

ATTACHMENT C

**TREE WISE MEN – REPORT ON
REVIEW OF PAST AND FUTURE
MANAGEMENT OPTIONS**

TREE WISE MEN[®]
AUSTRALIA PTY LTD

**Review of Past and Future Management Options
Central Avenue Hill's Figs
At
Hyde Park North and South
Sydney**

Prepared for:

**City of Sydney Council
Town Hall House
456 Kent Street
SYDNEY NSW 2000**

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ARBORICULTURAL CONSULTANCY

ACN 002 982 247 ABN 15 002 982 247
84 Fuller Street, Collaroy Plateau NSW 2097
Phone +61 2 9981 5219 Fax +61 2 9971 0881
treewise@treewisemen.com.au
www.treewisemen.com.au



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Peter Castor
Director

BSc (For.)
Member: IACA, AA, PIA, LGTRA, UDIA, MAE (UK)
23 April 2013



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1. EXECUTIVE SUMMARY

- 1.1.1 This report presents the findings of a review of tree management practices and documentation relating to the Hill's Fig, *Ficus microcarpa* var. *Hillii* (the Figs) in the Central Avenue of Hyde Park North and South.
- 1.1.2 In particular, a critical review has been undertaken of the appropriateness of the proposed block removal and replacement of the Figs, in the Hyde Park Plan of Management and Masterplan 2006 (the *PoM and Masterplan*). In this review of the proposed block removal, the individual arboricultural features and hazards of the Central Avenue Hill's Fig planting have been assessed.
- 1.1.3 The Fig planting was established in c1930 in less than ideal soil conditions and now displays signs of decline. Of the original 145 trees planted in Central Avenue as indicated in the 1943 aerial photo, 97 remain in 2013 this includes three replacement trees (Trees 86S, 89S and 90S). There has been no replanting of Central Avenue since c1994. The spatial arrangement of the previously removed trees has been depicted in the Tree Location Plans North and South at Attachment E.
- 1.1.4 There are now significant gaps in the planting caused by a combination of tree failures and tree removals resulting from defects and disease. Tree hazard management is on-going and includes regular, extensive hazard-reduction crown pruning works such as that recently completed in October, 2012. The last two trees to fail as a consequence of significant inclusions were Trees 101N and 102N.
- 1.1.5 Above ground defects such as deadwood, sunscald, branch failure have increased and will continue to do so as the trees enter the Over-mature age class. By way of example, the following statistics point to a future maintenance and management problem of significance proportion:
- In 2007 18% of assessed trees exhibited signs of branch failure. In 2012, despite the post 2007 assessment pruning works, 22% of assessed trees exhibited signs of branch failure.
 - In the 2007 assessment, 16% of assessed trees had branch/trunk defects. Despite the post 2007 pruning works, 52% of assessed trees had branch/trunk defects in 2012.
 - In 2007 94% of assessed trees had deadwood. In 2012, even though pruning works had been undertaken, 58% of assessed trees had deadwood.
 - In 2007 6% of assessed trees had significant inclusions. In 2012 14% of assessed trees exhibited significant inclusions.
 - Finally, as tree removals occur and adjacent trees become more exposed to the prevailing forces we note an increase in the incidence of sunscald. In the 2007 assessment 13% of assessed trees exhibited signs of sunscald. In 2012 the percentage of assessed trees with sunscald rose significantly to 27%.
- 1.1.6 Below ground defects in 2011 (UTM 2011) remain despite the removal of twenty three (23) trees with critical trunk decay in 2005. In 2011, 23% of assessed trees still contained decay.



- 1.1.7 We are of the opinion that the block removal and replacement of Hill's Figs in Central Avenue Hyde Park, is the only feasible option available to maintain an Avenue planting with the existing cathedral-like crown characteristics. The alternate options of individual in-fill (natural attrition) planting or mini-block removals and replanting will not be sufficient to re-establish the existing (but now depleted) Avenue characteristics (refer to Section 9).
- 1.1.8 Although natural attrition (in-fill) type removal and replacement may be possible (but not ideal) for other wider spaced, single rowed avenue plantings, the Central Avenue in Hyde Park is not suited to this type of management option. The tight spacings between trees, the four (rather than two) rows, the relatively narrow width of the Central Avenue footway and the fact that the trees are failing as whole trees (in addition to declining) creates a very challenging management scenario. For a true "avenue" to be created the individual trees need to be of the same size, age and form. This cannot be achieved with natural attrition type removal and replacement management.
- 1.1.9 The above and below ground defects still exist and will increase in the near future given the maturing age class of the planting. The re-emergence of above ground defects deadwood, branch failure and branch damage type crown defects to levels equivalent to the 2012 pre-pruning levels is likely within 2-3 growing seasons. Given that most significant bark inclusions are located at 1st and 2nd Order branch junctions, 20% reduction pruning will be required in 2-3 seasons to maintain the trees to an acceptable level of failure potential.
- 1.1.10 Sunscald damage is however the most difficult and expensive defect to monitor as most of the damage can only be observed from aloft in an EWP. As other individual trees are removed due to identified critical defects, adjacent trees are likely to suffer from new sunscald damage.
- 1.1.11 In the near future, the below ground defects associated with *Phellinus spp.* are likely to increase to critical levels in those nineteen (19) trees identified in 2005 with "some decay". When this will occur will be dependent upon the existing extent decay and ability of the tree to "defend" itself against the decay. Trees not currently exhibiting signs of decay are likely to become infected with *Phellinus sp.*, *Amillaria luteobubalina* or *Phytophthora* as they age and decline in vigour. The timeframe for this infection will be variable.

