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TREE DECAY DETECTION REPORT

CLIENT	Mr M Burroughs 18 All Saints Road Poringland Norwich NR14 7TA
SITE/TREE INSPECTED	As above Oak located in front garden
INSPECTED BY	Colin McDonald Tech Cert (ArborA) Arboricultural Consultant Treecare Consultants Ltd
DATE OF INSPECTION	11 October 2022

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1. INTRODUCTION

1.1. ASSIGNMENT

I have been instructed by Mr M Burroughs of 18 All Saints Road, Poringland to carry out decay investigation and analysis of an early mature Oak tree in the front garden by means of a Picus Sonic Tomograph and an IML Resi PD400 resistance microdrill. The results of this are presented in this report.

1.2. QUALIFICATIONS AND EXPERIENCE

I have based this report on my site observations and investigations and I have come to conclusions in the light of my academic and experiential knowledge. I have qualifications and practical experience in arboriculture and list the details in Appendix 1.

1.3 LIMITATIONS AND USE OF COPYRIGHT

Trees are living organisms whose health and condition can change rapidly. The conclusions and recommendations in this report are only valid for six months. Any changes to the site as it stands at present, eg building of extensions, excavation works, importing of soils, extreme weather events etc will invalidate this report.

1.4 DISCLAIMER

I have no connection with any of the parties involved in this situation that could influence the opinions expressed in this report.

1.5 DECAY DETECTION

The decay detection was carried out with a Picus Sonic Tomograph and verified by a Resistance Drill Test. Further analysis was undertaken using ArboStApp software by Rinntech. Further information on these decay detection and analysis methods is detailed in Appendix 2.

2. THE SITE

2.1. SITE VISIT

I carried out the visit on 11 October 2022. The weather at the time of inspection was dry and bright with good visibility.

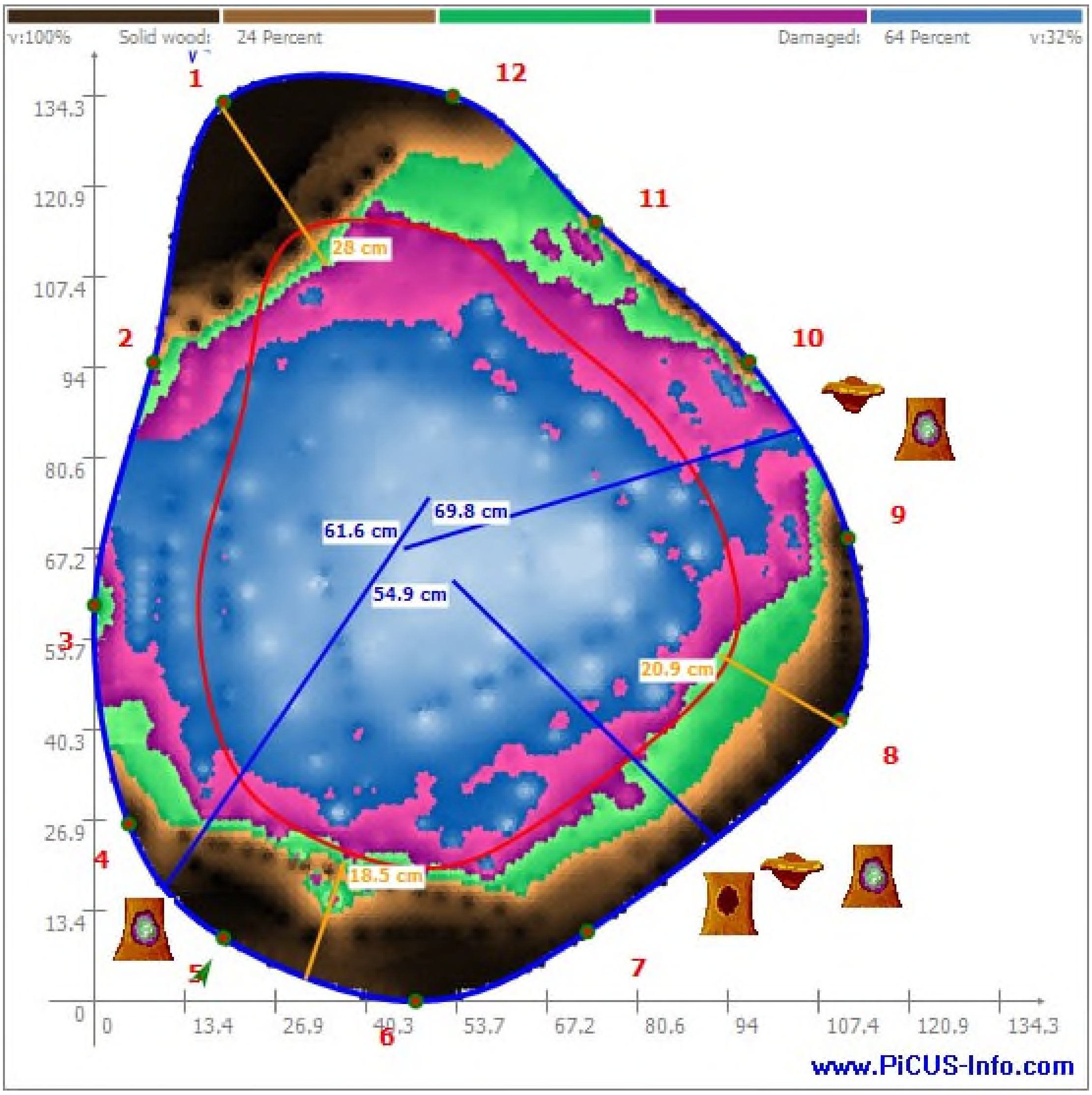
2.2 SITE DESCRIPTION

The detached two storey domestic property of 18 All Saints Road is located within a modern housing development in the village of Poringland. The Oak tree pre-dates the housing development which I would estimate was constructed in the mid 1990's. The tree is positioned within the front lawned garden at a distance of 6.5m to the east of the house. All Saints Road and public footpath is positioned 1.5m to the east of the tree. On the day of assessment the frequency of pedestrian traffic using the footpath was moderate especially around 3.45pm when the local school children and parents were returning home.

3. TREE DATA

Tree No:	1	**Species:**	Oak / Quercus robur					
Age:	Early mature	**Height:**	19	m				
Crown Spread (m):	**N**	7	**S**	7	**E**	6.5	**W**	5.5
Trunk Circumference at 1.3m:	233	cm						
Form:	Open grown tree with single main stem supporting a full spreading canopy.							
Comments:	There are no visible signs of instability of the root plate in the form of ground heave or subsidence. It is expected that there was significant root damage impact during the development of the housing scheme approximately 27 years ago. Single main stem which forks at 6m into two co-dominant stem with a strong U shaped union. Notable swelling of reactive growth over basal stem decay of the lower stem to 1m from ground level (see Picus Tomogram in section 4). There is an open cavity, 30cm x 15cm, on the south side of the lower stem at ground level. This cavity contains a fresh Ganoderma resinaceum fungal fruiting body as well as a clump of old blackened and decayed fungal fruiting bodies which are also possibly Ganoderma resinaceum. When probed the metal probe entered significantly into the lower stem decay by 55cm. There is an area between the root buttresses on the east side of the lower stem where fungal fruiting bodies have recently been removed. When probing between root buttresses at this point, the probe entered significantly into the stem decay by 63cm. An area of sunken bark was evident on the west side of the stem base at ground level. When probed the probe entered significantly into the stem decay to 70cm. There was a notable hollow tone on the southern and western stem base when sounded with a mallet. The crown appeared to be in reasonable vigour with no evidence of notable die-back. There is a natural amount of small to medium sized deadwood less than 7cm in diameter throughout the crown. There are two long narrow ribs of growth adjacent to each other on the east and west side of the co-dominant stem to the north at 7m from ground level. These ribs are 2.5m in length and have formed as adaptive growth possibly as the result of an old crack.							
Position of Tomogram taken:	Through the stem.							
Level of measurement above ground level:	5	cm						

4. TOMOGRAM



Blue lines indicate depth and positions of metal probe into decay within the lower stem.
Orange lines indicate depth of remaining solid wood.

