SAFE AND SUSTAINABLE TREES FOR THE BUSH CAPITAL - AN ASSET MANAGEMENT STRATEGY FOR CANBERRA'S URBAN TREES

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SAFE AND SUSTAINABLE TREES FOR THE BUSH CAPITAL

Trees fill Canberra's suburbs, streets, parks and places, bringing life and colour to the city and earning its reputation as a 'garden city' and the 'bush capital'.

While trees provide many benefits, recent drought, fires and storms have made Canberrans more aware of the dangers of unsafe, dead or dying trees.

Now, with many of Canberra's street and park trees at the end of their healthy life, we face a critical challenge to sustain the bush capital yet keep our trees safe. This recently prepared asset management strategy outlines a cost-effective approach for maintaining the urban forest to meet that challenge.

Safe and Sustainable Trees for the Bush Capital is based on ANU research for the *Urban Trees Asset Management Plan 2005–06* prepared by Territory and Municipal Services' (TAMS).

OUR GREAT TREE CHALLENGE

A comprehensive Australian National University study[1] of all Canberra's street and park trees shows that large numbers of these trees are at the end of their safe life and are in serious decline. That research anticipates this situation will be dramatically magnified over the next 10 to 20 years with the simultaneous decline and death of trees from two large planting periods:

- pre-1925 plantings (largely deciduous)
- 1955–1975 plantings (mainly eucalypts)

While older trees are more costly to prune and maintain, current funding is only sufficient to respond to maintenance requests from the public and does not provide for systematic inspection and maintenance of trees.

Canberra's great tree challenge is to implement a strategy that:

- retains the urban forest and its many benefits
- avoids the huge costs and risks of a large proportion of trees dying and needing to be replaced at the same time
- maintains, removes and replants trees in a way that is affordable and sustainable

TREES: AN ASSET THAT 'MAKES' THE BUSH CAPITAL

Trees are a vital part of Canberra's landscape and the reason the city has been dubbed the 'garden city' or 'bush capital'.

Canberra has well over one million trees in its urban forest including more than 600 000 trees managed by the ACT Government. The ACT Government-managed trees include: 212,000 street trees, 235,000 park trees and an estimated 178,000 trees in other urban open space[3]. This is the largest urban forest in Australia under the jurisdiction of one government agency.

Trees provide shelter, add to our heritage, provide havens for wildlife, and add tremendously to the look and feel of the city, making Canberra an attractive place to live, work and visit.

Trees are an essential part of Canberra's green infrastructure, providing a range of utility and environmental services such as:

- interception of stormwater flows
- reduction of pollution through absorption of contaminants and release of oxygen
- savings in energy use and extension in the life of materials through shading, wind shielding, and moderation of air temperatures and solar radiation.

An Australian National University study[2] conducted in 2005 calculated the amenity value of Canberra's street and park trees to have a value of $1.1 billion (or $3100 per tree). The same study calculated the direct economic value of the environmental benefits to Canberra at more than $15 million each year (or $43 per tree per year) including:

- $3.9 million each year for energy reduction
- $7.9 million each year for pollution mitigation
- $3.5 million each year for stormwater mitigation.

The total replacement value of all 625 000 of Canberra's urban trees was $413 million (in 2003-04). This includes $312.5 million in removal costs and 100.5 million in replanting costs.

An Australian National University study calculated the amenity value of Canberra's street and park trees to be around $1.1 billion

TREES AGEING TOGETHER

Tree age and condition data collected, analysed and modelled in the ANU study, indicates that trees from two large planting phases, including more than 70 per cent of Canberra's street and park trees, are reaching the end of their safe life at around the same time (see Figure 1).

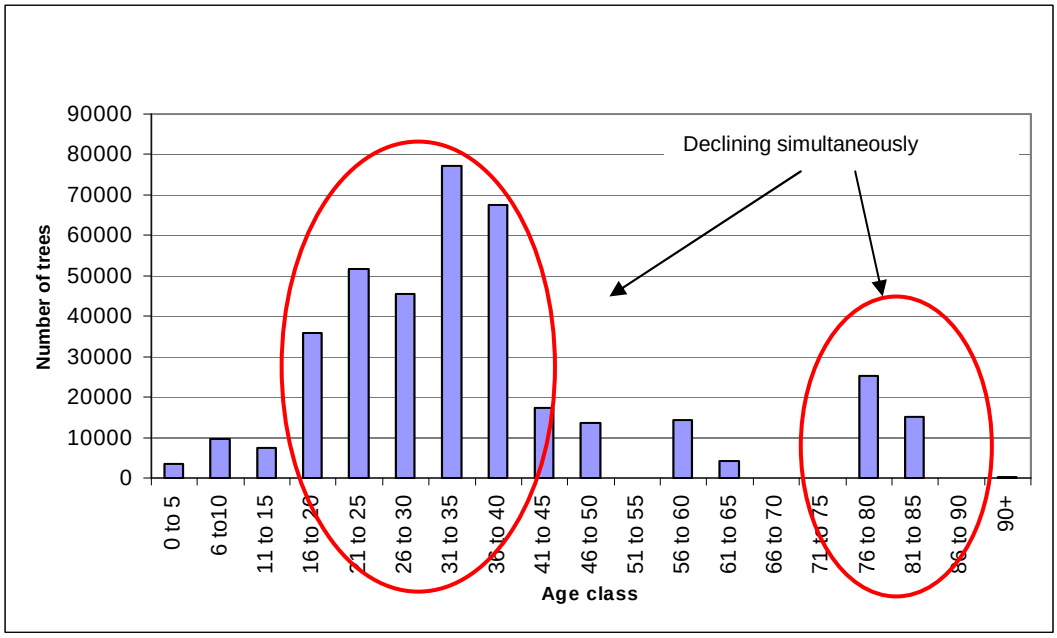


Figure 1: The age class distribution of Canberra's ageing trees

The simultaneous decline of plantings involves the:

