

water by **design**

an initiative of Healthy land & water 

WaterWise

Street Trees

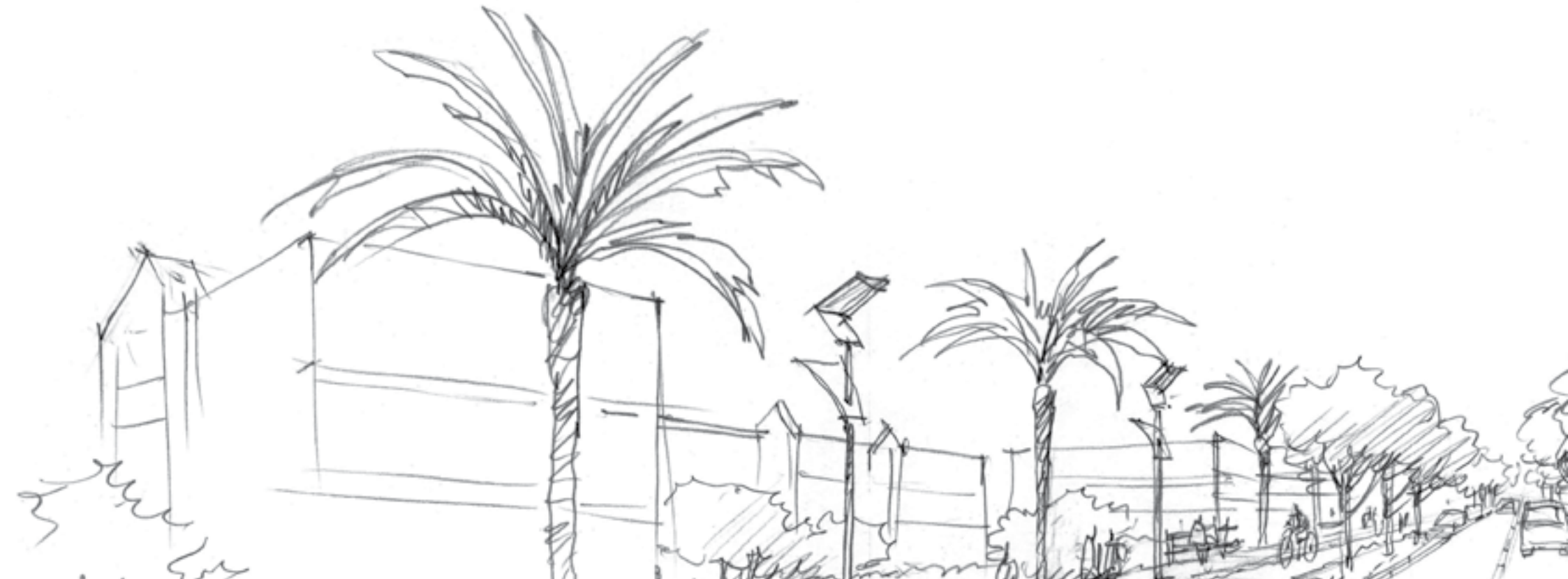
Concept Design Catalogue



Healthy Land and Water is an independent organisation dedicated to improving and protecting South East Queensland's environment. As experts in research, monitoring, evaluation and project management, we deliver innovative and science-based solutions to challenges affecting our landscapes, waterways and biodiversity. Our Water by Design initiative was established in 2005 and builds the capacity of the water and urban development sectors to help successfully implement sustainable cities through better urban water management.

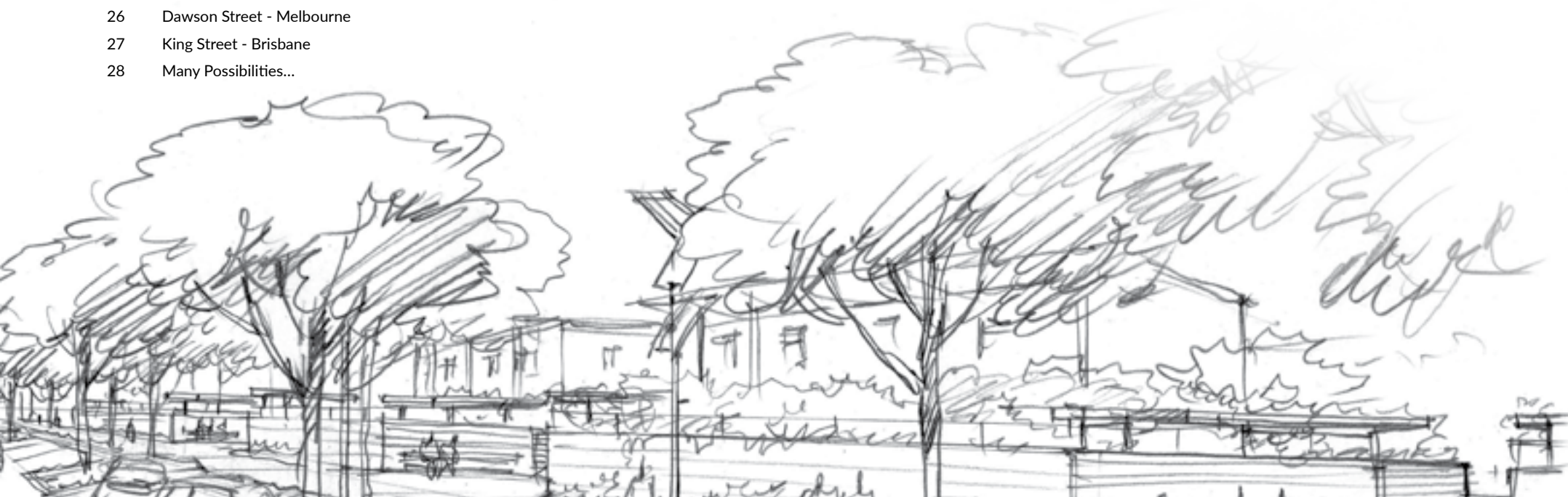
Find out more at www.waterbydesign.com.au

For further information about this guideline, or other projects, please email: info@hlw.org.au or telephone (07) 3177 9100.



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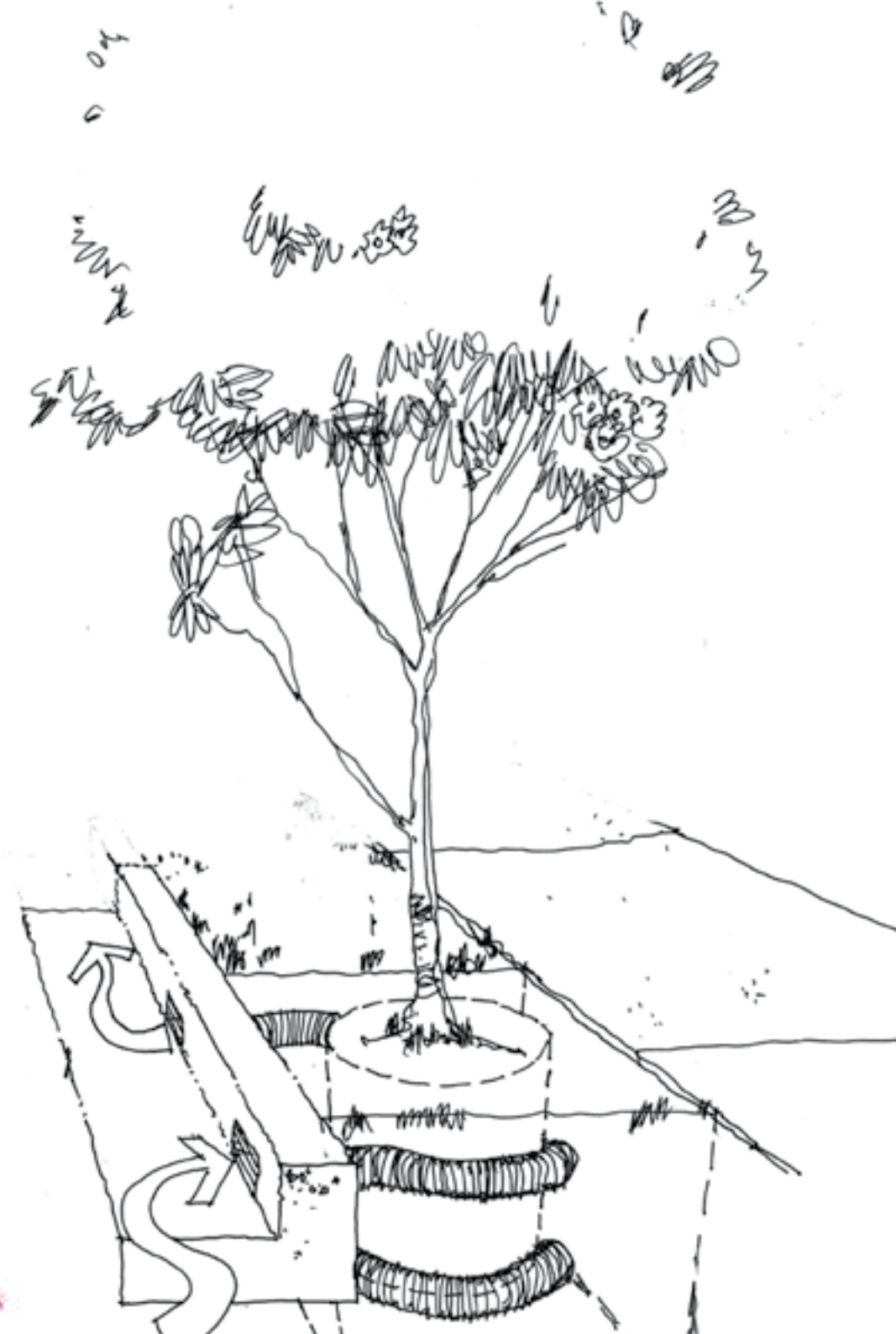


