Using i-Tree to Inform a Strategic Approach for Future Management of Ealing's Urban Forest

Methodology Paper

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Overview

In summer 2017 Ealing Council, in partnership with Trees for Cities, Treeconomics, the Greater London Authority, Forestry Commission and Forest Research will be gathering data to quantify the structure, ecosystem services, and calculate the value of all public and privately owned trees in the borough. This data will be used to better inform future management and maintenance strategies, strengthen the business case to retain existing trees in the borough, and inform future planting strategy.

The Project Steering Group has developed a three tiered data collection approach to ensure that the project gathers appropriate information with sufficient detail. A combination of assessment methods and valuation tools will be implemented; random sample i-Tree Eco assessment, Council inventory i-Tree Eco assessment, Canopy Cover assessment and CAVAT. We can predict a number of outcomes from this study, such as quantifying the public and private forest structure, applying value to some of the ecosystem services Ealing's public and private trees provide, applying amenity value to trees in terms of replacement costs and community value, quantifying canopy cover for each ward, as well as the borough total, providing a baseline for comparison with future surveys. However, there are likely to be a number of unknown outcomes which may prompt future study.

We are ambitious for this innovative methodology to not only inform a strategic approach for future management of Ealing's urban forest, but to establish a robust, holistic model that can be scaled and replicated across other local authorities and communities.

This document provides a summary of our pioneering methodology.

Methodologies

1. i-Tree Eco Assessment Informed Using Random Sample Plot Inventory and CAVAT

Inventory Type: Random sample
Landowner: Public and Private
Scale: Borough level
**Output**: Estimated monetary value of Ealing's public and private trees by type of benefit

i-Tree Eco v.6 model uses random plot samples along with local hourly air pollution and meteorological data to estimate ecosystem services and structural characteristics of the urban forest. i-Tree Eco provides a broad picture of the services outlined in Table 1 for both public and private trees. i-Tree Eco applies a monetary value to these services where possible and appropriate.

Table 1 Outputs of Methodology 1 - Random Sample iTree Eco Assessment and CAVAT Valuation Tool

Urban forest Structure and Composition	Species diversity, tree canopy cover, age class and leaf area
	Land use and ground cover
Ecosystem Services	Hourly air pollution removal for CO, NO_2, SO_2, O_3 and PM2.5
	% of total air pollution removed by trees
	Current carbon storage by Ealing's urban forest
	Carbon sequestered annually
	Annual storm water runoff reductions
Structural Values	Replacement cost in £
	Carbon storage and sequestration value in £
	Pollution removal value in £
	Amenity value in £
Potential risk of Pest and Disease	Acute oak decline
	Asian longhorn beetle
	Chalara dieback of ash
	Emerald ash borer
	Gypsy moth
	Plane wilt

As the London Borough of Ealing has 23 wards, ideally we would stratify an even number of random plots per ward to allow ward-level comparison. However, to make this method statistically reliable a minimum of 30 sample plots per ward would be required, totaling 690 plots. Due to resource constraints, 220 random unstratified sample plots were generated across the entire borough (Figure 1), allowing broad estimates to be made for the borough as a whole. The Canopy Cover methodology described later in this document will be used to extrapolate these estimates down to ward level information.

