EARTHSCAPE HORTICULTURAL SERVICES
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ARBORICULTURAL IMPACT ASSESSMENT REPORT

PROPOSED ALTERATIONS AND ADDITIONS

AUSTRALIAN MUSEUM
6 COLLEGE STREET, SYDNEY

September 2018

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TABLE OF CONTENTS

1 INTRODUCTION

1.1.1 This report was commissioned by Hames Sharley on behalf of the Australian Museum to assess the health and condition of eight (8) trees located within or immediately adjacent to the Australian Museum, 6 College Street, Sydney. The report has been prepared to aid in the assessment of a State Significant Development Application (SSDA) [SSD 18_9452] for re-development of the Crystal Hall entrance building, together with associated landscape works within the site and adjacent public domain.

1.1.2 The purpose of this report is to assess the potential impact of the proposed development on the subject trees, together with recommendations for amendments to the design or construction methodology where necessary to minimise any adverse impact. The report also provides recommended tree protection measures to ensure the long-term preservation of the trees to be retained where appropriate.

1.1.3 This report has been prepared in accordance with the City of Sydney Council's guidelines for preparation of Arborists Reports as outlined in Schedule 8 of the *Sydney Development Control Plan* (SDCP) 2012 and Sections 2.3.2-2.3.5 of the Australian Standard for *Protection of Trees on Development Sites* (AS 4970:2009).

2 THE SITE

2.1.1 The subject property is crown land consisting of a number of allotments known as Lot 1 in DP 1157811, Lot 3 in DP 1046458 and Lot 11 in DP 588102, being the Australian Museum, 6 College Street, Sydney. For the purposes of this report, the subject allotments will be referred to as "the Site". The site is zoned Metropolitan Centre [B8] under the *Sydney Local Environmental Plan 2012* (SLEP). The site contains a multi-storey building comprising the Australia Museum. The northern side of the building (William Street frontage) contains terraced gardens and walkways. The site contains a few mature trees, including a variety of locally-indigenous, non-local native and exotic (introduced) species.

2.1.2 Soils of this area are typical of the Gymea Landscape Group (as classified in the *Soil Landscapes of the Sydney 1:100,000 Sheet*), consisting of "shallow to moderately deep (300 – 1000 mm) *Yellow Earths* and *Earthy Sands* on crests and inside of benches and shallow (< 200 mm) *Siliceous Sands* on leading edges of benches; localised *Gleyed Podzolic Soils* and *Yellow Podzolic Soils* on shale lenses; and shallow to moderately deep (< 1000mm) *Siliceous Sands* and *Leached Sands* along Drainage Lines."[1] Soil materials are derived Hawkesbury Sandstone and may be discontinuous with localised rock outcrop.

2.1.3 The original vegetation of this area consisted of open forest & woodland typical of Hawkesbury Sandstone areas.[2] The original locally-indigenous tree species formerly occurring in this area included *Angophora costata* (Sydney Red Gum), *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus haemastoma* (Scribbly Gum). Other species found in this vegetation community may include *Allocasuarina littoralis* (Black She-Oak), *Eucalyptus globoidea* (White Stringybark), *Eucalyptus sieberi* (Silvertop Ash) and *Banksia serrata* (Old Man Banksia).

3 SUBJECT TREES

3.1.1 The subject trees were inspected by Earthscape Horticultural Services (EHS) on the 18th September 2018. Each tree has been provided with an identification number for reference purposes denoted on the attached Tree Location Plan (**Appendix 5**), based on the survey prepared by Lockley Land Title Solutions, Dwg. Ref No. 28600 Rev C dated 13/02/2008. The numbers used on this plan correlate with the Tree Assessment Schedule (**Appendix 3**). Tree No.s T7, T9, T10 &

T11 were not shown on the original survey and have been plotted on the drawing in their approximate positions.

4 HEALTH AND CONDITION ASSESSMENT

4.1 Methodology

4.1.1 An assessment of each tree was made using the Visual Tree Assessment (VTA) procedure.[3] All of the trees were assessed in view from the ground. No aerial inspection or diagnostic testing has been undertaken as part of this assessment.

4.1.2 The following information was collected for each tree:-

- Tree Species (Botanical & Common Name);
- Approximate height;
- Canopy spread; measured using a metric tape and an average taken.
- Trunk diameter (measured at 1.4 metres from ground level);
- Live Crown Size; (measured by subtracting the total height of the tree from the lowest point of the crown and multiplying by the average crown spread to give a value in square metres).
- Health & vigour; using foliage size, colour, extension growth, presence of disease or pest infestation, canopy density, presence of deadwood, dieback and epicormic growth as indicators,
- Condition; using visible evidence of structural defects, instability, evidence of previous pruning and physical damage as indicators.
- Suitability of the tree to the site and its existing location; in consideration of damage or potential damage to services or structures, available space for future development and nuisance issues.

4.1.3 This information is presented in a tabulated form in **Appendix 3**.

4.2 Safe Useful Life Expectancy (SULE)

4.2.1 The remaining Safe Useful Life Expectancy[4] of the tree is an estimate of the sustainability of the tree in the landscape, calculated based on an estimate of the average age of the species in an urban area, less its estimated current age. The life expectancy of the tree has been further modified where necessary in consideration of its current health and vigour, condition and suitability to the site. The estimated SULE of each tree is shown in **Appendix 3.**

4.2.2 The following ranges have been allocated to each tree:-

- Greater than 40 years (Long)
- Between 15 and 40 years (Medium)
- Between 5 and 15 years (Short)
- Less than 5 years (Transient)
- Dead or immediately hazardous (defective or unstable)

4.2.1 SULE ratings are intended to provide a general overview of the long term sustainability of the trees within the site in consideration of these factors. The allocated ranges are not intended to be absolute. This information is useful in guiding future planning by highlighting the probable lifespan of individual trees, for which a clear pattern may emerge. This information may be helpful in forecasting likely tree senescence and planning for replacement planting to ensure continuity in tree canopy across the site. It should be noted that SULEs *may* be extended or reduced depending on the way trees are managed. Intervention and remedial works may extend the SULE of some trees.

5 LANDSCAPE SIGNIFICANCE

5.1 Methodology for Determining Landscape Significance

5.1.1 The significance of a tree in the landscape is a combination of its environmental, heritage and amenity values. Whilst these values may be fairly subjective and difficult to assess consistently, some measure is necessary to assist in determining the retention value of each tree. To ensure a consistent approach, the assessment criteria shown in **Appendix 1** have been used in this assessment.

5.1.2 A rating has been applied to each tree to give an understanding of the relative significance of each tree in the landscape and to assist in determining priorities for retention, in accordance with the following categories:-

1. **Significant**
2. **Very High**
3. **High**
4. **Moderate**
5. **Low**
6. **Very Low**
7. **Insignificant**

5.2 Environmental Significance

5.2.1 Tree Management Controls

Prescribed Trees within the City of Sydney Local Government Area (LGA) are protected under the provisions of under Section 3.5.3 of the *Sydney Development Control Plan 2012* (SDCP) made pursuant to Clause 9 of the *State Environmental Planning Policy (Vegetation in Non-rural Areas) 2017* (SEPP VNRA). The SDCP generally protects all trees of a height of five (5) metres or greater or with a canopy spread of five (5) metres or greater, or trunk diameter of 300mm or greater (measured at ground level) or any tree listed on Council's Significant Tree Register. Some exemptions apply. However, all of the subject trees are protected under the provisions of SDCP.

5.2.2 Wildlife Habitat

Angophora costata (Sydney Red Gum) [T3, T4 & T5] is a locally-indigenous species, representative of the original vegetation of the area and would be of benefit to native wildlife. These trees are not remnant, but have been planted within the site. None of the trees contain cavities suitable as nesting hollows for arboreal mammals or birds or other visible signs of wildlife habitation.

5.2.3 Noxious Plants & Environmental Weeds

None of the subject trees are scheduled as a potential 'Biosecurity Risk' ('Priority Weed' – formerly 'Noxious Weed') within NSW under the provisions of the *Biosecurity Act 2015*. None of the subject trees are listed as Environmental Weed Species within the Sydney City LGA.

5.2.4 Threatened Species & Ecological Communities

None of the subject trees are listed as Threatened or Vulnerable Species or form part of Endangered Ecological Communities (EECs) under the provisions of the *Biodiversity Conservation Act 2016* (NSW) or the *Environment Protection and Biodiversity Conservation Act 1999*.

