Sydney Arbor Trees
PO Box 286, Botany
NSW, 1455
Tel: 02 9666 6821
Fax: 02 9666 6312
Mob: 0425 330 283
sydneyarbor@hotmail.com
ABN: 39 106 413 610

Prepared for: Rosanne Fitzgibbon, Architecture & Building Works

Arboricultural Assessment

Address: 66-68 The Grand Parade, Brighton Le Sands

Prepared by: Tom Hare – Consulting Arborist (AQF Level 5)
February 17, 2015

1 SUMMARY

This report has been commissioned by Rosanne Fitzgibbon of Architecture & Building Works, to discuss the health and structural condition of 6x Norfolk Island Pine (*Araucaria heterophylla*) located on Princess St, Brighton Le Sands.

According to the heritage documentation the trees are approximately 125 years old. A search of 1943 Aerial imagery was inconclusive but appeared to bear this out. The trees are displaying symptoms of senescence associated with ageing trees within the urban environment.

The development proposal in unlikely to pose any significant impacts upon these trees.

TABLE OF CONTENTS

2 INTRODUCTION & AIM

This report has been commissioned by Rosanne Fitzgibbon of Architecture & Building Works. The report is to discuss the health and structural condition of 6x Norfolk Island Pine (*Araucaria heterophylla*) located on Princess St, Brighton Le Sands. It is to provide recommendations for their long-term viability within the site in regards to structure and health, but particularly in relation to the proposed development for the opposite side of Princess Street, (#64-68 The Grand Parade), and any associated construction activities.

3 METHOD

Assessments of the trees were made using some elements of the 'Visual Tree Assessment' (VTA – see Section 3.1) procedure and then given a rating for their 'Safe Useful Life Expectancy' (SULE – see Section 3.2). The trees were allocated 'Tree Protection Zones' and 'Structural Root Zones' (TPZ & SRZ – see Section 3.3). Retention Values were determined using the 'Significance of a Tree, Assessment Rating System' (STARS – see Section 3.4). The trees were assessed from the ground only on Thursday January 22th, 2015. This report will discuss the current structural condition and health of the trees, and will provide recommendations regarding their viability relative to proposed works.

- No internal diagnostic testing has been completed.
- No sub surface root testing or soil testing has been completed.
- All observations were made from the ground only.
- Tree heights have been estimated and stem diameters have been measured with a diameter tape.
- Shadow diagrams were obtained from Architecture & Building Works, and assessed to determine any changes to current shade patterns that may result from the proposed development.
- The Bureau of Meteorology website was consulted to determine current wind patterns.

3.1 VISUAL TREE ASSESSMENT (VTA)

The VTA system is based on the theory of tree biology, physiology and tree architecture and structure. This method is used by arborists to identify visible signs on trees that indicate good health or potential problems. Symptoms of decay, growth patterns and defects are identified and assessed as to their potential to cause whole tree, part tree or branch failure. This system is based around methods discussed in `*The Body Language of Trees*'[1]. For the purpose of this report, parts of the VTA system will be used along with other industry standard literature and other relevant studies that provide an insight into potential hazards in trees. This assessment is a snapshot of what could be reasonably seen or determined from a basic visual inspection. The VTA system is generally used as a means to identify hazardous trees; however it is important to realize that for a tree to be hazardous there must be a target. In this case the target potential is very high with the certainty that, if there were to be a significant failure, it could only fall onto the roadway or surrounding buildings.

