BENTLETTS FARM SCRAPYARD, CLAYGATE ROAD, COLLIER STREET

TREE SURVEY

ISSUE 1
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LaDellWood

Landscape Architects Ecology & Environment Masterplanning Arboriculture Historic Landscapes

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CONTENTS

1.0 **The Site and Setting**

1.1 The site is a scrap metal yard between the villages of Collier Street and Laddingford. These activities cover most of the yard with almost all the trees being on the site boundaries. The access is from Claygate Road and the site is shown on drawing no. 2130/14/B/1.

2.0 **Tree Survey Methodology**

2.1 The trees on the site and those that could be affected by the development have been surveyed in accordance with BS5837:2012, Trees in relation to design, demolition and construction - Recommendations. They have been recorded on site and are detailed in the Tree Survey Schedule and in Figures 1 to 14. They are located on drawing no. 2130/14/B/1, Tree survey and constraints. The trees in relation to the proposed development are shown on 2130/14/B/2, Tree retention, removal and protection during construction.

2.2 The trees have been recorded for this survey only for the purposes of BS5837:2012. All observations are of the external physical appearance of the trees and they have been made from ground level, without climbing the trees or employing intrusive investigation techniques. This is thus not a health and safety investigation. Where the external physical condition of the tree indicates that further inspection is desirable, it is noted that a climbing inspection is recommended in the Notes in the Tree Survey Schedule.

2.3 The locations of the trees on the drawings follow the land survey provided for this tree survey. Additional trees or hedges within the site or outside the site boundary have been located by LaDellWood without the use of surveying equipment and not to the accuracy of the trees on the land survey.

3.0 **Tree Evaluation**

3.1 The trees on the site are all on the boundaries apart from one small tree. Tree 1 in Figure 1 is a weeping willow at the site entrance. On the other side of the access road the line of ash in Figure 2 are hedgerow trees that have been cut regularly in the past. Trees 2 to 5 in Figure 3 are mostly poor with the exception of Tree 3 which is outside the site. Group 6 in Figure 4 is a row of mature hybrid poplars. These were bred for forestry use, mainly for the production of matchsticks, and have been used as windbreaks and visual screens. They are not the native black poplar and have a quite different form. Trees 7 and 8 on the southern boundary (Figures 5 and 6) are good smaller specimens of oak and ash.

3.2 Trees 9 to 15 (Figure 7) are a group of oak trees of variable quality at the southern end of the western boundary but effective as a group. The other trees on this boundary are dying (Figure 8). Trees 16 to 20 are the better trees in a larger group shown in Figure 9. The trees to their east are shown in Figure 10 and form a pleasant belt on the northern boundary as a group. The only tree in the centre of the site is the ash, Tree 26, and this is shown in Figures 11 and 12. There are trees to the north of the site boundary and those to the east of Tree 26 are shown in Figure 13. Group 29 is another line of hybrid poplars.

3.3 Root Protection Areas (RPAs) are calculated as described in Annex 2. This is a theoretical calculation, not bases on any scientific evidence. The principles are correct that most trees have wide spreading and shallow rooting 'root plate' and this must be taken in to account in assessing the area around a tree that must be protected from all construction activity if the tree is to be retained in the development proposals. This has been evaluated by two long experienced arboricultural professionals in the papers in Annex 3. The predicted RPA is assessed on site following the BS5837 calculations and amending it for any conditions on site where roots will not be able to grow. This may, for example, be under a building or paving where the soil will be dry and roots will not grow or the physical barrier of a wall with deep enough foundations so that roots can not grow under it or a retaining wall. In each case the tree size and species are assessed together with the soils and actual conditions and structures on the site. The predicted root spread in then plotted on the Tree survey and constraints drawing.

4.0 Tree Retention, Removal and Protection During Construction, Arboricultural Impact Assessment and Arboricultural Method Statement

4.1 The proposal is to build 31 new dwellings on the site with a shared central access road and houses fronting it with rear gardens towards the site boundaries. Tree 1, a grade C weeping willow, will be removed. Trees 2 to 5 will be retained. The line of hybrid poplars, 6 in the Tree schedule, will be removed as unsuitable for their location and in relation to the proposed houses. The development offers a chance to replace them with locally native trees in a native species hedgerow which will be viable in the long term and appropriate in the wider landscape. Some trees have to be removed on the northern boundary, together with the other line of hybrid poplars Group 29. The details of the construction following BS5837:2012 are shown on drawing no. 2130/14/B/2. All the tree protection fencing will be erected before work starts on site and this will ensure that the trees are properly protected during construction and will not be affected by these works.

4.2 The requirements of the Arboricultural Impact Assessment and the Tree Protection Plan are fulfilled in drawing no. 2130/14/B/2, where all the trees, constraints and protection during construction are recorded. The predicted root protection areas are shown on the drawing. These take account of buildings, paved areas and structures such as retaining walls that will prevent root growth in an area of the RPA calculated in the Tree Survey Schedule. In determining these, professional judgment and experience has been used after investigation of the actual conditions on the site.

4.3 The requirements of the Arboricultural Method Statement have been accounted for in the preparation of the detailed proposals on drawing no. 2130/14/B/2. All construction details, access and working methods that could affect the trees in the proposed development have been accounted for. The tree protection fence is an absolute exclusion area for all activities associated with construction from commencement on site to completion of all the works. The drawing shows all the tree protection considerations in the context of the proposed development in a manner that provides full details to enable the trees to be considered in a planning application. It is also a practical drawing for use during construction, to install the protective measures and show the tree protection requirements for the entire period of construction.

4.4 It is proposed that the boundaries of the site are fully assessed for their potential for new tree planting of locally native species which will be appropriate in their location to the proposed dwellings and will have the potential to develop to maturity without conflicting with the uses of the houses and their gardens. These can be complemented with native species hedgerows on the boundaries and these will help form valuable wildlife corridors.

