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ARBORICULTURAL VALUATION

Capital Asset Value for Amenity Trees (CAVAT)

SITE

Trees Scheduled for Removal in Connection with NGT Metro Development Between St Chad's Drive & Hollin Road, Leeds, West Yorkshire

AUTHORISING CLIENT

Drummond/Churchwood Resident's Association

12 October 2013

QTRA Licensed User

MEMBER ISA

1. EXECUTIVE SUMMARY

1.1. Findings

1.1.1. This report presents the findings of a tree valuation study undertaken on a section of trees which are of relevance to the Drummond/Churchwood Residents' Association.

1.1.2. The Capital Asset Value for Amenity Trees (CAVAT) method for was used to assess the financial value of 21 trees proposed for removal in order to facilitate the NGT Metro development.

1.1.3. From this sample of trees a value of approximately £500,000.00 worth of trees was identified.

1.1.4. The sample is largely representative of the overall size, age and quality of trees proposed for removal along the entire route. Using data provided by Mott MacDonald within their Arboricultural Assessment, It was possible to identify an extrapolated value of approximately £14,000,000.00 worth of trees for the proposed entirety of tree loss along the route.

1.1.5. It was found that the existing BS 5837 assessment had been conducted to an appropriate standard but that some information obtained in this survey was not clearly communicated to the wider public in their report.

1.1.6. A number of realistic assumptions regarding re-planting specifications were made in the absence of availability of precise details. It was then estimated that the initial capital asset value of replacement trees to be planted as mitigation for loss of existing value equated to approximately £700,000.00 worth of capital asset. This represents less than 5% of the value of the existing cover. It should be noted that this initial value will increase as the trees develop.

1.1.7. In the opinion of the author, and based on his experience as a professional arboriculturist, the proposed loss of tree cover in association with this development is significant.

1.1.8. Whether this loss of value from tree removal is proportionate in terms of the benefits brought by the NGT development, relative to the increased economic output for the local area, is beyond the remit of the report as it falls outside of the author's specialism. It is the author's intention that this information be considered and used to make more informed management decisions at a senior policy level.

2. PREAMBLE

2.1. Tree Valuation

2.1.1. The practice of assessing the financial value to a tree or group of trees can largely be attributed to the pioneering work of Rodney Helliwell through the development of 'The Helliwell System'. This was the first system to assess the monetary value of trees in the UK and was started in the 1960s. Since then there have been many developments in the field, the extent of which is not appropriate to discuss in this report.

2.1.2. Section 198 of the Town & Country Planning Act (1990) covers the public amenity value of trees, and furthermore it places a duty on local authorities to protect trees in the public interest. Interestingly, it does not prescribe how their value should be estimated, and a number of urban street tree valuation systems have now been developed.

2.1.3. CAVAT is a system widely used by councils and other public authorities which works by calculating a unit value for each square centimetre of a tree stem by extrapolation from the cost of a newly planted standard tree. The ratio between respective trunk areas is used as the critical measurement. This method has been selected for this valuation given its wide use by local authorities across the UK. Since the trees being assessed are publicly owned, and their proposed removal is for a public infrastructure project. It seemed appropriate to use this system so as to best meet the needs of the client.

2.1.4. For further details of the various benefits and limitations of the various tree valuation systems, Forest Research (the research body of the Forestry Commission) have developed a useful Research Note on the subject (Sarajevs 2011).

2.2. Aim of Survey

2.2.1. "To provide professional arboricultural advice to the Drummond/Churchwood Resident's Association regarding proposed tree removal in their locality for the NGT Metro development."

2.3. Objective 1

2.3.1. "To provide an assessment of the financial value of the loss of tree cover of a selection of trees along Otley Road, using a recognized system (CAVAT)."

2.4. Objective 2

2.4.1. "Use the information obtained in Objective 1 to estimate the financial value of the overall loss of tree cover proposed through the scheme (through extrapolation)"

2.5. Objective 3

2.5.1. "Critically evaluate the existing arboricultural assessment and proposals for re-planting undertaken by Mott MacDonald. A brief assessment of the cost:benefit ratio regarding the loss of tree cover will be undertaken but this is by no means intended to be a full assessment of the costs and benefits provided by the development."

2.6. Author's Signature & Declaration

2.6.1. All information in this report has been collected and presented to the best of the author's abilities at the time of publication. All information presented within this report is either a fact based in objectivity, a clearly designated opinion of the author or a duly referenced piece of work produced by an external author/institution.

2.6.2. Trees are living organisms, which form a self-optimizing structure which is constantly changing in response to a dynamic natural environment. For this reason it must be accepted that any information regarding the trees in this report can be only be interpreted as fully relevant at the time of inspection, it is not appropriate to give a definite cut-off as to when this report becomes invalid but more so to accept that as the time since inspection increases, the relevance of the information decreases proportionally.

2.6.3. Signed

2.6.4. **Sam Turner BSc (Hons) Arboriculture, TechArborA**
Arboricultural Consultant

2.6.5. Saturday, 26 October 2013

2.7. Abbreviations

Table 1.0 - Abbreviations Used in this Report
Every effort has been made to make this report as clear and succinct as possible, whilst still retaining an attention to detail. As a general rule the author has tried to avoid using abbreviated terminology where the option arose, but they have been used in situations where a specialist phrase was being repeatedly used, of it the term would normally be referred to by its abbreviated form in common parlance.