Figure 1 Map of the London Borough of Ealing showing position of random plots
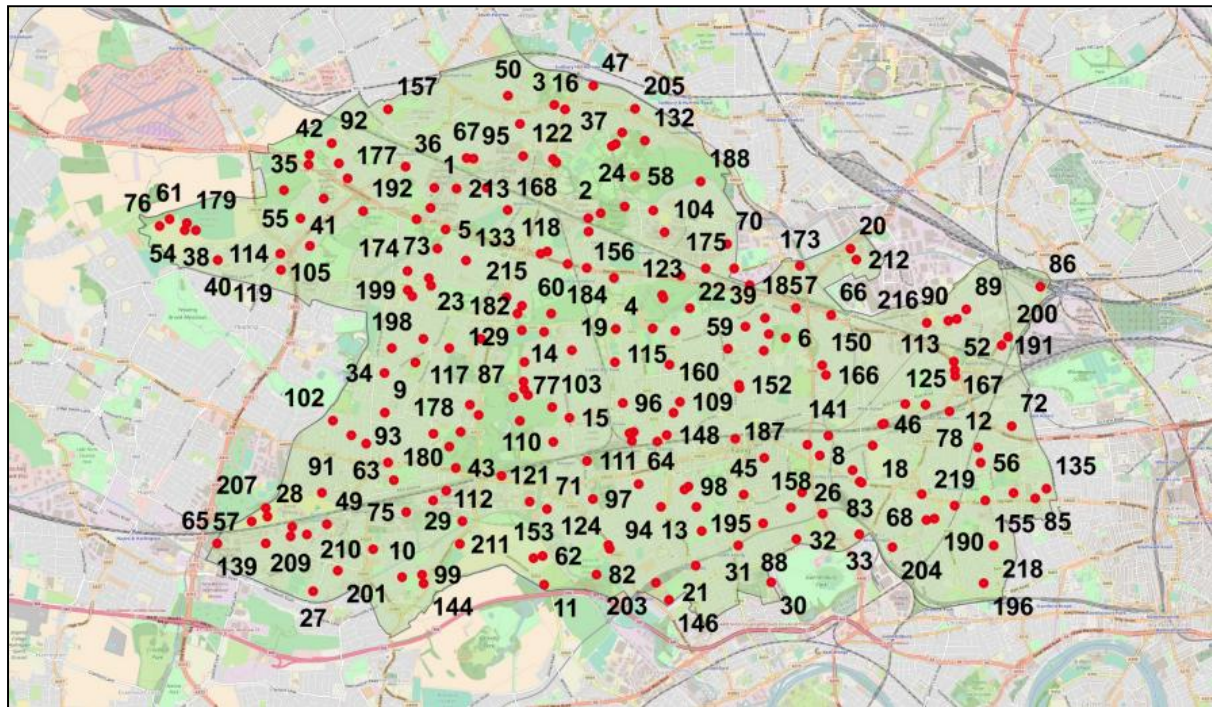
Plot locations will be surveyed by teams of trained volunteers over the summer of 2017. It is proposed that teams will consist of a Team Leader (with tree survey experience and good species identification knowledge) and two volunteers (ideally those that live or work in Ealing) and be allocated no more than 15 plots. In field measurements are summarized in Table 2.

Table 2 Field Survey Data Collected

Plot information	Tree information
• Land use • % tree cover • % shrub cover • % plantable space • % ground cover type • Distance to plot centre	• Species identification • Diameter at Breast Height (DBH) • Total height • Height to crown base • Crown width • % crown missing • % dieback • Crown light exposure

An induction to i-Tree and the purpose behind the Ealing survey will be given by the Project Coordinator and Treeconomics as soon as the core of volunteers has been identified. Treeconomics will provide a detailed training workshop in tree assessment and measurement close to the start of the survey so volunteers are confident in the methods when surveying begins. The workshop will include an induction in the health & safety issues pertinent to the survey.

Tree data will be captured on paper forms and submitted to the Project Co-ordinator on a regular basis. The Project Co-ordinator will examine the data for completeness, consistency and accuracy before transferring to the i-Tree database. In addition, Treeconomics will resurvey a minimum of 7%

of plots, ensuring each team is quality controlled once and any errors highlighted will be corrected. Should error trends show to be consistent from plot to plot, corrective action will be taken to: retrain the teams, fix the data sheets, and/or go back to the affected plots and remeasure the necessary items. For plots with <5 trees, every tree on the plot will have DBH and total height re-measured and species identification checked. For plots with >5 tress, all species identification will be checked before randomly selecting 5 trees to re-measure DBH and total height. Once all plots have been surveyed and Quality Control checks have been carried out, the data will be sent to Treeconomics for processing.

The Project Co-ordinator will offer support and encouragement to the teams, check on survey progress and identify if further teams need to be appointed. Each volunteer will sign a Risk Assessment related to the tasks expected of them, and will be issued with appropriate personal protective equipment (PPE) such as hi-vis vests and first aid kits.

Further details regarding standardising the sampling method are to be agreed as the project develops e.g. minimum DBH for recording, recording taxonomy at species/genus/family level etc.

For further details about this methodology please read the i-Tree Eco field manual.

2. i-Tree Eco Assessment Informed Using Local Authority Database and CAVAT

Inventory Type: Complete
Landowner: Public
Scale: Borough level
Output: Estimated monetary value of council-owned trees by type of benefit

Ealing Council already hold a wealth of data for trees on the council's highways, parks and housing. This methodology uses this existing database to run an i-Tree Eco v6 assessment. Similar to the random plot sampling method, Ealing's existing tree data is processed along with local hourly air pollution and meteorological data to estimate some of the ecosystem services and structural characteristics of the trees inventoried, which are those owned and managed by Ealing Council.