70-year-old and older trees from the pre-1930s	→	mainly deciduous and evergreen trees with a maximum safe age of 80 years
30–50 year-old trees from large-scale plantings during Canberra's rapid growth during 1955–75.		mainly eucalypts with a maximum safe age of 50 years

trees from two large planting phases, including more than 70 per cent of Canberra's street and park trees, are reaching the end of their safe life at around the same time

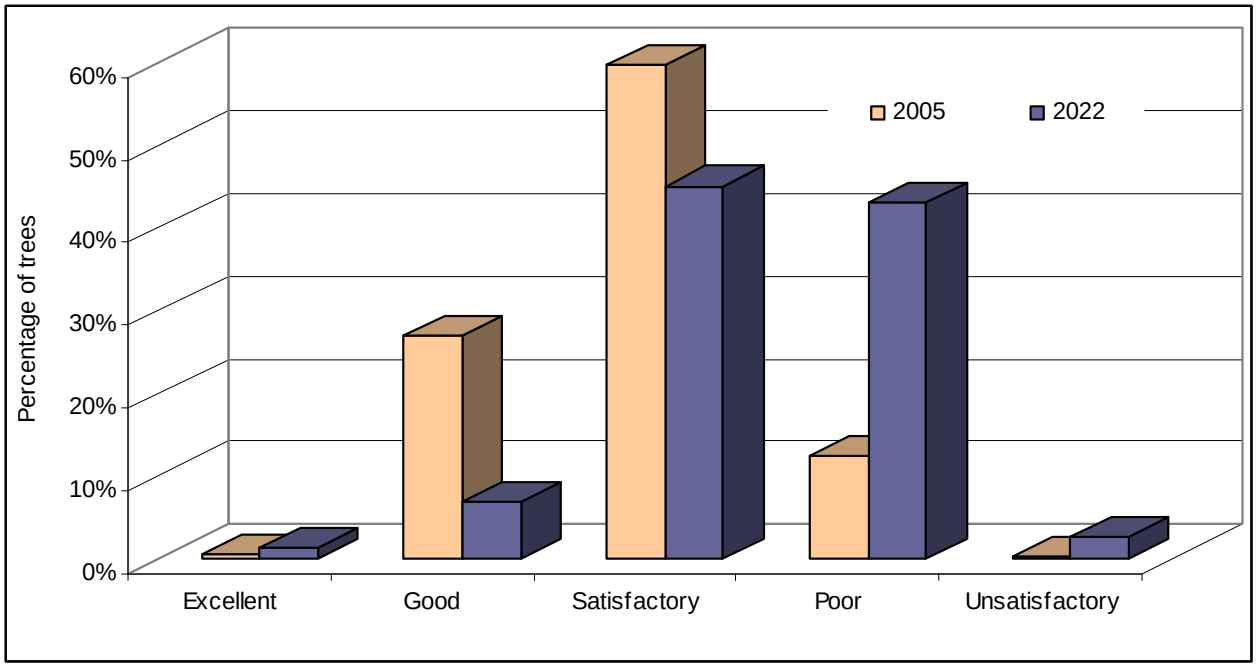
DECLINING TREE CONDITION

With this wave of ageing trees, the ACT can expect further declines in its urban forest if service levels are unchanged. A dramatic increase in tree deaths and the number of ACT street and park trees in poor and unsafe condition during the next 10 to 20 years is forecast (based upon the ANU research[1]).

ANU projections of asset condition show a great percentage of trees will move from 'good' and 'satisfactory' condition in 2002 to 'satisfactory', 'poor' or 'unsatisfactory' condition by 2022, with dire implications for public safety and maintenance costs. At current service levels the research predicts that the number of 'unsatisfactory' trees will rise sevenfold to more than 10,000 trees and the number of 'poor' trees will rise almost fourfold to more than 180 000 trees (Figure 2)

The ANU recently ground-truthed its predictions for street and park trees and found that tree condition in 2005 was worse than predicted for that year and even worse than predicted for 2007. Drought, fire and storm were thought to contribute to this worse-than-expected result.