Acronym	Description
AIA	Arboricultural Implications Assessment
BS	British Standard
CAVAT	Capital Asset Value for Amenity Trees
CTI	Community Tree Index
ERC	Estimated Remaining Contribution
LA	Local Authority
LCC	Leeds City Council
NGT	New Generation Transport
ONS	Office for National Statistics
RPA	Root Protection Area
SULE	Safe Useful Life Expectancy
TCP	Tree Constraints Plan
TWAO	Transport and Works Act Order
UVF	Unit Value Factor

3. INTRODUCTORY DETAILS

3.1. Client

3.1.1. Drummond/Churchwood Resident's Association

3.2. OSGB Grid Reference (approximate centre of site)

3.2.1. SE 27650 36705

3.3. Total Visible Area of Site Assessed (Ha)

3.3.1. 8.01

3.4. Date of Data Collection

3.4.1. 19/10/2013

3.5. Conditions at time of inspection

3.5.1. Sunny with good (above average) level of visibility, there were no strong winds and the trees were generally in full leaf although a minority were beginning to shed their leaves.

3.6. Specific Caveats & Limitations

3.6.1. This assessment uses data collected by Mott MacDonald as part of an arboricultural survey to BS 5837: 2012. Specifically stem diameter and Estimated Remaining Contribution (ERC). Whilst the author may have some level of disagreement as to exact figures for ERC (especially in terms of Safe Useful Life Expectancy - SULE), the extent of this difference in opinion is not significant enough to invalidate fully the initial findings of the BS 5837 report. Therefore as much data as possible has been taken from the initial BS 5837 survey, so as to limit the possibility for accusation of subjectivity when assessing the trees' relative merits.

3.6.2. Given that the the BS 5837 survey was carried out prior to the CAVAT assessment. The stem diameters used will reflect a smaller tree than is present at this time, this is significant as the calculations used in CAVAT for valuation are dependent on stem diameter. Therefore the financial values given in this report are liable to be conservative ones, again this is intentional to limit accusations of subjectivity or intentional skewing of results.

3.6.3. This assessment is not a full health & safety appraisal and should not be used to justify management decisions based on the perceived hazard status of any trees surveyed.

3.6.4. Observations and consequent conclusions regarding the trees have been based on information obtained from inspection of the trees from ground level only. No internal decay detection equipment has been used to assess for the presence of internal decay and no aerial inspections were made to provide an in depth assessment of the tree's upper canopy. There was also no investigation of the chemical or physical properties of the soil surrounding the trees undertaken.

4. METHODOLOGY

4.1. Outline

4.1.1. An outline of the methodology used in this assessment is presented below, much of this is paraphrased from instructions detailed in the "CAVAT Full Method: User's Guide", by Christopher Neilan. This is presented so as to provide transparency of process regarding this valuation and is not intended to be interpreted as the author's own work.

4.2. CAVAT Full Method - Five Steps

4.2.1. The full methodology for CAVAT is comprised of five steps, within these steps there are several key variables, these are outlined below:

4.3. Step 1 - Basic Value/Unit Value x Size

4.3.1. "The basic value (V) is calculated using trunk area as the key measure of size. The trunk area (A) is calculated in the standard way by using the measured trunk diameter or circumference, and converted to give the radius. The current national Unit Value Factor (UVF) is selected to allow the basic value to be calculated, using the following equation:"

4.3.2. $V = A * UVF$

4.3.3. "The UVF represents the full costs of a newly planted tree in a given area, divided by its trunk area. It has two components; the nursery gate price, expressed in terms of the cost of each square centimetre of stem, (or unit area cost) and the planting cost (transport, planting, materials, immediate care and management costs, but *NOT* after-care). The calculation of the unit area cost is from the average cost of a basket of species rather than for each individual species, in order to eliminated differences based only on production factors or variations in demand."

4.4. Basic Value Worked Example - Tree 500 (Sycamore)

Table 2.0 - Worked Example 1
Basic Value Worked example of first tree surveyed, used to demonstrate methodology

Stem Diameter (cm)	Stem Radius (cm)	Stem Area (cm^2)	UVF	Basic Value (£)
35.1	17.55	967.62	15.26	£14 765.86

4.5. Step 2 - CTI Value/Location, in terms of population and use, and accessibility

4.5.1. "Step two consists of two operations. Firstly, the basic value is adjusted to take account of the local population density using the Community Tree Index (CTI) factor. Then the modified basic value is discounted by up to 60%, according to how accessible the tree is in the particular location."

4.5.2. "The CTI index factor is a measure of the relative population density potentially able to benefit form the trees, derived from Office of National Statistics (ONS) information. The CTI index is separated into bands and varies from 100% for the majority of the country, up to a maximum of 250% according to the published population density." The area in question for this survey (Leeds) has a population density/Ha of <20 and therefore falls into the majority bracket of 100%.

4.5.3. **Operation 1** - "The CTI index gives the basic adjustment for the Local Authority. In some instances, the area may not be typical of the Local Authority's overall area. In that case the ward figure, also available from the ONS website, should be used." In this case the population density for the Headingley area still falls within the <20/Ha bracket so no further change is needed from the Leeds average.

4.5.4. **Operation 2** - "The second operation is to consider the relative accessibility to the public of the tree in its general locality. The tree may retain 100% of its value, or be discounted by up to 60%." In this situation, all trees surveyed are considered to be fully accessible to the general public and therefore they have all retained 100% of their value.

4.6. CTI Value/Location Worked Example - Tree 500 (Sycamore)

Table 3.0 - Worked Example 2
CTI Value Worked example of first tree surveyed, used to demonstrate methodology

Populations Density/Ha	CTI Factor (%)	Accessibility	Accessibility Modifier (%)	CTI Value (£)
<20	100%	Not Limited	100%	£14 765.86

4.7. Step 4 - Functional Value/Functional Status

4.7.1. "The CTI value is then reduced according to the surveyor's expert assessment of the tree's functionality, i.e. How well it is performing biologically, as against what would be expected of a well-grown and healthy tree of the same species and girth in that location."

