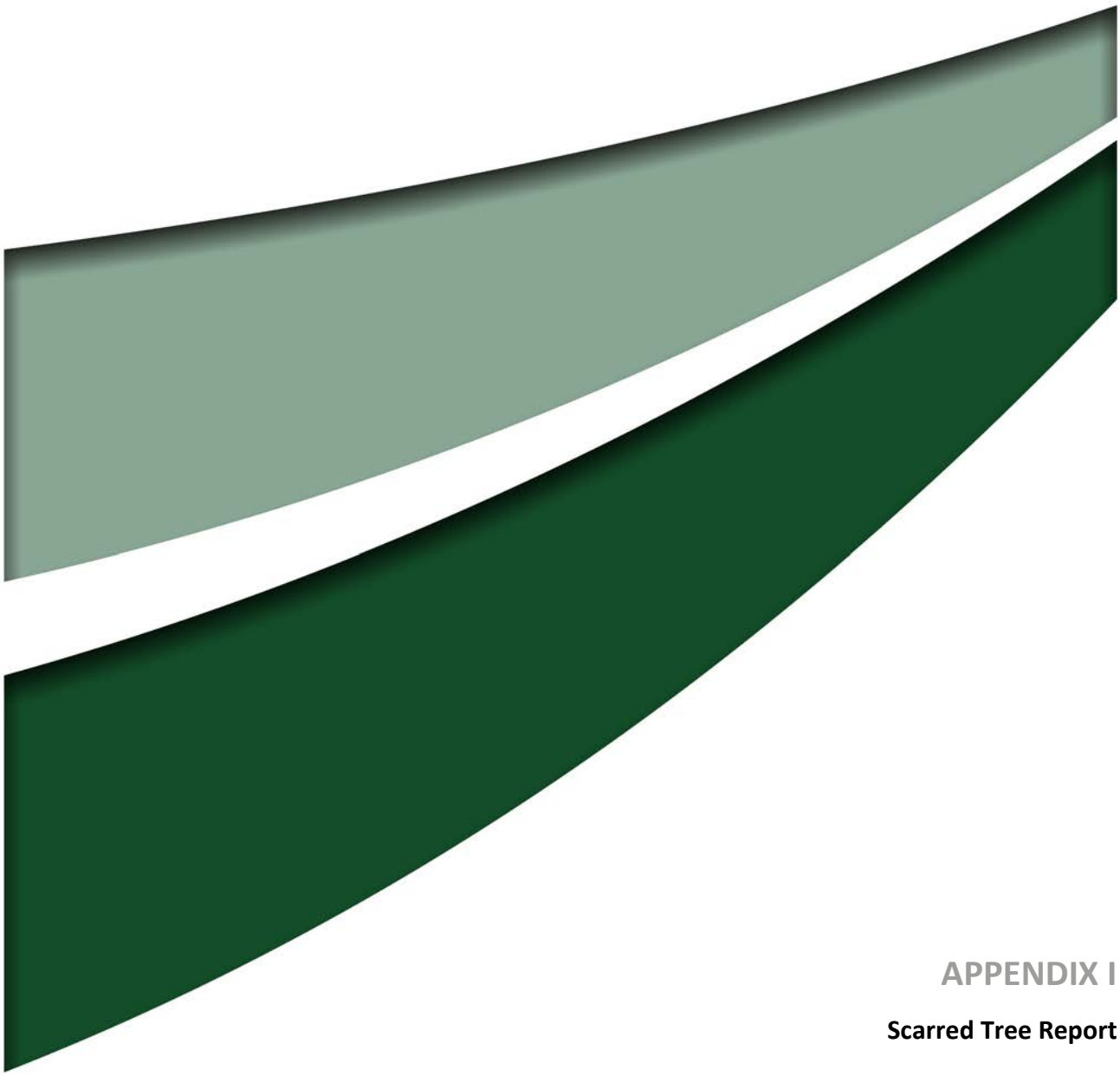


APPENDIX I

Scarred Tree Report

URBAN TREE MANAGEMENT

CONSULTING
ARBORICULTURISTS
& HORTICULTURISTS

Urban Tree Management Australia Pty Ltd
ACN 098 599 805
ABN 56 098 599 805

65 Excelsior Street
Merrylands NSW 2160

Phone 02 9760 1389

admin@utma.com.au
www.utma.com.au

Accredited member of
INSTITUTE OF AUSTRALIAN
CONSULTING ARBORICULTURISTS ®

REPORT:

ARBORICULTURAL ASSESSMENT
OF
Scarred Tree/s

AT
Lynwood
Hume Highway
Marulan
New South Wales

FOR
Umwelt Pty Ltd
On behalf of
Holcim (Australia) Pty Ltd

Prepared 24 June 2015
Reference 17162.1

Contents

1.0 SUMMARY

Urban Tree Management was engaged to prepare this report for Janice Wilson *(Manager cultural heritage/Associate*), Umwelt (Australia) Pty Ltd, 75 York Street, Teralba NSW 2284 on behalf of Holcim (Australia) Pty Ltd, Lynwood, Hume Highway, Marulan NSW. The report examines 4 trees summarized in Table 1.0. The tree/s were located within the premises of Lynwood, Marulan NSW (*the site*). Detailed arboricultural assessment of the 4 trees revealed 2 trees with scars of Aboriginal cultural origin and 2 trees each with a wound of origins from abrasion impact events and one of those possible from burl harvesting.

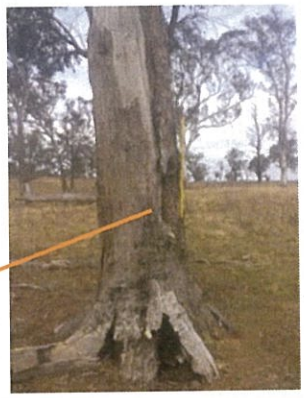
Table 1.0 Summary of each tree including likely age, wounding and cause of wounding.

Tree No. / Archaeological No.	Genus and species	Common name	1. Age range of tree in yrs. approx. / 2. Age range of wound in yrs. approx.	Likely origin of wound/s
1 / LKST1	*Eucalyptus mannifera* subsp. *mannifera* Mudie	Brittle Gum	1. 200 - <250 2. 100 - <150	1. Aboriginal cultural origin.
Photograph/s of tree/s showing wound/s				

Tree No. / Archaeological No.	Genus and species	Common name	1. Age range of tree in yrs. approx. / 2. Age range of wound in yrs. approx.	Likely origin of wound/s
2 / LKST2	*Eucalyptus aggregata* Deane & Maiden	Black Gum	1. 150 - <200 2. 30 - <50	1. Abrasion impact wound or incision from burl harvesting.
Photograph/s of tree/s showing wound/s				

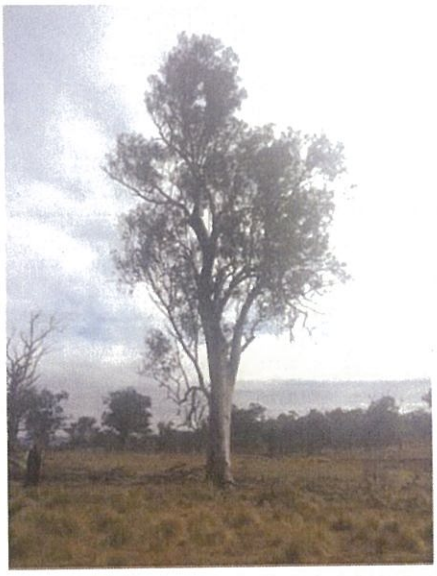
Tree No. / Archaeological No.	Genus and species	Common name	1. Age range of tree in yrs. approx. / 2. Age range of wound in yrs. approx.	Likely origin of wound/s
3 / LKST3	*Eucalyptus aggregata* Deane & Maiden	Black Gum	1. 150 - <200 2. 30 - <50	1. Abrasion impact wound.

