Tree Survey Report
Arboricultural Impact Assessment
and Arboricultural Method Statement

for

Martins Way Ledbury

On behalf of

Fed3

January 2019

Planning

thelandscapepartnership
planning and designing environments for life

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Accompanying Drawings

1 Introduction

1.1 The Landscape Partnership has been commissioned by Fed3 to carry out a tree survey at Martins Way, Ledbury. The survey includes the trees likely to be affected by the proposed development of the site as a care home.

1.2 The scope of survey work includes a site visit and visual tree inspection, the collection of tree data, the production of a tree condition survey report and a tree constraint drawing. The tree survey and arboricultural assessments have been carried out in accordance with British Standard 5837: 2012.

1.3 The site survey was carried out by Michael Roseveare in June 2018.

2 Site Description

2.1 The site is an area of land to the west of Martins Way adjacent to Leadon Way on the western outskirts of Ledbury. The adjacent road, Leadon Way forms a ring road for Ledbury which is currently being improved by adding roundabouts and cycle footways. This work has affected the western edge of the site, removing verge trees and vegetation and the creation of an earth bund adjacent to the south east corner of the site.

2.2 The Herefordshire Council website indicates that the site is not within a Conservation Area and that there are no Tree Preservation Orders on the site.

3 Survey Methodology

3.1 The majority of the trees were surveyed with the benefit of a topographical survey. However, where trees included within the survey were not shown on the topographical survey their location has been plotted approximately using aerial photographs. These trees have an underlined tag to show that their location requires checking when further topographical information is available.

3.2 The trees were inspected from ground level and measurements taken in accordance with the recommendations set out in the British Standard 5837:2012. Canopy spreads have been measured and plotted to the 4 compass points (north, south, east and west).

3.3 The location of the surveyed trees is shown on the accompanying Tree Survey Plans numbered B18058-TLP-601. Where access was not possible measurements have been estimated. The surveyed trees are colour coded on the accompanying tree survey drawing according to their relevant BS category as follows:

A	High quality and value (shown green)
B	Moderate quality and value (shown blue)
C	Low quality and value (shown grey)
U	Unsuitable for retention (shown red)

3.4 The trees are also placed into sub categories 1, 2 and 3 according to the criteria in Table 1 in BS 5837:2012 (see Appendix 1).

3.5 The tree data collected is used to enable the current canopy spread of the surveyed trees and Root Protection Area (RPA) to be plotted on a drawing. The RPA is defined in accordance with the recommendations set out in section 4.6 of BS 5837:2012.

3.6 The calculated RPA should be capped at 707m², which is equivalent to a circle with a radius of 15m or a square with approximately 26m sides.

3.7 The RPA may be refined, by considering current on-site constraints to root activity such as buildings, earthworks and hard paving. This forms part of the design process for the proposed development.

3.8 The site survey also provides a schedule of recommendations for tree surgery works where appropriate.

4 Description of Trees and Hedgerows

4.1 The surveyed trees form mixed species groups within the site and vary in terms of their condition and quality. The trees can be divided into the following character groups:

Character group one: includes the several mature trees within the hedgerow which forms the sites northern boundary with the adjacent open grassland. These trees appear to have developed over a number of years as self-seeded trees in the case of the mature Ash and perhaps when regular hedge cutting ceased and trees were able to develop from hedge species such as Field Maple and Hawthorn. There are also several Hazel clumps within this boundary feature which have developed substantial coppice forms. Many of the trees within this character group are multi stemmed suggesting that periodically they were cut back to form coppice stools and then left to regrow. This form of management appears to have ceased several decades ago, resulting in a substantial if somewhat informal boundary feature which provides intermittent screening to the adjacent open grassland.

Character group two: includes trees growing along the sites southern boundary with Leadon Way, similar to character group one but with the dominant large tree species being Goat Willow which have formed multi stemmed specimens following periodic coppicing and then being left to regrow. These trees are close to the edge of the site and may have been affected by recent road improvements including the construction of a wide foot/cycleway which has replaced a vegetated verge. Soil levels between the trees and the new path appear to have been raised, potentially exacerbating any tree root damage which has occurred. There has also been some minor crown damage although this is unlikely to affect the health of the trees. The hedge element of this boundary is incomplete, enabling views into the site. A number of trees which were growing in the area of the new earth bund have been recently removed.

Character group three: includes the many small self-seeded trees which have developed in the middle of the site but have been swamped by the growth of vegetation. Largely hawthorn and ash these trees will develop into a dense scrub if left unmanaged. Within the centre of the site is a large heap of brash, presumably created when the scrub in the centre of the site was last removed.

4.2 Common ash trees included within the survey may succumb to Ash Dieback. Whilst no trees are currently showing significant signs of infection, advice on symptoms and the management of affected trees is available at the Forestry Commission website as follows:

http://www.forestry.gov.uk/ashdieback

5 Arboricultural Impact Assessment (AIA)

5.1 The AIA uses information provided in the tree survey to identify areas where the proposed development construction may be at odds with accepted standards in terms of a tree's requirements for space in which to maintain existing roots and shoots and space for future growth.

5.2 Details of the trees surveyed are given in the accompanying Tree Survey Schedule. Tree locations are shown on the accompanying Tree Survey Drawing B18058-TLP-601.

5.3 The quality and relative importance of each is shown as coloured polygons. The colour used relates to the British Standard categories as follows: A, green; B, blue; C, grey and U, red (see drawing B18058-TLP-601). Red trees are discounted as they are recommended for removal. In general, the design process will try to retain A and B category trees. Proposed construction will therefore normally be excluded from the root protection area of A and B category trees.

5.4 The root protection area (RPA) is shown as a circle on the Tree Survey Drawing B18058-TLP-601.

5.5 The AIA considers existing site conditions and the effect that they may have on the development of the surveyed trees root systems. Hard structures such as buildings and paved roads and paths can influence the root activity of trees by reducing the availability of both moisture and nutrients.

6 Impact of Proposed Development on Retained Trees

6.1 Refer to the accompanying AIA AMS drawing B18058-TLP-602 for the relationship between the proposed development and the trees on the site.

6.2 The proposed redevelopment includes the retention of the bulk of the surveyed trees. No retained trees will be significantly adversely affected by the construction of the proposed development.

6.3 Trees to be removed for Arboricultural reasons:

T13 White Willow	Dead tree adjacent to offsite footpath, check ownership before carrying out work

6.4 The following trees will be removed to enable the proposed development:

T1 Cherry Plum	To enable the proposed pumping station and access
T24 Goat Willow	To enable the proposed landscaping
T25 Goat Willow	To enable the proposed retaining wall
G26 Various Native species	To enable the proposed landscaping

6.5 The following trees will be affected by the proposed development.

T2 Field Maple	Proposed parking bay construction
T3 Field Maple	Proposed parking bay construction
T5 Field Maple	Proposed parking bay construction

7 Arboricultural Method Statement Methodology

7.1 The arboricultural method statement provides the means by which areas of construction, or working space identified in the AIA as being within the RPA of retained trees, can be achieved whilst minimising the impact of that construction activity on the affected trees.

7.2 The excavation of foundations for buildings and hard surfaces on sites where trees are present may result in root damage and removal. Where root loss is likely to occur, it is important that a method of construction that minimises the impact on tree roots is used.

8 Site Clearance and Construction Close to Retained Trees

8.1 The proposed development requires the clearance of recent scrub growth within the body of the site. This work should be carried out in conjunction with the erection of the tree protection barrier before the construction phase of the development commences. Soil stripping will be limited to areas outside the tree protection which excludes construction activity within the root protection areas of retained trees. The exception to this is an area of parking which is within the root protection area of T2, T3 and T5. This area will also be excluded from soil stripping operations as the constriction of the parking bays is to be "no dig" to prevent tree root loss and damage.