BENTLETTS YARD, LADDINGFORD — **Job No** 2130

TREE SURVEY SCHEDULE TO BS5837:2012 — **Inspected on:** 21 May 2014

No.	Species	Height m	Stem Diameter at 1.5m (mm) Single Stem	2 to 5 Stems (S1–S5)	2 to 5 Stems Combined Dia	5+ Stems Combined Dia (Mean Dia / Number of Stems)	Branch spread m (N / W / S / E)	Height to crown m	Life Stage	Condi-tion	Struc-ture	BS5837 lifespan (years)	Cate-gory	RPA m2	RRPA m	Notes and Management
1	Weeping Willow - Salix sepulcralis chrysocoma	18.0	800				N 6.0 W 6.0 S 6.0 E 6.0	1.6	m	g	p	10-20	C	290	9.60	Very dense ivy to 10m. Tight fork 1.6m. Requires inspection.
2	Ash - Fraxinus excelsior	8.0	120				N 2.0 W 0.0 S 1.0 E 3.0	2.0	y	g	g	40+	C	7	1.44	Young enough to replace.
3	Ash - Fraxinus excelsior	12.0	350				N 4.0 W 3.0 S 3.0 E 3.0	5.0	ma	g	g	40+	A	55	4.20	No access. Dense ivy to 8m.
4	Ash - Fraxinus excelsior	11.0	400				N 4.0 W 0.0 S 4.0 E 3.0	1.8	m	f	p	10-20	C	72	4.80	No access. Dense ivy to 8m. Poor fork at 1.8m. Requires inspection.
5	Oak - Quercus robur	14.0	300				N 3.0 W 4.0 S 4.0 E 4.0	2.5	y	f	f	20-40	C	41	3.60	No access. On adjacent plot. Very dense ivy to 10m. Trunk lean to south. Poor extension growth.
6	Hybrid poplar - Populus euramericana	20.0	400				N W S E		m	f	f	10-20	C	72	4.80	Group of 12 mature trees. Some single trunks and some low branching.
7	Oak - Quercus robur	12.0	380				N 5.0 W 3.0 S 6.0 E 3.0	2.0	y	g	g	40+	A	65	4.56	Ground raised by 300mm on east side of trunk. Infill should be removed.
8	Ash - Fraxinus excelsior	10.0	300				N 4.0 W 2.0 S 4.0 E 3.0	2.5	y	f	g	40+	C	41	3.60	On adjacent site. No access. Some dieback in lower crown.
9	Oak - Quercus robur	18.0	400				N 4.0 W 3.0 S 4.0 E 2.0	8.0	ma	f	g	40+	B	72	4.80	On adjacent site. No access.
10	Oak - Quercus robur	16.0		S1 240, S2 230	332		N 3.0 W 3.0 S 2.0 E 2.0		om	p	p	10-20	U	50	3.99	Severe decay at base

Life stage:

- **y** young
- **sm** semi mature
- **em** early mature
- **m** mature
- **ma** middle aged
- **om** over mature
- **v** veteran

Condition/Structure:

- **g** good
- **f** fair
- **p** poor
- **d** dead

RPA	Root Protection Area
RRPA	Radius of Root Protection Area

Category

- **A** High quality trees expected to have a safe lifespan of over 40 years
- **B** Moderate quality trees expected to have a safe lifespan of over 20 years
- **C** Low quality trees expected to have a safe lifespan of over 10 years
- **U** Unsuitable for retention

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Inspected on: 21 May 2014

TREE SURVEY SCHEDULE TO BS5837:2012

No.	Species	Height m	Stem Diameter at 1.5m (mm): Single Stem	Stem Diameter at 1.5m (mm): 2 to 5 Stems	2 to 5 Stems Combined Dia	5+ Stems Combined Dia	Branch spread m	Height to crown m	Life Stage	Condition	Structure	BS5837 lifespan (years)	Category	RPA m2	RRPA m	Notes and Management
11	Oak - Quercus robur	16.0	410	S1 S2 S3 S4 S5		Mean Dia; Number of Stems	N 3.0 W 4.0 S 3.0 E 3.0	4.0	ma	f	g	40+	B	76	4.92	Bark damage on south side at base of trunk.
12	Oak - Quercus robur	14.0	290	S1 S2 S3 S4 S5		Mean Dia; Number of Stems	N 3.0 W 1.0 S 1.0 E 2.0	6.0	y	f	g	20-40	B	38	3.48	Lean to north
13	Ash - Fraxinus excelsior	18.0		S1 310, S2 290, S3, S4, S5	424	Mean Dia; Number of Stems	N 2.0 W 4.0 S 2.0 E 4.0		om	p	p	10-20	U	82	5.09	Tight fork at 0.5m. Severe bark loss on eastern trunk.
14	Oak - Quercus robur	20.0		S1 300, S2 420, S3, S4, S5	516	Mean Dia; Number of Stems	N 4.0 W 4.0 S 3.0 E 3.0		m	f	f	20-40	B	121	6.19	Two trunks from base.
15	Oak - Quercus robur	18.0		S1 420, S2 300, S3 230, S4, S5	565	Mean Dia; Number of Stems	N 4.0 W 3.0 S 4.0 E 6.0		m	f	f	20-40	B	144	6.78	No access. Dieback in eastern trunk which should be removed.
16	Oak - Quercus robur	18.0	520	S1 S2 S3 S4 S5		Mean Dia; Number of Stems	N 5.0 W 2.0 S 4.0 E 6.0	1.8	m	f	g	20-40	B	122	6.24	Lean to east. Growing out of southern bank of pond.
17	Oak - Quercus robur	18.0	1100	S1 S2 S3 S4 S5		Mean Dia; Number of Stems	N 5.0 W 6.0 S 5.0 E 4.0	1.6	m	f	f	20-40	B	547	13.20	Growing out of east side of ditch.
18	Oak - Quercus robur	18.0	450	S1 S2 S3 S4 S5		Mean Dia; Number of Stems	N 4.0 W 4.0 S 4.0 E 4.0	4.0	ma	g	g	40+	A	92	5.40	No access. On adjacent site.
19	Oak - Quercus robur	16.0	300	S1 S2 S3 S4 S5		Mean Dia; Number of Stems	N 3.0 W 4.0 S 5.0 E 4.0	5.0	ma	g	g	40+	A	41	3.60	
20	Oak - Quercus robur	18.0	380	S1 S2 S3 S4 S5		Mean Dia; Number of Stems	N 3.0 W 3.0 S 4.0 E 3.0	6.0	ma	g	g	40+	A	65	4.56	

Life stage:

y	young
sm	semi mature
em	early mature
m	mature
ma	middle aged
om	over mature
v	veteran

Condition/Structure:

g	good
f	fair
p	poor
d	dead

RPA	Root Protection Area
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Category

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TREE SURVEY SCHEDULE TO BS5837:2012 Inspected on: 21 May 2014