4.7.2. "The surveyor must consider crown size and crown condition. Only one combined adjustment of the basic value is required, giving overall functional value. Precision is required in the assessment, either maintaining the value at 100% or reducing it proportionately in increments of 10%"

4.7.3. "A dead or effectively dead tree, or one requiring urgent removal, scored 0% value retained, and thus has a value of £0.00"

4.7.4. Given the need for precision in this step, calculations of canopy size have been made by the author using a matrix system: as demonstrated below in Plate 1.0. Each square on the grid is equal to one square metre. A further example of a fully functioning canopy is presented overleaf in Plate 2.0. Physiological condition is calculated through expert opinion, the author has attempted to quantify the relative ability for the tree to respond to adverse conditions in its environment. For example for a tree which appears to be showing diminished extension growth (for unknown reasons) the decrease in growth from what would be expected has been quantified and given a 10% bracket. The majority of the trees surveyed appeared to be showing high levels of functionality.

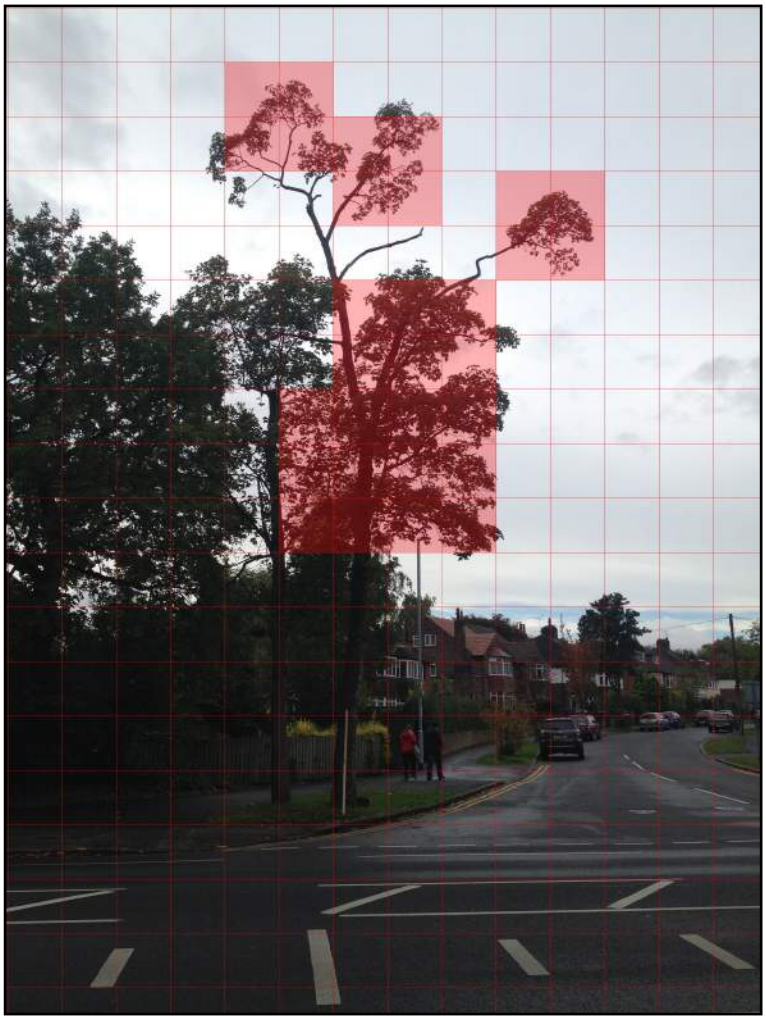

Plate 1.0 - Assessment of dysfunctional canopy area.
For this example (Tree 500 - Sycamore) it has been calculated that the tree is showing approximately 60% of the full canopy which would be expected of a tree which a canopy extent equivalent to this one.

