GALBRAITH & Associates

Tree Consultants & Contractors

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1 Dec 2015

Planning Panels Victoria
Level 1
8 Nicholson Street
East Melbourne 3002

Dear Sir,

re: Wollert Precinct Structure Plan and Tree Protection Zones for Remnant Type Trees, Particularly River Red Gums

Introduction

In preparation for the ongoing expansion of the Melbourne metropolis into Wollert, the Whittlesea City Council (WCC) and the Metropolitan Planning Authority (MPA) have developed the Wollert Precinct Structure Plan (PSP), the purpose of which is to provide a high quality living area for thousands of people (approximately 37,811 according to the PSP). Integral with that is the encouragement of the retention and planting of large canopy trees. The great bulk of the significant naturally occurring canopy trees within the precinct are comprised of River Red Gums, the dominant long lived woody floral element of the area.

The successful long term retention of such trees in any re-development must take into account factors such as tree condition, ultimate size, the soil volume requirements, the root and crown distribution and the existing and proposed land use close to the trees. In providing spacing requirements around the trees to be retained, The City of Whittlesea relies on its Revision A Technical note issued 3 November 2014 titled 'Retention and Protection of Existing Trees'. A copy of this is appended to the end of this statement. This is referred to in R5 of the PSP and partially reproduced in appendix 4.4 of the PSP. The guidelines are generally good, particularly in relation to the minimum distances required to be maintained when building dwellings near trees, however it is readily apparent that encroachment from roads, driveways, paving, retaining walls, level reductions and battering, fill, soil compaction and sometimes buildings and dwellings, can often take place at closer distances without impacting negatively on tree longevity.

Galbraith and Associates has been retained by the Wollert Development Consortium to provide a statement which discusses the refinement of the tree protection zone guidelines, as referred to in R5 of the PSP and elaborated on in appendix 4.4 of the PSP, allowing one to still be very confident of long term protection of trees identified for retention, but allowing more flexibility in designing around them.

I have also been asked to briefly comment on R3 of the PSP.

River Red Gums (Eucalyptus camaldulensis)
The species grows quite rapidly when young, then after approximately 70 years of age slows down considerably. The trees may then go on to live for several hundred years or more. Contrary to popular belief that the bulk of the roots penetrate to great depth, in reality the great mass of the roots spread out laterally in the topsoil, commonly in the upper 600mm where there is ample oxygen, fertility and where the soil is reasonably conducive to penetration. These lateral roots may have many fine roots which penetrate denser more compact soil at depth, via fissures, where they tap into the moister subsoil. Hence it is important that minimum clearance zones from the trunks are provided which must be kept clear of soil excavation to avoid significant root loss. The roots of this species is renowned for its ability to cope with poorly oxygenated soils, such as what occurs during periodic waterlogging, inundation with fill, soil compaction or is found at substantial soil depth.

As with many eucalypt species, this species has a tendency to shed branches, an important ecological adaptation given that the resultant wounds often hollow out over many years to form hollows for bird and mammalian nesting sites. Overall the rate of branch shed is relatively low, so that healthy mature trees may only shed on average a branch over 150mm thickness every few years or so. In any population however there will be a minority which have a prolific limb shed propensity. River Red Gums, unlike many other eucalypt species, lend themselves well to hazard reduction pruning. This is because there are many relatively shade tolerant secondary branches within the canopy which arise from the primary branches. When branches are seen to become too long and heavy relative to their thickness, taper, load, load distribution and internal defects, and hence their ability to adequately support themselves, they can be readily and effectively weight reduced by shortening the branch ends back to the secondary branches.

City of Whittlesea Tree Protection Zone Guidelines as per Revision A Technical note dated November 2014 titled 'Retention and Protection of Existing Trees'

"Tree protection zones are defined by a circle, whose centre point is the centre point of the tree at ground level and whose radius is equal to half the height of the tree or half the crown width (whichever is the greatest) plus the tree canopy plus one metre (refer to SDL.2.01). Tree protection zones shall be determined by a consulting arborist and pegged on site by a licensed surveyor.

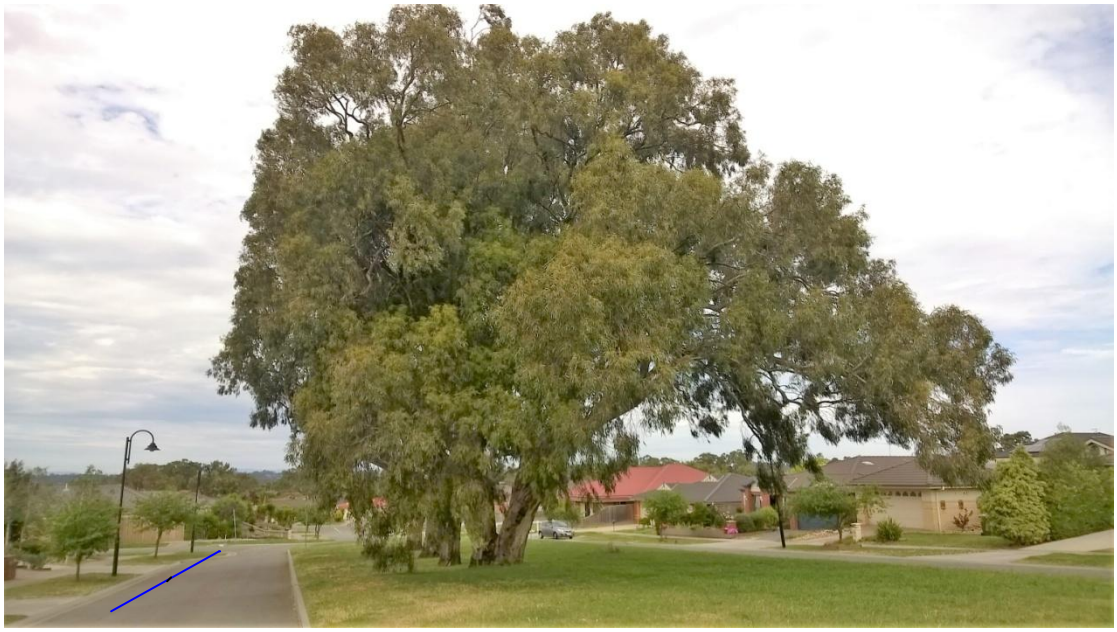
Council's tree protection zone guideline shall supersede AS4970 – 2009 and/or any other tree protection zone standard/calculation. In this regard, Council's guideline considers both the ongoing health of the tree and has been developed to protect people, infrastructure and property (ie the shape considers the impact of falling limbs and delineates a pedestrian exclusion zone) whereas AS4970 – 2009 only considers the impact of works on the on-going health of the tree."

Clearly there is an inference that the Council`s guidelines are superior to those of the relevant Australian Standard 4970:2009, because they not only take into account the ongoing tree health, but also the protection of people and property by minimizing the risk post development caused by falling branches. The Australian Standard tree protection zone is solely proportional to trunk diameter. In many instances, encroachment within the tree canopy is acceptable under the Aust Std. guidelines which may be entirely reasonable for earthworks but not for building, particularly of dwellings.