Introduction

With a changing climate and increasing urbanisation, the relationship between street trees and water is coming to the fore. The environment of the street tree is often harsh. Large amounts of impervious surfaces prevent water from reaching trees, while hard structures prevent tree growth and provide inhospitable habitat for roots. At the same time, increasing urbanisation means that there is more surface water available in our cities than ever before. With this increase in water flow, comes pollution and the increasing ability for this water to erode our creeks and rivers.

There is an elegant but simple solution to both problems. We can ease the stress on our water systems and at the same time create lush green shaded streets adding significantly to our comfort and to the vitality of the street trees.

How? by connecting the street tree to a free and fit for purpose supply of stormwater from the road gutter. Simple as that.





A Waterwise Street Tree garden integrated into a busy plaza precinct in downtown Penticton, Canada.

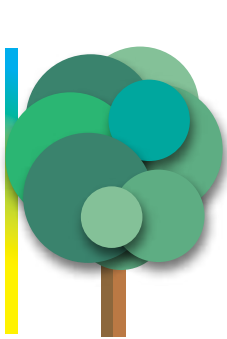
Artwork: Purnima Periwal

Why Use Water Wise Street Trees

Water Wise Street Trees are a gamechanging technology. it turns a hazard (i.e. too much nutrient-laden stormwater) into a multitude of benefits as outlined below.

"The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased; and not impaired in value."

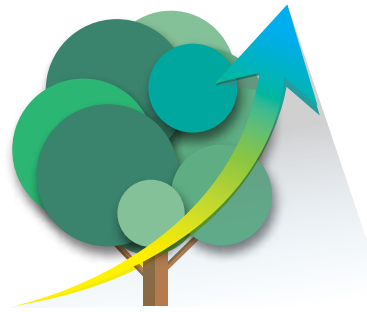
- Theodore Roosevelt



DOUBLE THE GROWTH RATE



CANOPY 8-10X LARGER



INCREASED LIFESPAN FROM 13 TO 50 YEARS



ALTERNATIVE WATER SOURCES



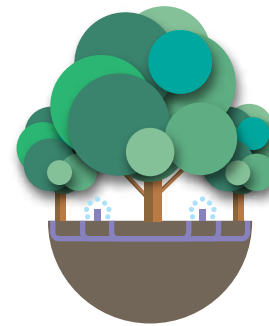
LOCAL MICROCLIMATE COOLING BENEFITS



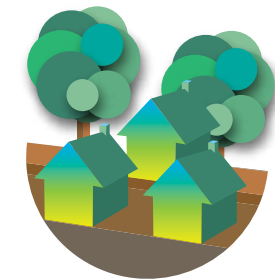
PROTECT RECEIVING ENVIRONMENTS



ACHIEVE STORMWATER



REDUCE NEED FOR ACTIVE IRRIGATION

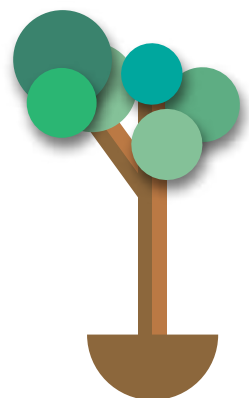


LEAFY STREETS IMPROVE PROPERTY VALUE BY 3%

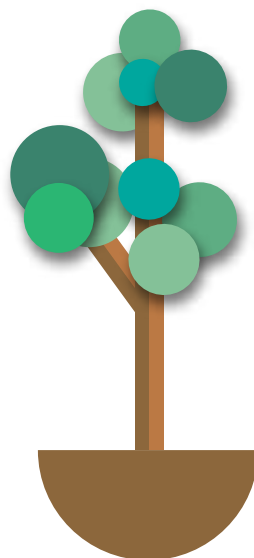
Different Types of Water Wise Street Trees

"Someone's sitting in the shade today because someone planted a tree a long time ago."