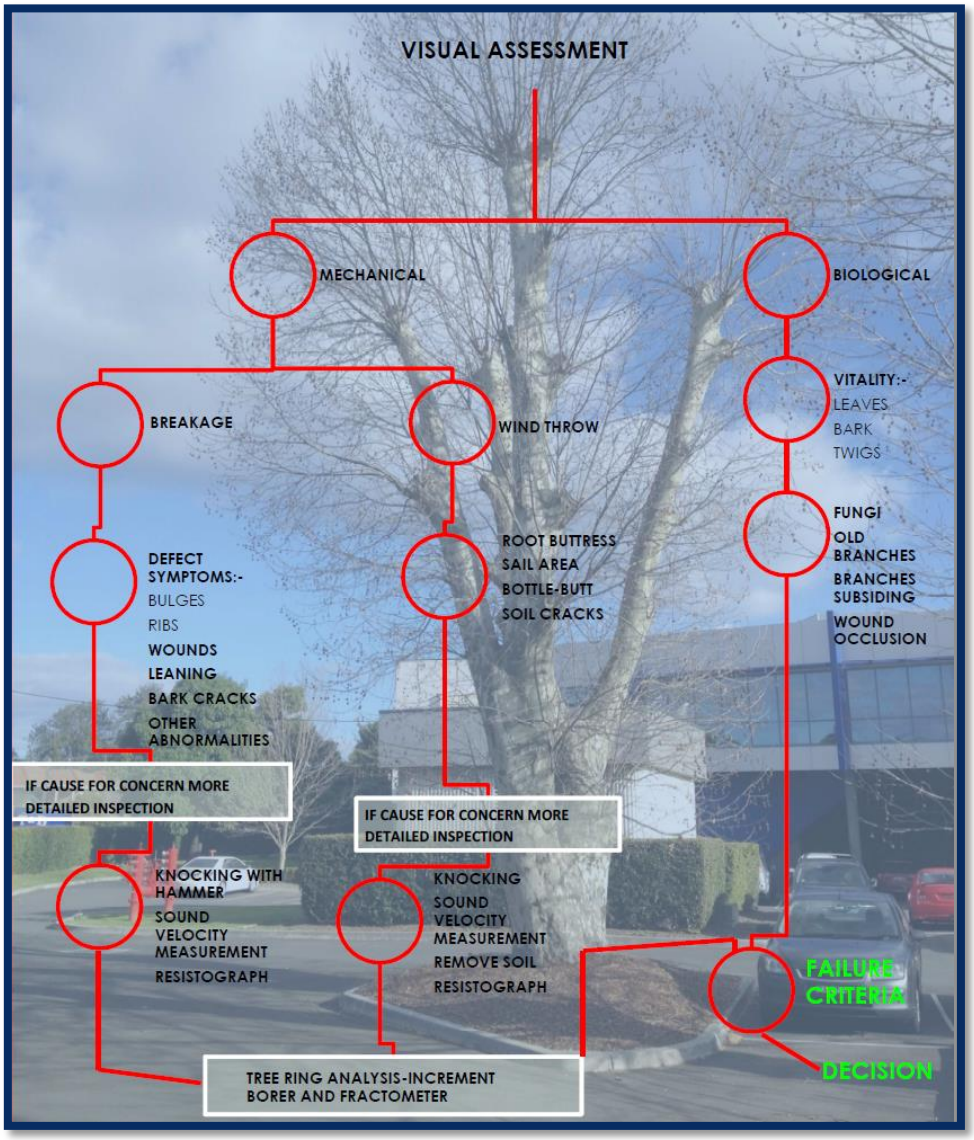


Figure 1 – An interpretation of VTA procedure outlined in '*The Body Language of Trees*'[1].

[1] Mattheck, C. & Breloer, H. 1994. *The Body Language of Trees.*

3.2 SAFE USEFUL LIFE EXPECTANCY (SULE)

The remaining Safe Useful Life Expectancy (SULE) of a tree is an estimation of the sustainability of the tree in the landscape. This calculation is based on an estimate of the average lifespan of a particular species, less its estimated current age. The life expectancy of the tree is then further modified (where necessary) in consideration of its natural range of occurrence, climatic preferences, rainfall, micro-climate, soil types, current health and vigour, condition and suitability to the site. This system is the accepted industry standard and was developed by Jeremy Barrell, a highly respected British arborist. It is important to understand that a SULE rating is based upon the trees at the time of inspection and from what could be seen or established at the time of inspection through a reasonable level of examination. Also it should be noted that trees can fail at any time without warning and there is always an inherent risk associated with trees. Table 1 shows the categories of SULE and the associated descriptions are how trees are allocated a rating.

Table 1 - SULE categories[2].

	Category:	Description:
1.	**Long SULE –** Trees that appeared retainable (at the time of assessment) for over 40 years with an acceptable degree of risk, assuming reasonable maintenance.	**a.** Structurally sound trees located in positions that can accommodate future growth. **b.** Trees, which could be made suitable for long term retention by remedial care. **c.** Trees of special significance which would warrant extraordinary efforts to secure their long term retention.
2.	**Medium SULE** – Tree that appeared to be retainable (at the time of assessment) for 15-40 years with an acceptable degree of risk, assuming reasonable maintenance.	**a.** Trees, which may only live from 15-40 years. **b.** Trees that may live for more than 40 years but may be removed for safety or nuisance reasons. **c.** Trees which may live for more than 40 years but would be removed to prevent interference with more suitable individuals or to provide space for new plantings. **d.** Trees which could be made suitable for retention in the medium term with remedial care.
3	**Short SULE** - Trees that appeared to be retainable (at the time of assessment) for 5-15 years with an acceptable degree of risk, assuming reasonable maintenance.	**a.** Trees which may only live from 5 to 15 years. **b.** Trees that may live for more than 15 years but may be removed for safety or nuisance reasons. **c.** Trees which may live for more than 15 years but would be removed to prevent interference with more suitable individuals or to provide space for new plantings. **d.** Trees which require substantial remediation and are only suitable for retention in the short term.
4	**Removal** - Trees that should be removed within the next 5 years.	**a.** Dead, dying suppressed or declining trees **b.** Dangerous trees through instability or recent loss of adjacent trees. Dangerous trees because of structural defects including cavities decay included bark, wounds or poor form. **c.** Damaged trees that are clearly not safe to retain. **d.** Trees which may live for more than 5 years but would be removed to prevent interference with more suitable individuals or to provide space for new plantings. **e.** Trees which are damaging or may cause damage to existing structures within the next 5 years. **f.** Trees that will become dangerous after the removal of other trees for the reasons given in (A) to (F). **g.** Trees in categories (A) to (G) that have a high wild life habitat value and with appropriate treatment could be retained subject to regular review.
5	**Small, young or regularly pruned** - Trees that can be reliably moved or replaced.	**a.** Small trees less than 5m in height. **b.** Young trees less than 15 years old but over 5m in height. **c.** Formal hedges and trees intended for regular pruning to artificially control growth.

[2] Barrell, J. 2009. *SULE: Its use and status into the new millennium.*

3.3 TREE PROTECTION ZONE (TPZ) & STRUCTURAL ROOT ZONE (TPZ) CALCULATIONS

In accordance with Australian Standard AS4970-2009[3], Tree Protection Zone (TPZ) radius is calculated using the following procedure. Diameter of the trunk is measured at approximately 1.4m above ground level; this measurement is referred to as DBH (Diameter at Breast Height). $R_{TPZ} = DBH \times 12$. For multi-stemmed trees the formula used is $R_{TPZ} = \sqrt{[(DBH1)^2 + (DBH2)^2 + (DBH3)^2]}$. The TPZ is measured radially from the centre of the stem and must be protected on all sides.

