



Identifying and managing dangerous trees when prescribed burning



Imagine the impact on a light unit



What is the tree-caused fatality risk?

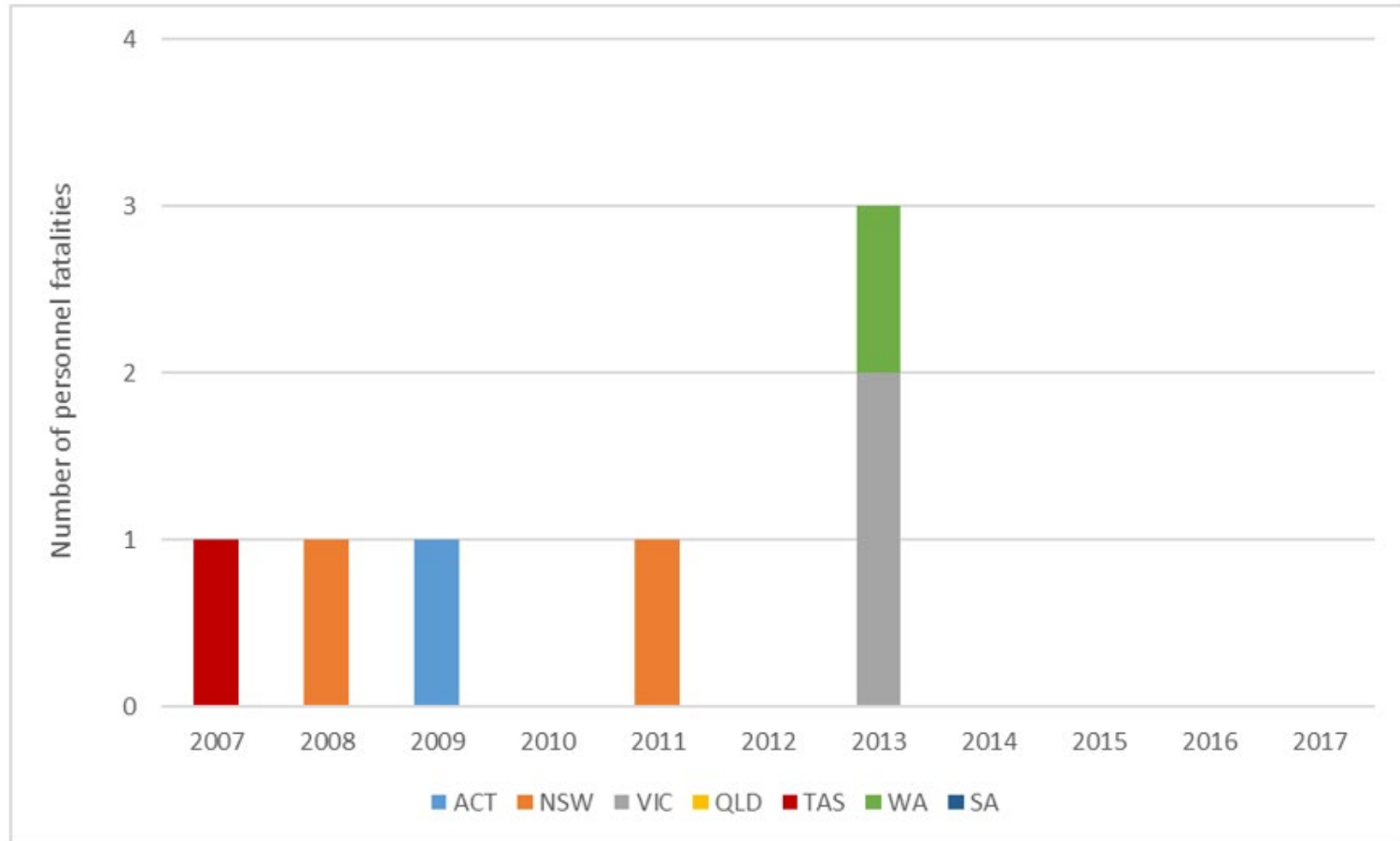
- Not a 'Black Swan' event – future fatalities and injuries are foreseeable
- It's a rare occurrence but is often considered a catastrophic consequence in risk assessment
- It's a numbers game...happens more at unplanned fires than at planned fires
- When tree or branch-fall fatalities arise, inevitable inquiries will examine the adequacy of risk assessment and controls, including training and qualifications (forensic scrutiny for PB incidents can be expected)
- The imperative is to put robust risk control systems in place to prevent fatalities, not in response to them