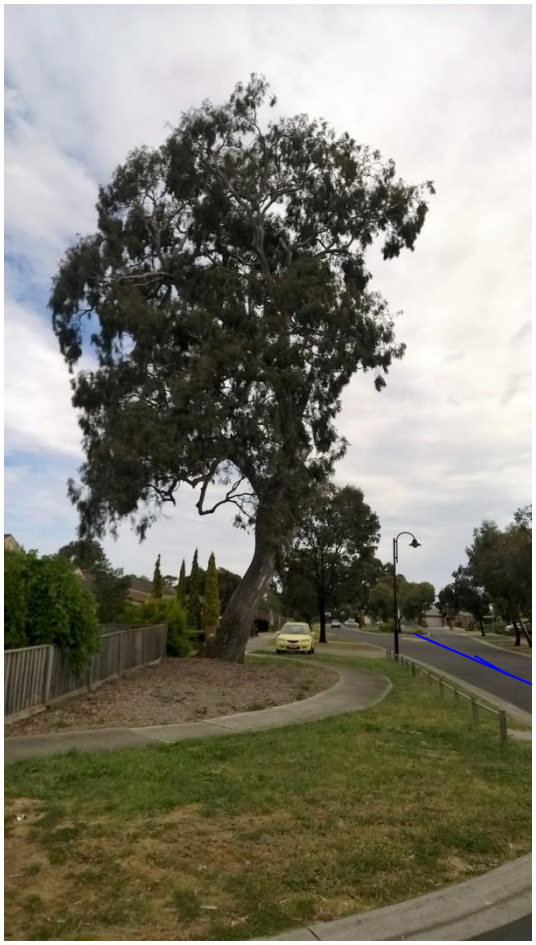
Retention of River Red Gums in Residential Subdivisions

River Red Gums can be readily and responsibly retained in road and recreational reserves in residential subdivisions. This has already occurred throughout numerous residential broad acre subdivisions of River Red Gum dominated open woodland within Roxburgh Park, Epping North, South Morang, Mernda, Doreen, Rockbank, Craigieburn, Mickleham, Sydenham, Melton South, Cranbourne, Lynbrook, Dandenong South etc. These are all areas with which I have been involved with new residential developments since the early 1990s. The following photos show examples where River Red Gums have been retained in road reserves within developments at Aurora and Lyndarum in Epping North, and an Australand development to the north of Plenty Road in South Morang and at Legend Hill Epping North.

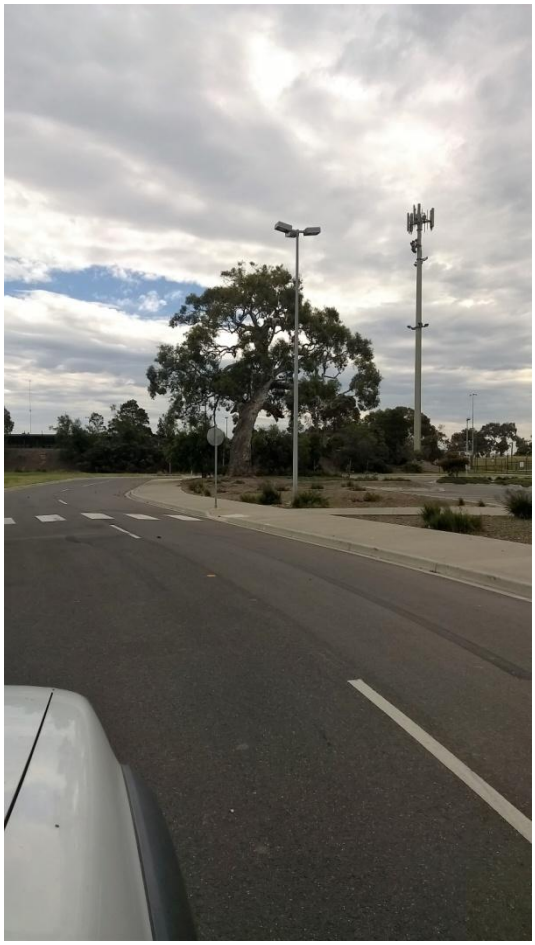
It is readily apparent that in a number of the following photos that the necessary excavation for road construction, which usually requires at least a 600mm deep excavation, along with deeper excavations for drains and services, encroach well within the City of Whittlesea`s tree protection zone guidelines of maintaining a clearance of a metre outside the canopy or half the height of the tree, whichever the greater. Despite this, the River Red Gums have not succumbed, nor do they show any sign of doing so. This is because River Red Gums are relatively tolerant of root loss. It is also apparent that the excavations for the necessary drains, services and road construction have been close to or inside the guidelines of the relevant Australian Standard 4970:2009 'Protection of trees on development sites'.



The above trees have been successfully retained in a lineal park enclosed by Outcrop Crescent in an estate in South Morang which has been built in the last twelve years or so. The row of trees was of a similar size as to now, located in a paddock before the civil works were undertaken. According to the City of Whittlesea specifications, the road and any excavation works associated with its construction should have been kept at least half the height of the trees in distance from the trunk centres, i.e. approximately along the blue line. However as is evident, ample space has been provided for indefinite retention of these trees. The current alignment of the road to the left of the trees is reflective of the Aust Std. guidelines.

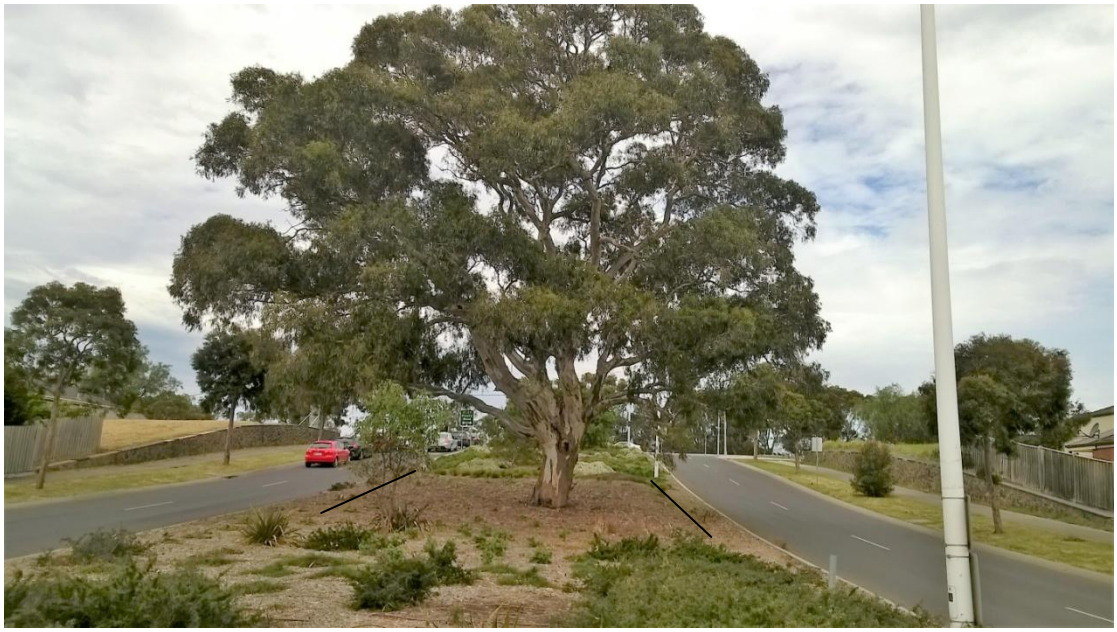


The above is of a River Red Gum in Lake Boulevard, South Morang, a road built some 12 years ago. According to the Council TPZ specs., there should have been no excavation closer to the tree than the blue line. In reality, the excavation has taken place even within the Aust. Std. guidelines.