The Structural Root Zone (SRZ) radius is calculated by measuring the diameter of the stem close to ground level, just above the basal flare. This measurement is taken as ***D*** and then used in the following formula: $R_{SRZ} = (Dx50)^{0.42} \times 0.64$ and becomes the Structural Root Zone, measured radially from the centre of the stem.

It is important to realize that these calculations provide a notional figure only and tree dynamics, form and site conditions will greatly affect these zones, and it is the job of the arborist to interpret the information correctly.

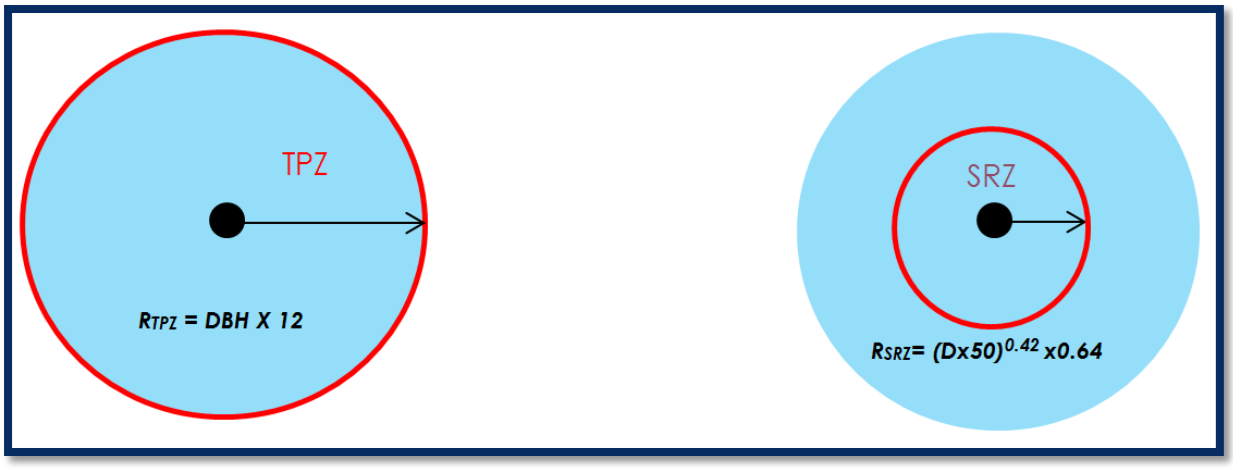


Figure 2 - TPZ & SRZ calculations.

[3] Standards Australia. 2009. *AS4970-2009 Protection of trees on development sites.*

3.4 SIGNIFICANCE OF A TREE, ASSESSMENT RATING SYSTEM (STARS)

The STARS[4] system was developed by IACA, and is useful for determining the retention values of trees, by assessing the trees' significance within the landscape, and expected lifespan. Landscape significance is determined by criteria from Table 2. (Note: a tree must have a minimum of 3 criteria in a category to be classified in that group.) The assessment criteria are for individual specimens, but can also be applied to tree stands of like species ie. hedges. A tree that is an environmental pest or noxious weed, or that is hazardous or in irreversible decline, is automatically placed in the Low Significance category.

Table 2 outlines the criteria for Tree Significance.

Table 2 - Criteria for assessment of Tree Significance using STARS.

Category	Criteria
1. High Significance	- The tree is in good condition and good vigour
	- The tree has a form typical for the species
	- The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age
	- The tree is listed as a Heritage Item, Threatened Species or part of an Endangered Ecological Community or listed on Council's Significant Tree Register.
	- The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity
	- The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values
	- The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa *in situ* – tree is appropriate to the site conditions
2. Medium Significance	- The tree is in fair-good condition and good or low vigour
	- The tree has form typical or atypical of the species
	- The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area
	- The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street
	- The tree provides a fair contribution to the visual character and amenity of the local area
	- The tree's growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa *in situ*
3. Low Significance	- The tree is in fair-poor condition and good or low vigour
	- The tree has form atypical of the species
	- The tree in not visible or is partly visible from surrounding properties as is obstructed by other vegetation or buildings
	- The tree provides a minor contribution or has a negative impact on the visual charcter and amenity of the local area
	- The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation Orders or similar protection mechanisms and can easily be replaced with a suitable specimen
	- The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa *in situ* – tree is inappropriate to the site conditions
	- The tree is listed as exempt under the provisions of the local Council's Tree Preservation Order or similar protection mechanisms
	- The tree has a wound or defect that has potential to become structurally unsound
3. Environmental Pest/ Noxious Weed Species	- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties
	- The tree is a declared noxious weed by legislation
3. Hazardous/ Irreversible Decline	- The tree is structurally unsound and/or unstable and is considered potentially dangerous
	- The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in the immediate or short term

[4] IACA. 2010. *Significance of a Tree, Assessment Rating System (STARS).*

Once the tree is placed into a Significance category, an assessment is also made of its Estimated Life Expectancy (ELE). This is an estimate of the sustainability of the tree in the landscape. This calculation is based on an estimate of the average lifespan of the species, less its estimated current age. The life expectancy of the tree is then further modified where necessary in consideration of its natural range of occurrence, climatic preferences, rainfall, microclimate, soil types, current health and vigour, condition and suitability to the site.