No.	Species	Height m	Stem Diameter at 1.5m (mm): Single Stem	2 to 5 Stems	2 to 5 Stems Combined Dia	5+ Stems	5+ Stems Combined Dia	Branch spread m	Height to crown m	Life Stage	Condition	Structure	BS5837 lifespan (years)	Category	RPA m2	RRPA m	Notes and Management
21	Oak - Quercus robur	18.0	400	S1 S2 S3 S4 S5		Mean Dia Number of Stems		N 5.0 W 6.0 S 6.0 E 5.0	5.0	m	f	g	20-40	C	72	4.80	Branch loss at 5m. On southern bank of pond.
22	Oak - Quercus robur	18.0	550	S1 S2 S3 S4 S5		Mean Dia Number of Stems		N 4.0 W 3.0 S 0.0 E 2.0	5.0	m	f	f	20-40	B	137	6.60	
23	Oak - Quercus robur	18.0	520	S1 S2 S3 S4 S5		Mean Dia Number of Stems		N 5.0 W 5.0 S 2.0 E 2.0	6.0	m	f	f	20-40	B	122	6.24	Branch loss on western side.
24	Ash - Fraxinus excelsior	16.0		S1 300 S2 300 S3 S4 S5	424	Mean Dia Number of Stems		N 1.0 W 0.0 S 1.0 E 3.0		om	p	p	01-10	U	81	5.09	2 trunks from base
25	Oak - Quercus robur	16.0	650	S1 S2 S3 S4 S5		Mean Dia Number of Stems		N 3.0 W 6.0 S 8.0 E 5.0	5.0	m	f	f	20-40	B	191	7.80	Branch stumps on northern side and branch loss on eastern side. Reduce length of lowest branch on southern side.
26	Ash - Fraxinus excelsior	10.0	300	S1 S2 S3 S4 S5		Mean Dia Number of Stems		N 4.0 W 5.0 S 4.0 E 4.0	1.6	y	g	p	10-20	C	41	3.60	No access.
27	Ash - Fraxinus excelsior	16.0		S1 300 S2 300 S3 350 S4 S5	550	Mean Dia Number of Stems		N 5.0 W 4.0 S 5.0 E 4.0		om	f	p	01-10	U	137	6.60	No access. Tight fork at 1.2m.
28	Field maple - Acer campestre	9.0	175	S1 S2 S3 S4 S5		Mean Dia Number of Stems		N 4.0 W 4.0 S 4.0 E 4.0	1.6	y	g	f	20-40	B	14	2.10	Tight fork at 1.7m. Hard core on south side which should be removed.
29	Hybrid poplar - Populus euramericana	20.0	400	S1 S2 S3 S4 S5		Mean Dia Number of Stems		N W S E		m	f	f	10-20	C	72	4.80	Group of 10 mature trees. Some single trunks and some low branching.
30				S1 S2 S3 S4 S5		Mean Dia Number of Stems		N W S E									

Life stage:

y	young
sm	semi mature
em	early mature
m	mature
ma	middle aged
om	over mature
v	veteran

Condition/Structure:

g	good
f	fair
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RPA	Root Protection Area
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Category

A	High quality trees expected to have a safe lifespan of over 40 years
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C	Low quality trees expected to have a safe lifespan of over 10 years
U	Unsuitable for retention

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Tree 1 Figure 1

The overgrown hedgerow trees on the western side of the access road from CLaygate Road from the north. Figure 2

Tree 2 on the left and Trees 3 to 5 to the right. Figure 3

The hybrid poplars in Group 6. Figure 4

Tree 7 Figure 5

Tree 8 Figure 6

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Trees 9 to 15 with Tree 15 on the right Figure 7

The dying trees on the western boundary. Figure 8

Trees 16 to 20 with Tree 20 on the right. Figure 9

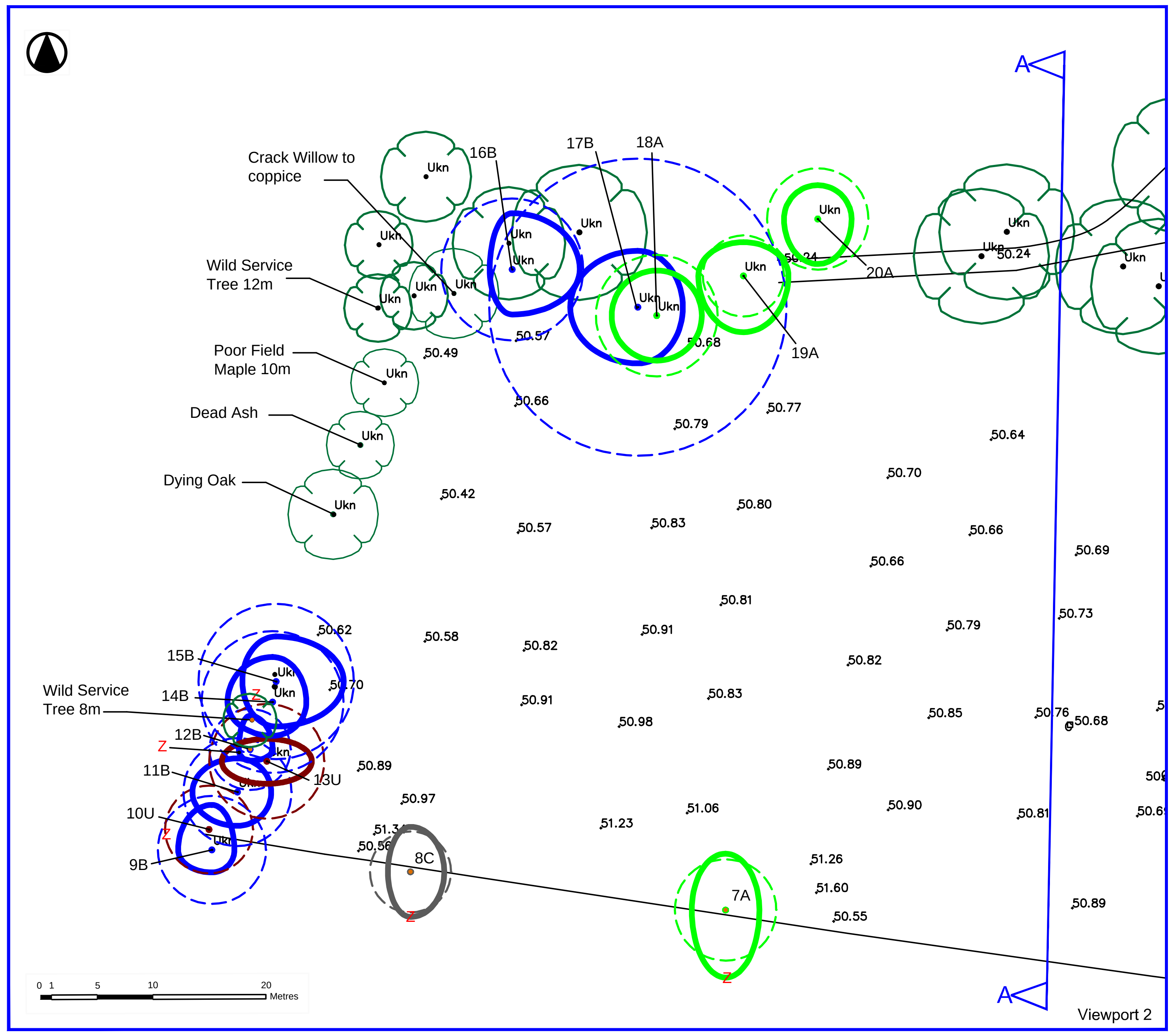
The trees between Trees 27 and 28 on the northern boundary. Figure 10

Tree 26 Figure 11

Tight fork in Tree 26 Figure 12


The trees between Trees 28 and 29 on the northern boundary. Figure 13


The hybrid poplars in Group 29. Figure 14



Trees, shrubs and hedges on land survey

Category A — Tree trunk diameter; Tree canopy; Root protection area. Trees of high quality with an estimated remaining life expectancy of at least 40 years.