5.3 Heritage Significance

5.3.1 Heritage Items

The subject property is listed as an item of Environmental Heritage [Item I246] of State Significance under Schedule 5, Part 1 of the *Sydney Local Environmental Plan 2012* (SLEP). The

Australian Museum is the oldest surviving purpose-built museum building in Australia, dating from the early 19th Century (c.1846). The former National School Building (including interior) in the eastern portion of the site is also listed as an item of Environmental Heritage [Item I495] of Local Significance under Schedule 5, Part 1 of the SLEP 2012.

5.3.2 Heritage Conservation Area

The site is *not* located within a Heritage Conservation Area under Schedule 5, Part 2 of the SLEP 2012.

5.3.3 Significant Tree Register

None of the subject trees are listed on Council's *Register of Significant Trees* Volume 3 (Significant Trees: Other Government Authorities, Institutional, Religious and Non-government Organisations)[5] or Volume 2 (Significant Street Trees).[6]

5.3.4 General

None of the subject trees have any known or suspected heritage significance.

5.4 Amenity Value

5.4.1 Criteria for the assessment of amenity values are incorporated into **Appendix 1**. The amenity value of a tree is a measure of its live crown size, visual appearance (form, habit, crown density), visibility and position in the landscape and contribution to the visual character of an area. Generally the larger and more prominently located the tree, and the better its form and habit, the higher its amenity value.

6 TREE RETENTION VALUES

6.1.1 The Retention Values shown in **Appendix 3** and **Appendix 5** have been determined on the basis of the estimated longevity of the trees and their landscape significance rating, in accordance with **Table 1**. Together with guidelines contained in **Section 7** (Tree Protection Zones) this information should be used to determine the most appropriate position of building footprints and other infrastructure within the site, with due consideration to other site constraints, to minimise the impact on trees considered worthy of preservation.

TABLE 1 – TREE RETENTION VALUES – ASSESSMENT METHODOLOGY

	Landscape Significance Rating						
Estimated Life Expectancy	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Long - Greater than 40 Years	High Retention Value						
Medium- 15 to 40 Years			Moderate Retention Value				
Short - 5 to 15 years				Low Ret. Value			
Transient - Less than 5 Years				Very Low Retention Value			
Dead or Potentially Hazardous							

6.1.2 The following table describes the implications of the retention values on site layout and design.

TABLE 2 – TREE RETENTION PRIORITES.

RETENTION VALUE	RECOMMENDED ACTION
"High"	These trees considered worthy of preservation; as such careful consideration should be given to their retention as a priority. Proposed site design and placement of buildings and infrastructure should consider the recommended setbacks as discussed in the following section (refer also **Appendix 2**) to avoid any adverse impact on these trees. In addition to Tree Protection Zones, the extent of the canopy (canopy drip-line) should also be considered, particularly in relation to high rise developments. Significant pruning of the trees to accommodate the building envelope or temporary scaffolding is generally not acceptable.
"Moderate"	The retention of these trees is desirable, but not essential. These trees should be retained as part of any proposed development if possible. However, these trees are considered less critical for retention. If these trees must be removed, replacement planting should be considered in accordance with Council's Tree Replenishment Policy to compensate for loss of amenity (refer also **Section 9**).
"Low"	These trees are not considered to worthy of any special measures to ensure their preservation, due to current health, condition or suitability. They do not have any special ecological, heritage or amenity value, or these values are substantially diminished due to their SULE. These trees should not be considered as a constraint to the future development of the site.
"Very Low"	These trees are considered potentially hazardous or very poor specimens, or may be environmental or noxious weeds. The removal of these trees is therefore recommended regardless of the implications of any proposed development.

7 TREE PROTECTION ZONES

7.1.1 The Tree Protection Zone (TPZ) is a radial distance measured from the centre of the trunk of the tree as specified in **Appendix 4**. These have been calculated in accordance with AS 4970-2009 (Protection of Trees on Development Sites).[7]

7.1.2 The intention of the TPZ is to ensure protection of the root system and canopy from the potential damage from construction works and ensure the long-term health and stability of each tree to be retained. Incursions to the root zone may occur due to excavations, changes in ground levels, (either lowering or raising the grade), trenching or other forms or soil disturbance such as ripping, grading or inverting the soil profile. Such works may cause damage or loss of part of the root system, leading to an adverse impact on the tree.

7.2 Structural Root Zone (SRZ)

7.2.1 The Structural Root Zone (SRZ) provides the bulk of mechanical support and anchorage for a tree. This is also a radial distance measured from the centre of the trunk as specified in **Appendix 4**. The SRZ has been calculated in accordance with AS 4970-2009 (Protection of Trees on Development Sites).

7.2.2 Incursions within the SRZ are not recommended as they are likely to result in the severance of woody roots which may compromise the stability of the tree or lead to its decline and demise.

7.3 Acceptable Encroachments to the Tree Protection Zone.

7.3.1 Where encroachment to the TPZ is unavoidable, an incursion to the TPZ of not exceeding 10% of the area of the TPZ and outside the SRZ may be acceptable. Examples of acceptable incursions are shown in **Appendix 2**. Greater incursions to the TPZ may result in an adverse impact on the tree.

7.3.2 Where incursions greater than 10% of the TPZ are unavoidable, exploratory excavation using non-destructive methods may be required to evaluate the extent of the root system affected and determine whether or not the tree can remain viable

7.4 Acceptable Encroachments to the Canopy

7.4.1 The removal of a small portion of the crown (foliage and branches) is generally tolerable provided that the extent of pruning required is less than 10% of the total foliage volume of the tree and the removal of branches does not create large wounds or disfigure the natural form and habit of the tree. All pruning cuts must be undertaken in accordance with AS 4373:2007. This generally involves reduction of the affected branches back to the nearest branch collar at the junction with the parent branch, rather than at an intermediate point. The latter is referred to as "lopping" and is no longer an acceptable arboricultural practice. Generally speaking, the minimum pruning as required to accommodate any proposed works is desirable. Extensive pruning can result in a detrimental impact on tree health and may lead to exposure of remaining branches to wind forces that they were previously sheltered from, leading to a greater risk of branch failure.

7.4.2 Clearance to between the building line and canopy should take into account any projecting structures, such as balconies, awnings and the roofline and any requirement for temporary scaffolding to be erected during construction (typically 1-1.5 metres wide). High structures should preferably be located outside the canopy dripline (as shown indicatively on the attached plans) in order to avoid or minimise canopy pruning.

8 PROPOSED DEVELOPMENT

8.1.1 The proposed development includes the alterations and additions to the existing museum building (Crystal Hall entrance) and external landscape works within the site and adjoining public domain areas, including construction of a new bus parking bay.

9 IMPACT ASSESSMENT

9.1.1 The intention of this assessment is to determine the incursions to the root zones and canopies created by the proposed development and evaluate the likely impact of the proposed works on the subject trees. Details shown on the following plans were used in this assessment:-

Title	Author	Dwg No.	Date
Landscape Plans and Sections	Sue Barnsley Design	DA 01 – DA 13 [A]	17/08/2018

9.1.2 A summary of the impact of the proposed development on each tree within the site is shown in **Appendix 5**. The following criteria have been examined as part of this assessment:-

- Existing Relative Levels (R.L.);
- Tree Protection Zone (TPZ);
- Structural Root Zone (SRZ);
- Footprint and envelope of the proposed development and temporary structures (scaffolding, hoardings etc);
- Incursions to the TPZ & SRZ, including estimated cut & fill beyond the building footprint;

- Incursions to the tree canopy from the building envelope and temporary structures; and
- Assessment of the likely impact of the works on existing trees.

9.1.3 The proposed development will necessitate the removal of one (1) tree of low retention value, being T7 (West Australian Flowering Gum). This tree is not considered significant or worthy of special measures to ensure its preservation. The removal of this tree to accommodate the proposed development is therefore considered warranted in this instance.

9.1.4 The proposed development will also necessitate the removal of two (2) trees of moderate retention value. These include Tree No.s T9 & T10 (London Plane trees within the William Street road reserve). These trees are not considered significant, but are in good health and condition and make a fair contribution to the amenity of the site and streetscape. In order to compensate for loss of amenity resulting from the removal of these trees to accommodate the proposed development, consideration should be given to replacement planting elsewhere within the road reserve in accordance with **Section 11**.