When both Significance and ELE have been determined, the matrix in Table 3 is used to determine Retention Value. Retention Values are 'Priority for Retention', 'Consider for Retention', 'Consider for Removal' and 'Priority for Removal' (see Table 4).

Table 3 - Tree Retention Values priority matrix[4].

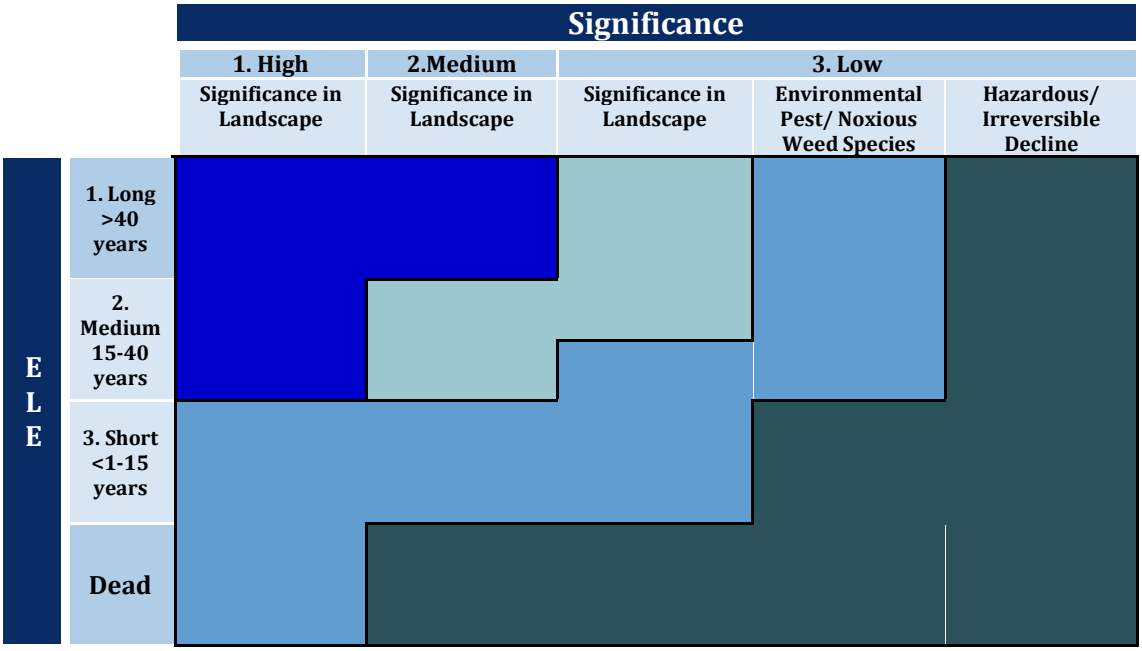


Table 4 - Legend for matrix assessment[4].

	Priority for Retention (High) – These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard *AS4970-2009 Protection of trees on development sites.* Tree sensitive construction measures must be implemented e.g. pier and beam etc if works are to proceed within the Tree Protection Zone.
	Consider for Retention (Medium) – These trees may be retained and protected. These trees are considered less critical; however their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
	Consider for Removal (Low) – These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
	Priority for Removal – These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

4 SITE DETAILS

The trees are located on the Council-owned nature strip on Princess Street, Brighton Le Sands (see Figures 3 & 4). Access to the site is best achieved from Princess Street.

Figure 3 – The site (marked in red), with frontages on Princess Street & The Grand Parade. The approximate locations of the trees is marked have been numbered. Taken from Google Maps[5].

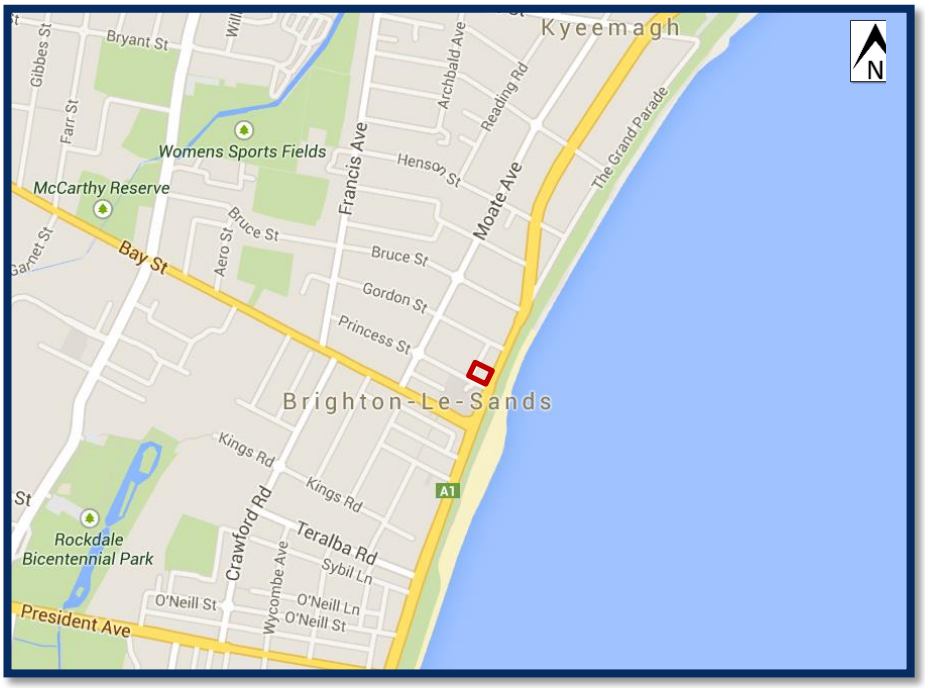


Figure 4 - The site (in red) in relation to the surrounding area. Taken from Google Maps[4].

