth agenda for the area.

The original brief was to:

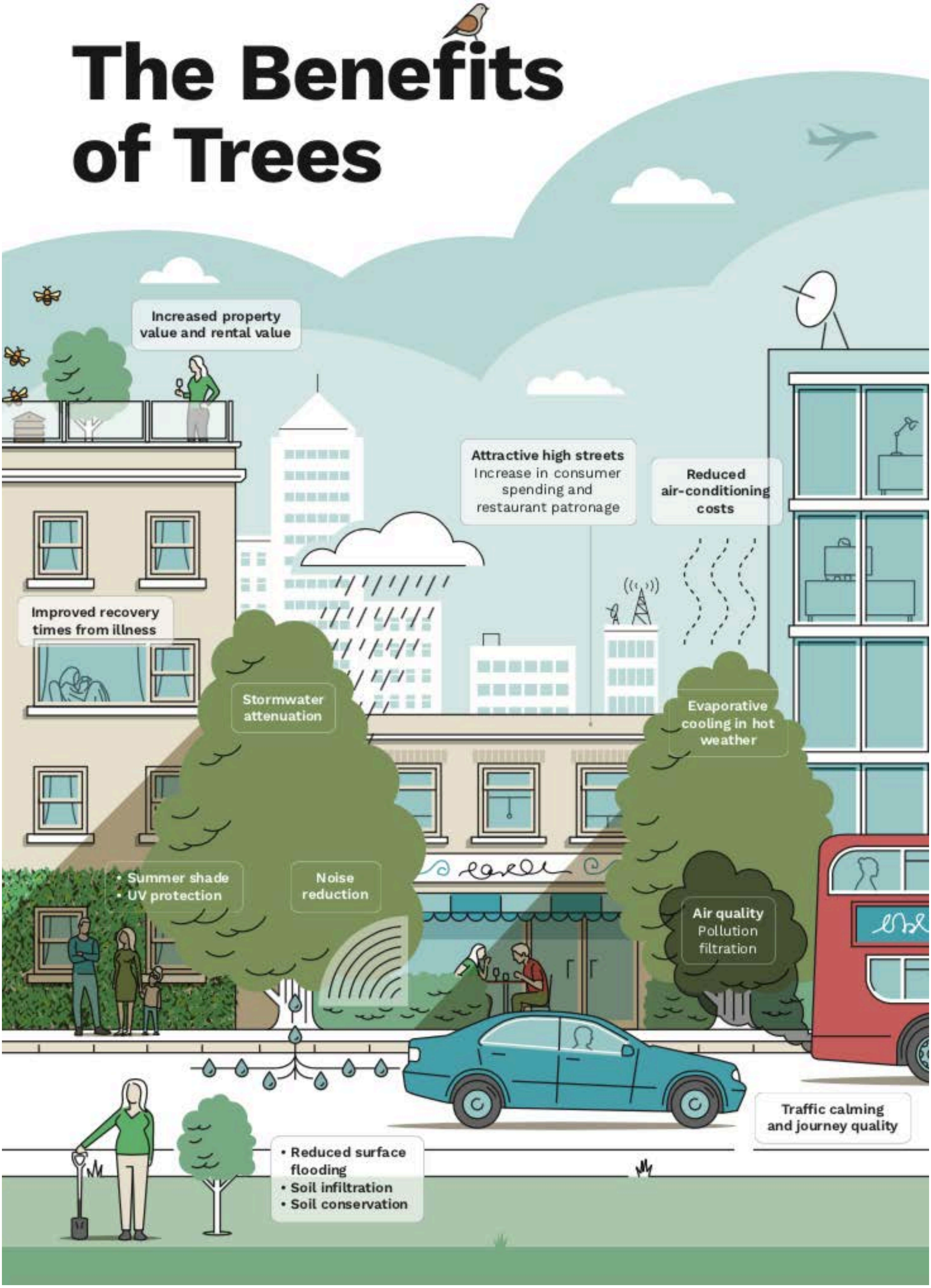
- use Bluesky's National Tree Map data to calculate percentage tree canopy cover for each of the 17 wards of Southend;
- compare tree canopy cover with available ONS statistical data on Health, Crime and Deprivation.

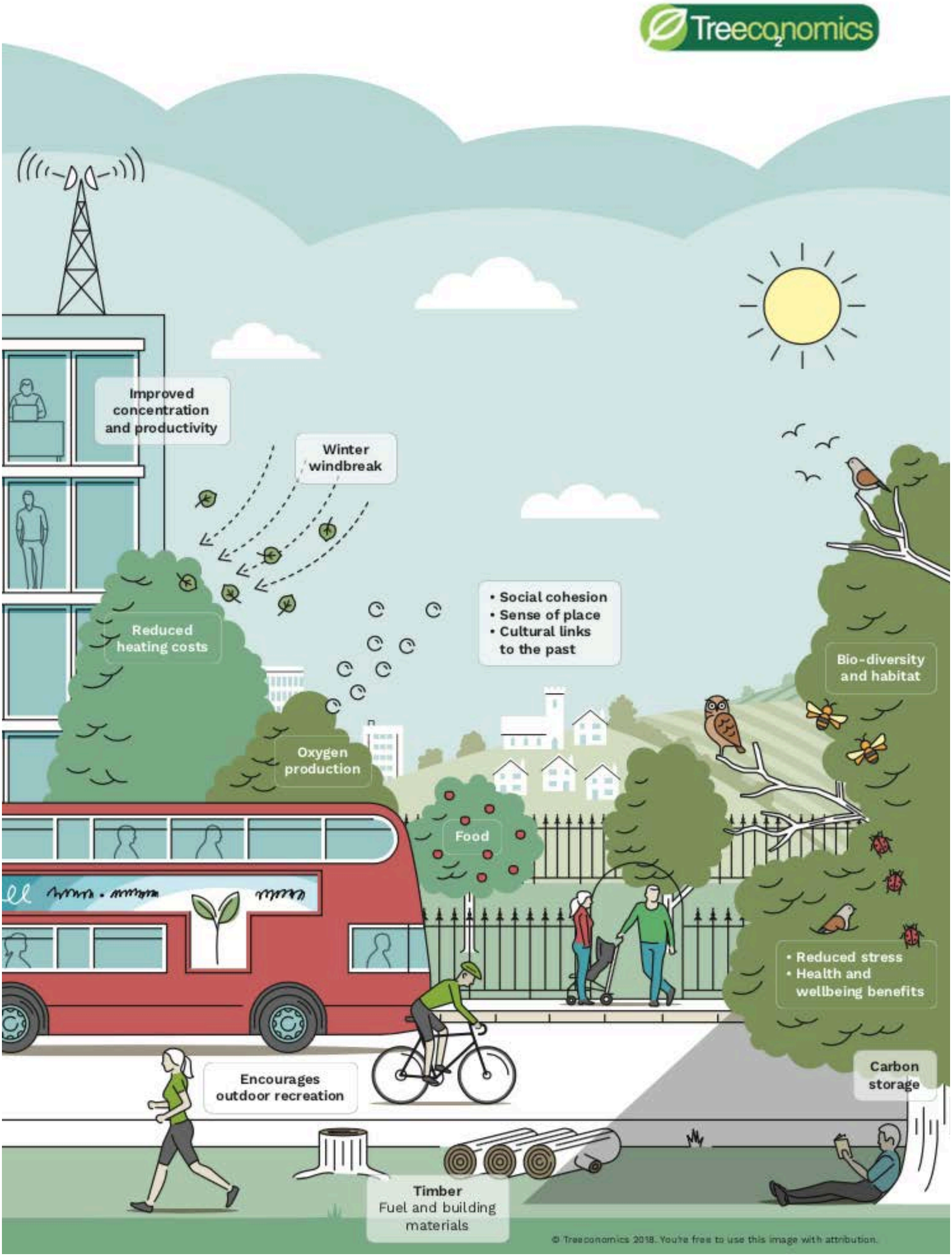
A key area where this information is particularly relevant is in planning and development; this document has been written with an emphasis on informing local planning policy (see also Appendix III and IV). However, its purpose is not to create policy within the document itself, but to highlight the importance of the urban forest as a distinct and unique element of green infrastructure networks.

The data presented here can be used to inform tree policies and other environmental strategies so that residents and visitors to Southend can continue to enjoy the benefits of urban trees long into the future. The information will be useful in targeting future planting and management schemes. Tree planting, protection and maintenance as a means to increase canopy cover will be an important part of delivering equitable access to the benefits trees provide.

This study also explores any possible correlations between tree canopy cover and human health and wellbeing, by comparing canopy cover information with selected, geographically explicit data from the Office of National Statistics (ONS).

The Benefits of Trees




Improved concentration and productivity
Winter windbreak
Reduced heating costs
Oxygen production
• Social cohesion
• Sense of place
• Cultural links to the past
Bio-diversity and habitat
Food
• Reduced stress
• Health and wellbeing benefits
Carbon storage
Encourages outdoor recreation
Timber
Fuel and building materials
© Treeconomics 2018. You're free to use this image with attribution.

1.3 The Role of Trees in Cities

In 2014, around 54% of the world's population were living in towns and cities. That figure is set to increase to 70% by 2050 (Ekelund, 2015). In addition, it is estimated that almost two-thirds of the urban environment which will exist in 2030 is yet to be built. This suggests that the rate of urban development is set to accelerate considerably.

If we are to produce happy, healthy communities, it is paramount that we create and maintain healthy and sustainable urban environments, designed to incorporate inter-connected elements of green infrastructure and urban forest to improve the liveability of the places in which people live.

Understanding the value and extent of canopy cover in the borough of Southend will inform decisions that will improve human health and environmental quality.

In a study of 283 UK towns and cities, Doick et al. (2017) recommended a minimum canopy cover target of 20% (with 15% for coastal locations), and currently many UK cities are aiming to exceed this. For example, London is aiming for 30% canopy cover and both Torbay and Plymouth have set goals of 20% canopy cover. Bristol has set a target to double its canopy cover by 2050 from 15 to 30%. This therefore gives an indication of the potential canopy cover goals for the areas surveyed in this report.

2. Data analysis

2.1 Methodology

GIS Project boundaries of Southend and its individual wards were accessed using the London Datastore. Additional background mapping data was obtained from various open source web portals, referenced on the maps.

Tree canopy cover within the borough of Southend was assessed using Bluesky's National Tree Map. This data provides polygons of the canopy across Southend and idealised crown polygons, along with point data representing each tree[3]. This information can be used to estimate the canopy cover percentage for the area as a whole and for each ward.

Health and socio-economic data has been obtained from the Office of National Statistics (ONS) and Public Health England (PHE) official published data.

Where the data obtained was presented at Lower Super Output Area (LSOA) level, it has been aggregated to ward level. This was carried out using the 'Lower Layer Super Output Area (2011) to Ward (2018) Lookup in England and Wales' table provided by ONS.

The most recent and up to date available data has been used within this report, and the year of publication can be seen in the Bibliography. These three datasets were combined using Geographical Information System (GIS) software to provide the maps used in this report.

[3] Definitions of crown polygon types are provided in Appendix I

3. Results

3.1 Canopy Cover

3.1.1 Average Canopy Cover

The average canopy cover across the borough of Southend was calculated at 12%.

Canopy cover by ward is depicted in Figure 3 and Figure 4 (overleaf).

Canopy cover values range from 8.5% in Westborough Ward, to 23.3% in Belfairs Ward of Southend.