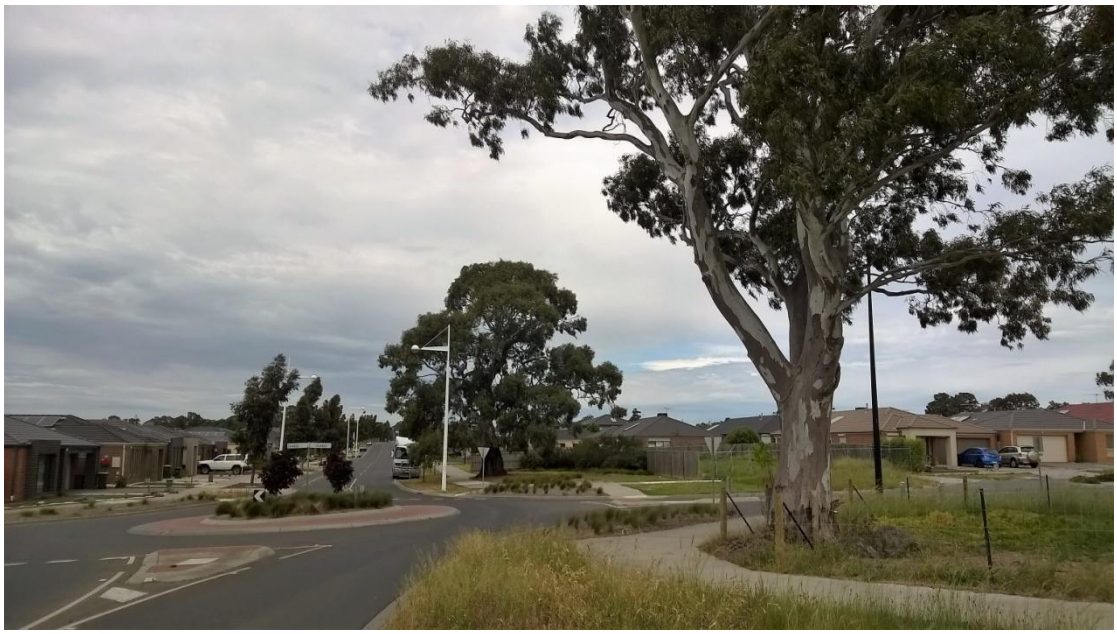


The above road was built through paddock at Lyndarum estate some 5 years ago. According to the Council TPZ specs., there should have been no excavation closer to the tree than well past the kerb.

Under the Australian Standard 4970:2009 (see notes on pages 11 and 12), the tree protection zone (TPZ) is calculated purely by multiplying the trunk diameter at 1.4m above ground (DBH) by 12. It is acceptable to encroach with excavation into up to 10% of the TPZ area, so long as there is substantially further soil volume available for root exploitation outside the areas of encroachment. Thus if encroachment is from one side only, such as occurs with the construction of a road on one side of the tree, along with the associated trenching for drains and services along the road edge, the guidelines dictate that a clearance of approximately 8 times the DBH from the trunk centre at the closest point is necessary. In the great majority of circumstances, River Red Gums will readily cope with a substantially greater than 10% encroachment of the TPZ areas, much more like a 15% encroachment. It is only in situations where the soil is unusually shallow such as when the tree has a DBH of greater than 130cm, where the soil layer available for root exploitation is close to the surface such as occurs in rocky rises, or when the tree is in poor health or when a prolonged drought after the excavation has occurred that there is a heightened risk of the tree being thrust into health decline.

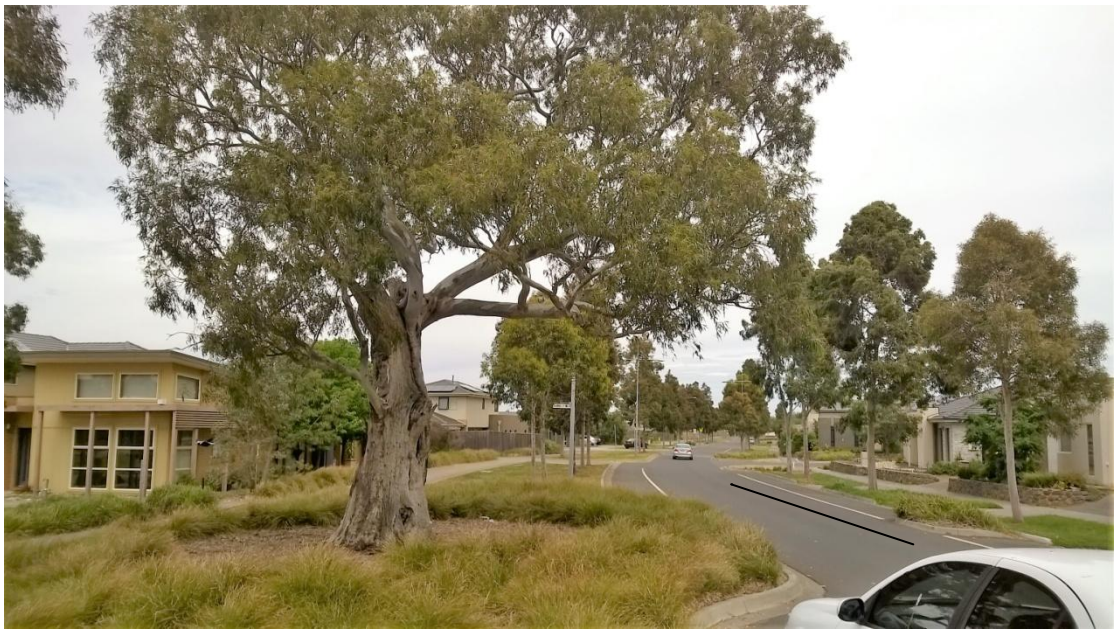


Non root destructive exploratory excavation was undertaken by Galbraith and Associates before any road construction began on either side of this tree for The Lakes Boulevard, South Morang. The trenching took place approximately along the black lines either side of the tree above to the north of Plenty Road, halfway between South Morang and Mernda. The roots were then cut to allow the road, service and drainage excavations along these lines. This occurred some 12 years ago. Under the Council guide lines, there should not have been excavation any closer to the tree than at least the road centres. Under the Aust Std. guidelines, the excavation could have occurred substantially closer than under the City of Whittlesea guidelines, but not nearly as close as what actually occurred.