Category B — Trees of moderate quality with an estimated remaining life expectancy of at least 20 years.

Category C — Trees of low quality with an estimated remaining life expectancy of at least 10 years, or young trees with a stem diameter below 150mm.

Category U — Those in such a condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years.

Trees and shrubs not in tree schedule

Trees, shrubs and hedges located on site

Z — Trees, shrubs and hedges located by LaDellWood LLP are indicated by this symbol marked on the canopy

For further details see Tree Survey Schedule.

Predicted root spread and root protection areas

Predicted root spread in relevant category colour

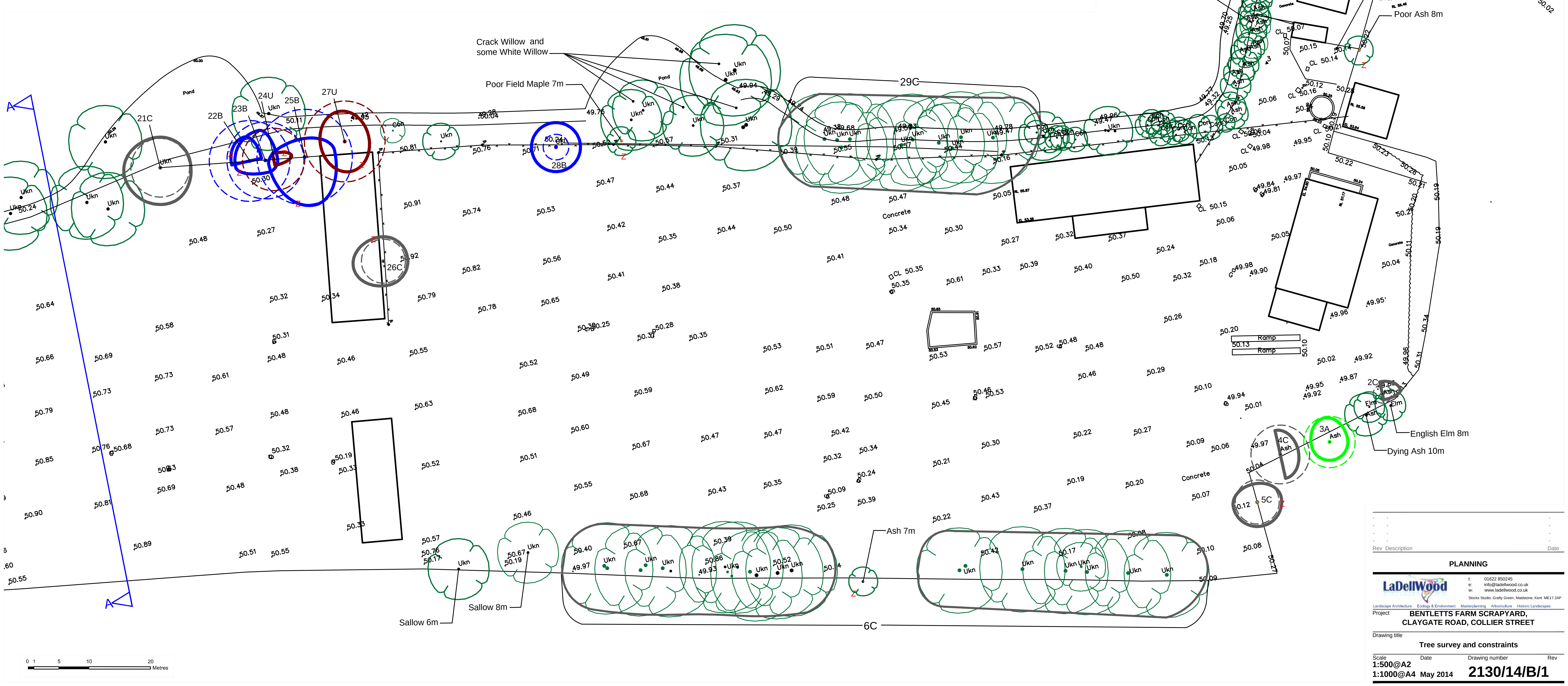
The root protection area is an assessment of the root spread of the tree required for it to survive, based on the calculation in BS 5837:2012, Trees in relation to design, demolition and construction - Recommendations.

It may be modified by site conditions such as walls and paving that can restrict root spread. The species of tree, adjacent trees and soil conditions can also affect the root spread.

The root protection areas should be kept free of all construction and all working areas and be fenced off to prevent access during construction.

The area can be reduced on one side by an agreed amount if the protection area is increased on another side.

Construction is permitted within the root protection area:
- Where there is no excavation of the topsoil or subsoil
- Construction takes place on the existing soil surface
- The construction is detailed on the tree protection during construction drawing and is designed to result in insignificant compaction of the soil beneath it.