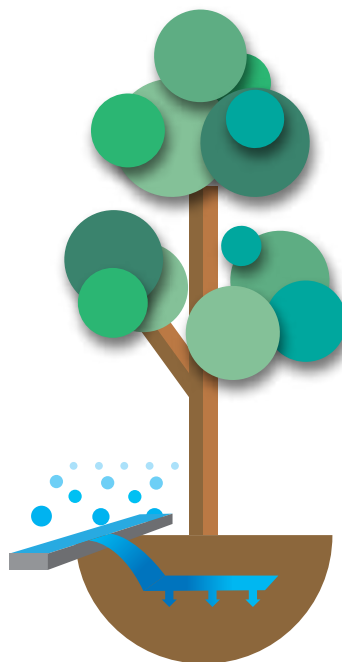
- Warren Buffett



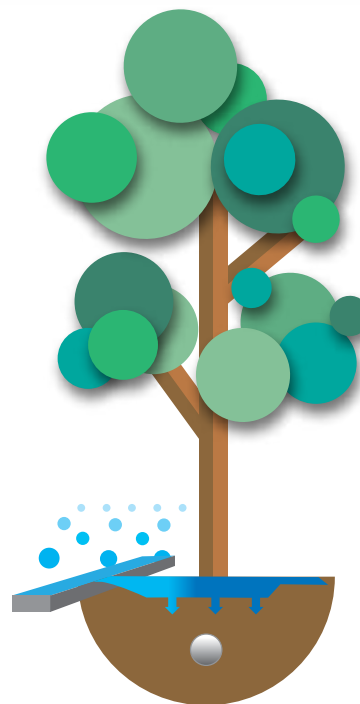
STANDARD



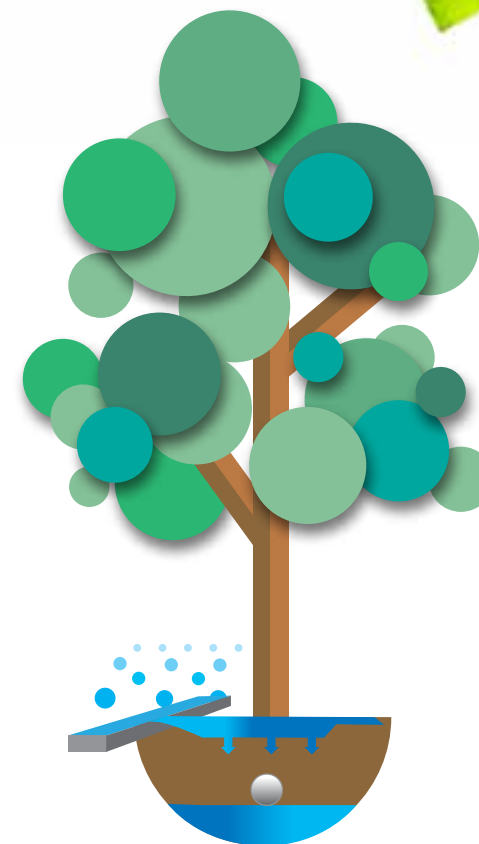
+ SOIL VOL



BRISBANE CITY
COUNCIL'S WATER
SMART STREET TREE



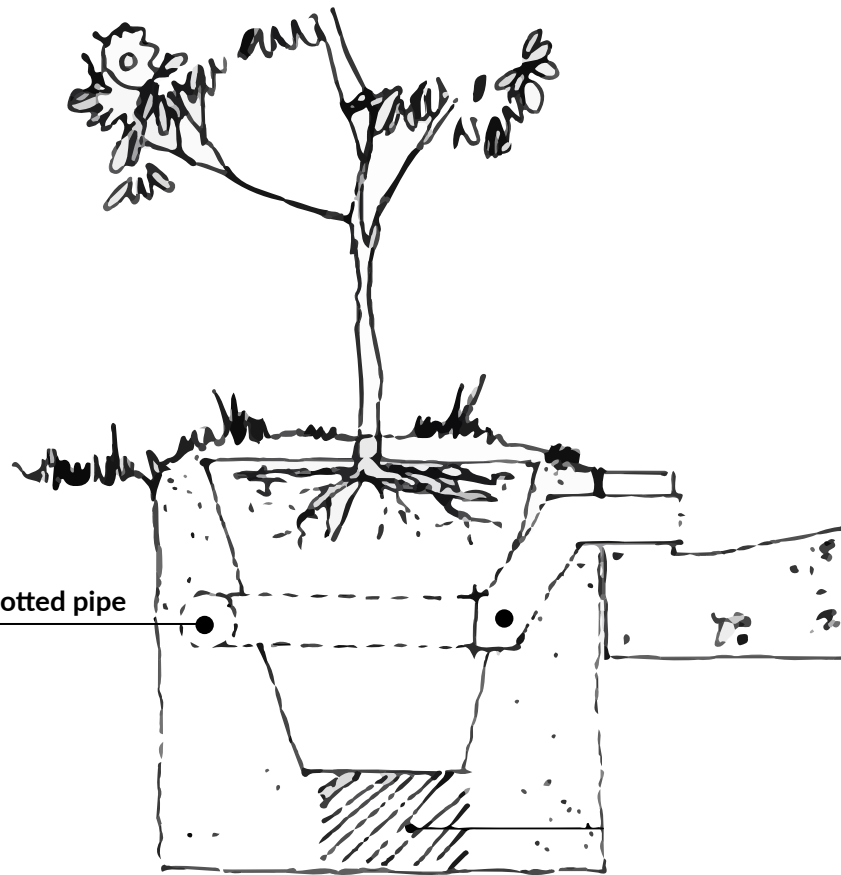
BIORETENTION STREET
TREE



BIORETENTION
STREET TREE WITH
SATURATED ZONE

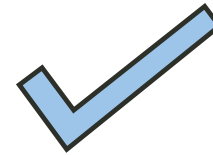
The Basic Water Wise Street Tree

A simple connection between the gutter and the street tree is all it takes to vastly improve the health and vigour of a street tree.

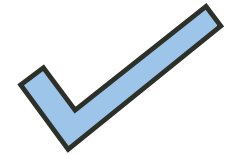


Distribution slotted pipe

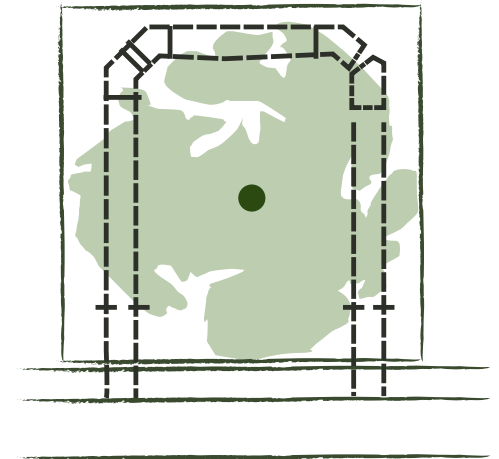
Inlet pipe drops from
kerb to distribution pipe



flexible corrugated



slotted rigid



A Stormwater Source

Photo credits: Brisbane City Council



A Traditional Street Tree



A Water Smart Tree

Both trees were installed on the same day on the same side of the same street. The growth difference is remarkable.

*"When one tugs at a single thing in nature,
he finds it attached to the rest of the world."*
- John Muir

Caring for Our Country Grant

SEQ Catchments

Brisbane City Council - Water Smart Street Tree Program

Ipswich Road

Albert Street

Wynnum Road

Project partner



Dedicated to a better Brisbane

As part of Brisbane City Council's commitment to achieving its vision of being a Water Smart City with a "Healthy River and Bay", in 2013 they applied for Australian Government 'Caring for our Country' grant funding for the installation of 100 water smart street trees, between 2014 and 2018. This funding was received as part of a successful collaborative grant application led by SEQ Catchments (now Healthy Land and Water Ltd) titled 'Brisbane Communities Working Together to restore Urban Waterways'. Under the provisions of the grant, the trees were to be delivered through Council's Shadeways and Boulevards Program.

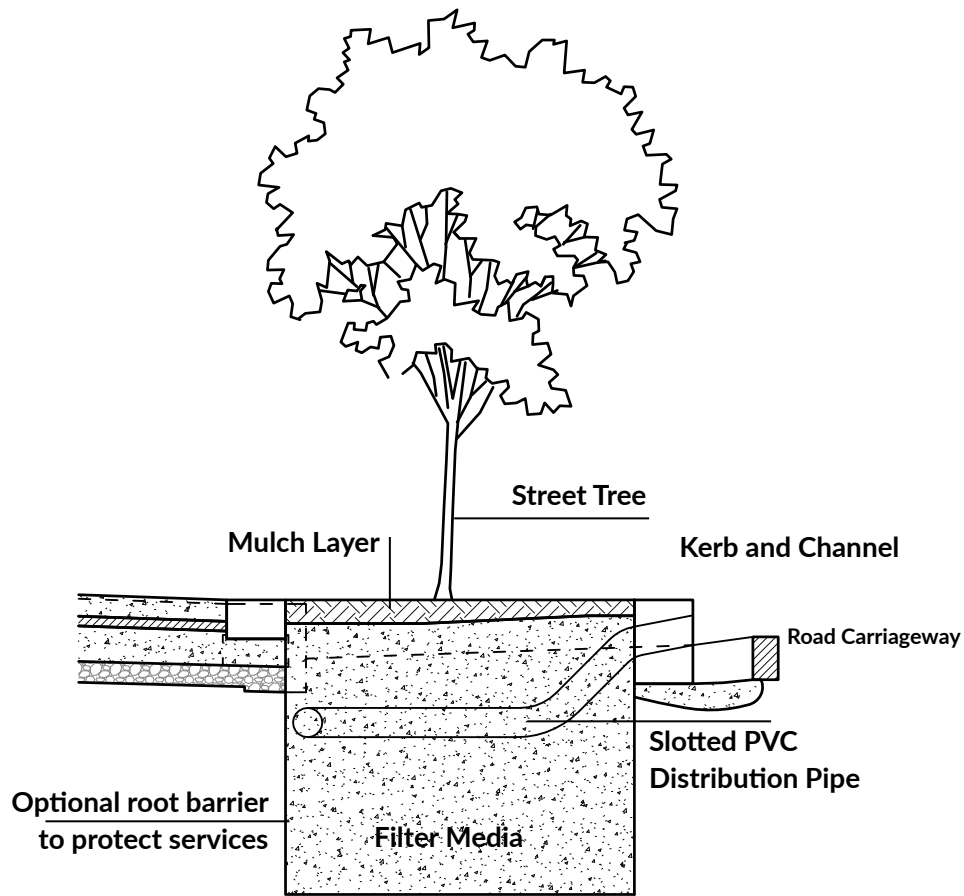
Water Smart Street Trees (WSST) provide an innovative way to deliver an alternate source of water to maintain street trees by diverting stormwater from the kerb to the root zone of street trees planted in adjacent garden beds. To achieve this, the garden beds incorporate specialised designs and technologies. The stormwater and nutrients delivered to the trees is intended to improve tree growth and survival, reduced maintenance costs and reduced potable water use.

WSST also aim to reduce sediment and nutrients flowing into downstream waterways. The grant provided an opportunity to develop and field trial a range of water smart street tree designs and technologies that could be incorporated into business as usual street tree plantings. Through this project Council has also sought to provide a practical demonstration of innovative, cost effective applications of water sensitive urban design principles.