Photograph/s of tree/s showing wound/s

Tree No. / Archaeological No.	Genus and species	Common name	1. Age range of tree in yrs. approx. / 2. Age range of wound in yrs. approx.	Likely origin of wound/s
4/ LKST4	*Eucalyptus mannifera* subsp. *mannifera* Mudie	Brittle Gum	1. 250 - <300 2. 150 <200	1. Aboriginal cultural origin.

Photograph/s of tree/s showing wound/s




2.0 INTRODUCTION

Danny Draper *(the author)* attended *the site* containing the 4 trees on Wednesday 10 June 2015 in the company of Janice Wilson (*Archaeologist*) of Umwelt Pty Ltd, and the trees and their growing environments and wounding were examined and assessed from the ground to determine the likely cause and estimated age of scarring and the wounds' longevity and protection if shown to be of Aboriginal cultural origin, subject to proposed works nearby, where appropriate.

The dimensions of the tree wound/s were recorded and each tree and wound/s photographed by the author. The age of each tree provided is an estimate only and offered within a range due to the uncertainty of such unsubstantiated field observations without the application of Dendrochronology or other records. Without such precise data the age of trees are usually considered in stages of life span against their biomass *in situ* as Young (0-20%), Mature (20-80%) and Over-mature (senescent) (80-100%).

3.0 METHODOLOGY

The locations of the tree/s are recorded by the Archaeologist/s and each tree identified by a unique code number. Here for ease of reference each tree was assigned a sequential number by UTMA Pty Ltd followed by the code assigned by the Archaeologists, e.g. 1 / GA Scarred Tree. Where a number was not assigned, the tree has been denoted by its GPS coordinates for latitude and longitude as Northings and Eastings, respectively.

Each inspection was undertaken by a visual assessment conducted from the ground and considered as part of the assessment/s the remaining lifespan of a live tree or durability of the remains of a dead tree where the scarred section is to be preserved.

A glossary of terms is included as Appendix C covering the description of the tree/s.

Assessment of Trees

The following criteria were recorded to reflect the current status of the trees being: Age class, Condition class, Form class, Dimensions, Crown cover (live foliage as %), Crown density (density of live foliage evident as %), vigour class and Sustainable Retention Index Value (SRIV) version 4 (IACA, 2010) of each live tree (Appendix A), where appropriate.

The age of the trees was estimated from a sound professional knowledge or research of the individual tree taxa, growth of trees within the region based on habitat, rainfall, soil type and land use practices and considered against the dimensions of each tree encountered and the limitations of its growing environment *in situ*. A tree may be described in greater detail than others where it was considered appropriate to more accurately describe the location of the wound or the circumstances which may have led to its formation.

Assessment of Wounds to determine Archaeological status as Scarred Trees

As a tree grows vascular cambium as a thin layer of dynamic cells close to the surface produces xylem to form wood on the inner side, and phloem to form bark on the outer side. The cambium grows as a continuous ring and is laid down as fibres along the trunk, stems and roots when a new growth increment layer is developed. The vascular cambium translocates nutrients in solution through the fibres from the roots to the leaves through the xylem and sugars produced in the leaves as photosynthates through the phloem and ray cells and to the roots. Their structural importance allows for strength and flexibility as energy from loading forces from the trees mass and wind movement stimulates adaptive growth and reactive growth. The shape and form of a tree is affected as wind moves along stems from the distal to proximal end dissipating and diminishing through damping through the trunk and roots and out into the ground (James *et al* 2006, Mattheck & Breloer 1994, pp. 14-19).

When the vascular cambium is disrupted a wound occurs. If the vascular cambium is severed to a sufficient depth fibres above and below will become desiccated and die forming a wound with the extent of tissue dieback often unpredictable and extending beyond the initial point of wounding. The coating of live tissue allows for a uniform distribution of loading forces over the entire tree – the *axiom of uniform stress* (Mattheck & Breloer 1994, p. 183), with additional or less wood produced depending on loading forces of compression, tension, shear and torsion. The stimulus of wounding usually changes the distribution of loading forces and the growth responses from the tree which can manifest as altered growth patterns as the load bearing capacity of the tree is modified and the crown and growing conditions alter over the life of the tree. Such changes may be caused by shedding branches, hollowing from termites, fungal decay or fire, clearing of nearby trees increasing exposure to winds, branch shedding, further wounding, and root damage from excavation, soil cultivation or erosion.

When wounding occurs the trees biomechanics predispose it to attempt to restore the alignment of its fibres and to protect it from pathogens by the growth of new wood and to isolate the wound through 4 walls of defence as provided by (CODIT) Compartmentalization of Decay In Trees (Shigo 1989, p. 45) by chemically altering surrounding wood and walling off the damage using barriers provided by existing cellular structures as Walls 1-3 and finally to conceal the wound separating it from the damage caused at the time of wounding beneath layers of new wood as Wall 4. At the time of wounding Wall 1 is formed by plugging xylem vessels vertically above and below the wound. Wall 2 is formed tangentially in growth rings by the concentration of lignin in the cells of late season's growth acting to prevent the inward spread of pathogens. Wall 3 forms at the sides of the wound from ray cells producing toxins which limits spread laterally. Wall 4 is the new wood separating the initial wound site from new growth and forms the *wound margin*.

The sides of the wound are *wound margin left* and *wound margin right* which slowly converge and usually form an oblong, circular or elliptic shape (Draper and Richards 2009). The distal and proximal ends of a wound are the *wound apex* and *wound base* respectively and may be irregular, jagged, obtuse, rounded, truncate to acute ($<90^{O}$) where the margins converge often forming a wound seam or partial occlusion (Draper and Richards 2009). The wood exposed by the removal of the bark is the *wound face* although this may be absent if a void is evident as a *cavity* or a larger void as a *hollow* (Draper and Richards 2009).

No matter what the shape of the wound the tree will ultimately attempt to align the fibres to grow over and conceal the wound to restore the cover of living wood around and along the stem to return the stem to its structural optimum, capable of receiving a uniform stress loading (Mattheck and Breloer 1994, pp. 12-16). Ultimately most margins converge and graft to conceal the *wound face* and it is then that the tree has achieved wound *occlusion* (Draper and Richards 2009). The living tissue disrupted at the time of wounding will always die, remain damaged and continue to deteriorate even when a wound is occluded by successive growth rings because trees do not heal they can only conceal the damaged cells with consecutive layers formed by each seasons growth (Mattheck and Breloer 1994, pp. 12-16).