9.1.5 The existing low timber retaining walls and terrace landscape areas along the William Street frontage are proposed to be demolished within the TPZs of T4 & T5 (Sydney Red Gums). The area is proposed to be regraded to form an even slope between the existing stone wall on the northern boundary and the stone kerb located just south of the trees alongside the Crystal Hall pedestrian entry ramp. This will require a small amount of ground disturbance within the TPZ of T5 (equivalent to 10% of the TPZ) and a moderate amount of disturbance within the TPZ of T6 (equivalent to 20% of the TPZ). Proposed ground level changes at the western end of the terraces (within the TPZs of these trees) will be relatively minor. This work will not result in any adverse impact on these trees provided that demolition of the existing low timber retaining walls within the TPZs is undertaken in accordance with **Section 10.5**. Any required excavations within the TPZs should be undertaken in accordance with **Section 10.6** and supply and placement of any required fill (to achieve the proposed even grade) should be undertaken in accordance with **Section 10.8**.

9.1.6 The existing stone kerb and road pavement is proposed to be demolished within the SRZ and TPZ of T11 (London Plane tree) to permit installation of a larger soft landscape area (island). A new kerb will be installed within the TPZ, requiring some excavations for the footings. However, the new kerb is located wholly within the existing road pavement and therefore the excavation will not result in any actual incursion to the root zone. The proposed works will not result in any adverse impact on this tree, provided that demolition of the existing kerb and paved areas within the TPZ are undertaken in accordance with **Section 10.5**. Any required excavations within the TPZ (for kerb footings etc) should be undertaken in accordance with **Section 10.6** and supply and placement of any required fill (for the new soft landscape 'island') should be undertaken in accordance with **Section 10.8.**

9.1.7 No other trees will be adversely affected by the proposed development.

10 RECOMMENDED TREE PROTECTION MEASURES

10.1 Tree Protection Plan

10.1.1 The following Tree Protection Measures should be read in accordance with the Tree Protection Plan (**Appendix 6**). The Tree Protection Plan (TPP) indicates the position of tree protection devices and other recommended measures to ensure the protection of trees within the site to be retained as part of the proposed development.

10.2 Prohibited Activities

10.2.1 The following activities should be avoided within specified Tree Protection Zones (refer **Appendix 4 & 6** for extent of the TPZ for each tree):-

- Excavations and trenching (with exception of the approved remediation works, underground services, building foundations or pavement sub-grade);
- Soil disturbance, surface grading, compaction, tyning, ripping or cultivation of soil;
- Mechanical removal of vegetation, including extraction of tree stumps;
- Soil level changes including the placement of fill material (excluding imported validated fill for remediation works or placement of fill for approved works)
- Movement and storage of plant, equipment & vehicles (except within defined temporary haul roads, where ground protection has been installed, or within the footprint of existing floor slabs or paved areas);
- Erection of site sheds (except where approved by the site arborist);
- Affixing of signage, barricades or hoardings to trees;
- Storage of building materials, waste and waste receptacles;
- Stockpiling of spoil or fill;
- Stockpiling of bulk materials, such as soil, sand, gravel, roadbase or the like;
- Stockpiling of demolition waste;
- Disposal of waste materials and chemicals including paint, solvents, cement slurry, fuel, oil and other toxic liquids;
- Other physical damage to the trunk or root system; and
- Any other activity likely to cause damage to the tree.

10.3 Tree Protection Fencing

10.3.1 Trees [**T3, T4 & T5**] shall be protected prior to and during construction from all activities that may result in detrimental impact by erecting a suitable protective fence in the positions as indicated on the Tree Protection Plan (**Appendix 6**). As a minimum, the fence shall consist of temporary chain wire panels of 1.8 metres in height, supported by steel stakes as required and fastened together and supported to prevent sideways movement using corner braces where required. The fence shall be erected prior to the commencement of any work on-site and shall be maintained in good condition for the duration of construction. Where tree protection zones merge together a single fence encompassing the area is deemed to be adequate. Existing site boundary fences may form part of the enclosure.

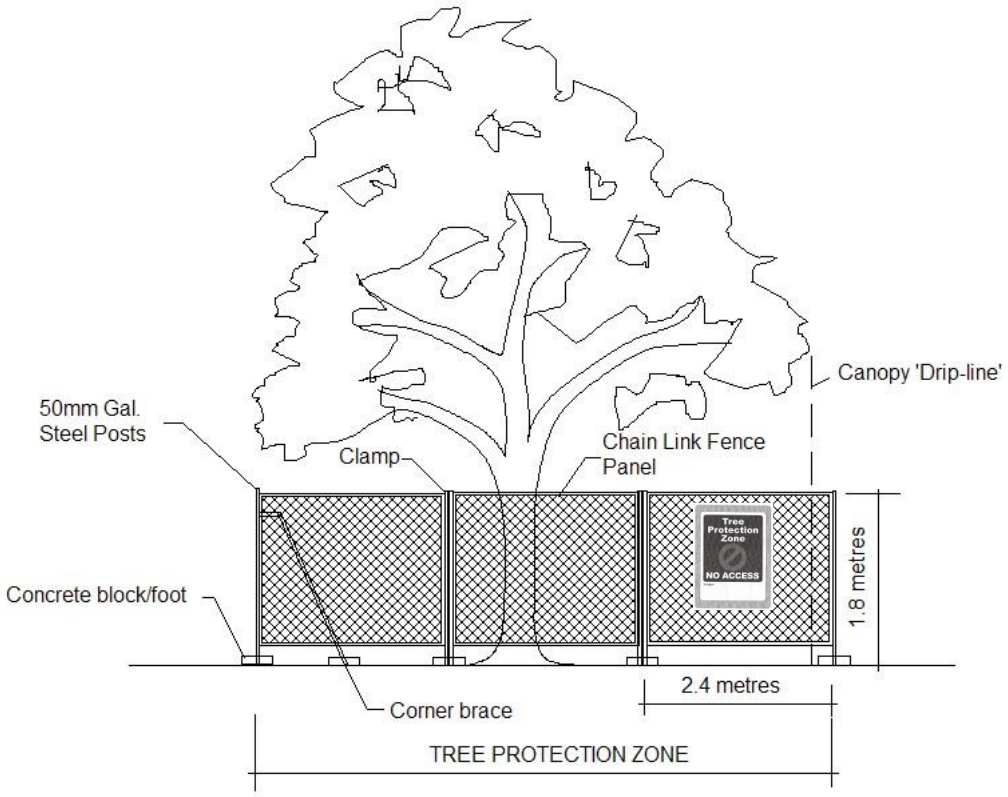


Figure 1 – Detail of Tree Protection Fence

10.3.2 Signs shall be installed on the Tree Protection Fence to prevent unauthorised movement of plant and equipment or entry to the Tree Protection Zone. The signs shall be securely attached to the fence using cable ties or equivalent. Signs shall be placed at minimum 10 metre intervals. The wording and layout of the sign shall comply with AS 4970-2009 as shown in **Figure 2**.

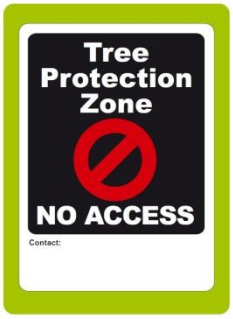


Figure 2 – Detail of Tree Protection Sign

10.4 Trunk Protection

10.4.1 Trunk protection boarding shall be erected around Trees [**T11**] to avoid accidental damage, as indicated on the Tree Protection Plan (**Appendix 6**). The trunk protection shall consist of a layer of carpet underfelt (or similar) wrapped around the trunk, followed by 1.8 metre lengths of softwood timbers (90 x 45mm in section) aligned vertically and spaced evenly around the trunk at 150mm centres (i.e. with a 50mm gap) and secured together with 2mm galvanised wire or galvanised hoop strap as shown in **Figure 3**. Recycled timber (such as demolition waste) may be suitable for this purpose, subject to the approval of the Project Arborist. The timbers shall be wrapped around the trunk (over the carpet underfelt), but not fixed to the tree to avoid mechanical injury or damage to the trunk. Trunk protection should be installed prior to any site works and maintained in good condition for the duration of the construction period. Carpet underfelt (alone) is sufficient for trees with a trunk diameter of less than 200mm. This shall be wrapped around the trunk in a double layer and held in place with heavy-duty fibre reinforced adhesive tape (e.g. Gaffer Tape).