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5. PHOTOGRAPHS

Oak from the south

Oak from the east

Open cavity with fungal fruiting bodies on south side of lower stem – Red line indicates scan level

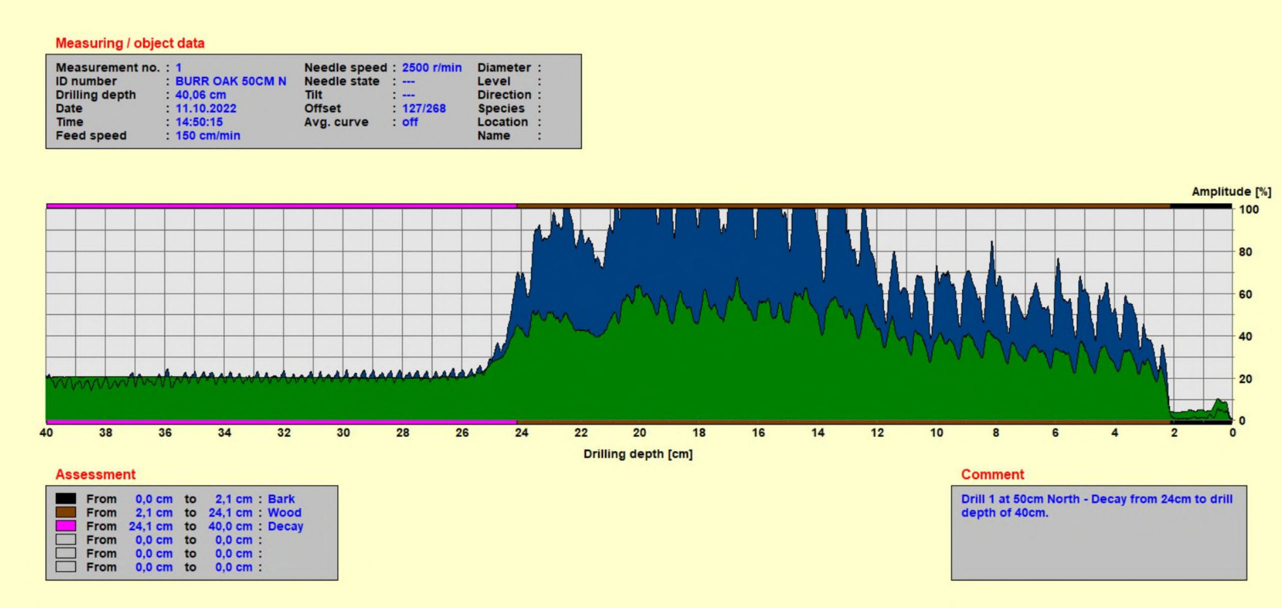
Open cavity with scars from removed fungal fruiting bodies on east side of lower stem