Source: Water Smart Street Trees – Final Report BCC 2018

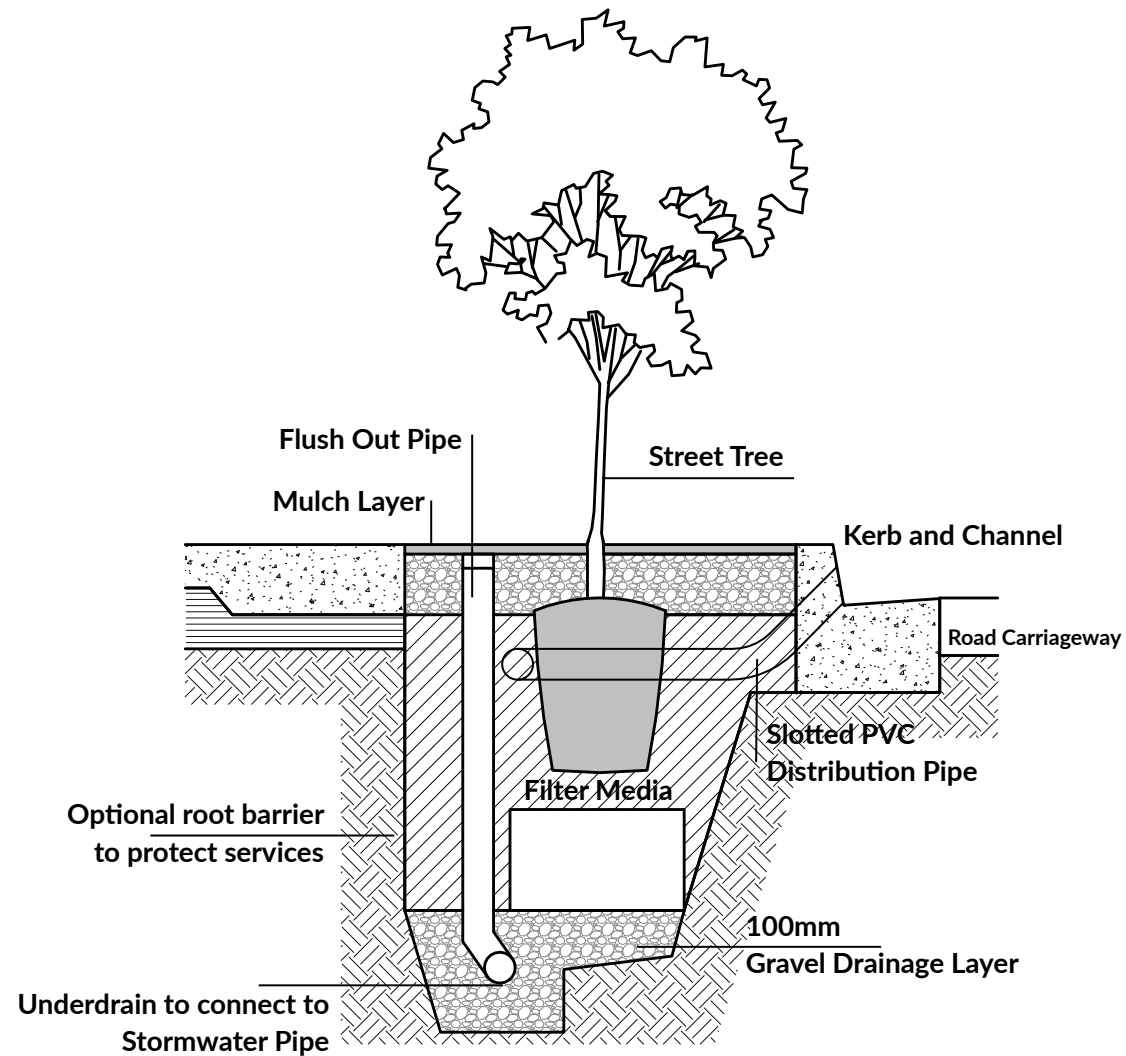


Water Smart Street Tree - Without Underdrainage



The additional cost of WSUD components ranged from approximately \$500 to \$2000 (depending on site constraints and traffic control).

Water Smart Street Tree - With Underdrainage



Ipswich Road - Yeronga

Ipswich Road used to be quite uncomfortable to walk beside on a Summer afternoon. In 2016, Street Scape planting begun and has changed the character of the street and appeal to pedestrians significantly.



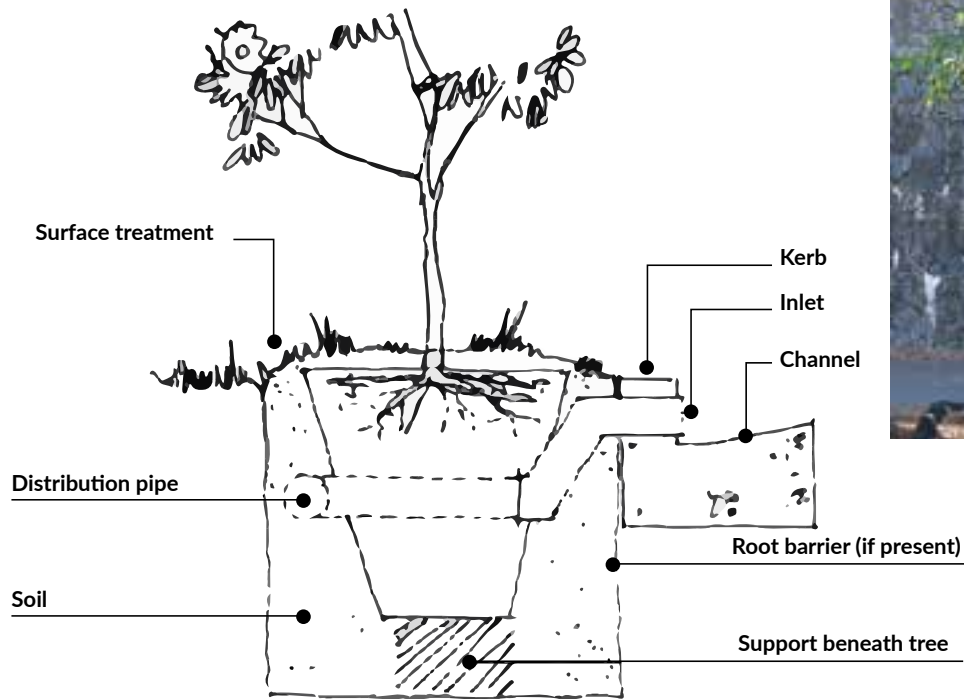
Albert St - City



◀ As a steep street, Albert Street required inlet modifications to combat scouring issues and allow for the planting of vital street trees.

Albert St - City (Continued)

In just three years, the trees along Albert Street have doubled in size. This is due to their newfound reliable water supply.



July 2015



Jun 2016



Apr 2018

▲
A cross section of a water smart street tree

Wynnum Rd

The Street Trees along Wynnum Road have benefited greatly from passive irrigation of storm water. The series below shows a large increase in the tree canopy.



Dec 2015



Dec 2016



Jun 2017



Mar 2018



Water Wise Street Tree Trial 2019

Maud Street - Mirani, Mackay

Batten Street - Kedron, Brisbane

Stanley Street - Townsville

Grande Avenue - Spring Mountain, Ipswich

Water by Design are organising a water wise street tree planting trial across the state to promote passive irrigation technology. This simple technology can help improve tree health as well as providing water quality and hydrologic benefits.

This initiative aims to monitor and compare the growth rate of water wise trees against standard 'control' trees right across the state. Participating organisations can submit photos and height records of the trees at 3-monthly intervals and results will be shared on our website.

The scientific data collected will be valuable for comparing the climatic impacts on street tree growth across the state. It will also help validate design parameters to improve the technology.