Figure 2: Condition of ACT trees in 2005 and 2022

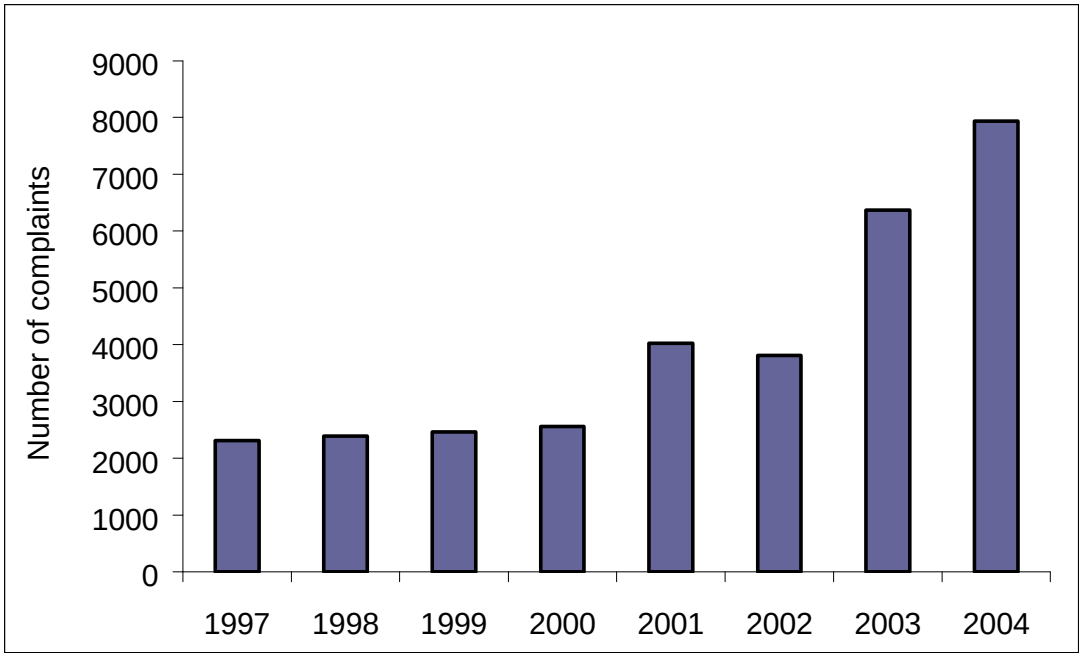


most trees will move from good and satisfactory condition in 2002 to satisfactory, poor or unsatisfactory condition by 2022, with dire implications for public safety and maintenance costs

TREE COMPLAINTS UP

The growing number of complaints from the public about tree condition (for example, falling branches and dead and split trees) supports the research predictions of declining tree health. While drought and fires were also a key factor in this period, customer complaints in 2004 were double those made in 2002 and close to four times the number made in the four years before 2001 (see Figure 3).

Figure 3: Tree-related complaints in each year from 1997 to 2004



AT 15 METRES, SIZE REALLY MATTERS

When it comes to cost-effectively pruning and maintaining trees, size really matters, particularly around 14 to15 metres tall.

Trees less than 14 metres tall can be pruned at $50 per hour with a mini tower

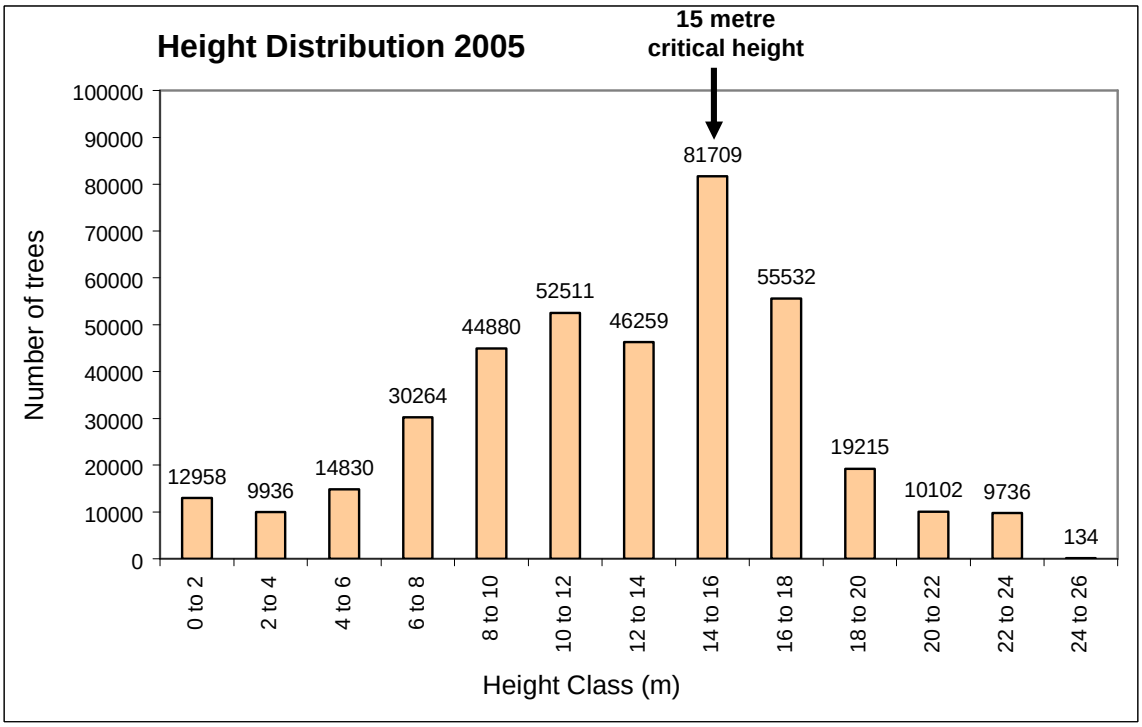
Pruning trees that are more than 15 metres tall requires use of a travel tower at a cost of around $170 per hour.