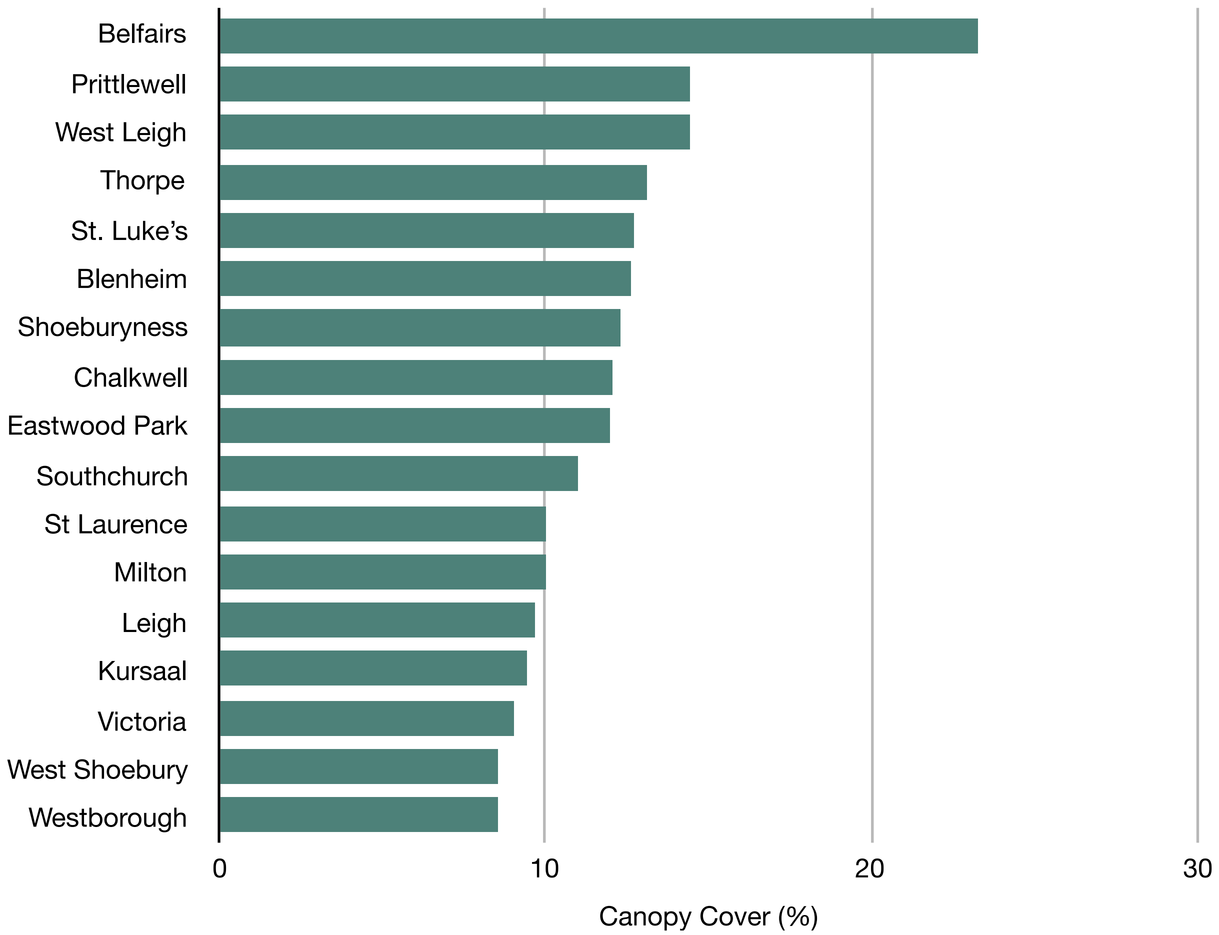


Figure 3: Canopy Cover ranked by % area per ward for Southend

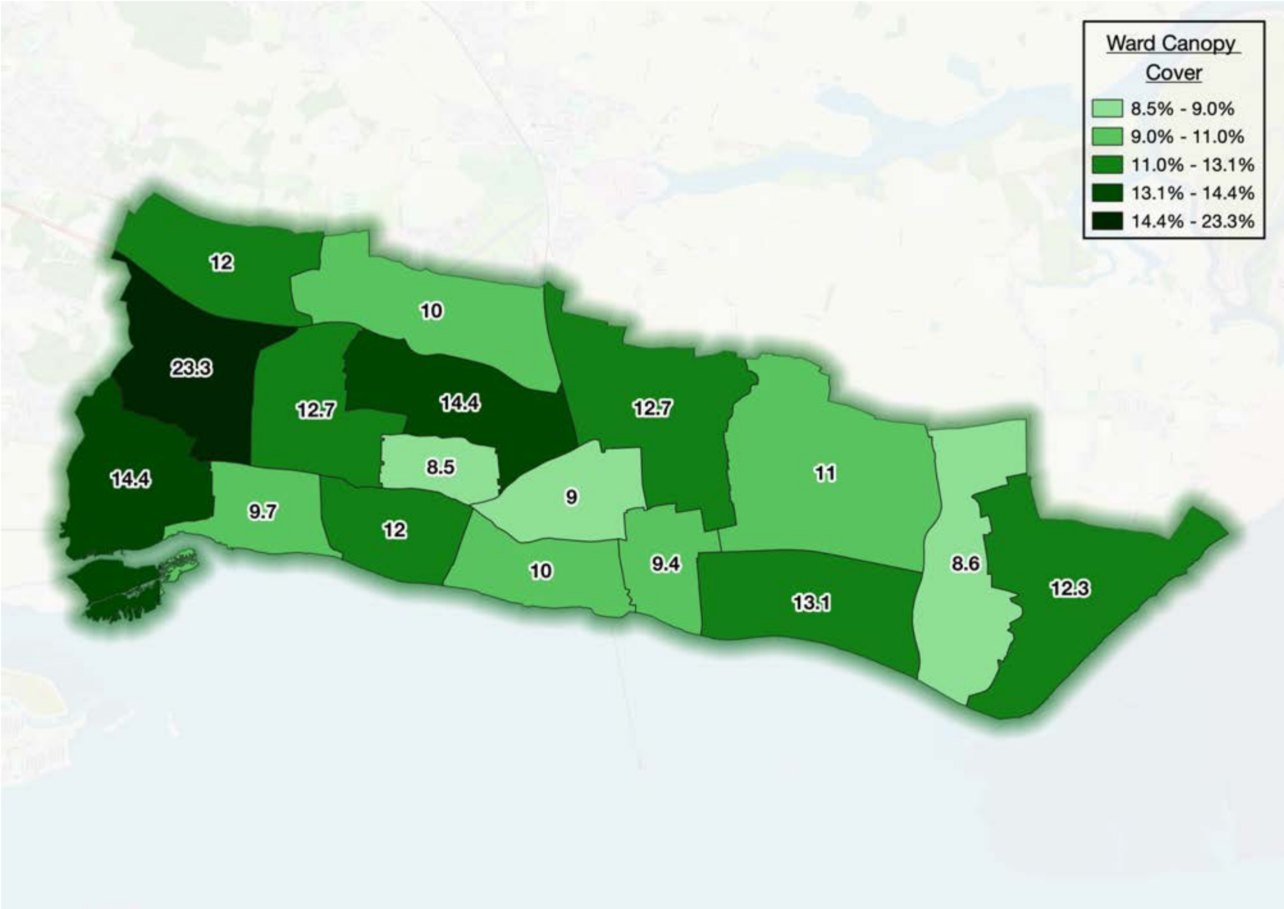


Figure 4: Map of Canopy Cover by ward

3.1.2 Canopy Cover by Ward (Individual Maps)

Figure 5: Belfairs Ward Bluesky Canopy Cover is 23%.

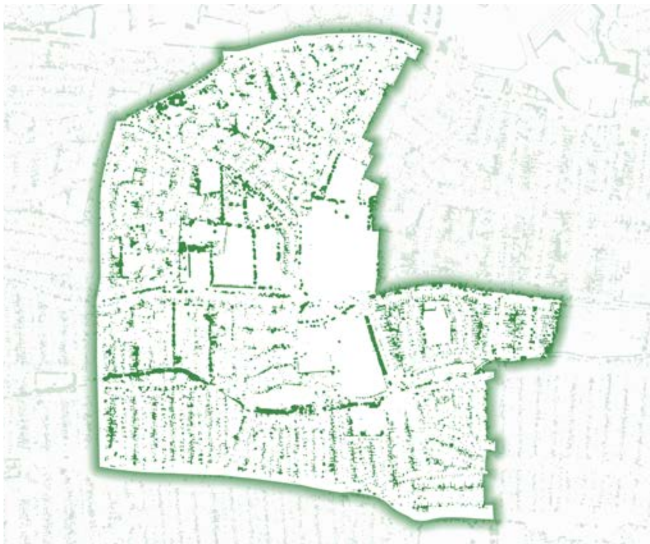


Figure 6: Blenheim Ward Bluesky Canopy Cover is 13%.

Figure 7: Chalkwell Ward Bluesky Canopy Cover is 12%.

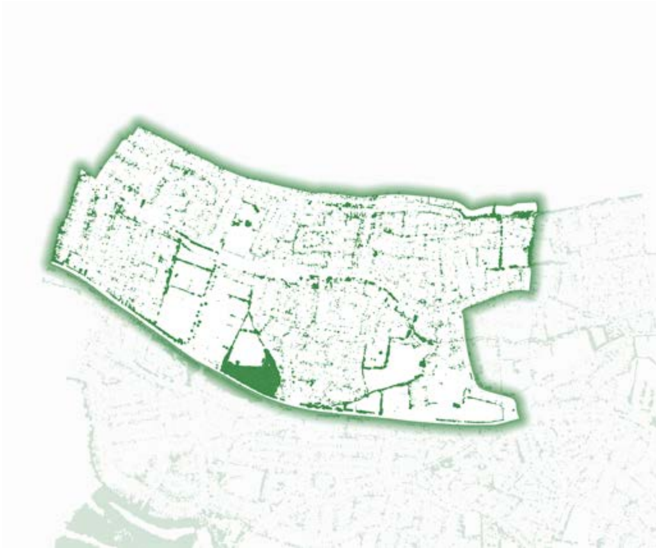


Figure 8: Eastwood Park Ward Bluesky Canopy Cover is 12%.

Figure 9: Kursaal Park Ward Bluesky Canopy Cover is 9%.

Figure 10: Leigh Ward Bluesky Canopy Cover is 10%.

Figure 11: Milton Ward Bluesky Canopy Cover is 10%.

Figure 12: Prittlewell Ward Bluesky Canopy Cover is 14%.

Figure 13: Shoeburyness Ward Bluesky Canopy Cover is 12%.

Figure 14: Southchurch Ward Bluesky Canopy Cover is 11%.

Figure 15: St Laurence Ward Bluesky Canopy Cover is 10%.

Figure 16: St Luke's Ward Bluesky Canopy Cover is 13%.

Figure 17: Thorpe Ward Bluesky Canopy Cover is 13%.

Figure 18: Victoria Ward Bluesky Canopy Cover is 9%.

Figure 19: West Leigh Ward Bluesky Canopy Cover is 14%.

Figure 20: West Shoebury Ward Bluesky Canopy Cover is 9%.

Figure 21: Westborough Bluesky Canopy Cover is 9%.

3.2 How does Southend compare to previous Canopy Cover Estimates?

Comparing canopy cover values between cities is an interesting exercise but should be made with caution as there are many attributes of a city which will affect urban forest structure and function. Furthermore, other studies may have used different methods to assess canopy cover. Nonetheless, these figures can be informative in providing an approximate benchmark for Southend.

