URBAN TREE MANAGEMENT

CONSULTING ARBORICULTURISTS & HORTICULTURISTS

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19 December 2010

NSW Health
C/- Earthscapes Horticultural Services
PO Box 364
Berowra NSW 2081

Report: Arboricultural Hazard Assessment & Resistograph Testing Wollongong Hospital, Wollongong NSW *(the site)***.**

To Whom It May Concern,

URBAN TREE MANAGEMENT ®© has prepared this report for Mr Andrew Morton of Earthscapes Horticultural Services on behalf of NSW Health.

The purpose of this report was to undertake a hazard assessment, including Resistograph testing on x2 *Ficus macrophylla* – Moreton Bay Figs (*the trees)*. Concerns have been raised regarding the structural integrity of *the trees* due fungal fruiting brackets present within the interbuttress zone of Tree 1. Internal diagnostic testing was undertaken by a Resistograph to measure the extent of internal decay.

The trees have been numerically identified as Trees 1 & 2 to correspond with the Arboricultural Report undertaken by Earthscapes Horticultural Services. The general assessment details have therefore been omitted from the report to prevent duplication with only a hazard assessment and Resistograph testing provided.

Mr. Laurie Dorfer (*the author*) attended *the site* on Wednesday 15 December 2010 and the trees and their growing environment were examined.

The inspection of *the trees* was undertaken by a visual assessment from the ground (Visual Tree Assessment - VTA). The trunk and buttresses were further investigated, including 100 mm -150 mm below the existing ground surface. Excavation was undertaken with an air spade by Mr. Ken Cantor of Glochidion Arboricultural and Horticultural Services Ph: 9523 7632.

Resistograph Drilling - General

Drilling was undertaken between root buttresses where access allowed.

Resistograph calculations used within this report are evaluated against C. Mattheck's formulae for Centralised Defects. Mattheck states that if the thickness of the sound residual wall is less than 30%-35% of the stem radius, failure is probable from bending fracture or cross sectional flattening (Mattheck 1998, p. 186).

The t/R formula when applied to Fig Trees, particularly at the root crown where large buttresses exist are to be used as a guide only. The t/R has been developed to reflect the form of a cylinder; this being compared to a trunk/branch. Limitations arise with the test when the trunk or branch moves away from the shape of a cylinder - the greater this disparity, the greater the inaccuracy. When decay is present, consideration of additional criteria such as adaptive wood – tree response; buttresses – number of, positioning and size; direction of loads; wind exposure etc are all mandatory. The t/R can not be relied upon for these trees and therefore the pass/fail has been omitted from this report.

The fungal fruiting brackets observed on Tree 1 were characteristic of *Ganoderma* species. These typically cause a root- and butt-rot which is where investigative works were concentrated. Partially decayed wood by *Ganoderma* retains considerable tensile strength, for this reason the residual wall thickness of sound wood tends to be much less than the 30 – 35% t/R (Lonsdale 1999, p. 104).

Furthermore, due to the increase in flexibility of the woody tissue of *Ficus spp.,* it has been anecdotally suggested that the sound residual walls for *Ficus spp*. may be safely reduced to approx. 25%, i.e. t/R of 0.25, however no scientific research has yet to confirmed this. Therefore, it may be reasonably suggested that further reductions of the t/R may be accepted as the minimum safety requirements.

Determination for drilling heights and locations were provided visually by the fungal fruiting brackets and preliminary drills. Residual wall thicknesses were compared; with cross sectional drilling undertaken where maximum decay was determined.

All drills were undertaken towards the stem/buttress centre, at angles less than 15 degrees approximately above or below horizontal.

Tree 1

Preliminary drills were undertaken below the fungal bracket (approx. 100 mm below G.L.) and at 300 mm & 500 mm above existing ground level, from north to south. Cross-sectional drilling was maintained at and undertaken at 100 mm below G.L. The 300 mm provided increased sound residual wall thickness (decay tapering) with the 500 mm providing no decay to a drilling depth of 480 mm – this being typical for *Ganoderma* species.

Preliminary drills were also undertaken to buttresses proximate to the brackets (See Figure A) to determine overall extent of decay.

Tree 1 - t/R Calculations @ 100 mm below G.L.