Figure 3 – Detail of Trunk Protection

10.5 Demolition Works within Tree Protection Zones

10.5.1 Demolition of paved areas within the Tree Protection Zones (TPZs) of trees [**T4, T5 & T11**] shall be undertaken under the supervision of a qualified Arborist [Australian Qualification Framework (AQF) Level 5].

10.5.1 Concrete pavements shall be demolished by breaking the slab into manageable sections (using a rock hammer or similar) and asphalt pavements shall be removed by breaking the topcoat into manageable pieces. The broken sections shall be carefully lifted and folded over the remaining paved surface to minimise disturbance and compaction of the underlying soil profile. Special care shall be taken where underlying woody roots have lifted or displaced the pavement. Any plant or equipment used in demolition work shall operate within the footprint of existing paved areas and avoid traversing soft landscape areas. Where this is unavoidable, suitable ground protection shall first be installed in accordance with **Section 10.11**.

10.5.2 The pavement sub-base within the TPZ shall be gradually removed (where required) in layers of no greater than 50mm thick using a small rubber tracked excavator or alternative approved method to avoid excessive disturbance and compaction of the underlying soil profile and damage to underlying roots and minimise. The machine shall work within the footprint of the existing path footprint to avoid compaction of the underlying soil. The final layer of sub-base material shall be removed using hand tools were required to avoid compaction of the underlying soil profile and avoid damage to any underlying woody roots.

10.5.3 Following removal of the pavement surface and sub-base, clean, friable topsoil shall be used to fill in the excavated area and bring flush with surrounding levels within new landscape areas. Soil shall only be imported and spread when the underlying soil conditions are dry to avoid compaction of the soil profile. Where there is insufficient recovered site topsoil for this purpose, any imported material shall be free of rocks, vegetation, heavy clay or other extraneous matter and supplied and spread in accordance with **Section 10.8**. Any imported soil material should be similar in texture to the existing site topsoil.

10.5.4 Demolition of existing walls, kerbs and other structures within the TPZ of trees [**T4, T5 & T11**] shall be undertaken under the supervision of a qualified Arborist [AQF level 5]. The structures

shall be demolished using equipment on stationed outside the TPZ where possible or within the footprint of existing hardstand areas.

10.5.5 Care shall be taken to avoid the root systems, trunks and lower branches of trees in the vicinity of the structures during demolition works, with special attention required during demolition of the footings and other sub-surface members to avoid damage to woody roots. An observer ('spotter') shall be employed to assist the plant operator in order to detect and avoid damage to underlying woody roots during demolition. Trunk and/or branch protection shall be installed where there is a potential risk of damage to trees in proximity or overhead of the work.

10.6 Excavations within Tree Protection Zones

10.6.1 Any required excavations to facilitate re-grading of the embankment within the TPZs of Trees [**T4 & T5**] shall be undertaken using only hand-held implements. All care shall be undertaken to preserve woody roots intact and undamaged during excavation works. Any roots encountered of greater than 40mm in diameter shall be maintained intact. The root zone in the vicinity of the re-grading shall be kept moist following excavation for the duration of construction phase to minimise moisture stress on the trees.

10.6.2 All excavations for the new kerb footings within the TPZ of Trees [**T11**] shall be undertaken using only hand-held implements.

10.7 Underground Services

10.7.1 All proposed stormwater lines and other underground services should be located outside TPZs of trees proposed to be retained wherever possible or installed by alternative measures. Alternative measures include suspending pipelines beneath the floor of a building or structure (to avoid excavation with the TPZ), non-destructive excavation methods or Horizontal Directional Drilling (HDD). Where the installation of service lines within TPZs is unavoidable, the pipelines or conduits should be installed as follows.

10.7.2 Trenching for underground services and stormwater pipes within the TPZs of Trees [**any tree nominated for retention**], shall be undertaken using non-destructive excavation in accordance with **Section 10.6**. Where large woody roots are encountered during excavation or trenching (root diameter greater than 40mm), these shall be retained intact wherever possible (e.g. by tunnelling beneath roots and inserting the pipeline or conduit beneath or re-routing the service etc). Where this is not practical and root pruning is the only alternative, proposed root pruning should be assessed by a qualified arborist [AQF 5] to evaluate the potential impact on the health and stability of the subject tree.

10.7.3 Installation of underground services and stormwater pipes within the SRZs of Trees [**any tree nominated for retention**], shall only be undertaken by Horizontal Directional Drilling (HDD) (also referred to as sub-surface boring or Micro-tunnelling for large diameter pipes). The Invert Level of the pipe, plus the pipe diameter, must be lower than the estimated root zone depth as specified. At this site a minimum depth of 1 metre to the invert level of the pipe is specified.

10.8 Placement of Fill Material

10.8.1 Any required fill material to be placed within the TPZs of Trees [**T4, T5 & T11**] for re-grading or new soft landscape areas shall be a well-drained friable material, equivalent in texture to the existing site topsoil material. The fill should be free from rocks, vegetation and other extraneous material complying with AS 4419:2003 (*Soils for Landscaping and Garden Use*).

10.8.2 The fill may be lightly consolidated, but shall not be compacted to engineering standards. No fill material should be placed in direct contact with the trunk.

10.8.3 Plant and equipment used to place and spread fill material should be stationed outside the TPZ where possible. Where not possible, suitable ground protection should be installed in accordance with **Section 10.11** to avoid compaction of the underlying soil profile and root zone.

10.9 Tree Damage

10.9.1 Care shall be taken when operating cranes, drilling rigs and similar equipment near trees to avoid damage to tree canopies (foliage and branches). Under no circumstances shall branches be torn-off by construction equipment. Where there is potential conflict between tree canopy and construction activities, the advice of the Project Arborist must be sought.

10.9.2 In the event of any tree becoming damaged for any reason during the construction period a consulting arborist [Australian Qualification Framework Level 5] shall be engaged to inspect and provide advice on any remedial action to minimise any adverse impact. Such remedial action shall be implemented as soon as practicable and certified by the arborist.

10.10 Tree Removal

10.10.1 The removal of Trees [**T7, T9 & T10**] shall be carried out by an experienced tree surgeon in accordance with the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998). Care shall be taken to avoid damage to other trees during the felling operation.

10.10.2 Stumps located within the TPZs of trees to be retained shall be grubbed-out where required using a mechanical stump grinder (or by hand where less than 150mm in diameter) without damage to the root system of other trees. Where trees to be removed are within the SRZ of any trees to be retained, consideration should be given to cutting the stump close to ground level and retaining the root crown intact. Stumps within the Tree Protection Zone of other trees to be retained shall **not** be pulled out using excavation equipment or similar.

10.11 Ground Protection

10.11.1 A 100mm layer of woodchip mulch shall be installed within designated areas of the TPZs of trees [**T3, T4 & T5**] as indicated on the Tree Protection Plan (**Appendix 6**) to minimise moisture stress during construction.

10.11.2 Construction haul routes shall be confined to existing paved areas wherever possible. Where this is not feasible and construction haul routes or access for plant and equipment must traverse soft landscape areas within TPZs of [**any tree nominated for retention**], 20mm thick marine ply sheets or truck mats (such as Envirex Versadeck® access mats) (refer **Figure 6)** shall be placed over the top of the ground surface to minimise compaction and disturbance of the underlying soil profile and root zone.

Figure 6 – Showing typical detail for truck mats.

10.11.3 Ground protection shall be installed prior to any site works and maintained in good condition for the duration of the construction period. On completion of the works, ground protection shall be removed without damage or disturbance to the underlying soil profile.

11 REPLACEMENT PLANTING

11.1.1 In order to compensate for loss of amenity resulting from the removal of trees to accommodate the proposed development, a minimum number of two (2) new trees capable of attaining a height of at least ten (10) metres at maturity should be planted within the William Street road reserve.

11.1.2 The City of Sydney *Street Tree Master Plan* (STMP) 2011 (revised 2015) [refer Precinct 23 – Woolloomooloo] indicates that the prescribed tree species selection for William Street is *Platanus x acerifolia* (London Plane tree).

11.1.3 The Landscape Plan [DA 04] prepared by Sue Barnsley Design indicates two (2) new *Platanus x acerifolia* (London Plane tree) to be planted within new tree pits within the William Street road reserve at either end of the proposed new bus parking bay, which is compliant with Council's STMP. These new trees will compensate for loss of amenity resulting from the removal of Trees T9 & T10 within the short term (next ten years), provided that the trees are supplied and installed in accordance with Council's Technical Guidelines contained in Part D of the STMP.