Rev Description Date

PLANNING

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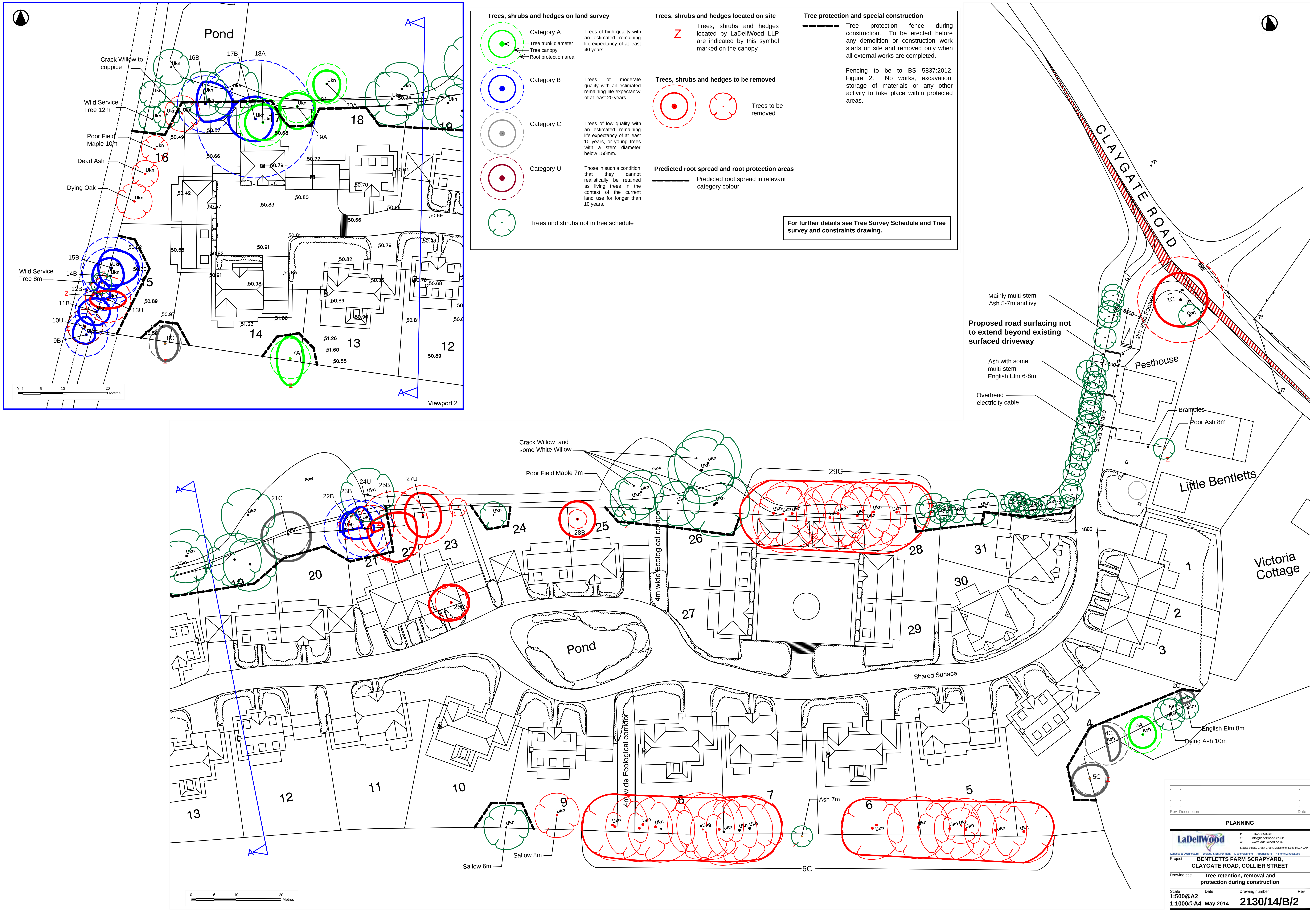
Project: BENTLETTS FARM SCRAPYARD, CLAYGATE ROAD, COLLIER STREET

Drawing title: Tree survey and constraints

Scale	Date	Drawing number	Rev
1:500@A2 1:1000@A4	May 2014	2130/14/B/1	



Trees, shrubs and hedges on land survey
Category A
Tree trunk diameter
Tree canopy
Root protection area
Trees of high quality with an estimated remaining life expectancy of at least 40 years.
Category B
Trees of moderate quality with an estimated remaining life expectancy of at least 20 years.
Category C
Trees of low quality with an estimated remaining life expectancy of at least 10 years, or young trees with a stem diameter below 150mm.
Category U
Those in such a condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years.
Trees and shrubs not in tree schedule
Trees, shrubs and hedges located on site
Z
Trees, shrubs and hedges located by LaDellWood LLP are indicated by this symbol marked on the canopy
Trees, shrubs and hedges to be removed
Trees to be removed
Predicted root spread and root protection areas
Predicted root spread in relevant category colour
Tree protection and special construction
Tree protection fence during construction. To be erected before any demolition or construction work starts on site and removed only when all external works are completed.
Fencing to be to BS 5837:2012, Figure 2. No works, excavation, storage of materials or any other activity to take place within protected areas.
For further details see Tree Survey Schedule and Tree survey and constraints drawing.
Pond
Crack Willow to coppice
Wild Service Tree 12m
Poor Field Maple 10m
Dead Ash
Dying Oak
Wild Service Tree 8m
Viewport 2
Metres
CLAYGATE ROAD
Mainly multi-stem Ash 5-7m and ivy
Proposed road surfacing not to extend beyond existing surfaced driveway
Ash with some multi-stem English Elm 6-8m
Overhead electricity cable
Pesthouse
Brambles
Poor Ash 8m
Little Bentletts
Victoria Cottage
Shared Surface
Crack Willow and some White Willow
Poor Field Maple 7m
4m wide Ecological corridor
English Elm 8m
Dying Ash 10m
Ash 7m
Sallow 8m
Sallow 6m
PLANNING
LaDellWood
Project BENTLETTS FARM SCRAPYARD, CLAYGATE ROAD, COLLIER STREET
Drawing title Tree retention, removal and protection during construction
Scale 1:500@A2 1:1000@A4
Date May 2014
Drawing number 2130/14/B/2

TREE QUALITY ASSESSMENT AND IDENTIFICATION IN ACCORDANCE WITH BS5837:2012

ANNEX 1

Tree Quality Assessment and Identification in Accordance with BS5837:2012

1. Tree Quality Assessment in accordance with Table 1 of BS5837:2012

Category	Definition
U	Those in such condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years.
A	Trees of high quality with an estimated remaining life expectancy of at least 40 years.
B	Trees of moderate quality with an estimated remaining life expectancy of at least 20 years.
C	Trees of low quality with an estimated remaining life expectancy of at least 10 years, or young trees with a stem diameter below 150mm.

2. Identification of Tree Categories in accordance with Table 2 of BS5837:2012

Category	Colour
U	Dark red
A	Light green
B	Mid blue
C	Grey

ROOT PROTECTION AREA CALCULATIONS AND PREDICTED ROOT SPREAD IN ACCORDANCE WITH BS5837:2012

ANNEX 2

Root Protection Area Calculations and Predicted Root Spread in Accordance with BS5837:2012

1. Single Stem Root Protection Area

The Root Protection Area (RPA) should be calculated as an area equivalent to a circle with a radius 12 times the stem diameter.

2. Multiple Stem Root Protection Area

2.1 Trees with 2 to 5 stems

The combined stem diameter should be calculated using the formula below:

$$\sqrt{(\text{stem diameter 1})^2 + (\text{stem diameter 2})^2 \ldots + (\text{stem diameter 5})^2}$$

2.2 Trees with more than 5 stems

The combined stem diameter should be calculated using the formula below:

$$\sqrt{(\text{mean stem diameter 1})^2 \times \text{number of stems}}$$

3.0 Predicted Root Spread

The RPA for each tree should initially be plotted as a circle centred on the base of the stem. Where pre-existing site conditions or other factors indicate that rooting has occurred asymmetrically, a polygon of equivalent area should be produced. Modifications to the shape of the RPA should reflect a soundly based arboricultural assessment of likely root distribution.