8.2 **Construction** of the proposed structure of the building is wholly outside the root protection area of the retained trees. There are however several proposed features which occur within the root protection areas of retained trees, including parking bays, a retaining wall and paved paths through the landscaped grounds of the development.

8.3 **Parking bay construction** will be carried out by employing a "no dig" form of construction as illustrated in the document at appendix 3. The edges of the parking bay construction will be made up using topsoil which tapers to the existing soil levels before it reaches the affected retained tree.

This work will be supervised by the project arboriculturist to ensure that tree root disturbance is avoided.

8.4 Damage to retained tree roots is to be avoided during all building activity on the site.

9 Services

9.1 All service runs are to be placed outside the RPA of trees on and adjacent to the site. Where it is not possible to achieve this, the section of service run which passes within the RPA of a tree will be hand dug in accordance with 'broken trenches' (NJUG 4 section 4, appendix 13.4). This will ensure that tree roots are not damaged during the installation of the service. All root pruning will be agreed beforehand with the named arboriculturist in consultation with the local authority arboricultural officer. All root pruning will be in accordance with BS 3998: 2010. All routes for overhead services will aim to avoid the trees. Where this is unavoidable any tree work will be agreed prior to commencement with the Council's Arboricultural Officer.

10 Tree Protection Barrier

10.1 Trees retained in close proximity to the construction area of the site will be protected by the use of a tree protection barrier erected in the location shown on the accompanying AIA AMS Plan Number B18058-TLP-602. The fence will consist of "Heras" type panels or similar braced at appropriate intervals and secured to keep in place. The tree protection barrier will be erected prior to the site clearance phase of the development and remain in situ for the duration of the development and will only be removed once construction work has been completed and landscape work begins.

11 Conclusions

11.1 The site is bounded to the north and south by informal hedge features which include mature trees. The eastern boundary is more or less open which enables views into the site, the centre of which is currently overgrown with vegetation and a number of young tree saplings. Included within the survey are a number of British Standard 5837 2012 B category trees, although they have developed from previously cut hedgerows and several could be treated as coppice as part of a management program for the sites trees and hedgerows. The Goat Willows along the southern boundary may have suffered root damage as a result of the recent road improvements in Leadon Way. These trees are in any event reaching over maturity and will begin to decline and collapse over the next few years. Coppicing will help mitigate any root damage caused by the road works and will enable their retention for several decades. Coppicing is advisable on a 5-10 years cycle.

12 Recommendations

12.1 This report should be read in conjunction with the accompanying tree survey schedule and drawings B18058-TLP-601.

12.2 The recommendations outlined in the Arboricultural Method Statement if followed should ensure that retained trees are not damaged during the refurbishment work.

12.3 A post development tree survey should be carried out and, where appropriate, remedial tree surgery works completed.

13 Project Contact Details

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Arboriculturist:	Michael Roseveare, The Landscape Partnership Tel: 01394 380509
Local Planning Authority:	Herefordshire Council

APPENDICES 1-3

1 Table 1 from BS 5837:2012 Cascade Chart for tree quality assessment

2 Tree Survey Schedule

3 AAIS APN12

Table 1 **Cascade chart for tree quality assessment**

Category and definition	Criteria (including subcategories where appropriate)			Identification on plan
Trees unsuitable for retention (see Note)				
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 that have a serious, irremediable, structural defect, such that their early loss is expected due to collapse, including those that will become unviable after removal of other category U trees (e.g. where, for whatever reason, the loss of companion shelter cannot be mitigated by pruning) • Trees that are dead or are showing signs of significant, immediate, and irreversible overall decline • Trees infected with pathogens of significance to the health and/or safety of other trees nearby, or very low quality trees suppressing adjacent trees of better quality *NOTE Category U trees can have existing or potential conservation value which it might be desirable to preserve; see **4.5.7**.*			See Table 2
	1 Mainly arboricultural qualities	**2 Mainly landscape qualities**	**3 Mainly cultural values, including conservation**	
Trees to be considered for retention				
Category A **Trees of high quality** with an estimated remaining life expectancy of at least 40 years	Trees that are particularly good examples of their species, especially if rare or unusual; or those that are essential components of groups or formal or semi-formal arboricultural features (e.g. the dominant and/or principal trees within an avenue)	Trees, groups or woodlands of particular visual importance as arboricultural and/or landscape features	Trees, groups or woodlands of significant conservation, historical, commemorative or other value (e.g. veteran trees or wood-pasture)	See Table 2
Category B **Trees of moderate quality** with an estimated remaining life expectancy of at least 20 years	Trees that might be included in category A, but are downgraded because of impaired condition (e.g. presence of significant though remediable defects, including unsympathetic past management and storm damage), such that they are unlikely to be suitable for retention for beyond 40 years; or trees lacking the special quality necessary to merit the category A designation	Trees present in numbers, usually growing as groups or woodlands, such that they attract a higher collective rating than they might as individuals; or trees occurring as collectives but situated so as to make little visual contribution to the wider locality	Trees with material conservation or other cultural value	See Table 2
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 150 mm	Unremarkable trees of very limited merit or such impaired condition that they do not qualify in higher categories	Trees present in groups or woodlands, but without this conferring on them significantly greater collective landscape value; and/or trees offering low or only temporary/transient landscape benefits	Trees with no material conservation or other cultural value	See Table 2

Project:	Martins way, Ledgury							BS 5837:2012 Trees in relation to construction-recommendations			Surveyed by	MR		
Ref:	B18058										Weather	Cool and overcast		
Date:	June 2018										Tagged	No		
Client:	Fed3													
				Canopy Spread										
Tree No.	Tree species name	Height (m)	DBH (mm)	N	E	S	W	Height of branch clearance N,S,E,W	Height of crown clearance	Age class	Physiological/Structural condition problems/comments	Preliminary management	Estimated remaining contribution years	BS category U, A, B, C
T1	Prunus cerasifera (Cherry Plum)	4.5	50	2.4	2.4	2.4	2.4	0	0.5	SM	Good	None	20+	C1
T2	Acer campestre (Field Maple)	10	175,200,350,400	5	5	5	5	2	1	M	Good, ivy	Remove Ivy.	40+	B2
T3	Acer campestre (Field Maple)	10	250	3	1	2.5	3	2	1	M	Good, ivy	Remove Ivy.	40+	B2
T4	Acer campestre (Field Maple)	10	150	3	2	2.5	1	2	1	M	Good, ivy	Remove Ivy.	40+	B2
T5	Acer campestre (Field Maple)	10	200,200	3	1	3.5	5	2	1	M	Good, ivy	Remove Ivy.	40+	B2
T6	Corylus avellana (Hazel)	7	100,100,100,100,100,200,200	5	5	5	5	0	0	M	Good	None	40+	B3

Project:	Martins way, Ledgury							BS 5837:2012 Trees in relation to construction-recommendations			Surveyed by	MR		
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Tree No.	Tree species name	Height (m)	DBH (mm)	N	E	S	W	Height of branch clearance N,S,E,W	Height of crown clearance	Age class	Physiological/Structural condition problems/comments	Preliminary management	Estimated remaining contribution years	BS category U, A, B, C
H7	Crataegus monogyna (Hawthorn)	6	150	1	1	1	1	0	1	M	Fair	None	20+	C1
T8	Fraxinus excelsior (Ash)	14	500	7	7	7	7	3	2	M	Good	Remove Ivy.	10+	C1
H9	Crataegus monogyna (Hawthorn)	6	150	1	1	1	1	0	1	M	Fair	None	20+	C1
T10	Corylus avellana (Hazel)	7	100,100,100,100,100	4	4	4	4	0	0	M	Good	None	40+	B3
G11	Corylus avellana (Hazel)	6	100	1.5	1.5	1.5	1.5	0	0	M	Good	None	20+	C1
T12	Salix caprea (Goat Willow)	10	350,200,250	4	4	3.5	4.5	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1
T13	Salix alba (White Willow)	13	500,500,450,300	4	4	4	4	2	1	OM	Dead, ivy	Remove tree and root.	<10	U