***“Do not be afraid to go out on a limb...
That’s where the fruit is.”***

- Anonymous

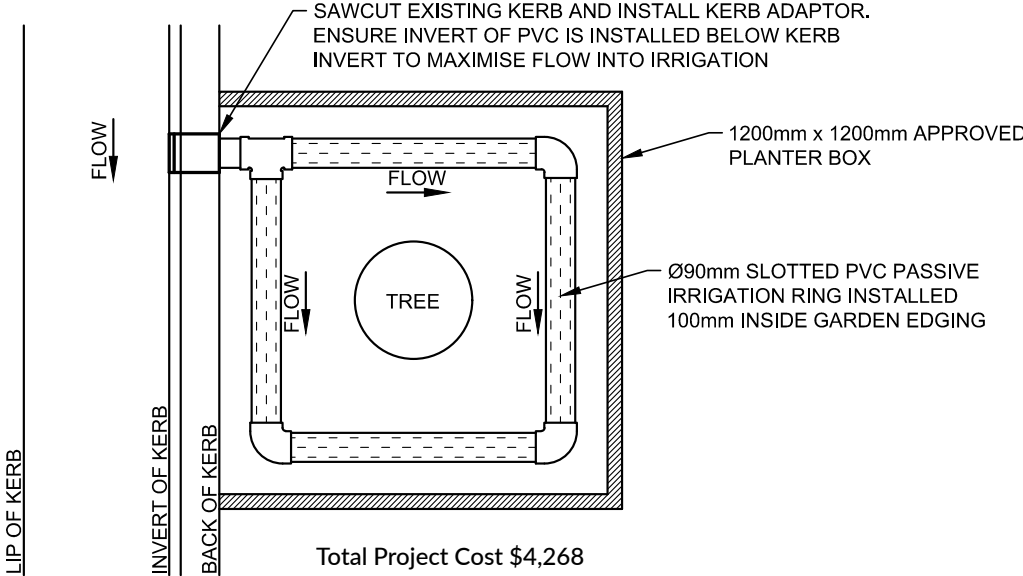
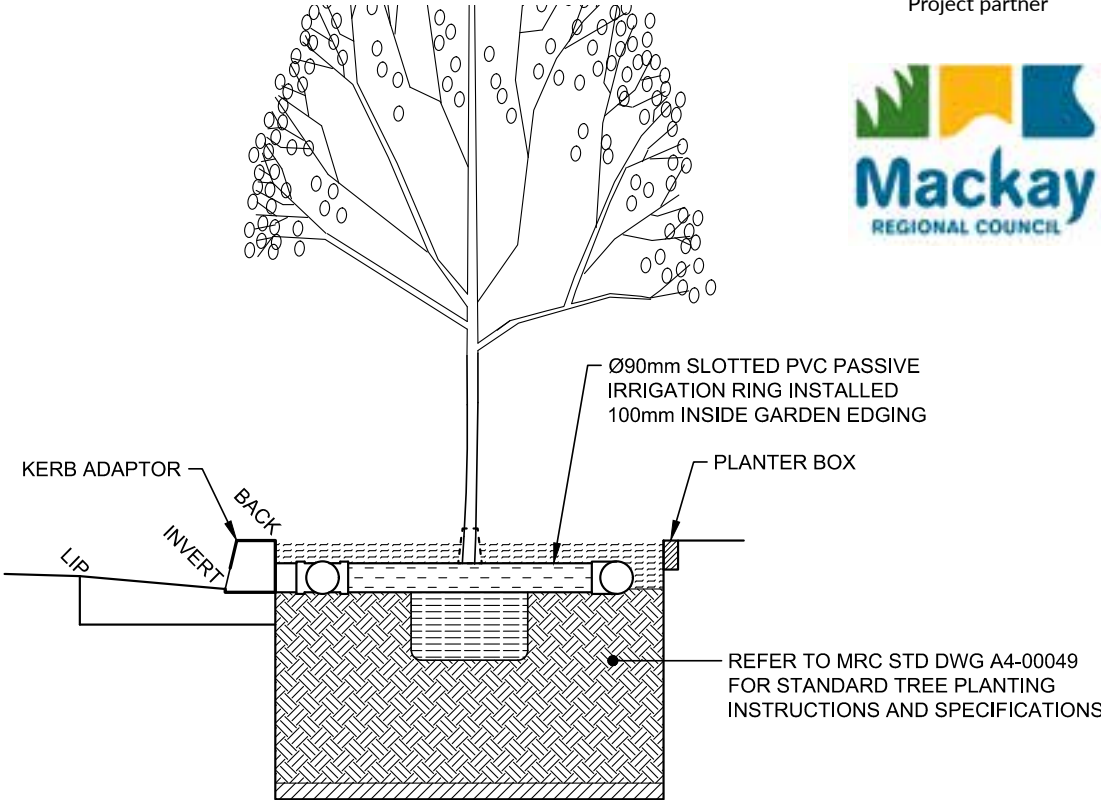




Maud Street - Mirani, Mackay



Above: installation of subsurface stormwater distribution pipe
Below: installation of Water Wise Tree species (*melaleuca viridiflora*)



Total Project Cost \$4,268
(2x Standard Trees and 2x Water Wise Trees)



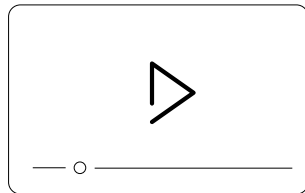
Control Tree



Water Wise Tree



February 2019



Part 1 - Construction

<https://youtu.be/YbNABPMgak>

Part 2 - Some months later

<https://youtu.be/NQ06MLxpiZE>



Photo credits: Tim Davies, BCC

May 2019

Stanley Street - Townsville

A Water Wise Street Tree was retrofitted into the Townsville CBD as part of a recent street upgrade.

Project partner



Photo credits: Jared Johnston, TCC

Grande Avenue - Spring Mountain, Ipswich

The Grande Avenue project site was established in partnership between the Ipswich City Council and local developers.

The project was completed in late June 2019.

Construction cost: \$2,600 per Water Wise tree.

Project partner



Photo credits: Chris Meehan, Eureka Landscapes



The Advanced Water Wise Street Tree

Pelican Waters – Sunshine Coast

Ready Made Pits, Sydney

Penticton - British Columbia – Canada

Dawson Street - Melbourne

King Street - Brisbane

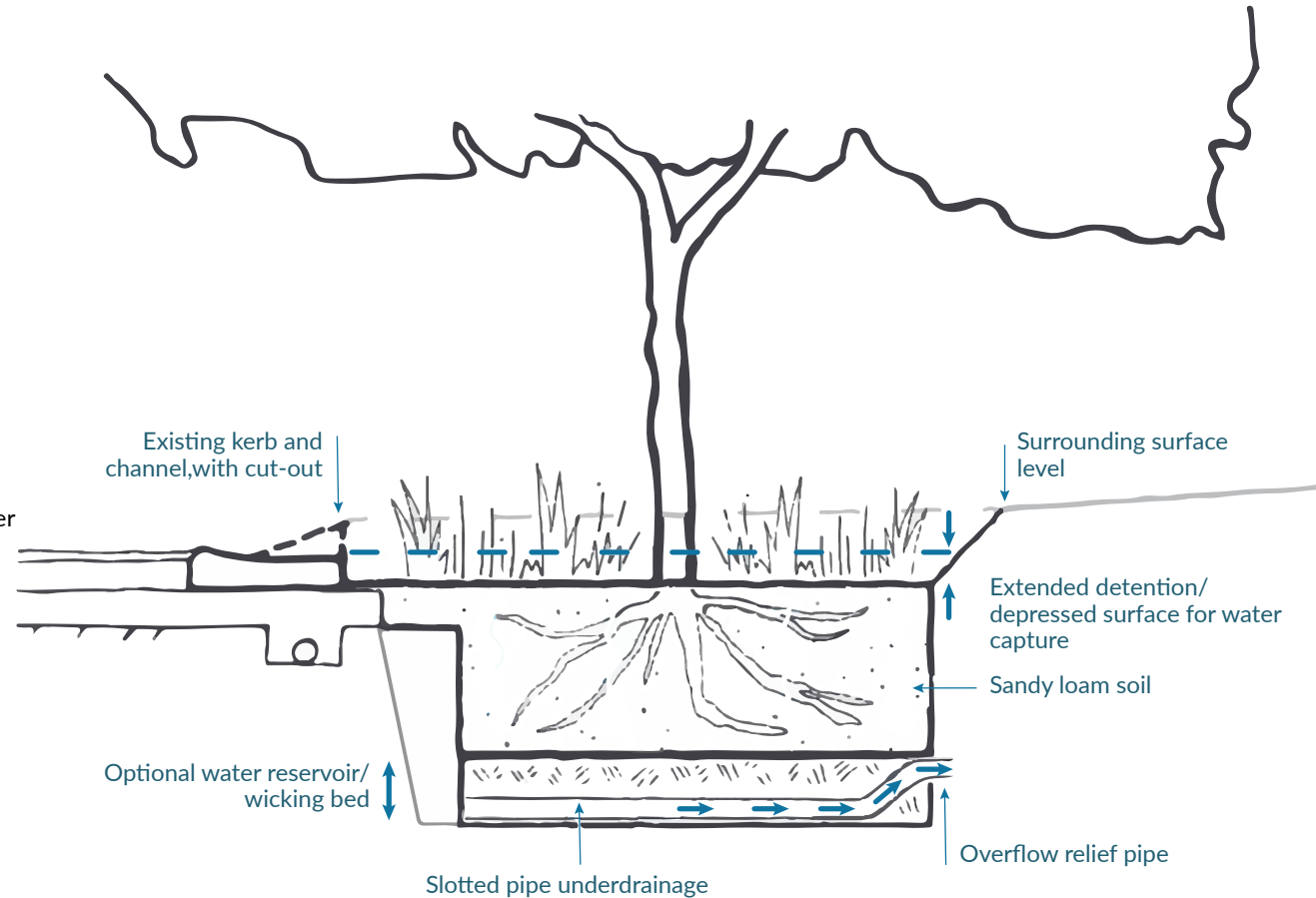
Water Wise street trees can be designed to deliver the optimal soil moisture throughout the majority of the year by adjusting the treatment area to catchment area ratio as per our Water Wise Street Tree factsheet (WbD 2018).

The tree pit can be further optimised by adjusting the soil hydraulic conductivity and adding a wicking (or submerged) zone.

By making these adjustments it is possible to also meet the Stormwater Quality Design Objectives under the State Planning Policy, effectively doing away with end of line treatment systems.