[5] Google Maps. 2014. *http://maps.google.com*

5 TREE DETAILS

Table 2 shows a range of criteria the subject trees were assessed on during a site visit.

Table 5 - Tree details.

Tree #	1	2	3	4	5	6
Species	*Araucaria heterophylla*	*Araucaria heterophylla*	*Araucaria heterophylla*	*Araucaria heterophylla*	*Araucaria heterophylla*	*Araucaria heterophylla*
Common Name	Norfolk Island Pine	Norfolk Island Pine	Norfolk Island Pine	Norfolk Island Pine	Norfolk Island Pine	Norfolk Island Pine
Height (m)	24	27	30	27	25	20
DBH/D (mm)	870/1100	890/1050	880/1010	840/880	660/740	550/630
TPZ/SRZ (m)	10.4/3.4	10.7/3.4	10.6/3.3	10.1/3.1	7.9/2.9	6.6/2.7
Defects	Lopped/ previous failures	Lopped/ previous failures	Lopped/ previous failures	Lopped/ previous failures	Lopped/ previous failures	Lopped/ previous failures
Structure	Good	Good	Good	Good	Fair	Good
Health & Vigour	Good	Good	Fair	Fair	Poor	Fair
Age Class	Mature	Mature	Mature	Mature	Mature	Mature
Significance	High	High	High	High	High	High
SULE	2 (Medium)	2 (Medium)	2 (Medium)	2 (Medium)	2 (Medium)	2 (Medium)
Comments	Pruned for building clearance, Wounds on trunk at ~0.8m (west) and ~1.8m (north), Deadwood	Pruned for building clearance, Contains fairy lights	Pruned for building clearance, Contains fairy lights, Wound on trunk at ~1m (northeast) and large wound on trunk at ~0.5m (west)	Pruned for building clearance, Contains fairy lights	Pruned for building clearance, Contains fairy lights, Dieback through upper canopy, Large wound on trunk at ~0.1m (northeast), Distorted foliage growth at ~4m (northeast)	Pruned for building clearance, Contains fairy lights, Dieback through lower canopy, Wound on trunk at ~0.5m, Seam on trunk from ground level to ~1.8m high

5.1 THE TREES

During a site visit, observations were made regarding the health and structural condition of the trees.

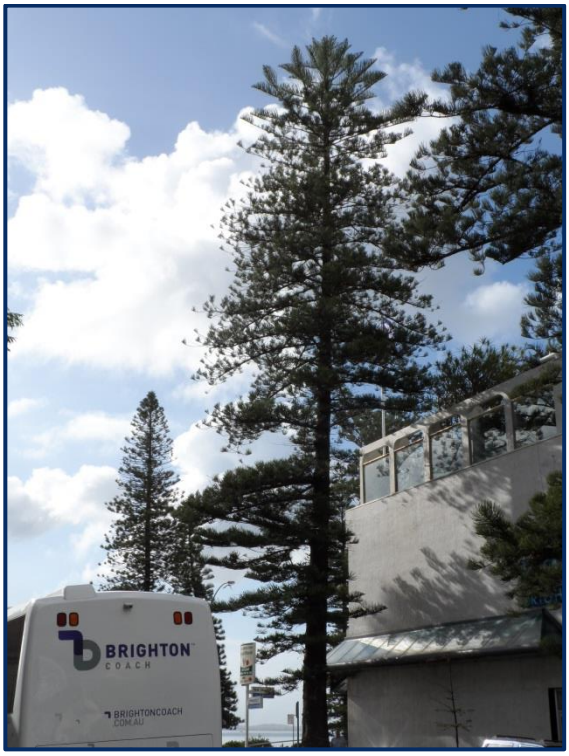


Figure 5 - The *Araucarias* are located along the nature strip directly adjacent to the Novotel hotel.

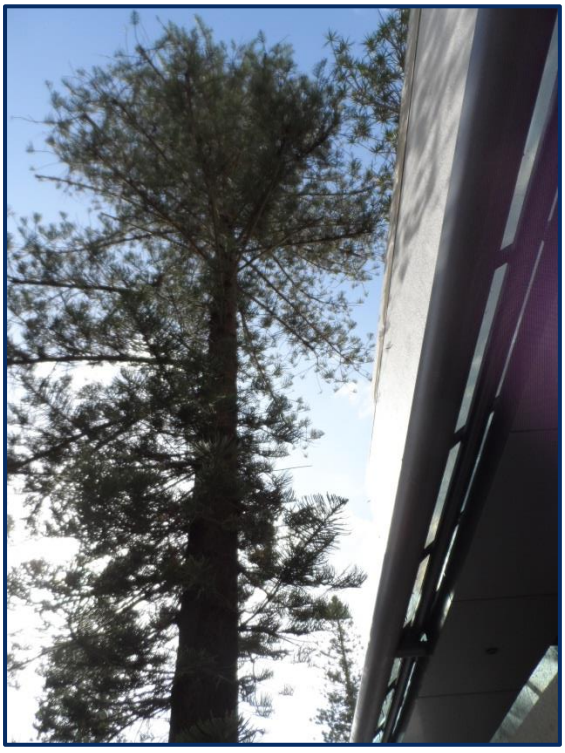


Figure 6 - The *Araucarias* have been regularly pruned on the Southern side to provide clearance from the Novotel.