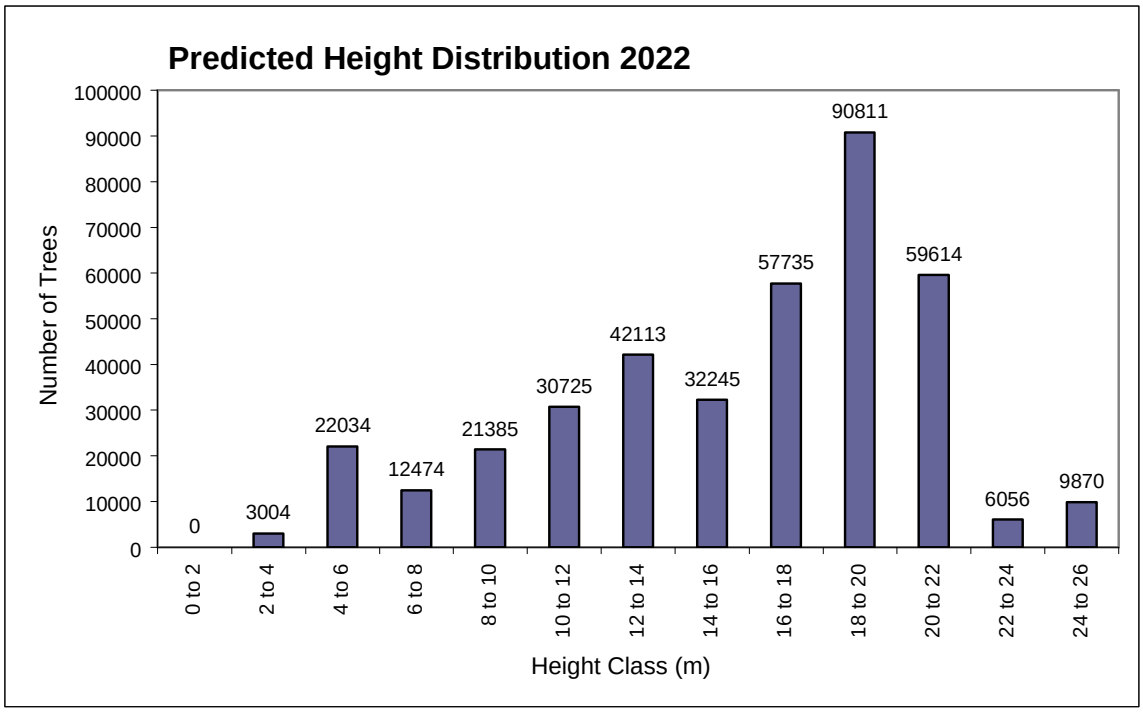
Because trees taller than 15 metres are projected to make up more than 66 per cent of Canberra's ageing urban forest by 2022 (Figure 4), the greater requirement to use travel towers would increase estimated pruning costs by $1.4 million per year.

This cost is an unavoidable consequence of a maturing urban forest and it must be planned for.

... by 2022, the greater requirement to use travel towers would increase estimated pruning costs by $1.4 million each year