Wound margins encroach over the wound face as new growth ring increments are added around the tree. The *wound margin depth* on the left and right sides usually deepens over time before the wound is occluded and can be measured perpendicular from the wound face to the outer edge of the trunk, or from the outer edge of the trunk to the inner edge of the void if the wound face is absent (Draper and Richards 2009). It is not uncommon for the depth of the *wound margin right* and *wound margin left* or the distances from the *initial wound margin* to the *wound margin* to be different because of reactive growth stimulated by differential loading along the stem in compression, tension, torsion or shear stimulating more wood to be laid down on the side bearing the greatest load (Mattheck and Breloer 1994, pp. 12-16). Where margins are of a similar width and depth they are usually equally loaded or may both be neutrally loaded (Mattheck 2004, p. 17).

As the wound wood margins grow across the wound face from the point of initial wounding a general differentiation in the colour of bark and its texture from surrounding unwounded tissue will sometimes be evident and can assist to indicate the extent of the width of the wound and the approximate location or extent of the *initial wound margin* (Draper and Richards 2009). However this may become less apparent over time with wounds that have been *occluded* for long periods due to the successive growth increments added sometimes concealing the wound entirely, or on trees with thick bark.

By measuring the width of the wound between the left and right *initial wound margin* the diameter of the trunk at the time of wounding and the approximate age of the tree can be estimated. The location of a wound on a trunk is static although the diameter of the stem is increased circumferentially by rings as growth increments, hence the wound margins and wound occlusion. The circumference of the trunk and stems of large old trees increases with age and the layers may be slightly thinner over a radial distance where such growth has slowed, than for younger trees or where they are not stimulated by loading.

Trees in the area are expected to have a relatively moderate growth rate due to their location on poor shallow soils, with cool winters and a short growing season, with a comparable average annual rainfall of 643 mm recorded at the nearby Goulburn TAFE, collected from 1971-2015, Latitude: 34.75° S Longitude: 149.70° E, Elevation: 670 m, approximately 21 km away to SSW (Australian Government Bureau of Meteorology 2015).

To differentiate between *cultural scarring*, historical scarring, recent mechanical damage or natural causes, the following were considered:

1. Age class
2. Ease of access to the location of wounding
3. Tree and its dimensions at the time of wounding
4. Extent of wounding, its symmetry (symmetrical / asymmetrical)
5. Extent of growth around wound site since initial wounding whether tree alive/dead
6. Impact of that wounding on the tree since the wounding event
7. Land use history
8. Condition class
9. Vigour class
10. Influence of its growing environment and its constraints
11. Proximity to other trees, shape and growth habit
12. Crown form
13. Shading
14. Rainfall
15. Insect damage
16. Fire
17. Soil
18. Aspect
19. Slope
20. Drainage

This Arboricultural assessment will assist Archaeologists and Aboriginal community members determine the status of scarred trees and to manage the tree/s, by eliminating natural or mechanical causes of wounding and determining the estimated remaining safe life span or works to prolong a live tree *in situ* or to conserve and protect remaining dead tree/s or relevant section/s where required.

4.0 TREE ASSESSMENT

4.1 Assessment of Tree/s – Tree 1 / LKST1

Tree No. / Genus & species Common Name	**1. Age Class** **Y** = Young **M** = Mature **O** = Over-mature (Senescent) **2. Age range of tree** in yrs. approx. **3. Age range of wound** in yrs. approx. 4. **Date range since tree died** in yrs. approx., e.g. died, cut down, ring-barked	**Condition** **G** = Good **F** = Fair **P** = Poor **D** = Dead	**Form** **D** = Dominant **C** = Co-dominant **I** = Intermediate **S** = Suppressed **F** = Forest **E** = Emergent	**Height** in metres approx. / **Crown spread** approx. length x breadth metres / **Crown spread orientation.**	**Trunk diameter** in mm @ 1.4m, or as stated / **Trunk diameter orientation**	**Crown cover / Crown density** approx. %	**SRIV** Age, Vigour, Condition / Index Rating App A. / Remaining life expectancy 1. Long 2. Medium 3. Short
1 / LKST1 *Eucalyptus mannifera* subsp. *mannifera* Mudie Brittle Gum	1. M 2. 150 - <200 3.1 100 - <150 4. N/A	F	C	12.6 / 12 R	500x900, 700 Av. E/W	75 / 70	MGVF – 9 1

Description

E. mannifera subsp. *mannifera* Mudie – Brittle Gum is a small to medium sized tree (Brooker and Kleinig 1999, p. 145) with crown spread 10 - 20 m and commonly attaining a height of 10 - 20 m (Elliot and Jones 1986, p. 140) to 15 - 25 m, smaller on sites with poor soil, with a diameter up to 30 – 60 cm DBH, straight trunk usually half the tree height (Boland *et al*, 2006, p. 322). Its wood has a low density of 870 kg / m^3, is close grained, moderately durable and very brittle with commercial use restricted to firewood (Boland *et al*, 2006, p. 392). Moderate weathering of the wound face is evident. The trunk is straight, but leaning 21^O to north, opposite the wound, likely to be the result of root death caused by the disruption to the vascular cambium and subsequent instability. The tree is leaning onto the ground supported partly by branches form its own crown and is partly supported by leaning against the crotch of structural branches of an adjacent tree.

Wound 1

Trunk wound, rectangular - oval, symmetrical, on south side extending from ground to 2220 mm and 1090 mm at widest at center. Wound face extending from 200 – 2000 mm and 700 mm at widest at center. Wound face complete, weathered to heartwood with remnant layers adjacent the right wound margin (see Photograph 1.2). Moderate weathering of the wound face is evident, with the wound facing south and somewhat protected from weathering from shading by the crowns of adjacent trees and the moderate lean of the trunk 21^O allowing the wound face to drain readily, indicative of an older wounding event. The reduced direct sunlight likely to contribute to slowing the process of delignification.

Wound margins entire, apex truncate, base irregular. Depth of margins: right 80 - 140 mm proximal - distal, and left 100 – 180 mm proximal – distal, respectively. Width of margins: right 50 mm, left 60 mm. Initial wound margins: right 200 mm, left 250 mm, from growth evident adjacent the apex.

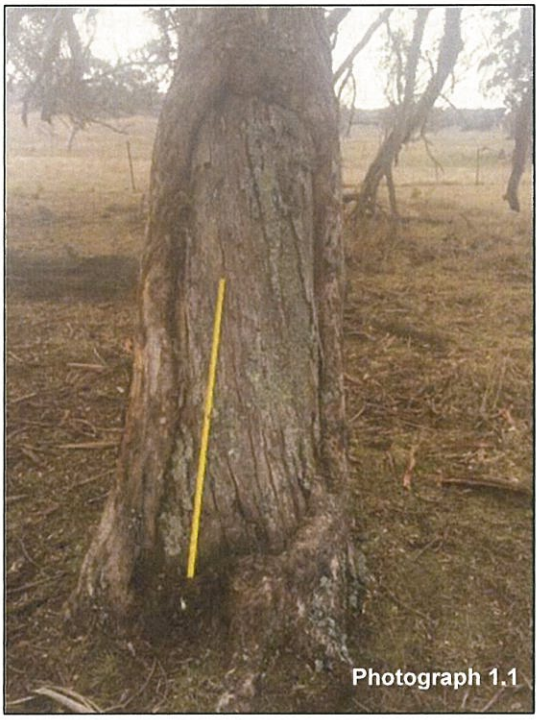
Trees that sustain large wounds have slower subsequent growth rates due to the reduced area of active cambium and a reduced ability to sustain themselves against predation. From the width of initial wound margins, size of wound, root death and subsequent lean of the once upright tree, weathering of the wound face slowed by the lean of the tree and shading of the wound and slowed tree growth by the large wound affecting approximately 50% of trunk circumference *in situ* and wound approximately 100 - <150 years old, the wound is expected to have been derived from bark extraction possibly for a shelter and of Aboriginal cultural origin.

