The significance of urban tree canopy cover and climate change

16 March 2024

Greg Moore

Nilumbik Climate Month

School of Agriculture, Food and Ecosystem Sciences

- The tree cover of greater Melbourne is by no means as dense as many Melbournians might think, or perhaps wish.
- Over the whole of the greater city of Melbourne:
  - 19 Local Government Areas (LGA) have a tree cover of less that 20% (most in the west, north and inner parts)
- There is a great need to protect what cover we have in LGAs and to provide more cover in LGAs that are deficient.
- Cover on public land is relatively stable and LGAs have policies seeking to increase their tree canopy cover
- Overall canopy cover is falling due to tree losses in urban and suburban private open space (in-fill development, along roads and in heavily urbanised places)

A forest is defined as tree canopy cover equal to or greater than 30%; less is woodland.

- if the term urban forest is used should canopy cover also be equal to or greater than 30%
- if not, is it really an urban woodland?

Language matters as it connotes concept and meaning. When the term urban forest is used does it connote a canopy cover that is greater, (often far greater), than the reality of cover in Australian cities?.

Is 30% an arboricultural magic number?

- A forest is defined by a tree canopy cover of or greater than **30%.**
- To maximise the benefits that canopy can cover in terms of environmental services a canopy cover of or greater than **30%** is required.
- When people buy a suburban home there is an increase in property value when trees are present, until the cover is **30% -** cover higher than 30% sees a decrease in value of the property.
- The target canopy cover for urban cities in Australia, under climate change scenarios should be **30%.**

Significant developments over the past 19 months

- The South Australian Parliament announced a review into tree losses across Adelaide prior to Christmas 2022
- They estimated an 11% canopy cover loss in 10 years and tree removals at 75000 per annum. Melbourne is worse!
- The NSW government committed to the concept of natural capital which will put an economic value on species
- The IPCC delivered its latest report on climate change
- Perhaps these will initiate real change in tree management across Australia

- Significant developments in the last few months
- In the ACT they revealed that their canopy cover is declining and they are not meeting tree planting targets
- A developer was fined $225K for illegal tree removal in Campbellfield, but VCAT approved the development!
- Infrastructure Victoria handed down a CIE report on 5 planning options for Melbourne. The preferred was for more intense development in existing inner suburbs, but no mention of trees
- Parks and gardens ratio is to remain as it is
- The SA Parliament handed down its recommendations on Adelaide tree canopy – more protection, higher fines, only allow tree removal for a sound reason

In contrast to our indigenous people, most Australians have under-valued our large old trees for nearly two centuries.

For indigenous peoples around the world, the older a tree, the more it is venerated for all the things that it has done as it grew to great size and age and for the things it is doing still.

It makes sense to do so, of course, as many of the ecological and environmental benefits that large old trees provide increase as the trees grow and age over decades and perhaps centuries. These benefits are crucial to urban liveability and sustainability.

A very recent study, calculated that to replace the carbon stored in one large, urban, mature oak, would require 48,000 seedlings, but there was no space to plant them.

Currently there is a world-wide movement to preserve old trees for as long as we can to maximise benefits derived.

It is not preservation at any cost, recognition that proper cost:benefit analysis shows large old trees outperform younger trees, and that unnecessary removal of large old trees is unstainable both environmentally and economically.

This does not mean we should not replace dangerous trees or those that are rapidly declining, but there should be no removal of large old trees without demonstrably sound reasons.

Too many large, old, urban trees are being removed unnecessarily because alternatives are not considered.

Whether it is theft or bureaucratic tree removal, the loss of fine old trees will cost us and society dearly as climate changes.

A significant benefit that trees provide over other vegetation is that their leaf area is often more than double canopy cover which has a great cooling effect; shade, evapotranspiration.

Large trees are unequalled in cooling their environment.

The amount of carbon contained in trees relates to how trees grow and old trees simply do things on a scale that small young trees cannot.

As a tree grows and a new tree grows over the old wood, its diameter increases and so a slow growing old tree can take in and sequester more carbon that a quick growing seedling.

We have known for decades that trees are associated with 30 - 50 other species – birds, mammals, reptiles, insects, fungi, algae and others. Tree removal sees the demise of most, if not all, of these species. However, in a recent study of a single ancient English oak (*Quercus robur*) in England, it was found that there were over 2000 dependent and associated species .

With urban trees, it takes years to reach carbon neutrality. The production, planting and maintenance processes all use resource - energy and fossil fuels - meaning that it can take 25 - 30 years before a tree is large enough to have become carbon positive and sequestered more carbon than has been used in getting it to this age.

In the urban forest, many planted trees do not survive the first 2-5 years, but for those that do there is a second rise in tree deaths and removals at about 30 years, meaning that many urban trees never reach carbon neutrality.