Andrew Morton
EARTHSCAPE HORTICULTURAL SERVICES
26th September 2018

12 REFERENCES

[1] GA Chapman & CL Murphy (1989)
Soil Landscapes of the Sydney 1:100,000 Sheet
Soil Conservation Service of NSW. Sydney

[2] Benson, Doug & Howell, Jocelyn (1990)
Taken for Granted: the Bushland of Sydney and its Suburbs.
Kangaroo Press & The Royal Botanic Gardens, Sydney, NSW

[3] Mattheck, Dr. Claus & Breloer, Helge (1994) – Sixth Edition (2001)
The Body Language of Trees – A Handbook for Failure Analysis
The Stationery Office, London, England

[4] Barrell, Jeremy (1996)
Pre-development Tree Assessment
Proceedings of the International Conference on Trees and Building Sites (Chicago)
International Society of arboriculture, Illinois, USA

[5] Ruting, Noel (November 2005)
Register of Significant Trees – Part 3 of 4; Significant Trees on land under the care control and management of Other Government Authorities, Institutional, Religious and Non-Government Organisations (City of Sydney)
Landarc Pty Ltd & the Council of the City of Sydney, Sydney NSW

[6] Ruting, Noel (November 2005)
Register of Significant Trees – Part 2 of 4; Significant Street Trees (City of Sydney)
Landarc Pty Ltd & the Council of the City of Sydney, Sydney NSW

[7] Council of Standards Australia (August 2009)
AS 4970 – 2009 – Protection of Trees on Development Sites
Standards Australia, Sydney

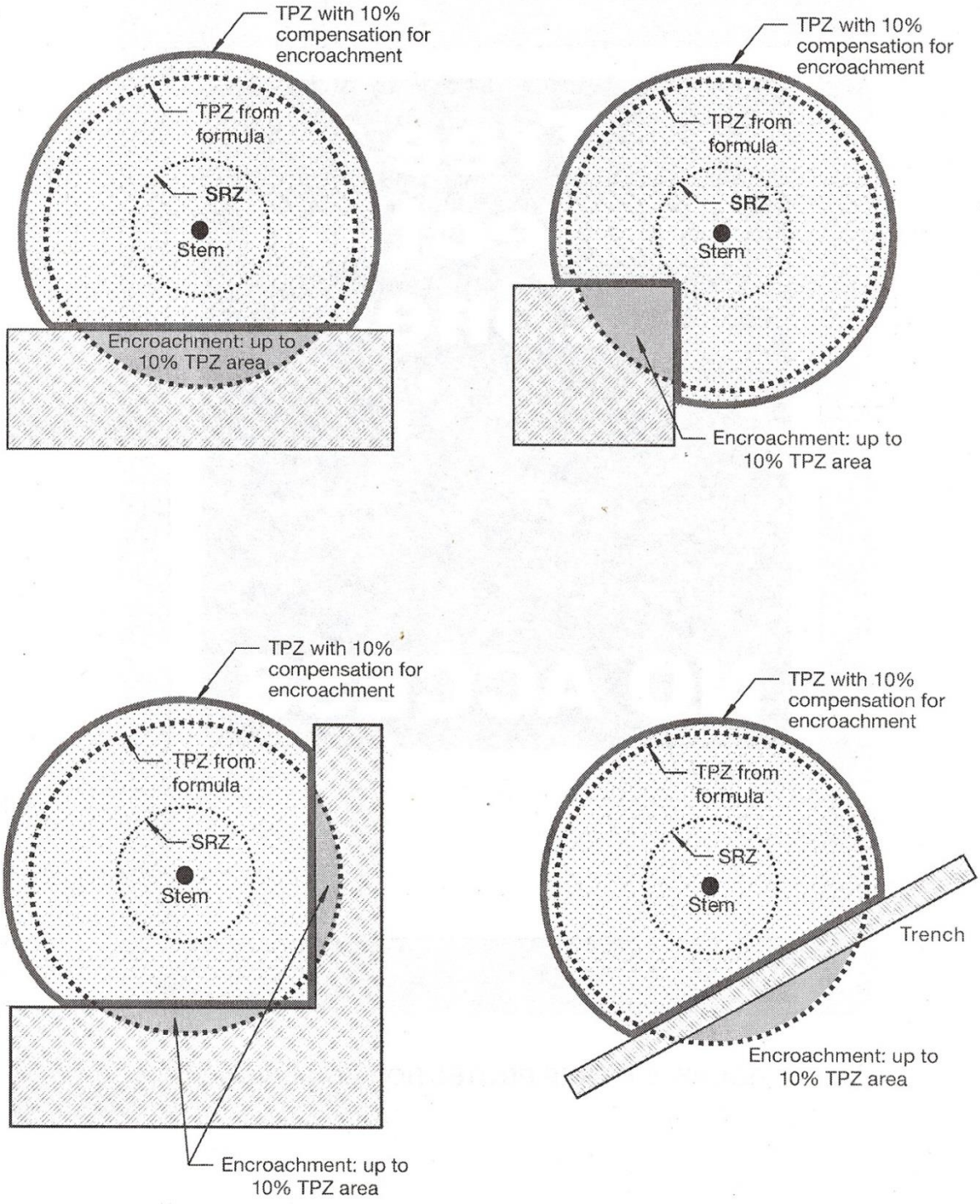
APPENDIX 1 - CRITERIA FOR ASSESSMENT OF LANDSCAPE SIGNIFICANCE

RATING	HERITAGE VALUE	ECOLOGICAL VALUE	AMENITY VALUE
1. SIGNIFICANT	The subject tree is listed as a Heritage Item under the Local Environment Plan (LEP) with a local, state or national level of significance or is listed on Council's Significant Tree Register	The subject tree is scheduled as a Threatened Species as defined under the Threatened Species Conservation Act 1995 (NSW) or the Environmental Protection and Biodiversity Conservation Act 1999	The subject tree has a very large live crown size exceeding 300m² with normal to dense foliage cover, is located in a visually prominent position in the landscape, exhibits very good form and habit typical of the species
	The subject tree forms part of the curtilage of a Heritage Item (building /structure /artefact as defined under the LEP) and has a known or documented association with that item	The tree is a locally indigenous species, representative of the original vegetation of the area and is known as an important food, shelter or nesting tree for endangered or threatened fauna species	The subject tree makes a significant contribution to the amenity and visual character of the area by creating a sense of place or creating a sense of identity
	The subject tree is a Commemorative Planting having been planted by an important historical person (s) or to commemorate an important historical event	The subject tree is a Remnant Tree, being a tree in existence prior to development of the area	The tree is visually prominent in view from surrounding areas, being a landmark or visible from a considerable distance.
2. VERY HIGH	The tree has a strong historical association with a heritage item (building/structure/artefact/garden etc) within or adjacent the property and/or exemplifies a particular era or style of landscape design associated with the original development of the site.	The tree is a locally-indigenous species, representative of the original vegetation of the area and is a dominant or associated canopy species of an Endangered Ecological Community (EEC) formerly occurring in the area occupied by the site.	The subject tree has a very large live crown size exceeding 200m²; a crown density exceeding 70% (normal-dense), is a very good representative of the species in terms of its form and branching habit or is aesthetically distinctive and makes a positive contribution to the visual character and the amenity of the area
3. HIGH	The tree has a suspected historical association with a heritage item or landscape supported by anecdotal or visual evidence	The tree is a locally-indigenous species and representative of the original vegetation of the area and the tree is located within a defined Vegetation Link / Wildlife Corridor or has known wildlife habitat value	The subject tree has a large live crown size exceeding 100m²; The tree is a good representative of the species in terms of its form and branching habit with minor deviations from normal (e.g. crown distortion/suppression) with a crown density of at least 70% (normal); The subject tree is visible from the street and surrounding properties and makes a positive contribution to the visual character and the amenity of the area
4. MODERATE	The tree has no known or suspected historical association, but does not detract or diminish the value of the item and is sympathetic to the original era of planting.	The subject tree is a non-local native or exotic species that is protected under the provisions of this DCP.	The subject tree has a medium live crown size exceeding 40m²;The tree is a fair representative of the species, exhibiting moderate deviations from typical form (distortion/suppression etc) with a crown density of more than 50% (thinning to normal); and
			The tree is visible from surrounding properties, but is not visually prominent – view may be partially obscured by other vegetation or built forms. The tree makes a fair contribution to the visual character and amenity of the area.
5. LOW	The subject tree detracts from heritage values or diminishes the value of a heritage item	The subject tree is scheduled as exempt (not protected) under the provisions of this DCP due to its species, nuisance or position relative to buildings or other structures.	The subject tree has a small live crown size of less than 40m² and can be replaced within the short term (5-10 years) with new tree planting
6. VERY LOW	The subject tree is causing significant damage to a heritage Item.	The subject tree is listed as an Environment Weed Species in the relevant Local Government Area, being invasive, or is a known nuisance species.	The subject tree is not visible from surrounding properties (visibility obscured) and makes a negligible contribution or has a negative impact on the amenity and visual character of the area. The tree is a poor representative of the species, showing significant deviations from the typical form and branching habit with a crown density of less than 50% (sparse).
7. INSIGNIFICANT	The tree is completely dead and has no visible habitat value	The tree is a declared Noxious Weed under the Noxious Weeds Act (NSW) 1993 within the relevant Local Government Area.	The tree is completely dead and represents a potential hazard.