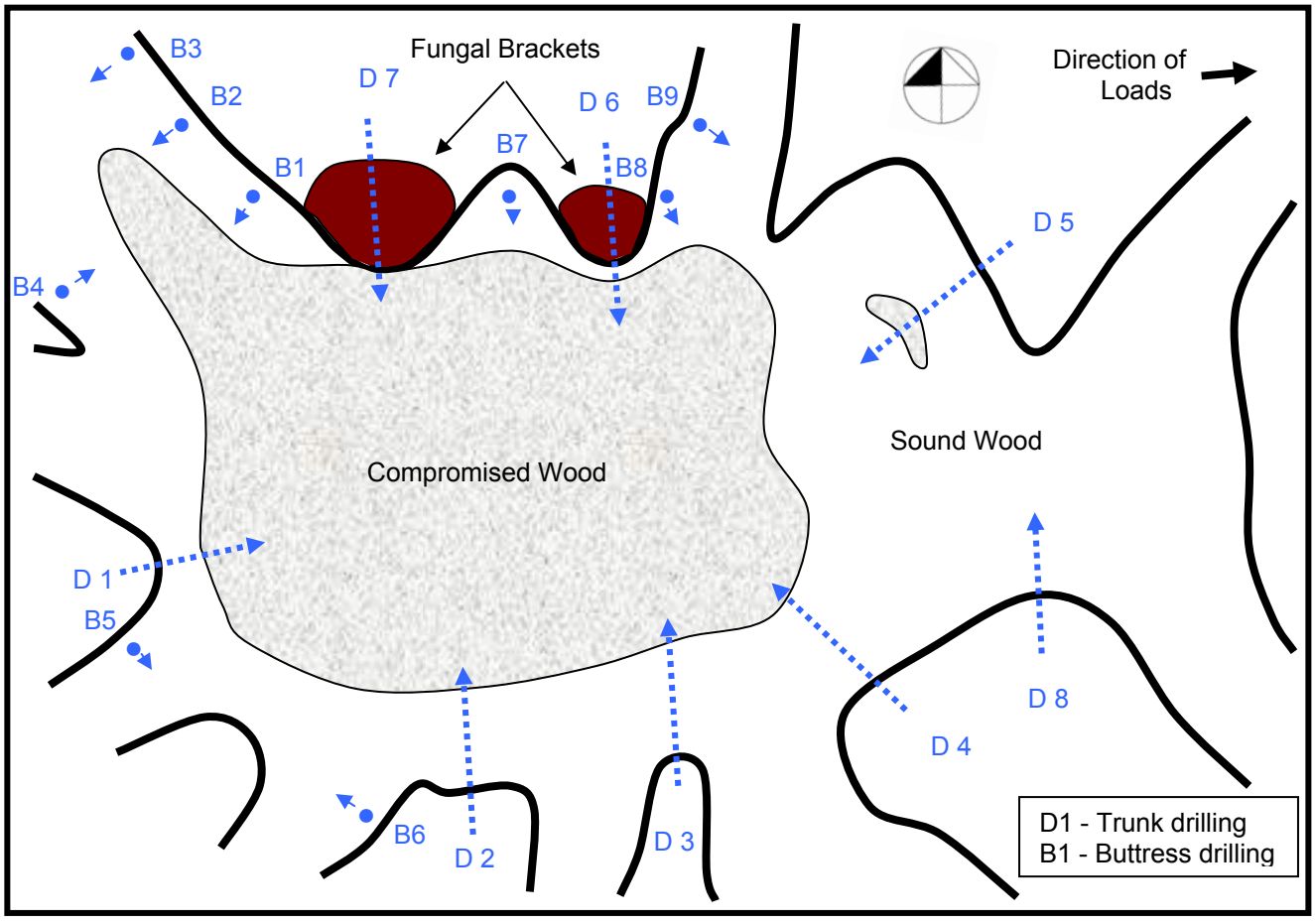
Table 1

Tree No.	Drilling No.	Drilling Direction	Trunk Diameter Φ (cm)	Radius R* (cm)	Required Sound Wall thickness (cm) **	Actual Thickness Detected t (cm)	Test t/R
1	D1	W→E	220	102.5	30.5	4.5	0.04
	D2	S→N	100	45.5	13.5	12.5	0.27
	D3	S→N	90	41	12	12	0.29
	D4	SE→NW	110	54	16	16.5	0.30
	D5	NE→SW	130	61.5	18.5	20	0.32
	D6	N→S	90	45	13.5	1	0.02
	D7	N→S	100	50	15	0	0
	D8	S→N	36	15.5	4.5	15.5	1

