

Tree Management for Carbon, Energy and Drought Efficiency

Dr Greg M Moore

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The following are extracts from a paper by Dr Greg Moore taken from Treenet proceedings. Dr Greg Moore is from the Associate School of Resource Management and Burnley Campus, University of Melbourne.

The attitude of many Australian citizens to urban trees still seems to be that they are decorative items which are optional in the urban environment. This completely underestimates the many functional roles that mature trees play in created and natural landscapes. These functional roles have been underestimated in the past to the social, environmental and economic peril of those societies which failed to appreciate that the trees are assets performing important functional roles, often over very long periods of time. The costs associated with trees in urban landscapes are often well known but their real direct and indirect benefits are rarely fully valued. Economists, driven by the huge real costs of damage to the environment, and the costs of attempting environmental amelioration and rehabilitation, are only now starting to redress this problem and put balance back into the economic models. The impact of trees on the urban microclimate and city infrastructure are being recognized (Table 1).

The Kyoto Protocol has altered the political environment surrounding urban vegetation and should see the value of urban vegetation increase. Mature trees are significant assets to our environment and our society regardless of where they occur or whether they are native or exotic. A great deal of effort has gone into managing, conserving and preserving the trees.

Table 1: Climate and environmental values associated with mature trees
(After Grey and Deneke, 1978: Anon, 1989: Harris, 1992: Finnigan, 1994, Moore, 1997)

Climate related values	Environmental values
Shade	Production of oxygen
Shelter from the wind	Fixing of carbon dioxide
Thermal insulation	Reduced soil erosion
Temperature modification	Improved edaphic (soil) environment
Reduction in glare	Protecting watersheds
Interception of rainfall	Ameliorating windflow
Humidification of the air	Improved air quality
Filtration of polluted air	Altering ambient temperature
Reduced water runoff	Noise abatement
Reduced stream turbidity	Wildlife habitat
Altered effective precipitation	Create ecosystems

Trees and Carbon Balance

Mature trees are significant sinks of carbon and sequester atmospheric carbon dioxide for very long periods of time. Should the trees die, the carbon which is the major element of their structure would be released to the atmosphere making matters significantly worse (Table 2).

Table 2: Carbon fixed in urban trees in inner Melbourne	
Estimated number of trees in private and public open space in inner Melbourne	100,000
Average weight of whole tree, including above and below ground components	100 tonnes
Water content of tree (approximation)	80%
Dry matter mass of trees (varies so conservative estimate)	20%
Carbon content of dry matter (varies so conservative estimate)	50%
Amount of carbon sequestered in each tree	10 tonnes
Total carbon sequestered in urban trees of inner Melbourne	1,000,000 tonnes

If we take these calculations further, it can be calculated what effect pruning such mature trees might have in terms of carbon (Table 3). Data for 30% canopy reduction are shown.

Table 3: Carbon lost in pruning mature urban trees canopies	
Average weight of whole tree, including above and below ground components	100 tonnes
Amount of carbon sequestered in each tree	10 tonnes
Amount of carbon sequestered in the canopy of each tree	5 tonnes
Amount of carbon lost if 30% of canopy pruned from each tree	1.5 tonnes

Given that pruning contracts and operations managed by local governments usually involve hundreds or perhaps even thousands of trees, it is worth estimating overall carbon losses for 100 trees (Table 4). Furthermore, if you value carbon at AUD\$10.00 per tonne, the significance of the losses becomes clearer. When these values are considered it becomes apparent that they could affect the economic value of pruning as a management tool, and could see the rapid move to underground services. This is especially so when costs for 3 and 5 year pruning cycles are calculated.

Table 4: Carbon lost and its value for pruning 100 mature urban trees canopies	
Percentage of canopy pruned	30%
Amount of carbon lost from 100 trees	150 tonnes
Value of carbon pruned from 100 trees	\$1,500.00

There is also growing evidence that there has been a general and significant undervaluation of carbon fixed below ground by mycorrhizae and the other microbes associated with plant root systems.

Drought and changed weather patterns

The current drought that has affected the south eastern part of Australia is unprecedented over the period for which we have data. It has been a chronic drought with below average rainfall month after month, and year after year. It is not known whether this drought is a part of a regular natural pattern that occurs over a longer period of time, as current meteorological data are too recent to reveal such patterns. There has been huge public interest in efficient and effective water use and conservation. Restrictions to water use have been applied to urban gardens, parks and streetscapes and these have placed the vegetation under considerable stress. There have been debates about whether trees - native or exotic - should be irrigated over the summer, and suggestions that perhaps the drought should take its course and consequently trees could be left to die. This is neither asset nor environmental management! Our knowledge of trees and particularly their root biology can be applied to effective and efficient management practices (Table 5).

Table 5: Tree management imperatives at times of drought and climate change
Since absorbing roots are near the soil surface, use this in management
Plant trees in large mulched beds
Mulch of any type is beneficial, but organic mulches have much to offer
Large old trees must use significant amounts of water
A few irrigations over summer will see trees through the driest periods of the year
Focus on younger trees so that there are new generations of trees for the future
Select trees wisely for the particular landscape role that is intended
Consider water efficiency as part of any urban tree management program

Mature trees will have a significant place in urban landscapes of the future and they must be managed to ensure that they remain healthy and fulfil the full potential of their lifespans. Through recognizing tree structure, appropriate space must be provided for

their canopies and root systems. This will reduce human interference with root systems in particular, leading to healthier, longer lived trees and lowered maintenance costs. Larger spaces to accommodate trees must be a part of sustainable urban design. Use of mulch must be an integral part of proper design.

As climate changes, the impact of vegetation on stormwater runoff could save billions of dollars in infrastructure costs to Australia's cities. Trees not only hold rainwater on their canopies but, through transpiration, reduce significantly the volume of water entering drains. Estimates suggest that trees may hold up to 40% of the rain water that impacts on them and that as little as 40% of water striking trees may enter drains.