ROOT PROTECTION AREAS, ARBMagazine, 165:2014

ANNEX 3

Science & Opinion

Thinking about root protection areas

The mainstay of arboricultural consultancy in the UK is to do with development, and central to this is the use of Standard 5837:2012 Trees in relation to design, demolition and construction – Recommendations. *This standard has been in existence since 1980, with three revisions in 1991, 2005 and 2012, and is the fulcrum upon which the integration of trees into development is focused. Whilst its evolution is an interesting account, its implementation tends to give rise to animated discussion and one can say with surety that the root protection area is the most common subject of disagreement. When these disagreements are solely based on the strict arithmetical calculation of a root protection area, the practice of arboriculture is devalued. BS 5837 provides sound guidance to which one must apply knowledge and experience to the reasoned interpretation used to justify the means of protecting tree root systems in site-specific terms.*

***Hal Appleyard** and **Jim Quaife** are well-established consultants (Registered with the Arboricultural Association) who both deal with development as the single largest element of their practices' turnover.*

Hal Appleyard

I have a problem. The bird food I put out is not being consumed by the intended recipients. Although somewhat obscure on the face of it, there is a strange alignment with a grey squirrel that enters my garden and an ability to demonstrate how construction can be successfully achieved within a likely root spread of a tree.

The grey squirrel (which I call 'Major' owing to its grey and boring appearance) studies the obstacles I put in his way to prevent him from stealing the bird food. He thinks for a moment and then overcomes the problem to reach his target of seed-covered fat. He must be really hungry. (A gun would solve my problem but then there are thousands more Majors waiting to be fed and the noise frightens the birds and neighbours alike.)

The similarity between the two situations exists where the simple application of some thought overcomes the problem.

The British Standards Institution's BS 5837:2012 *Trees in relation to design, demolition and construction – Recommendations* (the BS) is an unashamed guide to assessing a potential development site, the trees it supports and how development should be best integrated into the landscape. By and large, the document and the procedures it recommends work well for both specialists and lay people. The document has to work if it is to be regarded as a respectable industry tool.

There is no doubt, too, that it is has its limitations. One such limitation is the subject of a tree's root protection area or RPA. This is defined in the BS as a **'... layout design tool indicating the minimum area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree's viability, and where the protection of the roots and soil structure is treated as a priority'**. There is a calculation system to obtain the area, which takes the form of a circle in the first instance. For single-stemmed trees the area is calculated by multiplying the trunk diameter by 12, which provides a radial (r) measurement, which forms the basis of a circular area calculation ($\prod r^2$). For multi-stemmed trees, it is more complex but the principle is the same – obtain a radial measurement and calculate the area of a circle; draw a circle around the tree's trunk on a plan and there you have the layout design tool indicating the minimum area around the tree deemed to contain sufficient rooting volume in order to sustain the tree's viability.

Having conducted a world-wide search to establish the science behind the calculation, I have found nothing: nothing of any specific correlation between a tree trunk measurement and the root spread, but more importantly, I can find nothing scientific to confirm how many roots can be lost before a tree dies. I wasn't likely to, however.

In real-life situations, the morphology of root spread is influenced by myriad factors, and assessing where roots may grow by looking at the site is very difficult, particularly in the urban setting. I think it is fair to say, however, that roots are restricted in their lateral spread by the presence of features like established roads, retaining walls and building foundations, and that roots may exploit the soil where no such restrictions are present. Of course, we cannot see the soil structure differences, the localised hydrological differences or the pH alterations, which also have a significant influence upon root development and morphology, and thus our assessments are crude and mechanical at best. The BS: **'4.6.2 The RPA for each tree should initially be plotted as a circle centred on the base of the stem. Where pre-existing site conditions or other factors indicate that rooting has occurred asymmetrically, a polygon of equivalent area should be produced. Modifications to the shape of the RPA should reflect a soundly based arboricultural assessment of likely root distribution.'**

The idea that professionals should attempt to draw an RPA that provides an equivalent area, but in a form which takes account of local site features, is frankly fatuous and simply guesswork. This leads to each party preferring the guesswork which suits their position best. It is not uncommon for a battle to develop between designers (applicants for development) and planning officers over how much in 'percentage

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terms' of a BS RPA can be used for construction. Such battles are often fought on the basis that one party simply feels that construction within the RPA will bring about the premature demise of the tree, no matter how limited the incursion. The other party argues against that and so it goes – it is time wasting in the extreme and based on nothing scientific. It's an unsophisticated argument, which is normally highly frustrating and professionally embarrassing.

We need only to stop and think, pause and consider for a few minutes the actuality of the relationship between the desire for built form and the rooting spread of trees: we would see a much clearer and more sensible approach. There is, in fact, plenty of study and written work available upon the required soil volume for normal tree growth into maturity, not least provided through the years by Helliwell, Basuk and Lindsey, Kopinger, Moll and Urban, Perry, Arnold, Bakker, Watson and more. Useful references to tree species' tolerance to root loss, low oxygen levels and root depth exist but are seldom appreciated. The work carried out by Cutler and Richardson provides an indirect record and analysis of root spread, as does the National House Building Council Standard 4.2. It only needs a brief grasp of the previous work to understand that trees, whilst possessing sensitive rooting areas, can also be expected to tolerate changes in the rooting environment including the loss of some roots and the loss of some potential soil volume.

Where the spatial area for tree roots to grow unimpeded radially in all directions within 1m of the ground surface does not exist, roots MUST grow somewhere

or the tree dies. The size and viability of trees are reliant upon the availability of soil, air and moisture and of course the species' profile. Assuming roots can grow in 1m of soil, the maximum soil volume set out in the BS for trees is 707m³, which is equivalent to 12 times a trunk diameter of 125cm. De facto, this presumes that trees with larger trunk diameters do not need any more soil. In any event 707m³ is equivalent to the volume of six double decker buses (something you'll not forget), which is more than enough for even the largest of trees you'll encounter. A tree of large proportions does not *need* all this soil but it will use it if no physical barriers exist. We see evidence of this every day in the nooks and crannies as well as the pavements of our cities, which support some very large trees with proportionally low available soil volume.

The degree of emphasis currently levied upon the BS RPA is misplaced in my view, where assessments of tree growth, volume and tolerances are more relevant. The RPA is therefore nothing more than a rough guide and attempts to modify its shape or provide depictions of where roots grow are useless guesses, which are both unhelpful and unprofessional.

The BS RPA can only be and must only be used as a preliminary guide. There are too many variables for the current BS RPA to ever be considered as a construction exclusion area, and this being, so, the discussion between the experts must refer to and rely upon site-specific factors, existing studies and science, rather national generalisations. As with my annoying squirrel Major, all becomes clear and achievable with a little thought.

Jim Quaife

A fair examination question would be to explain all the factors which could affect tree root morphology. The difficulty in answering it would be to fit the answer into the allotted time.