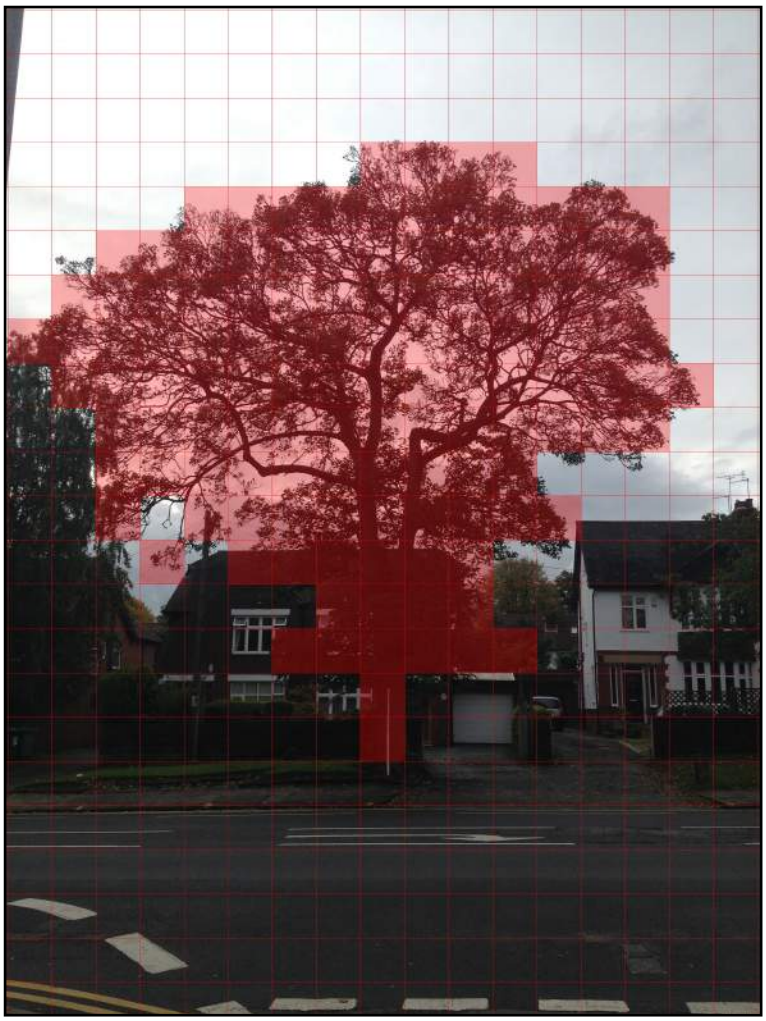

Plate 2.0 - Assessment of functional canopy area.
For this example (Tree 488 - Ash) it has been calculated that the tree is showing approximately 100% of the full canopy which would be expected of a tree which a canopy extent equivalent to this one.

4.7.5. Further details as the specific methodology in this process can be found in the CAVAT: Full Method Guide but it is felt that the amount of background information given in this outline is enough to provide transparency for the purposes of the author.

4.8. Functional Value Worked Example - Tree 500 (Sycamore)

Table 4.0 - Worked Example 3
Functional Value Worked example of first tree surveyed, used to demonstrate methodology

Functional Value Factor (0-100%)	Functional Value (£)
60%	£8 860.51

4.9. Step 5 - Adjusted Value/Amenity Factors (Positive & Negative)

4.9.1. "The value may be increased to take account of features of the tree that are of special benefit to the community. Special factor adjustment should be used sparingly; most trees will not have any special factor adjustment. There may be up to a maximum of 4 special factors and a total adjustment of up to 40%; (10% for each amenity factor, other than Veteran/Ancient Trees; 30%"

4.9.2. Various examples are given in the CAVAT guidance notes but the only one appropriate to this report is if the trees are within a conservation area, particularly where the presence of trees has contributed to the designation.

4.9.3. Leeds City Council's "Far Headingley Conservation Area Appraisal & Management Plan" gives the following description of the benefit of trees in the local area:

4.9.4. "Trees are an important part of the distinctive character of the area. Tree-lined roads are a defining feature. Most of the specimens are planted within front garden plots providing privacy from the road. The combined group value of these trees has great amenity value for the area. Species vary but are typically deciduous and include horse chestnut, sycamore, beech and copper beech."

4.9.5. As a result, all trees surveyed have been given a +10% Amenity Factor rating to take this into account.

4.9.6. "Conversely, the value may be reduced as for amenity factors by 10% each and by up to 40% if the species is seriously inappropriate for its location causing a problem or foreseeable direct hazard not effectively controlled by management. For example: Inappropriate species characteristics for the location causing obstruction or inconvenience (various examples) or problems relating to the particular specimen (again various examples given in guidance notes).

4.10. Adjusted Value/Amenity Factors Worked Example - Tree 500 (Sycamore)

Table 5.0 - Worked Example 4
Adjusted Value/Amenity FactorsValue Worked example of first tree surveyed, used to demonstrate methodology

Amenity Factors (+40% Max.)	Appropriateness (-40% Max)	Adjusted Value (%)	Calculated Total (£)
+10%	No Change (Appropriate to situation)	110%	£9745

4.11. Step 5 - Safe Life Expectancy Adjustment

4.11.1. "Safe Life Expectancy (SLE) is accounted for by a potential depreciation of up to 90% of the adjusted value. The principles followed to generate the adjustment are those of SULE, but the final step relating to usefulness is omitted in order to avoid double accounting. As generally in CAVAT, the banding approach is used, for robustness and to reflect some of the practical difficulties of estimating age. The surveyor may be expected to more accurately estimate the SLE in a tree's later years, when changes in the tree condition will have a much bigger impact on the SLE"

4.11.2. SLE is banded as according to the following table:

Table 6.0 - SLE Adjustment Bands
Reference - "Table B Safe Life Expectancy Adjustment" from CAVAT Full Method Guidance Notes

Life Expectancy (Years)	% Value Retained
>80	100
40-80	95
20-40	80
10-20	55
5-10	30
<5	10

4.11.3. In terms of assessment of SLE by the author, values have been obtained directly from the ERC values given in the BS 5837 survey carried out by Mott MacDonald. The BS 5837 bandings have been transposed into the CAVAT equivalent. Since BS 5837 gives a maximum of >40 years ERC, no tree in this survey has been able to obtain the 100% value retained band given by an SLE of >80 years.

4.12. Safe Life Expectancy Adjustment Worked Example - Tree 500 (Sycamore)

Table 7.0 - Worked Example 5
Adjusted Value/Amenity FactorsValue Worked example of first tree surveyed, used to demonstrate methodology

SLE Factor (Years)	% Value Retained	Final Value (£)
5-10	30%	£2 923.64

5. DISCUSSION

5.1. Objective 1

5.1.1. "To provide an assessment of the financial value of the loss of tree cover of a selection of trees along Otley Road, using a recognized system (CAVAT)."

