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Arborist's Report

Site: 7-9 Castle Drive
Lennox Head NSW 2478

Client: Ballina Shire Council

Attention: Darrin Robinson

Prepared by: Adam Tom
The Tree Doctor (Qld) Pty Ltd

Date: 9 March 2018

[R1153]

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Brief
I was requested by Ballina Shire Council officer, Darrin Robinson, to inspect a fig tree located within the road reserve on Castle Drive at Lennox Head with reference to the suitability of the specimen for retention in situ or relocation to a suitable position on site. A report containing my findings was to be provided.

Objective
This report has been commissioned to provide additional information to Ballina Shire Council (the Council) so as to assist in the decision to retain or remove the tree as a result of damage to adjacent properties.

Site Inspection
The site was inspected on Friday, 2 March 2018. The weather during the inspection was overcast but clear with no impediment to visual assessment of the subject specimen.

Data Collection
Tree heights were shot using a Nikon 550 laser hypsometer. Trunk diameters were measured using a Lufkin forestry trunk diameter tape. Canopy diameters, where noted, are paced estimates. Images were collected using a Nikon D7100 digital SLR camera. Visual canopy inspection was performed using Bushnell 7x – 15x binoculars.

Documents Provided
The following supplementary documentation was provided by the client:

1. **terraARK.** *Assessment and Management Options – Ficus macrophylla – Castle Drive, Lennox Head.* Dated: February 2018.

Tree Assessment
The tree was assessed using the principles of Visual Tree Assessment (VTA), as proposed by Mattheck and Breloer (2002) and Mattheck *et al* (2015); with methods for hazard assessment as proposed by Matheny and Clark (1994) and Lonsdale (1999).

Site Location
The site is located on Castle Drive at Lennox Head. (see Figure 1).

Tree Location
The subject tree is located approximately 18 metres behind kerb on the north side of Castle Drive (the street) and is positioned immediately to the south of the common boundary alignment between the properties at 7 and 9 (see Figure 1). The southern property boundaries have been curved around the north face of the root crown of the tree during design of the subdivision so as to allow retention of the specimen.

Figure 1. *Aerial image of site with subject tree indicated. (Source: NearMap.com - Image date: 6 December 2017).*

Growing Conditions

The subject tree is growing in the open grassed area immediately to the north of the street surface. The area under the canopy of the tree is dominated by pronounced buttressing of the lower stem and root crown; a thick layer of organic detritus is also present under the tree (see Figures 4 & 6).

The tree appears to be growing at or near to natural grades with the presence of fill over the root zone being noted to the north-west of the root zone (see Figure 4). The site exhibits a gentle slope to the south of less than 5º.

Inspection of the surrounding area and discussions on site revealed the soil profile to be of a volcanic basaltic origin. The soil is most probably a red krasnozem containing basalt 'floaters' of varying size and frequency. Soil reaction should be acidic with a low cation exchange capacity (CEC) and organic carbon content. Soil profile depth and horizon structure is not known.

Vegetation Protection

It has been assumed that the tree is not currently protected by local or state government vegetation protection orders.

Wildlife Habitat
A hive of European honey bees is present in the east face of the lower stem.

SUBJECT TREE

Species
Ficus macrophylla

Common Name
Moreton Bay Fig

Tree Dimensions
24m (H) x 35m (W) x 4500mm (est DBH)

Tree Health
Tree health is excellent, as evidenced by very good leaf size, foliage colour, canopy density and shoot extension. No evidence or symptoms of acute or chronic stresses were noted.

Fungal Pathogens
No evidence of active fungal pathogens was noted during inspection.

Insect Pests
No significant infestation of insect pests was noted during inspection. A minor occurrence of fig psyllid (chewing gum psyllid), *Mycopsylla fici*, was noted to be present in the lower canopy.

Tree Structure
The tree is of a strongly decurrent form, i.e. the canopy is wider than the tree is tall, which is typical of the species. The structure is based on a short, massive trunk of approximately 2 metres in height which broadens to form the first order branches/stems (see Figures 5 to 8).

The upper canopy is of typical form and acceptable structure with strong branch taper and branch attachment evident. The upper stem and several first order branches exhibit evidence of past heavy pruning or lopping with several large wounds being evident (see Figures 10 and 11). The pruning may have been a result of storm damage repair and hazard mitigation. Live crown ratio is approximately 90% (see Figures 2 and 3).