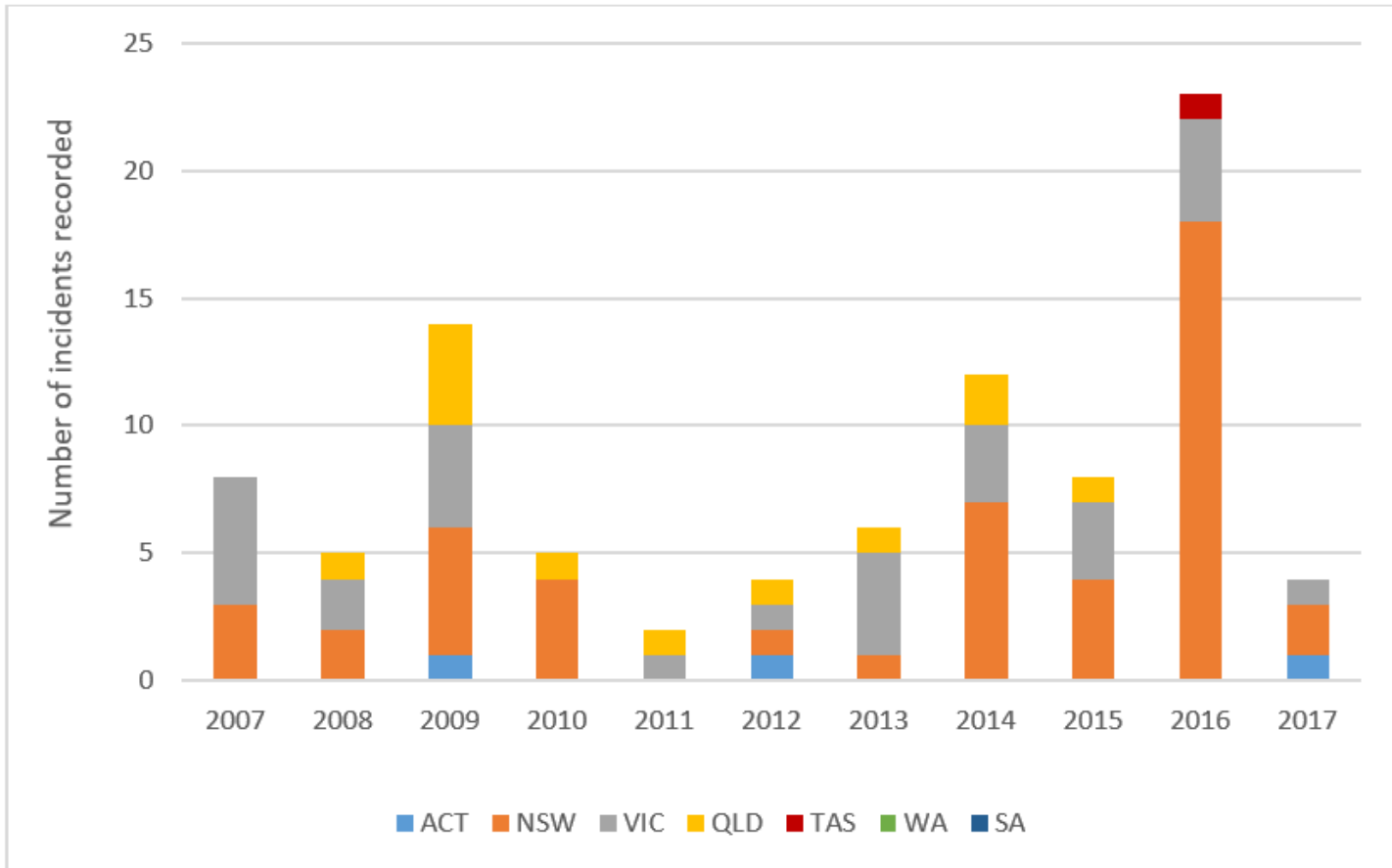
A direct hit or a near miss?

What is the tree-caused fatality risk?