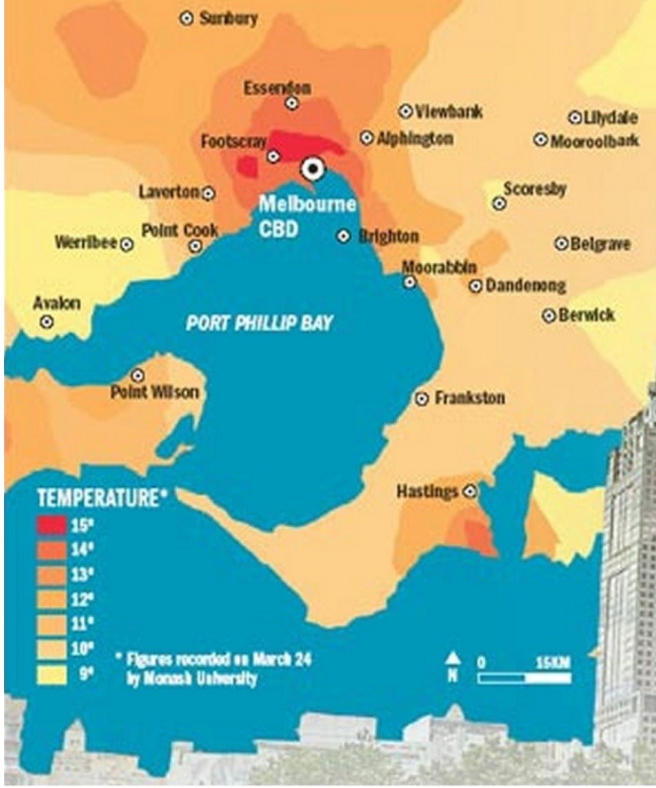
This situation is unsustainable environmentally and ludicrous economically, but seems to go largely unnoticed.

We have accrue all of the costs of growing and planting these trees but recoup none of the potential benefits associated with them.

THE AGE • MONDAY, NOVEMBER 15, 2004
theage.com.au

HOT IN THE CITY

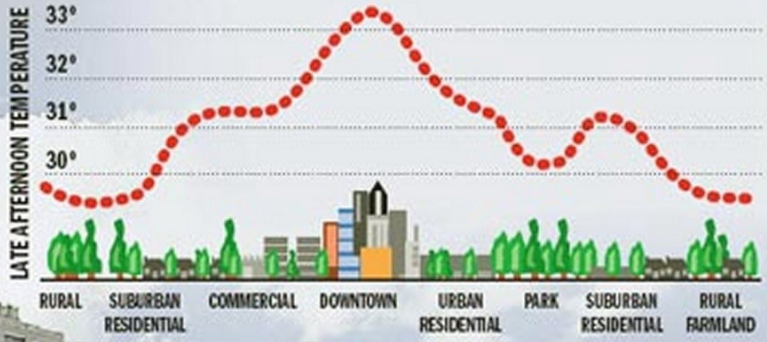
MELBOURNE'S HEAT-ISLAND PROFILE



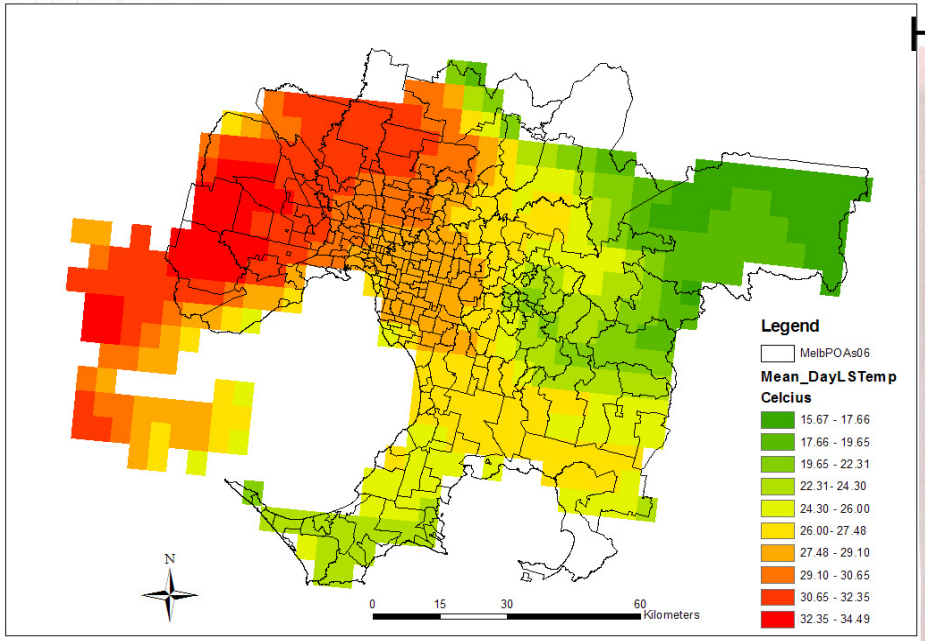
WHAT CAUSES URBAN HEAT ISLANDS

Less vegetation to shade buildings, intercept solar radiation and cool the air.