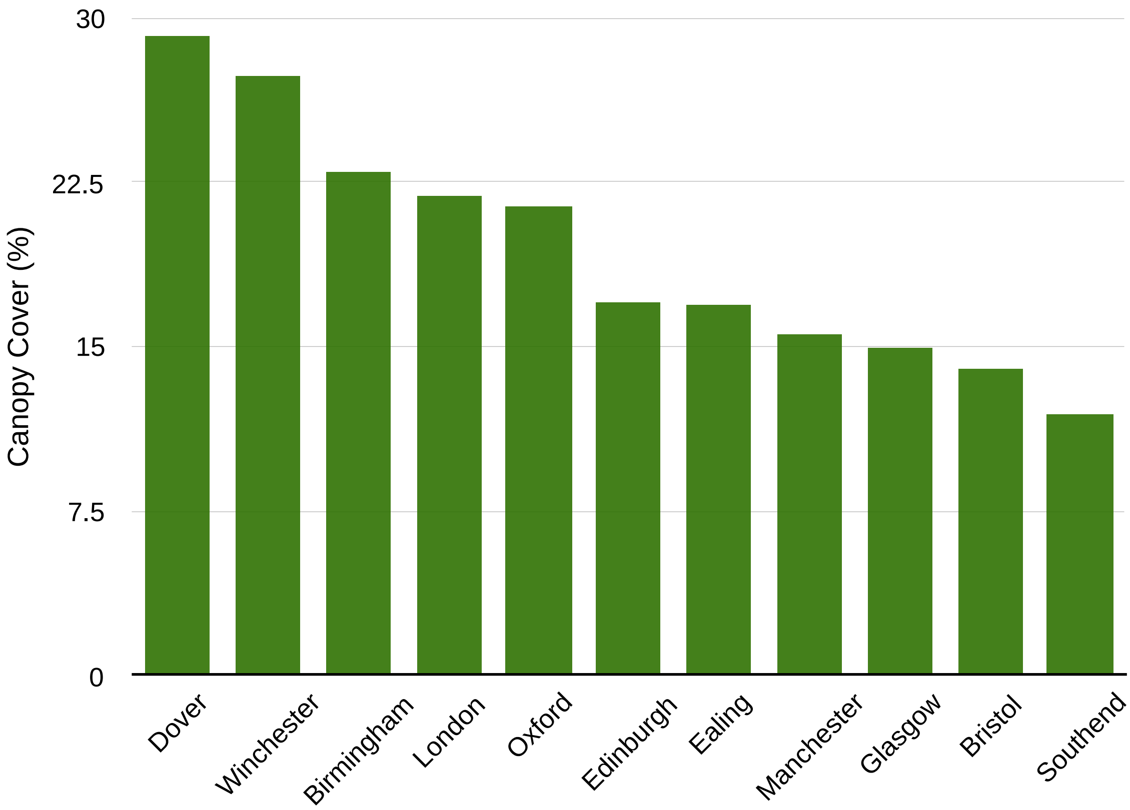


Figure 22: Canopy Cover estimates for selected UK urban areas

In comparison with other studies (Urban Tree Cover, 2018), Southend-on-Sea's canopy cover is below the average (17%) estimated in the 320 towns and cities surveyed in the UK. However, Southend-on-Sea's canopy cover does fall close to the coastal town average (13.7%) and is higher than the majority (20/30 towns, which had below 10% canopy cover) (Doick *et al*, 2017).

4. Canopy Cover and Quality of Life

This section compares canopy cover with various quality of life indicators for Southend-on-Sea. These are shown for the ward level, for appropriate comparison to the canopy cover assessment.

The information presented in the charts below does not necessarily show a clear correlation, nor does it show a causation. This is important to consider when interpreting or using the presented data. However, it highlights the fact that areas with higher tree canopy cover generally perform well on other indicators (e.g. greater tree cover = less “*deprived*”).

The insert on each map shows the corresponding canopy cover replicated from Figure 4 (page 15).

4.1 Life Expectancy

Measuring life expectancy is increasing across the UK, and gives an indication of the health of the population. Across Southend-on-Sea, there are stark differences in life expectancy.

The difference between average male life expectancy between Kursaal and West Leigh is 8.4 years (Kursaal having lower life expectancy). For female life expectancy, Victoria ward presents the lowest life expectancy at 78.7 years, and Thorpe shows the highest with 88.2 years.

The results (see Figure 8) show that in areas with higher tree canopy cover, life expectancy is also generally higher. However other socio-economic factors will also influence the result (for example higher paid families and individuals, leading healthier lifestyles in leafier environments). Yet, these results do serve to highlight that access to tree canopy cover is not always equitable and issues of environmental justice need to be considered when devising tree strategies or developing new areas for housing.

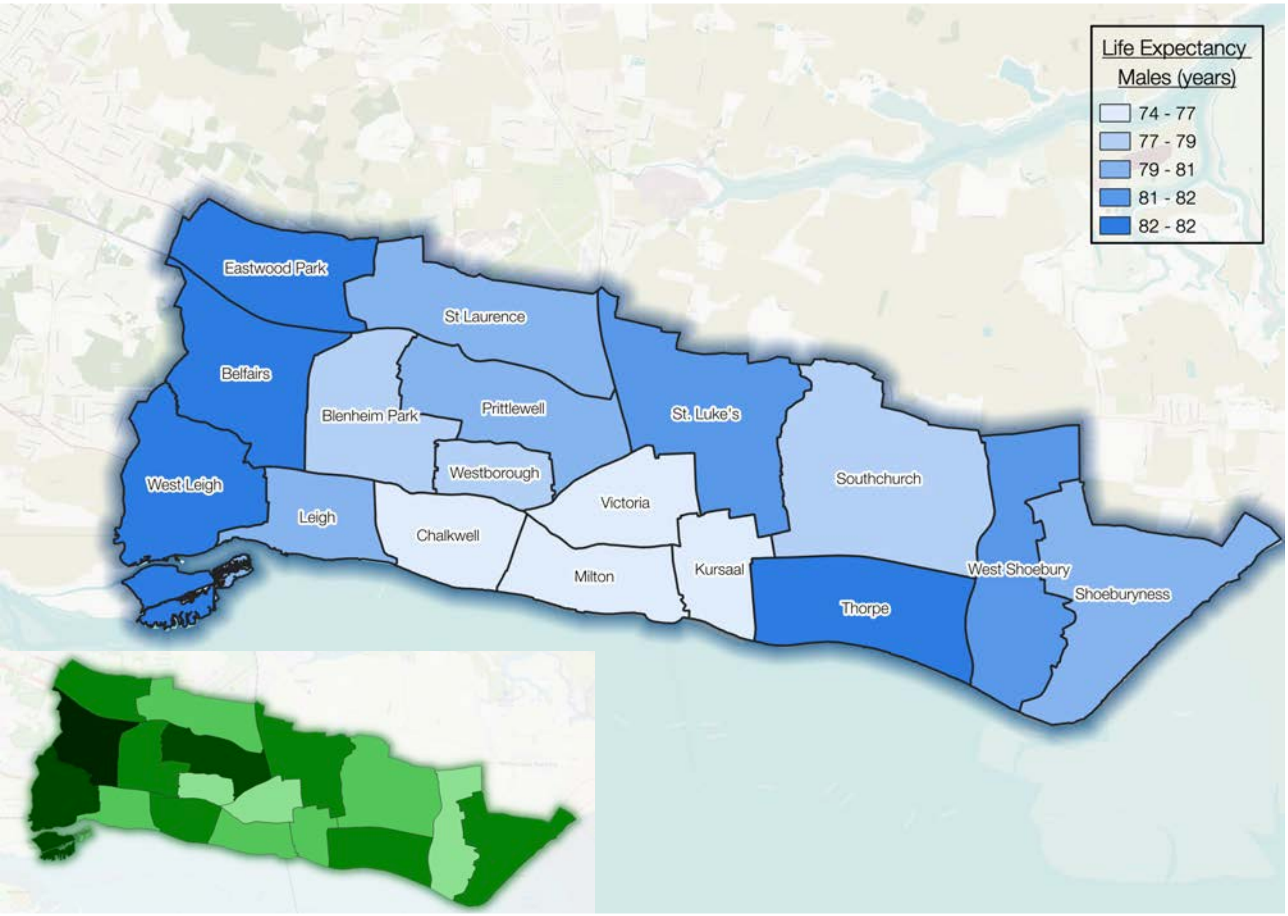


Figure 6: Life Expectancy (years) for males by ward area. (Inset: Canopy Cover by ward)

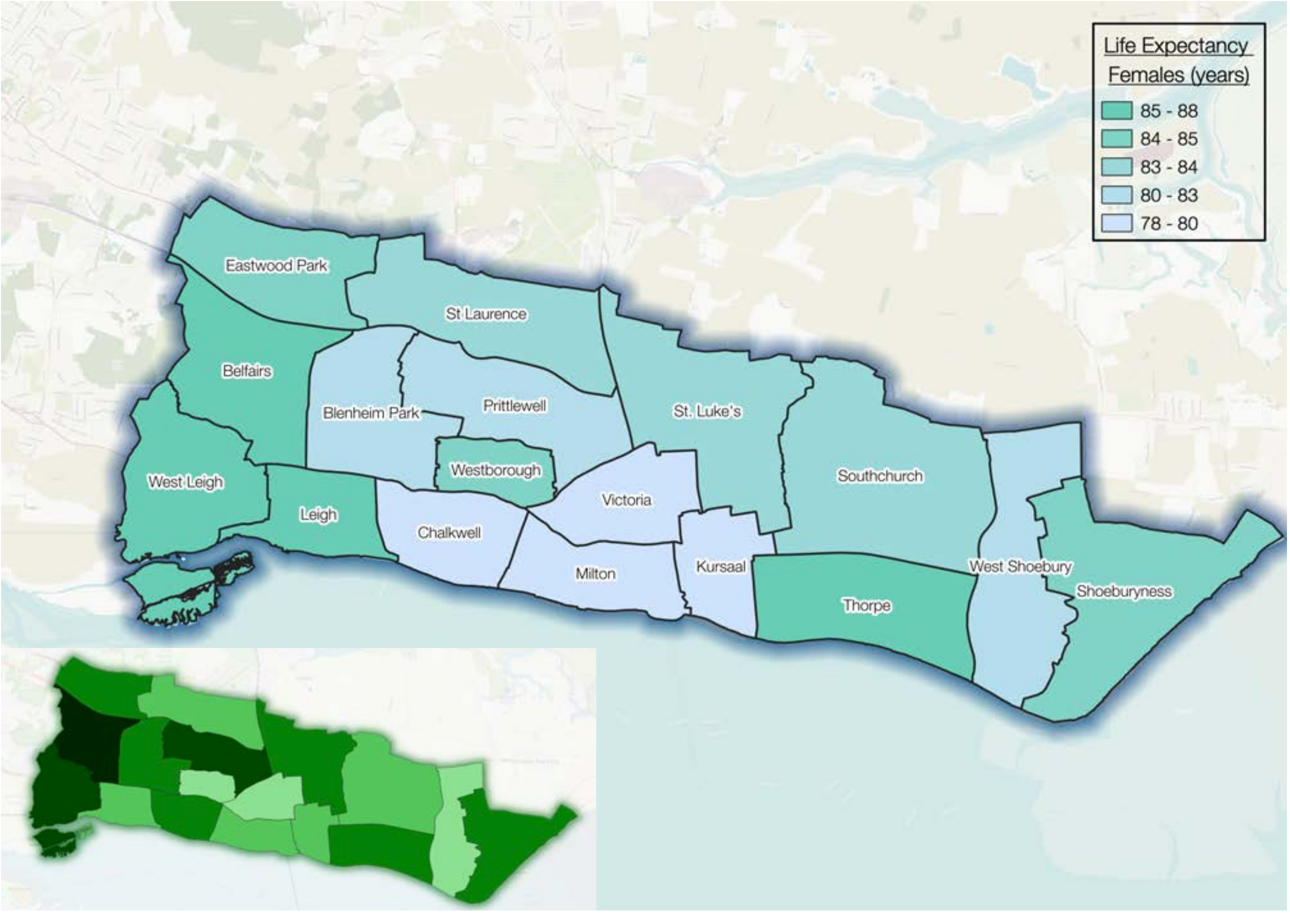


Figure 7: Life Expectancy (years) for females by ward area. (Inset: Canopy Cover by ward)