The epicormic regrowth resulting from the pruning and damage is generally of acceptable form and structure with strong attachments and production of adaptive growth being evident. Some saprophytic surface decay of larger wounds is evident, as is typical of the species, however, no significant structural weakness was noted. Some small diameter epicormic shoots, i.e. less than 100mm diameter, are evident; this growth will become redundant and will be shed as deadwood (see Figures 2 and 3).

Other than the evidence of the lopping, no other significant structural defects were noted.

Some pruning to raise the canopy has been performed on the south face. The canopy has been reduced in width on the north face to reduce encroachment and provide building clearance to the dwelling at 9 Castle Drive. The pruning will have no detrimental effect on the tree (see Figure 9).

The root crown is of good form with extensive, pronounced buttressing present and is without evidence of weakness or defect (see Figures 5 to 8).

Figure 2. *Subject tree viewed to north-west.*

Figure 3. *Subject tree viewed to east.*

Figure 4. *Subject tree viewed to south-west.*

Figure 5. *Subject tree – root crown detail west face.*

Figure 6. *Subject tree – root crown detail north face.*

Figure 7. *Subject tree – root crown detail east face.*

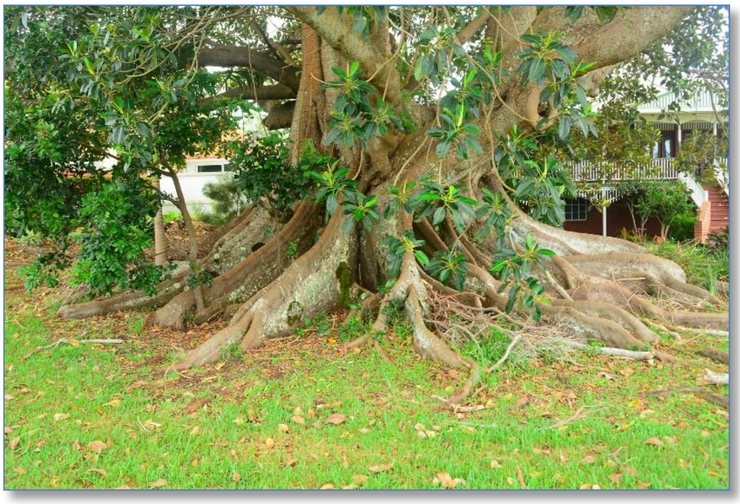

Figure 8. *Subject tree – root crown detail south face.*

Figure 9. *Subject tree –pruning to provide building clearance on the north face of the canopy.*

Figure 10. *Wounds created by previous lopping and or storm damage repair viewed from north-west.*

Figure 11. *Wounds created by previous lopping and/or storm damage repair viewed from south-east.*

Figure 12. *Subject tree viewed to north from open space area suitable for the planting of the relocated tree.*

Figure 13. *Open space area viewed to west. Note the decline in gradient of approximately 2- 3m depending distance moved.*

Tree Age

The decurrent form of the tree suggests that the specimen grew in an open field situation, i.e. the tree grew and matured after clearing of the area. However, the size of the tree is indicative of a specimen which pre-dates European settlement of the area. I am of the opinion that the tree is most likely in the vicinity of 200 years old.

Comment

The health, size and form of the tree are all indicative of the tree being a suitable specimen retention and or relocation within the site. There is no justifiable reason for removal of the specimen based on tree health, structural defect or risk to pedestrians.

