

Internal Decay Assessment of a Common Beech


Gatekeepers Lodge  
Dyrham  
SN14 8HN

For Lawrence Tree Services

July 2023



## Record Sheet

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## 1.0 Introduction and scope of survey

- 1.1 I was instructed by Aimee Lawrence to carry out an internal decay assessment of a common beech at the Gatekeepers Lodge in Dyrham. This tree was previously assessed in November 2017.
- 1.2 The investigation was carried out on 21<sup>st</sup> July 2023.
- 1.3 A detailed visual tree assessment was not undertaken but any obvious defects or features were noted.
- 1.4 The survey was carried out using a combination of a PiCUS sonic tomograph and an IML Resi-PD400 digital wood inspection drill, more commonly referred to as a Resistograph.
- 1.5 Comments and recommendations are limited to the findings of the PiCUS and Resistograph surveys only and are valid for a period of twelve months from the date of this report.

## 2.0 PiCUS Sonic Tomography - explanatory notes

- 2.1 The PiCUS tomograph measures the time taken for sonic stress waves to pass through the wood of a tree between sensors that are placed at a predetermined level around the tree stem.
- 2.2 The relative velocities of these waves help determine the wood density of a cross-section of the tree (sonic waves generally travel faster through sound wood than through decayed wood). These velocities are then calculated and interpreted by the PiCUS software to produce a colour tomogram of internal decay patterns.
- 2.3 The different colours on the tomogram indicate changes in relative sound velocities through the cross-section which help identify varying levels of wood density:
  - Dark brown represents the highest velocity and therefore dense or sound wood.
  - Pink and blue are the lowest relative velocities and may indicate decayed wood, cracks, included bark and/or cavities.
  - Green identifies velocities between these two thresholds. This may be wood that has a reduced density but is not yet decayed, such as wood with active/early fungal infection.
- 2.4 The interior red line indicates the t/R ratio. This is based on Mattheck and Breloer's (1994) method for calculating the safety margin of hollow/decayed stems. It is the ratio between the thickness of sound residual wall remaining (t) and the radius of the cross-section (R). For a central cavity, Mattheck affirms that this ratio should be no less than 0.3 (or 30% of the radius). If the ratio is less than this, then remedial work should be undertaken to reduce the lever-arm of the affected stem.

- 2.5 It should be noted that this calculation is provided as a baseline safety factor only. Research has shown that trees can remain safely standing with t/R ratios significantly less than 0.3. When assessing risk of stem failure, the t/R ratio is therefore utilised in conjunction with other factors including the type of decay or defect as well as tree species, age, stem geometry, height/stem diameter ratio (HDR), aspect, location and vitality.
- 2.6 The red numbers around the tomogram indicate the measuring points (MPs). The graph axis shows the dimension of the cross-section in centimetres. North is indicated by a blue arrow on the tomogram.
- 2.7 The height on the tree stem at which the tomogram is taken is measured from ground level on the upper slope aspect of the stem and is recorded in the survey notes. The sensors are placed horizontally around the stem from this point.
- 2.8 The tomogram represents a cross-section of the tree at the measurement level only. The extent of decay may differ above or below the point of measurement.

### 3.0 Resi-PD400 Resistograph - explanatory notes

- 3.1 The PD400 measures the drilling resistance of wood and comprises a portable micro-drill with a 400mm x 1.5mm needle and a 3mm drill tip. The drilling needle is driven into the wood under constant drive and the energy required along the drilling depth is measured and electronically recorded.
- 3.2 The PD400 measures both the drill resistance (shaft friction) and force required to push the needle into the wood. The captured data is evaluated and processed to deliver a measuring curve, which is presented as a digital line graph. The drill resistance curve is shown in green and the feed force in blue.
- 3.3 Interpretation of these measurement profiles not only helps to determine variations in wood density and condition but also the ratio of sound wood to decayed wood.
- 3.4 The resistograph measures wood quality at specific drilling points only. Decay levels may differ above or below the points of measurement.
- 3.5 The estimated t/R ratio is provided with the results. The depth of bark has been excluded from the calculation.