The demands upon CoS to manage these problems in a timely and cost effective manner, is in our opinion, now neither possible nor best Arboricultural practice. As demonstrated by Hitchmough J 1994 the benefits of the Central Avenue Hill's Fig planting are now outweighed by the cost to maintain it.



2. RECOMMENDATIONS

2.1 SUPPORT FOR BLOCK REMOVALS

- 2.1.1 We recommend the implementation of block replacement of the Central Avenue Hill's Figs, commencing without further delay. Even though the subject trees have a Short (5-15 years) SULE there are other important tree management considerations which support a proactive recommendation for removal. The high level of use of Central Avenue, the "avenue" rather than "individual" planting, the steady decline in tree vigour and condition due to Mature to Over-mature age and the underlying soil pathogen problem all contribute to an avenue planting which is not sustainable in its current form.
- 2.1.2 There are no feasible mitigating procedures or strategies which will stop or control the decline in the vigour and condition of the planting.
- 2.1.3 There are no feasible mitigating procedures which will significantly reduce the public risk associated with the existing and emerging defects in the planting. Central Avenue is utilised for a large number of specific, public events as well as daily by workers and visitors to the Park. Where there is foreseeable risk of tree failure and concomitant injury and damage, Arboricultural risk management plans generally adopt the "removal of targets" strategy. The "removal of targets" on Central Hyde Park is not possible, as this would mean removal of existing seating with the fall zone of trees, restricting pedestrian access within the fall zones of trees and limiting or abandoning the use of Central Avenue for major events. None of these proposals are realistic solutions to the potential risk posed by the Central Avenue Figs.
- 2.1.4 The current proposed four stage block removal detailed at page 34 of the Tree Management Plan 2006 is not however supported given the necessary soil remediation, infrastructure works and the practical problems associated with the removal and installation of large trees in confined spacings. The interface between Stages will create edge effects similar to those associated with "natural attrition" type strategy.
- 2.1.5 From an Arboricultural perspective we propose a three Stage block removal process. Stage 1 is the removal of all trees in Hyde Park South, Stage 2 will be the removal of the trees in Hyde Park North from the Archibald Fountain north to Macquarie Street and in Stage 3 those south of the Archibald Fountain in Hyde Park North. The reason for this shift from the four Stage proposal is that the implementation of the soil remediation and disease control works, the installation of subsoil drains and other below ground services will be significantly complicated at the interface between the Stages in Hyde Park North. Further, the removal of mature trees at the interface with newly established plantings and infrastructure works will be problematic. The installation of new services and soil remediation works will cause damage to roots of trees retained in later stages. Trees retained at the interface will be prone to storm wind damage due to "edge effects".



- 2.1.6 The proposed three stage block removal detailed above is the preferred option that will allow for an even-aged avenue planting with the capacity to recreate the cathedral-type crown form over the central axis path. Block removal is the only option that enables the improvement in the existing soil quality, subsoil drainage and soil borne disease control to be undertaken.

2.2 TREE MANAGEMENT IN THE INTERIM

- 2.2.1 The existing proactive tree hazard monitoring and crown pruning should continue up until the time of the block removal works. Particular attention will need to be given to managing trees which have been predisposed to storm winds from the south exacerbated by recent tree removals. The trees with sunscald damage similarly require annual aerial inspections.
- 2.2.2 Trees which are identified through independent internal diagnostic testing as being unacceptably prone to failure should be removed as soon as possible following diagnosis.
- 2.2.3 Current disease management being undertaken by CoS with assistance from RBG should be maintained. Specific training of field staff in the identification of *Phellinus* spp. fruiting bodies is required.
- 2.2.4 People movements beneath the crown of the Central Avenue trees should be limited wherever feasible so as to reduce the risk of injury. Where possible the fixed benches beneath the crown of the trees at the edge of the pavement should be removed. Where possible, public events proposed beneath the crown of the trees should be relocated away from the trees. The gathering of large crowds beneath the trees should be discouraged.



3. BACKGROUND

3.1 INTRODUCTION

- 3.1.1 The Central Avenue planting of Hill's Figs, *Ficus microcarpa* var. *Hillii* is the key landscape element in Hyde Park, a Park with outstanding heritage significance Tree Management Plan (TMP). The TMP states (pg 11):

"The Central Avenue planting of Hill's Figs, so characteristic of Hyde Park, is the most significant and fragile asset in the Park."

The Figs which were planted in c1930 have formed a remarkable avenue, with an attractive, cathedral-like crown structure over the central footpath, predominantly in Hyde Park North.

- 3.1.2 In recent years several trees with apparently "healthy" crowns have failed (collapsed) at near ground level and have been removed. Other trees have split at major branch junctions and similarly required whole tree removal. Various fungal pathogens have been identified as contributing to many of these failures.
- 3.1.3 The PoM and Masterplan 2006 and Tree Management Plan 2006 recommended progressive block removal and replacement of the trees to enable the Avenue to be re-established. This report critically assesses the block removal proposal based on a review of the history of removals in the Central Avenue, the existing hazard features and the particular characteristics of the planting.
- 3.1.4 Some of the earlier, cited Arboricultural reports assessed Hill's Figs beyond Central Avenue while other reports assessed only a subset of the total Central Avenue planting. Care is required when comparing tree numbers between different reports. For the purpose of this report the row of Hill's Figs adjacent to the Archibald Fountain have been included as Central Avenue trees in line with Precincts 1A and 1B, The Central Avenue of the Plan of Management and Masterplan 2006.