Stem base from the west

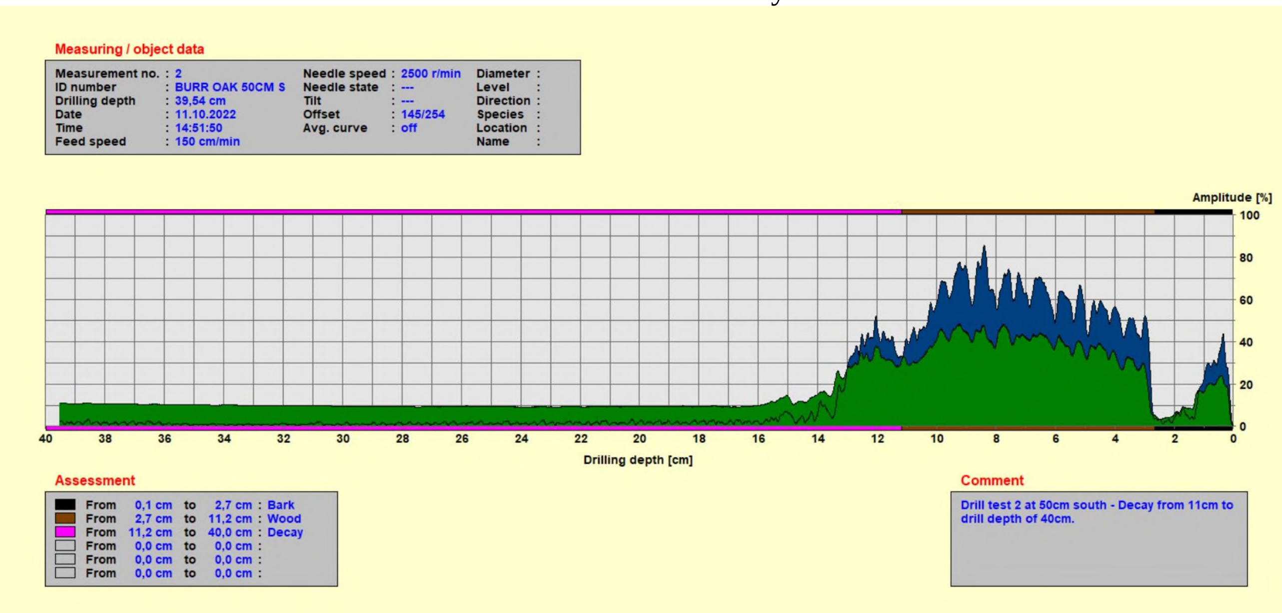
Main stem section

6. RESISTANCE DRILL TESTS

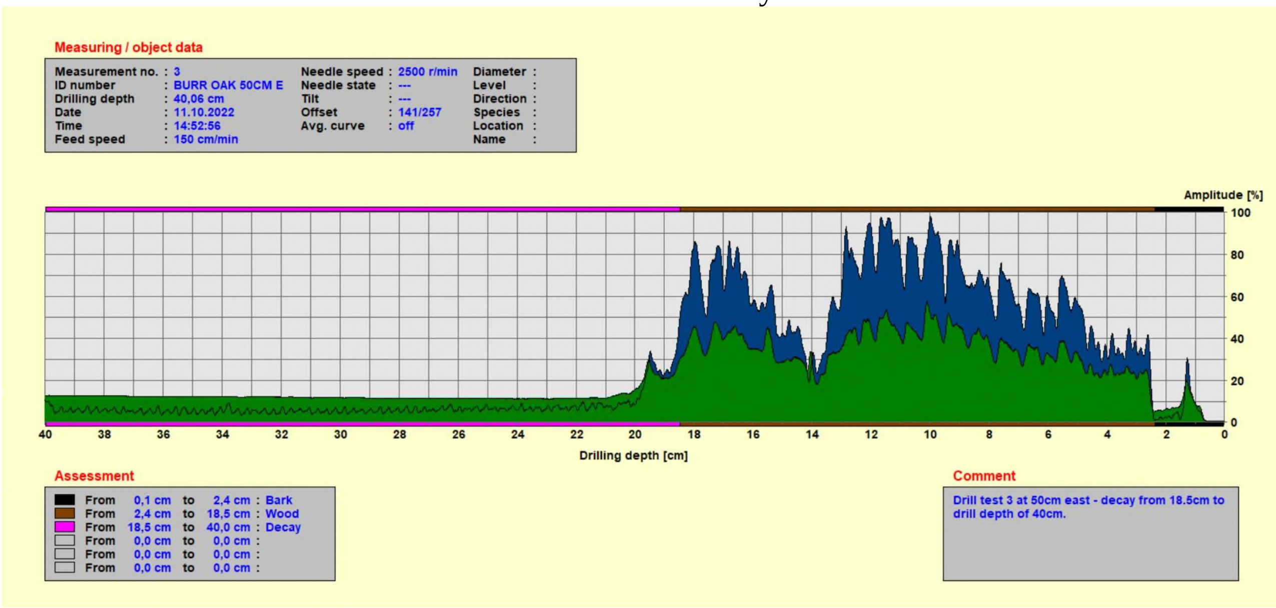
Drill test 1 at 50cm north – Decay from 24cm



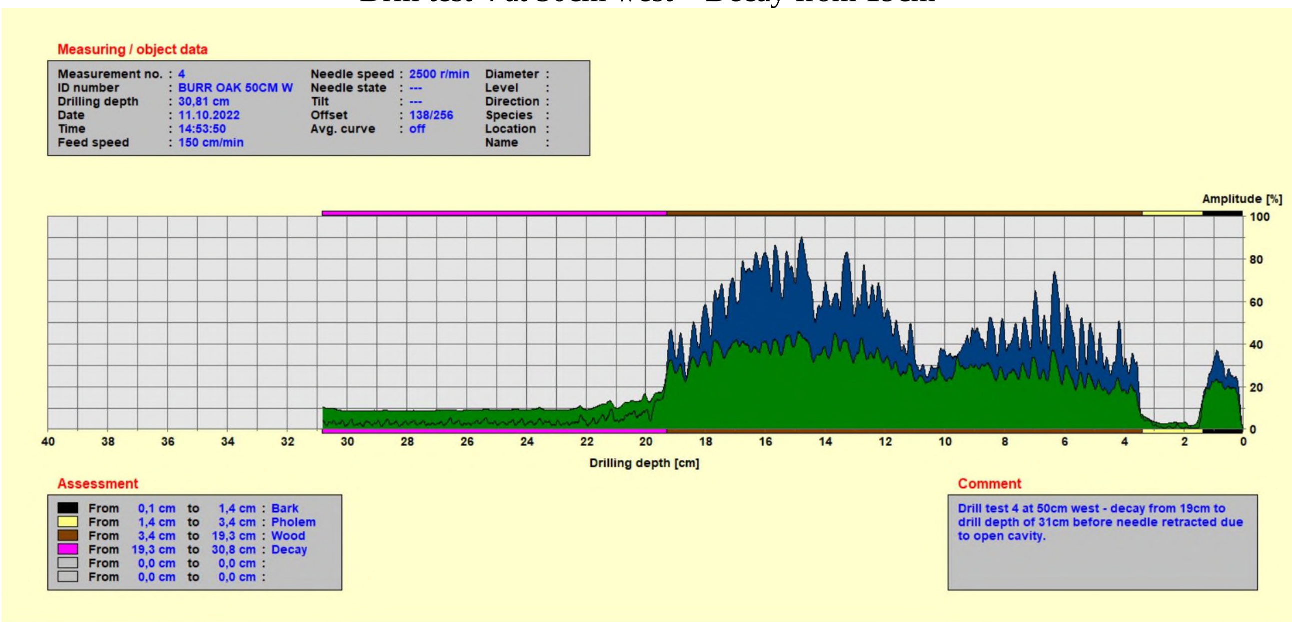
Drill test 2 at 50cm south – Decay from 11cm



Drill test 3 at 50cm east – Decay from 18cm



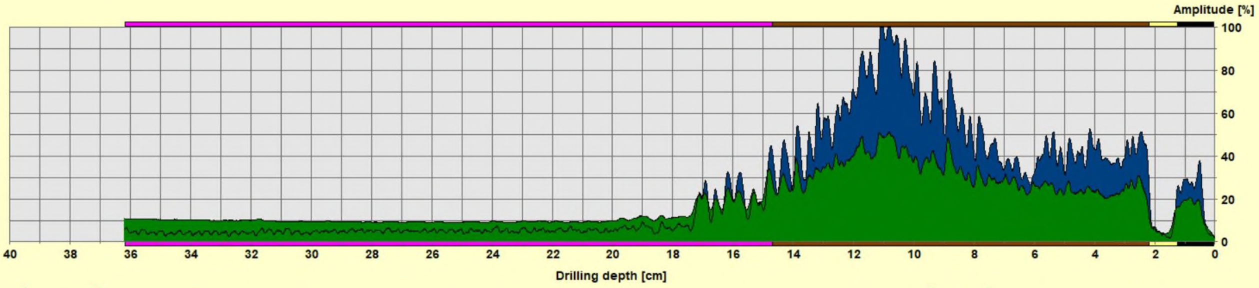
Drill test 4 at 50cm west – Decay from 19cm



Drill test 5 at 100cm south – Decay from 15cm

Measuring / object data

Measurement no.	: 5	Needle speed	: 2500 r/min	Diameter	:
ID number	: BURR OAK 100CM S	Needle state	: ---	Level	:
Drilling depth	: 36,21 cm	Tilt	: ---	Direction	:
Date	: 11.10.2022	Offset	: 129/257	Species	:
Time	: 14:55:10	Avg. curve	: off	Location	:
Feed speed	: 150 cm/min			Name	:



Assessment

From 0,1 cm to 1,2 cm : Bark
From 1,2 cm to 2,2 cm : Pholem
From 2,2 cm to 14,7 cm : Wood
From 14,7 cm to 36,2 cm : Decay
From 0,0 cm to 0,0 cm :
From 0,0 cm to 0,0 cm :

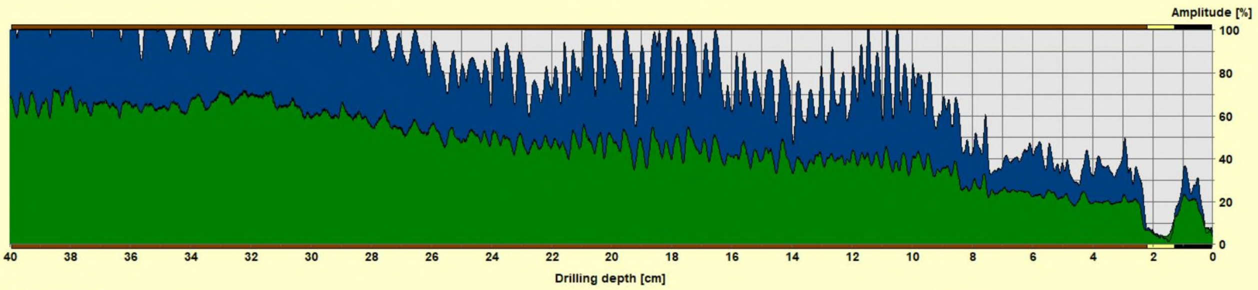
Comment

Drill test 5 at 100cm south - decy from 15cm to drill depth of 36cm before needle retracted due to open cavity.