The minimum data required by i-Tree Eco v.6 is tree species and trunk diameter, however the greater the range of data entered for each tree the more accurate the result (including height and crown spread for example). The Eco model uses various approaches to fill in any missing variables for the trees with the minimum information. Some of these approaches use a default value, meaning all trees will be assigned the same value. Where defaults are not used, the model will use regression equations to fill in the other missing variables based on average tree values for the species. All trees in the Inventory without the minimum required data will be removed prior to analysis. For example, data for woodland blocks and tree groups cannot be processed.

Please read the Eco Guide to Data Limitations for further information on how the additional recommended variables are estimated.

Ealing's tree database currently holds:

- Location
- Species
- Height
- DBH
- Canopy spread

Table 3 Outputs of Methodology 2 – Ealing Inventory iTree Eco Assessment and CAVAT Valuation Tool

Urban forest Structure and Composition	Species diversity, tree canopy cover, age class and leaf area Land use and ground cover
Ecosystem Services	Hourly air pollution removal for CO, NO2, SO2, O3 and PM2.5 % of total air pollution removed by trees Current carbon storage by Ealing's urban forest Carbon sequestered annually Storm water runoff
Structural Values	Replacement cost in £ Carbon storage and sequestration value in £ Pollution removal value in £ Amenity value in £
Potential risk of Pest and Disease	Acute oak decline Asian longhorn beetle Chalara dieback of ash Emerald ash borer Gypsy moth Plane wilt

This method is integral to the project as it provides Ealing's arboriculture department with baseline data explicitly for Council managed trees, allowing strategic planning and maintenance that accounts for the value, resource, risk and resilience of the council's tree population.

3. Canopy Cover Assessment

The Canopy Cover assessment will be utilised in a number of ways. As the i-Tree Eco random sample plot inventory method provides a canopy cover figure for the entire borough, a ward level Canopy Cover assessment will give more localised information, enabling borough officers to plan localised tree strategies and canopy cover targets. The canopy data can also be classified by land ownership to establish how much of the urban forest is owned privately, by the council or by TFL etc. Finally, we will be able to study the relationship between canopy cover and other health and socio-economic data such as social deprivation, flooding, crime rates or house prices, to provide further context.

i-Tree Canopy

Inventory Type: Random sample

Landowner: Public and Private
Scale: Ward level
Output: Estimated canopy cover and land use as a percentage

i-Tree Canopy uses Google Maps aerial photography at random points to conduct a land cover assessment within the defined project area. This method uses randomly generated sample points and zooms to each one so you can choose from your pre-defined list of cover types for that spot (e.g. tree canopy, road, water).

Shapefiles for each of Ealing's 23 wards were downloaded from the London data Store. 500 - 700 random sample points will be classified per ward to improve the reliability of the estimate. Table 3 lists definitions of each classification. Several land classifications were included in addition to tree canopy cover to give the findings more versatility for future study and to provide an opportunity to contribute to the data gathered in the i-Tree Eco assessment.

Table 3: Description of Land Use Classifications

Classification	Description
Building	Any buildings (public, private, residential and commercial) This includes warehouses, sheds, train depots, greenhouses etc.
Bare Ground	All exposed ground surface e.g. turf (gold course, lawn), dirt/exposed soil, allotment beds
Other manmade	Any other manmade infrastructure. This may include astroturf sports pitches, fences, walls, a public square etc.
Shrub	Any shrub e.g. small shrubs (understory), herbaceous plants. Non-grass and non-tree
Transport	Any impermeable surfaces on which people walk, drive, ride and park. If the classification point falls on top of a vehicle on a piece of transport infrastructure, then classify as 'Transport'. Private driveways would also be classed as 'Transport'. Impermeable surfaces used for pedestrians to travel along (e.g. pavements, walkways, footbridges) have been classed as Transport but public squares and garden patios are classified as 'Other manmade'
Tree Canopy	All tree canopy cover from woodland to street trees. This avoids subjectivity in classifying woodland and individual trees.
Unclassified	All unclassified land due to shadow or distortion
Water	Any surface water body (river, lake, canal, reservoir, pond, swimming pool)

As a Quality Control measure, tree canopy for each ward will be classified to a standard error of +/- 1.5 %. Furthermore, to manage the subjectivity of the assessment 10 % of sample plots for each ward will be randomly selected for re-classification by another user. Variations in classifications greater than 10 % will trigger complete reclassification of the image and a repeat of the quality control exercise.