5.1.2. Following the previously described methodology, the following financial values were obtained for the trees assessed:

Table 8.0 - Full CAVAT Values
Collection of final CAVAT values collected in survey. For full details of each step in the process, please see Appendix B - Full CAVAT Survey Data

Tree No.	Species ID	Final Value (£)
500	Sycamore	£2 923.64
493a	Sycamore	£37 213.45
490	Sycamore	£31 311.27
489	Sycamore	£10 973.47
488	Sycamore	£50 661.14
487	Cherry	£15 552.12
486	Sycamore	£3 975.18
484	Sycamore	£16 412.62
483	Sycamore	£16 412.62
482	Sycamore	£26 501.86
481	Sycamore	£20 340.93
480	Sycamore	£70 917.72
479a	Ash	£45 009.33
G470a	Lime	£45 942.54
G470b	Lime	£14 719.20
G470c	Lime	£31 097.59
G470d	Horse Chestnut	£24 604.89
G470e	Sycamore	£22 511.84
G470f	Holly	£889.90
G470g	Lime	£12 007.75
G470h	Sycamore	£18 661.02

5.1.3. This gave an average value per tree surveyed of £24,697.15 and a total financial value for proposed tree loss of £514,640.08.

5.1.4. Taking the mid points of each Safe Life Expectancy (SLE) grouping, the average SLE per tree was 40.4 years

5.1.5. The maximum value for an individual tree was £70 917.72 and the minimum was £889.90. Giving quite a substantial range, however over half of the trees surveyed had a value of between £14 000.00 and £35 000.00.

5.2. Objective 2

5.2.1. "Use the information obtained in Objective 1 to estimate the financial value of the overall loss of tree cover proposed through the scheme (through extrapolation)"

5.2.2. Given that (scientifically speaking) the sample size for this study was small (21 individual trees) any extrapolation used for this investigation is limited in its accuracy. To combat this issue in the face of limited time and resources, all values and calculations are biased towards the conservative side, rather than the generous.

5.2.3. The Drummond/Churchwood sample featured in this study consists of trees largely similar in age and species to the majority of proposed tree loss along Otley road, and therefore it is not considered overly unrepresentative to use this sample as the basis for extrapolation, as long as the aforementioned caveats and limitations are taken into account.

5.2.4. NGT Metro's BS 5837 survey report outlines the following breakdown of proposed tree loss over the entire scheme (CAVAT Values have been added following this assessment):

Table 9.0 - Breakdown of proposed tree loss for the NGT development
Reference for tree loss figures - Paragraph 7.6 of the NGT Metro Environmental Statement: Volume IV: Supporting Document - Arboriculture Assessment

BS 5837 Retention Category/ Classification	Quantity	Average Value per Item based on Drummond/Churchwood Sample
A	17	£555 477.21
B	174	£5 188 890.00
C	246	£4 083 012.88
U	16	£84 380.21
Groups - Clear felling [1]	22	£3 651 474.93
Groups - Sectional Felling [2]	11	£608 579.16
"At Risk" Trees [3]	50	£276 626.89
"At Risk" Groups [4]	3	£165 976.13
Hedgerows [5]	3	N/A

5.2.5. 1 - Clarification of the term 'Group' is not specified in the BS 5837 survey undertaken by Mott MacDonald and therefore an estimate of 10 trees per group and an average rating of "C" has been given per tree. The author is aware that this is a significant assumption to make and would be willing to discuss the accuracy of this assumption with a suitably qualified arborist/planner/ statistician. Ideally further investigation of the impact of the entire scheme should be undertaken, unfortunately the time & resources available for this report were not significant enough to take this route of action. Therefore an individual group of ten trees is considered to have a value of £165,976.13 for the purposes of this report.

5.2.6. 2 - Again a group size of 10 trees and "C" rating is assumed, but this time the term 'Sectional Felling' is assumed as 1/3 of the total group. Again this assumption is up for discussion but is not considered unreasonable by the author at this time, given his experience with common levels of tree loss on development sites when terms such as 'unforeseen at this time' are used in reference to proposed tree loss.

5.2.7. 3 - These trees are assumed as being of a “C” rating and once again it assumed that 1/3 of them will be felled or heavily pruned so that an equivalent loss of canopy in terms of financial value will be the net result.

5.2.8. 4 - As before, a group size of 10 trees with a “C” rating and a net loss of 1/3.

5.2.9. 5 - These hedgerows of course still have value but it is has not been possible to value them using the CAVAT system.

5.3. Estimated Total of Tree Capital Asset Value (in terms of trees identified for removal for the proposed NGT Metro development).

5.3.1. £14,614,417.42

5.4. Objective 3

5.4.1. "Critically evaluate the existing arboricultural assessment and proposals for re-planting undertaken by Mott MacDonald. A brief assessment of the cost:benefit ratio regarding the loss of tree cover will be undertaken but this is by no means intended to be a full assessment of the costs and benefits provided by the development."

5.5. Evaluation of Existing Arboricultural Assessment

5.5.1. The author's intention is to "bring new information to the table" (in the form of a financial value per tree) which may not have already been taken into account when determining the costs/benefits of the proposed NGT development. This is in contrast to focusing on making a critique of the existing arboricultural assessments undertaken by Mott MacDonald. This approach was intentionally chosen so as to be primarily constructive rather than critical. However this document will still raise some issues identified by the author with regards to the current arboricultural proposals for the scheme.

5.5.2. Overall the BS 5837 survey appears to have undertaken accurately and effectively. Mott MacDonald deserve particular praise for the fact that they went back to up date their survey to the updated framework set out in the 2012 update to BS 5837 following a period of delay. This would have been no small undertaking.

5.5.3. It is the presentation of information which would appear to be deserving harsher criticism than the survey itself. For example the presentation of figures regarding tree loss can be quite misleading if the reader is not aware of the implications of the term 'group'. If a group can indeed be considered to be constructed of ten trees on average (as assumed in this report) then the phrase "22 tree groups to be felled" is equivalent to "220 trees to be felled". Another shortcoming is the lack of clarity regarding what categorization these groups come under. The individual Tree Constraints Plans (TCPs) often give a reference to a group categorization value but the overview does not. Given the size of the project, extracting information on an overview assessment scale can be a daunting prospect (as the author has discovered first hand).