Drill test 6 at 150cm – No decay present to drill depth of 40cm.

Measuring / object data

Measurement no.	: 6	Needle speed	: 2500 r/min	Diameter	:
ID number	: BURR OAK 150CM S	Needle state	: ---	Level	:
Drilling depth	: 40,06 cm	Tilt	: ---	Direction	:
Date	: 11.10.2022	Offset	: 139/253	Species	:
Time	: 14:56:43	Avg. curve	: off	Location	:
Feed speed	: 150 cm/min			Name	:



Assessment

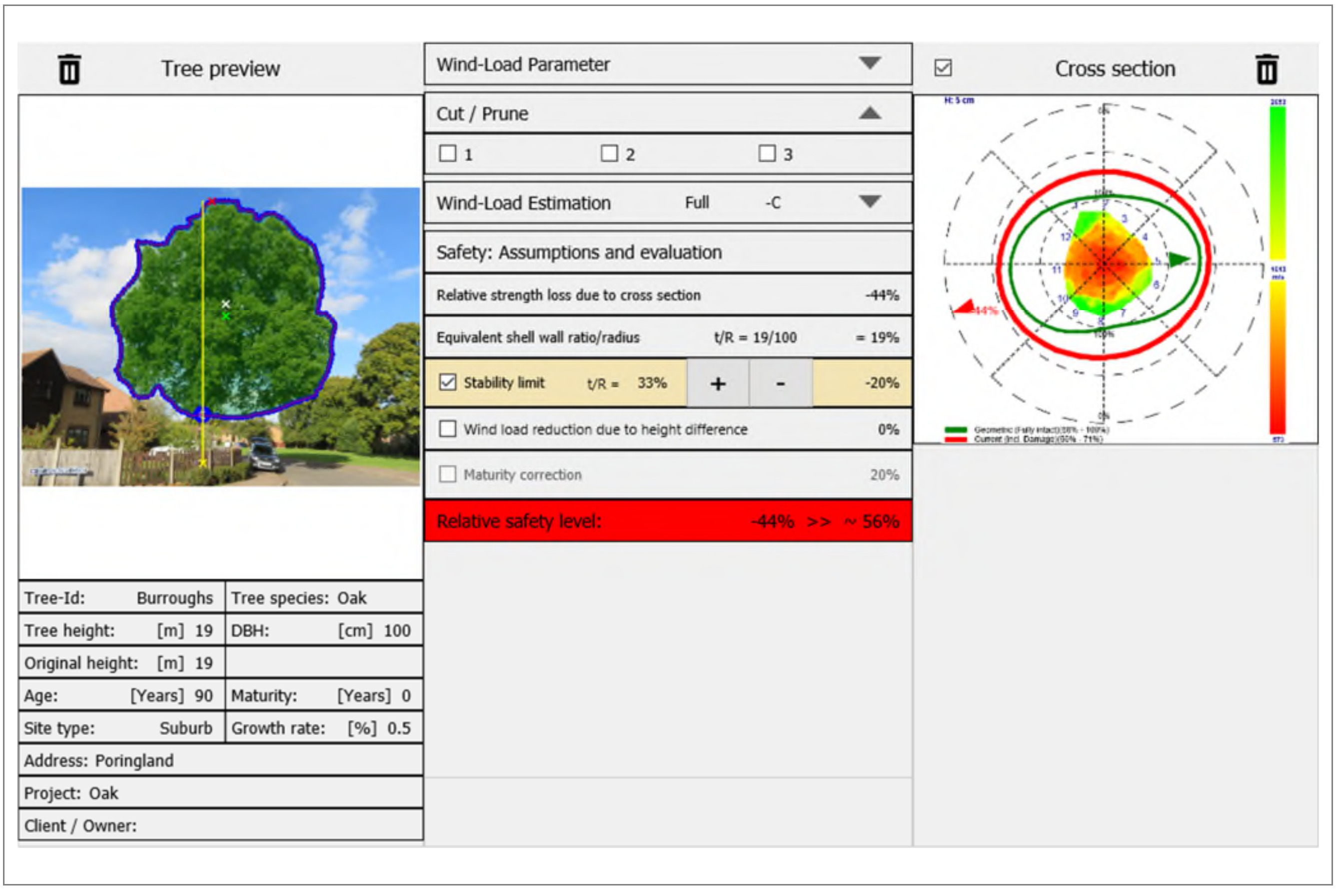
From 0,1 cm to 1,3 cm : Bark
From 1,3 cm to 2,2 cm : Pholem
From 2,2 cm to 39,9 cm : Wood
From 0,0 cm to 0,0 cm :
From 0,0 cm to 0,0 cm :
From 0,0 cm to 0,0 cm :

Comment

Drill test 6 at 150cm south - No decay present to drill depyh of 40cm.

7. BIOMECHANICS SOFTWARE ANALYSES

Results as the tree stands at present in relation to the relative strength loss due to decay – Relative Safety Level = 56%. The minimum acceptable level would be 100%.



8. CONCLUSION

As requested, I have visited the property of 18 All Saints Road, Poringland to carry out a detailed decay assessment of the lower stem. An initial visual assessment identified the presence of both fresh and old fungal fruiting bodies of what would appear to be Ganoderma resinaceum on the southern and eastern sides of the lower stem. There was a notable hollow tone to the lower stem on the southern and eastern sides when sounded with a mallet. On probing the stem at ground level with a metal probe, the probe entered significantly into the stem on the southern, eastern and western aspects by up to 70cm depth. There is notable stem swelling of the lower stem to 60cm above ground in reaction to underlying decay.

In order to fully establish the extent of decay a Picus Tomograph decay scan was carried out at just above ground level. The resulting tomogram identified an extensive area of decay within the stem base and root crown. The tomogram estimates 64% damaged wood shown by the blue and violet colouring with only 24% of solid wood remaining shown as brown. The green colouring is intact wood with less density than the solid wood but most likely contains insipient decay which makes up the remaining 12% of the cross section tissue.

The decay pattern is shown to be breaking through to the outer shell wall of the stem on the east and west side with minimal solid wood connection to the northern and southern outer shell walls. There is a large solid root buttress to the north but the solid wood residual wall to the south is notably thin with less than 20cm depth.

In order to establish how high the decay extends up the stem, resistance drill tests were carried out at 50cm above ground on the main compass aspects. The results of these tests are shown in section 6 of this report. The drill tests identified an extensive decay cavity at a depth of between 11cm and 24cm. A drill test was taken on the southern side of the stem at 100cm which identified decay at 15cm depth and a further drill test taken at 150cm on the same side identified no decay. The internal decay cavity therefore extends up the stem to a height of approximately 125cm.

Ganoderma resinaceum is mainly found in the warmer climate of southern England and East Anglia. It is usually found on Oak species and London Plane and it is associated with root and lower stem decay. The fruiting bodies of Ganoderma resinaceum are annual, soft and corky which distinguishes it from other Ganoderma species in this country. The outer surface has a waxy crust which cracks with pressure. Ganoderma species causes a white, soft, spongy rot where lignin is selectively removed over a period of time. As the decay progresses, the wood becomes progressively softer and loses its stiffness but not its toughness. In the early stages, the decay can still contribute to the stability and fracture safety of the tree. The decay can develop extensively as the decay has the ability to compromise the previously sound sapwood. Recent research by Francis Schwarze suggests that Ganoderma resinaceum has some ability to break through reaction zones. These reaction zones are laid down by the tree to compartmentalise the decay from sound wood. If the decay is extensive, uprooting or stem breakage can occur.