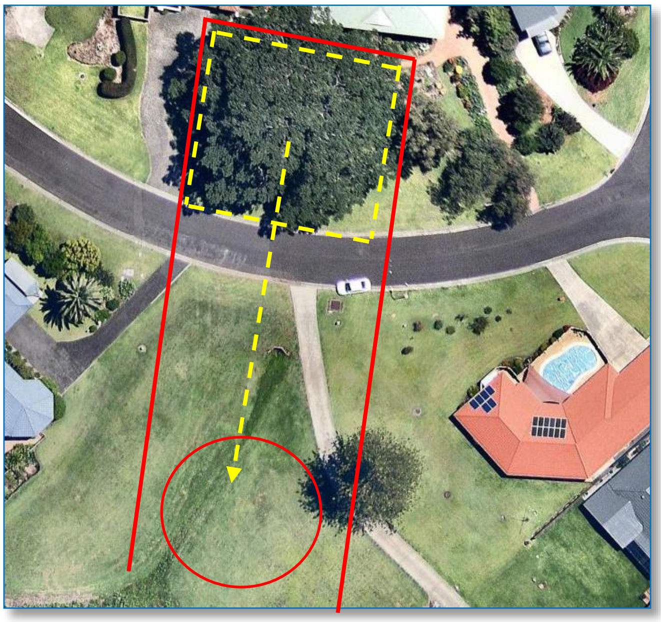

Figure 14. *Aerial image of site indicating approximate position, orientation and direction of movement of a 14m x14m rootball (dashed) and limits of excavation (red). A suitable planting area is also indicated.*

Best Practice Transplant Methodology

Based on a root ball area of 196m^2 and a root ball depth of approximately 1000mm, a total tree weight of approximately 400 tonnes is estimated. Trees of this size are best lifted from under the root mass so as to retain a solid root mass of usable volume. To lift the tree, a raft of high tensile steel pipes are inserted under the tree by pushing the pipes under the prepared root mass using an excavator and rock hammer (see Figure 9).

The pipes are locked in place using a cross beam positioned perpendicular to the pipes at each end of the pipe raft. The raft is then used to lift and support the tree and may be lifted by crane(s) or from jacking systems installed under the raft. The use of hydraulic heavy lift cranes is becoming increasingly expensive and the larger cranes require long establishment times; this results in projects becoming slower and more costly.

The use of cranes is negated by the use of pneumatic and hydraulic jacking systems. In this instance, the use of the pneumatic ArborLift™ System is recommended where the air bladders and supported load are then rolled to the new planting location. Likewise, the tree may be lifted, loaded and transplanted by truck to the planting site.

To install the pipe raft under the tree, a drive line is required; an area approximately 18 metres wide and 30 metres long is needed to allow the pipes to be installed by the excavator. In this instance and so as to minimize excavation and allow ease of tree movement, the drive line is best sited to the south of the tree across the road toward the proposed planting area (see Figure 13).

Preparation

Whilst figs may be moved cold, i.e. without pre-transplant root pruning and maintenance, it is preferred that transplant preparation is performed. A minimum of 6 months preparation is advisable or longer, if possible. With correct pre-transplant preparation, tree survival is better than 99%. In this instance, root pruning, mulching and regular irrigation would be required.

Figure 15. *Lifting a very large Ficus microcarpa var 'Hillii' using a pipe raft, under beams and heavy lift cranes.*

Planting Site
A large open area, suitable for the planting of the relocated tree, is present to the south of the tree on the opposite side of the street (see Figures 12 to 14). Other than planting site excavation and the installation of drainage around the root ball, no significant works are required to plant the tree in the open space. An exact planting position for the tree was not discussed or determined, however, the open space area is of sufficient size for the tree to be replanted without hindrance to adjacent properties and for suitable root control systems to be installed.

Post-Transplant Maintenance
A minimum of 24 months post-transplant maintenance is required. Occasional, thorough irrigation may be required after the initial 24 months if dry weather conditions occur.

Site Constraints
Site inspection revealed that several significant constraints in relation to the relocation of the tree are present on site.

<u>Tree location</u> The tree is located within very close proximity to the dwellings on 7 and 9 Castle Drive. Preparation for the transplant of the tree will require excavation on the west, south and east faces of the root mass. It is probable that excavation will encroach into the adjacent properties with approximately 15-20m^2 of both properties being affected immediately inside the southern boundary.

<u>Tree size</u> The tree is very large and may be considered in the upper range of tree size that may be transplanted. Site inspection revealed the exposed root plate, i.e. to the edge of the obvious buttress, to be an average of 13m in diameter. A root ball of approximately 14m in width would be required for relocation. The total weight of approximately 390 - 400 tonnes is significantly heavier than trees which have been transplanted in Australia. Trees of this size have been relocated in the USA.