* Denotes radius (Stem Diameter ÷ 2) – Bark Thickness = R
** Denotes minimal residual wall thickness of sound wood - t/R test (30% of R)

Trunk in Cross-section @ 100 mm below GL

Figure A



Note: Representative only and not to scale.

Reduced residual walls were detected proximate to the fungal brackets below ground level. Decay movement was detected within the north/west buttress only. Decay was positioned basally only and tapered off relatively suddenly between 300 mm and 500 mm above ground level.

Significant sound buttresses provided additional support reaching heights of 1.5 m to 2.5 m, and some reaching the first order structural branches. The tree has responded very well to the previous and current load distribution of the crown with the placement of additional adaptive wood along the length of the trunk.

As Ganoderma species maintain considerable tensile strength and flexure, it may take many years before the decayed zone becomes dangerously large in relation to the extent of sound wood. This allows suitable time for the production of compensatory growth (Lonsdale 1999, p. 104). However, this may alter in the future due to the current reduced vigour.

Adequate sound wood is currently expected with ample sound wood situated above the decay within the buttress to the north/west.

The failure potential at the lower trunk is currently considered low to medium.

The crown of the tree primarily overhangs garden area where low targets exist within the drop zone - people occupancy was considered low at the time of inspection. The building to the south was situated within the fall zone, although at considerable distance.

Mechanically the tree may be retained for the short to medium term – however the condition and vigour will likely be the determining factor.

Tree 1 should again be assessed with Resistograph testing undertaken in 3 -5 years to determine the speed of deterioration and pattern of internal decay.

Tree 2

Preliminary drills were undertaken approx. 100 mm below G.L., and 400 mm & 800 mm above the existing ground level, from north/west to south/east. The 300 mm & 800 mm drillings detected no decay to a drilling depth of 480 mm. Cross-sectional drilling was maintained at and undertaken at 100 mm below G.L.

No drills were undertaken to buttresses due to the minor volume of decay detected within the trunk and depth of residual wall thicknesses within the trunk adjacent to buttresses.

Tree 2 - t/R Calculations @ 100 mm below G.L.

As the drilling depth of the Resi -500 did not have the capabilities of reaching the entire trunk radius and the sound wood detected was greater then the drilling depth of the Resistograph, the 30% of the radius was calculated directly from the radius (R) only without the t/R determined.