A biomechanics Rinntech software analysis estimates a stem cross sectional strength loss in relation to the decay as -44% (see section 7). The relative safety level of the stem cross section at present is therefore calculated as 56%. The minimum acceptable level would be 100% without having to mitigate with intervention and therefore the tree has an unacceptable level of safety at present. The decay within the lower stem is excessive and is breaking through the outer residual stem wall on two sides. The risk is therefore that the lower stem will collapse through torsional loading from wind forces exerted on the crown lever arm causing twisting of the stem base. The decay will continue to progress increasing the risk and it is therefore recommended that this tree is removed at this stage in order to prevent the risk of harm or damage occurring as a result of structural failure of the tree

9. RECOMMENDATIONS

It is recommended that the tree is felled as soon as practically possible but within six months.

10. COMMENTS

10.1 IMPLEMENTATION OF WORKS

All tree work should be carried out to BS 3998:2010 ‘Tree work - Recommendations’.

10.2 TREES SUBJECT TO STATUTORY CONTROLS

Individual trees and woodlands in any location may be protected by legislation for various reasons. The reasons for protection can include visual amenity, biodiversity, wildlife protection or to avoid unnecessary tree loss. Substantial penalties can be incurred for contravention of legal protection. The main type of protection in an urban setting is when trees are protected within a Conservation Area or by a Tree Preservation Order (TPO) or if they are occupied by specific wildlife.

A search of the Local Planning Authority (South Norfolk Council) website identifies that the tree is subject to a Tree Preservation Order No TPO SN372. It will be necessary to apply to the LPA for permission to carry out any work on protected trees. The LPA has eight weeks to respond to the application to either refuse or permit the work applied for. The LPA can also make alternative work recommendations.

If an application for work is refused, or allowed subject to conditions, or if the council fails to deal with the application within 8 weeks, the applicant has a right of appeal to the Secretary of State under the provisions of section 78 of the Town and Country Planning Act 1990 (as amended).

The work specified in this report is necessary for reasonable management and should be acceptable to the LPA. However, tree owners should appreciate that they may take an alternative point of view and have the option to refuse consent.

Habitats Regulations

Bats, nesting birds and some mammals are protected under the Conservation of Habitats and Species Regulations 2010, Wildlife and Countryside Act 1981 and (as amended) Wildlife and Countryside Act 2000. A risk assessment will be required prior to commencement of any tree work or felling to assess the likelihood of disturbing or endangering any protected wildlife or habitat. If any protected species are present in any of the trees, or if the tree has a known bird nest or bat roost, then consultation with the Statutory Nature Conservation Organisation (SNCO) must be undertaken, prior to commencement of work.

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APPENDIX 1

QUALIFICATIONS

Colin McDonald Tech ArborA

Qualifications and Professional Development

1. QUALIFICATIONS

- IOSH Health & Safety – Leading Safely – Feb 2017
- LANTRA Professional Tree Inspection – July 2007. Refresher – Oct 2014
- Tech Cert (ArborA) - ABC Arboricultural Association's Technicians Certificate 2005
- NPTC – certificates of competence in Arboriculture
- City and Guilds stages I & II in Forestry – 1981 – Inverness Technical College

2. CAREER SUMMARY

Colin McDonald began his career with trees after leaving school in 1978 serving an apprenticeship with Livingston Development Corporation. After gaining practical experience he attended Inverness Forestry College gaining a City and Guilds certificate at distinction level and was awarded student of the year for obtaining the highest mark in the country for stage II. Colin worked his way up to Chargehand Forester/Arborist within the Corporation before leaving in 1986 to join Norwich City Council Tree Department as an Arborist.

In 1989 he went into partnership with Nick Coleman and together they formed Treecare. He gained his Arboricultural Association Technician's Certificate in 2005. In June 2005, the business became incorporated as Treecare Consultants Ltd. Through practical experience, continual professional development and Colin has now gained a reputation as a leading arboricultural consultant.

3. AREAS OF EXPERTISE

- Tree hazard risk assessments for tree owners
- Decay assessment and mapping
- Development Site Surveys to 'BS5837 2012: Trees in relation to Design, Demolition and Construction – Recommendations', including Arboricultural Impact Assessments and Method Statements
- Diagnosis of tree disorders
- Tree management reports to prioritise maintenance programs
- Tree ecology and conservation advice, in particular with relation to the specific needs of ancient trees
- Woodland design for conservation
- General arboricultural advice

4. CONTINUAL PROFESSIONAL DEVELOPMENT

Some relevant courses attended:

- Tree Architecture – Tom Joye of Inverde (Belgium), Ancient Tree Forum – November 2019
- Fungal symposium – Arboricultural Association online learning - 2021
- Refresher Course - Picus Sonic Tomograph/IMLResi decay detecting drill – Sorbus International with John Harraway – October 2019
- The mycorrhizal world with Lucio Montecchio – Barcham Trees 10 July 2019
- Tree Architecture and Morphophysiology with Stefania Gasperini and Biovanni Morelli – Barcham Trees – April 2019
- Applied Tree Biology – Arboricultural Association - November 2018
- Re-inventing pruning – Barcham trees and Bruce Fraederich – October 2018
- Ash dieback seminar – Norfolk County Council – August 2018
- Thinking Arb Day – Outdoor seminar Nottingham Forest Arboricultural Association – Feb 2018

- MTOA: Tree Safety Inspections and Advanced Tree Safety Inspections for Arborists - Frank Rinn – September 2017
- Tree Risk: What's the Likelihood of Failure – Arboricultural Association - August 2017
- Assessment of Tree Forks – Arboricultural Association – August 2017
- Risk Assessment for Commercial Arboriculture, Arboriculture Association – March 2017
- IOSH Leading Safely Course – February 2017
- Picus Sonic Tomograph – tree ultrasound decay assessment masterclass at Kew Gardens – October 2016
- BS5837: Tree Surveying and Categorisation – April 2015
- BS5837: Advanced: Tree assessment for Planning – May 2016
- BS5837: Advanced: Managing Trees on Construction Sites – May 2016
- ISA Tree Risk Assessment Qualified (TRAQ), International Society of Arboriculture – July 2014
- Sustainability and the Urban Forest – 49th Arboricultural Association Conference 2015
- Tree research update with Glyn Percival of Bartlett Trees – April 2015
- Professional Tree Inspector refresher and update – October 2014
- Visual Tree Assessment Methodology – latest research and update seminar. Dr Claus Mattheck – May 2014
- What's new in tree risk management and tree heritage assessment – Nov 2012
- Veteranisation Course – National Trust – Nov 2012
- BS 5837 2012 – Overview of the recent changes – Richard Nicholson, Barcham Trees May 2012
- Consulting Arborist Society – Mortgage and Insurance – February 2012
- Bats Survey: Surveying Trees – March 2011
- Biology of Decay in Trees – National Trust – October 2010
- Modern Diagnostic Devices for Decay/Defect Assessment – April 2010
- Meripilus Seminar – November 2008
- Subsidence and Trees: A Collaborative Approach – October 2008
- Council Decay Detection Master Class (Picus Sonic Tomograph) – July 2008
- Professional Tree Inspection – July 2007
- Tree Morphology Part II – June 2007
- Certificate in Continuing Education : Field Identification of Fungi – October 2006
- The Future of Tree Risk Management – September 2006
- British Standard 5837 Applications and Implications – March 2006
- Mean Streets, Trees in the Urban Environment – Feb 2006
- Decay Detection Master Class (Picus Sonic Tomograph) – May 2005
- Arboriculture and Bats – Guide for Practitioners Feb 2005
- Defensible Tree Management Systems – October 2004
- Root Mechanics and Tree Engineering with Dr Claus Mattheck – May 2004
- Writing Professional Reports Workshop – April 2004
- Tree Statics and Dynamics Seminar – July 2003
- Principles of Tree Risk Assessment – July 2002
- Tree Mechanics with Dr Claus Mattheck – 2002
- Modern Arboriculture – A System Approach to Practical Tree Care – Dr Alex Shigo - 1992