As part of our work we are asked regularly to comment about the condition of trees and for the most part this relates to risk – indeed we cannot really look at any tree without regard to risk. We are hardly likely to suggest a pruning specification to relieve shade for a dangerous tree. The structural integrity of a tree is integral and this includes stability. With experience one instinctively weighs up the visual appearance of a tree and forms an initial view as to whether it 'looks right'. This initial view needs to be refined and a written report must contain all pertinent justifications, and these will include an appreciation of the rooting habit of the tree. We cannot see the root system, but we know that there is a fundamental balance between its assimilative function and photosynthetic area, and if the tree is in satisfactory health then it must have a root system that is providing structural and physiological support.

I don't think anyone uses the root protection area (RPA) calculation recommended by BS 5837 in forming an opinion about root stability. We know that, as with all parts of a tree, roots grow adaptively to achieve optimum functionality in any given growing circumstances. If for whatever reason they don't, the tree will fail to grow in a manner which is considered to be normal for the species.

BS 5837 recommends that a simple calculation is used to establish an RPA and, with reference to Annex A.2.2, this is based upon an open-grown model of root distribution where the majority of non-woody root mass is in the top 600mm of soil. This is generally accepted, and certainly the abundance of upturned root plates after October 1987 prompted many comments about the shallowness of roots. I suspect that much of this was due to the contrast between the visible root plates and the commonly held misconception that root distribution mirrors the shape of a tree's crown, but root plate depth does rather depend upon soil type.

However, where does this put the guidance in Chapter 4.2 of NHBC Standards? Why would a strip foundation say 15m from an oak tree (20m mature height) need to be 2m deep? In fact if one then applies the data in Cutler and Richardson (*Tree Roots and Buildings* 1989) for oak, the maximum distance recorded was 30m. I accept that these data need to be used with caution

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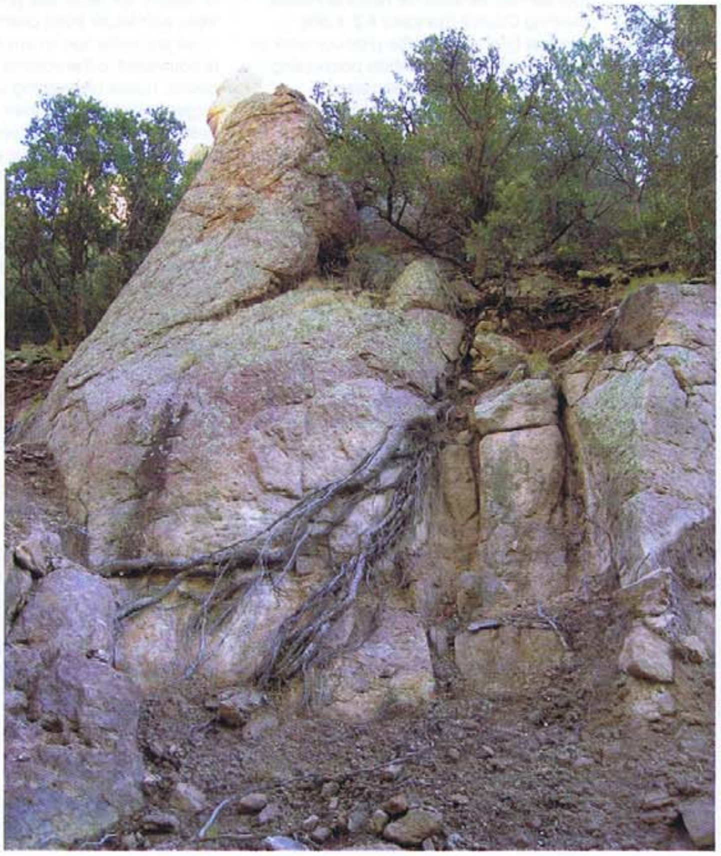
and the tables and diagrams only show the frequency of distance against species,[1] but one has to ask what actually happened at 30m – or over 18m for the 10% of recorded cases?

At that distance (exceeding the 707m² 15m radius maximum RPA), what was the depth of root influence? There was clearly enough influence to cause damage that required repair. If we were to assume that the structure had shallow footings of say 500mm, logically this was extremely unlikely to have been at the maximum extent of the root system, and in the absence of subterranean impediments the periphery of a root system becomes progressively shallower rather than having a sudden cut-off. Cutler and Richardson do write in their oak section that *Q. robur* and *Q. petraea* are 'deep rooted on clay soils'.

1 The record cards used to conduct the survey contain a range of details, but the individual tree entries in the book only show the number of trees implicated in damage and the distance from that damage. There are no indications of anything about the trees themselves in terms of their condition, vigour, size, pruning history, age or proximity to other trees; no details of the damage caused in terms of severity, extent or pattern; no description of the buildings or structures involved in terms of size, orientation, location of damage, age, whether original or an extension; and no records of site circumstances in terms of topography, hydrology, other site features, underground impediments, surfacing, exposure or even the soil type, depth or characteristics.



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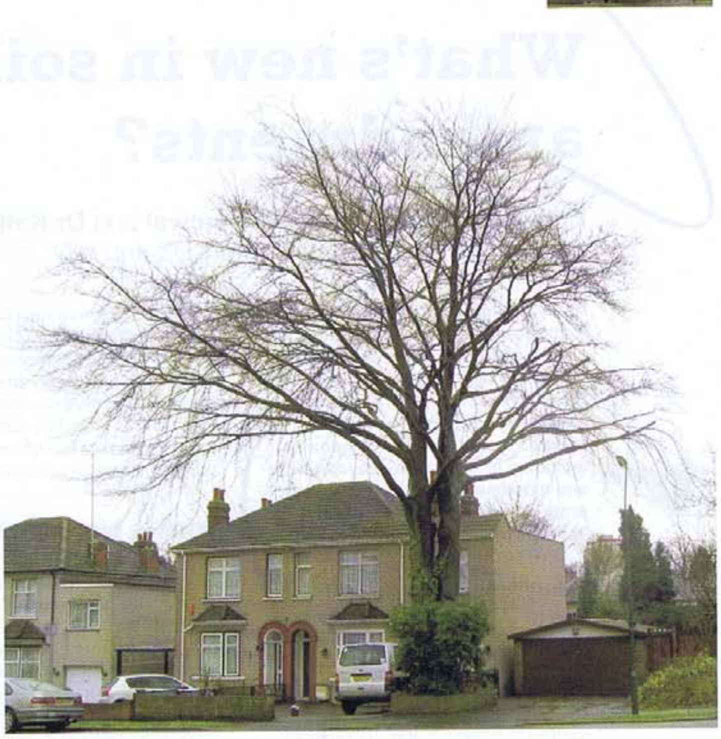
BS 5837 does not actually define the RPA in terms of a root system. Logically an RPA is an estimation of the area of the root system that would need to be retained to sustain the condition of the tree if all the other roots outside it were to be severed. Clearly the RPA is not the entire root system, but the proportion it represents could be anything from 60% down to 25%. (If, for instance, the radius of an RPA is half that of the root system, the RPA represents only some 25% of that root system.)