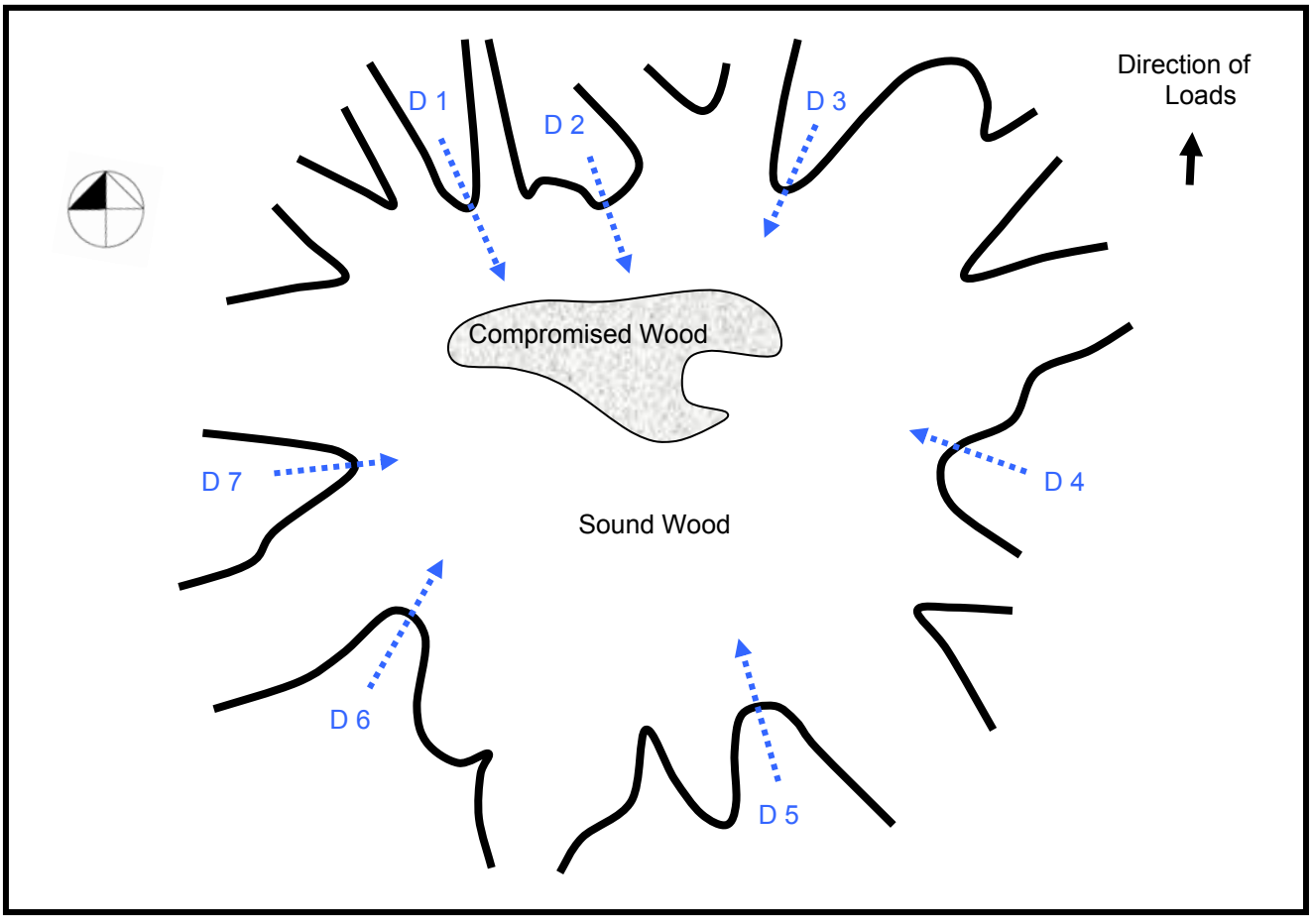
Table 2

Tree No.	Drilling No.	Drilling Direction	Trunk Diameter Φ (cm)	Radius R* (cm)	Required Sound Wall thickness (cm) **	Actual Thickness Detected t (cm)
2	D1	NW→SE	110	50	15	13.5
	D2	N→S	100	48.5	14.5	19.5
	D3	NE→SW	120	55	16.5	23.5
	D4	E→W	120	56	17	44.5
	D5	SE→NW	110	51.5	15.5	44.5
	D6	SW→NE	110	49.5	15	39.5
	D7	W→E	120	55	16.5	36

* Denotes radius (Stem Diameter ÷ 2) – Bark Thickness = R
** Denotes minimal residual wall thickness of sound wood - t/R test (30% of R)

Trunk in Cross-section @ 100 mm below GL

Figure B



Note: Representative only and not to scale.

Sufficient supporting wood remained at the lower trunk in cross section. Minimal decay only was detected, with no adverse affect on the mechanical strength expected.

The tree was observed to be currently structurally sound and stable, with no indication of potential failure by bending fracture or cross sectional flattening. The failure potential for Tree 2 at the cross section examined is currently considered low.

Tree 2 is currently expected to be retained for the short to medium term as such is reflected by Tree 1.

Conclusion/Recommendations

Tree 1 supported decay which was situated basally and predominately confined to the trunk tissue. Adequate sound wood remains with a low to medium failure potential.

Tree 1 should again be assessed with Resistograph testing in 3 - 5 years.

Tree 2 supported minimal decay with the failure potential considered low.

Retain Trees 1 and 2 for the short to medium term.