5. PROFESSIONAL AFFILIATIONS

- Arboricultural Association
- Tree Care Industry Association
- The Tree Register of Britain and Ireland

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APPENDIX 2

EXPLANATION OF

DECAY DETECTION

1 DECAY IN TREES

Decay in trees is of major concern in relation to human safety and damage to property. Significant decay can eventually weaken stems, branches or roots enough to increase the chance of mechanical failure. Decay is a natural process and commonly occurs in trees without causing structural weakness. It is therefore inappropriate to regard a tree as hazardous merely because decay has been identified.

It is therefore important to be able to evaluate the tree to determine the extent of the decay so that informed management decisions can be made. This will ensure that hazardous trees are correctly identified and relatively safe trees are not removed or unsuitably pruned.

2 DECAY DETECTION METHOD WITH PICUS SONIC TOMOGRAPH

The method of decay detection is based on the fact that solid wood is a better sound wave conductor than wood that is decayed or structurally damaged. The Picus Sonic Tomograph consists of a set of sensors which are strategically placed around the area of the tree previously identified as potentially having decay or structural fault. Each sensor is connected to a nail which is tapped through the bark into contact with the wood. This process is virtually non-invasive to the tree's system (unlike other decay detection methods). The sensors are connected by data cable to a power supply and lap top computer. Each nail is tapped in turn and the sound wave flight paths are measured by each of the sensors. This results in a dense network of sound velocities through a cross section of the tree.

The velocity of sound through wood depends on the degree of elasticity and density of the material. Tree damage such as white rot, brown rot, soft rot, cavities and cracks reduce the elasticity and density of the wood.

The data from the sensors is translated by the computer software into a full colour tomogram of the cross section of the tree. This tomogram gives information about the presence of decay, cavities, faults or cracks in the tree. Features such as remaining wall thickness, opening angle of cavities and percentage of solid, decayed or altered wood can be measured by the computer.

3 READING THE TOMOGRAM

- It is important that final interpretation of the tomograms and prescription of action is undertaken by Arboricultural Consultants experienced and trained in using the Picus Sonic Tomograph.

- The Picus Sonic Tomograph detects and shows differences in the ability of wood to transmit sound waves.

- Dark colours on the tomogram, such as black and brown indicate areas of the trunk's cross section where the sound travels relatively fast. This can be indicative of areas of solid or reasonably solid or sound wood.

- The tomograph does not differentiate between extensive decay and open cavity; both are shown as pale blue or white.

- White, blue or violet areas on the tomogram show areas that sound travels relatively slowly, indicating significant decay.

- Green areas, are of lower density in comparison to black or brown areas. Green areas may not necessarily be decayed.

- Axis scales at the left and bottom of the tomogram represent the extent of the examined cross section.

- The numbered red points around the tomogram denote the sensor positions. Sensor number 1 usually denotes the north position unless stated otherwise and the other sensors are arranged anticlockwise direction.

- The tomogram can be superimposed with a circle in red (known as the t/R ratio) which shows 70% of the area of the cross section of the stem. Field studies worldwide have shown that the failure rate of hollow trees increases rapidly as it progresses beyond the 70% margin (Mattheck).

- The tomogram can also be superimposed with a green circle known as the Tree Stability Assessment or Tree SA. This depicts the calculated minimum wall thickness based on Tree Statics research (Wessolly). This method incorporates factors such as tree size, species, wood properties, environmental exposure and crown shape to calculate the recommended minimum wall thickness for that particular tree.

- The tomogram can also be annotated with the position of external damage or fungal fruiting bodies, distances can be measured and the position of resistograph tests can be shown.

- Some anomalies in the tomogram can occur due to cracks, voids between root buttresses, included bark and wet wood. These idiosyncrasies require careful interpretation by an experienced operator.

4. IML-RESI PD 400 MICRO RESISTANCE DRILL

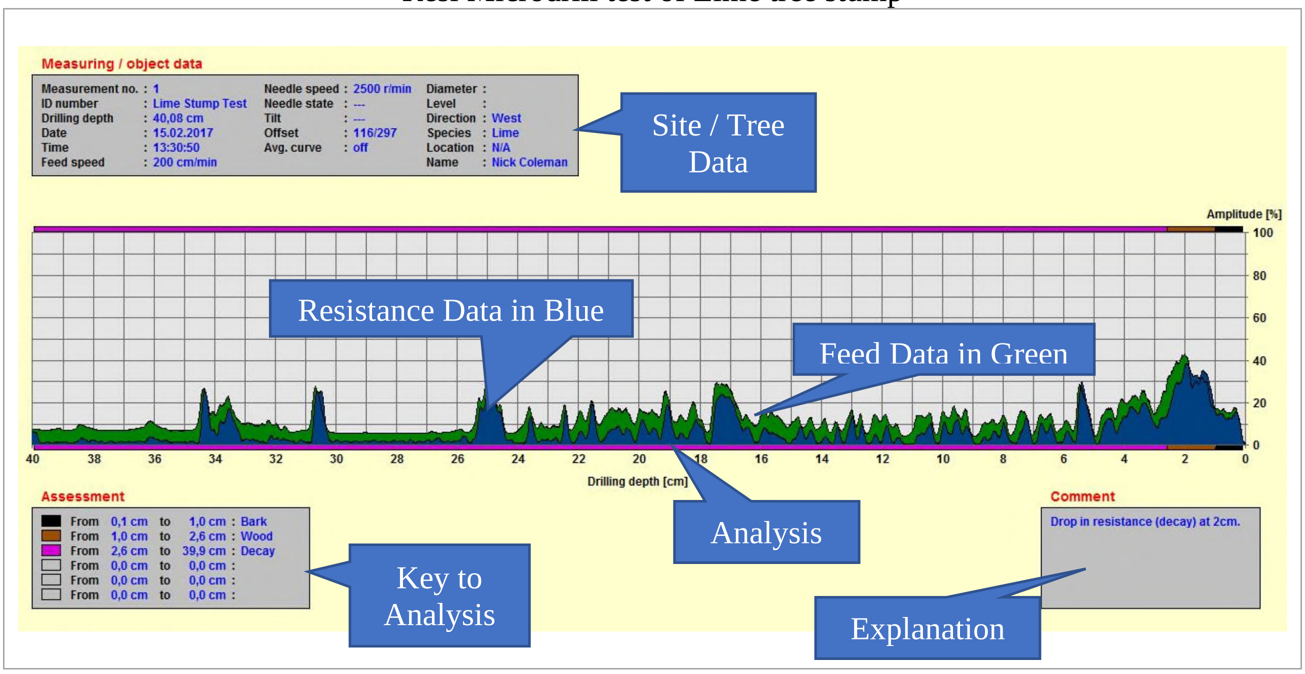
The IML-RESI PD 400 is a specialist instrument designed for accurate measurement of the resistance given by wood to drilling. Resistance of wood to drilling is not a comprehensive measure of wood strength, but resistance is usually significantly reduced or altered if wood is weakened by decay, cracks or defects.

