



17th August 2012

Turf Design Studio
Mr. Mike Horne
95 The Kingsway
Cronulla NSW 2230

Dear Mr. Horne

Re: Discovery Point Neighbourhood Park - Application to Modify Project Approval
Review of Park Growing Conditions

1.0 Introduction

- 1.1 The following report has been prepared for Turf Design regarding the proposed tree planting areas to be installed effectively as a roof garden (above a car park) as part of the Discovery Point Neighbourhood Park. This review of proposed growing conditions is in part to satisfy the requirements for the application to modify Project Approval.
- 1.2 The purpose of this report is to provide an assessment of the suitability of proposed growing conditions for the trees and to a lesser extent turf, in the context of the current design proposal for Neighbourhood Park. In particular, this report reviews issues such as soil depth, soil volume, soil specifications, profiles and water availability over the longer term so as to ensure both initial establishment and longer term viability of the trees. The report also provides a comparison of the likely performance for the proposed 'on structure landscape' compared to the approved concept plan for Neighbourhood Park.
- 1.3 Assessments and recommendations provided in this report are based on a review of information and drawings provided by Turf Design and Bonacci Group, together with a review of the recommendations provide by Sydney Environmental and Soil Laboratory (SESL) (30/07/12 and 17/08/12). Documents reviewed include:

Concept Masterplan – Site 7 SK128 prepared by Turf, 27/07/12

Carpark Extension - SK129 prepared by Turf, 27/07/12

Carpark Extension proposed planting- SK130 prepared by Turf, 27/07/12

Carpark Extension soil mass requirements- SK131 prepared by Turf, 27/07/12

Section AA- SK132 prepared by Turf, 27/01/12

Carpark Roof Beam Options prepared by Bonacci Group, 25/07/12

Building 3 Section- SK133 prepared by Turf, 27/01/12

Public Domain – Feature Seating Wall - S01-L-902 prepared by Turf, 07/10/11

Carpark Extension – Soil Plan - S01-L-403 prepared by Turf, 1/08/12 updated 13/08/12

Discovery Point Park Landscape Sections - prepared by Turf, 13/08.12

Contamination Report - prepared by Coffey Environments Australia, 9/06/10

Assessment of Groundwater Impacts - prepared by Coffey Environments Australia, 11/06/10

Early Works Bulk Earthworks Plan – Stage 1 – C005 prepared by Coffey Environments Australia, April 2011

GARRY CLUBLEY

Arborist and Landscape Consultant

• 100 Rowntree St Balmain 2041. • Ph: 9818 8220 • Fax: 9555 6875
• E-mail: garry.clubley@ozemail.com.au • ABN: 26 302 609 148

- 1.4 The most recent concept designs have been reviewed and these incorporate a number of recommendations to ensure growing conditions have further been enhanced and the longer term viability of the trees addressed.

2.0 Issues Summary

- 2.1 The following outlines the main observations and issues arising from a review of the various documents provided by Turf Design:

- The current concept design for Neighbourhood Park is a revised version of the approved Concept Design with the main design elements remaining the same. The main difference is that the Park is now to be incorporated as an 'on structure landscape'. The main issue from a horticultural perspective is whether the structural elements required for constructing the underground carpark can still provide adequate soil conditions to accommodate the longer term growth and survival of the proposed plantings.
- A comparison of the current 'on structure landscape' proposal and the approved Concept Design indicates a number of critical similarities. In the approved design the park was to be installed over compacted fill. This would have prevented root breakout to the underlying deep alluvial sands and watertable. In effect, the approved design involved the containerisation of the planting elements. The current 'on structure landscape' proposal therefore effectively creates the same underlying conditions for the trees and turf.
- The benefits of the park area in terms of control of runoff from the 'on structure landscape' appear to remain unchanged. Runoff control and biofiltration through mechanisms such as soil storage of precipitation; interception by leaf cover (by both mature tree cover and grass leaves) and evapotranspiration are the same or improved over the original design. The proposed incorporation of a soil/aggregate or modular rootzones beneath most pavement areas will extend the volume of water contained on site.
- It should be noted that stormwater retention calculations for bioretention in planted landscapes typically account only for soil storage, not for interception and evapotranspiration.
- All of the tree species selected for the proposed planting should reach relatively large dimensions in maturity if adequate growing conditions are provided. The London Planes will have the greatest requirements for water and soil nutrients. The Jacarandas will grow more slowly and achieve smaller dimensions. The Scribbly Gums will be the smallest at maturity and will have the lowest water requirements of the three tree species. This is a generalisation to some extent as water demands will depend on a number of factors including; season, wind, precipitation and tree health and vigour.
- Soil volume will be the main limiting factor for tree growth as this directly affects soil moisture availability. However, assuming adequate root breakout to surrounding turf areas, then the total soil volume across the park area should be adequate to support trees and turf.
- Allowance should be made for maintaining adequate soil moisture during dry periods over the life of the trees. A suitable irrigation system is recommended to supplement natural precipitation. Subsoil drainage should be adequate to cope with peak infiltration periods.
- Trees are to be planted into continuous or combined trenches. This approach will favour the trees as combined trenches typically allow for utilisation of shared water and nutrients and trees tend to achieve larger dimensions than trees grown in individual, isolated tree pits.
- The revised design proposal indicates that there will be unimpeded root breakout to the areas of adjacent turf. This will be provided by the soil/aggregate or modular rootzones beneath pavement areas.
- The footing for the seating wall will required further input from the engineer, to ensure that the bridges sections to allow root breakout are adequate and are not hindered by other components of the structure.