Photograph 1.0 (above) taken by Danny Draper. View to northwest of Tree 1 / LKST1 *Eucalyptus mannifera* subsp. *mannifera* – Brittle Gum, (center), leaning, supported by branches resting into the ground. Wound 1 on its south side (see Photograph 2.0) location indicated by arrow.

Risks to tree

Damage from fire, fungal decay, termites and gradual continued structural deterioration leading to the collapse of the trunk.

Filling near tree - Australian Standard 4970 *Protection of trees on development sites*, sec 3, 3.2 *Determining the Tree Protection Zone (TPZ)* (Standards Australia, 2009, p. 11) provides for a radial exclusion zone from works, e.g. filling, from the center of trunk radiating from the base of the tree of 12 multiples of trunk diameter at breast height (DBH) to protect the crown and roots. For this tree AS4970 provides 12 x 700 mm (DBH), therefore a radial TPZ of 8.4 m to provide for the ongoing viability of the living tree.



Photograph 1.1 (above) taken by Danny Draper. View to northwest of Tree 1 / LKST1 *Eucalyptus mannifera* subsp. *mannifera* – Brittle Gum, (center). Wound 1 on its south side shown with a yellow 1 m ruler.

4.2 Assessment of Tree/s – Tree 2 / LKST2

Tree No. / Genus & species Common Name	**1. Age Class** **Y** = Young **M** = Mature **O** = Over-mature (Senescent) **2. Age range of tree** in yrs. approx. **3. Age range of wound** in yrs. approx. **4. Date range since tree died** in yrs. approx., e.g. died, cut down, ring-barked	**Condition** **G** = Good **F** = Fair **P** = Poor **D** = Dead	**Form** **D** = Dominant **C** = Co-dominant **I** = Intermediate **S** = Suppressed **F** = Forest **E** = Emergent	**Height** in metres approx. / **Crown spread** approx. length x breadth metres / **Crown spread orientation.**	**Trunk diameter** in mm @ 1.4m, or as stated / **Trunk diameter orientation**	**Crown cover / Crown density** approx. %	**SRIV** Age, Vigour, Condition / Index Rating App A. / Remaining life expectancy 1. Long 2. Medium 3. Short
2 / LKST2 *Eucalyptus aggregata* Deane & Maiden Black Gum	1. O 2. 150 - <200 3.1 30 - <50 4. <5	D	F – D?	Stump to 6 m / N/A	900, R	N/A	N/A

Description

E. aggregata Dean and Maiden – Black Gum, is a small to medium sized woodland tree with the bark rough and persistent to smaller branches (Brooker and Kleinig 1999, p. 136) with trunk, short, straight or crooked, crown elongated to spreading, crown spread 5 - 12 m and commonly attaining a height of 10 - 18 m (Elliot and Jones 1986, p. 16) with a diameter 700 – 900 mm DBH. The timber is soft and of no use commercially (Elliot and Jones 1986, p. 16). Tree died <5 years ago evident by the remains of fine branches of epicormic shoots on its lower trunk. The tree has collapsed to a stump at approximately 6 m.

Wound 1

Trunk, oval – elliptical, on west side of trunk extending from 1000 – 1700 mm and 370 mm at widest at center. Wound face extending from 1160 - 1550 and 170 mm at widest at center. Wound face entire, wound margins entire, apex and base both rounded, affecting approximately 5% of trunk circumference. Horizontal striations across the wound face are evident at 1420 mm, weathered to 40 mm wide as a shallow depression up to 4 mm deep extending under the right wound margin and obscured under the left wound margin. Wound face weathered to ray cells with vertical cracks evident along the wood grain with circular holes up to 2 mm diameter evident throughout indicative of Lyctus borer exit holes.

The width of the initial wound margins: right 110 mm approx. and left 40 mm approx. The depth of wound margins: right 70 mm approx. and left 40 mm approx. The wound margin width: right 110 mm approx. and left 120 mm approx.

The tree is located near to an old farm rubbish tip (no longer present) where visitations from farm equipment such as trucks or tractors with trailers would have been frequent over an extended period providing many opportunities for an abrasion impact event with this tree.

From the shallow depth of wound margins, size of wound, presence of a horizontal striation across the wound face, susceptibility of the timber to weathering and presence of small burls on the trunk (see Photograph 2.2), location near an old farm rubbish tip, the wound affecting approx. 5% of trunk circumference – small enough for extraction of a burl, and the wound age of approx. 30 - <50 years, the wound is expected to have originated from an abrasion impact event or burl harvesting.

Risks to tree

Damage if retained, from fire, fungal decay, termites, and continued structural deterioration leading to the collapse of the trunk.

Photograph 2.0 (above left) taken by Danny Draper. View to northeast of remaining stump of Tree 2 / LKST2 *Eucalyptus aggregata* – Black Gum, (center). Wound 1 on its northeast side.

Photograph 2.1 (above right) taken by Danny Draper. View to northeast of Tree 2 / LKST2 *Eucalyptus aggregata* – Black Gum, showing Wound 1 on its southwest side shown with a yellow 1 m ruler.

Photograph 2.2 (right) taken by Danny Draper. View to northeast of Tree 2 / LKST2 *Eucalyptus aggregata* – Black Gum, numbered arrows showing locations of:

1. Burls on its lower trunk,
2. Wound 1.

4.4 Assessment of Tree/s – Tree 3 / LKST3

Tree No. / Genus & species Common Name	**1. Age Class** **Y** = Young **M** = Mature **O** = Over-mature (Senescent) **2. Age range of tree** in yrs. approx. **3. Age range of wound** in yrs. approx. **4. Date range since tree died** in yrs. approx., e.g. died, cut down, ring-barked	**Condition** **G** = Good **F** = Fair **P** = Poor **D** = Dead	**Form** **D** = Dominant **C** = Co-dominant **I** = Intermediate **S** = Suppressed **F** = Forest **E** = Emergent	**Height** in metres approx. / **Crown spread** approx. length x breadth metres / **Crown spread orientation.**	**Trunk diameter** in mm @ 1.4m, or as stated / **Trunk diameter orientation**	**Crown cover / Crown density** approx. %	**SRIV** Age, Vigour, Condition / Index Rating App A. / Remaining life expectancy 1. Long 2. Medium 3. Short
3 / LKST3 *Eucalyptus aggregata* Deane & Maiden Black Gum	1. O 2. 150 - <200 3.1 30 - <50 4. N/A	P	F	12 / 5 R	700 R	90 / 90	OGVP – 4 2

Description

E. aggregata Dean and Maiden – Black Gum, is a small to medium sized woodland tree with the bark rough and persistent to smaller branches (Brooker and Kleinig 1999, p. 136) with trunk, short, straight or crooked, crown elongated to spreading, crown spread 5 - 12 m and commonly attaining a height of 10 - 18 m (Elliot and Jones 1986, p. 16) with a diameter 700 – 900 mm DBH. The timber is soft and of no use commercially (Elliot and Jones 1986, p. 16). Tree had a branch bark inclusion in the crotch of its first order structural branches (FOSB) and subsequently a split developed and continued down the trunk with the north section dying. The split down the trunk caused the left wound margin to die and the right side to continue growing, supported by a secondary crown that is likely to have developed after the dieback of the upper crown and its subsequent collapse.