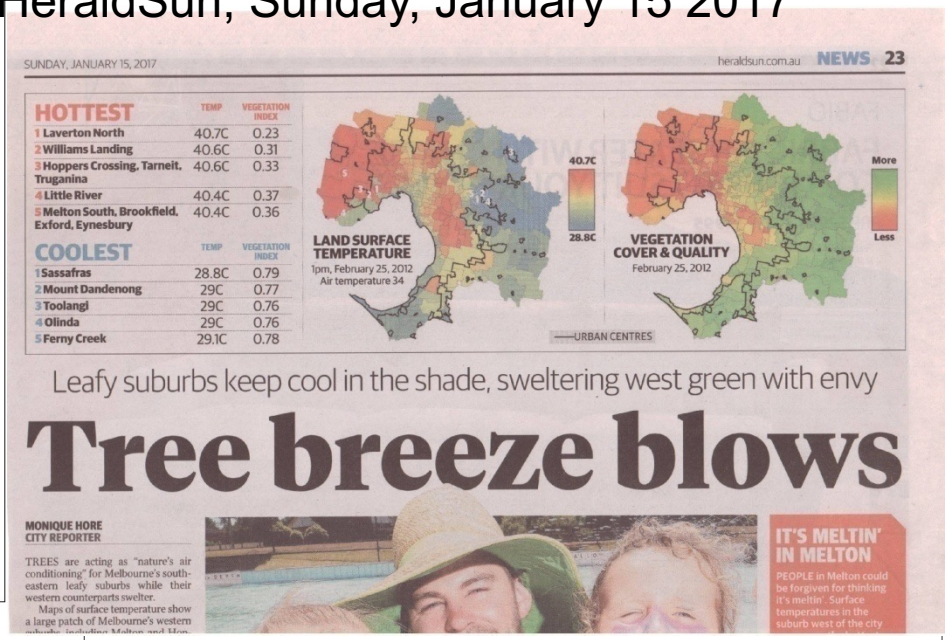
Buildings and pavement made of dark materials absorb the sun's rays, causing surface and air temperature to rise.



Concern on 'islands in the sun'



HeraldSun, Sunday, January 15 2017



SUNDAY, JANUARY 15, 2017 heraldsun.com.au NEWS 23

HOTTEST

	TEMP	VEGETATION INDEX
1 Laverton North	40.7C	0.23
2 Williams Landing	40.6C	0.31
3 Hoppers Crossing, Tarneit, Truganina	40.6C	0.33
4 Little River	40.4C	0.37
5 Melton South, Brookfield, Exford, Eynesbury	40.4C	0.36

COOLEST

	TEMP	VEGETATION INDEX
1 Sassafras	28.8C	0.79
2 Mount Dandenong	29C	0.77
3 Toolangi	29C	0.76
4 Olinda	29C	0.76
5 Ferny Creek	29.1C	0.78

LAND SURFACE TEMPERATURE
1pm, February 25, 2012
Air temperature 34

40.7C
28.8C

VEGETATION COVER & QUALITY
February 25, 2012

More
Less

URBAN CENTRES

Leafy suburbs keep cool in the shade, sweltering west green with envy

Tree breeze blows

MONIQUE HORE
CITY REPORTER

TREES are acting as "nature's air conditioning" for Melbourne's south-eastern leafy suburbs while their western counterparts swelter.

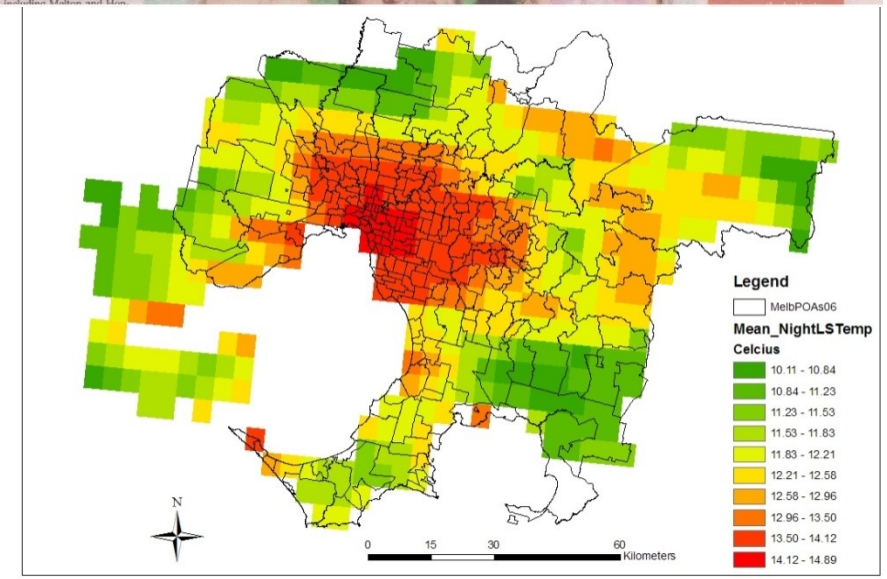
Maps of surface temperature show a large patch of Melbourne's western