Figure 7: Mechanical damage to buttresses.

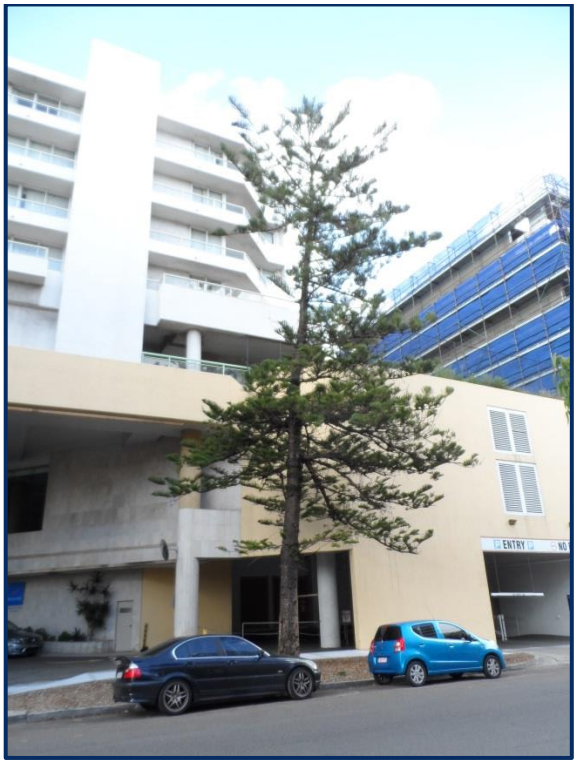


Figure 8: Tree 6 is smaller and displays reduced vigour.

Figure 9: Tree 5 is showing poor health and vigour.

In general the trees are displaying good structure apart from Tree Five (5). Most of the trees have mechanical damage to the buttress area, however none of them appear to have been significantly weakened by the damage, this could be confirmed with internal diagnostic testing but this is outside of the scope of this report and the proposed construction appears unlikely to have any bearing on the structure of these trees. The trees are far enough away from the construction for any negative impacts through construction damage. It appears that the only potential implications from the construction would be through alteration of light patterns and alteration of wind speeds.

6 DISCUSSION

6.1 THE TREES

The trees are displaying a range of health and vigour with Trees 1 & 2 being of good health and vigour, 3, 4 & 6 are showing fair health and vigour, whilst Tree 5 shows poor health and vigour.

The trees are historically significant as evidence of the early development of the 1886 Fairlight Estate.

Tree Six (6) is significantly smaller than Trees 1-5 and it is assumed that this may be a more recent replacement planting.

The heritage listing suggests that these trees were planted circa 1890 which would make them 125 years old. This species is thought to have an average life expectancy of around 150-170 years so these trees have been allocated a medium SULE based upon the urbanised environment where they are located.

6.2 THE PROPOSED DEVELOPMENT

Figure 10: Drawing PN.0399/001 showing interpretation of the proposed development.