5.5.4. The TCPs are drawn to a very high standard and the author is in no doubt that on site developers will have Root Protection Areas (RPAs) and other retained tree protection measures explained to them as clearly as it is possible to do so. However it should be noted that the explanation of tree protection measures and the implementation of them are two very distinct concepts. The view could be taken that the design proposals do very well to identify measures to protect the retained trees, but that not enough has been done to adequately accommodate the retention of existing trees (in terms of layout modification). This may be due to the inflexibility of a scheme of such a scale, or a lack of willingness to seek design modifications which better accommodate tree retention.

5.5.5. Section 7.8 of the NGT Metro Arboricultural Assessment makes the following statement:

5.5.6. "During the detailed design of the scheme subsequent to submission of the TWAO application, a qualified arboriculturist will: undertake an Arboricultural Impact Assessment to identify, evaluate and possibly mitigate the extent of direct and indirect impacts on existing trees. This will include identifying the requirements for tree works (either felling or pruning) to facilitate construction of the scheme."

5.5.7. Given a scheme of this magnitude, it is assumed that a comprehensive Arboriculture Implications Assessment (AIA) is essential in order to identify the best measures available to limit the impacts on existing trees. However this does not yet appear to have been completed. The author has searched all TWAO documentation available on the online portal but to no avail. If it is indeed available it does not appear to be listed under the 'Environmental Assessment' section and therefore it could be argued that the information has not been clearly presented to the public.

5.6. Assessment of Re-Planting Proposals

5.6.1. Given limited availability of information, this assessment is based on a number of assumptions. These are as follows:

5.6.2. It has not been possible to find out what the specifications are for replanting stock are to be (other than the terminology “Trees to be planted” and “Super Trees to be planted”. Both arboricultural assessments and landscaping proposals have been inspected. It is assumed with reasonable confidence that replacement trees will be of a similar species (largely native broadleaf) and to a size of approximately 12-14cm girth (circumference).

5.6.3. The terminology of ‘Super Trees’ is not one the author is familiar with but it is assumed that they refer to a tree that is larger than average or otherwise more valuable, either in terms of species, cost or location (or a combination of these factors). A “super tree” has therefore been taken to be a replacement tree with a stem diameter of 10 cm when planted (in the opinion of the author this is an extremely large tree to use as a replant, and although they may well have a significant immediate visual impact, the biological stresses exerted on a such a large tree when being transplanted are likely to lead to significant dieback/rates of failure unless extremely effective planting routines and aftercare is implemented). The cost of this aftercare would be significant but is not considered in this report as the author does not want to make too many assumptions based on further assumptions. However, any further assessments should factor in this financial implication.

5.6.4. Table 5.1 from the NGT arboricultural assessment lists the following:

Table 10.0
Proposed Replacement Planting (information taken from Table 5.1 of NGT Arboricultural Assessment).

Replacement Trees (Total)	Replacement Super Trees (Total)	Groups/Woodland Lost (m^2)	Woodland to be planted (m^2)
1717	60	10531	61124

5.6.5. Therefore re-planting can be considered to be being undertaken on roughly a 4:1 ratio for individual trees and roughly a 6:1 ratio for area of woodlands lost.

5.6.6. It is assumed that individual trees planted will have a 95% success rate (this is very generous given that for the majority of trees planted in urban environments in the UK there is closer to a 75% successful establishment rate due to death from competition, vandalism and insufficient aftercare routines.

5.6.7. For woodland areas, it is assumed that the trees will be planted as 1-2 year old transplants (approximately 40-100cm height) and that the trees will have a 75% rate of establishment. There may be further individual thinning out of the trees in the mid to long term but this is beyond the spectrum of this assessment. It is also assumed that these will be planted at a 2-2.5m spacing which equates to approximately 2000/Ha. These assumptions have been made in the absence of specific information in the documentation available to the public at the time of publication.

Table 11.1
Estimated Initial CAVAT Score - Individual Trees

Replacement Trees (Total)	Stem Diameter in cm (12-14cm girth - Heavy Standard)	Stem Area (cm^2)	Estimated basic CAVAT score (no modifiers for applicability or functionality)
1717	4.14	13.45	**£334753.61**

Table 11.2
Estimated Initial CAVAT Score - Super Trees

Replacement "Super" Trees	Stem Diameter in cm (on 10cm DBH)	Stem Area (cm^2)	Estimated basic CAVAT score (no modifiers for applicability or functionality)
60	10.00	78.54	**£68315.5**

Table 11.3
Estimated Initial CAVAT Score - Woodland/Groups

Woodland to be planted (m^2)	Stem Diameter in cm (1-2 year old transplants)	Stem Area (cm^2)	Planting Density (Trees/m^2)	Estimated basic CAVAT score (no modifiers for applicability or functionality)
61124	0.8	1.99	0.2	**£278352.3**

5.6.8. Please note that the estimated basic CAVAT scores for these trees are not meant to be representative of the wholesale prices of the trees to be replanted (this will be much lower) but instead the Capital Asset Value to the local community once the tree has been bought, delivered and planted (but NOT including the costs of aftercare).

5.7. Estimated Total of Tree Capital Asset Value (in terms of trees proposed for replanting as mitigation for trees lost for the NGT Metro development):

5.7.1. £681,421.41

5.8. Percentage Value of Initial Replacement Value Relative to Current Value:

5.8.1. 4.7%

5.8.2. It should be remembered that this value will of increase significantly as the trees develop, however, a future value has not been estimated due to the uncertainties involved with estimating lifespan when it is not clear what species of tree will be planted and furthermore there a a myriad of different factors involved in how successful rates of establishment will actually be. There will also be variations base on how appropriate to the situation the trees will be. Finally it would not require a significant stretch of the imagination to see significant failure rates if improper aftercare routines are not implemented (a common shortcoming of urban tree planting operations).