Project:	Martins way, Ledgury							BS 5837:2012 Trees in relation to construction-recommendations			Surveyed by	MR		
Ref:	B18058										Weather	Cool and overcast		
Date:	June 2018										Tagged	No		
Client:	Fed3													
				Canopy Spread										
Tree No.	Tree species name	Height (m)	DBH (mm)	N	E	S	W	Height of branch clearance N,S,E,W	Height of crown clearance	Age class	Physiological/Structural condition problems/comments	Preliminary management	Estimated remaining contribution years	BS category U, A, B, C
G14	Salix caprea (Goat Willow),Crataegus monogyna (Hawthorn)	6	100	2	2	2	2	1	1	M	Poor	None	10+	C1
T15	Acer campestre (Field Maple)	7	200	2.5	2.5	2.5	1	1	1	EM	Poor, damaged during road works	None	<10	C1
T16	Salix caprea (Goat Willow)	10	350,250,100,100,100,250	4.5	4.5	3	4.5	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1
T17	Salix caprea (Goat Willow)	10	100,100,100	2.75	2.75	2.75	2.75	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1
T18	Salix caprea (Goat Willow)	10	100,100,100,100,100,100,150	4.5	4.5	3	4.5	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1
T19	Salix caprea (Goat Willow)	10	100,100,100,100,100,100,100	3	3	3	3	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1
T20	Salix caprea (Goat Willow)	10	350,200,150,100,100,100	3	3	3	3	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1
T21	Salix caprea (Goat Willow)	10	200,100,100	3	3	3.5	2	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1

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Tree No.	Tree species name	Height (m)	DBH (mm)	N	E	S	W	Height of branch clearance N,S,E,W	Height of crown clearance	Age class	Physiological/Structural condition problems/comments	Preliminary management	Estimated remaining contribution years	BS category U, A, B, C
T22	Salix caprea (Goat Willow)	10	200,100,100,100,75	2	2	2	2	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1
T23	Salix caprea (Goat Willow)	10	200,100,100	2	3	5.5	3.5	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1
T24	Salix caprea (Goat Willow)	10	200	1.5	1.5	1.5	1.5	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1
T25	Salix caprea (Goat Willow)	10	350,250,150,100,75	4.5	4.5	3	4.5	1	1	M	Fair, previously pollarded, minor impact during road works	Repollard.	10+	C1
G26	Various Native Species	VAR	VAR	Varies				0	0	SM	Developing area of unmanaged scrub	None	20+	C1
G27	Various Native Species	VAR	VAR	Varies				0	0	SM	Developing area of unmanaged scrub	None	20+	C1
T28	Fraxinus excelsior (Ash)	14	150,150,150,200,250	7	7	7	7	3	2	M	Good, ivy	Remove Ivy.	20+	C1

Trees in focus

APN 12

Arboricultural Practice Notes

Through the Trees to Development

Derek Patch and Ben Holding

Arboricultural Advisory and Information Service

Summary

The majority of tree roots grow in the upper metre of soil and they may spread outwards in any direction a distance equal to the tree's height. Any disturbance of the ground within the root spread of a tree can damage its roots and may severely injure the tree. Damage to roots will interrupt the supply of water necessary to keep the tree alive and may cause decline in vigour, dieback or even death of the tree.The tree may also be made unstable and so pose an unacceptable threat to the safety of people and property. Development of a site, including construction of access routes, driveways and parking areas can result in substantial root severance of trees. Techniques for the construction of access drives, which may avoid or lessen the damage caused to trees, are described.

This note embraces the principles first published by The Tree Advice Trust as "Driveways Close to Trees" (Aboricutural Practice Note No. 1[1]) and reviews where the principles may be applied in practice.

Trees: A Cause of Conflict

Development of a site is sometimes hampered or prevented because of the presence of trees. Local authorities and residents may wish to see trees 'preserved' whilst developers seek permission to build close to them - often ignorant about the damage this may cause to trees. Even developments such as access drives and parking areas can threaten existing nearby trees.

Traditional driveway construction (excavation and backfilling with a compactable load-bearing sub-base material) can seriously damage tree roots. Such damage occurs because of a lack of understanding that roots mainly grow outwards from a tree's trunk, near to the soil surface, rather than downwards (Dobson 1995). Where there is a significant risk of damage to trees by root severance, or changes in soil conditions during construction, local planning authorities may sometimes refuse permission for installation of an access driveway or parking area close to trees - especially if the trees are subjects of Tree Preservation Orders.

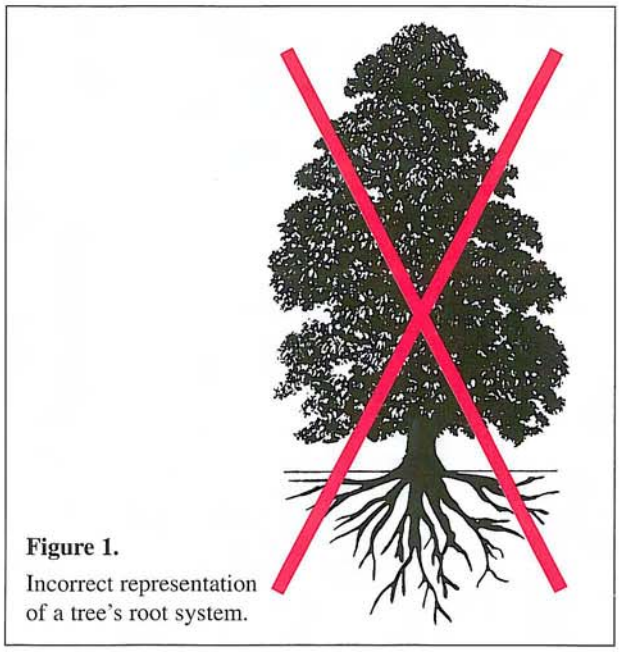


Figure 1.
Incorrect representation of a tree's root system.

However, if the potential for damage to the tree's root system (e.g. by severance or soil compaction) can be avoided during construction, development may be more easily accepted. A technique is described below which should reduce the risk of significant damage to tree roots while enabling access and parking for light vehicles to be constructed close to trees.

Where Do Tree Roots Grow?

Survival of a tree depends on its roots being able to absorb enough water from the soil to sustain the foliage (an estimated 1,000 litres per day in summer for a fully grown forest tree in a rural area) and on developing a strong root system capable of keeping the tree upright through autumn and winter gales. To achieve this the tree's roots must exploit a very large volume of soil. However, the assumption that these requirements are met by a system of roots growing predominantly downwards (Figure 1), and that anchoring roots are very thick and descend into the soil for many metres (like the base of a lamp post) is incorrect. In reality tree roots:

[1] Driveways Close to Trees, Arboricultural Practice Note No. 1 is withdrawn and superceded by this wider text.

- grow in any direction more or less parallel with the soil surface rather than vertically (Figure 2). This is also true for trees growing on sloping land.
- are usually relatively shallow - most of a tree's roots are in the upper metre of soil.
- usually radiate outwards from a tree for a distance equivalent to at least the tree's height (which for a mature tree may be 20 m or more).
- can be 30 cm or more in diameter at the base of the trunk.
- sub-divide and taper rapidly as they extend out from the trunk.
- are only 2-3 cm in diameter, and often much less at 3-4 m distance from the trunk.