Ref:- Morton, A (2006) **Determining the Retention Value of Trees on Development Sites**

TreeNet - Proceedings of the 7th National Street Tree Symposium 2006 Government of South Australia Department for Transport, Energy and Infrastructure

APPENDIX 2 – ACCEPTABLE INCURSIONS TO THE TREE PROTECTION ZONE (TPZ)



NOTE: Less than 10% TPZ area and outside SRZ. Any loss of TPZ compensated for elsewhere.

REF:- Council of Standards Australia (August 2009)
AS 4970 – 2009 – Protection of Trees on Development Sites
Standards Australia, Sydney

APPENDIX 3 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

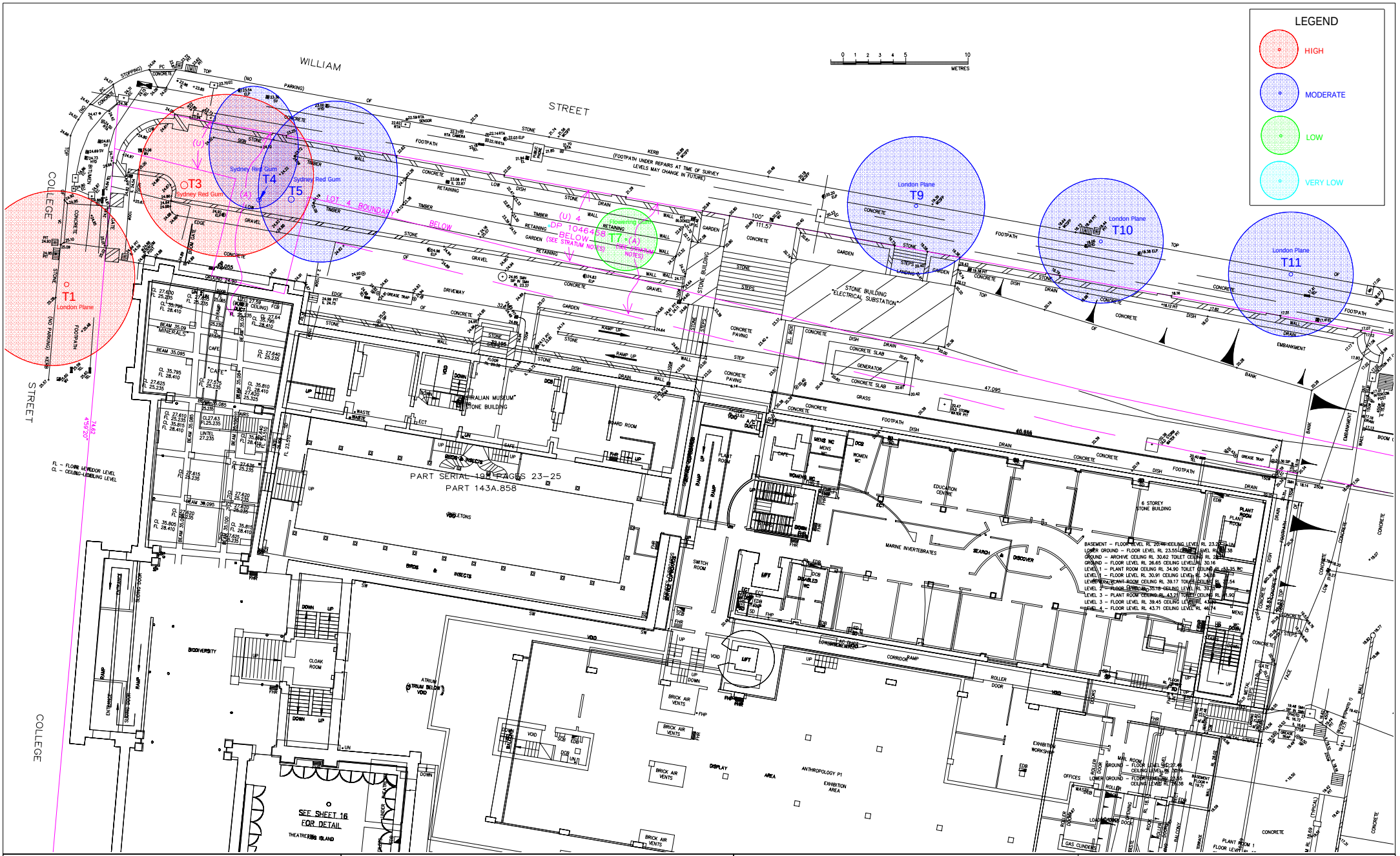
Tree Identification No.	Species	Height (m)	Spread (m)	Trunk Diameter (mm)	Live Crown Size (m^2)	Maturity Class	Condition	Previous Pruning	Health		Remaining Safe Useful Life Expectancy (SULE)	Landscape Significance Rating	Retention Value	Location
									Vigour	Pest & Disease				
1	***Platanus x hybrida*** (London Plane)	14	14	420	168	SM	Appears stable with sound branching structure. Exhibits a small occluded wound on lower trunk due to mechanical injury.	No Evidence	Very Good	Moderate foliar insect infestation (Sycamore Lace Bug)	Long - more than 40 years	3	**High**	Nature strip
3	***Angophora costata*** (Sydney Red Gum)	16	14	650	182	M	Appears stable with fair branching structure. Crown suppressed on the western side due to previous pruning. Moderate wound at 4 metres due previous pruning with some decay evident with suspected cavity.	Secondary leader (primary limb) lopped on west side. Deadwooded	Good	No Evidence	Medium 15-40 Years	3	**High**	On-site
4	***Angophora costata*** (Sydney Red Gum)	12	9	420	63	SM	Appears stable with sound branching structure. Crown suppressed on south side due to overshadowing. Prominent lean to the north. Upper crown & leader distorted.	Deadwooded	Good	No Evidence	Long - more than 40 years	4	**Moderate**	On-site
5	***Angophora costata*** (Sydney Red Gum)	11	13	500	91	M	Appears stable with sound branching structure. Exhibits a prominent lean to the north. Small occluded wound on lower trunk south side.	Selectively pruned to clear adj. building	Very Good	No Evidence	Long - more than 40 years	4	**Moderate**	On-site
7	***Corymbia ficifolia*** (Flowering Gum)	5.5	5	180	27.5	I	Appears stable with fair branching structure. Exhibits a prominent lean to the west (self-corrected). Located within narrow terrace area.	No Evidence	Very Good	No Evidence	Medium 15-40 Years	5	**Low**	On-site
9	***Platanus x hybrida*** (London Plane)	12	11	270	110	SM	Appears stable with sound branching structure. Located within small traffic island.	Crown lifted to 2.5 metres.	Good	Moderate foliar insect infestation (Sycamore Lace Bug)	Long - more than 40 years	4	**Moderate**	Nature strip
10	***Platanus x hybrida*** (London Plane)	13	10	250	110	SM	Appears stable with sound branching structure. Located within small traffic island.	Crown lifted to 2.5 metres.	Good	Moderate foliar insect infestation (Sycamore Lace Bug)	Long - more than 40 years	4	**Moderate**	Nature strip
11	***Platanus x hybrida*** (London Plane)	13	10	300	110	SM	Appears stable with sound branching structure. Located within small traffic island.	Crown lifted to 2.5 metres.	Good	Moderate foliar insect infestation (Sycamore Lace Bug)	Long - more than 40 years	4	**Moderate**	Nature strip