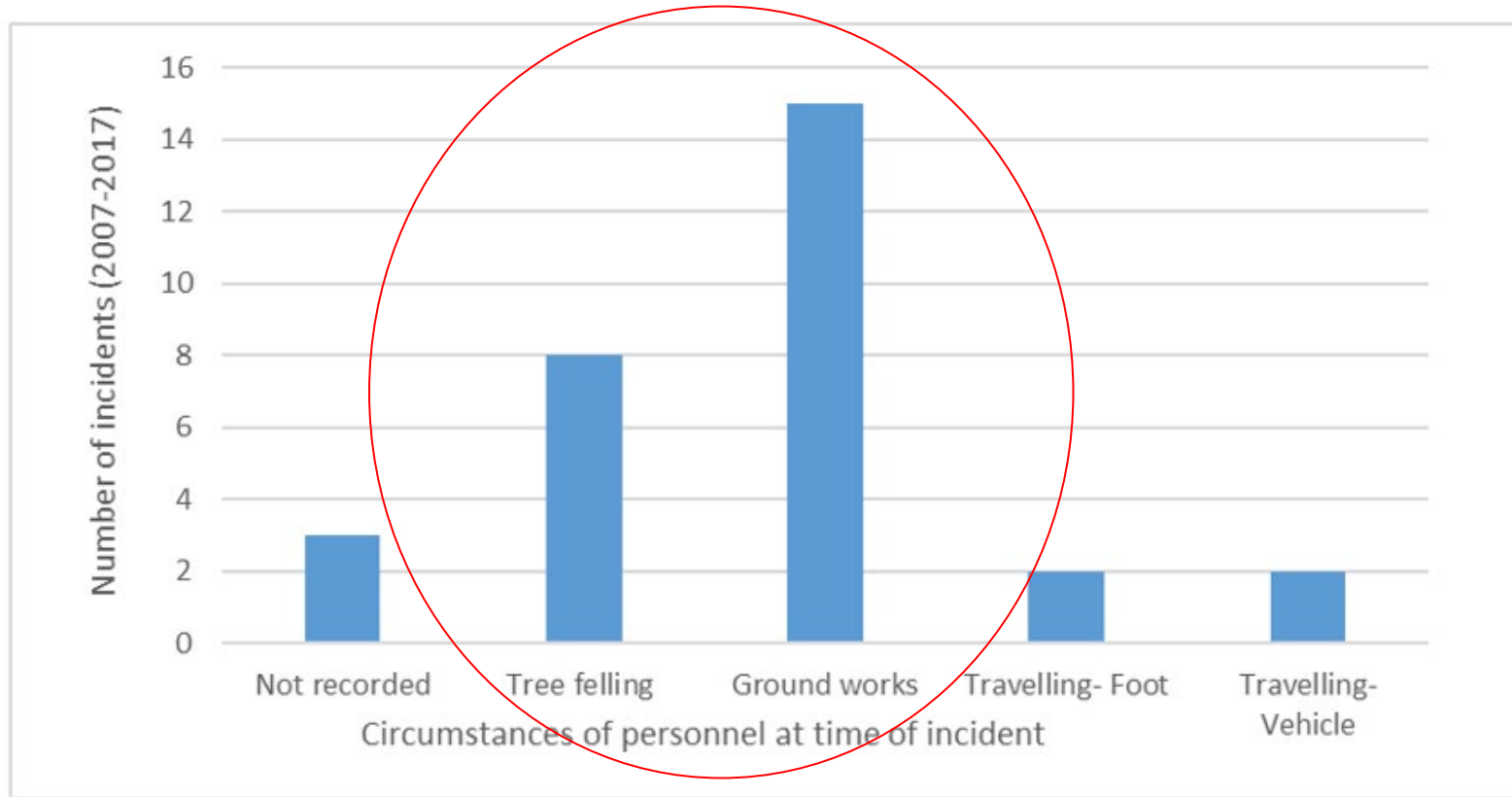
Fatalities (over 2007-2017 period) of fire fighters or emergency responders as a result of hazardous tree or limb fall

What is the tree-caused injury risk?



Injury incidents (over 2007-2017 period) of firefighters or emergency responders as a result of hazardous tree or limb fall

Work-type for tree-caused injury risk



Circumstances of incidents of DELWP personnel sustaining injury from hazardous tree or limb fall 2007 - 2017

Defective tree falling is inherently hazardous

A recent analysis of fatalities and also non-fatal injuries involving hospitalisation of arborists in the US provides some insight:

- Over a period of 17 years (2001-2017) in the arboriculture industry there were 865 fatal and 441 nonfatal incidents
- The leading cause of fatalities (173) was climbers falling from trees
- Second (145 fatalities) were fallers or their groundworkers being struck by a falling tree, and a further 104 by falling branches
- These incidents occur despite arborist industry safety training and national standards for fallers to retreat along retreat lines as trees begin to fall, and procedural controls for drop zone clearance