Following an external visual tree assessment this technical device is used to excavate a narrow, penetration track with a fine, needle drill where decay or defect is suspected. The resistance of the wood to drilling is indicated on a digital graph that records resistance to drilling and speed of feed curve. This graph can be analysed with specialist software and used to diagnose the wood structure, extent of decay and construct accurate decay maps. This data can be incorporated into detailed reports.

The main concerns in using drilling diagnostic techniques is that the holes bored into existing decay columns may introduce decay into the previously sound shell of outer wood. The IML-RESI PD 400 drill needle causes minimal damage as it is of very narrow diameter and backfills the excavated hole as it is withdrawn. As a precaution, we tend to restrict the use of resistance micro drill tests to confirm definite indicators of decay which has previously been identified by external visual tree assessment or to verify decay assessment previously undertaken with the Picus Sonic Tomograph. The IML-RESI PD400 can also be used in situations where the Picus is difficult to operate, such as through excavated tree roots, root buttresses or small diameter trees, limbs and branches.

There are many factors that can affect the resistance of wood to a penetrating drill. It is therefore important that the interpretation of the results is carried out by an experienced tree consultant familiar with this decay analysis method.

Resi Microdrill test of Lime tree stump

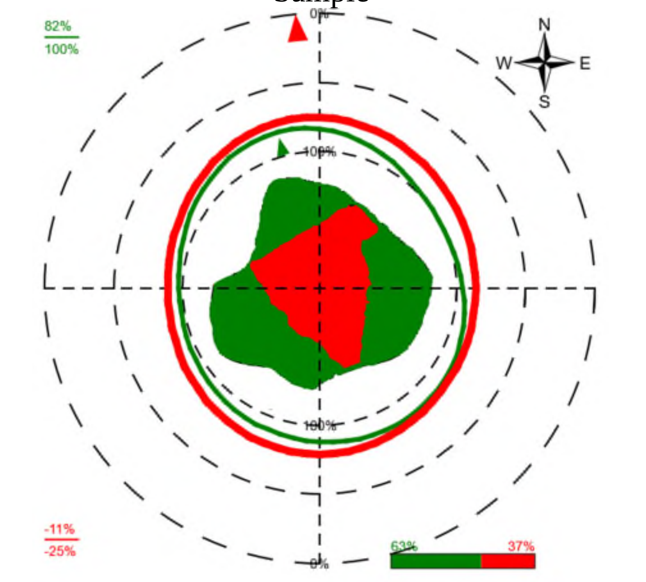


5. BIOMECHANICS SOFTWARE ANALYSES

5.1 ArboMech™ CROSS SECTION ANALYSIS

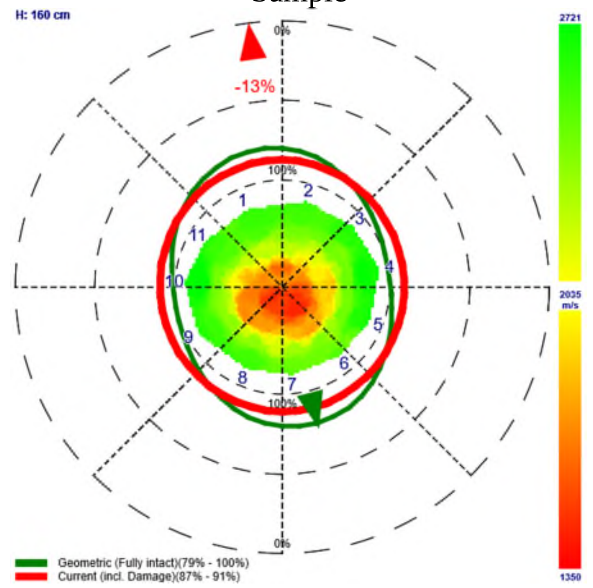
When a tree's stem or large limb has internal decay or defect it is important to know if the overall load carrying capacity has been compromised and if the likelihood of fracture and failure has increased. Tree safety evaluations have to take into consideration that the location of decay is more important than its overall size. For example large, central defects often cause only small mechanical weakness yet relatively small defects in outer areas can result in significant strength loss, especially when combined with openings in the outer surface (cavities). ArboMech™ software provides a quick solution based on conventional mechanical principles to estimate the actual cross section strength loss due to decay. The intact (green) and decayed or missing (red) areas of the cross section are either estimated or measured following visual inspection or detected with a resistance microdrill. Picus soundwave tomograms can also be directly uploaded into the software. The ArboMech™ application instantly determines the relative strength loss due to the defects for all load (wind) directions. This way, ArboMech™ makes prognosis more accurate and more reliable. It should be remembered that the results are only estimated as the mechanics can only be based on homogenous materials. Trees are not homogenous they are dynamic structures that can vary their wood strength and density in relation to loading. Nonetheless ArboMech™ is a useful tool to give the best quantified results. This data can also be incorporated with wind load calculations (ArboStApp) to determine relative safety levels and to prescribe remedial crown reduction scenarios.

Sample



Stem cross section. Decay in red, wood in green

Sample



Directly up loaded Picus tomogram.

5.2 ArboStApp BIOMECHANICS ANALYSIS

5.2.1 Wind Force

When assessing tree safety, it is important to evaluate expected loads on a tree structure. Load is a generic term in mechanics describing the impact of various forces impacting on a structure. One of the most important natural forces that exert a load on a tree structure is wind.

Wind exerts a dynamic (changing) force on the leaves, branches and the main structure from direct pressure and friction (drag). Wind forces acting on and within a tree's canopy vary because the wind energy is transferred to leaves, branches and limbs which move at different rates. Further load fluctuation occurs due to streamlining and reconfiguration of leaves and smaller branches.