3.2 THE BRIEF

- 3.2.1 This arboricultural review addresses the scope of works detailed in the City of Sydney letter (*the Brief*) dated 15 March, 2013. The review is to comply with *Section 4.5 of the City of Sydney's Consultant Arboricultural Services Contract No. 1038*. In part the Brief sought an assessment of:

- (a) defects, health and structure;
- (b) resulting impacts in risk to the public;
- (c) resulting impacts in longevity of the planting and individual trees and
- (d) any mitigating strategies that may alleviate defects and prevent further tree removal.

3.3 TREE WISE MEN® AUSTRALIA PTY LTD INVOLVEMENT SINCE 2003

- 3.3.1 Tree Wise Men® Australia Pty Ltd (TWM) has reported for City of Sydney (CoS) on the hazard condition of Hill's Figs in Hyde Park since 2003. Several reports have been prepared on specific Central Avenue trees, the latest being in 2012. Both above ground and below ground parts of the trees have been assessed.



- 3.3.2 TWMs are in a unique position to comment on the hazard potential and future management of the Central Avenue planting given this long-term involvement and the qualifications and experience of the author of this review Peter Castor.

3.4 HYDE PARK PLAN OF MANAGEMENT AND MASTER PLAN 2006

- 3.4.1 The Hyde Park Plan of Management and Masterplan 2006 (the PoM and Masterplan) is a comprehensive two volume document prepared by Clouston Associates for the City of Sydney addressing the future management of Hyde Park.
- 3.4.2 The Tree Management Plan 2006 prepared by CoS is listed at 1.1 of the *Volume 2 Support Documents*.
- 3.4.3 Precinct 1 (11.2.1) within the Park is The Central Avenue. Figure 11.10: Precincts 1A and 1B – Strategy Map contains the notation:

“Replace the Central Avenue and Archibald Fountain trees in accordance with the recommendations of the Tree Management Plan 2006.”

The same Map outlines infrastructure upgrade works which would be coordinated with the tree removal and replacement strategy.

- 3.4.4 Phase 1 of the Scoping for the implementation of the Masterplan works has been completed by a Consultant team lead by Clouston Associates. TWMs were part of that Consultant team, providing Arboricultural expertise.

3.5 TREE MANAGEMENT PLAN 2006

- 3.5.1 The Tree Management Plan 2006 (TMP) prepared by CoS is a comprehensive document guiding the PoM and Masterplan 2006. The proposed tree removal and replacement is detailed at 7.2 *Central Avenue Removal/Replacement Strategy*. At paragraph entitled “Block Removal” it states:

“The technically effective way to achieve satisfactory avenue replacement in the long term is to remove and replant entire sections or groups of trees. This is the only technique that can successfully achieve the uniform appearance typical of avenue planting. While dramatic, this is the only known and accepted approach to create growing conditions that allow for the uniform and consistent habit characteristic of avenue.” (Tree Masterplan for Centennial Parklands, 2002)

- 3.5.2 The four stages of the block removal and replacement strategy proposed in 2006 are illustrated on page 34. The intent of the four stage strategy over a period of 15 years is to minimise the overall visual impacts of the tree removal, whilst replanting the areas most in need of new trees.

3.6 THE TREES IN CENTRAL AVENUE

- 3.6.1 The original Central Avenue planting in c1930 contained approximately 145 trees (see 1943 aerial photo Attachment B). Table 1 below lists the 97 trees still standing and 48 trees previously removed. There have been a small number of replacement plantings since the initial 1930 layout. There are two CoS tree numbering systems referenced. There was a change in the tree numbering system c2004. Trees assessed which had the earlier numbering system have been identified with an asterisk (*). Where no survey or tree numbering information is available for missing trees, these trees have been identified with a question mark (T?).



- 3.6.2 All assessed Central Avenue trees were Hill's Figs, *Ficus microcarpa* var. *Hillii*. Being planted in c1930, the trees are approximately eighty three (83) years old and certainly in a Mature to Over-mature age class. Trees 86S, 89S, 90S have been recorded as "semi-mature" as they appear to be relatively recent replacement plantings.

Table 1: Existing and Previously Removed Trees

(* - pre-2004 tree number) (? – tree number unknown)