Further details are available here:

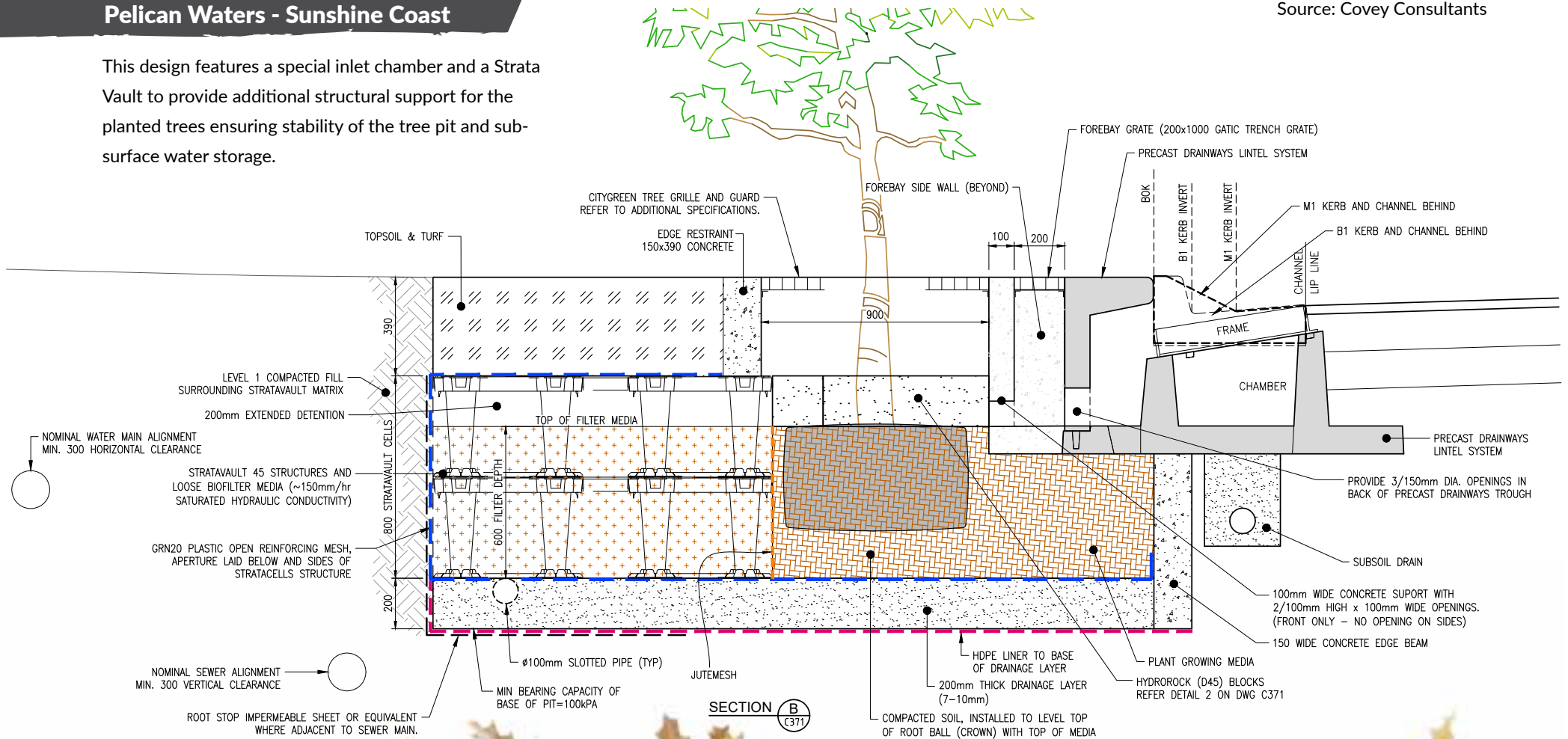
https://waterbydesign.com.au/download/flyer_3



Pelican Waters - Sunshine Coast

Source: Covey Consultants

This design features a special inlet chamber and a Strata Vault to provide additional structural support for the planted trees ensuring stability of the tree pit and sub-surface water storage.



Ready Made Tree Pits - Sydney

The Filterra® Bioretention System developed by Ocean Protect provides a 'ready-made' style of street tree pit.



Photo credits: Ocean Protect

Penticton - British Columbia -

Summer blooms form part of the species palette for this raingarden in downtown Penticton Canada.

Patrons to the popular weekend market may be none the wiser as to how special this garden bed is.

However pollutants (e.g. nitrogen) washed in from the road surface are trapped and recycled within the garden helping prevent hazardous algae outbreaks in the downstream waterways.



Dawson Street - Melbourne

1 This clever design allows water to flow in from both the street and the adjacent footpath.

2 A steel conduit is used to distribute water throughout the pit.

3 Street furniture is used as a device to encourage pedestrians not to step too close to the pit.

Photo credits:
Celeste Morgan, E2Designlab



1

2



3



King Street - Brisbane

As a luxury precinct, new Water Wise Trees were designed for King Street to allow for a more aesthetic street scape.

Photo credits: Purnima Periwal



Many Possibilities...

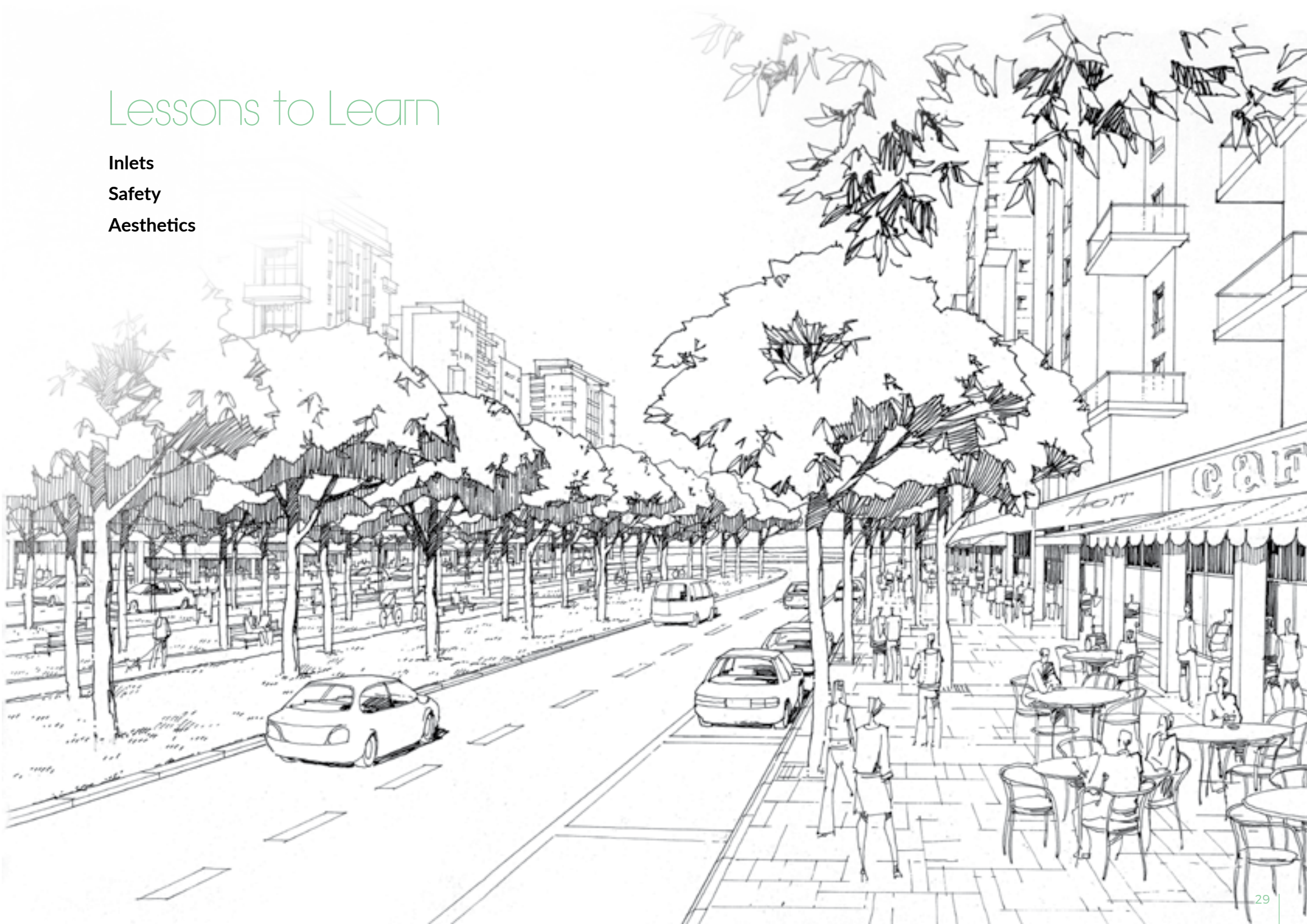


Lessons to Learn

Inlets

Safety

Aesthetics



Lessons to Learn - Inlet Blocking

Photo credits: Jack Mullaly, Ideanthro



A great design at Waitangi Park, Wellington?



Problem:
Inlets become blocked with sediment and leaf litter



A great design at Elizabeth Quay, WA?