Wound 1

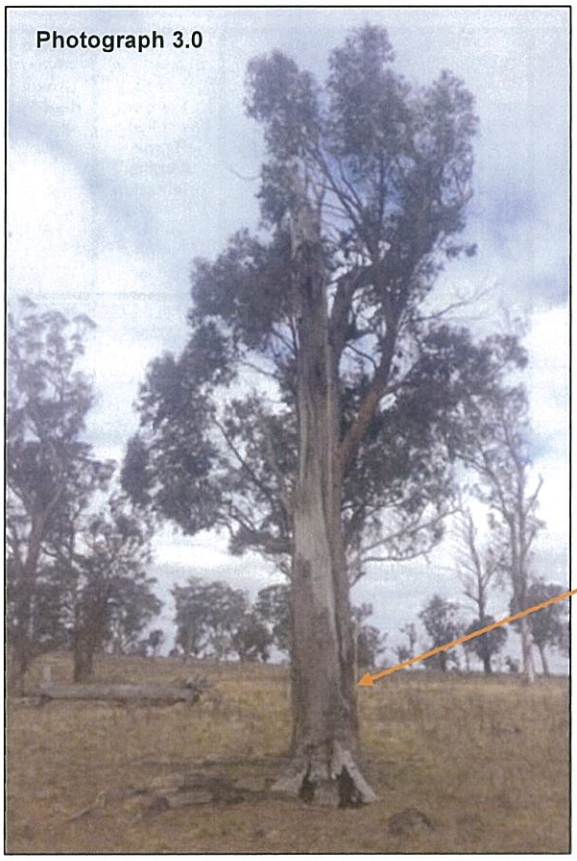
Trunk, oval, on west side of trunk extending from 1160 – 1860 mm and 670 mm at widest at center. Wound face extending from 1050 – 1750 mm and 450 mm at center. Wound split by trunk split vertically down the axis of the wound apex, face incomplete, desiccated with bark shedding from left margin where trunk section is dead, with delignification and decay at the base. Wound margins entire, apex acute but open due to trunk split, wound base acute, affecting approximately 5% of trunk circumference. Horizontal striations across the wound face are evident at 1420 mm, weathered to 70 mm wide as a shallow depression up to 10 mm deep. Circular holes up to 2 mm diameter evident throughout indicative of Lyctus borer exit holes.

The width of the initial wound margins: right 110 mm approx. and left 150 mm approx. The depth of wound margins: right 140 mm approx. and left 50 mm approx. The wound margin width: right 110 mm approx. and left 150 mm approx. The tree is located near to an old farm rubbish tip (no longer present) where visitations from farm equipment such as trucks or tractors with trailers would have been frequent over an extended period providing many opportunities for an abrasion impact event with this tree.

From the shallow depth of wound margins, size of wound, presence of a horizontal striation across the wound face, susceptibility of the timber, location near an old farm rubbish tip, the wound affecting approx. 5% of trunk circumference, and the wound age of approx. 30 - <50 years, the wound is expected to have originated from an abrasion impact event.

Risks to tree

Damage if retained, from fire, fungal decay, termites, and continued structural deterioration leading to the collapse of the trunk.



Photograph 3.0 (above left) taken by Danny Draper. View to southeast of Tree 3 / LKST3 *Eucalyptus aggregata* – Black Gum, (center) showing well developed secondary crown. Wound 1 on its west side, location indicated by arrow.

Photograph 3.1 (above right) taken by Danny Draper. View to southeast of Tree 3 / LKST3 *Eucalyptus aggregata* – Black Gum, showing Wound 1 on its west side shown with a yellow 1 m ruler.

Photograph 3.2 (right) taken by Danny Draper. View to northeast of Tree 2 / LKST2 *Eucalyptus aggregata* – Black Gum showing Wound 1 on its west side with a yellow 1 m ruler, numbered arrows indicating the locations of:

1. Trunk split extending through the wound apex,
2. Left wound margin dead and shedding bark.

4.4 Assessment of Tree/s – Tree 4 / LKST4

Tree No. / Genus & species Common Name	**1. Age Class** **Y** = Young **M** = Mature **O** = Over-mature (Senescent) **2. Age range of tree** in yrs. approx. **3. Age range of wound** in yrs. approx. **4. Date range since tree died** in yrs. approx., e.g. died, cut down, ring-barked	**Condition** **G** = Good **F** = Fair **P** = Poor **D** = Dead	**Form** **D** = Dominant **C** = Co-dominant **I** = Intermediate **S** = Suppressed **F** = Forest **E** = Emergent	**Height** in metres approx. / **Crown spread** approx. length x breadth metres / **Crown spread orientation.**	**Trunk diameter** in mm @ 1.4m, or as stated / **Trunk diameter orientation**	**Crown cover / Crown density** approx. %	**SRIV** Age, Vigour, Condition / Index Rating App A. / Remaining life expectancy 1. Long 2. Medium 3. Short
4 / LKST4 *Eucalyptus mannifera* subsp. *mannifera* Mudie Brittle Gum	1. M 2. 250 - <300 3.1 150 - <200 4. N/A	F	F - D	18.8 / 12 R	1100x1000, 1050 Av. N/S	75 / 80	MGVF – 9 1

Description

E. mannifera subsp. *mannifera* Mudie – Brittle Gum is a small to medium sized tree (Brooker and Kleinig 1999, p. 145) with crown spread 10 - 20 m and commonly attaining a height of 10 - 20 m (Elliot and Jones 1986, p. 140) to 15 - 25 m, smaller on sites with poor soil, with a diameter up to 30 – 60 cm DBH, straight trunk usually half the tree height (Boland *et al*, 2006, p. 322). Its wood has a low density of 870 kg / m^3, is close grained, moderately durable and very brittle with commercial use restricted to firewood (Boland *et al*, 2006, p. 392). Moderate weathering of the wound face is evident, with the wound facing south and somewhat protected from weathering, indicative of an older wounding event.