Hyde Park North (N)		Hyde Park South (S)	
Existing	Previously Removed	Existing	Previously Removed
11N, 12N, 13N, 50N, 51N, 52N, 53N, 54N, 55N, 56N, 58N, 60N, 61N, 78N, 79N, 80N, 81N, 82N, 83N, 84N, 85N, 86N, 89N, 103N, 144N, 169N, 171N, 172N, 173N, 174N, 175N, 176N, 177N, 184N, 185N, 186N, 188N, 189N, 190N, 191N, 192N, 193N, 194N, 195N, 218N, 219N, 220N, 227N, 228N, 235N, 236N, 237N, 238N, 239N, 241N, 242N, 243N, 244N, 245N, 246N, 248N, 251N, 255N, 256N, 257N, 259N, 260N, 262N, 263N, 264N, 265N, 266N, 267N, 268N, 269N	43N*, 57N, 59N, 77N, 87N, 88N, 95N, 94AN*, 101N, 102N, 107N*, 119N, 123N*, 124N*, 142N, 143N, 153N, 154N, 155N, 159N, 160N, 162N, 167N, 168N, 170N, 226N, 229N, 240N, 249N, 250N, 254N, 261N, 50NT?, 89NT?	14S, 62S, 63S, 65S, 69S, 71S, 73S, 74S, 75S, 76S, 77S, 79S, 80S, 81S, 83S, 84S, 86S, 89S, 90S, 92S, 93S, 94S.	13S, 61S, 64S, 66S, 67S, 68S, 70S, 72S, 78S, 82S, 85S, 87S, 88S, 91S
Total 75	Total 34	Total 22	Total 14

- 3.6.3 Refer to the Tree Schedules at Attachment B for detail on all assessed trees.

- 3.6.4 Refer to the Tree Plans (Attachment E) for tree locations (existing and previously removed).



4. METHODOLOGY

4.1 DOCUMENTS REVIEWED

- 4.1.1 The following documents were provided by CoS in the Brief:
- CoS Tree Location Plan, April 2012 indicating existing Central Avenue trees.
 - CoS Summary spreadsheet of previously assessed trees.
 - CoS Tree Assessment Schedule 2012.
 - Heritage Inventory Report for Hyde Park prepared by NSW Department of Environment and Heritage.
 - Soil Test Report August 2012 prepared by the Royal Botanic Gardens Sydney.
 - Arboricultural Hazard Assessment 24 October, 2011 prepared by Urban Tree Management (UTM)
- 4.1.2 Other documents referenced including TWM reports are listed in References (Attachment D).

4.2 ATTACHMENTS TO THIS REPORT

- 4.2.1 The Attachments in this Review include the following material:
- Attachment A: Photographs of key tree defects taken by the author.
 - Attachment B: Tree Schedules for Hyde Park North and South showing tree attributes, tree removal dates, reasons for removal, above ground defects (2007 and 2012), below ground defects (TWM 2005 and UTM 2011).
 - Attachment C: The aerial photo from 1943 showing trees at 13 years old on Central Avenue.
 - Attachment D: References.
- 4.2.2 Attachment E includes the Tree Plans prepared specifically for this report. These include:
- Historical Tree Location Plans Hyde Park North and South Showing trees retained and removed since c1930. (2 Sheet)
 - Extent of Decay Below Ground Hyde Park North and South TWM 2005. (2 Sheets)
 - Extent of Decay Below Ground Hyde Park North and South UTM 2011. (2 Sheets)
 - Extent of Branch Failure TWM 2007 (North only). (1 Sheet)
 - Extent of Branch Failure TWM 2012 (North only). (1 Sheet)
 - Extent of Branch/Trunk Damage TWM 2007 (North only). (1 Sheet)
 - Extent of Branch/Trunk Damage TWM 2012 (North only). (1 Sheet)
 - Extent of Sunscald TWM 2007 (North only). (1 Sheet)
 - Extent of Sunscald TWM 2012 (North only). (1 Sheet)
 - Extent of Deadwood TWM 2007 (North only). (1 Sheet)
 - Extent of Deadwood TWM 2012 (North only). (1 Sheet)
 - Extent of Inclusions TWM 2007 (North only). (1 Sheet)
 - Extent of Inclusions TWM 2012 (North only). (1 Sheet)



4.3 SUMMARY OF TWM IN-FIELD INVOLVEMENT

- 4.3.1 The report titled: *Significant Tree Assessment for Hyde Park (North and South)*, September, 2003 was a whole-of-park assessment and included many of the Central Avenue Hill's Figs. This report assessed a range of above and below ground defects and was the first report to confirm *Phellinus spp.* (following positive identification by the Royal Botanic Gardens) as the likely cause of whole-tree failures in the Park. Two trees had been reported as failing prior to the preparation of that 2003 report.
- 4.3.2 The report titled: *Arborist's Hazard Appraisal (Air Knife) for Hill's Figs at Hyde Park North and South*, September, 2005 assessed all the Central Avenue Figs. This report established a simple Category of Decay system to prioritise tree management. Twenty two (22) Central Avenue Figs were recommended for immediate removal having centralised decay in the base of the trunk which failed the 30% *t/R* strength loss formula of Mattheck (1999). One other tree (T57N) was recommended for immediate removal due to significant root damage caused by *Armillaria luteobubalina*. Twenty three (23) trees in total were removed from Central Avenue in 2005. A further thirty (30) trees were categorised as having some decay and recommended for further monitoring and testing.
- 4.3.3 Subsequent (in 2006 and 2009) internal decay testing, predominantly of these thirty (30) trees with non-critical pockets of decay was undertaken by TWM.
- 4.3.4 The above ground tree defects which were identified in the 2003 report were further assessed in 2007. Report titled: *Aerial Inspection Assessment of Figs at Hyde Park (North)*, May, 2007, assessed all the Central Avenue trees following the removal of trees in September, 2005. The assessment was undertaken from an elevated work platform (EWP) and categorised the crown defects in the following groups:
- Significant Inclusions
 - Deadwood
 - Branch Failure
 - Branch/Trunk Damage
 - Sunscald.