IT'S MELTIN' IN MELTON

PEOPLE in Melton could be forgiven for thinking it's meltin'. Surface temperatures in the suburb west of the city

Movement of hot air overnight

Chandra (2010)
Monash University



When Australians talk about climate change, it is apparent that:

- most are aware of the predictions of warmer weather and possibly lower rainfall
- most are unaware of the implication of raised atmospheric temperatures on storm events and wind speeds
- most seem to be unaware that for a huge continent like Australia, the effects will vary across the country
- generalising can be dangerously difficult
- few are aware of predictions of heavier rainfall events in drier months which compound the effect of a lowered rainfall or the increased likelihood of flash flooding

Applied scientists are practical people, working in the real world aiming to:

- solve problems
- stay out of party politics
- save society unnecessary expenditure

improve everyday lives.
do things well
be efficient.

The notion that if you do nothing about climate change it costs you nothing is nonsense – doing nothing costs you now, but ensures costs will be higher in the future.

The climate wars will cost Australia billions and loss of canopy cover seems to be similar. Warnings of canopy loss are being ignored

It is a transfer of a huge financial and economic liability to the future

THE VITAL ROLE OF TREES IN COPING WITH CLIMATE CHANGE

Despite knowing the value of tree canopy cover in reducing UHI, in most Australian cities canopy cover is declining;

- In Melbourne, the loss is 1-1.5% per annum
- Due to the removal of trees on private land – front and back yards - for more intense housing development
- North American studies show that development leads to an annual 1% decrease in urban canopy cover area above private land
- This can be a serious concern for cities and towns anticipating population increase and future densification

THE VITAL ROLE OF TREES IN COPING WITH CLIMATE CHANGE

- It is staggering that trees are removed because of minor nuisance or infrastructure damage
- Trees that have provided environmental services and economic benefit for decades are removed for damaging infrastructure that can be rectified for a few hundred dollars
- Where are the cost:benefit analyses in these cases?
- Worse are thoughtless tree removals based on whim, ignorance or prejudice precipitated when private property changes hands

Private land owners have a responsibility for managing trees for the greater community good

Some high value social and medical benefits correlated with higher tree canopy cover that are typically under-appreciated

Lower heatwave related rates of mortality	Higher average baby birth weights
Lower overall crime rates	Better learning outcomes for students
Quicker recovery after hospital treatment	Fewer prescription medicines for residents
Reduced social disadvantage	May reduce self harm and suicide rates
Increased human resilience under stress	May reduce domestic violence
Longer life spans	Higher levels of resident general health

Benefits of tree-shaded shopping centre car parks.

Benefits for shopping centre owners	**Environmental benefits**
Attract new shoppers who value their cars being protected from sun damage/heat	Reduced stormwater runoff if roots systems have access to water
Maintaining shopper loyalty	Reduced levels of pollution
Keeping shoppers at the centre longer	Carbon sequestered
Increasing the street appeal of the centre	Lower urban heat island effects (UHI)
Decreasing tenant vacancies	Improved air quality
Willingness to spend more for products	Extended life of bitumen
More frequent shopping visits	Moderation/reduction of wind speeds
Extended life of bitumen	Reduced vehicle hydrocarbons emissions

THE VITAL ROLE OF TREES IN COPING WITH CLIMATE CHANGE

- Heatwaves are the biggest killers of people of all natural disasters.
- In the Victorian on black Saturday 2009, 173 people died in the bushfires, but 374 people died of heat-related causes during the heatwave
- Greatest number of deaths were in western and northern suburbs
- Greatest number of deaths correlated with absence of trees and greenspace
- Hundreds of people have died in heatwaves since
- **The easiest, least costly and most sustainable way of cooling cities and towns is by increasing the green space and tree canopy, but we are not doing it**

At the 2016 TREENET Symposium in Adelaide

Epidemiologists reported the following analyses of the value of treed open space and its cost saving to the Australian national health system:

- For type-2 Diabetes up to $800 million pa could be saved
- For high blood pressure related illnesses and diseases, the cost savings were estimated at $4.2 billion pa.

The total saving were estimated at $5 billion per annum.

Much of these savings comes from the simple effect of an increase in passive or active recreation that treed and shaded open space encourages.

Website treenet .org

Recreational usage of Open Space Enhanced by the Presence of Trees:

The use of recreational open space for both active and passive recreation is known to be enhanced by the presence of trees in the landscapes.

The health benefits from increased activity and exercise can be quantified and in Victoria would save about $274 million per annum for the health department.

The Victorian Department of health noted:
promoting health and well being outcomes through promoting the use of alternative water resources such as stormwater to maintain green spaces, thereby enhancing physical activity and livability. (Dedman, 2010).