Problem:
Inlets become blocked with sediment and leaf litter

Lessons to Learn - Inlet Blocking

Problem:

Sediment blocks up underdrainage pipes

Possible Solution:

1. Corrugations in gutter trap sediment but can lead to an unsightly mess

Discarded solution:

2. Removable porous rubber bung can stop the inflow of sediment but also stops the inflow of water.

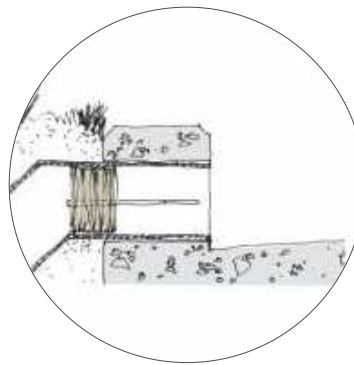


Photo credits: Jack Mullaly, Ideanthro

Lessons to Learn - Inlet Bypass

Photo credits: Jack Mullaly, Ideanthro

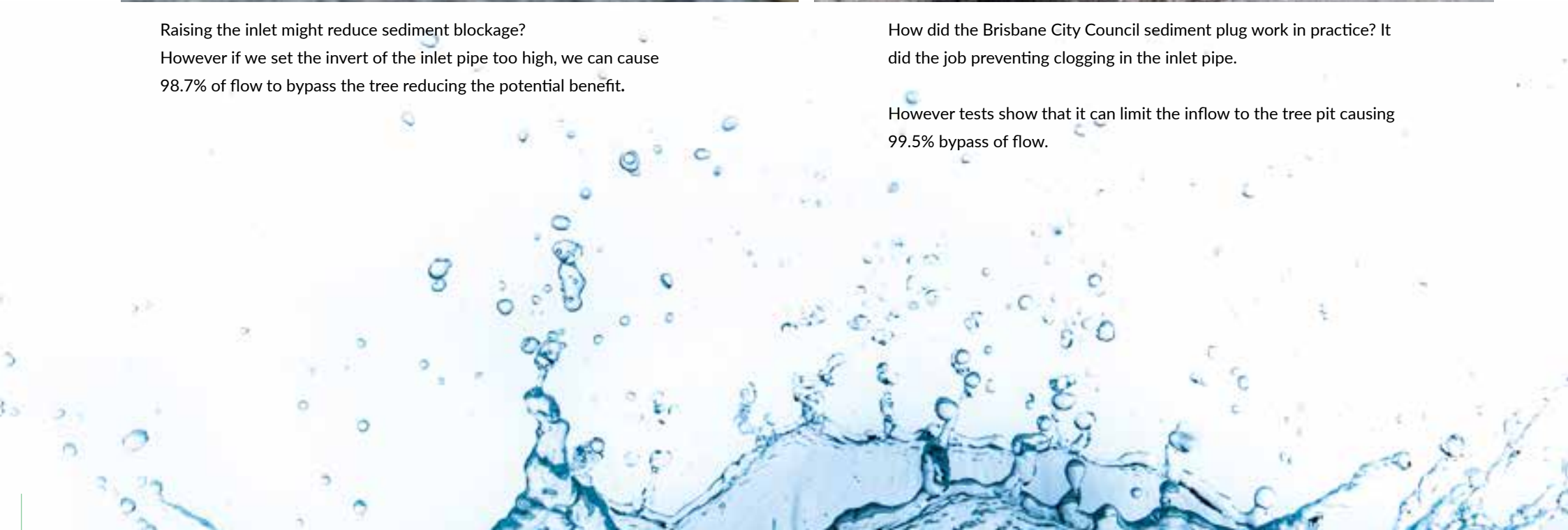


Raising the inlet might reduce sediment blockage?
However if we set the invert of the inlet pipe too high, we can cause 98.7% of flow to bypass the tree reducing the potential benefit.



How did the Brisbane City Council sediment plug work in practice? It did the job preventing clogging in the inlet pipe.

However tests show that it can limit the inflow to the tree pit causing 99.5% bypass of flow.



Solutions - Inlets - Urban Setting

Problem: Urban environment needs durable tree grate and inlet

Solutions:

1. Tree grate with removable panels
2. Inlet grate
3. Kerb cutout



Photo credits: E2Designlab

Solutions - Inlets - Residential Setting

Problem:

Stormwater needs to be directed from road into tree pit

Solutions:

1. Channel inlets
2. Kerb cutout
3. Wheel stops



Photo credits: E2Designlab



1



1



2



2



2



3

Solutions - Permeable Paving



Permeable paving can be used as a sediment pre-treatment device.

Location – Avoca, Bundaberg

Photo credits: Jason Reepsdorff – Bundaberg Regional Council



Improve water infiltration to the tree root bed with permeable paving in parking bays.

Location - Maki St, Auckland

Safety

Lessons to Learn - Pedestrian Safety

Photo credits: Jack Mullaly, Ideanthro



Is there another way to manage the drop off without the fence?

Location - Keble St, Corinda



A similar design with improved aesthetics and safety (thanks to adoption from local residents).

Location - Tiger Circuit, WA

Solutions - Pedestrian Safety

Photo credits: Jack Mullaly, Ideanthro



Use street furniture (e.g. a rubbish bin) to divert pedestrians around a tree pit.
Location – Ansett Place Auckland



Use a tree grate to avoid the fall hazard.
Location – King Street, Bowen Hills

Solutions - Surface Treatments

Problem:

Soil in tree pit needs to be covered to prevent erosion and/or allow pedestrian movement

Solutions:

1. Resin bound gravel
2. Porous paving
3. Garden bed



Photo credits: E2Designlab

Solutions - Edge Treatments

Problem:

Drop-off from footpath presents a hazard to pedestrian safety

Solutions:

1. Bike parking
2. Landscaped terraces
3. Bench seating



Photo credits: E2designlab



Aesthetics

Lessons to Learn - Materials and Aesthetics

Photo credits: Jack Mullaly, Ideanthro



Concrete collar can restrict tree growth.
Timber sleepers can age poorly.
Location - Market Place, Auckland



Rocks are known to capture sediment and propagate weeds.
Location- Warnboet Ln, Auckland

Solutions - Aesthetics

Photo credits: Jack Mullaly, Ideanthro



Use a repeating design along the street to magnify the effect.
Location - Pirrama Park, Sydney



Use flush kerbing to divert sheetflow into street tree pit.
Location - Ansett Place, Auckland

Solutions - Decorative Tree Grates





There are many options for street tree grates ranging from simple removable panels through to intricate cast iron masterpieces.

Photo credits: Purnima Periwal, Shutterstock

Tree Anchoring & Structural Systems

Problem:

Reduced pit volume causes tree instability, stunted tree growth, damaged pavements and safety issues.

Solution:

Tree anchoring systems (e.g. Stratavault or similar)

Problem:

Tree pit needs to support vehicle loads

Solution:

Structural soil systems (e.g. Stratavault or similar)

Photo credits: Citygreen Systems



Distribution and Underdrainage Pipes



FEATURE	SLOTTED RIGID PIPE	AG PIPE	MEGAFLO® PIPE
Ease of installation	Joining individual PVC pipe is easier, but the multiple bends required for a self-watering street tree mean that many joins and short lengths of pipe will be required.	Joining flexible corrugated pipe can require more sealant, however because it is flexible it is likely that only two joins will be required (the inlet and outlet).	MegaFlo® was shown to be an improvement on ag pipe. It is stronger, more compact and has larger capacity. But there is a need to slow the water flow down and create a reservoir within the garden. Research and development was conducted with the un-pre-holed hose obtained from the supplier, to determine a better pore size and number. This was to allow the water to infiltrate into the garden bed slowly over a few days, after the rain stops. A smaller hole size also meant that the water drips out only when soil is dryer and does not flow continuously, "flooding" the garden. Source: BCC Water Smart Street Tree Report
Filter sock	Not usually supplied with filter sock. Must be sourced separately.	Easy to source with filter sock installed.	
Maintenance	There is little resistance to flushing accumulated sediment and debris from the rigid pipe.	Corrugations and the flexibility of pipe make it harder to dislodge and flush sediment and debris.	
Resilience	More resilient to crushing, but brittle. Damage, when it occurs, is irreversible.	Flexible so can be crushed, but unlikely to shatter.	
Cost	More expensive.	Less expensive.	