Crown pruning was subsequently undertaken by CoS contractors based on the defects contained in the Tree Schedule.

- 4.3.5 The report titled: *Visual Tree Assessment (VTA) and Aerial Inspection for Specified Hill's Figs at Hyde Park North and South*, July, 2012 included all the Central Avenue Figs. The VTA included a rootcrown inspection for fungal fruiting bodies. The aerial inspection was undertaken from an EWP and defects categorised in the five groups adopted in 2007. Subsequent follow-up crown pruning was undertaken by Citywide contractors with certification by TWM at completion of pruning works.
- 4.3.6 The tree *condition* recordings contained in the *Visual Tree Assessment (VTA) and Aerial Inspection for Specified Hill's Figs at Hyde Park North and South*, July, 2012 were undertaken during the VTA component of the data collection. The condition recordings have been updated to acknowledge additional Aerial Inspection findings and findings from the UTM 2011 below ground report.



4.3.7 The SULE recordings of Short (5-15 years) for all except the three Semi-mature trees in Hyde Park South reflect the following:

- the Mature to Over- mature age class of the planting
- the poor soil conditions
- the disease related decay in lower trunks
- the above ground defects recorded
- proximity of trees to mapped (TMP 2006) disease hot spots

4.4 ARBORICULTURAL ASSESSMENT BY OTHERS

4.4.1 We understand that there have been numerous arboricultural reports prepared by other Consultants on the trees within Central Avenue Figs. These reports include:

- *Arboricultural Report – Health and Hazard Assessment*, 7 October, 2004 prepared by Ian English. Report on eight (8) Central Avenue Figs. All eight (8) were recommended for removal.
- *Arboricultural Hazard Assessment, Urban Tree Management* 24 October, 2011. Assessment was made of one hundred and six (106) Hill's Figs including all Central Avenue Figs. All trees were recommended for retention but twenty six (26) trees were recommended for retention in Short or Medium term due to detected levels of trunk decay.
- *Picus Sonic Tomograph Testing of Twelve Trees*, April, 2005 by Enspeg Pty Ltd (in TMP 2006 page 23).

4.5 BELOW GROUND ASSESSMENT METHODOLOGIES

4.5.1 TWM has undertaken both above and below ground assessments of the subject trees. The Visual Tree Assessment (VTA) and Aerial Assessment, 2012 included a project specific typical VTA, update of basic tree data and a tree by tree aerial assessment to 25 metres above ground level to record crown defects. This assessment method duplicated that used in the *Aerial Inspection Assessment of Figs at Hyde Park North*, 2007. The crown defects recorded were grouped into the following categories: *Significant Inclusions, Deadwood, Limb Failure, Trunk/Limb Damage and Sunscald*. Refer to Section 6 below for further discussion of these defect types.

4.5.2 TWM undertook various below ground (or ground level) internal diagnostic drill testing of the Central Avenue Figs. Following the collapse of several trees due to internal trunk decay caused by the white rot fungus *Phellinus sp.*, an assessment method was developed to test for internal decay at near ground level. The TWM method used an adapted 6mm x 280mm wood auger drill bit to test at specific locations for internal decay. The resistance to the drilling, the colour, smell and appearance of the wood shavings were noted and decay areas mapped. The method was deemed to be accurate following the tree removal undertaken in September, 2005 where cut stumps revealed comparable decay area to those mapped. The TWM testing method was reviewed and approved by The Tree School in the report titled: *Review of Tree Hazard Appraisal Reports, Hyde Park - North and South*, 13 September, 2005. Photo O illustrates decay in the base of one of these assessed which was removed in 2005.



4.5.3 Four categories of decay and management recommendations were used to prioritise tree removal or ongoing monitoring. These categories were:

- (a) *No decay - Retain long term (> 40 years)*
- (b) *Some decay – Retain short-medium term (5-40 years)*
- (c) *Decay that fails Mattheck – Remove immediately (< 1 year)*
- (d) *Decay that has broken out into buttresses – Remove immediately (< 1 year)*

The UTM 2011 report used the same categories of decay (a, b, c and d) but used a different management recommendation as listed below.

- (a) *No decay - Retain long term (> 15 years)*
- (b) *Some decay – Retain medium term (5 - 15 years)*
Retain short term (6 months - 5 years)
- (c) *Decay that fails Mattheck – Remove immediately (0 - 6 months)*
- (d) *Decay that has broken out into buttresses – Remove immediately (0 - 6 months)*

The Tree Schedules (Attachment B) and Plan titled *Extent of Decay Below Ground Hyde Park North and South UTM 2011* recorded and mapped the category of decay (a, b, c and d) only.

4.5.4 The reason this “first principles” TWMM method was adopted, was that the heavily buttressed rootcrown of the Hill’s Figs meant that the use of the Picus Sonic Tomography or similar sound wave technology had limited application.

4.5.5 Urban Tree Management (UTM) undertook an internal diagnostic testing on the Central Avenue Figs in report titled: *Arboricultural Hazard Assessment*, 24 October, 2011. UTM used a Resistograph F500 to record internal trunk decay at near ground level. Where possible the UTM testing was undertaken at similar locations as those undertaken by TWMM in 2005 (or for some trees in 2006 or 2009). UTM adopted the same categories of decay and management recommendations were adopted as developed by TWMM. Although there were some anomalies between the two reports for particular trees there was a high degree of correlation between the findings.