- Although data are hard to come by, parts of greater Melbourne are losing about 1-1.5% canopy cover per annum

- Most of this loss of trees is from private open space (front and back yards) rather than public open space, such as parks, gardens and streets

- About 95% or tree removal requests are ultimately approved in Victoria

- Ignorance → Inaction → Negligence?

- A Canadian study, removing all the trees around homes resulted in a doubling of wind speed and increased wind pressure that is responsible for up to 1/3 of a building's energy consumption

- Removing all the trees around buildings increased its energy consumption by up to 10% in winter and 15% in summer

- Bare branches play a role so deciduous trees also reduce pressure loading on buildings year round – it's not only evergreens that are important

Ignorance → Inactivity → Negligence?

Diabetes Type 2

No Parks/trees → Inactivity → Increased weight → increased rates of type-2 diabetes → Negligence?

Blood Pressure and cardiac Disease

No Parks/trees → Inactivity → Increased weight → increased rates of heart and cardiac disease → Negligence?

Heat Wave Related deaths

No Parks/trees → No shade (High UHI) → Increased excess deaths → Negligence?

The Age, Saturday, January 23, 2016

THE AGE SATURDAY, JANUARY 23, 2016

Frightening picture for Melbourne revealed in

Benjamin Preiss
Josh Gordon

Melburnians should prepare for more extreme heat with double the number of hot days, less rain and harsher fire conditions in coming decades, the state government has been warned.

Analysis prepared for the Andrews government paints a frightening picture of Melbourne's future climate, with transport infrastructure vulnerable to flooding and heat stress, longer and more severe bushfires and pressure on hospitals from heatwaves.

The modelling, from the CSIRO and Bureau of Meteorology, predicts climate change could have a major impact on the state's health system, economy and environment, including shorter snow seasons, food production challenges and problems with transport infrastructure.

The forecasts were prepared as the Andrews government seeks to elevate climate change as a political issue ahead of possible new laws to tackle emissions.

The predictions, based on international climate models, show that under a high emissions scenario similar to the current trend, the number of days over 35 degrees in Melbourne would more than double from an average of eight a year to 17 by 2070. Average rainfall could drop by up to 23 per cent in the most extreme case.

"Despite an overall trend of declining rainfall, more of the rain that does fall will be in increasingly extreme downpours," it said. "This is likely to lead to an increase in the incidence of flooding events, particularly in urban-

"In 2050, under high emissions, the climate of Melbourne will be more like Adelaide now," the report says.

Even under a lower emissions scenario, average temperatures would still rise by 1.5 per cent by 2070 compared to the 1986 to 2005 average.

Environment Minister Lisa Neville said Victorians were already feeling the effects of a warmer climate. She said the government was working to ensure the "right legislation" would "deliver climate change action".

The economic, environmental and social ramifications of the changes are likely to be significant. The report warns future governments may need to consider moving "selected populations" in areas of extreme heat to other parts of the state. In one scenario Mildura would have 66 hot days a year.

Increased temperatures would hit Victoria's tourism sector, the projections show. "The impacts of climate change on tourism are likely to include increased heatwaves and harsher fire weather. Significant reductions in stream flows will adversely affect water-based tourism," it says.

The report finds temperatures have increased by up to 1.6 degrees in some parts of Melbourne since 1950.

Victoria's transport network would also be hit under the most extreme forecasts.

"Transport infrastructure will be increasingly exposed to periodic flooding and increased heat loading. Extremely high temperatures may also reduce the performance of the railway network, potentially leading to disruptions."

Warming seas and increased storm surges could also harm coastal ecosys-

Herald Sun, Wed, March 14, 2012, P 12

Experts deliver soggy prediction

Get used to floods

Angus Thompson
weather reporter

AUSTRALIA can expect more drenching downpours, despite recording the wettest two-year period on record.

The second State of the Climate report, produced by the weather bureau and the CSIRO, says despite becoming hotter and drier with more droughts, Australia can expect wet periods featuring major rainfall.

The report comes as towns in northern Victoria mop up after the second consecutive year of widespread flooding, in which several rainfall records were broken.

Dr Rob Colman, the head of the weather bureau's climate change science team, said while southeastern Australia would have an estimated 10 per cent less rainfall by 2070, there would be periods of rain that were more frequent and more extreme.

"The frequency of very heavy rainfall events will be expected to increase from where they are at the moment," he said.

But Dr Colman said the science was still out on whether La Nina events, which caused major flooding in recent years, would increase in intensity.

As Australia heats up, the number of record hot days has more than doubled the number of extreme cold days in the past decade.

Weather bureau climate monitoring manager Dr Karl Braganza said there was a spike in the number of weather stations breaking their previous monthly records.

"You're having more and more hot nights, and record-breaking hot nights, and less and less nights that set frost and record-low minimums," he said.

An increase in cyclones wreaking havoc on northern Australia was also likely, according to the latest national report on climate change.