## 4.0 Inspection notes

Tree no.	n/a	Tree species	Common beech <i>Fagus sylvatica</i>			
Height (m)	21m	Stem diameter at 1.5m	103cm	Age class	Mature	
Crown spread in four cardinal directions (m)			North	South	East	West
			7m	8m	4m	9m
Physiological condition		Fair				
<ul style="list-style-type: none"> <li>• Growing on steep bank over road, 12.5m southeast of house and 13m west of Gatekeepers Lodge.</li> <li>• Previously group canopy with adjacent beech to east, now felled.</li> <li>• <i>Kretzschmaria deusta</i> fruit bodies with decay between buttress roots on southeast and south aspects.</li> <li>• Previous branch failure at 6m above ground level (agl) on south aspect and at 8m agl on northwest aspect with exudation.</li> <li>• Clear stem to crown break at 6m agl with occluded and partially occluded pruning wounds.</li> <li>• Crown asymmetry to west.</li> <li>• Previous remedial pruning/crown reduction.</li> <li>• Major deadwood.</li> </ul>						



Pl. 1 – Common beech

## 5.0 Tomograph and Resistograph findings

### PiCUS tomograph findings

- 5.1 One tomograph was taken at 5cm agl to assess any increase in the extent of decay.
- 5.2 The tomogram is presented in section 7.0 and the findings are summarised below. The 2017 findings are shown in brackets.

Measurement level	Percentage of cross-section identified as:		
	Cavity or decay (pink/blue shading)	Incipient decay / early wood degradation (green shading)	Sound wood (brown shading)
5cm	2% (0%)	15% (2%)	83% (98%)

### Resistograph findings

- 5.3 Six resistograph readings were taken at 5cm agl at corresponding locations to the PiCUS MPs.
- 5.4 The results are presented in section 9.0 and are summarised in the table below. When calculating the t/R ratio the depth of bark has been excluded. Figures are rounded to the nearest 5mm. The 2017 findings are shown in brackets.

Drill no.	Cardinal pt. PiCUS MP	Height (cm) agl	Stem Radius (cm) R	Radial depth of sound wood including bark (cm)	Radial depth of sound wood excluding bark (cm) t	t/R ratio
R1	North 1-2	5	61.0	18.5 (19.0)	17.5 (17.5)	0.29
R2	West 4	5	61.0	21.0 (30.0)	19.0 (28.0)	0.31
R3	Southwest 6-7	5	61.0	19.0	17.0	0.28
R4	South 8-9	5	61.0	1.5	0.0	0.00
R5	Southeast 9-10	5	61.0	2.5 (12.0)	2.0 (10.5)	0.03
R6	East 12	5	61.0	9.0	8.0	0.13

## 6.0 Discussion and management recommendations

- 6.1 The tomograph results are not conclusive but indicate an increase in the extent of decay since the last survey with 17% of the cross-section affected as opposed to 2% in 2017.
- 6.2 Due to the colonisation strategy of *Kretzschmaria deusta*, tomography does not always accurately plot early changes to wood properties. However, the pattern of light brown shading and green mottling indicate a reduction in sound velocities consistent with early stage decay.
- 6.3 The six resistograph readings correspond with the shading pattern on the tomogram and also suggest an increase in the extent of decay since the 2017 survey.
- 6.4 Readings R1, R2 and R3 identify sound residual wood of between 17cm and 19cm (28% to 31% of the stem radius).
- 6.5 Two readings, R4 and R5, taken into the area of fruit bodies confirm early and late stage decay to maximum drill depth (40cm) with no residual wall remaining.
- 6.6 R6 taken on the east aspect identifies only 8cm of sound wood (13% of the stem radius).
- 6.7 The resistograph readings confirm a marked increase in the extent of decay since 2017 which is now on the borderline of Mattheck's safety margin. The crown reduction has reduced wind loading and increased the tree's safety factor but may have also contributed to an increased rate of decay.
- 6.8 The tree is in fair physiological condition with no signs of crown dieback, suggesting that root function is not yet affected.
- 6.9 This tree is a prominent specimen of high visual amenity, but in the event of structural failure the target is the road and adjacent residential property.
- 6.10 In my opinion, based on the survey findings and apparent increase in decay, the tree has a short safe life expectancy and is likely to require removal within five years.
- 6.11 If retained, it should be visually inspected annually and a repeat internal decay assessment carried out in 2026.