6. CONCLUSIONS

6.1. Summary

6.1.1. In the opinion of the author, and based on his experience as a professional arboriculturist, the proposed loss of tree cover in association with this development is extremely significant.

6.1.2. Whether this loss of value from tree removal is proportionate in terms of the benefits brought by the development, relative to the increased economic output for the local area, is beyond the remit of the report as it falls outside of the author's specialism. It is the author's intention that this information be considered and used to make more informed management decisions at a senior policy level.

6.1.3. The vast majority of trees to be removed in this development are publicly owned by Leeds City Council (LCC) and therefore they are a Capital Asset of the Local Authority. It is understood that LCC is likely to contribute approximately £77,000,000.00 towards the total cost of the development. If consideration of the existing value of the tree cover proposed for removal has not been made by Mott MacDonald during their existing arboricultural and environmental assessments, then it could be argued that the project is 18% over budget (in terms of LCC's funding input) even before starting any works. This is based on the proposed £14,000,000.00 worth of tree cover loss identified in this assessment. The figure for LCC's input rather than the total project cost has been selected because of the fact that the trees are a local authority capital asset and therefore should be considered from the local authority's cost:benefit perspective.

6.2. Eco-System Service Benefits

6.2.1. Finally, the author is extremely keen to emphasis the fact that as useful, informative and powerful as the valuation of trees and woodlands can be, any systems used are limited by the following facets: (Quotation from Forest Research review of street tree valuation systems from 2011 (Sarajevs 2011)

6.2.2. "None of the three systems (Heliwell, CAVAT or iTree) are able to comprehensively quantify the biodiversity or social/cultural benefits of the trees despite these value components often being considered the most important in terms of their intrinsic value to society. The street tree valuation systems reviewed also omit the following ecosystem services expected to be covered by the UK National Ecosystem Assessment (NEA) in valuing the benefits of woodlands:"

6.2.3. a - Fuel provision (wood fuel from arboricultural operations)

6.2.4. b - Genetic resources provision (biodiversity)

6.2.5. c - Noise regulation

6.2.6. d - Spiritual

6.2.7. e - Recreation

6.2.8. f - Tourism

6.2.9. g - Community development

6.2.10. Therefore if the full ecosystem service benefits of the trees were to be calculated, the actual value of the trees would be exponentially higher than that identified in this survey.

7. REFERENCES

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2. Mott MacDonald, (2013), NGT Environmental Statement, Volume IV: Supporting Documents: Environmental Statement - Arboricultural Report, Mott MacDonald Internal Ref. 312694/RPT068TWAO Document Ref. A-08i. http://www.ngtmetro.com/Site/Templates/Pages/Content.aspx?pageid=4294967735

3. Neilan, C. (2010). CAVAT (Capital Asset Value for Amenity Trees) - Full Method: User's Guide. London Tree Officers Association, London, LTOA, http://www.ltoa.org.uk/resources/cavat

4. Sarajevs, V. (2011). Street tree valuation systems, Forest Research. Roslin, Forestry Commission. http://www.forestry.gov.uk/PDF/FCRN008.pdf/$FILE/FCRN008.pdf

5. BSI Group, (2012). BS 5837:2012 Trees in Relation to design, demolition and construction - Recommendations, ISBN 978 0 580 69917 7.

8. APPENDICES

8.1. Appendix A: Drawings Referred to in this document

8.1.1. Please see attached documentation for tree locations and existing canopy spread:

8.1.2. Mott MacDonald Tree Constraints/Tree Removal Plan for Otley Road/Weetwood Lane - Drawing Number: **312694/ARB/014**

8.1.3. Mott MacDonald Tree Constraints/Tree Removal Plan for Otley Road/St. Chads Drive - Drawing Number: **312694/ARB/015**

8.2. Appendix B: Full CAVAT Survey Data

		Step 1: Basic Value	Step 2: CTI Value	Step 3: Functional Value	Step 4: Adjusted Value			Step 5: Final Value	
Tree No.	Species ID	Stem Diameter (cm)	Accessibility	Functional Value Factor (0-100%)	Amenity Factors (+40% Max.)	Appropriateness (-40% Max)	Adjusted Value (%)	SLE Factor (Years)	Final Value (£)
500	Sycamore	35.1	100%	60%	+10%	0%	110%	5 - 10	**£2 923.64**
493a	Sycamore	59.4	100%	100%	+10%	0%	110%	20 - 40	**£37 213.45**
490	Sycamore	50.0	100%	100%	+10%	0%	110%	40 - 80	**£31 311.27**
489	Sycamore	29.6	100%	100%	+10%	0%	110%	40 - 80	**£10 973.47**
488	Sycamore	63.6	100%	100%	+10%	0%	110%	40 - 80	**£50 661.14**
487	Cherry	38.4	100%	100%	+10%	0%	110%	20 - 40	**£15 552.12**
486	Sycamore	23.0	100%	80%	+10%	0%	110%	40 - 80	**£3 975.18**
484	Sycamore	36.2	100%	100%	+10%	0%	110%	40 - 80	**£16 412.62**
483	Sycamore	46.0	100%	100%	+10%	0%	110%	40 - 80	**£16 412.62**
482	Sycamore	40.3	100%	100%	+10%	0%	110%	40 - 80	**£26 501.86**
481	Sycamore	82.0	100%	100%	+10%	0%	110%	40 - 80	**£20 340.93**
480	Sycamore	60.5	100%	100%	+10%	0%	110%	20 - 40	**£70 917.72**
479a	Ash	71.3	100%	90%	+10%	0%	120%	40 - 80	**£45 009.33**
G470a	Lime	66.0	100%	100%	+10%	0%	110%	10 - 20	**£45 942.54**
G470b	Lime	41.3	100%	90%	+10%	-10%	100%	20 - 40	**£14 719.20**
G470c	Lime	54.3	100%	100%	+10%	0%	110%	20 - 40	**£31 097.59**
G470d	Horse Chestnut	48.3	100%	100%	+10%	0%	110%	20 - 40	**£24 604.89**
G470e	Sycamore	46.2	100%	100%	+10%	0%	110%	20 - 40	**£22 511.84**