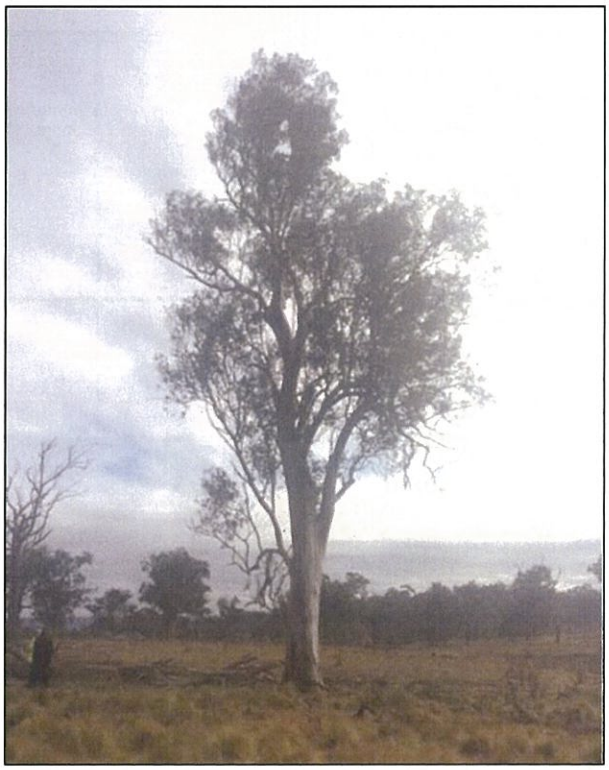
Wound 1

Trunk wound, narrow oval, symmetrical, on south southeast side extending from 200 – 1800 mm. Wound face extending from 400 – 1570 mm and 200 mm at widest at center. Wound face complete, with extensive weathering of sapwood and some delignification of heartwood with ash evident from fire damage adjacent the left wound margin distally. Wound affecting approximately 5% of trunk circumference. Wound margins entire, apex and base acute. Initial wound margins not evident. Depth of margins: right 230 mm, and left 130 mm. Width of margins unable to be determined.

From the depth of wound margins, size of wound, weathering of the wound face slowed by the reduced direct sunlight likely to have contributed to slowing the process of delignification of an old wound facing south and sheltered by well-developed wound margins, wound face of dimensions and preformed shape indicative of a shield or container artifact, affecting approximately 10% of trunk circumference *in situ*, and wound approximately 150 - <200 years old, the wound is expected to have been caused by bark extraction and of Aboriginal cultural origin.

Risks to tree

Damage if being retained, from fire, fungal decay, termites, and continued structural deterioration leading to the collapse of the trunk.



Photograph 4.0 (above left) taken by Danny Draper. View to northwest of Tree 4 / LKST4 *Eucalyptus mannifera* subsp. *mannifera* – Brittle Gum, Wound 1 on its south southeast side, location indicated by arrow.

Photograph 4.1 (above right) taken by Danny Draper. View to southeast of Tree 4 / LKST4 *Eucalyptus mannifera* subsp. *mannifera* – Brittle Gum, Wound 1 on its west side shown with a yellow 1 m ruler.

5.0 CONCLUSION

This is provided in table form and summarizes the key information

Tree No. / Archaeological reference	Age of Tree **Age range of tree** in yrs. approx.	Age of Scar **Age range of wound** in yrs. approx.	Likely origin of Scar/s
LKST1	200 - <250	1. 100 - <150	1. Aboriginal cultural origin
LKST2	150 - <200	1. 30 - <50	2. Abrasion impact event or incision from burl harvesting.
LKST3	150 - <200	1. 30 - <50	1. Abrasion impact event
LKST4	250 - <300	2. 150 - <200	1. Aboriginal cultural origin

Danny Draper
Principal Consultant
IACA ACM0012003
Dip. Hort. (Arboriculture)
Assoc. Dip. Hort. (Pk. Mgmt.)
Hort. Cert.

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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 deterioration from modification/s to its growing environment either existing or proposed, either above or below ground, contrary to our advice.

Appendix A

Matrix - Sustainable Retention Index Value (SRIV) ©

Version 4, 2010
Developed by IACA – Institute of Australian Consulting Arboriculturists www.iaca.org.au

The matrix is to be used with the value classes defined in the Glossary for Age / Vigour / Condition.
An index value is given to each category where ten (10) is the highest value.

Age Class	Vigour Class and Condition Class					
	Good Vigour & Good Condition (GVG)	Good Vigour & Fair Condition (GVF)	Good Vigour & Poor Condition (GVP)	Low Vigour & Good Condition (LVG)	Low Vigour & Fair Condition (LVF)	Low Vigour & Poor Condition (LVP)
	Able to be retained if sufficient space available above and below ground for future growth. No remedial work or improvement to growing environment required. May be subject to high vigour. Retention potential - Medium – Long Term.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work may be required or improvement to growing environment may assist. Retention potential - Medium Term. Potential for longer with remediation or favourable environmental conditions.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work unlikely to assist condition, improvement to growing environment may assist. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. No remedial work required, but improvement to growing environment may assist vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment may assist condition and vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	Unlikely to be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment unlikely to assist condition or vigour. Retention potential - Likely to be removed immediately or retained for Short Term. Potential for longer with remediation or favourable environmental conditions.
(Y) Young	**YGVG - 9** **Index Value 9** Retention potential - Long Term. Likely to provide minimal contribution to local amenity if height <5 m. High potential for future growth and adaptability. Retain, move or replace.	**YGVF - 8** **Index Value 8** Retention potential - Short – Medium Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Medium-high potential for future growth and adaptability. Retain, move or replace.	**YGVP - 5** **Index Value 5** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Low-medium potential for future growth and adaptability. Retain, move or replace.	**YLVG - 4** **Index Value 4** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Medium potential for future growth and adaptability. Retain, move or replace.	**YLVF - 3** **Index Value 3** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m. Low-medium potential for future growth and adaptability. Retain, move or replace.	**YLVP - 1** **Index Value 1** Retention potential - Likely to be removed immediately or retained for Short Term. Likely to provide minimal contribution to local amenity if height <5 m. Low potential for future growth and adaptability.
(M) Mature	**MGVG - 10** **Index Value 10** Retention potential - Medium - Long Term.	**MGVF - 9** **Index Value 9** Retention potential - Medium Term. Potential for longer with improved growing conditions.	**MGVP - 6** **Index Value 6** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVG - 5** **Index Value 5** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVF - 4** **Index Value 4** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVP - 2** **Index Value 2** Retention potential - Likely to be removed immediately or retained for Short Term.
(O) Over-mature	**OGVG - 6** **Index Value 6** Retention potential - Medium - Long Term.	**OGVF - 5** **Index Value 5** Retention potential - Medium Term.	**OGVP - 4** **Index Value 4** Retention potential - Short Term.	**OLVG - 3** **Index Value 3** Retention potential - Short Term. Potential for longer with improved growing conditions.	**OLVF - 2** **Index Value 2** Retention potential - Short Term.	**OLVP - 0** **Index Value 0** Retention potential - Likely to be removed immediately or retained for Short Term.

Appendix B

Glossary

From
Dictionary for Managing Trees in Urban Environments
Institute of Australian Consulting Arboriculturists (IACA) 2009, CSIRO Publishing.

Wounds

Abrasion Wound *Mechanical wound* causing *laceration* of tissue by an abrasive impact *episode* e.g. grazed by a motor vehicle or the continuous action of the rubbing of *crossed branches* or stems where no graft has formed.

Basal Trunk Wound A wound on the trunk extending to the *root crown* where the base of the wound is open at the ground and usually truncated. Dependent upon the width of its base such a wound may not become *occluded*.