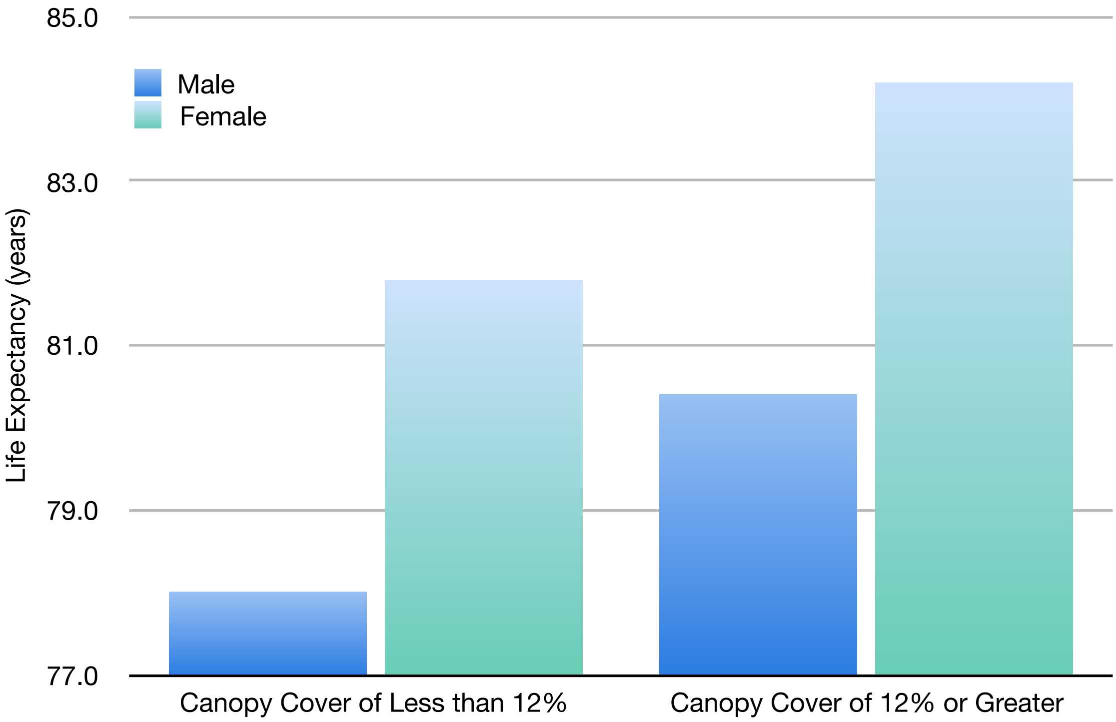


Figure 8: Healthy Life Expectancy and average ward Canopy Cover

4.2 Hospital Admissions

Trees help to promote healthy environments and there is a growing body of research which shows people are happier in leafier environments, with reduced levels of stress and blood pressure (Hartig, 2003).

Stress is one of the key contributing factors to mental health issues, which access to good quality green spaces can alleviate (White, 2013). Depressive disorders are now the foremost cause of disability in middle-to-high income countries and can be precursors to chronic health problems.

Increased tree cover can help to promote good health (and therefore reduced numbers of hospital admissions) passively, by filtering air pollution and lowering peak summer temperatures, for example, and by promoting physical activity. Where green space is available, it can be used for physical activity and may even help to reduce social health inequalities (Mitchell & Popham, 2008). This is important because in Europe 1 in every 15 deaths is associated with a lack of physical activity. A 2019 review of Southend-on-Sea's physical heath found that 24% of adults are "*inactive*", meaning they engage in less than 30 minutes of "*moderate intensity activity on a weekly basis*".This falls in line with the average for the UK. However, 74% of Southend-on-Sea's 15 year olds had a "*mean daily sedentary time*" of over 7 hours per day. This is "*worse*" than the UK average. Southend's 15 year olds were more physically active than then UK average, "*for at least one hour per day, seven days a week" (Southend-on-Sea, 2019)*.

Areas with more than Southend-on-Sea's average canopy cover of 12% correlate with both higher life expectancy and lower average numbers of hospital admissions. Areas with less than 12% canopy cover correlate with lower life expectancy and higher average numbers of hospital admissions.

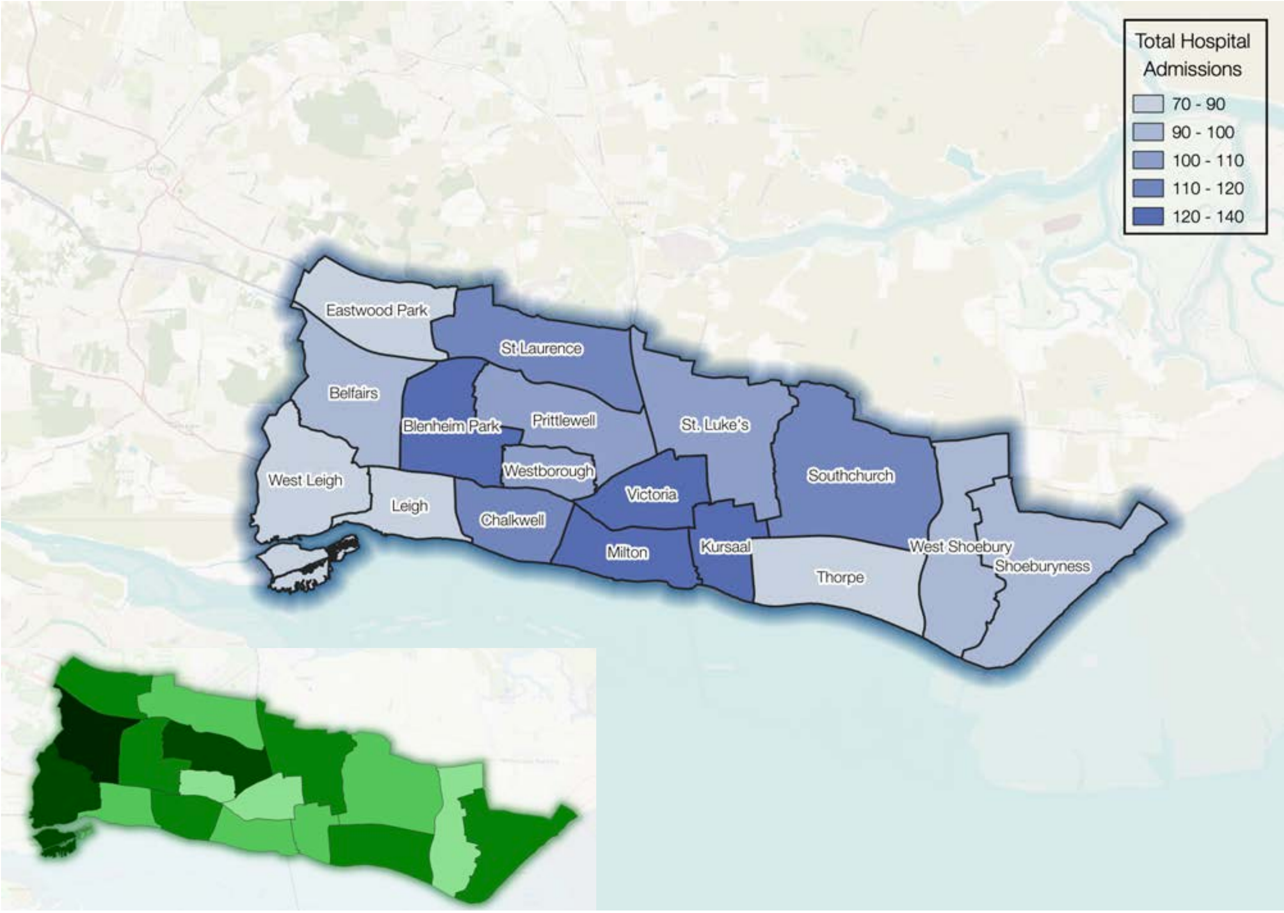


Figure 9: Total hospital admissions (emergency and elective) by Ward area. (Inset: Canopy cover by ward).

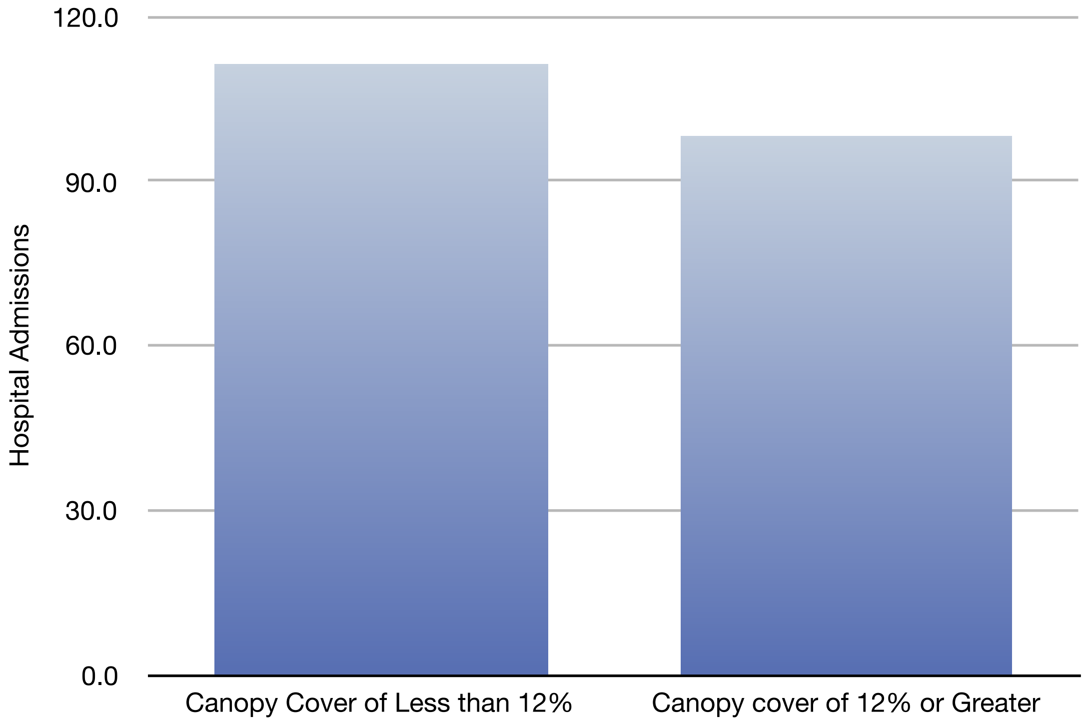


Figure 10: Hospital Admissions and average Tree Cover.

4.3 Index of Multiple Deprivation

Data concerning deprivation was collected at the LSOA scale. The average for each ward is displayed in the following charts and figures, contrasting the wards with less than 12% canopy cover and those with a canopy cover equal to or greater than 12%.

The Index of Multiple Deprivation (IMD) scores relate to a proportion of the relevant population experiencing that type of deprivation.

The scores for IMD do not relate straightforwardly to the proportion of the population experiencing deprivation. For example, an area with an IMD score of 60 is not necessarily twice as deprived as an area with a score of 30. The scores are derived from the raw data, which is why the following maps do not share a common scale.

IMD combines information from seven domains to produce an overall relative measure of deprivation.

The domains are combined using the following weights:

- Income Deprivation (22.5%)
- Employment Deprivation (22.5%)
- Education, Skills and Training Deprivation (13.5%)
- Health Deprivation and Disability (13.5%)
- Crime (9.3%)
- Barriers to Housing and Services (9.3%)
- Living Environment Deprivation (9.3%)

The weights were derived from consideration of the academic literature on poverty and deprivation, as well as the levels of robustness of the indicators. Combining information from the seven domains produces an overall relative measure of deprivation - the Index of Multiple Deprivation.

The relationship between canopy cover and IMD is illustrated in Figures 11 and 12 (below). These figures show that for IMD, on average, areas with above average canopy cover scored lower (18.2) than areas with below average canopy cover (30.0).