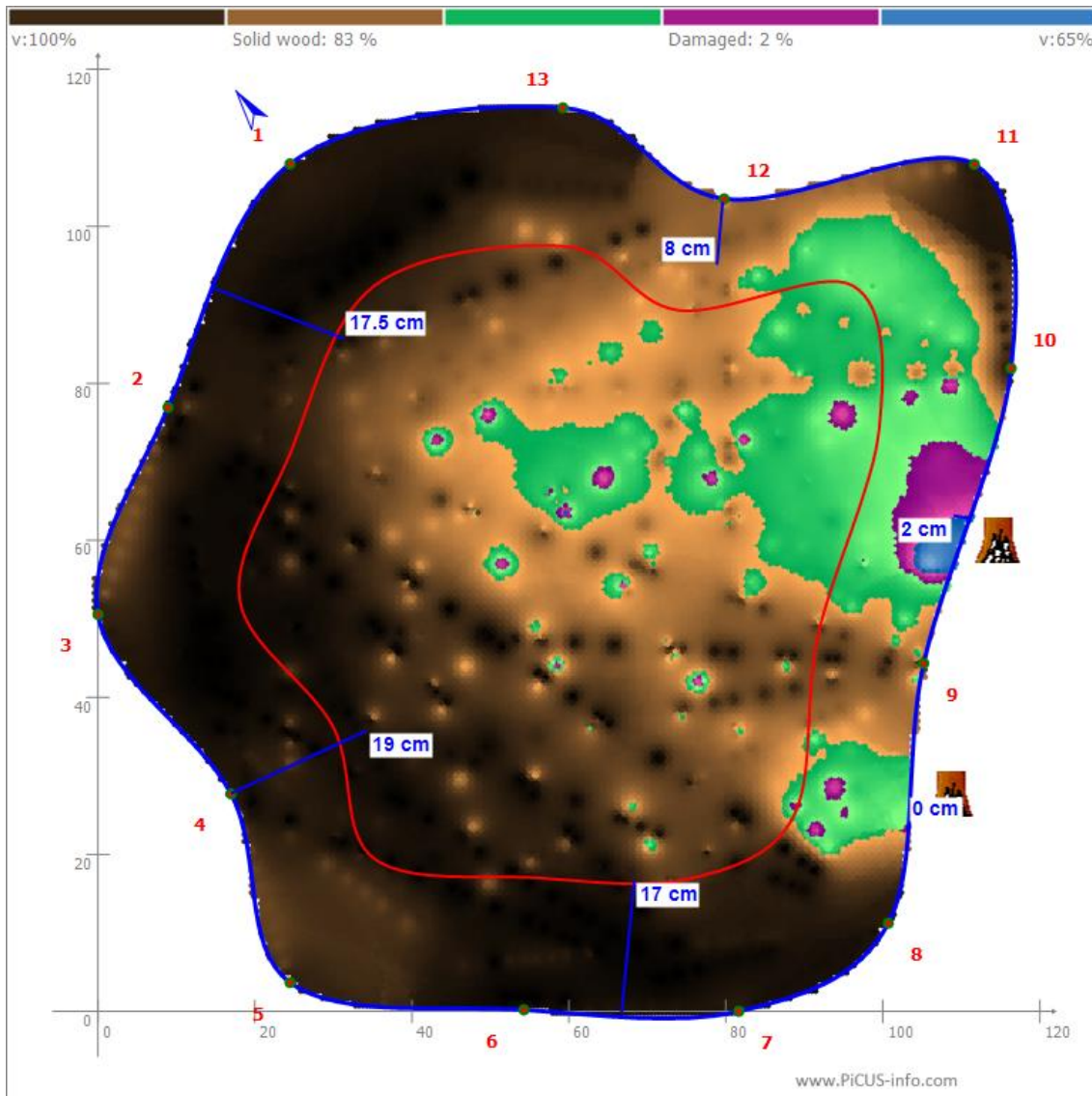


## 7.0 PiCUS Tomograph results July 2023

Tomogram taken at 5cm agl.

Stem diameter at measurement level is 122cm.

The direction and radial depth of sound wood (excluding bark) identified by the resistograph readings is shown in centimetres and indicated by the blue lines.