Hazardous tree removal has its own risks



Bushfire response vs Prescribed burning

- Different risk profiles/assessment task
- Different hazard assessment task/profile
 - › Bushfire response – typically viewing fire-impacted trees looking for visual signs of active burning or significant recent weakening by fire
 - › Prescribed burning – typically viewing unburnt trees (pre-burn) to distinguish potentially significant-hazard trees (could become hazardous if they catch alight) from very large numbers of insignificant-hazard trees (unlikely to catch alight and fail)

Bushfire response vs Prescribed burning



Visual Tree Risk Assessment

- Arborists (ISA) have three tiers of tree risk assessment:
 - **Level 1 – Limited visual assessment**
 - › “A visual assessment from a ‘specified perspective’ of an individual tree or a population of trees near ‘specified targets’. It is conducted to identify ‘obvious defects’ or ‘specified conditions’”. [Often undertaken by inspectors without arboricultural qualifications]
 - **Level 2 – Basic Assessment**
 - › “A detailed visual inspection of a tree and its surrounding site...requires a tree risk assessor to inspect completely around the tree looking at the site, and at visible buttress roots, trunk and branches” (typically requires specialised arboricultural knowledge)
 - **Level 3 – Advanced Assessment**
 - › Detailed assessment of defects or tree parts with specialised arboricultural equipment



What does your agency specify be done in pre-burn assessments for hazardous trees?

- Is it defined who is responsible for hazard tree assessment?
- What, if any, qualifications do they need to undertake assessments for hazardous trees?
- What training is provided to personnel tasked with undertaking or supervising hazardous tree assessment as part of PB operations?
- Is it acceptable to assess from a limited perspective only (e.g. a one-sided look from a control line) or are assessors required to take an all-round view of all trees to determine which are hazardous?



What does AFAC's Managing Tree Hazard doctrine say?



Managing Tree Hazards



PROCEDURAL

GUIDELINE

Version 1.0

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Doctrine ID: 3077



What does AFAC's Managing Tree Hazard doctrine say?

Component 1 : Hazardous tree identification, marking and isolation

Component of the risk assessment process	May be undertaken by	Recommended training or experience
<p>Identification, marking and isolation:</p> <p>Identification of tree hazards, marking of tree hazards (if safe to do so) with spray paint and isolation of tree hazards with barrier tape</p> <p>This applies to clear and present danger trees</p> <p>Agencies should determine the level of experience expertise required for identification, marking and isolation of potential clear and present danger trees</p>	<p>All personnel</p>	<p>Tree hazard awareness training (either as a specific workshop or within existing training modules)</p> <p>Local operational experience</p>



What does AFAC's Managing Tree Hazard doctrine say?

Component 2 : Tree hazard assessment

Component of the risk assessment process	May be undertaken by	Recommended training or experience
<p>Tree hazard assessment:</p> <p>Assessment and marking of individual tree hazard and determination of appropriate risk control measures</p> <p>This applies to clear and present danger trees and potential tree hazard</p>	<p>Personnel with relevant experience and expertise</p>	<p>Tree falling qualifications and experience</p> <p>Tree hazard assessment training</p> <p>The extent of expertise and experience required to assess tree hazard should be determined by agencies.</p>

What requirements does your agency set?



AFAC potential tree hazard characteristics

Characteristics that indicate potential tree hazard:

- trees with hangers or damaged limbs that could fall and impact personnel in planned work areas or access routes
- trees affected by one or more of the following: excessive rot content including dry sides, scars or hollows; exposed root systems; root, trunk or stem damage; storm, snow or fire damage; impact by machinery, snigged logs or insect attack
- trees with shallow root systems in unstable, eroded or steep ground
- dead trees
- trees that have been cut, wind thrown or pushed up and which have become caught in or lodged against another tree, stopping it from falling to the ground (e.g. a hung up tree)
- trees with excessive lean or an obvious lean towards the work area or trees with potential to fall on to other trees and impact the work area.