4.5.6 In the main the two assessments included the same trees. Some trees had been removed following the findings of the TWMM 2005 assessment. Given the period between the assessments and the different drill methods used there were some differences between the levels of decay detected. Variations in decay recordings are likely to have arisen due to:

- Accessibility to inter-buttress locations. The cordless drill used by TWMM and the Resistograph 500 used by UTM have different end sizes and hence ability to position flush against the bark in the often narrow inter-buttress locations.
- Different test location, compass bearing or orientation.
- Different drill length. The TWMM 2005 drill was 280mm long. The Resistograph 500 was 480mm long.
- Different interpretation of data. TWMM 2005 uses drill resistance “feel”, colour and smell of extracted shaving to determine extent of decay. UTM Resistograph 500 creates computer resistance data which is assessed by the trained operator. No shavings are produced.



4.6 SOIL TESTING

- 4.6.1 The less than ideal soil conditions have contributed to the less than ideal vigour, condition and SULE of the Central Avenue trees (see Tree Schedule at Attachment B). There have been several soil test reports undertaken within Hyde Park. The Tree Management Plan 2006 included at Attachment 3, *Hyde Park Soil Investigations*, June, 2005 prepared by Sydney Environmental and Soil Laboratory (SESL). This SESL report, which covered the entire Park, provides the baseline soil data which guided the TMP and PoM and Masterplan recommendations. Particular reference is made to the "large *F. hillii* in the Central Avenue".
- 4.6.2 Soil samples have also been tested for soil borne diseases. There have been various soil samples taken in locations adjacent to Central Avenue Figs and tested at the Plant Disease Diagnostic Unit at the Royal Botanic Gardens Sydney (RBG). The RBG has confirmed the presence of the three fungal pathogens: *Phellinus spp.*, *Armillaria luteobubalina* and *Phytophthora spp.* The latest (RBG) report dated 24 August 2012 confirmed samples from adjacent to Trees 177N and 169N were positive for *Pythium* and Tree 169N was positive for *Phytophthora spp.* (not *P. cinnamomi*).

4.7 SITE PHOTOGRAPHS

- 4.7.1 The Site Photographs (Attachment A) were taken by the author at various times since 2003. The photographs illustrate key arboricultural defects or particular features of the Central Avenue planting.
- 4.7.2 Reference is made to photos contained in other cited reports but not included in this report.



5. THE CENTRAL AVENUE

5.1 HISTORY

- 5.1.1 Hyde Park is Australia's oldest public park dating back to 1810 (TMP, page 3). The Central Avenue of Hill's Figs, *Ficus microcarpa* var. *Hillii*, is the Park's most significant element (TMP page 3): "The main avenue planting of *Ficus microcarpa* var. *Hillii*, planted c. 1930, is the main feature of the park and is its most significant element historically" (PoM, 1989, in TMP page 5).
- 5.1.2 Given the planting is approximately 83 years old and growing in less than ideal soil conditions, it has been categorised as Mature to Over-mature age class. The planting is amongst the oldest Avenue plantings in Australia. Hill's Figs were introduced into cultivation c1900 by the Botanic Gardens in Brisbane and quickly became a popular avenue and park shade tree in the eastern states of Australia.
- 5.1.3 Other public avenue plantings of Hill's Figs, *Ficus microcarpa* var. *Hillii* occur in Sydney. Amongst the oldest plantings is that in Driver Avenue, Moore Park which we understand (pers. comm. Ted Hoare Senior Arborist) was planted in c1920. There were four recorded tree failures prior to the Centennial Park and Moore Park Trust management of the Driver Avenue planting in 1999. Personal observations suggest that all remaining 29 Hill's Figs in Driver Avenue have bark inclusions of varying levels of severity. We understand that the Driver Avenue planting is under constant monitoring.
- 5.1.4 Avenue tree plantings designed to line or define a road or entrance to a place are generally comprised of even aged (same aged) trees of the same species. The Hyde Park Central Avenue planting designed by Norman Weekes in 1927 and amended by the panel of Assessors, was a formal, single species planting. The tree species chosen was deemed to be capable of coping with the "rather poor soil conditions" (TMP, 2006 page 4).

5.2 PLANTING STRUCTURE

- 5.2.1 The trees were planted in four rows nominally at 12 metres centres with 7.5 metres between rows. The inside row was approximately 4 metres from the back of kerb of the Central Avenue pavement (refer to the Tree Location Plans at Attachment E).
- 5.2.2 This relatively close spacing has led to the crown suppression of the two inside rows, creating tall upright cathedral-like crown architecture. Selective pruning has been undertaken to encourage this crown form. Many of the limbs closest to the Central Avenue axis are likely to have been pruned because of suppressed growth caused by the limited light levels. Many of these closest limbs over the pavement currently have dead ends but they have been retained in the latest pruning works so as to maintain as much leaf area as possible to facilitate tree longevity. These particular declining limbs are expected to decline further over time.