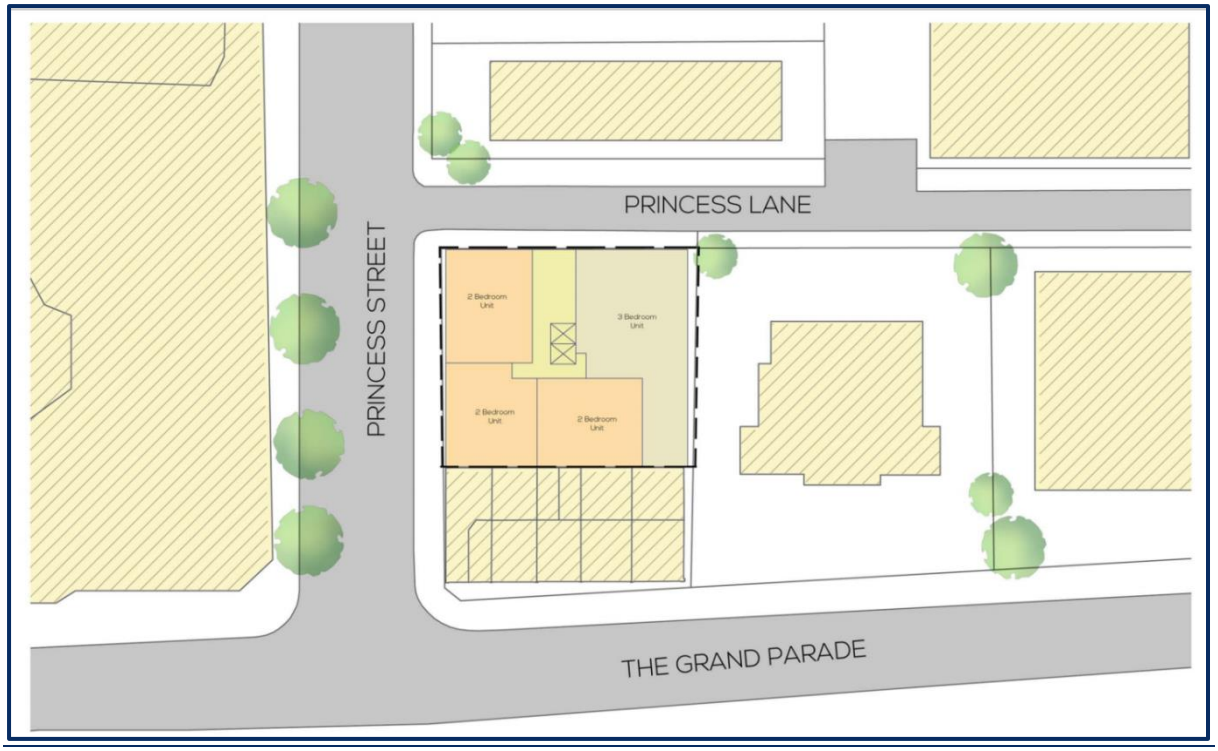


Figure 11: Drawing PN.0399/ 002 showing floor plan of the proposed development.

Figure 12: Drawing PN.0399/ 003 showing sections of the proposed development.

Figure 13: Drawing PN.0399/ 004 showing June shadows of the proposed development. The approximate locations of the trees are denoted by the red dots.

6.3 HERITAGE CONSIDERATIONS

Obviously as discussed the trees are heritage listed and are very important in the landscape. It appears unlikely that there will be any significant reduction of visual amenity of the trees from a viewing perspective in relation to the proposed development. The trees have been allocated a STARS[4] rating of 'Priority for Retention'.

6.4 IMPLICATIONS OF CHANGED SHADE PATTERNS

Trees need sunlight to photosynthesize. Photosynthesis is the process which the trees use to create energy for growth, reproduction, repair and all other essential actions. The trees foliage absorbs available light and begins a chain reaction. "During photosynthesis, carbon dioxide [CO_2] and water [H_2O] molecules enter [cells containing chlorophyll, and] light splits water into its component hydrogen and oxygen atoms. The oxygen atoms are combined to form oxygen gas (O_2) that escapes into the atmosphere. The hydrogen and carbon dioxide are incorporated into molecules of sugar."[6]

The sugar that is produced in the form of Carbohydrates is used to sustain the tree system. For a tree to survive "Energy is required to maintain the living processes in the cell –Metabolism (1)- to make more cells-growth (2) to make more trees –reproduction (3) and to keep the defence system ready at all times (4)"[7] .The budget is used in this order and once these costs have been paid the tree stores any extra energy that it has left over so it can access and use it if times get tough. When the system is damaged it starts a chain of events. Trees need to maintain a leaf-to-root balance, "if the tree roots are cut, damaged or have no more room to grow, branches die,

[6] Capon, B. 2010. *Botany for Gardeners: Third Edition.*
[7] Shigo, A. 1991. *Modern Arboriculture: Touch Trees.*

twigs do not grow as long, and the tree produces smaller/ and or fewer leaves. If branches are removed or die, tree roots will die or fail to grow the following year".[8]

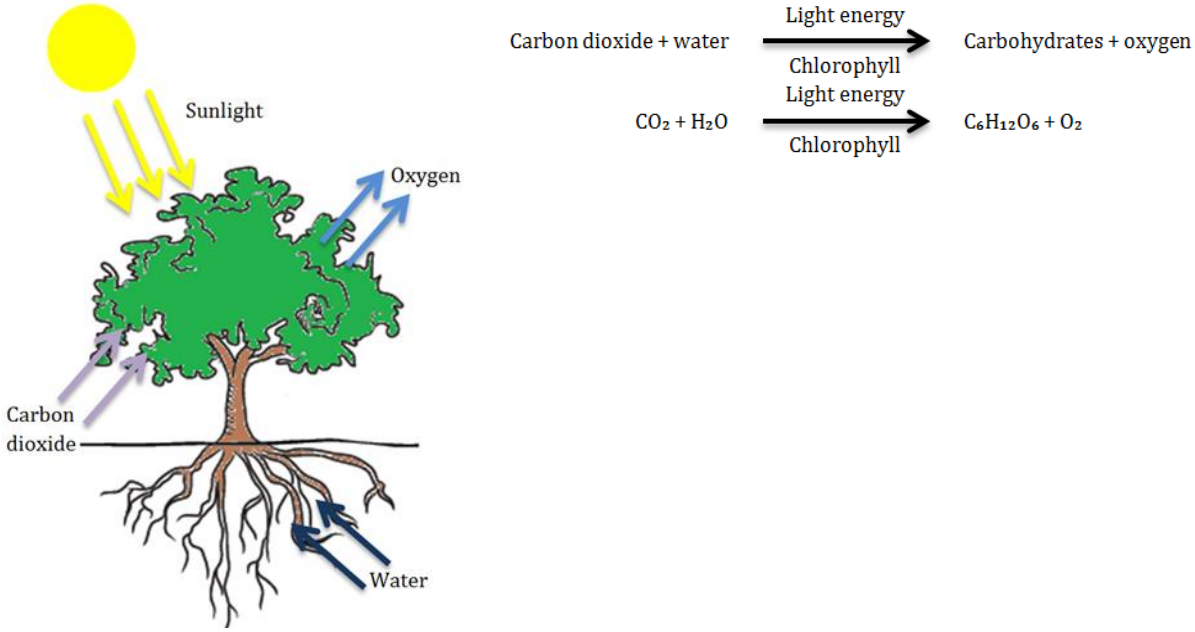


Figure 14: An interpretation of the processes involved in photosynthesis.