- The recommendations provided by SESL, regarding the soil mix and depths, are appropriate, and should be adopted.

3.0 Comparison of Park Design Proposals

- 3.1 The original underlying upper layer soils, as described in the Coffey documents, are alluvial sands over alluvial sandy clays to clays. These would have been suitable for tree growth with the addition of appropriate amendments. However the critical factor for the approved park design was that these sands would have been capped in accordance with the soil contamination recommendations.
- 3.2 The Coffey Contamination Report indicates that there would have been a compacted capping layer of 2.0 to 2.5 metres above existing ground levels under Neighbourhood Park. In that scenario, the only deep soils available to the tree plantings would have been the imported soil mix installed at similar depths to that proposed in the current 'on structure landscape' scheme. There would have been no accessible site soils available to tree roots and no opportunity for root breakout beyond the soils provided within the park area.
- 3.3 The approved Neighbourhood Park would have effectively provided the same growing conditions as the amended [on structure landscape design](#).

4.0 Comment on Soil Depth

- 4.1 Soil depth is critical to the eventual mature size of the three tree species and to their stability. I understand that the preferred design is a terracing beam slab rather than the previous upstand beam design. In principal a terraced slab does not necessarily affect tree growth if adequate soil depths over most of the slab can be achieved. Similarly, the vertical face of each terrace slab should not necessarily restrict root development into the turf area if there is adequate depth of soil over. Typically, tree roots will grow up and over or be deflected by what ever structures exist below the soil surface. A review of the current structural concept drawings indicates there will be adequate soil depth over all sections of the slab for each planting element.
- 4.2 I note that the SESL recommendations for turf areas indicate a total profile depth (including drainage layers) of 400mm. I agree with this, as actual soil depths less than 300mm typically result in stress in the turf due to cycles of drought and saturation. If there is no irrigation for the turf, then a soil depth of at least 300mm or greater permits grass roots to grow deeper and survive extended periods of drought. The greater depth also provides grass with improved resilience to wear and faster recovery. These aspects of turf performance should also be addressed in the maintenance regime to be implemented for the park
- 4.3 The current design details show the indicative soil depth in tree trenches as 1 to 1.1m. Allowing for the subsoil drainage system and the characteristics of soil moisture migration through the profile (described below in Item 5.3), the effective soil depth will be 0.9 to 1m. This is consistent with the SESL recommendations and is appropriate to establish stable root growth and to support longer term growth.

5.0 Comment on Soil Volume

- 5.1 The soil volume available to tree roots is critical to the longer term performance of the trees. A review of the drawings shows continuous trenches of 6m to 7.5m width and up to 1.1m depth. The latter effectively being reduced due to the saturation zone in the lower soil profile (see Item 5.3 below). Drawing S01-L-403 indicates 446m³ for the combined Plane Trees and Scribbly Gums. Although soil volume for both species will be reduced by sub-soil drainage. Assuming there are no below ground barriers to the tree planting areas, the overlap of the planting trenches will act as a shared rootzone.
- 5.2 Through the use of suitable growing media beneath pavements, the effective

accessible rootzone would be extended by another 133m³ within the turf areas.

- 5.3 The three Jacarandas have a calculated soil volume of 105 m³. With the use of either a soil/aggregate or modular rootzone beneath the adjacent pavement area, the accessible rootzone could be extended by another 50m³.
- 5.4 I don't have a problem with the structural soil components in principal, but since they reduce the total soil volume in the trenches, then root breakout into the turf areas becomes even more critical during extended dry periods. The use of a modular soil area beneath pavements is the preferred approach.
- 5.5 Using current methods for determining appropriate soil volumes for the different species, based on moisture requirements of different typical species (in the three most water stressed months) and using a typical leaf index to indicate transpiration rates¹, the three species would have the following soil volume requirements:

London Planes – 875m³

Jacaranda – 218m³

Scribbly Gum – < 218m³

The above calculations assume no precipitation during those critical months. However, if irrigation is included, even with only one irrigation event in each of the three months, the soil volume requirements drop to:

London Planes – 295m³

Jacaranda – 73m³

Scribbly Gum – < 73m³

(Note: more detailed calculations regarding soil volume requirements using leaf indices specific to the three species could be calculated using the methodology described by Lindsey and Bassuk (1991)² but the above approximations should be sufficient for this exercise)

- 5.6 I would strongly argue to maintain the width of tree trenches. The further the grass is from the base of the trees, the better the longer term tree health and growth.