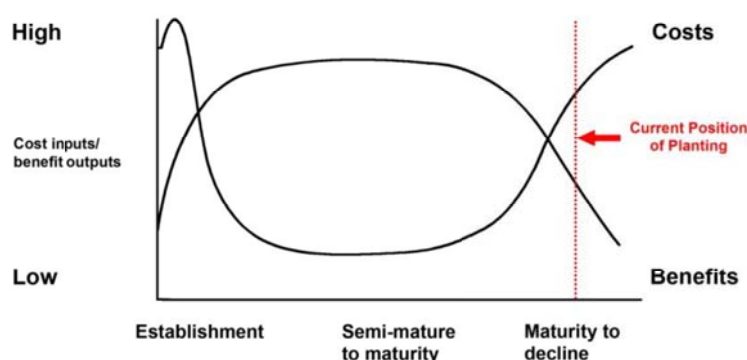


- 5.2.3 There are several individual trees which display significantly suppressed form (Photo I) due to suppression from adjacent, more dominant trees. Such suppressed individuals if left isolated with removal of adjacent trees, would be prone to wind damage and possible windthrow and would detract from the overall amenity value of the mass planting. It is the planting as a whole which is the element which is sought to be retained or reinstated rather than individual trees.
- 5.2.4 The proposed replanting strategy contained in the PoM and Masterplan 2006 and subsequent amendments to the Masterplan is to replant at similar centres and similar offsets to the Central Avenue pavement. As the same species is proposed the same crown form over the pavement and over the adjacent lawn areas is expected.

5.3 CHARACTERISTICS OF HILL'S FIGS - LIFE EXPECTANCY

- 5.3.1 Hill's Figs have been in cultivation in Australia since c. 1900. David Bidwell the Senior Horticulturist, Arboriculture at the Royal Botanic Gardens Sydney believes the oldest shade tree planting in NSW is along Art Gallery Road in the Domain which was planted in 1915 (Hewett, 2012). Some of this planting has been removed due to *Phellinus* white rot fungus.
- 5.3.2 The Driver Avenue planting in Moore Park which was planted c1920, has similarly been disrupted by tree failures and removals, following detailed internal diagnostic testing.
- 5.3.3 The life expectancy of a particular species of tree will vary depending upon the growing environment, whether it is indigenous to the locality, whether the soil environment is suitable and what competition exists from surrounding trees exists. In arboricultural assessments of urban trees these factors are considered when recording the age class of individual trees. The latest age class data on the Central Avenue trees are contained in the report titled: *Visual Tree Assessment (VTA) and Aerial Inspection*, July 2012. In this report all trees were given a Mature age class (except three semi-mature replanted trees in Hyde Park South). It is generally accepted that trees can maintain a Mature age class for 20%-80% of their total life expectancy. We are of the opinion that the Central Avenue trees are towards the 80% end of this scale entering the Over-mature age class category (see graph below). The incidence of white rot fungus, deadwood formation, and previous whole tree failures are generally accepted symptoms of the trees in a mature to over-mature age class.

Figure 1: Cost Benefit Analysis (Adapted from (Hitchmough, 1994))



- 5.3.4 Major tree failures due to bark inclusions are a common reason for removal of Hill's Figs. It is generally accepted Arboriculture opinion that bark inclusions are a common feature of Hill's Figs. Reduction pruning to 20% of total leaf area has recently been undertaken on trees with significant bark inclusions so as to reduce the risk of splitting/failure. The life expectancy of Hill's Figs which are free of bark inclusions is unknown.
- 5.3.5 Whole tree failures due to *Phellinus sp.* or *Ganoderma sp.* wood decay fungi is the other reason for Hill's Figs to be removed. *Phellinus sp.* has been identified (Summerell, 2004) in the Hill's Fig planting. The internal trunk hollows found following tree removal confirmed the extent of decay reported. *Ganoderma sp.*, wood decay fungi has also been identified in the Driver Avenue, Moore Park Hill's Figs. The basal defects created by *Phellinus sp.* are a major consideration in estimating the life expectancy of the Central Avenue planting. Monitoring for internal decay associated with *Phellinus sp.*, *Armillaria luteobubalina* and *Phytophthora* is ongoing. Rootcrown monitoring for the fruiting bodies of this fungus is ongoing.
- 5.3.6 The pavement upgrade works undertaken in 1994 (NSW Department of Environment and Heritage, n.d.) and associated root damage will have an ongoing effect on the spread and control of soil borne pathogens within Central Avenue.

5.4 SOILS

- 5.4.1 The Tree Management Plan 2006 contained at Attachment 3, the *Hyde Park Soil Investigations* June, 2005 prepared by Sydney Environmental and Soil Laboratory (SESL). This SESL report which covered the entire Park provides the baseline soil data which guided the TMP and PoM and Masterplan recommendations. The poor soil conditions are a result of railway construction works which were completed in 1926.
- 5.4.2 The less than ideal soils and identified poor subsoil drainage in particular, are likely to have led to the disease problems in Hyde Park. The three identified fungal pathogens *Phellinus spp.*, *Armillaria luteobubalina* and *Phytophthora spp.* are all favoured in poorly drained soil environments. Tree vigour is reduced in poorly drained soils, predisposing the tree to infection by pathogens.
- 5.4.3 Soil removal, importation of new, specifically tailored soils and installation of subsoil drains are proposed under the PoM and Masterplan works for the block tree removal and replacement of the Central Avenue Figs. This improved soil environment is likely to result in a reduced incidence of disease-related failures and a longer life expectancy for the new planting.