Based upon the provided shadow diagrams and the scale of the subject trees it appears that the light patterns will be slightly modified during the winter months. The shadow diagrams suggest that the shadows will be likely to affect Trees 3, 4 & 5 in the morning before moving to affect Trees 1 & 2 around midday and should have no impact on any of the trees by 3.00pm. It would be fair to suggest that the day length would be relatively unaffected and the shadows produced would be unlikely to have significant effect upon the subject trees.

6.5 IMPLICATIONS OF CHANGED WIND PATTERNS

Alteration of wind patterns can sometimes be of concern as "*trees are not able to respond quickly enough to these changes. The larger and older a tree, the more trouble it will have reacting*.[8]" Also, according to Lonsdale[9], "*In addition to 'defects' which may be evident in a tree, certain features of the site may also constitute a hazard. For example, the recent felling of another tree or the removal or erection of a building may have increased the exposure of the tree to the wind. This particular problem is important, as the strength of a tree develops in response to the range of windspeeds to which it has previously been exposed, and may be inadequate under the altered conditions. Many years of growth might have to elapse before a previously sheltered tree can regain its original safety factor, if ever*."

Given the location of the proposed development and the prevailing winds which are common to this area, it seems unlikely that the development would have significant impact on wind loading for the subject trees, although some wind tunnelling may occur under certain conditions.

[8] Urban, J. 2008. *Up By Roots: Healthy Soils and Trees in the Built Environment.*
[9] Lonsdale, D. 1999. *Principles of Tree Hazard Assessment and Management.*

7 CONCLUSIONS

Based on ground-based visual inspections alone, the following conclusions have been made for the 6 trees on Princess Street, Brighton Le Sands:

- The subject trees are six (6) mature/over-mature specimens of Norfolk Island Pine (*Araucaria heterophylla*).
- The trees are approximately 125 years old based on heritage documentation and some of the trees are starting to show symptoms of senescence and decline.
- A SULE rating of medium (15-40 years) has been allocated for the trees based upon the current condition of the trees and the urban environment which houses them.
- The proposed construction site is outside the Tree Protection Zones (TPZ) and Structural Root Zones (SRZ).
- The construction should cause no impacts related to soil disturbance or root damage.
- It is unlikely that there will be any significant alteration of wind patterns which may be detrimental to the subject trees, although some effects of wind tunnelling may occur during certain conditions.
- The shadow diagrams provided suggest that there will be a slight alteration to light patterns throughout the winter months; this affect appears unlikely to pose any significant impacts upon the subject trees.
- The impact upon the subject trees from the proposed development would appear to be low.

8 RECOMMENDATIONS

The following are the recommendations for the 6 trees on Princess Street, Brighton Le Sands.

Tree #	Recommendation
1	Retain and protect
2	Retain and protect
3	Retain and protect
4	Retain and protect
5	Retain and protect
6	Retain and protect

9 REFERENCES

Mattheck, C. & Broeler, H. 1994, *The Body Language of Trees*.
The Stationery Office. London.

Barrell, J. 2009. *SULE: Its use and status into the new millennium.*
Barrell Tree Consultancy. Hampshire, UK.

Standards Australia. 2009. *AS4970-2009 Protection of trees on development sites.*
Standards Australia. Sydney.

IACA. 2010. *IACA Significance of a Tree, Assessment Rating System (STARS).*
Institute of Australian Consulting Arboriculturists. Australia. **www.iaca.org.au**

Google Maps. 2014. *The location of Princess Street, Brighton Le Sands.*
Accessed at http://maps.google.com
Accessed 17/2/15.

Capon, B. 2010. *Botany for Gardeners: Third Edition.*
Timber Press. London.

Shigo, A. 1991. *Modern Arboriculture: Touch Trees.*
Shigo and Trees, Associates. New Hampshire.

Urban, J. 2008. *Up By Roots: Healthy Soils and Trees in the Built Environment.*
International Society of Arboriculture. Illinois.

Lonsdale, D. 1999. *Principles of Tree Hazard Assessment and Management.*
Arboricultural Association. Stonehouse (UK).

DISCLAIMER

The information contained within this report is to be used solely for the purposes that were specified at the time of engagement.

All attempts have been made to ensure the legitimacy of any information which has been gathered in the process of compiling this report, however Sydney Arbor Trees Pty. Ltd. cannot be held liable for inaccurate or misguiding information which has been provided by others.

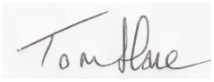
Any tree inspections or assessments which have been carried out for the purposes of this report are valid only at the time of inspection and are based on what could reasonably be seen or diagnosed from a visual inspection carried out from ground level.

All inspections unless otherwise stated are based upon Visual Tree Assessment (VTA) techniques, industry best practice and applied knowledge. No internal diagnostic testing or below ground investigation has been carried out unless otherwise stated.

Trees are a dynamic living organism and as such they have a finite lifespan the end of which cannot always be predicted or understood, even apparently healthy trees can die suddenly or fall without warning. As such there is no warranty or guarantee provided, or implied, regarding the future risks associated with any tree.

Please feel free to contact me either via telephone or email if you have any questions regarding this report.

Kind regards,



Tom Hare | Consulting Arborist | AQF Level 5
Sydney Arbor Trees Pty. Ltd.
info@sydneyarbor.com.au
0425 330 283