Laurie Dorfer
Senior Consultant
Urban Tree Management Australia P/L

BIBLIOGRAPHY

1. Mattheck, C. and Breloer, H (1998) ' *The Body Language of Trees- A Handbook for Failure Analysis*.' HMSO, London.

2. Lonsdale D. (1999). Principles of Tree Hazard Assessment and Management, Department for Transport, Local Government and the Regions, London.

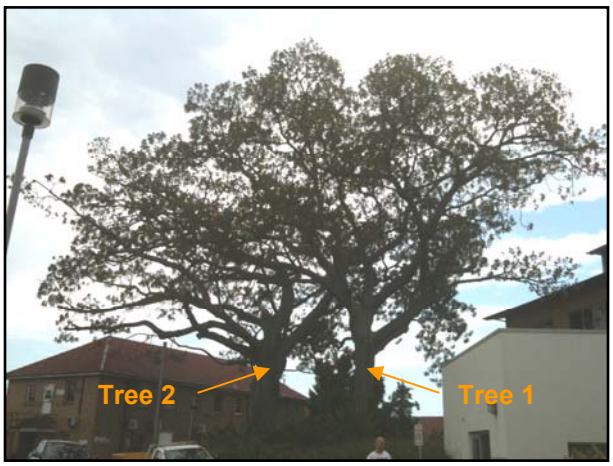
DISCLAIMER

The author and Urban Tree Management take no responsibility for actions taken and their consequences, contrary to those expert and professional instructions given as recommendations pertaining to safety by way of exercising our responsibility to our client and the public as our duty of care commitment, to mitigate or prevent hazards from arising, from a failure moment in full or part, from a structurally deficient or unsound tree or a tree likely to be rendered thus by its retention and subsequent modification/s to its growing environment either above or below ground contrary to our advice.

Appendix A

Photos taken by the author on Wednesday 15 December 2010.

Photo 1



Left – View of trees facing east.

Tree 1

Photo 2

Above – View of trunk facing north.

Photo 3

Above – View of trunk facing east

Photo 4

Right – View of trunk facing south.

Below – View of trunk facing west

Photo 5

Photo 6

Right – Fungal fruiting brackets.

Tree 2

Photo 7

Right – View of trunk facing south.

Photo 8

Left – View of trunk facing west.

Photo 9

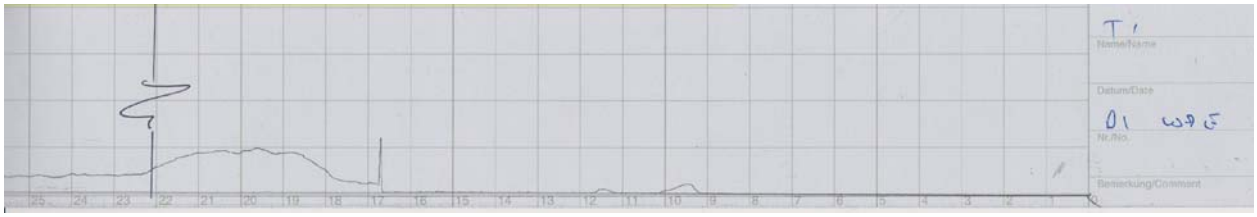
Right – View of trunk facing north/east. .

Appendix B

Graphs

F500 Resistograph

Tree 1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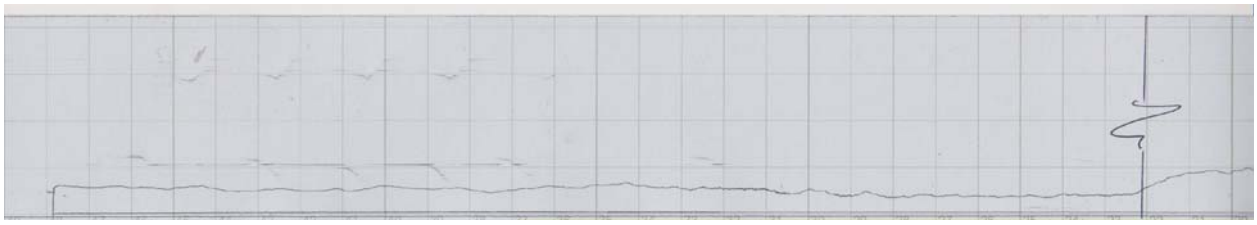