The small woody roots (those less than 3 cm diameter) taper very little but they may spread out for long distances. Smaller, non-woody roots (sometimes described as white, feeder, fibrous, fragile or absorbing roots) grow outwards and usually upwards from the woody roots and subdivide to exploit the better aerated surface soil. Although generally short lived they (and the fungi associated with them - called mycorrizas) are the principal absorbers of moisture and nutrients.

Most roots (both thick and fine) are situated close to the soil surface, forming a thin layer less than 1m deep, but some small roots (usually only a few mm in diameter) may reach 2 m or more deep.

Roots and the Soil

Roots are living and, like all plants and animals, must have oxygen if they are to survive. Without oxygen roots are unable to function properly or grow, and when they are starved of oxygen for prolonged periods, they die.

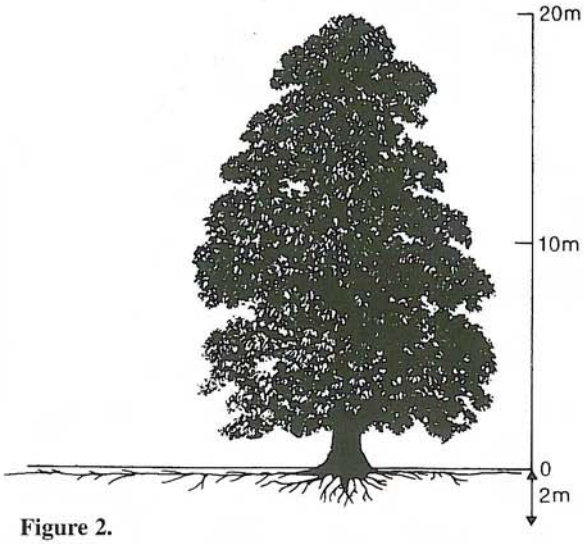


Figure 2.
Trees have a relatively shallow but wide spreading root system.

Both oxygen and water are held in the pores between the soil particles. Where the pores are large (e.g. in coarse or sandy soils) the soil will generally be freely draining and well-aerated, but where the pores are small (e.g. in heavy clays or soils which have been compacted) they may be full of water and have a poor supply of oxygen.

Most trees that have been growing undisturbed on a site for many years will have developed an extensive root system with the roots growing where the soil conditions are most favourable. There will be a balance between the development of the crown (which demands water) and the roots (which supply it). Any sudden alteration of the soil conditions within the tree's rooting area (a circle of radius equal to the tree's height) will therefore upset this balance. For example, the single passage of a machine will 'squeeze' the soil closing up the pores (causing compaction - especially in the upper levels) and so reduce the amount of oxygen available to roots which prevents them from growing through the soil. With each additional machinery movement the compaction increases and so do the problems for the tree and its roots.

Placing soil or other materials over the root system of a tree will impede air movement into and out of the soil around the roots and consequently reduce the availability of oxygen to the roots. The effect on the tree is usually progressive shoot and branch dieback until a new balance has been reached between the reduced capacity of the damaged root system to absorb water and the demands of the leaves. If damage is progressive or so severe that such a balance cannot be achieved, the tree will ultimately die.

Excavations - **even stripping the topsoil** - within the rooting area will sever roots. The closer the excavation is to the trunk of the tree the larger will be the roots lost and the greater the significance for the health and stability of the tree. Once the excavation is a metre deep virtually all of the roots growing into the excavated area will have been severed. The tree may then either be unable to absorb sufficient water to sustain the foliage and dieback will occur, or anchorage will be so reduced that the tree is unsafe and has to be severely pruned or even felled for safety.

Soil compaction, excavations and soil level increases will all damage roots and the closer to the trunk they occur the greater the damage inflicted on the tree. Nevertheless, healthy trees are generally able to withstand the loss of some roots (a maximum of about 20% of the rooting area, Helliwell and Fordham (1992)) without noticeable adverse effects.

Development Near Trees

British Standard BS 5837:2005 *Trees in Relation to Construction – Recommendations* recommends that on construction sites an area around a tree should be left undisturbed (the Root Protection Area) so that unacceptable damage to the root system is avoided. In the British Standard the Root Protection Area is calculated as

the equivalent of a circle about 12x the diameter of the tree's trunk (measured at 1.5m above ground level). The distance from the trunk extending to the branch spread, or half the tree's height, whichever is the greater (Figure 3) is a useful indicator of the typical Root Protection Area for a given tree.

The Root Protection Area is an area of protected ground around a tree within which any activity that could damage roots should be prohibited without the prior agreement of an aboriculturist.

However, if the principles and guidelines set out below are followed, installation of access driveways and parking for light vehicles within the Root Protection Area may, in many situations, be possible without causing significant, permanent damage to trees. Nevertheless, expert arboricultural advice should be sought to determine whether the tree and the site conditions lend themselves to the principles described in this Note. Any assessment of a site should include consideration of the health and overall condition of the tree(s). That is because old and declining trees may be vulnerable to sudden changes in the site conditions and so they may warrant a larger area than the minimum recommended in the British Standard.

Engineering Needs

Driveways, footpaths and car parking areas must be built on a firm, stable base. Engineers usually achieve this by excavating the soil to a depth of about 0.5 m, compacting the base if necessary, and backfilling with an inert material that can be compacted to form a stable platform. This usually involves progressive placement of layers of inert material with each being compacted by repeated passes of a powered roller or whacker plate. Each pass of a machine creates increasing compaction at depth in the soil. The edges of the excavation act as the supporting formation and kerbs or other edgings may be used to retain the surface material.

Any such excavations or soil stripping will sever roots and should be avoided within the Root Protection Area.

Compacting the base of an excavation can change the bulk density of the subsoil creating conditions unsuitable for the survival of any roots, particularly the water absorbing fine roots, contained in that volume. Placement and particularly compaction of load bearing construction materials will contribute to this creation of conditions unsuitable for root survival

On many sites it is possible to construct an adequately supported access driveway suitable for limited usage by light vehicles while retaining healthy, stable trees, by adoption of three principals particularly when construction is within the Root Protection Area as determined in consultation with an arboriculturist.

Where the finished structure will be adopted by the Highway Authority a more robust specification may be required. Provided the same principles are embraced construction across the root systems of trees should still be feasible.

Protection *and* Construction

For tree roots to be retained undamaged there must be *no excavation, no soil stripping* and *no grading of the site within the Root Protection Area* - in other words, **NO DIGGING**. This means that construction will have to be above the existing ground level.

Passage of vehicles across an unprotected soil surface must also be avoided, particularly where the soil is wet, as this will cause breakage of surface roots, soil compaction and consequently reduced soil aeration. These problems are heightened on clay soils. Most vulnerable to soil compaction are the fine white roots (those roots that are generally difficult to find when soil is examined) essential for water absorption. Surviving roots may not be able to grow through the compacted soil.

To reiterate there must be **NO COMPACTION** of the soil.

Where trees are to be retained on a site it is essential, therefore, that all but the immediate area of the development is protected from access and construction operations by fencing as recommended in BS 5837.