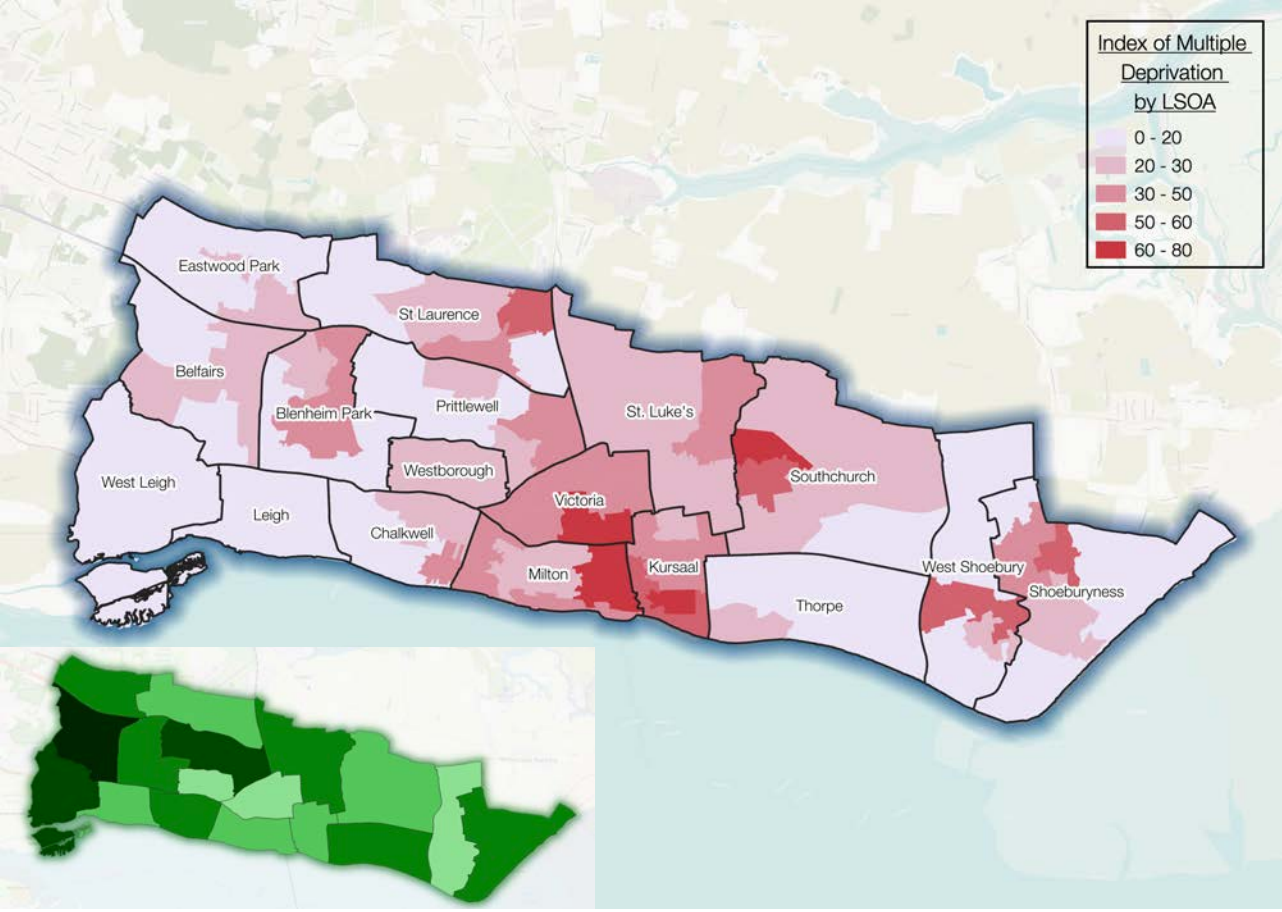


Figure 11: Index of Multiple Deprivation by Ward area. (Inset: Canopy Cover by ward).

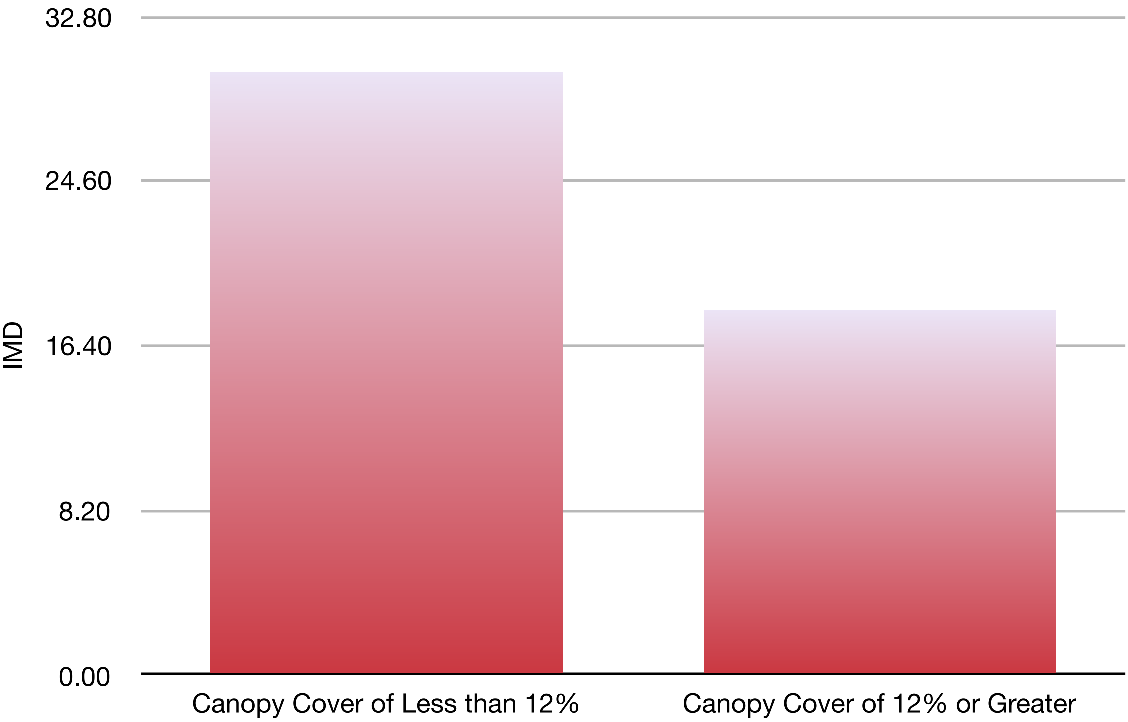


Figure 12: Index of Multiple Deprivation and average tree cover.

4.4 Crime

The crime domain measures the risk of personal and material victimisation at a local level. Crime levels have increased between September 2018 to August 2019 (Police UK, 2019). There are, however, variations between Lower Super Output Area (LSOA) data output areas across a small spatial area. Separating out the relative influences of a large number of factors on the presence of crime would require a detailed analysis, which is beyond the scope of this report.

Increasing tree cover can be one way to create safe and accessible environments, which are also visually attractive. However, poorly maintained areas can increase the perception of crime. Studies in The US have demonstrated that a 10% increase in tree cover correlated to a 12% reduction in crime (Troy, 2012). Furthermore, regarding minor crimes, there is less graffiti, vandalism, and littering in outdoor spaces with natural landscapes than in comparable spaces with little green open space (Brunson, 1999). There is a positive correlation between high canopy cover and lower crime rate in Southend-on-Sea, as shown in Figures 13 and 14 (below).

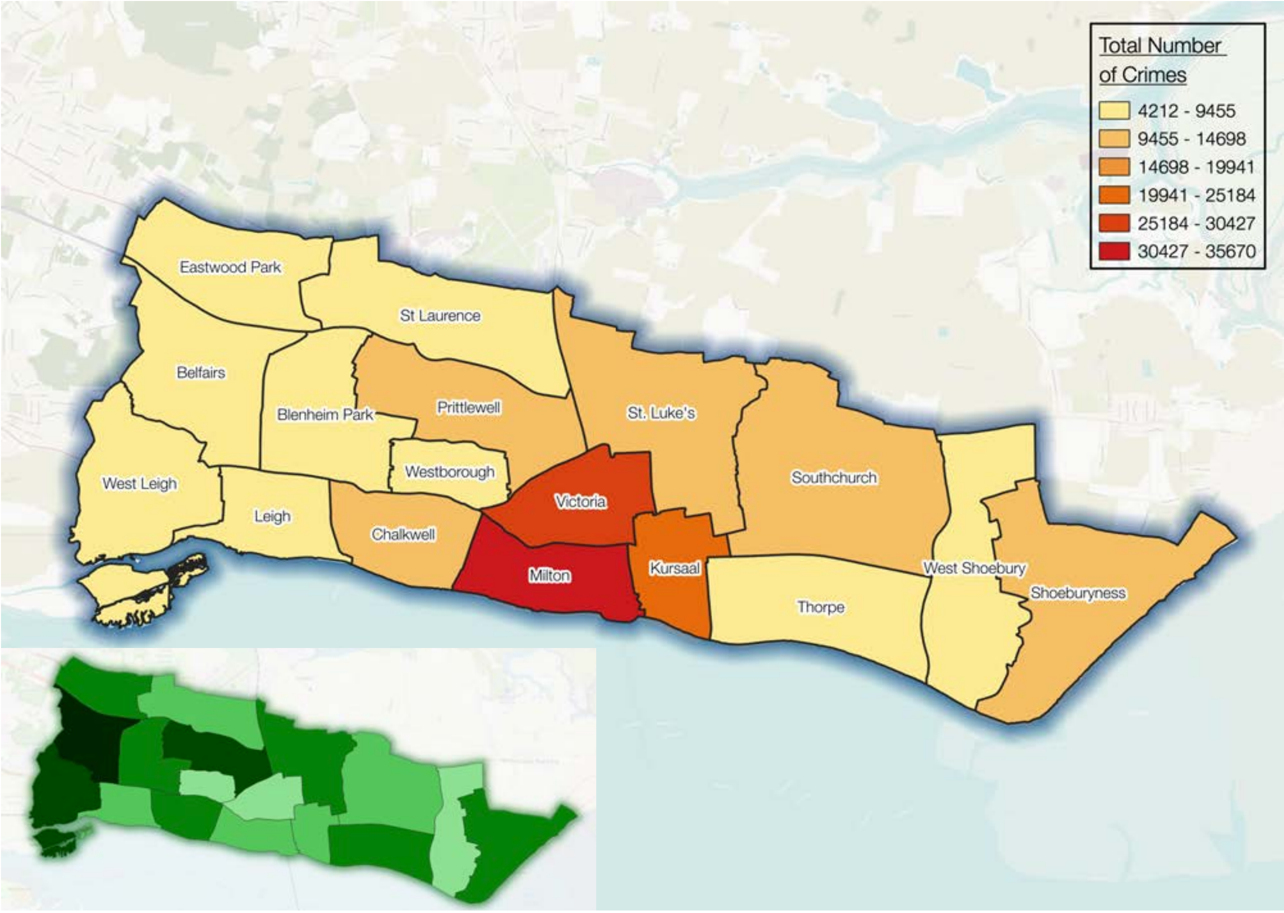


Figure 13: Total Crimes & ASB by Ward (Inset: Canopy Cover by ward).