5.5 TREE FAILURES

- 5.5.1 Two whole tree failures in Hyde Park were reported prior to 2003 (TWM, 2003). These failures were noted in Item E of CoS *Brief for Hazard Assessment Report* of 2003. It is unknown which trees these were and whether the failure was a result of bark inclusions or *Phellinus spp.* or *Armillaria luteobubalina* related trunk/rootcrown defects.
- 5.5.2 Tree 64N failed at 9am Sunday 18 July, 2004 due to *Phellinus spp.* related trunk defects (Photo N). This failure was detailed in TWM report 1458, August, 2004.



The TMP 2006 page 23 states:

“Following the most recent failure (30 June, 2005) of one of the Hill’s Figs located in the central avenue...”

- 5.5.3 From CoS records (Tree Assessment Schedule 2012) three trees have “*failed*”, two in Hyde Park North and one in Hyde Park South. There were 15 “*unknown*” removals from the original c1930 planting prior to records being kept: 12 in Hyde Park North and 3 in Hyde Park South. Some of these trees may have “*failed*”.
- 5.5.4 The twenty three (23) trees were removed in September, 2005 (TMP 2006, page 34). All of these trees were in Central Avenue and all of these trees had reported trunk defects at near ground level which had: “(c) *Decay that fails Mattheck*” or (d) *Decay that has broken out into buttress*” or had *Armillaria luteobubalina* symptoms (TWM, 2005).
- 5.5.5 Any whole tree failure is potentially catastrophic in terms of public risk. We have been informed by CoS that Hyde Park has in excess of 3,000,000 visitations annually. Many of these visitations will be within the fallzone radii of the Central Avenue Figs.
- 5.5.6 The public risk associated with live or dead limb drop exists and this is currently being managed by Citywide, the City’s maintenance service provider through its monitoring and pruning regime.



6. BELOW GROUND DEFECTS

6.1 METHOD OF EVALUATING BELOW GROUND DEFECTS

- 6.1.1 Below ground defects are those related to the identified tree diseases *Phellinus spp.*, *Armillaria luteobubalina* and *Phytophthora cinnamomi*. The location of these diseases is shown in *Location of Diseases – August, 2005* (TMP, 2006, page 47). The *Phytophthora cinnamomi* affected trees did not fail, but rather declined and suffered yellowing and chlorosis of the foliage.
- 6.1.2 The below ground defects relating to *Phellinus spp.* were measured through drill testing (TWM 2005) or Resistograph testing (UTM 2011) of the trunks at near ground level as this was shown to be the area of greatest defect. The results of these two assessments are summarised in the *Schedule of Central Avenue Hill's Figs, Hyde Park* (April, 2013) *Hyde Park North and South* (Attachment B). A Plan titled: *Central Avenue Hyde Park (North) or (South) Tree Location Plan, Extent of Decay in 2012*, showing the trees with some decay for each assessment is included at Attachment E.

6.2 INCIDENCE OF BELOW GROUND DEFECTS

- 6.2.1 Based on the TWM 2005 data for Central Avenue Figs included in this review there were 47 trees (from total of 110 assessed) with rootcrown defects (some decay). Of these trees 18 had decay that either "Failed Mattheck" or decay "which had broken out into buttresses". By contrast in the 2011 UTM study there were 49 (from a total of 99 assessed) with rootcrown defects (some decay). Of these trees 1 only (T185N) had decay that "Failed Mattheck". This tree was not removed as only one of three drill recordings marginally failed Mattheck. Table 2 below illustrates the extent of decay in the 2005 and 2011 assessments in more detail.

Table 2: Extent of Below Ground Defects in Central Avenue Assessed Figs (Hyde Park North and South)

Total Trees Assessed	TWM 2005 (No. = 110)		UTM 2011 (No. = 99)	
	No.	%	No.	%
Total trees with no decay (a)	63	57	50	51
Total trees with decay (b-d)	47	43	49	49
Trees with some decay (b)	29	26	48	48
Trees with decay that fails Mattheck (c)	15	14	1	1
Trees with decay that has broken out of the buttresses d)	3	3	-	-



- 6.2.2 The extent of decay associated with *Phellinus spp.*, is expected to increase with time based on the virulence of the fungus and the vigour of the trees. Given all, except three trees were of a Mature age class, the capacity of individual trees to grow new wood beyond the decay pockets will be limited. The lateral expansion of the internal decay pockets is unlikely to be contained (compartmentalised) by the trees' natural disease defence mechanisms.
- 6.2.3 Trees with recorded decay are likely to have greater levels of decay (greater risk of failure) in the future. The risk of whole tree failure is currently being managed with rootcrown monitoring and repeat internal diagnostic testing. No crown thinning or crown reduction pruning has been recommended or undertaken for trees with some recorded decay.
- 6.2.4 Summerell 2004 notes:
- "There are very few options for the control of this group of fungi [Phellinus]. There are no effective fungicides or other chemical treatments to stop the growth of the fungus once it begins the infection and infestation process."*
- 6.2.5 No assessment has been made in this report of "root damage 1994" (CoS Summary spreadsheet 2012) which we understand was associated with the trenching for electrical services and associated pavement upgrade works including to the Central Avenue pavement and kerbs. This root damage is a possible source of disease infection. The report by Arborcraft 1996 (in TMP 2006 page 22) made the following comment in relation to these trenching works:
- "The trenching, the tendency for Hill's Figs to have included bark and the presence of root rot fungus are wild cards that will have an impact on Hyde Park North over the next 20 years. It is possible that the avenue effects will be lost in some areas."*
- 6.2.6 The Arborcraft statement has come to fruition with the tree removals and failures since 1996.