<u>The roadway</u> Construction of the lifting frame requires the excavation of a long, wide trench, (the driveline) to one side of the tree. The driveline is typically 4m wider than the root ball, approximately 1m deep and is orientated in the direction of tree travel. In this instance, the driveline would be approximately 30m in length and with the tree being approximately 600mm higher than the road surface, would require excavation across the road at 500mm deep and 18m wide.

<u>Services</u> Site inspection revealed underground services to be present on or adjacent to the property boundary to the north of the tree. Transplant of the tree would require relocation of the services prior to excavation.

Works Cost Estimates

Based on costings for similar projects but of smaller dimension, a costing of $1.15/kg is calculated. Using the estimated weight of 390 tonnes, a transplant cost of $448,000.00 is calculated. This estimate does not include post-transplant maintenance. It is assumed maintenance would be performed by council staff or subcontractors and may be costed at $3,000.00 per month. All estimates are exclusive of GST.

Examples of Similar Works

The relocation of significant trees is common on development sites with The Tree Doctor having provided this service on many occasions throughout South-East Queensland. The Tree Doctor is currently contracted to Brisbane City Council to relocate several significant weeping figs in Mowbray Park in East Brisbane prior to the widening of Lytton Road.

Figure 16. *A very large white fig relocated in 2005 to allow construction of an apartment complex, 'Allisee' in Hollywell, Gold Coast region.*

Figure 17. *Three weeping figs relocated in 2007 to allow road construction at 'Riverstone Crossing' in Coomera, Gold Coast region.*

Figure 18. *A large Hill's weeping fig relocated in 2007 to allow residential construction at 'Riverstone Crossing' in Coomera. (Transplant in progress is also shown in Figure 15).*

Figure 19. *Two very large Moreton Bay figs relocated in 2001 to allow road construction at 'Emerald Lakes' in Carrara, Gold Coast region.*

Discussion

Inspection of the tree revealed it to be suitable for relocation into the open space to the south, provided the constraints noted during the inspection were able to be managed. The cost of the transplant, at around $450,000.00 plus maintenance (exluding GST) is significant and thus, all other methods of tree retention should be investigated.

The investigation into relocating the tree has occurred as a result of root invasion and damage to an adjacent property. Figs are fast growing, vigorous trees and have a wide spreading and highly invasive root system. Fig roots, as with all tree species, will produce root extension when water and oxygen are present in the growing media. Whilst most tree species will only produce roots in suitable soils, figs will produce roots in almost any chemically suitable substrate including sand, gravel, shattered stone and damp, dark voids where the humidity is sufficiently high to prevent root desiccation. Fig roots are frequently associated with damage to lightweight structures and drains.

There appears to be a great deal of misinformation and urban myth as to the destructive capabilities of fig roots. Fig roots cannot smell, detect or seek water in the soil and grow toward it. The roots must be surrounded by moisture before growth can occur; plant roots cannot grow through desiccated soil. Fig roots cannot penetrate correctly installed drains and pipes. If a root is present in a drain, it may have only entered through an existing opening or fault, i.e. the drain is defective or was broken prior to root entry. Correct design and installation of drains prevents root invasion. The repair of faulty drains is a building maintenance issue and the damage of such should not be directly attributed to figs or other tree species and while the drains remain defective many different species, including figs, may invade the drains. Analysis of root samples removed from blocked drains often reveal the roots to be not of figs but other nearby species. Correct building and property maintenance, including the prevention of root encroachment using the common law right of abatement, prevents many tree root related disputes. In some instances, the property owner must prove regular maintenance of the property in relation to the alleged damage before the tree owner becomes liable for damages. In this instance, no evidence of root pruning or control at the boundary line was noted.

On rare occasions, tree roots may damage slabs and lightweight structures. However, the lifting forces generated by any root is limited by the strength of the cells which form the wood in the root and the bearing area between the root and the structure. The bearing area is typically very small and insufficient for the forces generated by the root, usually around 800kPa, for movement to be initiated. Heavy slab driveways and larger brick veneer homes are sufficiently heavy that the roots, if located under the structure, cannot displace the structure and so deform and become flattened in cross section and/or the soil under the root displaces to allow root growth. In many instances, tree roots are blamed for structural damages resulting from soil subsidence on cut and fill or reactive soil sites and/or poor footing designs. The easy excuse for many structural damage assessors and less knowledgeable engineers, in the absence of sufficient investigation and data, is to blame the nearest tree.