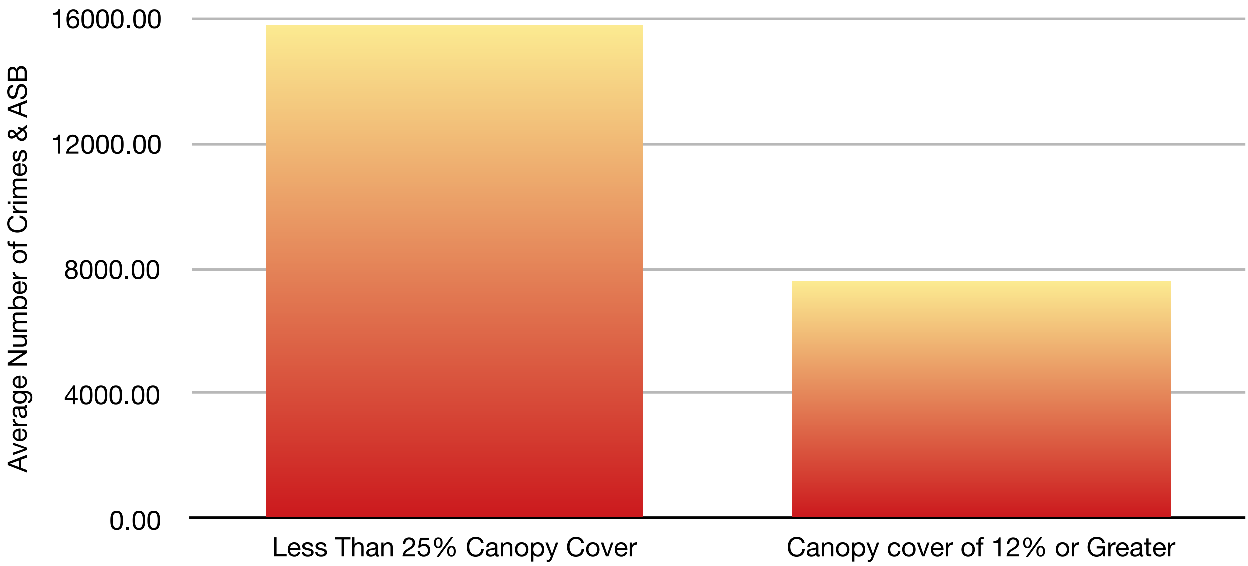


Figure 14: Total Crimes & ASB and Average Tree Cover

4.5 House Prices

Donovan *et al.* examined relationships between house prices and trees in Florida. The study found that house prices were significantly higher when trees were located within 152m of a property. The results of the study highlighted the relationships between house value and proximity to the natural environment (Donovan *et al.*, 2019). A similar study carried out in Australia also found that trees (in particular to this study, broadleaved trees) increased the "*median property price*" when located on street verges (Pandit *et al.*, 2013). Some studies have suggested that individuals should prepare to pay a higher price if they live in close proximity to woodlands and forests. One study reported that "*many real estate professionals agree that houses with mature trees are preferred to comparable houses without mature trees"* (Mansfield *et al*, 2002). This may be the result of tree cover improving the "*scenic quality*" of a town as opposed to the houses being "*more valuable*"[4].

The house price domain reports the median price paid for residential dwellings and are calculated using Land Registry data on property transactions. Please note that the most current house price data obtained were for the year 2015.

As the charts and the map in Figure 15 and 16 (below) show, house prices in areas of higher canopy cover are slightly higher than those in areas of lower canopy cover.

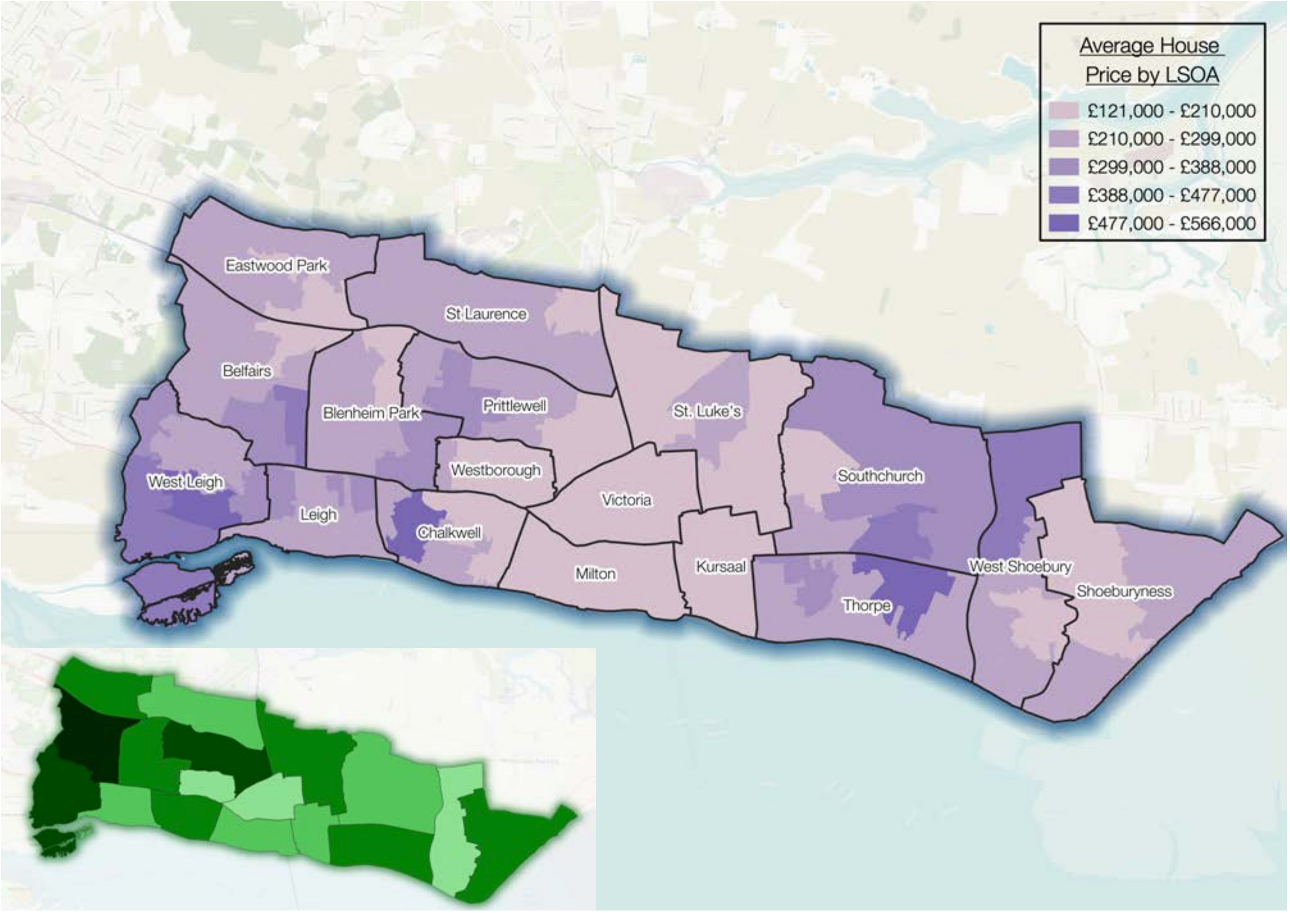


Figure 15: House Price (£) data (2018) by Ward area. (Inset: Canopy Cover by Ward).

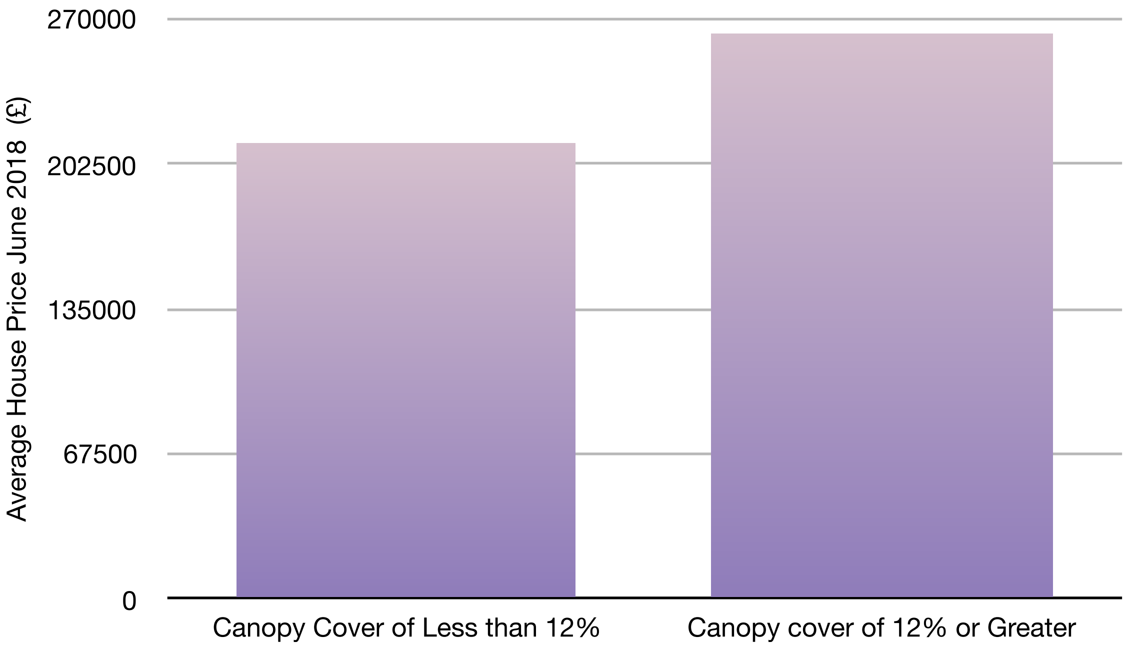


Figure 16: Average Residential Property Price and Canopy Cover

4.6 Educational Achievement

Studies have connected access to nature and the impact upon performance of students. '*Improved focus, vitality, productivity, and reduced stress'* greatly contribute to educational success. It is suggested that improved urban design with a greater focus on green infrastructure could mitigate negative effects upon academic achievement (Hodson *et* al, 2017). A separate study supported this theory through concluding that the current body of evidence indicates that greater amounts of trees on campuses are associated with increased performance (Kweon *et al*, 2017).

Educational Achievement is reported at the ward level by the Office for National Statistics (ONS). The variable used in this report is the percentage of pupils achieving five A*-C at GCSE Level. Whilst the grading system has now changed, only the historical data collected using the A*-F grading system is currently available.

The charts and map below show that between areas with less than average canopy cover and areas with more than average, there is a difference of 16.1% in GCSE attainment.

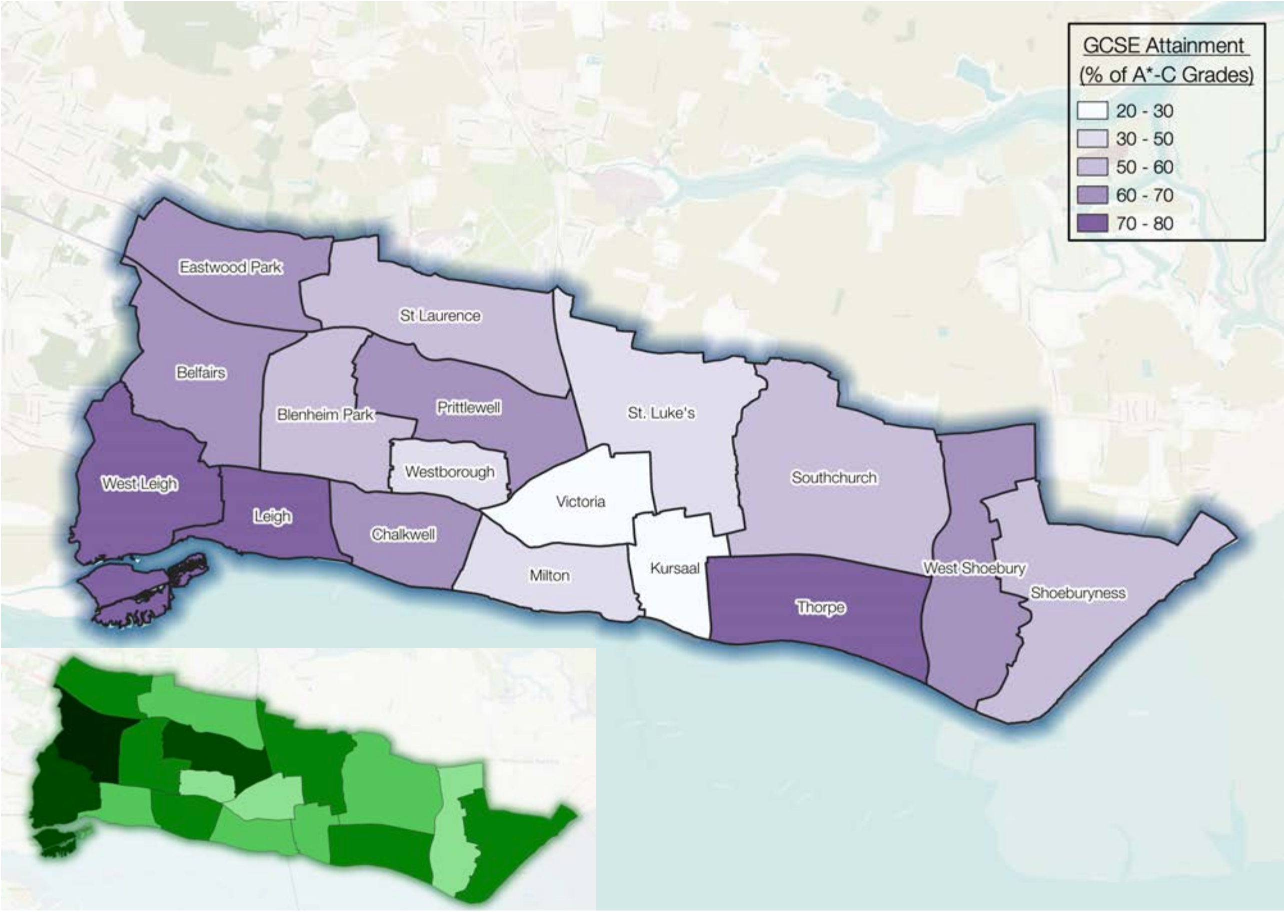


Figure 17: GCSE Attainment (% of 5 A*-C Grades) by Ward area. (Inset: Canopy Cover by Ward).