AFAC 'Potential CPD Tree' classes

[applicable for prescribed burning]

Potential CPD – protection not assured (also known as a 'slash tree' ⊘):

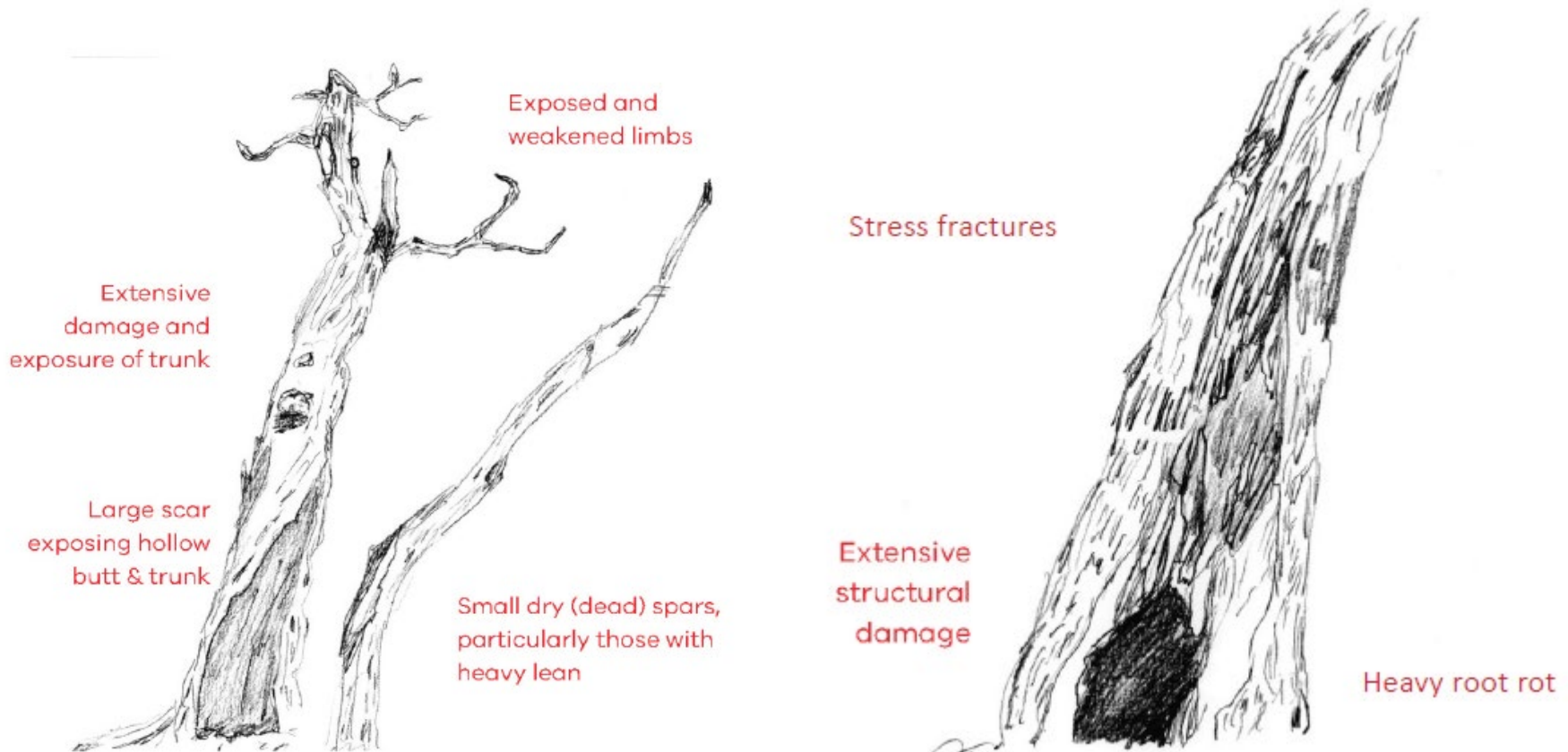
A tree which in its current state is not a CPD tree but may become a CPD tree if it catches alight or is impacted by wind or other disturbance. It does not have a high probability of surviving the current operation intact, based on the proposed protection measures and likely response resources available.

Potential CPD – protection assured (also known as a 'circle tree' ○):

A tree which in its current state is not a CPD tree, but may become a CPD tree if it catches alight or is impacted by wind or other disturbance. The tree has a high probability of surviving the fire intact, based on the proposed protection measures and likely response resources available.



AFAC 'Potential CPD Tree' classes [applicable for prescribed burning]



Applying arboricultural knowledge

What extent of butt hollowing renders a tree at-risk of failure if it catches alight?