This might be fine were it not for the fact that a root system is three-dimensional. If the root system of a tree is, say, 2m deep, then the area required to protect the same soil volume would be reduced by just over half (10m radius at 600mm deep = 5.4m radius at 2000mm deep).

In urban surroundings we have all seen large, healthy trees growing from a pavement with no bare soil or vegetation in the vicinity. Even though the dimensions of the root system are a mystery, we know there is a functional root system there somewhere. In one of my exploratory digs in central London the first significant roots of a London plane were discovered at 3.2m in depth. In such circumstances the application of an arithmetical RPA is baseless.



This begs the question at what point does the BS 5837 arithmetic become baseless? A description of the soil mass capable of supporting the critical functional part of a root system is essential, otherwise there would be a complete and undignified free-for-all. But how rigid should the application of the 12-times stem diameter multiplier be? There is no empirical research basis for an RPA. This alone is extraordinary given the reliance put upon it. However, perhaps this is not so extraordinary when we consider just how few empirical facts we have about trees. Practical tree protection is all about justification in the specific site circumstances.

The development of the Tree Protection Distance for the 1991 BS 5837 was derived from observations alone and the lead author does not claim that any science was involved. However, if those distances were observed diligently, they worked. The problem was that the 1991 BS 5837 was not taken seriously as consistently as it should have been. 1.2m high chestnut paling fencing was an invitation to 'nudge' it where construction space was tight, and although arboricultural management of construction sites is a matter of considerable focus currently, it was rather less prevalent in the 1990s. The shortcomings of the Tree Protection Distance were mostly due its deficient application rather than any fundamental problem of principle.

The 1991 BS 5837 had the infamous ⅓ reduction (actually a transposition) of the Tree Protection Distance available, but as with any arithmetical process when applied to nature, it was widely abused. The advent of the RPA was necessary to wake people up and to provide teeth to the 2005 BS 5837. We do not suggest that the principle of the RPA be abandoned, nor would we want to dispense with it as a means of guidance. Interestingly in the early stages of the formulation of the 2005 BS 5837 the ⅓ reduction was abandoned, but the consultation process resulted in its reinstatement as a 20% offset. (There then ensued discussion as to what constituted an open-grown tree!) However, the principle of RPA shape alteration survives in the 2012 BS 5837 [paragraph 4.6.2].

Although paragraph 4.6.2 makes the principle of justified interpretation of the RPA quite clear – indeed essential – this consideration is all too often missing. Why is it that there is a temptation for some arboriculturists, who in all other aspects are able to justify opinions and recommendations in terms, to just accept the RPA without question?

Trees need protection, and the pressure upon them is increasing all the time, but we owe it to reason and logic and professionalism to justify RPAs in the same way as we look at other factors. It can be that the calculated RPA is not enough, but often it is the shape that is inappropriate as a result of disconnection between the growth form of a tree and the calculation. Intrusions into the RPA must be assessed in site-specific terms. To have a justified intrusion, which represents a modest proportion of the RPA and does not compromise the assimilative or structural support functions of a tree in the context of the entire root system and its estimated shape, rejected on the basis of arithmetic is an affront to reasonableness.

This arithmetic area can frequently be seen recorded to two decimal places: an intriguing and disheartening belief in *faux* accuracy.

This is not an assault on BS 5837, which by its very nature cannot be precisely prescriptive about living organisms, but an encouragement, indeed a plea, for arboriculturists to use it as intended: as a foundation on which to standardise an approach by applying our knowledge and experience to each and every tree and not hiding behind dependence upon a calculator.

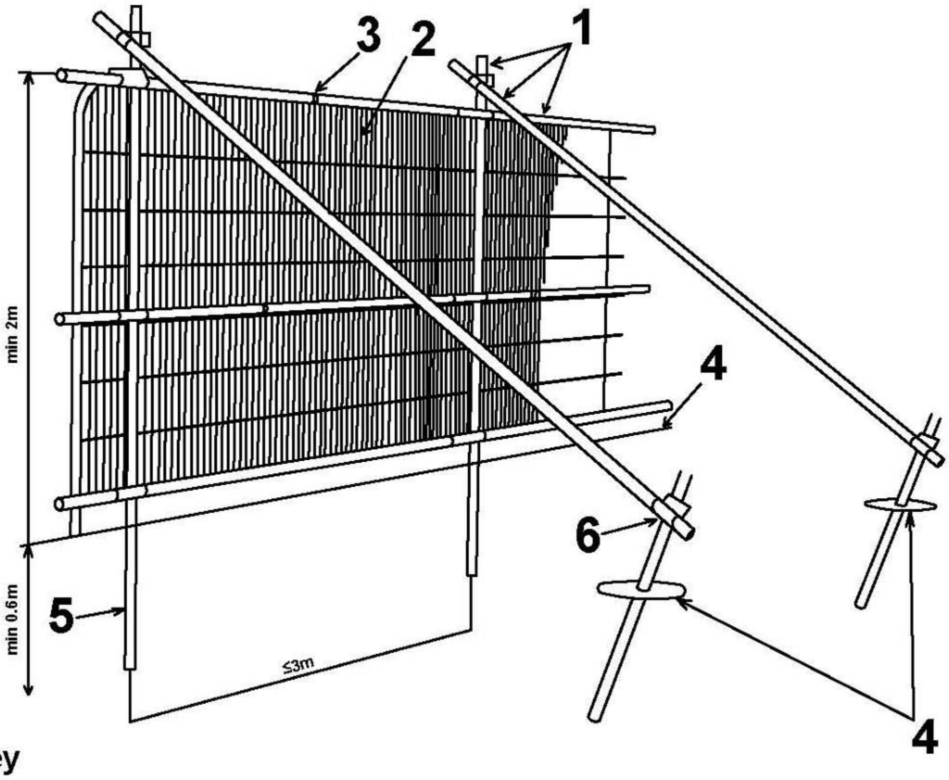
As a marker of the examination question, how many marks would you give to the one-liner of a simple, one-size-fits-all calculation?

TREE PROTECTION FENCING IN ACCORDANCE WITH BS5837:2012

ANNEX 4

Tree Protection Fencing in Accordance with BS5837:2012

5 Figure 2: Default specification for protective barrier **BS5837:2012**



Key

1	Standard scaffold poles
2	Heavy guage 2m tall galvanized tube and welded mesh infill panels
3	Panels secured to uprights and cross-members with wire ties
4	Ground level
5	Uprights driven into the ground until secure (minimum depth 0.6m
6	Standard scaffold clamps

LaDellWood