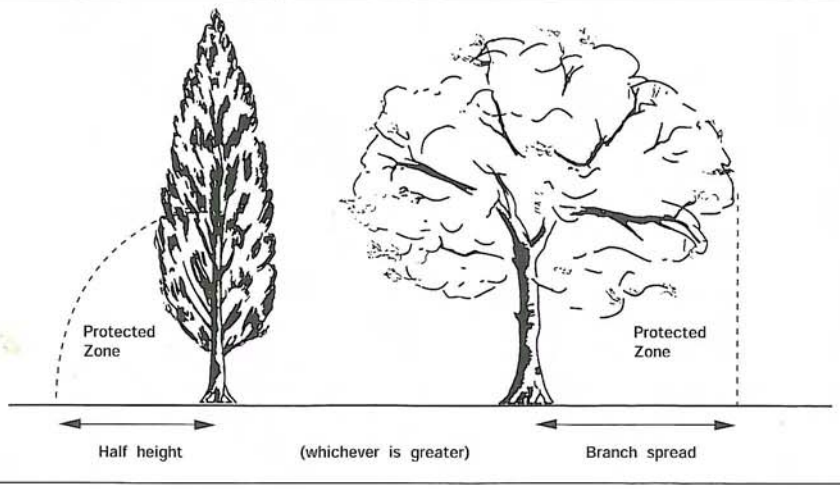


Figure 3.
Distance from a tree which constitutes the zone in which roots should be protected - i.e. no digging.

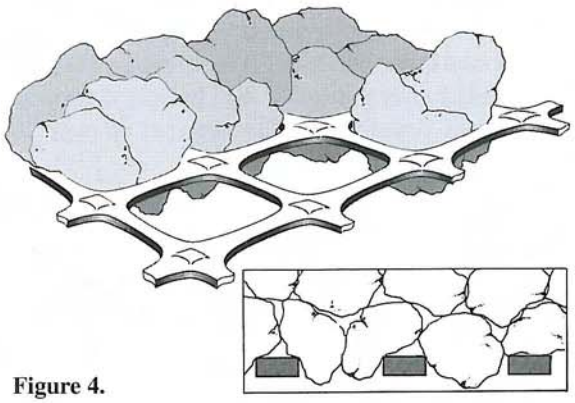


Figure 4.
The mechanism of interlock between aggregate and geogrid.

No-Dig Construction

Successful retention of trees, even when adopting a no-dig method, depends upon the condition (health and vigour) of the tree(s), which should be assessed by a qualified arboriculturist, and on adherence to three simple rules within the Root Protection Area:

- roots must not be severed, cut or broken – **no digging**
- ground levels must not be changed - **no digging, no soil level raising**
- **soil must not be compacted – no tracking of vehicles**
- oxygen must be able to diffuse into the soil beneath the engineered surface – **no tracking of vehicles**

Meeting the Engineering Needs

Damage to trees can be avoided only if the construction embraces the above simple principles and, within the fenced Root Protection Area, is no more than 5m wide.

Construction should incorporate two main components:

- a synthetic load spreading material
- a no-fines aggregate sub-base

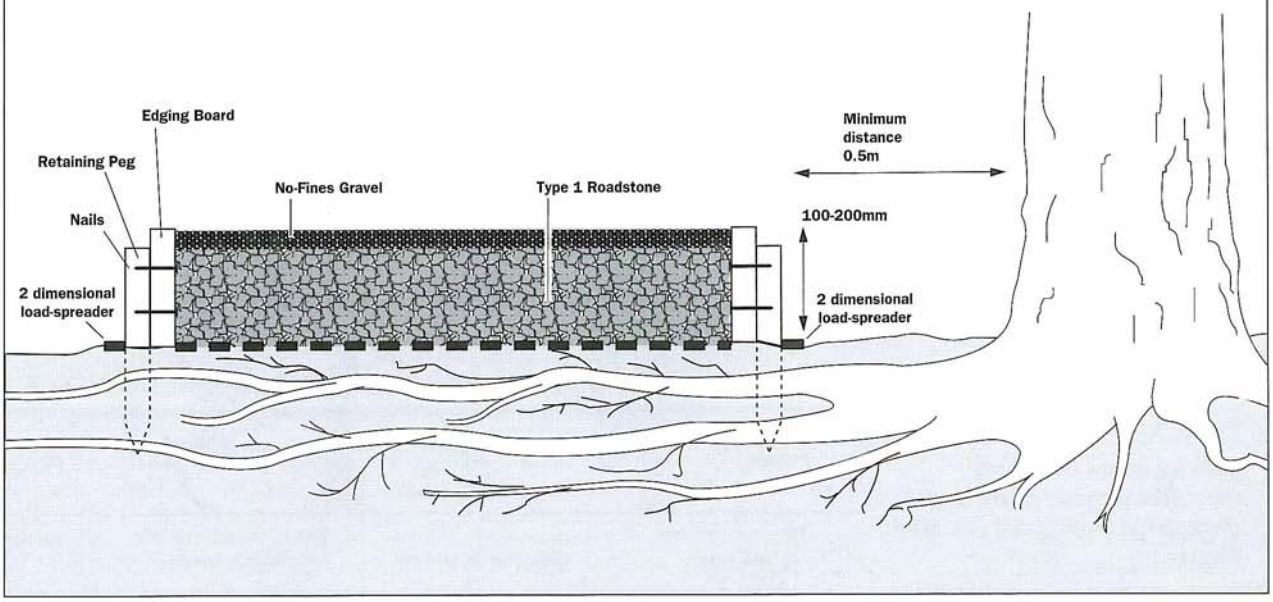
Note: a geotextile, which is usually used to prevent layers of different mineral materials mixing while allowing water to pass through, is not designed to be load bearing.

'Load spreading' materials, are synthetic grids/webs designed to support roads on soft ground by distributing the load of a wheel over a larger area than would normally occur. They may be 2- or 3-dimensional.

When placed on a 2-dimensional grid, appropriate, no-fines granular sub-base material penetrates the mesh, but is unable to pass through it, forming a positive interlock (Figure 4). This interlock between aggregate and grid provides a reinforced platform and efficient load spread into the underlying ground over a wider area than the footprint of the wheel on the surface. A suitable geogrid/aggregate combination constructed with the grid under tension should prevent rutting of the ground beneath the construction (Figure 5).

The 3-dimensional load spreading products (Cellular Confinement System) create cells into which the sub-base material is placed (Figure 6). Such a construction does not support the sub-base material, it confines the material in discrete cells. Manufacturers recommended, therefore, that a geotextile (see note above) is placed between the ground

Figure 5. Diagram of a 'no-dig' method for constructing access drives and parking near to trees in order to minimise damage to tree roots. *(Not to scale)*



and the load spreader to prevent the cell-contained mineral material being pressed down into the underlying soil.

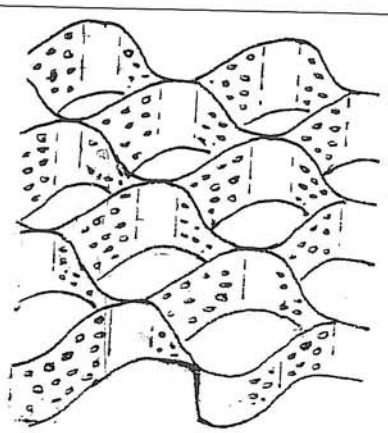


Figure 6.
3-dimensional load-spreader

A no-dig construction, that is a construction above ground level, will need to be contained to prevent outward creep under the weight of vehicles. This may be achieved with an edging support provided its construction does not involve excavation. A suitable material may be long-life timbers pinned through the load-spreader into the underlying soil. This could add strength to the structure because the pressure of vehicles forcing the sub-base downwards and outwards will tend to increase the tension on the grid and any tendency to rutting.

Note: some manufacturers specify that their product should be placed in a 100mm or greater depth of formation (i.e. excavation). It is important that before such a construction is adopted the agreement of an arboriculturist who has considered the circumstances of the tree's health and evaluated the site conditions, should be obtained. Failure to do so could result in breach of a Tree Preservation Order and Conservation Area legislation because roots will inevitably be damaged by an excavation of as little as 100mm.