Figure 4: Predicted height of Canberra's urban trees in 2005 and 2022

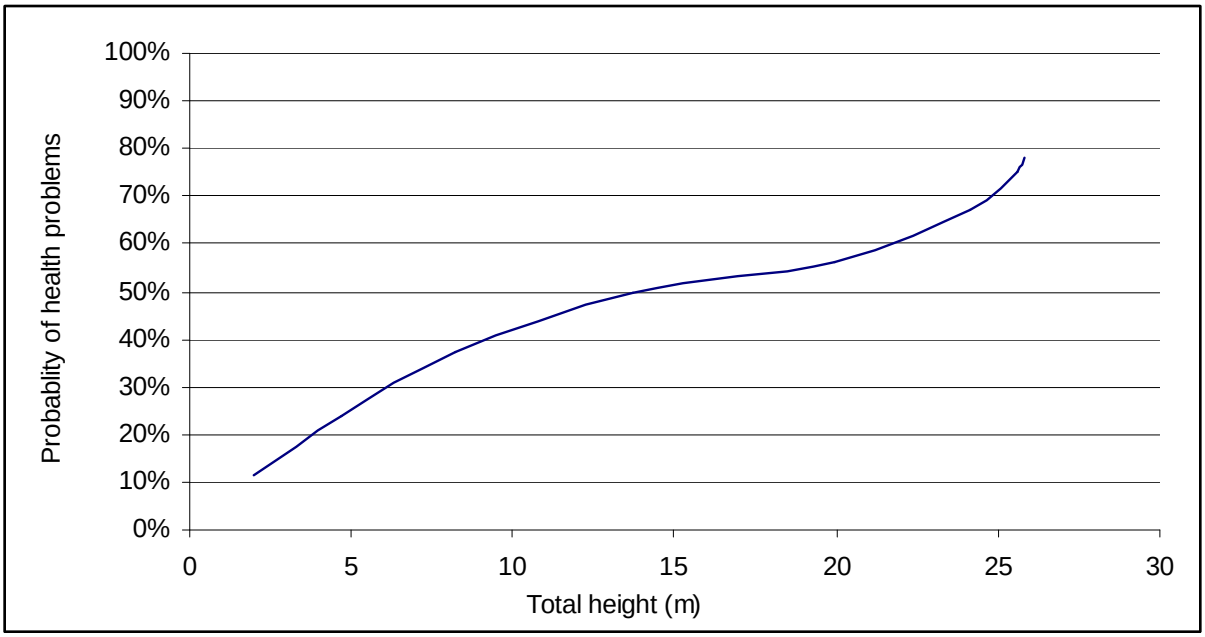




HEIGHT IS A KEY

ANU research shows that the likelihood of a tree having health problems increases with height. It is a key factor in tree health, potential risk to people and property and in tree pruning and maintenance costs. For eucalypts, the chance of ill-health is particularly high once the tree passes 20 metres. Each species has a unique health–height relationship but they follow a similar trend to that shown below.

Figure 5: Probability of trees having health problems in relation to height



For example, after growing taller than 20 metres, the chance of a eucalypt developing deadwood or epicormics[1] in the crown each year is more than 50 per cent. Beyond 25 metres tall, this probability increases rapidly to exceed 70 per cent.

The ANU research predicts that the number of trees around 20 metres or taller will increase from 39 187 trees in 2005 to 166 351 trees in 2022. This will inevitably increase maintenance costs.

After passing 20 metres tall, a eucalypt has greater than 50 per cent chance of developing deadwood or epicormics in the crown each year

[1] Soft shoots growing from mature branches in response to stress and decline in tree health

THE BIGGER THEY ARE, THE HARDER THEY FALL

The danger from growing numbers of older, taller trees with more dead wood, cannot be ignored, particularly in light of a recent Canberra death (not from a government-managed tree), near misses and loss of property. Three significant incidents in the past three years have involved government-managed trees and may result in large compensation payouts:

- 18 September 2002: a tree fell onto a car, trapping and seriously injuring the driver
- 24 December 2003: a large piece of a tree fell on private property injuring a father and son
- 4 February 2005: a tree fell on a truck, causing more than $20 000 damage.

The danger from growing numbers of older, taller trees with more dead wood cannot be ignored …

STRATEGY FOR OPTIMAL SERVICE LEVEL

The challenge presented to the ACT by this wave of older, taller and more dangerous trees is to develop a strategy of maintenance, removal and replacement that retains trees and their benefits in the urban landscape, spreads and optimises service costs and reduces risks.

Under the current funding arrangements the ACT spends 90 percent on 'reactive' maintenance—such as responding to public complaints and trees reported as an imminent risk. Limited routine or cyclical maintenance is carried out and is restricted to providing road and utility clearance for healthy trees. Under this arrangement, no programmed inspection or pruning is carried out on unhealthy, 'poor' or 'unsatisfactory' trees, leaving these trees as a significant fall threat.

To maintain tree health, form and safety, and avoid high costs later in the lifecycle, accepted aboricultural practice specifies routine maintenance of young healthy trees to manage their shape. Mature and ageing trees should be inspected and maintained every five years, depending on their location. Dead, rotten and damaged branches need removing to extend the safe, useful life of the urban forest. These measures are proposed for the ACT.

While funding has allowed 400 unsatisfactory trees to be replaced each year, the proposed program targets 1445 trees per year to replace the large number of trees classified 'unsatisfactory' over the next five years (see Table 1).

An annual investment increase in the order of $2 million is required to achieve an appropriate standard of tree health and safety. This includes funding for cyclic maintenance and tree replacement.

Table 1: Current and target service standards

Cost category	Current annual service level	Target annual service level
	Number of trees	Number of trees
Programmed cyclic maintenance (3–5 yr cycle)	46 300	112 550
Removal and replacement of unhealthy trees	400	1 445

A budget increase in the order of $2 million is needed for a healthy and safe urban forest

BENEFITS FROM TARGET SERVICE LEVEL

COST PER TREE IMPROVED

One of the expected benefits of a programmed inspection and maintenance cycle is the lower unit cost of tree maintenance. The cost per tree for mainly reactive maintenance is currently $57 but under a three to five year inspection/maintenance cycle it is estimated to fall to $36 per tree (see Table 2). Reactive maintenance costs more because it is inherently inefficient with higher travel costs and unproductive time.

Table 2 also compares Canberra's current and target level tree maintenance statistics with other benchmarked jurisdictions. While Canberra's current unit cost for tree maintenance is one of the highest of the cities benchmarked, the target unit cost is the second lowest.

Table 2: Benchmark comparisons with other jurisdictions

Benchmark Partner	Number of Trees	Average Inspection Cycle (years)	Number Inspected per annum	Budget excluding capital works $000	Cost per tree $
Melbourne City Council	40,000	2	22,500	1,230	55
Bayside	66,000	3	22,000	616	28
Ballarat	36,000	5	6,000	649	108
Stonnington	95,000	3	30,000	1,344	45
Monash	200,000	6	30,000	1,232	41
Auckland	31,000	3	10,300	643	62
Benchmark Average	*78,000*	*3.5*	*20,100*	*953*	*47*
Canberra					
Target Service Standard	**447,000**	**3–5**	**112,550**	**4,000**	**36**

CHANGE IN ASSET CONDITION

Another key benefit of implementing the target service level, including greater tree inspection and replacement, is the substantial improving condition of trees and the overall asset from 2005-2022 (see Figures 6 and 7 on the next page).