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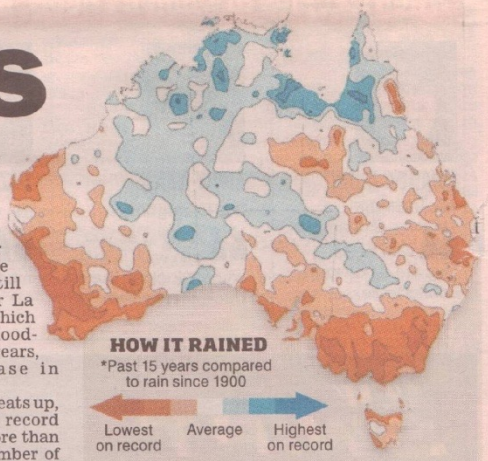

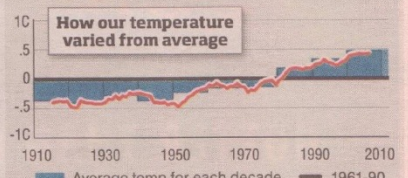

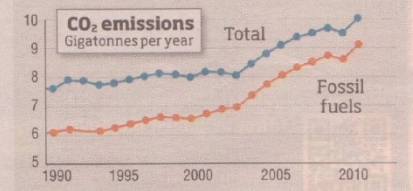

Source: *State of the Climate 2012*

The AGE, Tuesday, May 23, 2017, P 9.

Climate-change flood risk doubled in new modelling

Adam Carey

Tens of thousands of homes and businesses in Melbourne face a growing risk of tidal flooding by century's end, with major roads, tram routes and industrial areas slipping under water as sea levels rise, new modelling shows.

Updated modelling predicts Victoria's coastline could be hit by a rise in sea level of two metres or more by 2100, due to the rapid melting of ice sheets in Antarctica and Greenland.

Such a rise would flood low-lying suburbs in Melbourne, including South Melbourne, Albert Park, Port Melbourne, Southbank, Docklands, Altona, Williamstown, Elwood, St Kilda, Seaford, Carrum, Bonbeach and Aspendale.

Large areas in Geelong and the seaside towns of Barwon Heads, Queenscliff and Point Lonsdale would also be inundated at high tide by century's end, new research by the US National Oceanic and Atmospheric Association predicts.

Sections of major roads including CityLink, Flinders Street, Wurundjeri Way, Footscray Road, Clarendon Street and Queens Parade would also be under water at high tide, as well as several tram routes in Melbourne's bayside suburbs.

The projections updated projections made in the landmark 2013 report by the Intergovernmental Panel on Climate Change.

That report said a 74-centimetre sea level rise by 2100 was a worst-case scenario. Since then, ice sheets in Antarctica and Greenland have been found to be melting more rapidly than thought.

The 74-centimetre "worst-case scenario" is now considered probable, with a rise of two metres to 2.7 metres now a "plausible worst-case global mean sea level rise scenario", according to the NOAA.

> **'If the sea rises to that level it would be a national disaster.'**
> **Alan Stokes, Australian Coastal Councils Association**

The scientific agency mapped the updated effects on Australia's coastline using local tidal data and Google mapping technology.

Co-creator of the Coastal Risk Australia website Nathan Eaton said that just as the rate at which the sea level has risen has accelerated in the past few decades, much of the potential rise of two metres would occur in the latter half of this century.

"Anyone can look at these maps and visualise exactly how sea-level rise, driven by climate change, will permanently alter our coastline and neighbourhoods," Mr Eaton said. "We already knew this was going to be bad news for low-lying areas, but the latest science is telling us to brace for even worse."

Alan Stokes, executive director of the Australian Coastal Councils Association, said the revised modelling was a wake-up call for governments.

"If the sea rises to that level it would be a national disaster," Mr Stokes said.

He called on the federal government to reverse funding cuts it made to research to support climate-change adaptation, including an online tool for councils called Coast Adapt that faces a heavy funding cut from July 1.

"Coastal councils are at the forefront of dealing with these projected impacts but they are really tackling this problem with one arm tied behind their backs because they just don't have the resources to respond effectively," Mr Stokes said.

The global mean sea level has risen by 21 to 24 centimetres since 1880, with eight centimetres since 1993.

"Scientists expect that [sea levels] will continue to rise throughout the 21st century and beyond," the NOAA report says.

School of Ecosystem and Forest Sciences - Burnley

Along Taylor's Creek, Keilor, trees planted in a revegetation scheme in the 1980s have slowed flood water, reducing erosion and stream side scouring. The waters are spread over a greater area but this is available and so does not result in damage.

An unexpected consequence is that litter spreads away from creek and does not enter the Maribyrnong River or Port Philip Bay.

The litter can be easily and cheaply collected from the edges of the flood plain much closer to its source and with less environmental impact

The economic benefits of both reduced erosion and easier local litter collection could be readily established.