The granular sub-base material should have a no 'fines' content which means that even when it is compacted it should be freely draining and will allow oxygen to diffuse into, and damaging gases (e.g. carbon dioxide and methane) out of the soil.

For site-specific prescriptions and materials specifications advice should be sought from a qualified geotechnical or civil engineer who should work in consultation with an arboriculturist.

Putting the Principles into Practice

Is the site suitable for a no-dig construction? (see next section)

Construction should ideally be undertaken in dry weather between May and October when the ground is likely to be driest and least prone to damaging compaction.

There must be a method of working that does not require movement of machinery or heavy plant within the branch spread of the tree before the ground is protected by a load spreader and the sub-base. Then the movements must be only along the construction.

For example when making a new access into a site construction should commence at the entrance to the site and 'roll out' the driveway in front of the machinery which always remains over the sub-base.

Ground vegetation should be killed using a translocated herbicide such as glyphosate[2]. (This may be most appropriately done in consultation with an experienced arboriculturist to ensure that the chemical and application method do not result in damage to retained trees.) After allowing time for the chemical to be absorbed and kill the plants, including their roots, gather up the dead organic material - this will prevent the build up of anaerobic conditions beneath the construction which might otherwise occur as dead vegetation decomposes.

Carefully remove major protrusions such as rocks.

Remove tree or shrub stumps (stumps should be ground out rather than excavated to minimise soil disturbance).

Fill major hollows with clean sharp sand – **DO NOT GRADE-OFF HIGH SPOTS**.

If necessary, for example when using a three dimensional cellular confinement product as a load spreader, a geotextile should be spread over the area of the driveway or car park.

With a two dimensional load spreading product into which the no-fines sub-base stone forms a lock a geotextile may be used but it is not essential.

Lay the synthetic load spreader directly onto the levelled ground or the geotextile as appropriate.

Secure the synthetic load spreader under tension using long pins driven into the ground through the grid.

Note: Before driving pins into the ground check for underground services that could be damaged.

Construct an edging which is secured through the load spreader so that pressure on the running surface will force the edging outwards and so increase the tension on the load spreader.

Cover the load spreader with a minimum of 100 mm of no-fines aggregate. This should not be tipped straight onto the synthetic material, but should be placed at one end and then pushed onto the load spreader between the retaining edges so that machinery is supported by the spread sub-base material rather than directly on the load-spreader and not on the ground either side of it.

Compact the sub-base to ensure binding with the load spreader and to minimise future rutting.

[2] When selecting a herbicide care must be taken to select a product which does not damage the roots of desirable vegetation that may extend into the treated area. Always read the product label before use.

A further geotextile may be placed over the sub-base to prevent dry bedding materials or surfacings merging with the sub-base.

Place the final surface. In the main it is likely that this will consist of gravel or tarmacadam, although paving slabs and brick paviours may be acceptable provided they are dry bedded on the sub-base and the joints are not sealed with grout, to allow for infiltration of water and gaseous diffusion[3].

Where a mass concrete, or impervious surface material is required the specification for an adoptable road (see below) should be used.

Sites are not all the Same!

The principles detailed above, if applied sensibly, should permit access to be constructed across the root system of a healthy tree. That is where the construction passes through the Root Protected Area retained around a tree as recommended by British Standard BS 5837:2005 *Trees in relation to construction - Recommendations.*

Why the 'sensibly'? No two sites are the same, in fact some are totally unsuitable for a no-dig construction and it may be necessary to admit that access to the site cannot be achieved if certain trees are so important/valuable that their retention is essential. For example, where trees grow on an old hedge bank excavation to cut through the bank may be unavoidable and so an unacceptable proportion of the root system would be severed. In contrast ditches that can be filled/piped/bridged (Figure 7) should be less problematic.

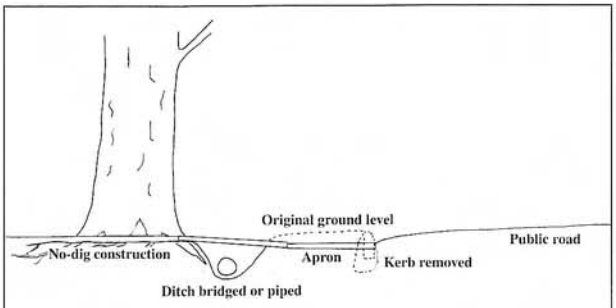


Figure 7. No-dig construction and a ditch.

When planning a driveway it is important to consider the ground levels on site and to relate them to the fixed level on the public thoroughfare into which the drive must connect and be tied. Where a roadside verge within the root protection area around a tree cannot be crossed without excavations then a different access point may be needed if the tree is deemed to be of very significant value to the amenities of the area.

Highway Authorities generally seek an 'apron' (upto 4m long), with a shallow or no gradient and a sealed surface at the entrance to a site where the drive joins the highway. This is to reduce the risk of loose material migrating onto the footpath and road where it could become a hazard. Such an apron may involve excavation thus reducing the scope for a drive constructed using the no-dig principles.

The simplest site on which a no-dig construction can be used is where the ground falls into the site from the edge of the road. Level sites should not pose significant problems provided there is an adequately wide verge/pavement to accommodate the 'apron' without severing roots.

It is also important to remember that the no-dig construction needs to tie onto the road and also the levels of the garage or damp proof course of a building.

The roots of a tree will generally grow parallel with the ground surface – they do not grow preferentially up, down or across the slope! As such trees growing on a slope do not present any problems different from those of trees growing on a flat site – it is the engineering requirements that differ! Where the drive crosses the contours at a gentle angle, there is no reason why the depth of a no-dig construction should be constant across its width of a drive. The engineering problem may be how to retain the structure. The scope for increasing the lift on one side of a drive is not unlimited – probably 1:3 should be a maximum (Figure 8).

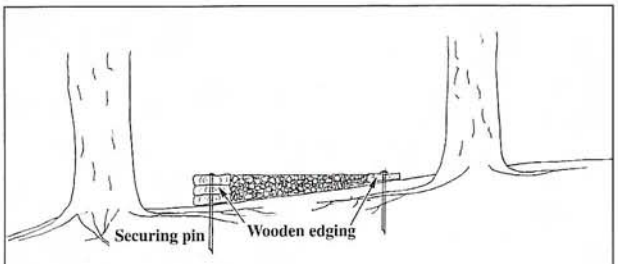


Figure 8. No-dig construction across a slope.

Permanently wet areas of ground should normally be drained, or they may be filled with no-fines stone, or if the water is flowing, they may be partially piped. In contrast, seasonally wet areas may benefit from drainage and building up the ground with coarse stone with a low fines component over which the drive is constructed.

The depth of each layer in the construction of a no-dig drive will be influenced by the bearing capacity of the ground over which the drive will pass. Also there must be consideration of the weight of traffic that will use the drive. The final design should, therefore, be achieved in discussion between a civil engineer and an arboriculturist.