Blaze A wound cut into a tree usually to the sapwood and sometimes extending to heartwood to create a marker point e.g. by a surveyor, the *wound face* may be further incised or painted to denote additional information.

Branch Core After a branch fails or is removed, this is the remaining branch section within the connecting branch or trunk walled off by compartmentalisation.

Branch Tear *See Branch Tear Out.*

Branch Tear Out Dislodging of a branch from its point of attachment where it is torn away from the *branch collar* snapping the *branch tail* causing a *laceration*, usually to the underside of the *branch union* of the branch or trunk to which it was attached forming a *tear out wound*.

Branch Tear Wound *See Tear Out Wound.*

Callus Wood Undifferentiated and unlignified wood that forms initially after wounding around the margins of a wound separating damaged existing wood from the later forming lignified wood or *wound wood*.

Canker A *wound* created by repeated localised killing of the *vascular cambium* and bark by wood *decay* fungi and bacterium usually marked by concentric disfiguration. The wound may appear as a depression as each successive *growth increment* develops around the *lesion* forming a *wound margin* (Shigo 1991, p. 140, Keane *et al* 2000, p. 332).

Cavity A usually shallow void often localized initiated by a *wound* and subsequent *decay* within the trunk, branches or roots, or beneath bark, and may be enclosed or have one or more opening.

Decay Process of degradation of wood by microorganisms (Australian Standard 2007, p. 6) and fungus.

Delaminate A *mechanical wound* caused when the bark is stripped from a tree, usually from the trunk as a continuous sheet back to the vascular cambium. This may occur from an impact or abrasion *episode* such as a collision with a motor vehicle and the tree may become *ringbarked*. See also *Partially Delaminated*.

Delamination The separation of fibres often evident as longitudinal splitting of wood (Lonsdale 1999, p. 313).

Delignification The decomposition of *lignin* from *wood* by chemical deterioration, resulting in loss of strength, evident by separation of fibres into hair like strands. See also *Lignification*.

Depth of Margin Distance from outer trunk perpendicular to the *wound face*. This may assist in determining the age of a wound.

Dieback Wound Wounding where *dieback* extends beyond a branch collar as with *natural pruning* and extends to other branches, trunk or roots. See also *Secondary Crown* and *Stag-headed*.

Enclosed Wound Wound with a perimeter of *wound wood* with a well-defined apex, base and margins and often evident on an older wound. On a pruned branch that is rounded the enclosing wound wood from the branch collar may be circular with no definite apex or base evident. However, on a pruned branch where the *wound face* is oval in shape due to *reaction wood*, the enclosing *wound wood* from the branch collar may form a definite apex, base or margins.

Environmental Wounding/Damage Wounding inflicted by environmental factors or modifications to the growing *environment* of a tree, e.g. sun-scald, drought, fire, water logging, wind damage to leaves, branches, bark or roots, phytotoxic damage from chemicals, or air, soil or water pollution.

Fire Wound Wounding caused by fire. Such wounds may cause initial damage or may be secondary from a previous wounding *episode*/s. Some fire damage may be superficial or may destroy a tree in full or part rendering it potentially vulnerable to failure. Note: fire damaged trees can be potentially hazardous and should be assessed carefully.

Hollow A large void initiated by a *wound* forming a *cavity* in the trunk, branches or roots and usually increased over time by *decay* or other contributing factors, e.g. fire, or fauna such as birds or insects e.g. ants or termites. A hollow can be categorized as an *Ascending Hollow* or a *Descending Hollow*.

Horizontal Wound Usually superficial horizontal wounding from insects burrowing between bark layers and revealed by decorticating bark. Often evident on smooth bark Eucalypts.

Impact Wound *Mechanical wound* caused by an impact *episode* e.g. collision by a motor vehicle.

Incision Wound caused by cutting or engraving. See also *Laceration*.

Increment strip A linear, usually narrow, *fluted* section of *adaptive wood,* forming in a place of high *stress* indicating the pattern of *force flow* (Mattheck 2004, p. 140). Evident as lighter coloured bark usually occurring around the edges of a *notch* or *branch stub*, along a *buttress*, or along a *sharp-edged rib*.

Initial Wound Margin The site of initial wounding often evident as a faint line of discoloured bark or bark of a different texture to adjacent undamaged trunk. This may assist in determining the age of a wound.

Insect Wound Wounding to any part of a tree caused by insect activity, e.g. borers and termites.

Laceration Wound caused by tearing. See also *Incision*.

Lightning Strike Wound A wound from a lightning strike. Such a wound may kill a tree outright or cause it to catch fire, or may destroy the tree in full or part, or no injury may be evident and a tree gradually declines through resulting *stress*. Bark may be exploded from the tree by pressure radiating from the core of the lightning path resulting in further compounded damage through water heating and steam explosions in the tissues and the electrical disruption of living cells (Coder 2004, pp. 35-44).

Mechanical Wound Wounding inflicted by abrasion e.g. by motor vehicles, grass mowing equipment, grazing by horses, cows or birds (parrots); impact e.g. by motor vehicle collisions; drilling e.g. with increment cores, resistographs, cable bracing, hanging pots, hammocks etc.; branch tearing e.g. from wind damage, collision from falling branches, vandalism; and root severance e.g. root pruning for excavation for building or utility services or for agricultural cultivation.

Open Wound Wound with poor to non-existent perimeter or *callus wood* or *wound wood* on an older wound without well-defined apex, base or margins and often this will be associated with a recent wounding *episode* or an older episode on a senescent tree or a tree in *poor condition* or of *low vigour*, or where repeated wounding episodes such as inflicted by ongoing borer activity damages and continually alters wound perimeters, or repeated scalping of exposed roots by lawn mowing equipment.

Occlusion Growth processes where *wound wood* develops to enclose the *wound face* by the merging of *wound margins* concealing the *wound* and restoring the growing surface of the structure with each *growth increment* gradually realigning *fibres* in the wood longitudinally along the stem to maximise uniform stress loading. See also *Axiom of Uniform Stress.*

Partial Occlusion *Wound wood* growth that encloses some of the *wound face* by the merging and *grafting* of some sections of the *wound margins*. Usually evident by reduced *wound face* width and indicated where an *apex* or *base* is *acute* with the vertical extent often indicated by the length of an *occlusion seam.*

Partially Bridged Occlusion *Wound wood* partly forming an *occlusion* by joining areas of the *wound margins* across the *wound face* at point/s other than the base or apex and may form an *occlusion seam.*

Pruning Wound A wound created by the act of *pruning*.

Ram's Horning *Wound wood* that becomes curled inward and can wrap around itself as it crosses a void such as a *cavity* and may succumb to cracking with those wounds susceptible to further infestation by *decay* pathogens.

Scarred Tree A tree containing a wound of cultural or scientific interest, inflicted initially for a specific purpose, e.g. by indigenous people to extract implements or carved as a marker or with a pattern for ceremonial purposes, or as a marker and *blaze* by a surveyor or explorer, or from an accidental *wound* that has not *occluded*.