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m²)	Incursions To Root Zone &/or Canopy	Likely Impact	Recommendation
1	***Platanus x hybrida*** (London Plane)	M	7.0	2.3	153.9	No proposed works within TPZ. Existing pavements within TPZ to be maintained intact.	No adverse impact.	To be retained - no special tree protection measures required.
3	***Angophora costata*** (Sydney Red Gum)	P	7.8	2.8	191.0	No proposed works within TPZ. Existing pavements within TPZ to be maintained intact.	No adverse impact.	To be retained - no special tree protection measures required.
4	***Angophora costata*** (Sydney Red Gum)	P	6.3	2.3	124.6	Existing low timber retaining walls offset 4.5 metres east and north-east to be demolished within TPZ. Minor re-grading of existing terraces to form even grade between upper and lower stone walls within TPZ. Area potentially disturbed = 10% of TPZ.	No adverse impact, provided that all works within TPZ are undertaken as recommended.	Retain in accordance with recommended Tree Protection Measures (Section 10). Demolish existing low timber retaining walls within TPZ in accordance with Section 10.5. Undertake any required excavations (for re-grading) within TPZ in accordance with Section 10.6. Supply and install any required fill material (for re-grading) in accordance with Section 10.8.
5	***Angophora costata*** (Sydney Red Gum)	P	7.5	2.5	176.6	Existing low timber retaining walls offset 2 metres east and 4.3 metres north to be demolished within TPZ. Re-grading of existing terraces to form even grade between upper and lower stone walls within TPZ. Area potentially disturbed = 20% of TPZ.	No adverse impact, provided that all works within TPZ are undertaken as recommended.	Retain in accordance with recommended Tree Protection Measures (Section 10). Demolish existing low timber retaining walls within TPZ in accordance with Section 10.5. Undertake any required excavations (for re-grading) within TPZ in accordance with Section 10.6. Supply and install any required fill material (for re-grading) in accordance with Section 10.8.
7	***Corymbia ficifolia*** (Flowering Gum)	P	2.5	1.6	19.6	Existing low timber retaining walls offset 0.6 metres north and south to be demolished within TPZ. Re-grading of existing terraces to form even grade between upper and lower stone walls within TPZ.	Proposed works will necessitate removal.	Remove tree.
9	***Platanus x hybrida*** (London Plane)	M	6.0	1.9	113.0	Located within footprint of proposed new bus parking bay.	Proposed works will necessitate removal.	Undertake replacement planting with a new tree elsewhere within the road reserve to complensate for loss of amenity in accordance with Section 11.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Incursions To Root Zone &/or Canopy	Likely Impact	Recommendation
10	***Platanus x hybrida*** (London Plane)	M	5.0	1.8	78.5	Located within footprint of proposed new bus parking bay.	Proposed works will necessitate removal.	Undertake replacement planting with a new tree elsewhere within the road reserve to complensate for loss of amenity in accordance with Section 11.
11	***Platanus x hybrida*** (London Plane)	M	5.0	2.0	78.5	Existing stone kerb and road pavement offset 0.8 metres east to be demolished within TPZ & SRZ and replaced with soft landscape 'island'. Existing granite paved footpath within TPZ to be maintained intact.	No adverse impact, provided that all works within TPZ are undertaken as recommended.	Retain in accordance with recommended Tree Protection Measures (Section 10). Demolish existing stone kerb and pavement within TPZ in accordance with Section 10.5. Supply and install any required fill material (for new soft landscape area) in accordance with Section 10.8. Undertake excavations for new kerb footings within TPZ in accordance with Section 10.6.



APPENDIX 5
TREE LOCATION PLAN SHOWING
TREE RETENTION VALUES

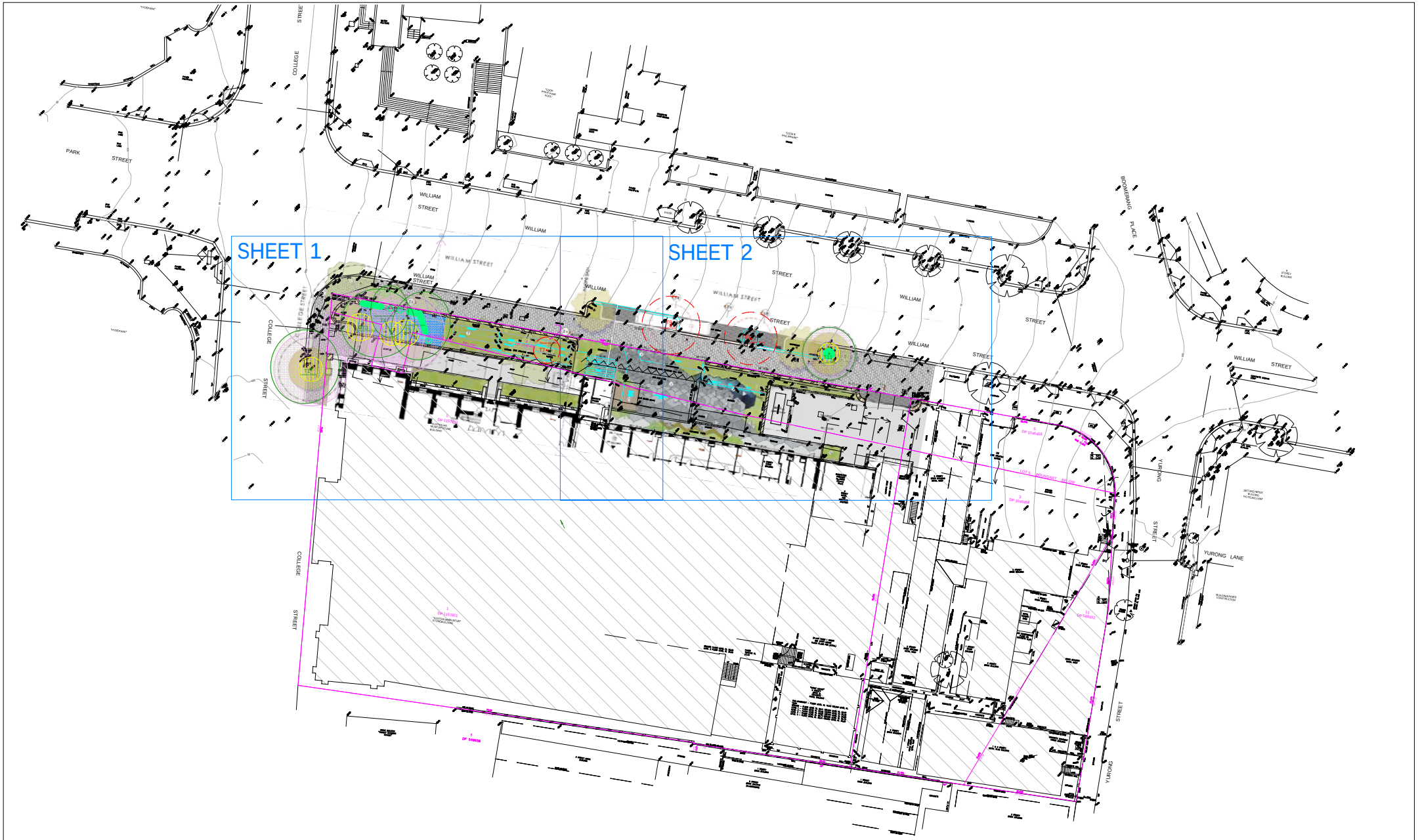
Australian Museum
6 College Street, SYDNEY, NSW

Earthscape Horticultural Services
Arboricultural and Horticultural Consultants
PO Box 364
BEROWRA NSW 2081
Ph: 02 9456 4787
Fax: 02 9456 5757 e: earthscape@iinet.net.au

Based on the Survey Drawing
prepared by Lockley Land Title Solutions
Dwg Ref No. 28600
Dated 13/02/2008 (Rev C)