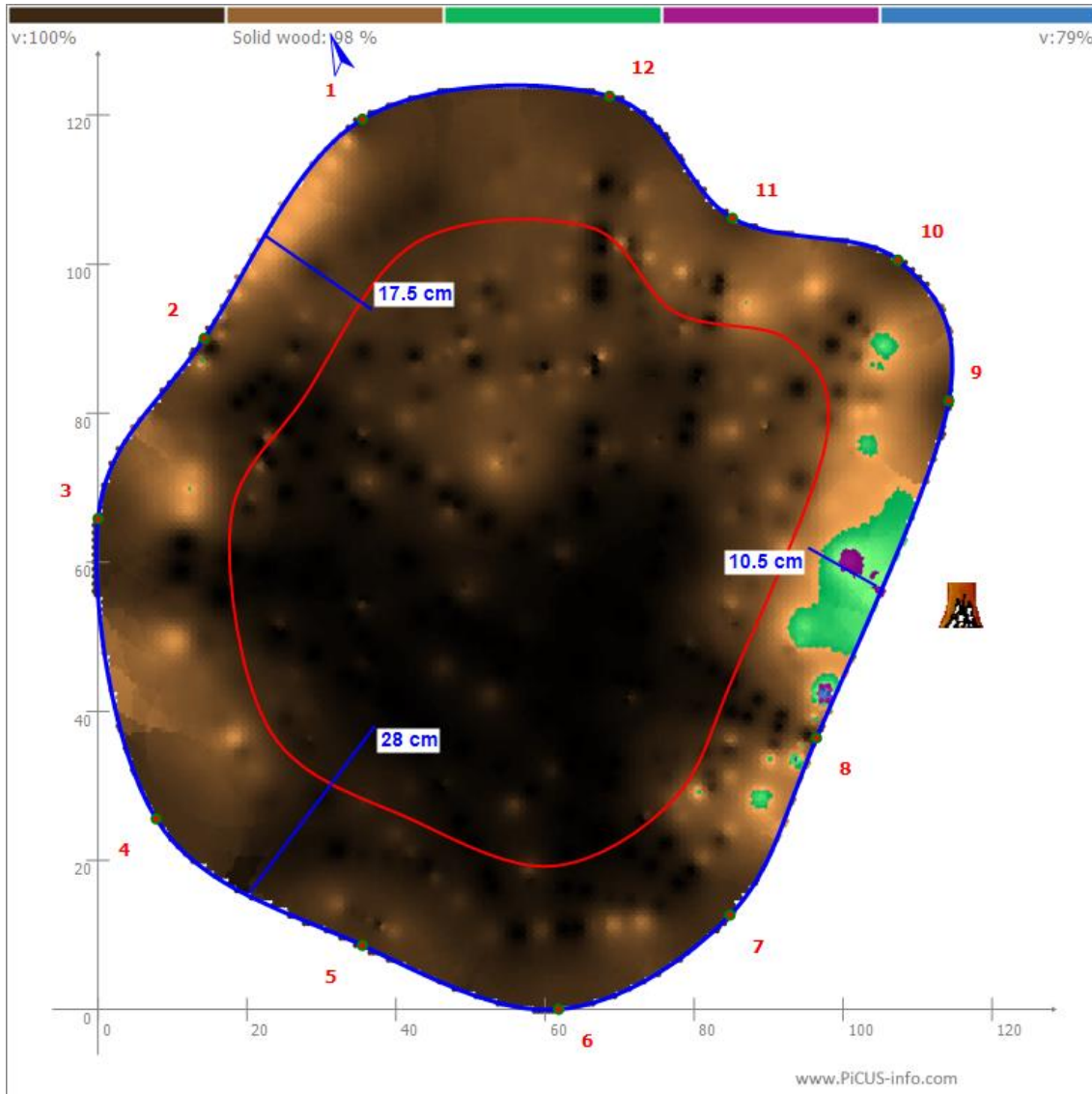


## 8.0 PiCUS Tomograph results November 2017

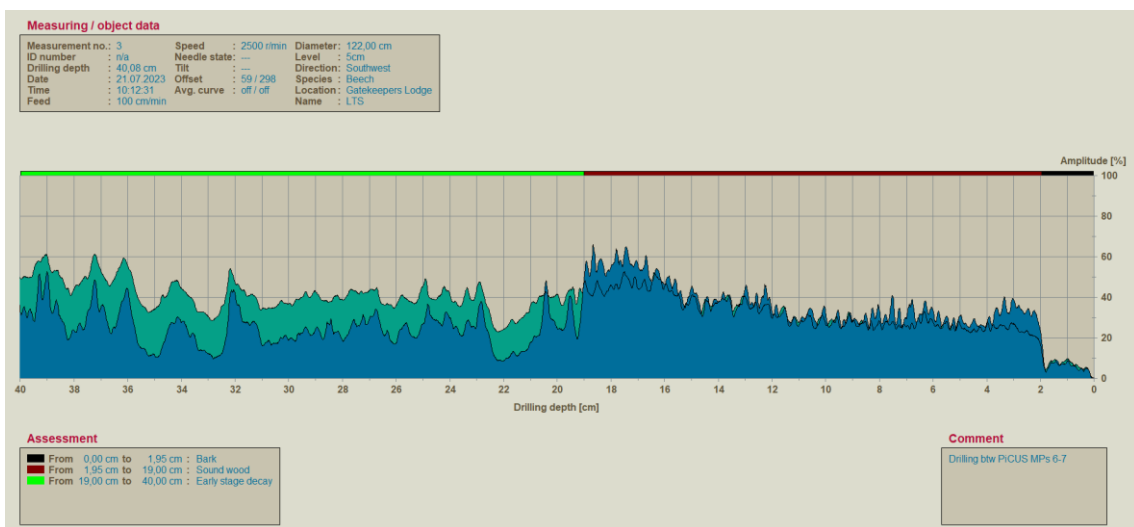