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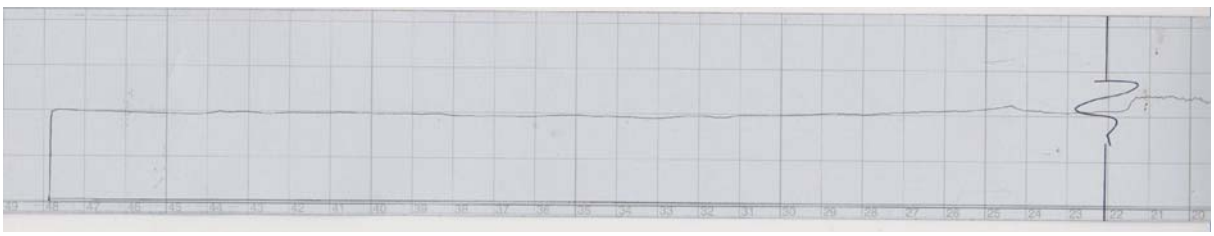


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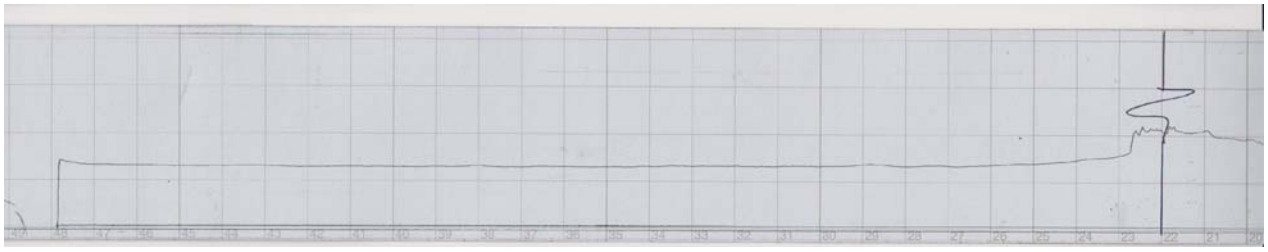


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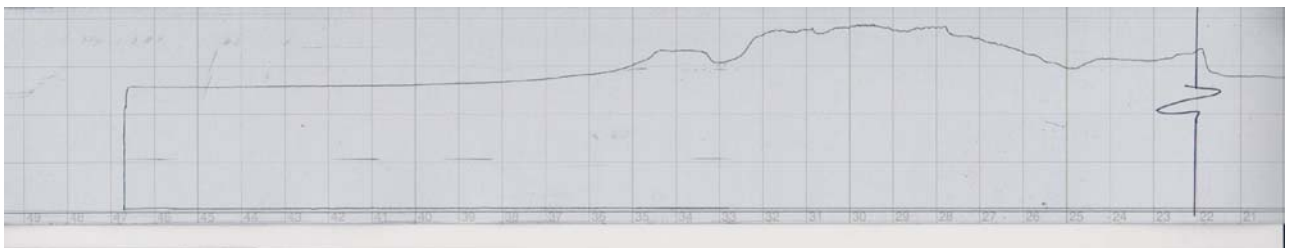


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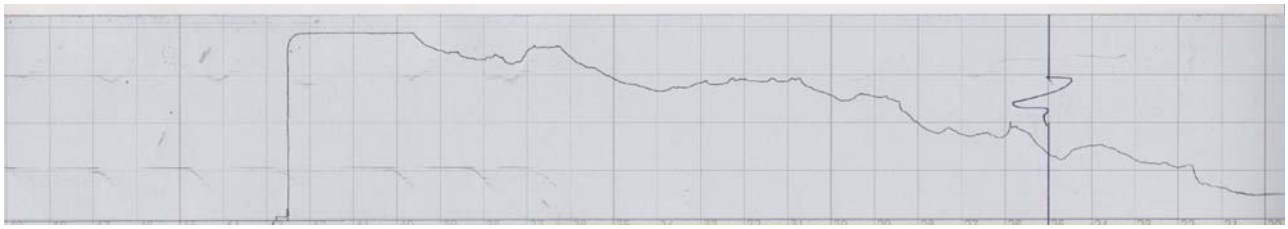