The use of root barriers between the tree and the damaged dwelling was discussed during the site inspection. The commonly used high density polythene barriers are inadequate for these works; figs usually bypass these structures within a short period of time and naturally graft back into the remaining severed roots. Reinforced concrete barriers may crack allowing root penetration but may be considered if correctly installed. I am of the opinion that the most suitable barrier in this instance is the lighter weight sheet piling that is often used on roads and other civil works. Provided the barriers are driven into the dense clays deeper in the profile, roots will not be able to pass under or through the structure. The structure has a small amount of flexibility and will not crack. Any fine roots that penetrate through the joints will be constricted by the narrow joint and fail to mature. The structure will last for many years.

It appears the front portion of the damaged dwelling has been constructed on fill and not an excavated natural profile. In fill situations, the structure would typically be engineered to the same standard as that for construction on a highly reactive soil as a minimum requirement.

Likewise, the presence of the tree immediately adjacent the site prior to design and construction would suggest to competent, experienced architects and builders that specialist design was required, e.g. a sufficiently stiff and heavy footing slab that is resistant to the loadings of the fig roots. In this case, it appears that this has not occurred. Additionally, structural inspections and thorough due diligence prior to purchase would indicate that the structure was not of a suitable design to be constructed adjacent to the fig. Thus, it would appear that this is not a tree problem, but in fact, a problem initiated by inadequate design and approval which has subsequently resulted in a significant part of the Lennox Head urban forest being threatened with removal.

I am of the opinion that the use of a steel sheet pile or concrete root barrier should be further investigated. The barrier will cost more than removal of the tree and should cost significantly less than relocating the tree across the street into the open space area. Site inspection revealed there to be sufficient room between the buttresses and the property boundary for the structure to be installed if the works are carefully performed. The underground services may require relocation. A brief methodology is provided below.

Methodology

1. Mulch the root zone to a depth of 150mm and a minimum radius of 15m outside the property boundaries.
2. Irrigate and maintain for 3 months to stimulate root growth.
3. Root prune tree using a high pressure water cutter along line of proposed root barrier.
4. Excavate outside line of water cut and remove roots and basalt floaters.
5. Drive interlocked sheet piles to maximum depth or into heavy clay.
6. Backfill outside barrier using compacted crusher dust and inside barrier using coarse washed river sand.
7. Construct concrete cap over barrier edge to prevent burial of the structure. It should be noted that many barriers fail due to roots being allowed to grow over the structure.

Root pruning will initiate a significant acute stress in the tree and pronounced leaf abscission on the north face should be expected. The root barrier installation will not kill the tree and will most probably not affect tree longevity to any extent. The works associated with the root barrier are far less damaging than that which would result from the transplant of the tree.

Conclusion

Assessment of the tree and the site revealed the tree to be in excellent health, of acceptable structure and suitable for relocation. The tree is a highly significant specimen, is of significant amenity value and should be considered an irreplaceable community asset. The existing location of the tree provides several constraints which complicate the process of transplanting the specimen; primarily the proximity of the adjacent dwellings, the proximity of underground services and the presence of the adjacent roadway. Due to the dimensions and weight of the tree, the costs associated with relocating the specimen will be significant and thus, whilst the tree may certainly be relocated, more cost effective alternatives which ensure retention of the specimen should be investigated further.

It is recommended that a well-designed and correctly installed root barrier be installed.

As a result of the assessment, I am of the opinion that the tree could be transplanted at significant expense, however, retention of the specimen in its existing location is the preferred outcome. I do not believe removal of what is a highly significant specimen can be justified on the basis of damage resulting from poor design and construction.

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Disclaimer

Care has been taken to obtain all information from reliable sources. All data has been verified as far as possible. However, The Tree Doctor (Qld) Pty Ltd can neither guarantee nor be responsible for the accuracy of information provided by others.

Unless stated otherwise:

- Information contained in this report covers only the trees that were examined and reflects the condition of the trees at the time of inspection, and;
- The inspection was limited to the visual examination of the subject trees from the ground without dissection, excavation, drilling, probing, coring or aerial inspection unless otherwise stated within this report. There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the subject trees may not arise in the future.

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