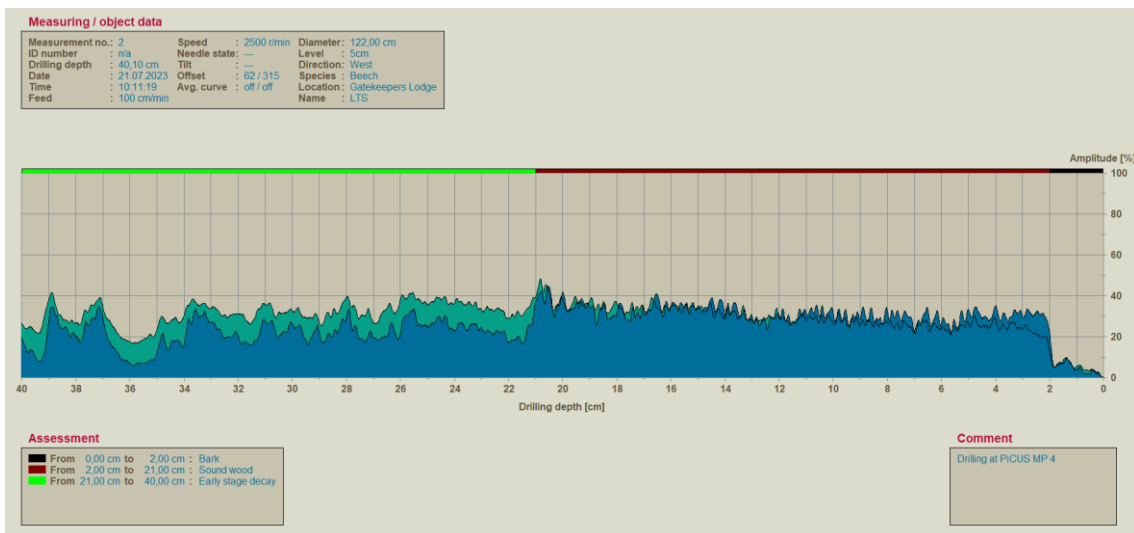
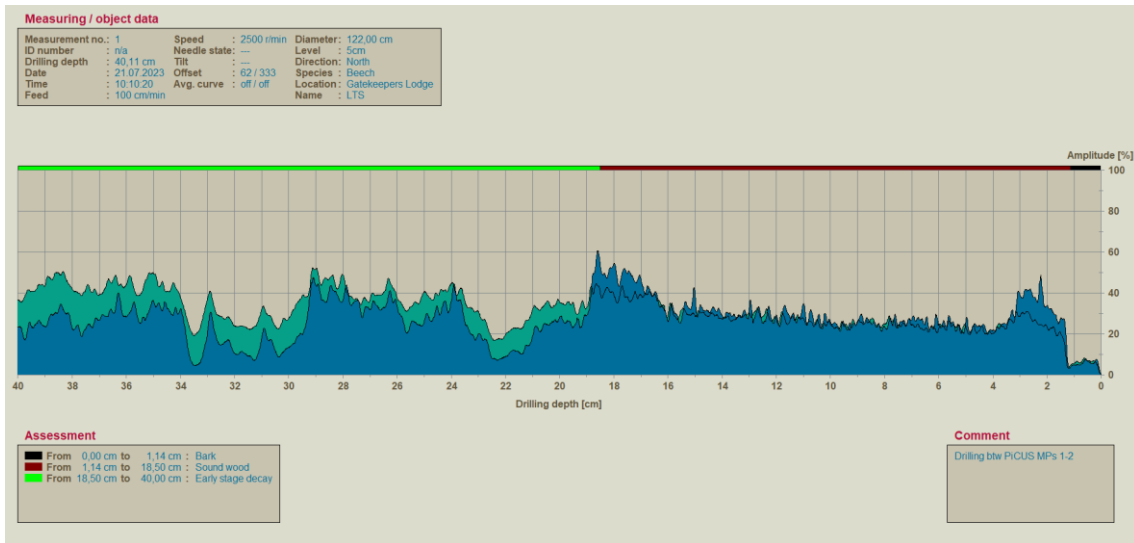
Tomogram taken at 5cm agl.