A Potential Benefit

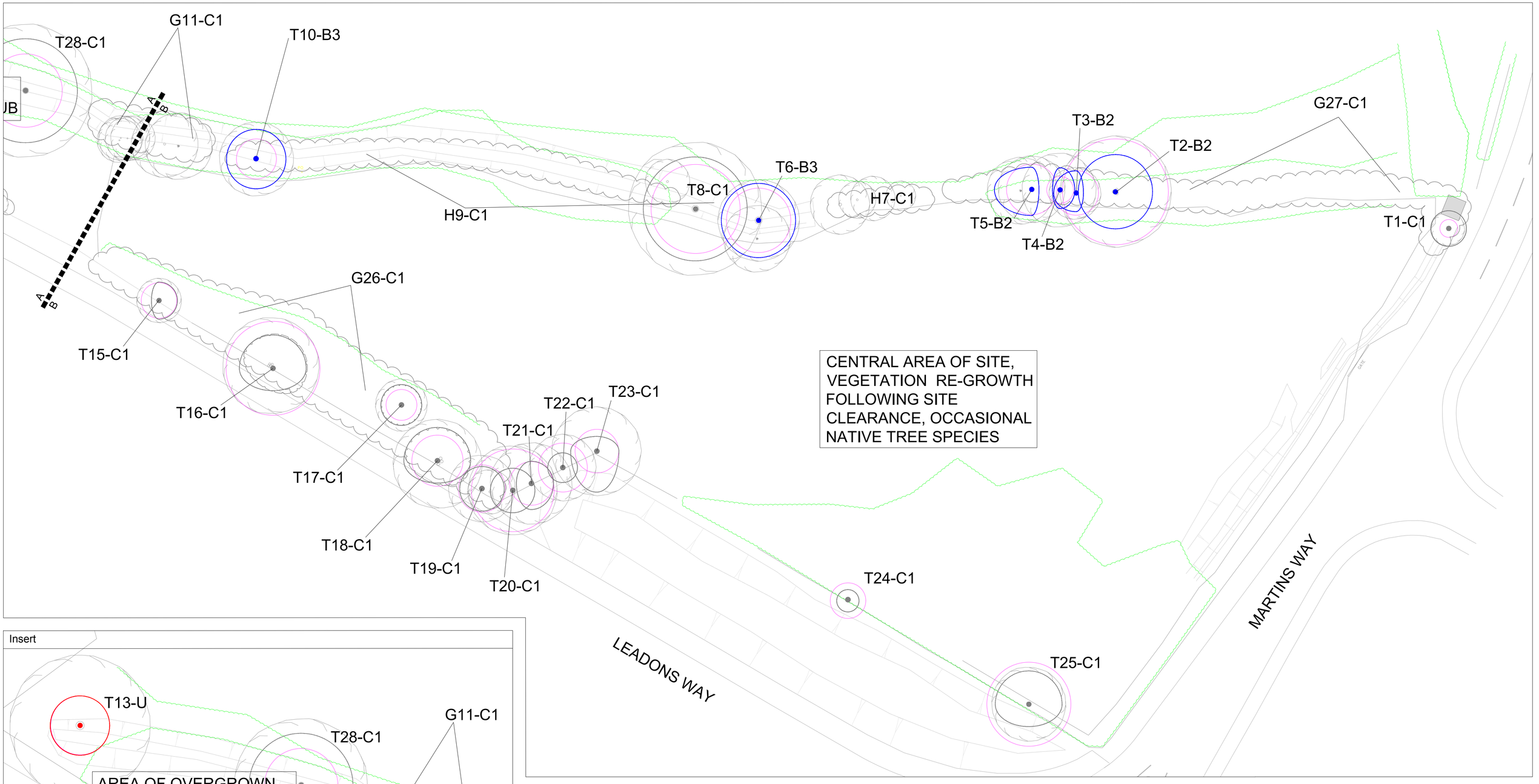
Inclusion of a load spreader in a construction should offer resistance to direct damage often caused to drives and car parks by diameter growth of roots under the structure.

[3] For drives less than 5m wide the finished surface may be constructed of a less permeable material such as asphalt/or reinforced mass concrete.

ACCOMPANYING DRAWINGS

1 Tree Survey Drawing B18058-TLP-601

2 AIA AMS Drawing B18058-TLP-602



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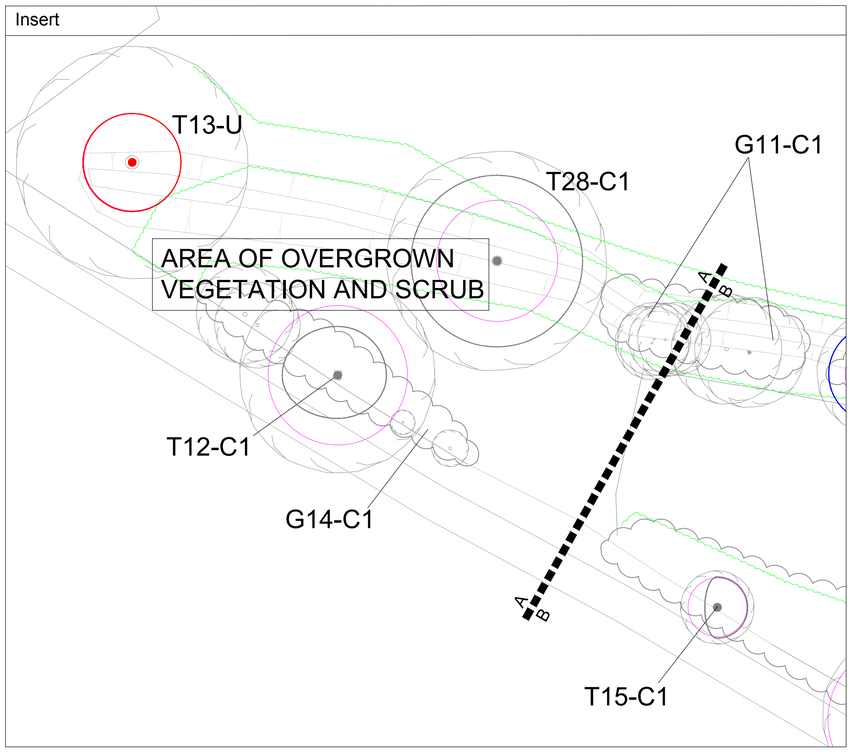

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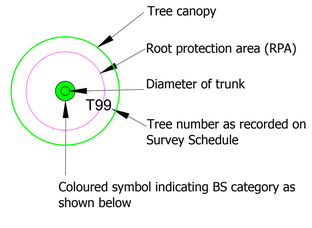
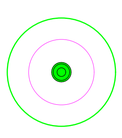
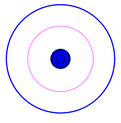


Note: Underlined tree number denotes tree located by eye. Locations should be checked on site and if necessary drawings amended.

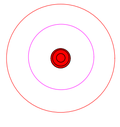


Category A tree
BS5837 2012



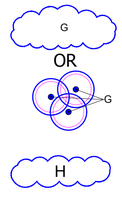
Category B tree
BS5837 2012

Category C tree
BS5837 2012



Category U tree
BS5837 2012

The BS categories (to the left) are judgements of quality and value based on the contribution each tree would be expected to make over a given period of time, categories A, B and C being high, moderate and low respectively. Category U represents trees that, in their current context, should be removed for sound arboricultural reasons. For exact definition of BS categories refer to notes accompanying schedule.