The target service level leads to an increasing number of trees in the 'excellent' condition, zero trees in the 'unsatisfactory' condition and decreasing numbers rated as 'poor' leading up to 2022. The current service levels produce almost the inverse, with increasing numbers of trees in 'unsatisfactory' or 'poor' condition and decreasing numbers classified as 'excellent'.

Figure 6: Asset condition between 2005 and 2022 for the current service level

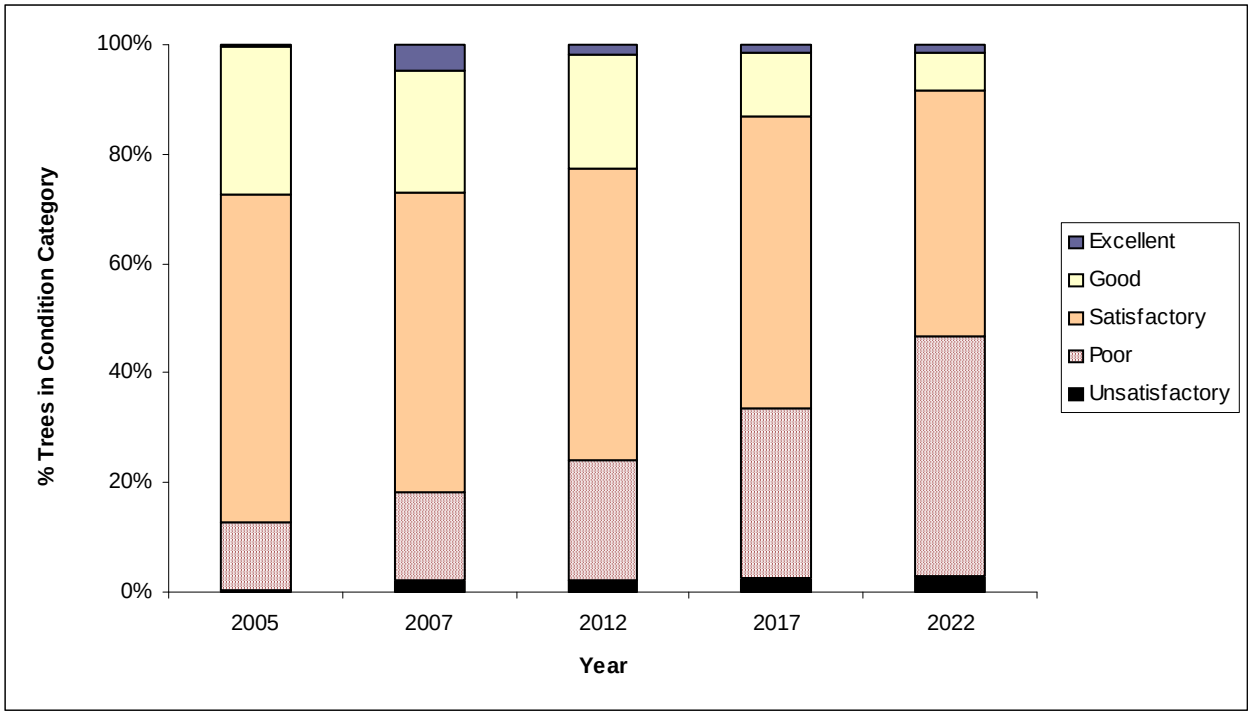
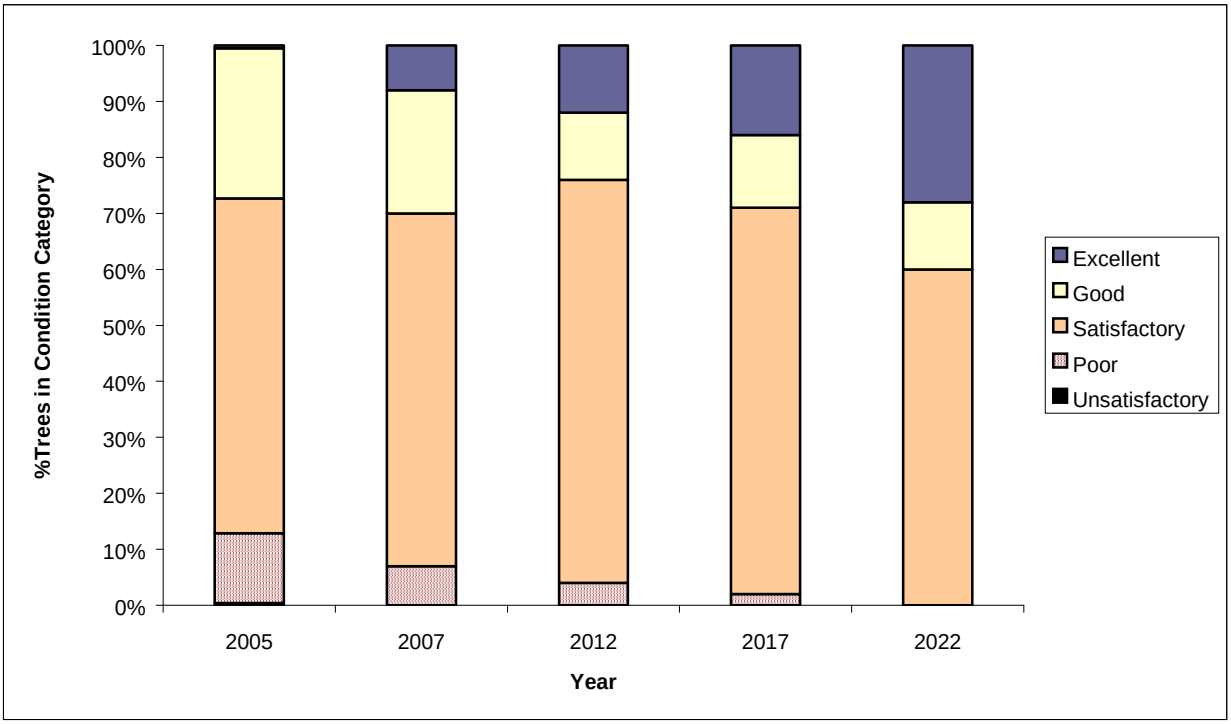