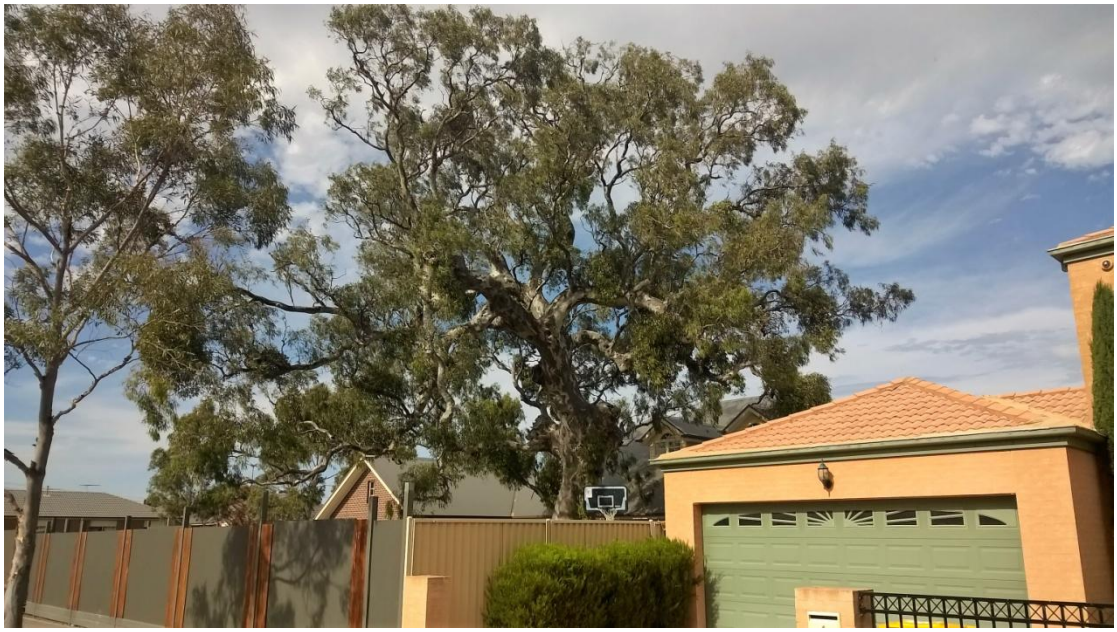


Established trees again in Lake Boulevard which have coped well despite very substantial encroachments during road construction of Council TPZ guidelines and substantial encroachments of the Aust Std guidelines.

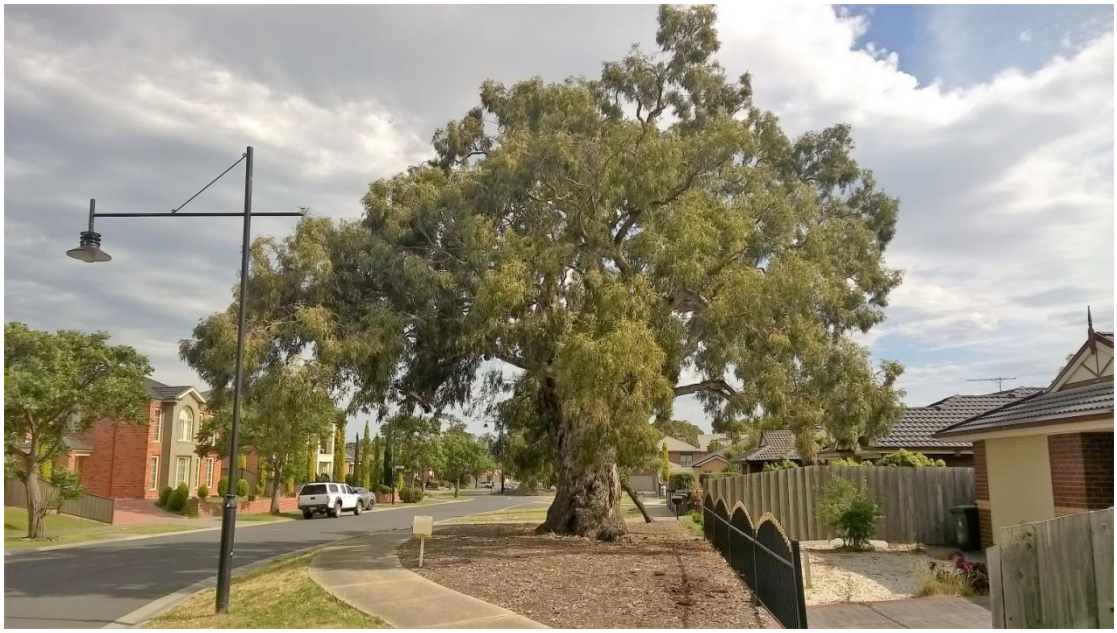
Lyndarum Estate. Substantial excavation works will have taken place quite close to the trunks of these trees for road construction, well within Council guidelines.



Aurora Estate. The line shows where works should have been kept according to the Council specifications. Again, according to the Aust Std, the road should have been kept further away than where it was built.



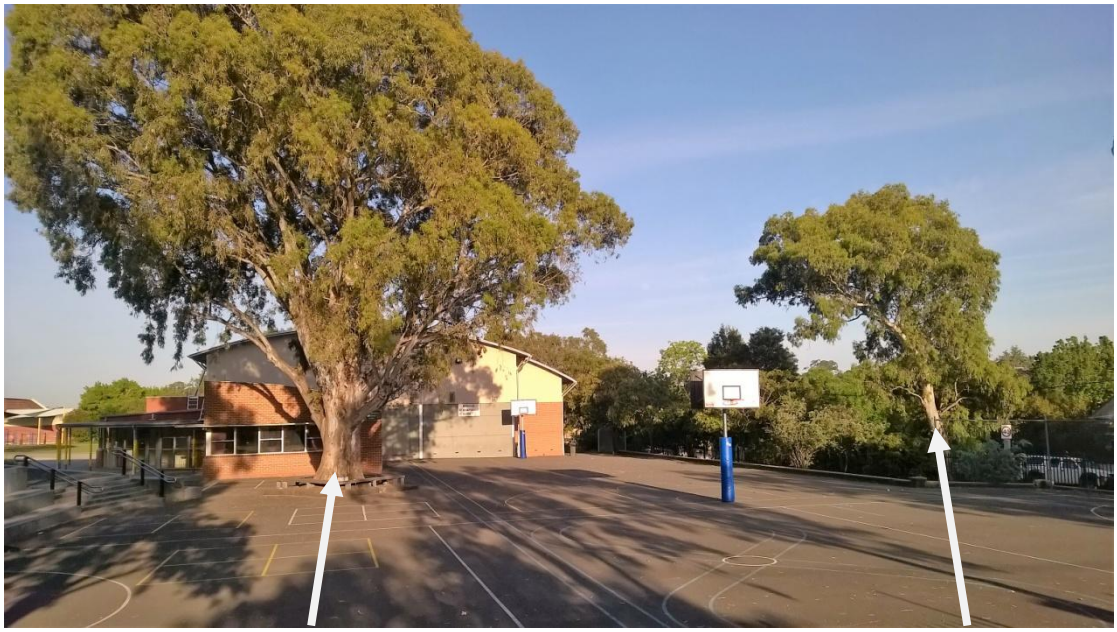
The above shows where a two storey grey roofed house in the background in Ripple Place, Epping has recently been built inside the canopy of a large River Red Gum. The tree `s health has not been compromised and in this case the risk posed by the tree to the house and the inhabitants within is very low, given that the tree leans away from the building and that the branches overhanging the roof have been weight reduced and are relatively small.