6.0 Comment on Soil Mix

- 6.1 I strongly endorse the recommendations provided by Simon Leake (SESL). In particular, the use of a sand drainage layer over the geotextile layer is important to prevent mobile particles blocking the geotextile, chiefly if the soil mix does not strictly conform to the specification (in terms of clay and silt content or soil chemistry).
- 6.2 The addition of a sand drainage layer in the profile design does further reduce the overall soil depth. This can partly be as a result of a saturated zone just above the freer draining sand. To overcome this reduction in depth, it is essential that the park design allows for the greatest soil depth possible in all areas.
- 6.3 The recommended soil mix will be very free draining. Therefore the subsoil drainage across the slab should be designed to accommodate rapid removal of infiltration water following storm events.

7.0 Comment on Drainage

- 7.1 In any constructed soil profile, it is essential to provide adequate drainage, particularly given the free draining characteristics of the proposed soil mix.
- 7.2 I note from the concept structural drawings that cross falls will be approximately 1:100. Given the relatively shallow depths, particularly across the turf areas, it is

¹ Hitchmough J. D. (ed) 1994 *Urban Landscape Management*. pp. 374 - 379 Inkata/Butterworths, Sydney, Australia

² Lindsey, P. and Bassuk, N. 1991 *Specifying Soil Volumes to Meet the Water Needs of Mature Urban Street Trees and Trees in Containers*. Journal of Arboriculture. 17(6) 141-149.

critical that adequate cross falls from the slab are provided. I understand that this will be addressed in the final detailed design through the inclusion of mass concrete build-up in appropriate sections of the slab.

8.0 Comment on Irrigation

- 8.1 The rough calculations provided above demonstrate that a good quality and well maintained irrigation system is essential to the longer term performance and survival of these trees and other plant material within Neighbourhood Park. The extended drought during the early 2000s demonstrated that access to water can be a severely limiting factor to tree growth.
- 8.2 An appropriate maintenance regime should be implemented to assess the effectiveness of the irrigation system in both turf areas and tree trenches. This should include periodic sampling of the deeper soil profile to assess soil moisture levels. Soil sample assessment should be carried out during the plant establishment period to determine appropriate rates and frequency for the irrigation system.

9.0 Comment on Soil Fertility

- 9.1 The recommendations provided by SESL for the soil mixes will address the short term requirements for soil fertility levels. As part of the park maintenance regime, a regular fertilising programme should be implemented. After the first 12 months of plant establishment, soil sampling and testing should be carried out to determine ongoing soil fertility requirements.

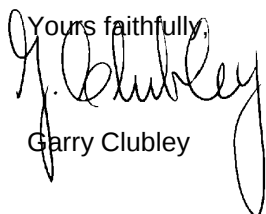
10.0 Comment on Other Constraints

- 10.1 At this stage I am not aware of other constraints that may limit the total soil volume or soil depth available to the trees. However, I would expect that there will be various services and conduits located on the concrete slab and within the soil profile. Ideally, these should be located well away from the tree trenches so as to avoid conflicts with tree roots and to reduce impacts on trees in the future if services have to be dug up.

11.0 Conclusions

- 11.1 As is usually the case with rooftop plantings, soil volumes on this project are at the lower end of what trees typically require. However, if these trees can utilise the soil within the turf areas then there should be adequate conditions to support longer term growth. The incorporation of irrigation to supplement rainfall, particularly during periods of drought should overcome the limits to growth created by accessible soil volume
- 11.2 An ongoing tree maintenance program, following establishment, and run over the medium to longer term should also make up for the deficits in soil volumes. The program should include periodic applications of organic matter and fertiliser to tree areas, monitoring and maintenance of irrigation, periodic testing of soil chemical characteristics and soil amendments applied as required.
- 11.3 Provided the various issues raised in this report are address adequately, the trees can be expected to achieve good growth and longer term viability.

I trust that this report adequately addressed the main arboricultural issues concerning the proposed tree planting at Discovery Point Neighbourhood Park. If you have further questions or require an explanation of the details discussed here, please contact me.

Yours faithfully,

Garry Clubley