Extensive structural damage



Applying arboricultural knowledge



Degree of butt-hollowing and failure-risk



Applying arboricultural knowledge

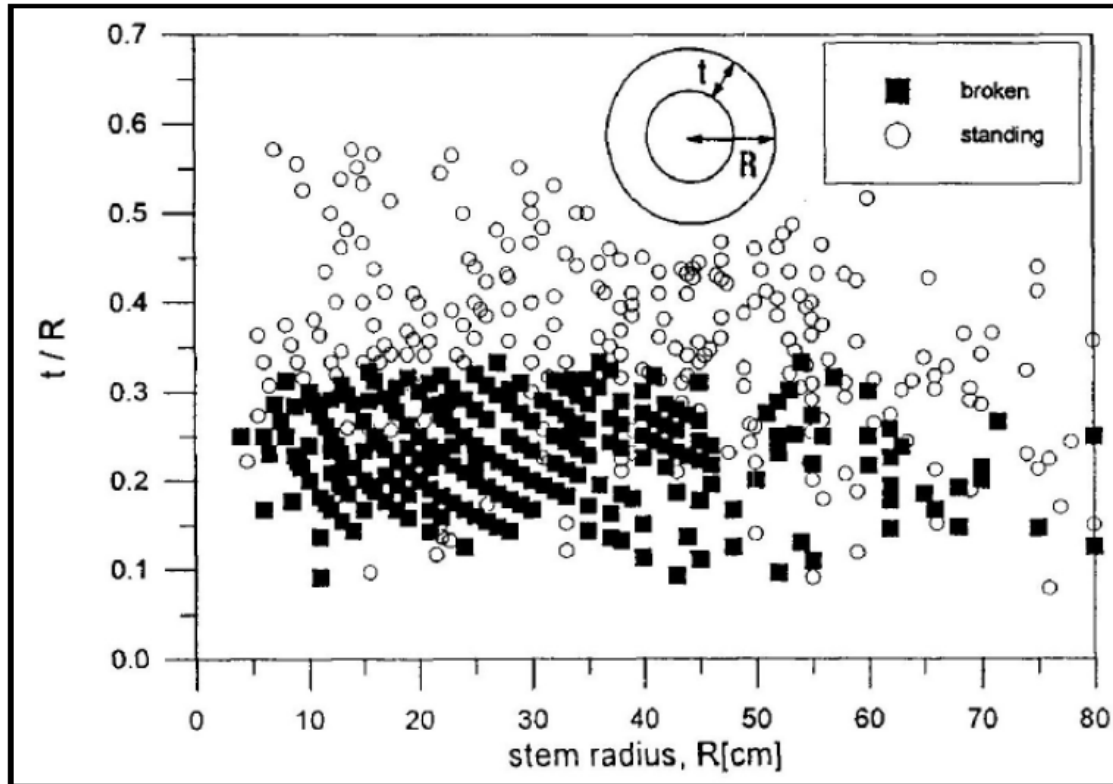


Figure 1. Trees plotted by t/R against radius (Mattheck and Breloer 1994).