Tree No.	Species ID	Step 1: Basic Value Stem Diameter (cm)	Step 2: CTI Value Accessibility	Step 3: Functional Value Functional Value Factor (0-100%)	Step 4: Adjusted Value Amenity Factors (+40% Max.)	Appropriateness (-40% Max)	Adjusted Value (%)	Step 5: Final Value SLE Factor (Years)	Final Value (£)
G470f	Holly	15.0	100%	100%	+10%	0%	110%	5 - 10	**£889.90**
G470g	Lime	55.1	100%	100%	+10%	0%	110%	5 - 10	**£12 007.75**
G470h	Sycamore	38.6	100%	100%	+10%	0%	110%	40 - 80	**£18 661.02**

8.3. Appendix C: Assessment of 'Viewable' Area for Drummond/Churchwood Area

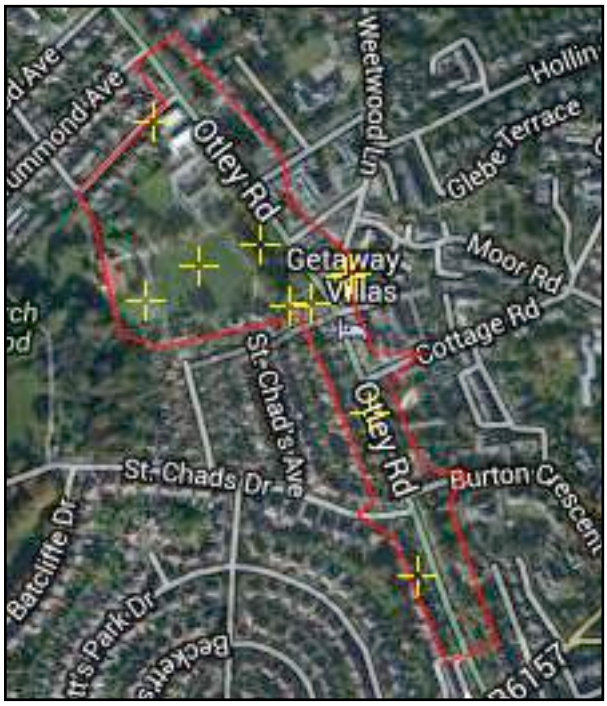

Plate 3.0 - Outline of "Total Viewable Area"
Red boundary denotes extent of visibility of majority of trees, "spikes" to outer edges are intended to represent vistas from side streets. Yellow cross hairs denote several view points taken from iTree Canopy software. Each location beneath the yellow cross hair is then allocated a "Tree" or "Not Tree" description which is then used to estimate the total canopy cover of the area. Larger data sets decrease the standard error, approximately 150 were used for this survey.

8.4. Appendix D: Assessment of Existing Canopy Cover for Drummond/Churchwood Area

Table 4.0 - Existing Canopy Cover
Reference - Data obtained from "iTree Canopy" online tools.
URL: http://www.itreetools.org/canopy/

Cover Class	Description	Abbreviation	Points	Area (Ha)	% Cover	SE (±)
Canopy Cover	Tree, (other green-space excluded)	T	43	2.30	28.7	3.69
Non-Canopy Cover	All other surfaces	NT	107	5.71	71.3	3.69

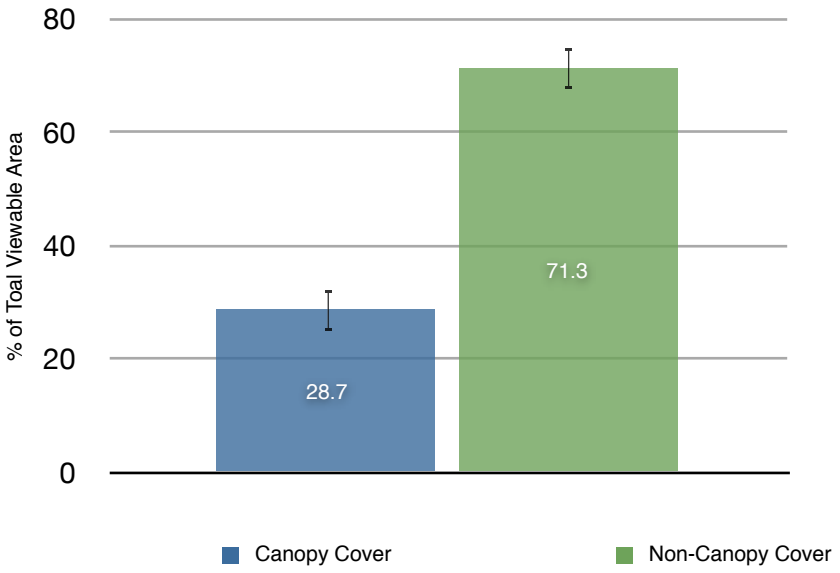

Figure 1.0
Existing level of 'canopy cover' present in the visual area assessed for this report - Trees Scheduled for Removal in Connection with NGT Metro Development Between St Chad's Drive & Hollin Road, Leeds, West Yorkshire