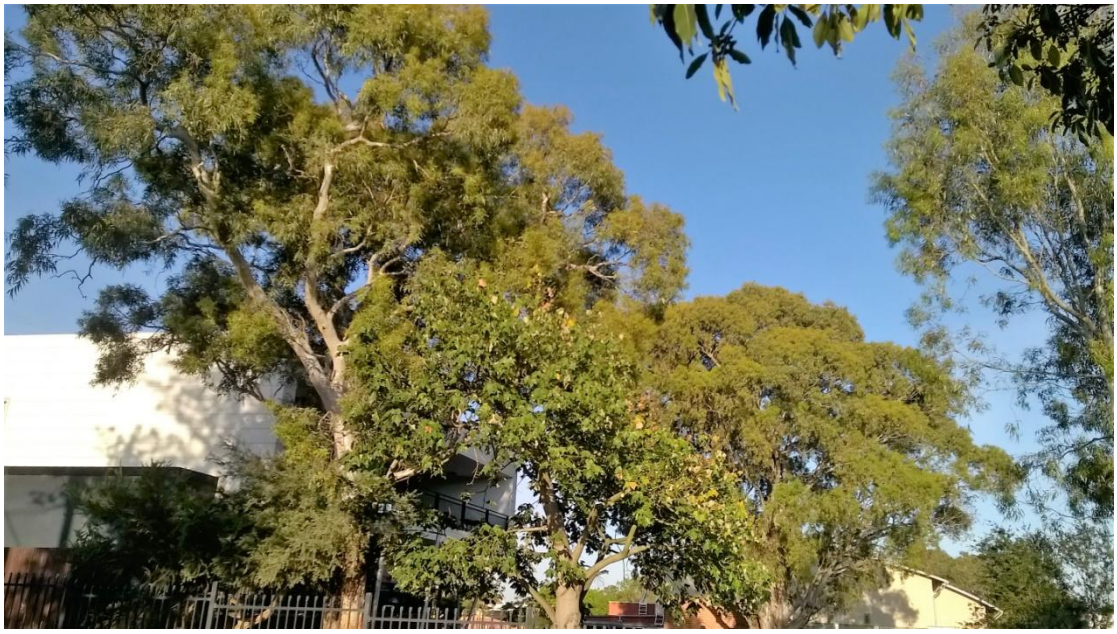
Tree in the Legend Hill Estate Epping where excavation for road and service construction has occurred well inside the canopy, as well as well within the Aust Std guidelines.

Retention of River Red Gums in Schools

Most schools throughout Melbourne have large trees and copses of trees on their grounds. Many of these have mature River Red Gums. Even some of the most prestigious schools such as Scotch College, St Kevins College, Mentone Boys Grammar, Parade College have multiple River Red Gums which are not secluded from the students, but rather overhang walk ways, sports fields, pedestrian paths and drives. The trees and grounds are regarded as valuable assets. The photo below is of a River Red Gum at Hartwell Primary School as well as a River Red Gum street tree overhanging. The central tree in the second photo is that of a tree of approximately 150 years of age. Furthermore, its structure was compromised by having been lopped at approximately 5m height some 60 years ago. Despite an extremely highly used play area beneath and around the tree, which has been in existence since the school`s inception, the tree poses little hazard as a result of prudent tree management and the school`s policy not to allow activity near the tree during inclement weather when conditions of severe winds prevail. I have only known of one branch of significance to have snapped from the tree, and this was approximately 17 years ago when a sprout peeled out from a lopped point before we were called in to manage the tree. The trees are highly prized assets at the school.



Hartwell Primary School playground above. The arrows point to two River Red Gums


A River Red Gum overhanging a building at Hartwell Primary School

Summary
Large trees, including River Red Gums, are a prized feature in residential subdivisions. Given appropriate balance, they are not seen as a hindrance to the provision of a well thought out subdivision. Mature River Red Gums of reasonable quality by and large can be easily and safely managed over long periods of time in built up areas. Activities such as the construction and maintenance of pedestrian walkways, roads, battering and retaining wall construction, excavation for drainage and service installation, excavation for foundations, constriction of carparks, paving and sports entities can often take place in a responsible manner well inside what is regarded as acceptable according to the City of Whittlesea`s tree protection guidelines, without impeding on tree longevity or posing significant risk to subsequent users. So in broad terms, excavation works should be in accordance with the recommendations which follow.

Recommendations

1. Maintain the City of Whittlesea`s tree protection guidelines for locating buildings and residences near trees. Only modify them where it can be reasonably argued that the construction and ongoing use of the building will pose little or no risk to the longevity of the tree, nor pose a risk to the building and occupants. For example, if the proposed building is built on the tension side of a leaning or lopsided tree, there is scope to build closer than the City of Whittlesea`s guidelines, even if one or several long branches can be weight reduced or removed without having an adverse impact on the tree`s longevity or aesthetic appeal. The building however outside the modified canopy.

2. Use the guidelines as espoused in the relevant Australian Standard 4970:2009 'Protection of trees on development sites', but modified, in keeping with the points 3 and 4 below, for determining the maximum permissible amounts of encroachment from excavation works for purposes such as level reductions and trenching. The Australian Standard with the suggested modifications can also be used as a guideline for limiting encroachment from excess soil compaction and addition of compacted fill.

3. In situations where the trunk diameters are abnormally large relative to the canopy volume, such as what commonly occurs where large sections of the crown have collapsed, then use the lesser TPZ calculation of either the Aust Std. 4970:2009 or the City of Whittlesea`s tree protection guidelines for determining the maximum levels of encroachment.