Stepped Incision A localised area of deeper wounding often extending to the heartwood, usually proximally within a *blaze*, removing a vertical semi-circular wedge like section from the *wound face* with a horizontal bench like structure formed by deep cuts as its base. Such wound sections usually taper distally and may be cut around the outer edges to assist removal of the semi-circular wedge, and likely undertaken to inhibit regrowth.

Structural Wound Any wound occurring on a tree as a result of a structural failure e.g. branch splitting or *hazard beam*, diminishing its stability in full or part.

Succession Wound Preceding layers of failed wound margin/s forming a step like sequence away from the *wound face*, where present, to the current wound margin/s indicating repeated cycles of formation and failure of *CODIT Wall 4.*

Sun Scald Wounding Wounding usually on the upper side of branches after sudden exposure to sunlight especially in summer e.g. after excessive pruning of the upper crown, or following storm damage stripping foliage or branches e.g. *Ficus spp.*

Survey Marker Wound *See Blaze.*

Tear Out *See Branch Tear Out.*

Tear Out Wound A wound of usually concave shape created by a *branch tear out.*

Wound Damage inflicted upon a tree through injury to its living cells, from biotic or abiotic causes, e.g. where *vascular cambium* has been damaged by branch breakage, impact or insect attack. Some wounds *decay* and cause *structural deterioration* or *defects*. Trees of *normal vigour* are able to resist and contain infection by walling off areas within the wood by *compartmentalization.* See *Compartmentalization Of Decay In Trees (CODIT).* An *occlusion* may eventually conceal a wound but the enclosed *defect* remains internally and *decay* may continue to develop further weakening the *heartwood* and *sapwood* compromising the tree's *structural integrity*. The cause of a wound may be accidental e.g. *branch tear out* or deliberate e.g. *carved tree*.

Wound Apex The distal end of a wound. The shape may be acute, irregular, jagged, obtuse, rounded, or truncate.

Wound Apex Acute Apex of a wound that is tapering and the *occlusion* interface angle is less than $<90^{o}$.

Wound Apex Irregular The *wound wood* growth at the apex mostly interrupted forming an edge that is not uniform or jagged. Often this may be influenced by a *successional wound* resulting in disproportionate development of *callous wood* and *wound wood.*

Wound Apex Jagged The *wound wood* growth or tissue damaged initially at the apex that is uneven and likely to have been caused by laceration.

Wound Apex Obtuse Apex of a wound that is tapering and the *occlusion* interface angle is greater than $>90^{o}$.

Wound Apex Rounded The *wound wood* growth at the apex that is curved.

Wound Apex Truncate The *wound wood* growth or tissue damaged initially at the apex that is even and likely to have been caused by incision.

Wound Base The proximal end of a wound. The shape may be acute, irregular, jagged, obtuse, rounded, or truncate.

Wound Base Acute Base of wound that is tapering and the *occlusion* interface angle is less than <90°.

Wound Base Irregular The *wound wood* growth at the base mostly interrupted forming an edge that is not uniform or jagged. Often this may be influenced by a *successional wound* resulting in disproportionate development of *callous wood* and *wound wood.*

Wound Base Jagged The *wound wood* growth or tissue damaged initially at the base that is uneven and likely to have been caused by laceration.

Wound Base Obtuse Base of wound that is tapering and the *occlusion* interface angle is greater than >90°.

Wound Base Rounded The *wound wood* growth at the base that is curved.

Wound Base Truncate The *wound wood* growth or tissue damaged initially at the base that is even and likely to have been caused by incision.

Wound Face Surface area of tissue exposed by injury, e.g. bark, sapwood, heartwood.

Wound Face Cracks Horizontal Transverse cracks in a *wound face* indicative of failure from *tension* force (Mattheck & Breloer 1994, p. 183).

Wound Face Cracks Vertical Longitudinal cracks in a *wound face* indicative of failure from *compression* force (Mattheck & Breloer 1994, p. 183).

Wound Face Entire Surface of exposed tissue is uniform without damage extending to a different layer or unaffected by borers or decay, e.g. possibly described as *wound face* entire to dead sapwood.

Wound Face Incomplete Surface of exposed tissue is not uniform with damage extending to different layers or affected by borers or decay, e.g. possibly described as *wound face incomplete* with cavity at apex. See also *Wound face entire.*

Wound Face Exposed Heartwood Wound extending to reveal the *heartwood*, or has deteriorated through *decay* to reveal this layer of wood.

Wound Face Exposed Sapwood Wound extending to reveal the sapwood, or has deteriorated through *decay* to reveal this layer of wood.

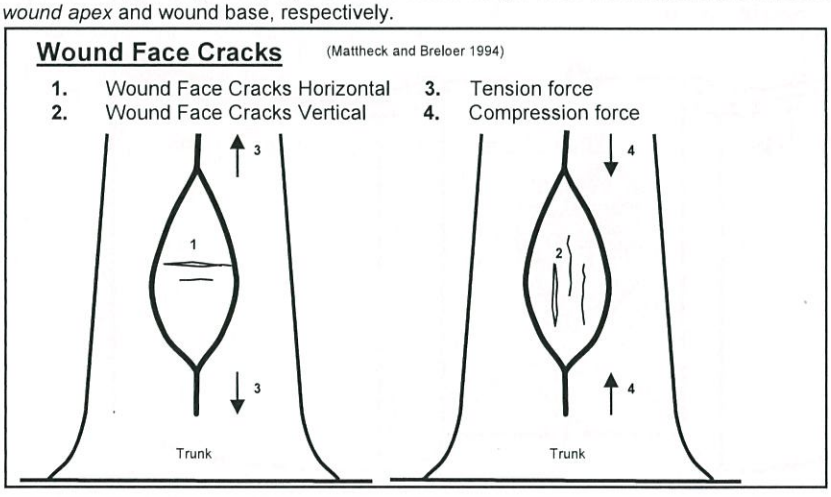
Wound Margin The left and right sides of a *wound* as bound by the alignment of fibres along a stem or root longitudinally, being either the remaining undamaged living cells and new *callus wood* and *wound wood* on older wounds. Here the fibres are usually formed from *meristematic* cells. A wound margin may be circular on a *pruning wound* or form around the perimeter of a *canker.*

Wound Margin Entire The *wound wood* growth in the margin is mostly uninterrupted forming a uniform edge.

Wound Margin Irregular The *wound wood* growth in the margin is mostly interrupted and forms an edge that is not uniform e.g. where repeated wounding *episode*s such as inflicted by ongoing borer activity damages and continually alters the *wound perimeter* with *callus wood* and *wound wood.* See also *Successional Wound.*

Wound Margin Left The left side of a wound margin when the distal and proximal ends of the wound is known, to determine the *wound apex* and *wound base*, respectively.

Wound Margin Right The right side of a wound margin when the distal and proximal end of the wound is known, to determine the *wound apex* and wound base, respectively.



Wound Margin Width Distance from *wound margin* to the site of initial wounding. Where evident the *initial wound margin* may be identified by discoloured bark or bark of a different texture to adjacent undamaged trunk. This may also assist in determining the age of a wound.

Wound Wood Aged *callus wood* around the margins of a wound that becomes differentiated to form *CODIT Wall 4* producing new lignified wood. This wood may grow to surround a wound and may eventually develop to enclose the wound by *occlusion.*