POSTERA CRESCAM LAUDE

THE VITAL ROLE OF TREES IN COPING WITH CLIMATE CHANGE

- As it gets hotter, there will be an increase in extremely hot days; a doubling in days above 40°C in some cities
- Air conditioners will be increasingly used to make homes liveable
- Increased electricity consumption, and greater carbon footprint
- With electricity prices soaring, it adds to family fuel bills

Two medium-sized trees (8-10m tall) placed to the north and/or north-west of you home can reduce the temperature inside your home by several degrees and save you in excess of AUD$200 per year

They also sequester carbon and extend the life of paint on your walls

Costs of running an air conditioner over summer and the savings in electricity due to shade from trees in you garden (2024 update from Moore 2013).

Power (Size) of Air Conditioner (kW)	**6**
Hours of use in an unshaded home over summer	**200**
Electricity tariff (an off peak general average) (cents per kWh)	**35**
Total air conditioner electricity bill ($)	**420**
Reduction due to one tree shading the afternoon sun (kWh)	**50**
Saving in electricity bill ($)	**105**
Reduction due to two trees shading the afternoon sun (kWh)	**100**
Saving in electricity bill ($)	**210**

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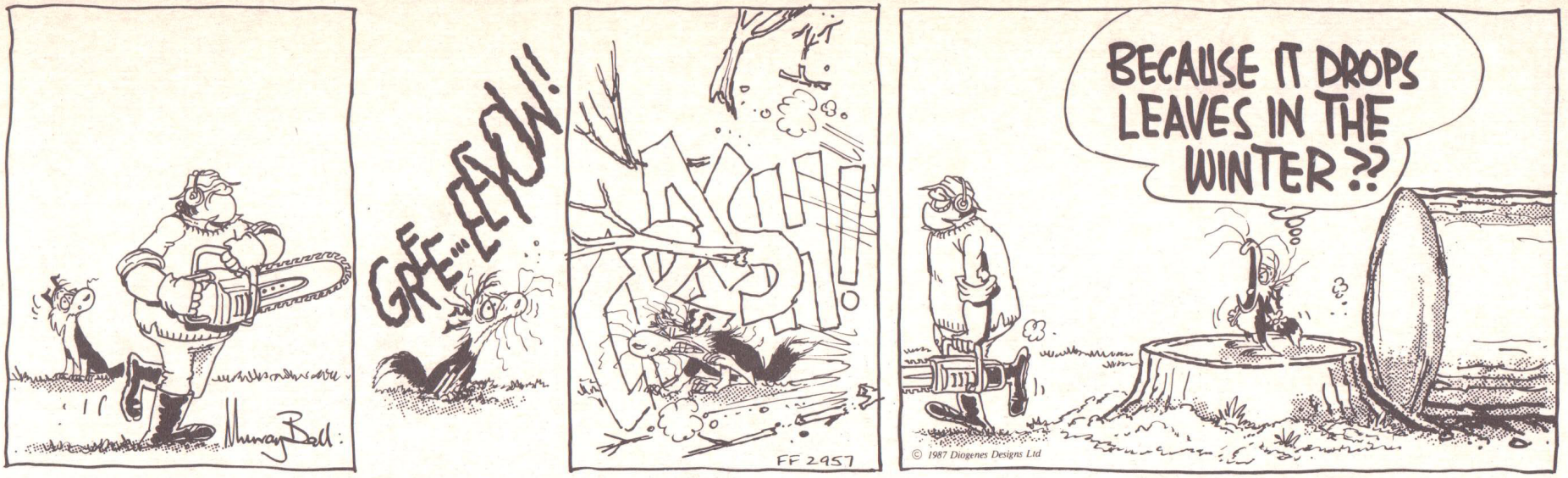

Economic value of trees in providing outdoor shade for schools, universities and other public buildings.	**Shade sail Replacement Option**
Cost of shade sail (50m^2 and support poles) AUD$	5000.00
Number of shade sails required	1
Useful life of shade Sail (Years)	10
Value of shade provided by tree over 10 years AUD$	5000,00
Value of shade provided by tree per annum AUD$	500.00

Economic value of shade for an urban street lined by 100 trees prolonging the life of bitumen.

Approximations used	**Value**
Estimated length of street (m)	**500**
Width of road surface (m)	**7**
Area of Bitumen road surface (m^2)	**3500**
50 trees on each side of the street so total number of trees	**100**
Shade from an individual tree canopy (m^2)	**75**
Area of bitumen shaded by tree canopy, estimated at 33% of total (m^2)	**37.3**
Total area of bitumen shaded by tree population of 100 trees (m^2)	**3,730**
Cost of resurfacing bitumen per m^2 (AUD$)	**450.00**
Total value of extending the life of the shaded bitumen from 20 to 30 years due to the 33% shade from 100 trees (AUD$)	**1,678,500**

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Carbon lost and its value for pruning 100 mature urban trees canopies.