4. Where encroachment by excavation, excessive soil compaction or heavily compacted fill is into as much as 15% of the TPZ area, yet outside the structural root zone (SRZ see notes) and where other large volumes of soil are available for root exploitation, this is permissible unless under the following scenarios:
   the trunk diameter is greater than 130cm (any tree with a DBH of over 125cm, irrespective of how big, is limited to a 15m radial TPZ according to the Aust. Std., hence the need for this proviso),
   where it is known that the root zone will be confined to a narrow band of soil close to the surface because of impenetrable layers on average less than 800mm from the surface,
   where it is assumed that root growth will be disproportionately greater in the area to be encroached because of limitations to root spread elsewhere.

   In such cases the encroachment must be no more than 10% of the TPZ area as per the existing Aust Std guidelines, unless for:
   very large trees with DBHs of greater than 150cm and average canopy spreads of 25m or more and heights of 20m or more, where I recommend that 5% of the TPZ area be the maximum threshold for TPZ area encroachment from earth works.
   Where massive trees of 30m spread or more are encountered, the City of Whittlesea tree protection zone guidelines must be used.

Regular and copious irrigation must occur for at least one late spring, summer and early autumn period after the earthworks have been undertaken where close to the maximum limits of encroachment have occurred.

5. If it is still sought to depart from these guidelines for encroachment by excavation and earthworks, then in order to determine whether it is likely to have an adverse impact on the tree`s longevity, exploratory excavation under arboricultural supervision must be undertaken. It must be carried out in a manner which does not cause damage or loss to roots of significance, i.e. those of approximately 50mm diameter or more. If it is determined by the arborists acting for both the Council and applicant that the resultant root loss is unlikely to impact on the longevity of the tree, then it is permissible to undertake the encroachment.

Comments on R3 of the PSP

I have been requested by Best Hooper Lawyers to comment on R3 in the PSP and, in particular, whether, in my opinion, this should be included as a guideline instead of a requirement under the PSP. R3 of the PSP requires that "No less than 80% of River Red Gums classified as Medium, Large or Very Large must be retained for their landscape and amenity value, to the satisfaction of the Responsible Authority. Trees shown for retention on Plan 4 will contribute to this percentage".

From an arboricultural point of view, my authority on commenting on this is somewhat limited. This is because many factors must be taken into consideration for such a requirement, including ecological and landscape issues, the need for existing shade trees, the need for acceptable yield to create cost effective housing, the need to provide limitations to urban sprawl and all the economic, infrastructure, transportational and ecological impacts and problems that go with it. From the point of view of an arborist, the quality of the trees marked in orange outside those shown to be retained in the reserves as shown on Plan 4 will influence the number to be retained. I have not undertaken an arboricultural assessment for each tree at this stage, and am therefore unable to comment whether the health and life expectancy of the trees shown in orange in Plan 4 do merit protection.

Therefore from my arboricultural perspective, it is apparent to me that the requirement should be a guide line, as opposed to a requirement.

Notes on Terminology
In order to understand the column headings of the table of data, I have provided the following explanations:

DBH diameter of trunk over bark at breast height In a number of cases where the tree has forked into multiple trunks below breast height (1.3-1.5m) the diameter is measured below the fork and an estimate is made for the single trunk equivalent at breast height, or else figures for each of the individual stems can be given.

SULE Safe useful life expectancy in years. Taken in the context that the area is to be developed for residential use, and that sensible distances are maintained between the buildings and the trees, this is the estimate of time that the tree will continue to provide useful amenity without imposing an onerous financial burden in order to maintain relative safety, and avoid excessive nuisance.

Condition This descriptor can be encapsulated by three terms, namely **Health (H), Structure (S) and Form (F).**

Health is largely governed by the ease in which the metabolic functions are occurring throughout the tree. Symptoms of health include the amount, distribution, density, size and colour of the foliage.

Structure refers to the structural stability of the tree and its branches. A well structured tree is not likely to shed branches or stems, or snap in the trunk or blow over, whereas a poorly structured tree is more likely to.

Form basically refers to the symmetry of the tree. A tree with a straight trunk and symmetrical crown and evenly distributed branches is referred to as having good form, whilst a lopsided leaning tree may have fair – poor form.

Tree Protection Zone (TPZ) According to the Australian Standard AS 4970-2009 'Protection of Trees on Building Sites', the TPZ is the principal means of protecting trees on development sites. It is a combination of the root area and crown area requiring protection. It is an area isolated from construction disturbance, so that the tree remains viable.' The radius of the TPZ is calculated by multiplying the DBH by 12. The radius is measured from the centre of the stem at ground level. An area of 10% of the TPZ is deemed acceptable to violate if 10% of the <u>*area*</u> of the TPZ is made up in other directions. *Thus if encroachment is from one side only, encroachment to as close as approximately 8 times the DBH (2/3 the listed TPZ radius) is permissible according to the Standard.*

The AS 4970-2009 should only be construed as a rough guide. Many factors such as the type of encroachment on the TPZ, species tolerance, age, presence of spiral grain, soil type, soil depth, tree lean, the existence of onsite structures or root directional impediments, level of wind exposure, irrigation and ongoing tree care and maintenance are each highly influential on the size and success of the TPZ estimation, therefore the figures derived from the Standard must be treated as rough guides only.

Structural Root Zone
According to the Aus Std. AS 4970:2009, the structural root zone is the area of the root plate required for a tree`s stability. In order to calculate the indicative radius of such a zone from the trunk centre, according to the Aus Std., one uses the following formula: SRZ radius is $(D \times 50)^{0.42} \times 0.64$, where D is the trunk diameter in metres taken from just above the root buttress. The minimum indicative SRZ radius is 1.5m for any tree, irrespective of how small. A graph is provided in the Aust Std, with a curve depicted relating the SRZ to trunk diameter. Unfortunately, the calculated figures do not match those derived from the graph. The Aust Std. does not mention from where this formula is taken although acknowledges the publication 'Mattheck, C. & Breloer, H. (1994) *The Body Language of Trees* HMSO Publications' in the preface and bibliography. The figures derived from the graph for the indicative SRZs are far greater than those implied from the curve of 95% fit for the results from studies of upturned root plates of windblown and winched over German trees (see Mattheck, C. & Breloer, H. (1994). Furthermore the figures derived from the graph for the indicative SRZs are far greater than what one calculates them to be, using the formula provided by the Standard i.e. $(D \times 50)^{0.42} \times 0.64$. The

calculated figures according to the Aust Std. are considerably greater for small and large trunks than those of Mattheck & Breloer.

In reality, the radii calculated whether by graph or using the formula, are much larger than necessary, except in cases such as where the soils are very shallow or where the structural root development is unidirectional or highly asymmetric for some reason, and the excavation is to be within the zone of the roots. The structural stability generally depends far more on what proportion of the circumference of the tree is to be excavated than the actual distance of excavation from a tree, and this is often not taken into account quite when using the SRZ.

Declaration:
I hereby declare that I have made all the enquiries that I believe are desirable and appropriate, and no matters of significance which I regard as relevant have to my knowledge been withheld from the respected Panel.