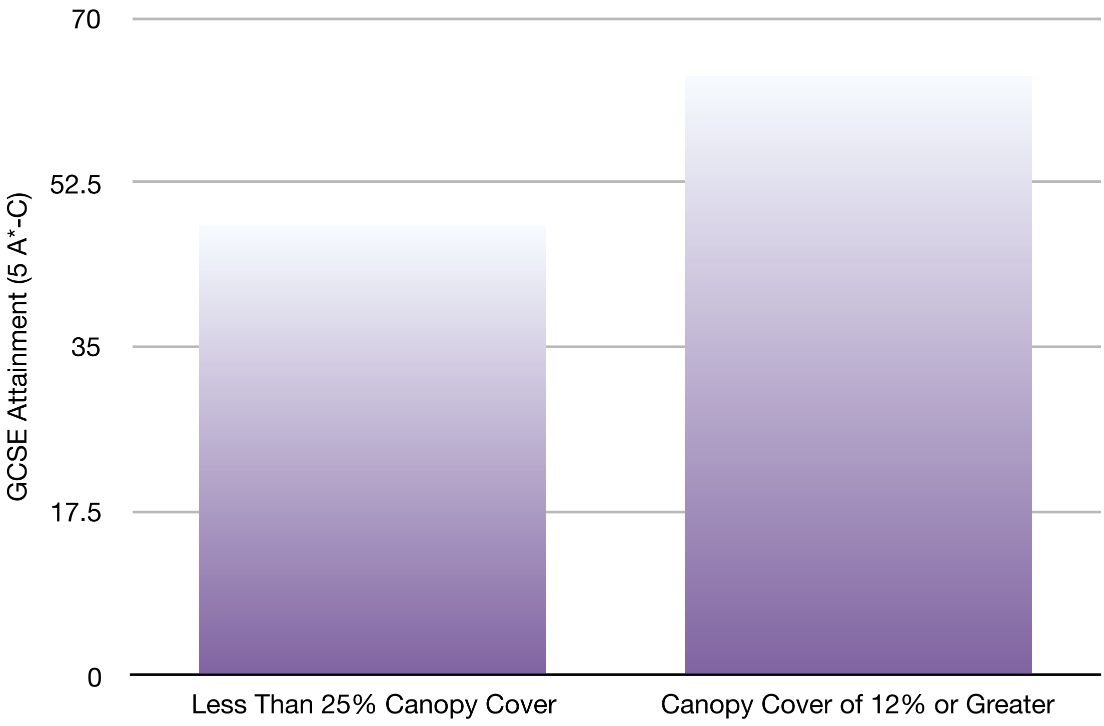


Figure 18: Number of students achieving 5 A*- C GCSE grades and Canopy Cover.

5. Conclusions

This preliminary study presents data on the canopy cover found in the borough of Southend-on-Sea and within its smaller administrative boundaries. It also establishes a baseline which can be used to monitor future progress, or for use in further research.

Primarily, the data collected can inform where there are opportunities to increase tree cover by highlighting areas of low tree canopy cover and the available plantable space within them. Furthermore, planting could also be targeted to the areas which are also the most deprived.

This report highlights the quantity of scientific research which supports the assertion that trees provide a wide range of valuable ecosystem services. Southend as a whole has 12% tree canopy cover, which ranges from 8.5% in Westborough Ward, to 23.3% in Belfairs Ward. Within many of the most deprived areas, the canopy cover is much lower, and so too is the value of ecosystem services provided.

Increasing tree cover in Southend-on-Sea will provide multiple benefits to the community and should be part of the solution in creating resilient places for people to live and work.

6. Recommendations

The following recommendations have been formulated to assist Southend Borough Council to make tree management decisions on the basis of the best available information and to ensure that resources are focused to maximise the benefits trees can provide, and that they can be targeted to areas where they are most needed.

6.1 Set a Canopy Cover Target

Many towns and cities in both this country and internationally have set a canopy cover target as a strategic objective. Typically, these are in the range of 20-30% (See Appendix II).

The level of ecosystem services increases as the percentage of canopy cover increases. However, it is clear that a canopy cover needs to not only be aspirational but also achievable, taking account of local geographies, land use and industrial heritage.

Decision-makers should seek to maintain rather than increase canopy cover in the wards with the highest canopy cover, whilst seeking to maximise tree planting in the most deprived areas that also lack tree canopy cover.

It is suggested that Southend-on-Sea should aim to increase canopy cover towards 15% as targeted for coastal towns by 2050. A further feasibility Tree Plant Strategy would identify a realistic and aspirational target.

6.2 Use the mapping to support future planting decisions

The canopy results presented within this report could also be used in a Tree Plant Strategy[5] to look at opportunities for increasing canopy cover in the borough of Southend-on-Sea. Factors such as building density (includes all artificial surfaces: roads, paths, houses, etc.), air pollution, flooding and tree canopy cover could be combined within a Geographical Information System. All these factors could then be weighted and combined to give an overall score. The higher the score, the greater the opportunity to create woodlands and to plant trees.

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[5] Produced for Islington Borough Council, this Tree Plant Strategy is not currently publicly available.

At the most basic level the maps could identify areas where there is:

- a high level of deprivation;
- low canopy cover;
- room to plant more trees.

As part of this study, Southend-on-Sea now has readily accessible and useable map files illustrating the tree canopy cover over the city. It is a straightforward and easily repeatable task to identify new planting areas at the ward level. This will help focus where to target resources for future tree planting.

6.3 Conduct an i-Tree Eco Survey

An i-Tree Eco sample survey would:

1. Provide more detailed information on the structure and composition of the urban forest such as the species present, the size and age (structural diversity) and health of the trees;
2. Risk Assess the impacts of pests and disease upon tree health;
3. Inform and facilitate planning of future planting and maintenance activities to ensure that current canopy levels can at least be sustained, if not improved where appropriate;
4. Quantify and estimate the economic value of the benefits trees are delivering.

This comprehensive understanding of the tree population within the study area will provide a basis for evidence-led, strategic planning and management of the urban forest and associated benefits, including best practices such as:

- **Strategic management of risks –** i-Tree Eco provides information on management concerns such as tree health, diversity, infrastructure conflicts and potential impact of pests such as Asian long-horned beetle, emerald ash borer, and chalara dieback of ash, enabling a thorough understanding of vulnerability. This can be balanced with the understanding of benefits and values that i-Tree Eco also provides, thus facilitating robust decision-making.
- **Financial planning –** The value assessment i-Tree Eco provides enables adherence to asset management and good practice for financial planning – allocating resources for investment based on needs and in commensurate amount to the asset value.

- **Benchmarking and monitoring –** The figures i-Tree Eco provide are standardised, thus making it easy to carry out year-on-year comparison and to benchmark with other tree populations / areas.
- **A compelling set of key facts for advocacy –** i-Tree Eco provides the information needed to develop strong headlines and a common language on the relevance of trees, allowing more effective communication and engagement of new audiences.

Example 1: The impact of the i-Tree Eco findings on tree planting in London Victoria.

In London Victoria, the i-Tree Eco study highlighted the dependence of the community on the large, mature London Plane for delivery of benefits, and a tree planting strategy was commissioned to seek to improve the age, size and species structure of the tree population.

Example 2: The impact of the i-Tree Eco findings on financial planning in Torbay.
Torbay's study revealed that the trees stored £5.1 million pounds worth of carbon and removed 50 tons of pollutants from the air every year, a service worth £1.4 million per annum. This information was crucial in making the case for trees and to secure investment for their ongoing management. In Torbay it led to an extra £25,000 to the tree planting and maintenance budget in both the year of study and in 2014.

Example 3: The impact of the i-Tree Eco findings on public engagement in Wrexham.
In Wrexham, on the day following the release of the i-Tree Eco report and before the local authority had issued their press release, the local media got interested in the key findings and put in the limelight the value of the benefits the local trees brings to the area. Such level of interest by the local press on the positive impacts of trees had never happened before.

6.4 Produce a Plan for Trees

The urban forest of Southend-on-Sea should be considered a unique attribute of the green infrastructure of the city with a variety of stakeholders who share an interest in its preservation and enhancement. To recognise its importance and uniqueness, the city would benefit from the preparation of a comprehensive tree strategy/urban forest masterplan for public and privately owned trees, which will:

1. Describe the nature and extent of the urban forest of Southend-on-Sea and provide a vision that is needed in the future, together with an action plan for delivery and monitoring;

2. Set individual canopy cover targets for key land uses and/or geographic areas as Key Performance Indicators, which is integral to the delivery of the Local Plan;

3. Set ambitious targets for cooperative development of the urban forest with communities, local business, utility companies and so on;

4. Monitor canopy cover as a Key Performance Indicator for management of the urban forest;

5. Identify and prioritise action through planting and management to ensure that tree cover is maintained, sustained and improved where this is appropriate;

6. Describe the role of trees within the landscape setting of Southend-on-Sea;

7. Develop a set of principles, standards, policies and constraints relating to trees that can be used to guide the design, development, deployment and operation of services delivered by trees in the borough of Southend-on-Sea.

The i-Tree Eco survey and the Plan for Trees will be essential tools to ensure trees are an integral part of the planning system as the population grows.

6.5 Tree Canopy Cover and Development Viability

This report highlights a lot of research which supports the assertion that trees provide a wide range of ecosystem services. Whilst the canopy cover for Southend-on-Sea as a whole is 12%, some of the more deprived areas possess much lower levels of canopy cover. Consequently, the value of ecosystem services provided by trees in these areas is much lower.

Many towns and cities in the UK have set a target for the level of canopy cover as a strategic objective. Typically these are in the range of 20-30%.

A previous canopy cover study for Wycombe showed that dwelling densities of 29 - 34 /ha could be designed to accommodate projected canopy cover of 25.6 - 32%. This projection also allowed for the prevailing trend of predominantly low-rise, detached residential development. More attached housing and multi-residential development, for example, would allow for more communal space with increased canopy cover without sacrificing total dwelling footprint size.