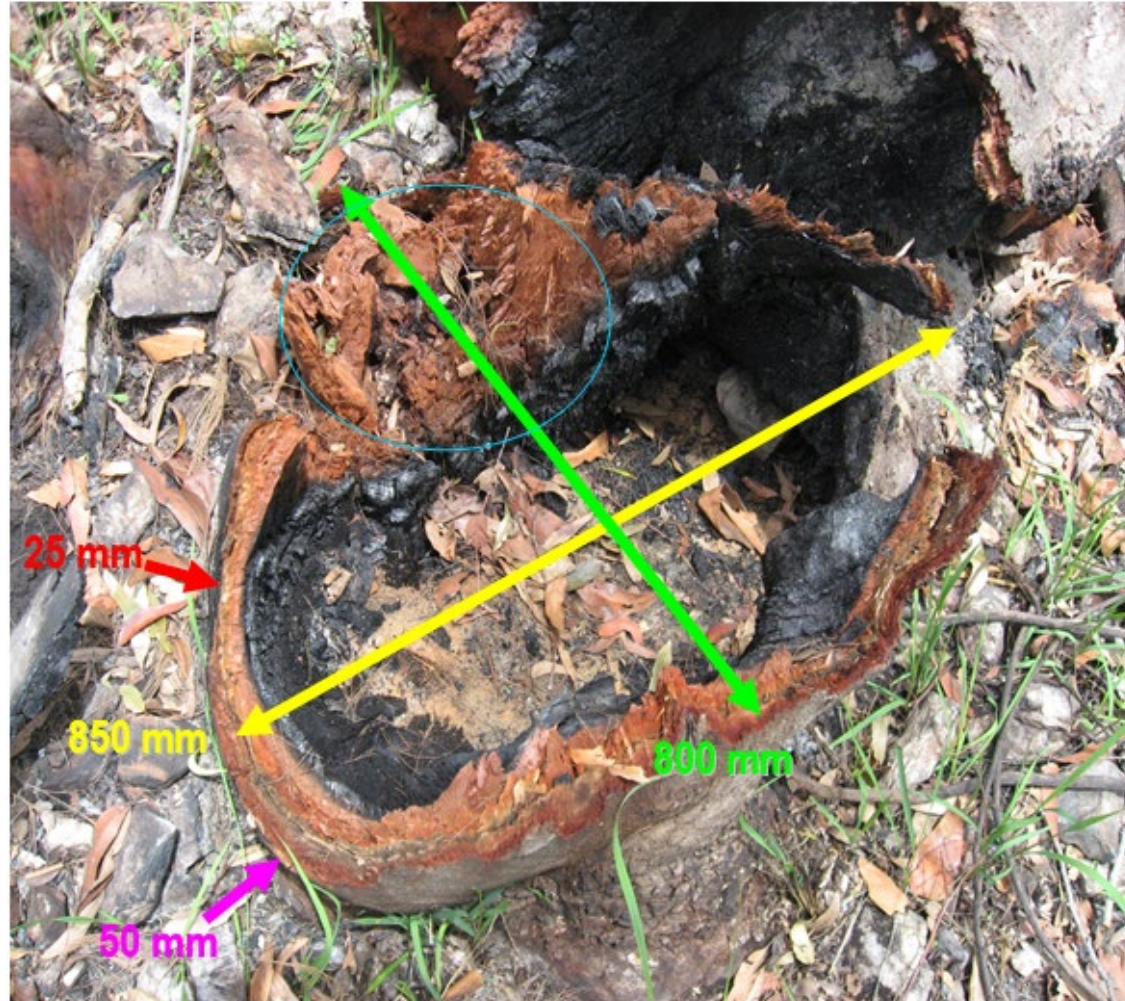
Mattheck and Breloer's t/R formula was derived from a large data set of "more than 1,200 broken and standing broadleaf and coniferous trees.



$t/R > 0.3$ to 0.35



Applying arboricultural knowledge



Not all dead trees are felled by fire impact



Not all dead trees are felled by fire impact

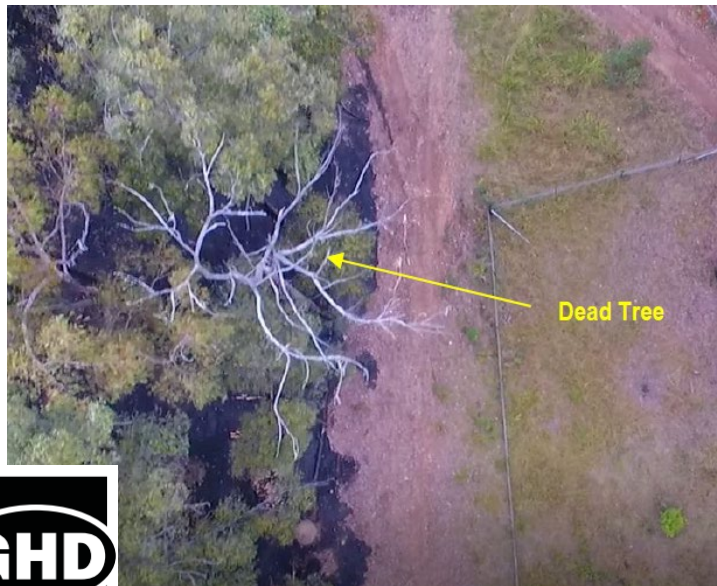


A recent coronial inquiry considered an easement which had 10 or more dead trees near the edge of the burnt area. One tree fell before being impacted by fire, three fell after being impacted by fire and at least 6 dead trees remained standing post-fire impact.

All the fallen trees had evidence of butt hollow damage at their base. The standing dead trees were not examined in detail, but likely had sound deadwood butts.

The presence of decaying wood at or near the tree base is an important vector for dead tree ignition – future research into this area might yield useful insight.

Exposed roots are a key issue for dead trees - in dry conditions they can burn away reducing tree support/stability.



Dry sides – sound wood vs decay



Many trees with dry sides (stems where fire has killed areas of cambium exposing dead wood) have survived multiple subsequent fire events with only shallow surface charring of the exposed dry side wood.

Dry sides with sound wood exposed have high potential to persist through low intensity prescribed burns.

If the dry side has a partial hollow and/or exposed decaying timber ignition potential is likely to be increased.