GALBRAITH & ASSOCIATES

Rob Galbraith

The following pages set out details of my qualifications and experience:

1. Name and Professional Address of Expert

Robert Cameron Galbraith
Arboriculturist
40 Glyndon Road
Camberwell Vic 3124
Tel: 9888 5214 Fax: 9888 5063

2. Qualifications and Experience

1977 Attained Degree in Forest Science from Melbourne University

1978-81 Forest inventory work and road locating in Gippsland, Tasmania and Northern Territory

1982 Foreman of a contract re-vegetation crew at various MMBW parks

1982-83 Attained the National Certificate of Horticulture in Arboriculture at Merrist Wood College, England, with Distinctions

1983-85 Foreman of a large Melbourne tree surgery company

1986-88 Tree surgery sub-contractor

1988-90 Manager of the Arboricultural Services Division of Rivett Enterprises. Arboricultural Consultant for Rivett Enterprises.

1991- Principal, Galbraith & Associates - Arboricultural Consultants and Contractors.

Consultants to Royal Botanic Gardens Sydney, Major Projects Victoria, St Kilda Botanic Gardens, Melbourne Parks & Waterways, Vic Urban, Office of Housing Department of Human Services, legal firms, insurance companies, developers, town planning consultants, architects, landscape architects, local government (Cities of Albury, Bayside, Boroondara, Manningham, Moreland, Stonnington, Whitehorse). Contracting in arboricultural services for private, government and commercial clients.

VOLUNTARY ARBORICULTURAL INDUSTRY WORKS

Arboricultural Association of Australia (President, 1994, 95, 96)
Major contributor to the Australian Standard AS4373-1996 Pruning of Amenity Trees.

3. Area of Expertise

My area of expertise is in amenity tree management.

4. Expertise to Prepare this Report

My expertise is based on substantial experience in forestry and arboriculture, with many years directly working with thousands of different trees in differing situations. The tasks of climbing, dismantling, pruning and excavating near trees, particularly in Melbourne, is, and has been, virtually a daily routine over

many years. I keep well abreast of important and relevant research in arboriculture, reading widely and conferring regularly with colleagues in the arboricultural field.

5. Instructions Received in Relation to this Matter

I have received instructions from Best Hooper Lawyers. They have asked me to provide a statement of evidence for Panels Victoria discussing the important factors relating to successful River Red Gum protection, the current tree protection zone guidelines used by the City of Whittlesea and referred to in R5 of the PSP, the provision of recommendations where relevant for allowing more flexibility in designing developments around the trees and to make brief comments on R3 of the PSP.

6. Facts/Matters/Assumptions/Reference Documents used to prepare this Report

The City of Whittlesea`s Revision A Technical note issued 3 November 2014 titled 'Retention and Protection of Existing Trees'

The Australian Standard 4970:2009 – 'Protection of Trees on Building Sites'

Wollert Precinct Structure Plan

7. Other Persons Relied Upon

Nil

8 Summary

Large trees, including River Red Gums, are a prized feature in residential subdivisions in the more recent residential developments in the outer northern suburbs and elsewhere. Given appropriate balance, they are not seen as a hindrance to the provision of a well thought out subdivision. Mature River Red Gums by and large can be easily and safely managed over long periods of time in built up areas. Activities such as the construction and maintenance of pedestrian walkways, roads, battering and retaining wall construction, excavation for drainage and service installation, carparks and sports can often take place in a responsible manner to some extent within the City of Whittlesea`s tree protection guidelines, without impeding on tree longevity. The recommendations in this statement if followed will allow for successful tree retention whilst allowing for more design flexibility than is available under the current guidelines.

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RETENTION AND PROTECTION OF EXISTING TREES

In addition to their heritage and environmental attributes, remnant and existing trees contribute significantly to the landscape amenity of an area and provide instant visual appeal in new developments. Where possible, existing trees shall be retained, protected and incorporated into the design of new developments. The retention of juvenile trees is considered equally as important as the preservation of mature specimens.

Tree Protection Zones

Tree protection zones (TPZ's) are exclusion zones designed to protect all trees and stags identified for retention in a development. No works are to be undertaken within tree protection zones. Boring for the provision of services/utilities will only be acceptable subject to proof of feasibility.

Calculating Tree Protection Zones

Tree protection zones are defined by a circle, whose centre point is the centre point of the tree at ground level and whose radius is equal to half the height of the tree or half the crown width (whichever is the greatest) plus the tree canopy plus one metre (refer to SDL.2.01). Tree protection zones shall be determined by a consulting arborist and pegged on site by a licensed surveyor.

Tree Protection Zone Fencing

Temporary tree protection fencing (refer to SDL.2.02) shall be erected around the perimeter of all tree protection zones and shall be inspected by a Council representative prior to any buildings, works or demolition commencing on a lot, open space and/or road reserve. Tree protection zone fencing shall comprise:
 Treated pine posts with a minimum height of 1.8 metres (total post length) at every corner or at a maximum interval of 9.0 metres. These posts shall be sunk 450mm into the ground. Concrete may affect the soil pH level and shall not be used to secure posts. Treated pine stays shall be fixed to all corner posts. Steel star pickets with a minimum height of 1.8 metres (total picket length) shall be installed between the treated pine posts at a maximum interval of 3.0 metres. These pickets shall be sunk 450mm into the ground and shall include high visibility safety caps. Ring lock wire mesh fencing with a minimum height of 1.2 metres shall be securely fixed at each post with wire ties. The fence shall completely enclose the tree protection zone. High visibility hazard marker tape shall be securely fixed to the top of the ring lock mesh fencing with wire ties. Signage shall be attached to the fence at regular intervals. Signage shall read "TREE PROTECTION ZONE. NO ENTRY EXCEPT TO AUTHORISED PERSONNEL. FINES SHALL BE IMPOSED FOR REMOVAL OR DAMAGE OF FENCING AND/OR TREES" (refer to SDL.2.03).

Tree protection zone fencing shall be regularly maintained and shall only be removed after the landscape pre-commencement meeting has occurred or until such date as is approved by the responsible authority in writing.

With the agreement of the responsible authority, tree exclusion zone fencing may not be required where permanent fencing is introduced prior to construction. The specification of the permanent fencing must be to the satisfaction of Council.
Enhanced Growing Environment within Tree Protection Zones
The area within the tree protection zone shall be modified to enhance the growing conditions and to help reduce stress or damage to the tree as a direct result of adjacent construction works.

Specific improvements might include one or a combination of the following:
 Ground surfaces within tree protection zones shall be left intact and a Glyphosate based herbicide mixed in accordance with the manufacturer's recommendations used to remove any weeds or unwanted vegetation. The area within the exclusion zone shall be mulched with wood chips to a depth of 150mm. If required or as directed by the responsible authority, trees are to receive supplementary water. The amount of water is to be determined by the consulting arborist and will be determined by the amount of disturbance the tree has sustained and/or climatic conditions. Where severing of roots (greater than 50mm in diameter) is required directly adjacent to tree protection zones, the roots shall be cleanly cut. Where possible this is to be completed at the beginning of the development of the site. Roots are not to be left exposed, they are to be back filled or covered with damp Hessian.
The health of retained trees will be recorded prior to the commencement of works and periodically monitored by the consulting arborist and the responsible authority.