Many factors will combine to influence the delivery of a desired level of future canopy cover in a development. These include:

1. Level of existing canopy cover (i.e. retention of existing trees)

- Guidance and legislation (e.g. BS 5837: 2012 Trees in relation to design, demolition and construction - Recommendations; Town and Country Planning Act 1990 (as amended))

2. Requirements from new tree planting (i.e. mature tree canopy projection)

   - Number, size and crown shape of trees

   - Soil requirements (quality and quantity)

3. Estimated time to achieve canopy cover target

4. Design of layout to accommodate future growth

5. Success in establishing trees and achieving longevity in the landscape. (BS 8545)

Incorporating these factors into the urban forest masterplan/strategy would help to engage a variety of stakeholders, including across the departments of the planning authority. This is key to incorporating canopy cover targets into the design process of new development.

Appendix I.

Blue Sky National Tree Map Technical Notes

The National Tree Map (NTM) by Bluesky International Ltd is a commercial product which seeks to identify all trees and shrubs in England and Wales over 3m in height.

Classification of trees is achieved using stereo aerial photography (RGB/CIR), Digital elevation models (DTM/DSM) and hydrological models. The process produces three datasets: crown polygons, idealised crowns and height points. The map operates a 5 year rolling update program (NTM, 2015).

Aerial photography

Crown polygons

Idealised crowns

Height points

The National Tree Map consists of three GIS datasets:

1. Crown Polygons (Vector - Polygon) - Representing individual trees or closely grouped tree crowns

2. Idealised Crowns (Vector - Polygon) – Crown polygons visualised as circles for ease of use. Area measurement remains true to original crown feature

3. Height points (Vector - Point) - Detailing the centre point and height of each crown.

The point locations of each tree in the NTM dataset allowed each individual tree to be assigned a ward, a lower layer super output area (LSOA) and a middle layer super output area (MSOA), allowing for comparing canopy cover with other statistics from ONS.

Bluesky claims that the product captures more than 90% of all canopy coverage and within 50m of buildings greater than 95% all canopy coverage (NTM, 2015).

Appendix II

Trees in the National Policy Planning Framework

The revised National Planning Policy Framework (NPPF - February 2019) makes specific mention of trees and woodland more frequently than the document which preceded it, in which trees were only mentioned in the context of *'aged or veteran trees'*. However, trees and urban tree cover are implicitly linked to other key concepts that are emphasised and highlighted within the framework.

Sustainability, ecosystem services and green infrastructure are all dependent on the significant contribution that trees in the urban forest make.

Of the 16 sections in the revised NPPF, trees are able to contribute to meeting the objectives of 11 of them.

Trees and the benefits which they provide are crucial to securing economic, social and environmentally sustainable development - NPPF Section 2 (*"Achieving sustainable development"*). Trees contribute to positive improvements in the quality of the built and natural environment and also have a central role to play in the strategic policy making of local authorities. Paragraph 20 of the NPPF sets out how council policies must make provision for the:

"conservation and enhancement of the natural, built and historic environment, including landscapes and green infrastructure, and planning measures to address climate change mitigation and adaptation"

Increased tree cover can increase economic growth (Rolls and Sunderland, 2014) and prosperity (Wolf, 2005) as leafier environments improve consumer spending. Additionally, businesses are prepared to pay greater ground rents (Laverne &. Winson_Geideman, 2003), associated with higher paid earners who are also more productive (Kaplan, 1993; Wolf, 1998).House prices increase and crime is reduced (Wolf (2007), Kuo & Sullivan (2001a, 2001b)). This accords with NPPF (Section 6) *"Building a strong, competitive economy"* and is also directly linked to (Section 7) *"Ensuring the vitality of town centres"*. Furthermore, trees also contribute to *"Supporting a prosperous rural economy"* (included as a separate heading within Section 6 *"Building a strong, competitive economy"*), through the provision of non woody forest products, wood fuel and timber.

Trees also improve journey quality (Davies et al., 2014) (Section 9) *"Promoting sustainable transport"* and can encourage use of alternative transport corridors such as pavements and cycleways (Trees and Design Action Group, 2014). Additionally, trees near road networks absorb pollution and airborne particulates, helping to fulfil obligations under local air quality action plans (Escobedo and Nowak, 2009), reduce noise (Van Renterghem, 2014; Van Renterghem et al., 2012) and lower traffic speeds (Mok et al., 2003).

The presence of trees helps to raise property prices thereby contributing to delivering a wide choice of high quality homes, a theme which is central to the NPPF. The incorporation of trees into new development, when done in the right way so that there is minimal conflict, will provide a positive contribution to good design. Section 12 of the NPPF *"Achieving well-designed places"* refers in many places to principles which would benefit from the careful consideration of the use of trees in development design.

Trees not only contribute to 'attractive' and 'comfortable' streetscapes (or tree-scapes) but also are an asset which appreciates, delivering even greater benefits as they grow, adding to the quality of the area during, over and above the lifetime of the development (paragraph 127). They are essential to the incorporation of *'green and other public space'* (paragraph 127e) and in the *'provision of safe and accessible green infrastructure'* (paragraph 91). Local authorities must also *'plan positively for the provision and use of shared spaces, community facilities...'* (paragraph 92), which includes the provision of public open space. Increases in tree cover have even been shown to reduce crime therefore helping to ensure places are *'safe and accessible'* (paragraph 91).

Trees help in delivering the requirements of Section 8 *"Promoting healthy and safe communities"*. There is a growing body of research that shows people are happier in leafier environments and with access to the natural environment: hospital recovery times (Ulrich, 1984) and stress (Korpela et al., 2008; Hauru et al., 2012) are reduced and birth weights are increased (Donovan et al., 2011), meaning fewer health issues later in life. Conversely, when tree cover is reduced, asthma rates and respiratory problems often increase. Trees thereby promote healthy communities. They also provide a cultural link to the wider environment (paragraph 172) and act as a focal point for shared space and can improve the provision of high quality open space (paragraph 96).

In *"Protecting Greenbelt"* (Section 13), trees are also key to enhancing biodiversity and providing places of recreation (paragraph 141). Trees are also fundamental to strategies which aim to help *"Meet the challenge of climate change, flooding and coastal" coastal what?* (Section 14). Trees reduce stormwater runoff by attenuating precipitation in their canopies (Thomas and Nisbet, 2007; Nisbet and Thomas, 2006) and also reduce peak summer temperatures in both the urban and wider environment by several degrees (Doick and Hutchings, 2012), thereby helping to:

'...shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure' (Paragraph 148).

Additionally, "*Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures[48]. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts*" (Paragraph 149).

New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure - this means trees are often the single largest component of green infrastructure.

Perhaps most commonly understood are trees' ability to "*Conserve and enhance the natural environment*" (Section 15). Specifically, in Paragraph 170 of the NPPF it states that "*Planning policies and decisions should contribute to and enhance the natural and local environment...*" "*...recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland*" (Paragraph 170 b).

A key reason for using tree canopy cover as a tool to maintain and enhance tree cover across Central Bedfordshire and within individual developments is that it offers a means by which improvements and "*development whose primary objective is to conserve or enhance biodiversity should be supported; while opportunities to incorporate biodiversity improvements in and around developments should be encouraged, especially where this can secure measurable net gains for biodiversity (Paragraph 175)*". Measuring canopy cover provides a means by which net change in habitat and biodiversity can be monitored.

As well as providing economic benefits, previously planted trees provide a cultural link to the past (Section 16) *"Conserving and enhancing the historic environment"* and protecting and enhancing valued landscapes. Old, mature and veteran trees that have cultural significance will require more than just the consideration of their habitat and biodiversity and amenity value.

The Government attaches great importance to the design of the built environment. Trees make a significant contribution to good design, which is a key aspect of sustainable development and is indivisible from good planning, and should therefore contribute positively to making places better for people.

Regardless of any other 'external drivers', under the current legislation (TCPA Act 1990), Local Planning Authorities (LPAs) have a statutory duty to consider the protection and planting of trees when granting planning permission for proposed development. The potential effect of development on trees, whether statutorily protected (e.g. by a tree preservation order or by their inclusion within a conservation area) or not, is a material consideration that must be taken into account when considering planning applications. In order to exercise that duty adequately, LPAs need to have an understanding of the existing tree resource so that they can make an informed judgement about what might be needed/appropriate, in terms of tree impact, from developments.

Appendix IV

Summary of Ecosystem Services Provided by Trees

Provisioning services[6]

Food provision

Urban forests are regarded primarily as service providers rather than as sources of goods. However, trees and woodlands provide humans with food resources both directly (e.g. fruits, berries and nuts that are produced by the trees themselves) and indirectly (e.g. mushrooms and deer that reside in woodland habitats).

Fuel provision (wood fuel)

Woody biomass is the accumulated mass, above and below ground, of the roots, wood, bark, and leaves of living and dead trees and woody shrubs. Through the processes of harvesting and combustion, woody biomass can be used as a source of heat, electricity, biofuel and biochemicals.

Wood provision

Trees can provide timber for construction, veneers and flooring, as well as wood chip and pulp for boards and paper.

Habitat provision

Trees provide unique ecological niches for a variety of wildlife. This in turn adds to the biodiversity of the local environment and increases the enjoyment and attractiveness of an area for locals and visitors alike, thus increasing economic opportunities.

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[6] This summary is taken from Davies *et al*., 2016, which should be referred to for more detailed information on each service.

Regulating services

Carbon sequestration and storage

Trees act as a sink for carbon dioxide (CO_2) by fixing carbon during photosynthesis and storing excess carbon as biomass. CO_2 sequestration refers to the annual rate of CO_2 storage in above- and below-ground biomass. Increasing the number of trees can therefore slow the accumulation of atmospheric carbon, a contributor to climate change.

Temperature regulation

Trees are not only good reflectors of short-wave radiation, but their canopies also shade low albedo surfaces that would otherwise absorb such radiation, reducing surface temperatures and convective heat. Trees also reduce warming of the local environment through the process of evapo-transpiration where the evaporation of water from leaf surfaces converts solar energy into latent rather than sensible heat, thus 'cooling' the surrounding air and improving human thermal comfort.

Stormwater regulation

Urban trees and woodlands regulate stormwater by intercepting and storing rainfall on their leaves, which either subsequently evaporates, or reaches the groundwater more slowly through gradual release as through-fall. Trees also improve infiltration into the soil by channelling water onto pervious surfaces around the trunk, and through the soil along root channels.

Air purification

Trees remove air pollutants from the atmosphere mainly through dry deposition, a mechanism by which gaseous and particulate pollutants are captured and transported to plants that absorb them through their leaves, branches and stems.

Noise mitigation

Urban areas can be a source of unwanted sound, for example road noise. Trees can mitigate urban noise through the scattering and absorption of (typically mid to high frequency) sound waves by the leaves, branches and trunks, thus obstructing the pathway between the noise and the receiver.

Cultural services

Health

By providing a setting where the activities can take place, the urban forest can support physical activities such as walking, running and cycling, and relaxing activities such as bird watching, reading or having a picnic; thus encouraging physical well-being, mental restoration, escape and freedom, and enjoyment and fun.

Nature / landscape connections

Benefits arise from visual aspects of an ecosystem, e.g. trees and woodland can obscure unsightly structures, as well as other senses such as the smell of honeysuckle or the sound of birdsong. People can gain a sense of place from their local or favourite woodland, whilst physical interactions with trees such as fruit picking or conservation volunteering can add to feelings of connection with nature.

Social development and connections

Activities undertaken within woodlands and parks can strengthen existing social relationships, while organised activities within treed environments can create the opportunity for new relationships, including people's involvement with volunteer groups and community forests (known as social capital).

Education and learning

This category includes personal development for people of all ages, gained through informal learning, such as parents teaching their children tree names or where wood and paper comes from, and formal education via approaches such as Forest School (O'Brien, 2009). Learning can also take place through activities such as volunteering, apprenticeships, and play for children.

Economy and cultural significance

The urban forest can contribute to the economy by encouraging inward investment, boosting tourism, providing a setting for recreation industries such as climbing and paint-balling, and by enabling environmental cost savings (EFTEC, 2013). The urban forest can also contribute directly to the economy through the generation of new employment, such as arboricultural consultants and tree surgeons, and to a lesser extent, through the provision of food, fuel or wood products.

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