Figure 7: Asset condition between 2005 and 2022 for the target service level



RISK REDUCTION

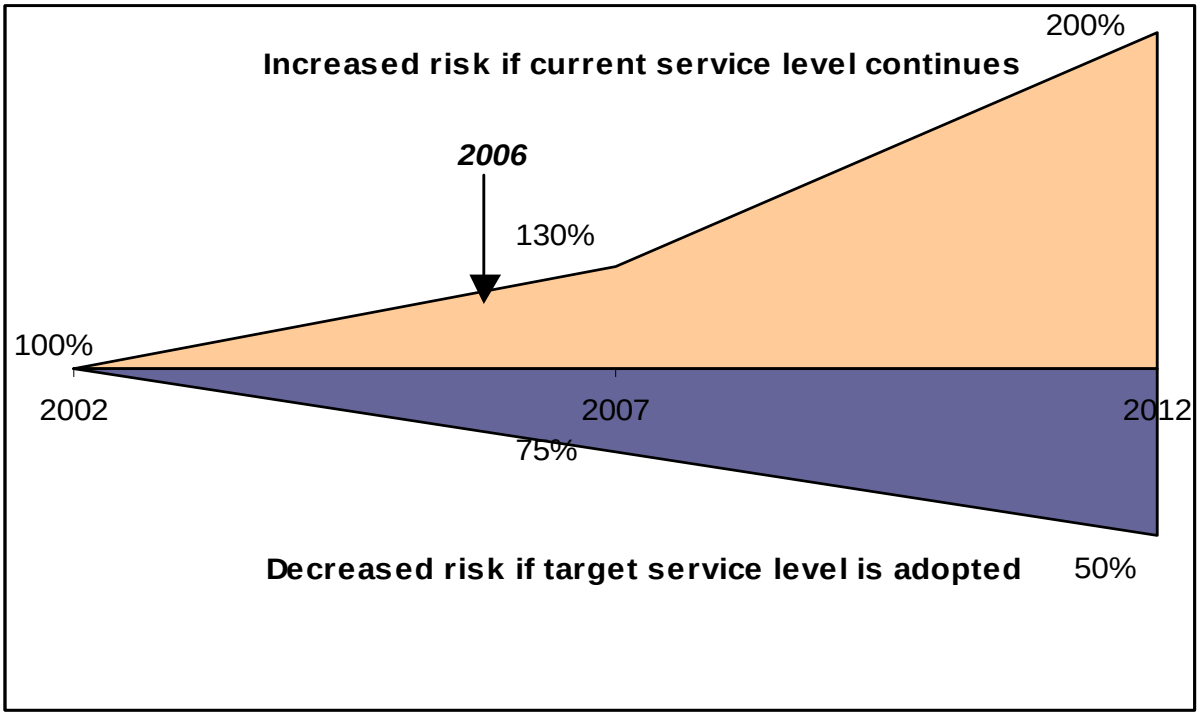
Perhaps the greatest benefit of the target service level is the effect it will have on lowering the risk of loss of human life, injury, costly damage to property and exposure to litigation.

In the absence of a standard way of determining the level of risk represented by public trees, recent ANU research[1] concluded that:

- the risk of injury or damage from trees is proportional to the number of trees that display visible evidence of stress or ill health
- the severity of an injury or damage may be directly related to the average size of trees—as larger trees drop larger branches from a greater height.

By identifying trees in the 'unsatisfactory' and 'poor' condition as the main risk source and setting 2005 as a base level, change in risk over time is mapped for both the current and target service levels (see Figure 8)

Figure 8: Change in safety related risk under current and target service levels



In contrast to the current service standard, the risks under the target service level halves by 2012 and drops by 70 per cent by 2022. At the current service level, the risk doubles by 2012 and increases almost four-fold by 2022.