Approximations used	**Single Tree**	**100 Trees**
Average weight of whole tree (above and below ground components (t)	**100**	
Amount of carbon sequestered in each tree (t)	**13**	
Amount of carbon sequestered in the canopy of each tree (t)	**6.5**	
Amount of carbon lost if 30% of canopy pruned from each tree (t)	**1.95**	**195**
Amount of carbon lost if 20% of canopy pruned from each tree (t)	**1.30**	**130**
Amount of carbon lost if 10% of canopy pruned from each tree (t)	**0.65**	**65**
Value of 1tonne of carbon $AUD	**23**	**23**
Value of carbon pruned from 100 trees when 30% pruned (AUD$)	**44.85**	**4485.00**
Value of carbon pruned from 100 trees when 20% pruned (AUD$)	**29.90**	**2990.00**
Value of carbon pruned from 100 trees when 10% pruned (AUD$)	**14.95**	**1495.00**

Gross Annual Benefits from an Adelaide Street Tree

BENEFIT CATEGORY	Value
Energy Savings	$64.00
Air Quality	
CO2 (reduced power output)	$1.00
Air Pollution	$34.50
Storm Water	$6.50
Aesthetics/others	$65.00
Repaving Savings	?
Estimated Gross Benefits	$171.00

These estimates were made in 2002.

A more recent estimate in 2009 put the value at $424.00.

The estimate has more than doubled in 7 Years

It is not just the above ground parts of the trees that provide benefits and services

Roots and mycorrhizae:

- Sequester large amounts of carbon
- Consolidate soil and reduce soil erosion
- Reduce risks of landslides

Roots have an economic value just as stems and branches do


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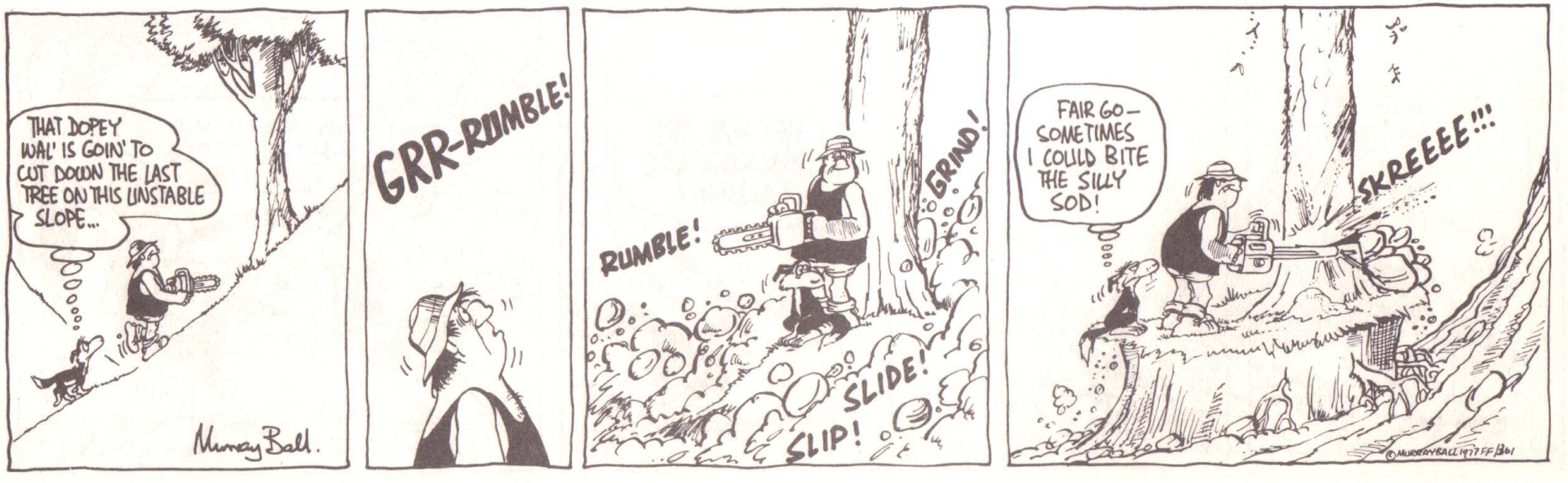

Value of trees in stabilising land	**Piling Replacement**	**Value from 5 trees over 50 years**
Number of trees	5	5
Cost of Piling (AUD$)	50,000.00	50,000.00
Total value of 5 trees	50,000.00	1000.00 per annum
Value per tree per annum	1000.00	200.00

Tree Value and property value:

- A good front garden tree adds $5,000 to property value
- Others value as high as $50,000 or 5.4% of property value
- Turf Australia surveying 114 estate agents and estimated that people were prepared to pay an additional $75000 for a house with a green lawn (Williams 2014).
- 73% of Australians want a backyard and
- 57% of Australians want a park within a 5-10 minute walk of their home

- A tree-lined nature strip added $30, 000 to properties in streets that had trees compared to similar houses on treeless streets two streets away (no one wanted the trees in front of their place!)


POSTERA CRESCAM LAUDE