Group (Group of similar trees recorded together in schedule). Colours same as BS5837 2012 categories for trees (above)

Hedge Colours same as BS5837 2012 categories for trees (above)

Revision	Number	By	Date
Enter revision description	XX	XX	XX-XX-XXXX

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Project
Martins Way, Ledbury

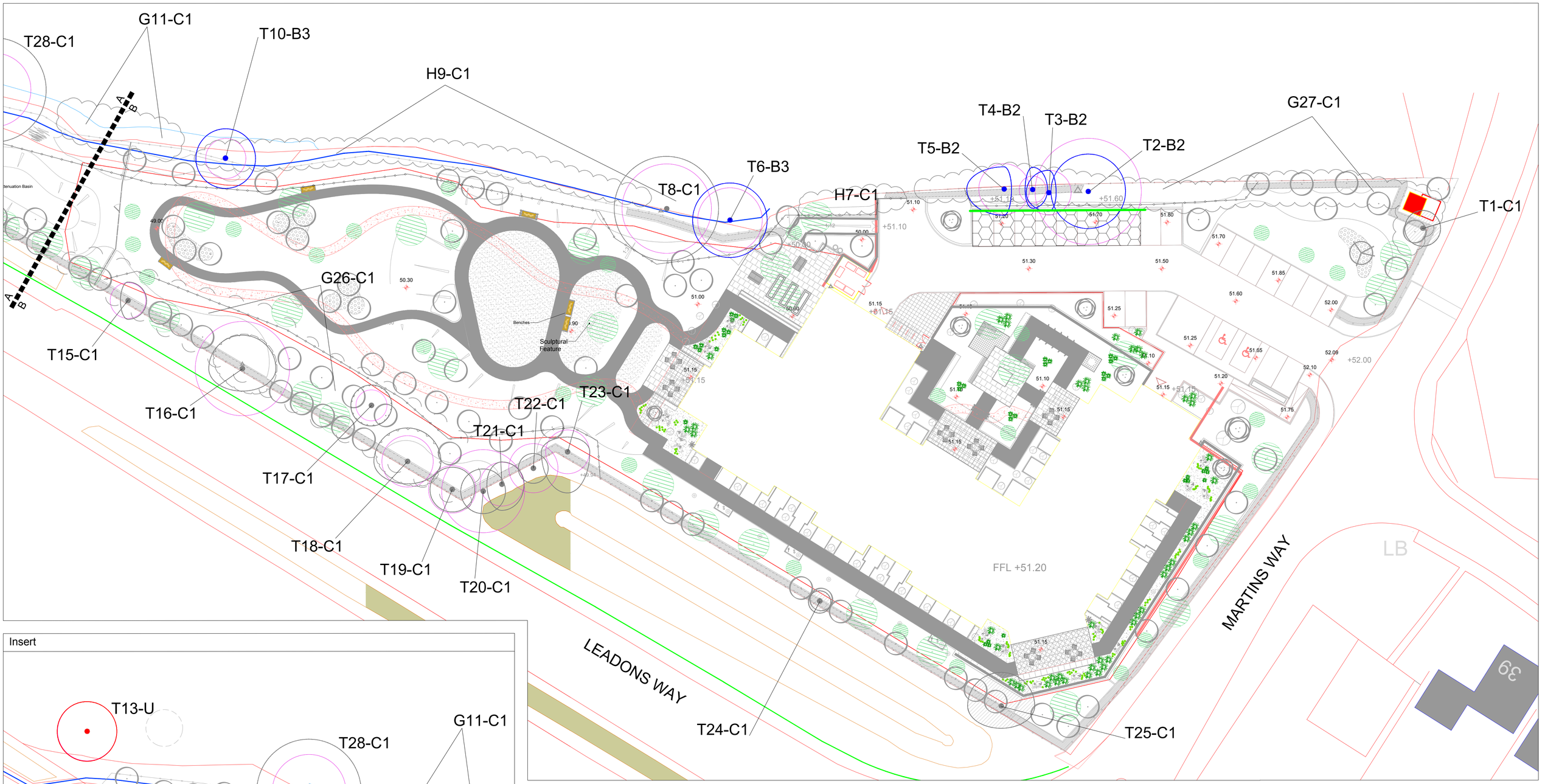
Bedford	01234 261315	☐
Woodbridge	01394 380509	☒
London	020 3092 4141	☐
Norwich	01603 230777	☐

Drawing
Tree survey

Job No.	B18058
Dwg. No.	B18058-TLP-601
Scale	1:250@A1
Drawn	LH
Checked	MLR
Date	02-07-2018

Status
PLANNING

North



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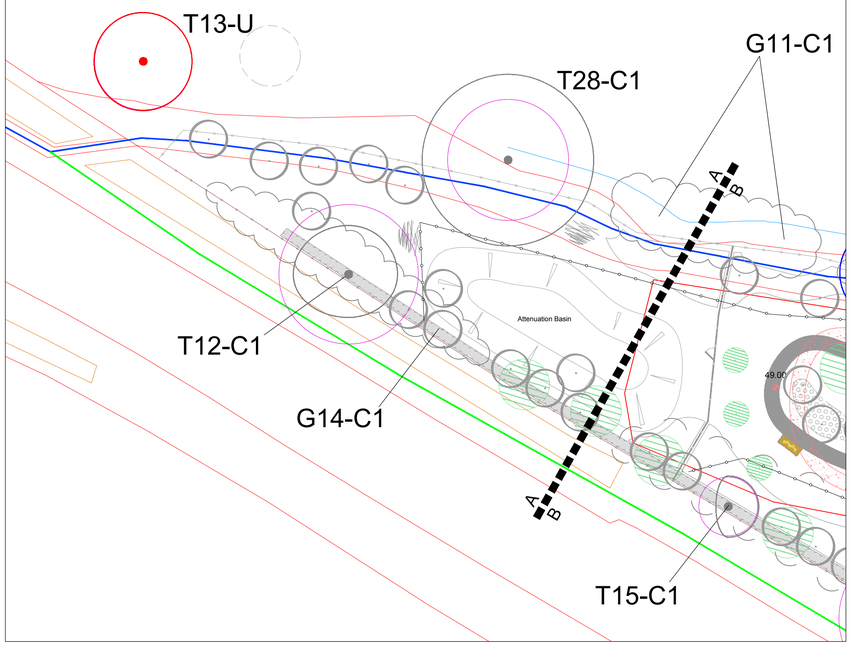

Key

Tree categories

- Category A tree — BS5837 2012
- Category B tree — BS5837 2012
- Category C tree — BS5837 2012
- Category U tree — BS5837 2012

Tree canopy
Root protection area (RPA)
Diameter of trunk
T2 — Tree number as recorded on Survey Schedule
Coloured symbol indicating BS category as shown left

G — Group (Group of similar trees recorded together in schedule). Colours same as BS5837 2012 categories for trees (above)

H — Hedge Colours same as BS5837 2012 categories for trees (left)

The BS categories (to the left) are judgements of quality and value based on the contribution each tree would be expected to make over a given period of time, categories A, B and C being high, moderate and low respectively. Category U represents trees that, in their current context, should be removed for sound arboricultural reasons. For exact definition of BS categories refer to notes accompanying schedule.

Note: Underlined tree number denotes tree located by eye. Locations should be checked on site and if necessary drawings amended.

Arboricultural Strategy

- Tree to be retained — Colour reference in accordance with the categories defined by BS:5837
- Tree to be removed — Colour reference in accordance with the categories defined by BS:5837
- Tree group to be retained — G1 — Colour reference in accordance with the categories defined by BS:5837
- Group/Part of group to be removed — G1 — Colour reference in accordance with the categories defined by BS:5837

Line along which Tree Protection Barrier should be installed. Refer to accompanying AIA/AMS report for specification.

Area of hard surface to be installed following a 'no dig' method of construction in accordance with APN12

Area of supervised construction. Refer to accompanying AIA/AMS report for details.

Revision	Number	By	Date
Enter revision description	XX	XX	XX-XX-XXXX

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Norwich 01603 230777 ☐

Project
Martins Way, Ledbury

Drawing
Arboricultural Impact Assessment and Arboricultural Method Statement

Job No.	B18058
Dwg. No.	B18058-TLP-602
Scale	1:250@A1
Drawn	sm
Checked	MLR
Date	24-01-2019

Status
PLANNING

North