DWG No. T18-092401

DATE:24/09/2018



APPENDIX 6

TREE PROTECTION PLAN

AUSTRALIAN MUSEUM
6 College Street, SYDNEY, NSW

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Arboricultural and Horticultural Consultants
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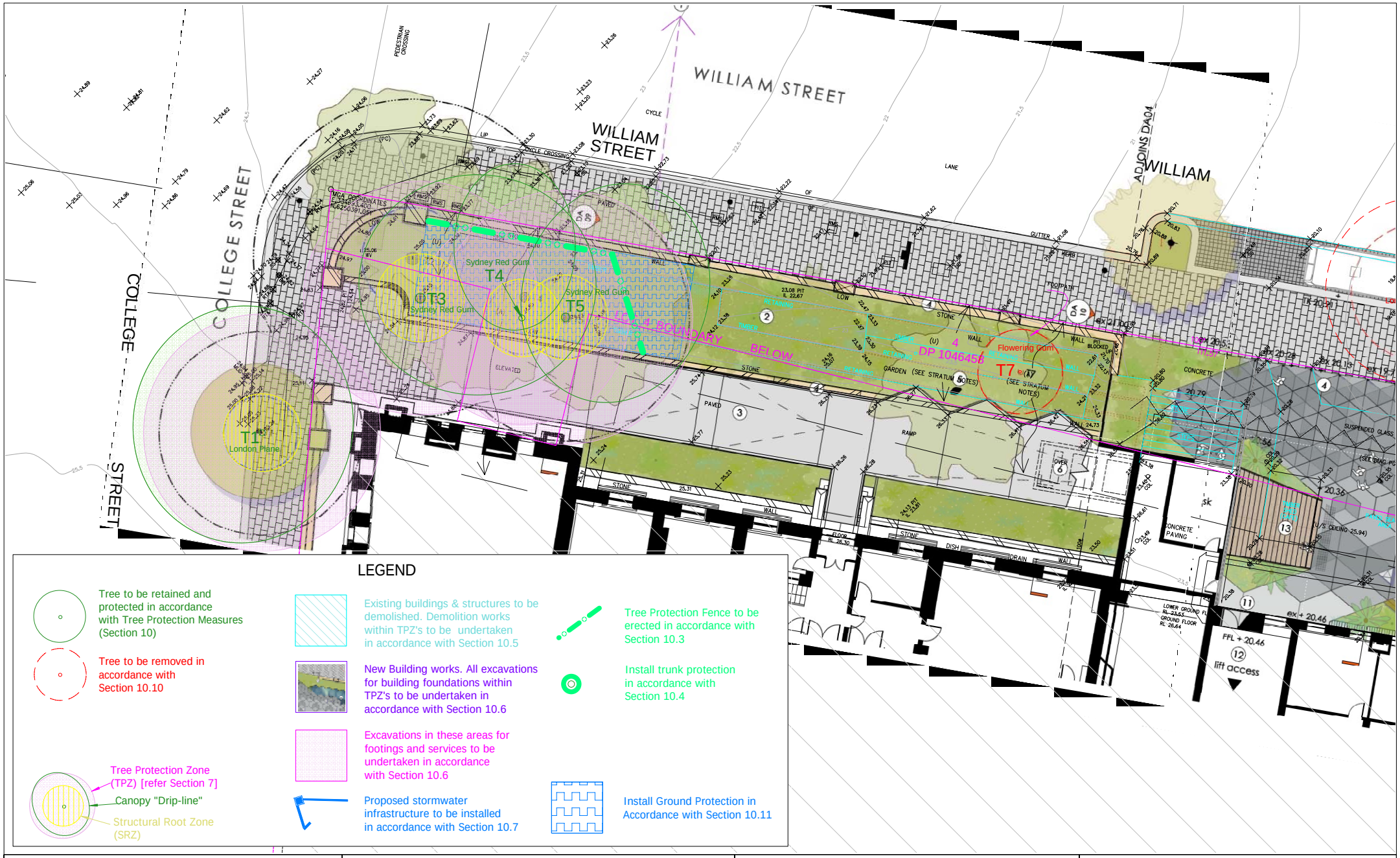
Fax: 02 9456 5757 e: earthscape@iinet.net.au

Based on the Survey Drawing
prepared by Lockley Land Title Solutions
Dwg Ref No. 41057DT [G]
Dated 16/07/2018

DWG No. T18-092602

KEY PLAN

DATE: 26/09/2018



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TREE PROTECTION PLAN

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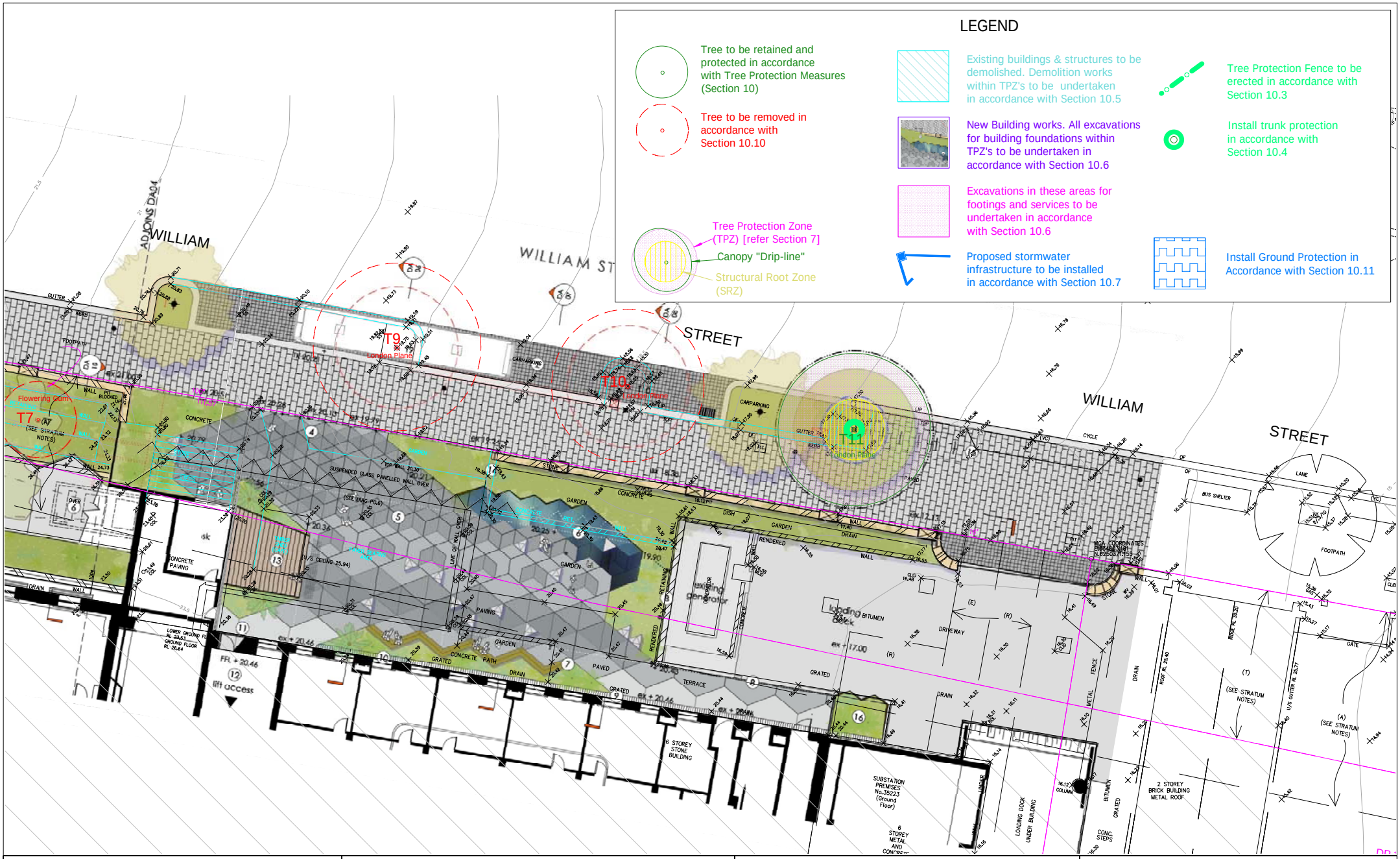
Dated 16/07/2018

DWG No. T18-092602

SHEET 1

DATE: 26/09/2018



APPENDIX 6

TREE PROTECTION PLAN

AUSTRALIAN MUSEUM
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Based on the Survey Drawing
prepared by Lockley Land Title Solutions
Dwg Ref No. 41057DT [G]
Dated 16/07/2018

DWG No. T18-092602

SHEET 2

DATE: 26/09/2018