A more nuanced approach to tree protection during prescribed burns

Issue	Opportunity
Not all dead or dry-sided trees will become CPD trees during prescribed burns	Dead or dry-sided trees with sound exposed wood at their base can be risk-assessed for potential retention and protection
Not all hollow-butt trees will become CPD trees during prescribed burns	Trees with $t/R > 0.35$ can be safely retained, with protection to prevent ignition
Smooth-barked trees with live cambium intact all around the base are unlikely to be adversely impacted by low intensity fire	Minimal protection is required for smooth-barked trees with sound butts, even if they have hollows or decaying branch stubs/exposed deadwood aloft
Not all exposed decaying timber will catch alight (particularly if moist)	Wetting down inside butt hollows with foam and surrounding fuels can be protective

Falling potentially hazardous trees may be riskier than retaining them

Issue	Opportunity
Most tree-related fatalities and serious injuries occur during falling – sometimes to fallers, other times to ground crews	As far as practicable avoid falling trees with significant structural defects and evidence of decay aloft – extinguish them (or wet them down) from a safe distance if possible but otherwise leave them to burn and plan to manage the planned burn consequences when they collapse
Trees with structural defects aloft are problematic and high-risk to treat if they catch alight	Take extra protective measures to prevent such trees from catching alight

Apply the right treatment for the risk

Issue	Opportunity
Raking around trees is not always possible and adds significant preparatory workload (more sustainable to economise on workload if satisfactory alternatives are available)	Differentiate between trees requiring high-protection treatment, limited treatment, and no treatment. Identify how alternative treatments such as water application, foam application, partial raking, and burn/douse technique can be used to protect fire-vulnerable features or trees.
Not all potentially hazardous trees will be vulnerable to fire all the time	Identify how selection of burning conditions can be used for protection

Current training

- Current training in relation to tree hazard assessment is focussed on relatively obvious CPD trees in bushfire response operations – this is not well aligned with training needs for PB operations
- For PB the training need has two key elements:
 - › Assess trees for the potential to fail if the catch alight;
 - › Determine the best course of action (if any)) to prevent them catching alight – noting the safer option may be to avoid pre-emptive felling
- Current tree hazard training is not well-aligned to this requirement



High intensity fire initiating tree damage



Dry sides

- Most often on the uphill side of tree (more difficult to see from downhill tracks)
- Exposes deadwood – more vulnerable to ignition by a subsequent high intensity fire than a low intensity burn
- Protectable during PB
- Don't need to be an arborist to assess

High intensity fire initiating tree damage



Dry sides

- Gums typically have high resilience to dry side damage
- Impressive response-wood production and cambial occlusion
- Internal insect attack compartmentalised
- This fire-damaged dry-sided tree maintained high t/R ratio and was at near-zero risk of failure
- Very poor cutting technique!

High intensity fire progressing tree damage



Dry sides can become butt hollows with repeated bushfire impact

- Exposed decaying deadwood catches alight and burns – hollows get deeper and larger with each fire
- Protectable during PB but some deep butt hollows can be difficult to detect
- Butt-hollows more challenging to evaluate than dry sides – they need closer inspection

High intensity fires will further damage



21 years since fire; low-grade dry side

- Trained eye can detect
- Straight forward to protect with foam for PB
- No need to rake around tree
- Protection will facilitate continued wound occlusion and basal strengthening

Fire intrusion may exacerbate damage



Advanced wound occlusion concealing butt hollow

- Trained eye can detect
- If fire establishes within hollow, mostly enclosed form of hollow facilitates radiant heat drying and spread (like a pizza oven)
- Pre-burn internal foam application, and to surrounding fuels can protect
- No need to rake all around tree (rake entrance) – rest of circumference is sound
- Protection readily achieved if protection requirement is identified

Fire intrusion may exacerbate damage



Advanced wound occlusion concealing tall butt hollow

- Trained eye can detect
- In addition to internally reflected radiation, convective draw can establish in tall or open-topped hollows
- Pre-burn internal foam application, and to surrounding fuels can protect
- Rake fuels away from hollow entrance – rest of circumference is sound
- Protection readily achieved if protection requirement is identified

Improvement imperative is broader than safety



- Opponents of prescribed burning are now targeting tree hollow decline as a reason to lobby against PB
- High intensity fire impact is the main agent of tree weakening and collapse not PB, and well-managed PB can help reduce extent of veteran tree loss to wildfire
- But we need to be attentive to tree protection during PB
- Excessive pre-emptive tree removal for PB will work against social licence, and is mostly unnecessary

Thankyou