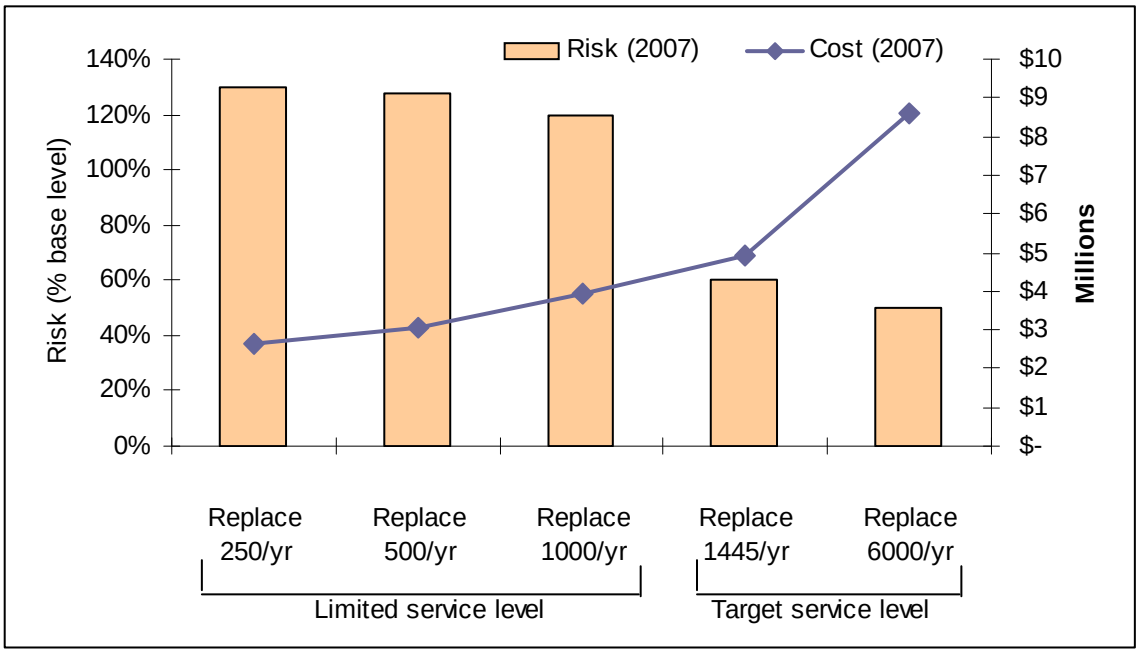
OPTIMAL TREE REPLACEMENT

Based on the ANU research[1], risk and costs associated with five different scenarios of tree inspection/pruning and replacement are shown in Figure 9. The graph shows an optimal level of tree replacement, below which risks are unnecessarily high and above which costs increase greatly with only marginal benefit:

- the risk remains high under the current service level of only a limited tree inspection and pruning program, and for each of the three scenarios where 250 to 1000 ageing trees are removed and replaced each year
- the risk is significantly reduced only when the target service level is reached, with all trees being inspected every five years and all trees in an 'unsatisfactory' condition (around 1445 trees per year) being progressively removed and replaced.

This target tree management scenario is the optimal target level for keeping the ACT's trees safe and sustainable. The risk cannot be reduced by half measures.

Figure 9: Summary of risk and estimated inspection/pruning and replacement costs (2005–07) for scenarios modelled by the ANU



an optimal level of tree replacement, below which risks are unnecessarily high, and above which costs increase greatly with only marginal benefit

IMPLEMENTING THE STRATEGY FOR SAFE, SUSTAINABLE TREES

Canberra's urban forest is a valuable resource that contributes significantly to the character of Canberra, but, as described in this paper, a strategy with immediate and decisive action is needed to sustain the value and safety of this asset.

With a great proportion of our street and park trees simultaneously reaching the end of their safe life, an increased level of inspection, maintenance and replacement is required to avoid excessively high future cost burdens, including tree-related injuries, deaths and litigation.

THE KEY ELEMENTS OF THE STRATEGY TO ACHIEVE THIS ARE TO:

- implement programmed (five-year cycle) inspection of all 'satisfactory' and 'poor' condition trees (currently 82 300)
- replace 'unsatisfactory' trees at the optimal rate of 1445 trees per year with the aim of replacing all unsatisfactory trees over the next five years
- retain reactive maintenance (public complaints) and routine maintenance providing road and utility clearance for 'healthy' trees
- increase annual spending by 70% to deliver the target service level

... an increased level of inspection, maintenance and replacement is required to avoid an excessively high future cost burden, including tree-related injuries, deaths and litigation.

REFERENCES

The predictions about tree age and condition are based upon a comprehensive survey[3] of street and park trees conducted by the ANU during 1997–2000 and more recent modelling[1] of that survey data and related data stored in the Decision Information System for Managing Urban Trees (DISMUT). The survey gathered information on the number of trees, species, size and health and condition.

[1] **Banks, J.C.G., Brack, CL, James, RN** (2002) F*uture Growth and Life Cycle Cost Modelling for Canberra's Public Urban Tree Assets*. Report for Canberra Urban Parks and Places.

[2] **Brack, C and Merritt, W** (2005) *Quantifying the asset, economic, environmental and social values of Canberra's urban forest estate*. Research Consultancy Report for Canberra Urban Parks and Places.

[3] **Banks, J.C.G., Brack, C.L. and James, R.N.** (1998) *Canberra Urban Tree Management Survey of Urban Tree Assets:* Volumes I to IV. Report for Canberra Urban Parks.