Wind loads acting on a tree structure lead to internal stresses and strains. There are five basic stresses within a tree structure;

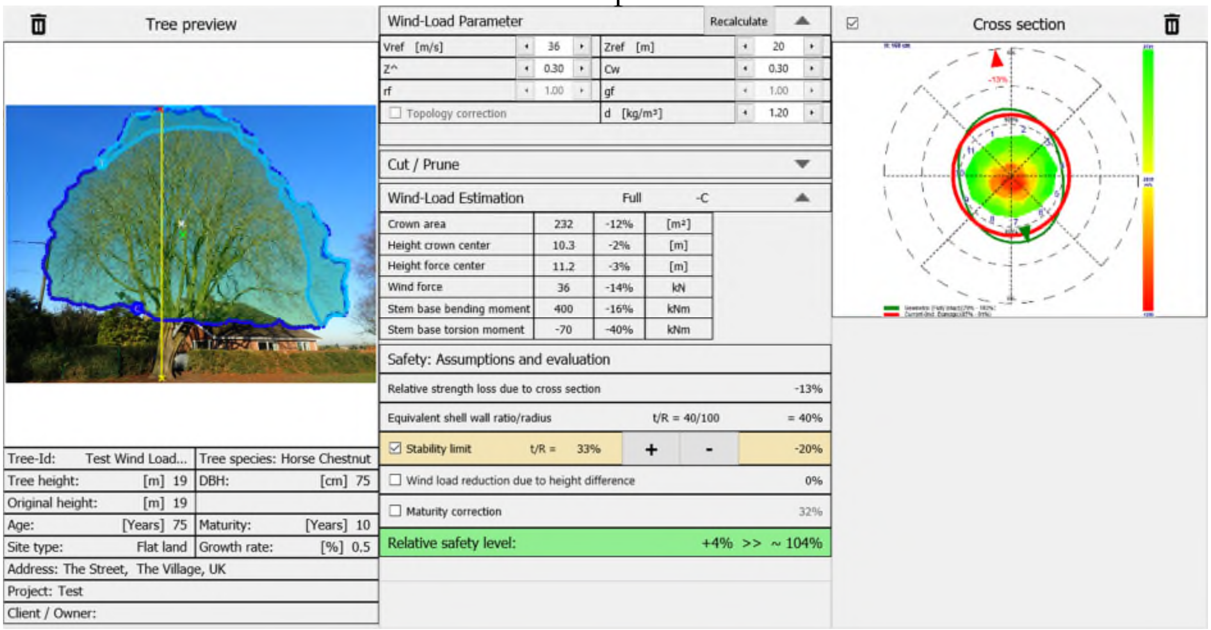
1. **Compression** force squeezes a material.
2. **Tension** force pulls a material in different directions.
3. **Shear stress** occurs when component materials attempt to slide relative to one another. This is usually at the interface between tension and compression forces.
4. **Torsion** is a shear stress caused by twisting where the maximum stress is concentrated near the outer perimeter.
5. **Bending** occurs when a force is applied perpendicular to the longitudinal (long) dimension of a slender component. It causes compression on the surface to which it is applied and tension on the opposite surface.

5.2.2 ArboStApp

The ArboStApp software calculates the perceived wind loading based on a profile photograph of the tree, combined with onsite measurements of tree height and stem diameter. Other factors considered are site topography (exposure), the tree's stage of life (Maturity Factor) and if there has been a previous height reduction. The relative wind load, stem bending moment and torsion force acting on the tree can then be predicted from these parameters.

The ArboMech cross section strength loss results and ArboReft minimum shell wall information can also be uploaded into the program to gain more specific results. From this biomechanical data, it is possible to prescribe various crown reduction scenarios to reduce and balance the stress forces on the tree's structure. The prescribed crown reduction will lessen the overall wind load on the tree structure; shorten the load centre and decrease the bending and torsion forces acting on the defective area.

Sample



5.3 Disclaimer

Wind load analysis is not an exact science as the results are based on mechanical models with some standard variables applied. Trees are not static structures they are dynamic and can sway, optimise their crown profile and adapt their wood strength to dissipate loading in an attempt to achieve uniform loading. These natural, dynamic factors cannot be precisely calculated. Nonetheless, the software is a useful tool to understand the typical forces impacting on a tree’s structure and estimate the impact of various load reduction scenarios through pruning.

Please note that only the information from the decay assessment level is used, therefore the software is not aware of any other parts of the tree structure outside the measured region.

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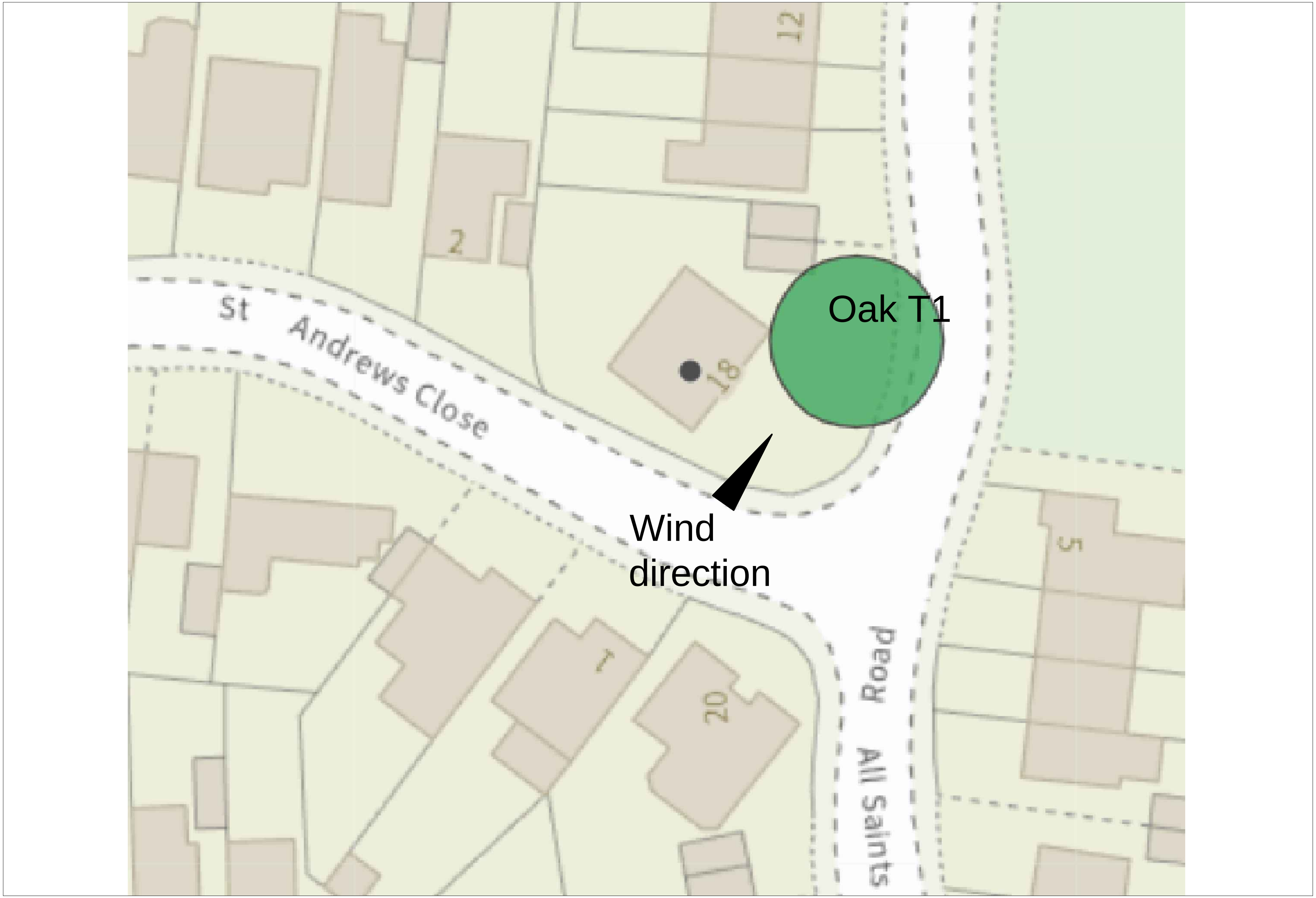
APPENDIX 3

SITE PLAN



12
2
St Andrews Close
18
Oak T1
Wind direction
5
1
20
All Saints Road