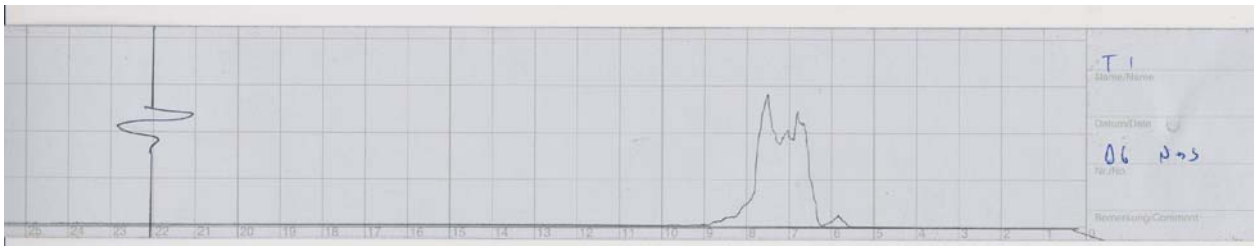
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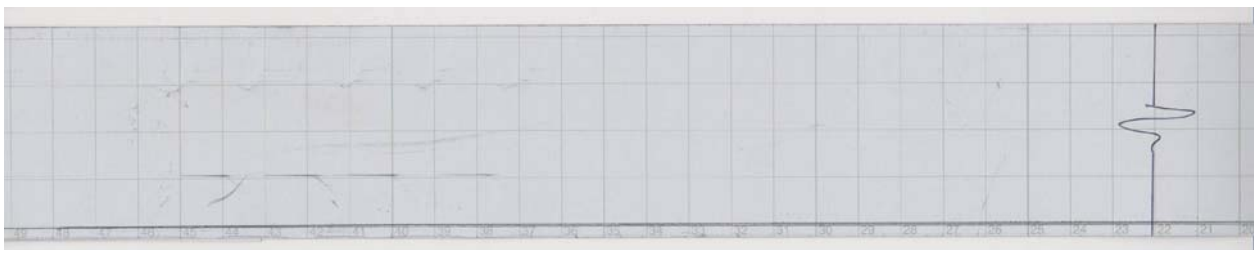