Tree Protection Zone Induction
Prior to any works commencing in proximity to tree protection zones, the consulting arborist shall induct all personnel involved in construction in close proximity to and/or involved in works that may impact tree protection zones.
Construction personnel shall be advised:

 Unless authorised by the consulting arborist or as directed by the responsible authority, no party shall enter into a tree protection zone or modify the tree protection zone fencing in any way. No buildings or works (including loading and unloading, storage of materials, dumping of waste, vehicle access and parking or other construction activity) are to occur in the tree protection zone without the written consent of and to the satisfaction of the responsible authority. The storing or disposal of chemicals or toxic material shall not be untaken within 10 metres of any exclusion zone. Where the slope of the land suggests that these materials may drain towards an exclusion zone, the storing or disposal of these materials is strictly forbidden. Any trees that are to be removed next to exclusion zones are to be done so manually under the direct supervision of the consulting arborist (ie. cut not pushed). Stumps are to be ground and not excavated to prevent damage to trees in close proximity.

Tree Protection Bond
Prior to commencement of the subdivision, a bank guarantee for the amount of $100,000.00 (or in accordance with the planning permit) shall be submitted to the responsible authority as a security deposit for the satisfactory completion of the requirements in relation to tree preservation and to ensure that trees are not damaged during the construction phase.

Upon completion of the subdivision works to the satisfaction of the responsible authority, the bank guarantee will be returned to the developer.

Where it is determined to the satisfaction of the responsible authority that a tree covered by a tree protection zone has been damaged as a result of buildings and works by the applicant or its contractors, to an extent that it affects detrimentally the life, health and appearance of the tree or its contribution to the landscape, financial damages will be paid by the applicant with all monies to be used to purchase trees for planting on the land or to prune or otherwise rehabilitate existing trees, all to the satisfaction of the responsible authority. The extent of damages must be established through the appointment of an independent suitably qualified person at the applicant's expense.

Variation of a Tree Protection Zone
Tree protection zones can only be varied if it can be determined that the works proposed within the zone will not adversely impact or damage any part of the tree including canopy, branches, trunk and roots or the variation is required to minimise risk to the public and/or property. All variations to tree protection zones must be approved by the responsible authority in writing.

Works within Tree Protection Zones
There shall be no works or encroachment into tree protection zones except for "no dig" footpaths, mulching and limited soft landscaping. Lighting, drainage works and structures within tree protection zones will only be accepted in exceptional circumstances and shall be considered on a case by case basis.

All footpaths shall be pegged on site and confirmed by the responsible authority prior to construction and all works shall be undertaken by hand to minimise disturbance to surface roots. Boring for services through tree protection zones is discouraged and only permitted when all other alternative alignments have been investigated and determined unfeasible.

Planting below existing trees shall be designed to act as a physical barrier to deter pedestrian access into the tree protection zone when the temporary fencing has been removed, to minimise weed establishment, encourage habitat values and generally improve the visual amenity. Alternative permeable mulching (ie oversized gravel) below existing trees shall be considered on a case by case basis.

All works within tree protection zones shall be documented in the civil infrastructure drawings and landscape plans, or is subject to the written approval of the responsible authority.

All works located in or in close proximity to a tree protection zone shall be supervised by a suitably qualified and experienced consulting arborist.

Hazard Reduction Pruning
Prior to the issue of the landscape Certificate of Practical Completion, all trees that are to be retained shall be hazard reduction pruned by a suitably qualified and experienced arborist to ensure the tree does not present an unreasonable risk. If necessary, pruning works shall include:

 Removal of all dead and diseased branches. Specifically, dead branches greater than 40mm in diameter (measured at the base of the branch) shall be removed from the canopy unless they contain hollows that are clearly being used for habitat. Due care shall be given to ensure the integrity of the tree as habitat for native fauna is not compromised (larger material shall be left on site for its habitat value). Weight reduction and canopy thinning (especially for branches overhanging trafficable areas and fixed infrastructure). No live branches greater than 200 mm in diameter shall be removed from the tree without authorisation from the responsible authority. Remove no more than 20% of live foliage from any tree. Removal of epiphytic plant material, wire and any attached debris/rubbish.

Prior to any pruning works being undertaken, the arborist engaged to undertake the works shall arrange a site meeting with a representative from Council's Parks and Open Space Department.

All pruning works shall be to approved arboricultural practices and have regard to AS4373 - 2007.

Tree Removal
Unless a tree presents an unacceptable safety risk or is a weed species, wherever possible the tree should be protected, retained and incorporated into the design of the open space, road reserve or lot.

No native vegetation, other than that approved for removal on the endorsed plan, shall be destroyed, felled, lopped, ringbarked or uprooted without the consent of the Responsible Authority.

Where tree removal is unavoidable, the following conditions apply:
 Each tree nominated for removal shall be suitably marked prior to its removal and an inspection arranged with an appropriate Council Officer to verify that the tree marked accords with the permit and/or endorsed removal plan. Prior to removal, the subject tree shall be inspected by an appropriately qualified and experienced zoologist to determine the presence of any native animals living or nesting in the tree. Should any native animals be detected they must be caught and relocated to a site deemed appropriate by the zoologist. The project manager is to ensure that tree removal is carried out in a safe manner. The project manager is to locate all services either above or below ground prior to the commencement of any works. Stumps and any surface roots are to be ground down below ground level. Ground and chipped material to a depth of 50mm is to be removed from site at the direction of the project manager. The project manager shall supply and place suitable topsoil and seed the area making certain that the reinstated ground surface is level, even and safe. All stumps not removed immediately after removal of the tree are to be paint marked with a suitable bright yellow reflective marking paint. Stumps shall be removed within 14 days of removal of the tree. Where ever possible and appropriate, native trees to be removed should be retained for use in core conservation areas for habitat purposes or reused in open space as urban art, park furniture and/or other use determined appropriate by the responsible authority. After a tree has been fallen, the tree shall be protected from firewood harvesting via temporary fencing and signage to the satisfaction of Council until such time as the tree has been relocated for habitat or mulched. All timber greater than 300mm in diameter that cannot be reused as

habitat, furniture or another use determined appropriate by the responsible authority shall be hammer milled and shredded for reuse as mulch within the subject site. All timber less than 300mm in diameter and branch/leaf material shall be shredded for reuse as mulch within the subject site.

AS4970 - 2009 Tree Protection Zones on Development Sites
Council's tree protection zone guideline shall supersede AS4970 – 2009 and/or any other tree protection zone standard/calculation. In this regard, Council's guideline considers both the ongoing health of the tree and has been developed to protect people, infrastructure and property (ie the shape considers the impact of falling limbs and delineates a pedestrian exclusion zone) whereas AS4970 – 2009 only considers the impact of works on the on-going health of the tree.