Stem diameter at measurement level is 118cm.

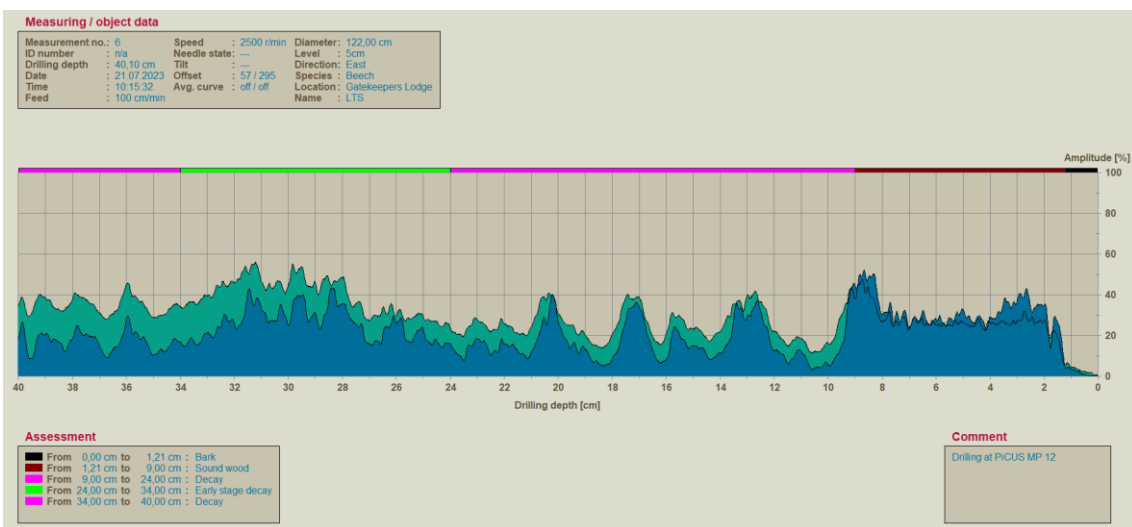
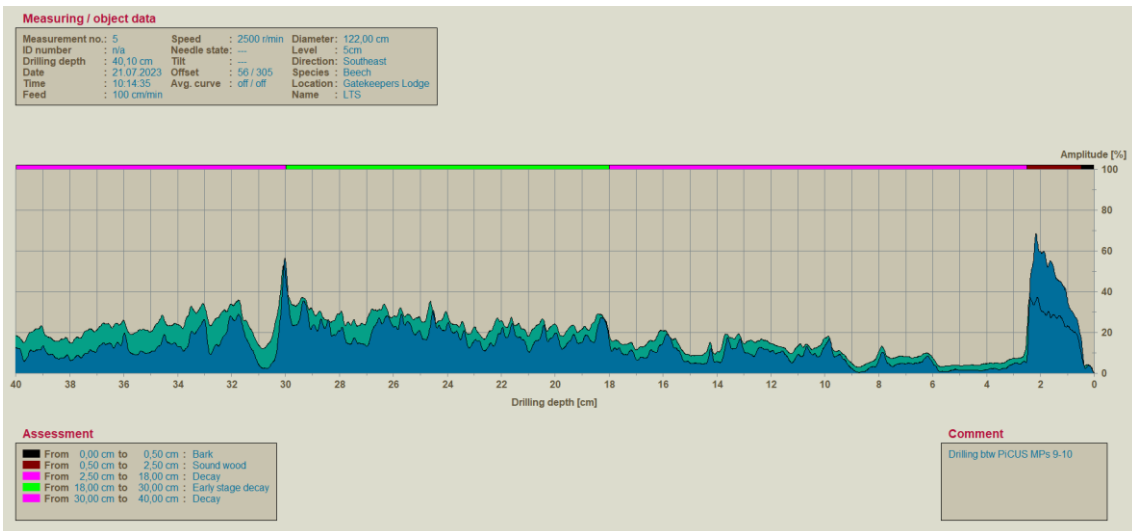
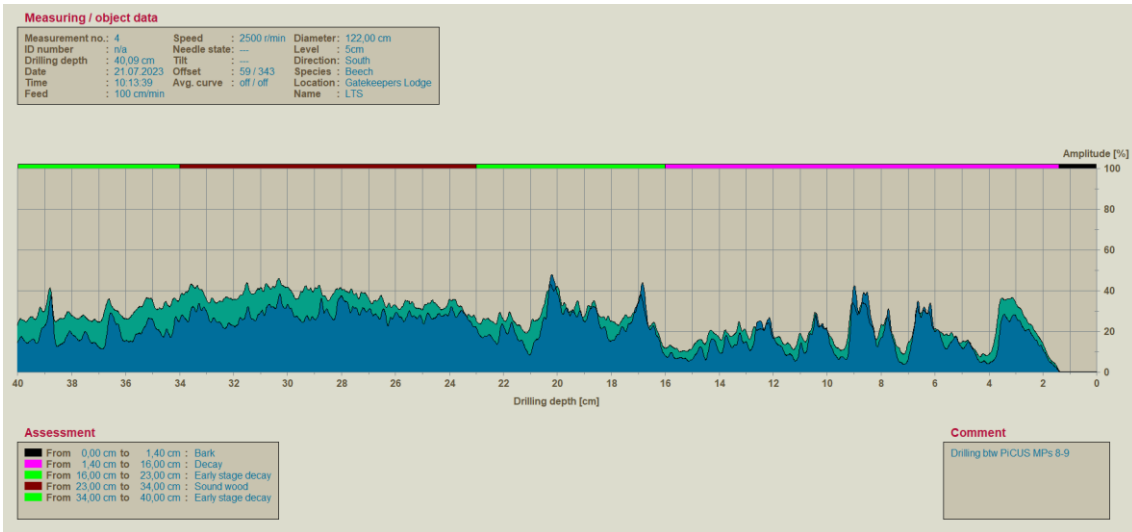
The direction and radial depth of sound wood (excluding bark) identified by the 2017 resistograph readings is shown in centimetres and indicated by the blue lines.



## 9.0 Resi-PD400 Resistograph results



Gatekeepers Lodge, Dyrham, SN14 8HN



## 10.0 Photographs



Pl. 2 - *Kretzschmaria deusta* fruit bodies between PicCUS MPs 8-9



Pl. 3 - *Kretzschmaria deusta* fruit bodies between PicCUS MPs 9-10



Pl. 4 - PicCUS MPs 13 & 1-3 at 5cm agl shown in red. Resistograph drill point R1



Pl. 5 - PiCUS MPs 2-7 at 5cm agl shown in red. Resistograph drill points R2 & R3



Pl. 6 - PiCUS MPs 7 - 11 at 5cm agl shown in red. Resistograph drill points R4 & R5



Pl. 7 - PiCUS MPs 11-13 & 1 at 5cm agl shown in red. Resistograph drill point R6

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