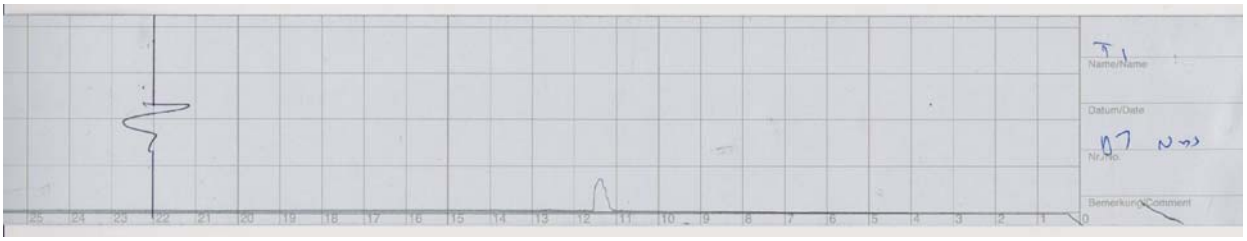

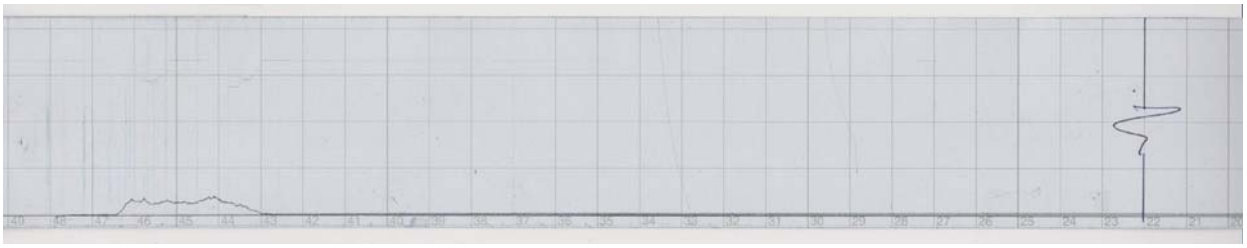

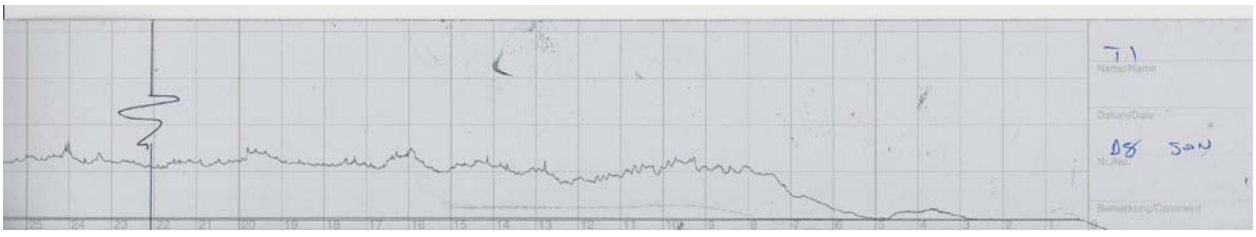

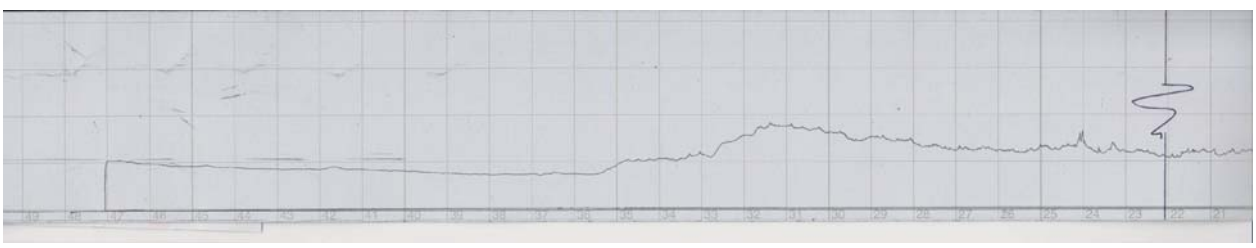

Tree 2


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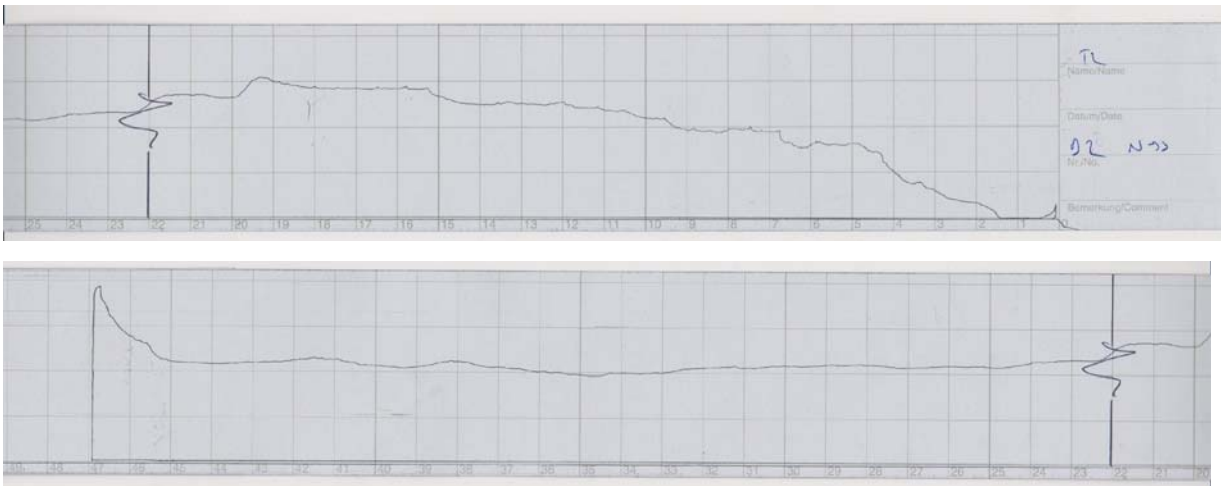
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