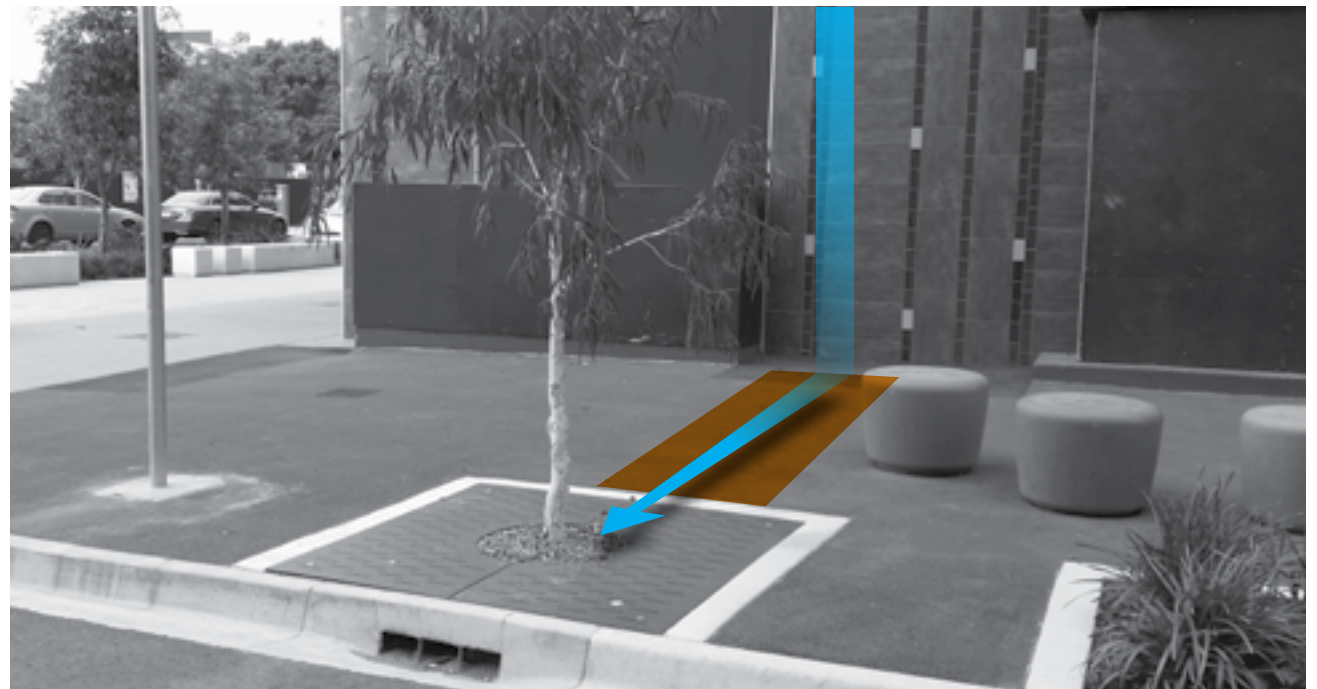
TREENET Inlet

A reliable water source can be provided to a street tree by installing an adjacent soakage well for as little as \$500 per unit (treenet.org).



Upstream Water Storage

Capture rainwater from a downpipe. Use a void beneath permeable paving as a temporary water storage and allow slow release of water into tree pit.



Permeable Kerb and Channel

Use permeable kerb to allow transfer of water to the tree pit.

This can be achieved using resin bound gravel to replace the kerb and channel. Sediment build-up can be cleaned with a high-pressure gurney.



Photo credits: Brick n Pave



Slotted Roof Water Pipe

Use a slotted roof water pipe to water a tree pit on its way to the gutter with minimal additional cost.



Education and Signage

Claim it! Explain it! Promote it!



Photo credits: Glenn Browning HLW and Jack Mullaly, Ideanthro

Stormwater Purification and Reuse



Send the treated stormwater to tanks for irrigating a neighbouring park.
Location - Marine Parade, Redcliffe

Photo credits: Glenn Browning HLW and Jack Mullaly, Ideanthro

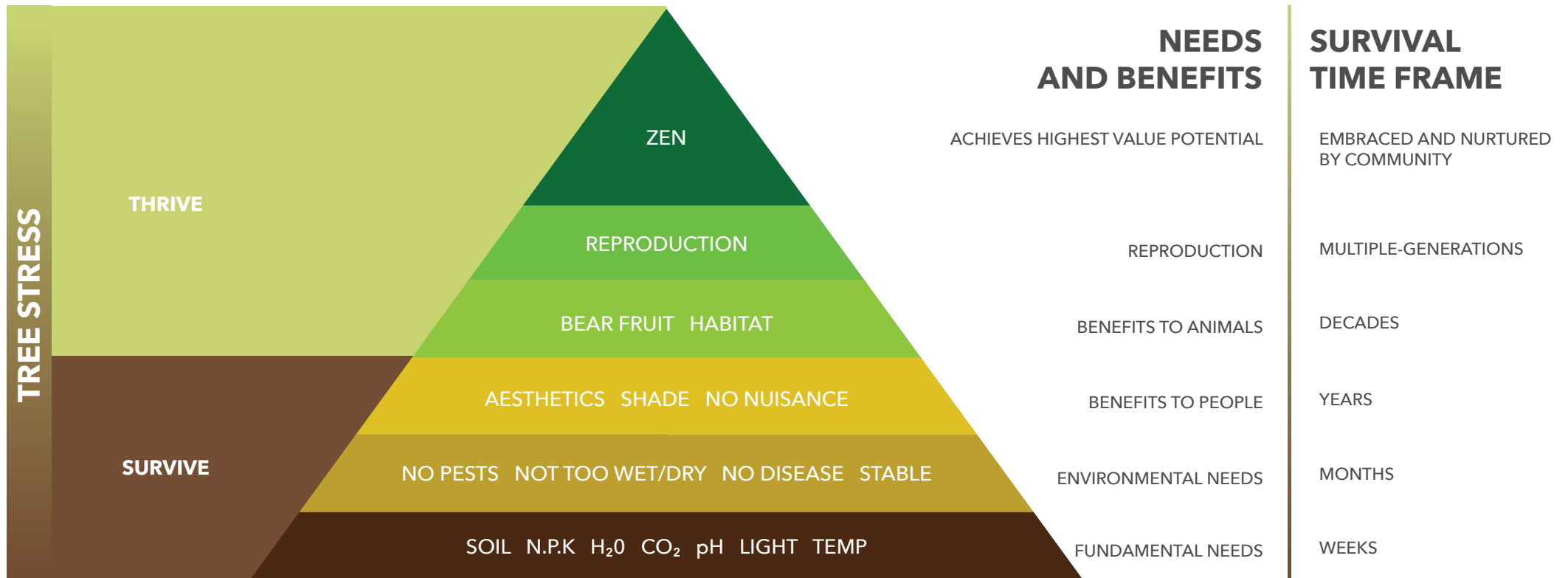


Zen for Street Trees

Hierarchy of Needs for Street Trees

What needs must be met before a street tree can reach its highest possible value?
This chart explores the fundamental needs through to the higher order needs.

"The forest is a peculiar organism of unlimited kindness and benevolence that makes no demands for its sustenance and extends generously the products of its life and activity; it affords protection to all beings."
- Buddhist Sutra



Street Tree Art

A few quirky art pieces can instantly give your street trees colour, style and character. Melbournians have even started writing emails to their trees.

www.abc.net.au/news/2018-12-12/people-are-emailing-trees/10468964

1 QUT Goodwill Bridge

2 Yarn Bombing

www.daysoftheyear.com/days/yarn-bombing-day/

3 Newstead Park



1



2



3

Urban Orchard

With permission from your local government authority, residents may be able to establish gardens within their verge. Verge gardens could include native, edible or rain gardens.

For example, the Sunshine Coast Council has produced Guidelines for planting a self-assessable verge garden to help support residents wishing to enhance or beautify the road verge in front of their property.

<https://www.sunshinecoast.qld.gov.au/Environment/Trees-Plants-and-Gardens/Plant-a-verge-garden>

Farmers of the Urban Footpaths – design guidelines for street verge gardens also shares some inspiration for verge garden and the realities of their installation.

More information on community gardens can be found here:
<https://www.communitygarden.org.au/>

“A seed hidden in the heart of an apple is an orchard invisible.”
- Welsh proverb



Habitat Boxes

Trees do not usually develop hollows suitable for our local wildlife for many decades. Installing nest boxes can provide much needed homes for birds and small marsupials in the meantime.



Photo credits: B4C

"What we are doing to the forests of the world is but a mirror reflection of what we are doing to ourselves and to one another."
- Mahatma Gandhi



Photo credits: Glenn Browning - HLW

Tree Species

Neighborhood friendly tree species
Low maintenance, good all rounders.



Banksia Aemula



Banksia Integrifolia



Banksia Robur

For more species visit:
www.waterbydesign.com.au/street-trees

Rare tree species to consider
Think outside the box with these
rare and endangered trees.

E: Endangered

V: Vulnerable

NT: Near Threatened



Brachychiton Sp. Ormeau (E)



Cupaniopsis Newmanii (NT)



Davidsonia Johnsonii (E)

"To me a lush carpet of pine needles or spongy grass is more welcome than the most luxurious Persian rug."

- Helen Keller

"Suburbia is where the developer bulldozes out the trees, then names the streets after them."

- Bill Vaughan

Photo credits: Paul Donatiu, HLW. John Moss,
via Wikimedia Commons, austplants.com.au



Casuarina Equisetifolia



Elaeocarpus Reticulatus



Leptospermum Petersonii



Melaleuca Nodosa



Hicksbeachia Pinnatifolia (V)



Eucalyptus Curtisii (NT)



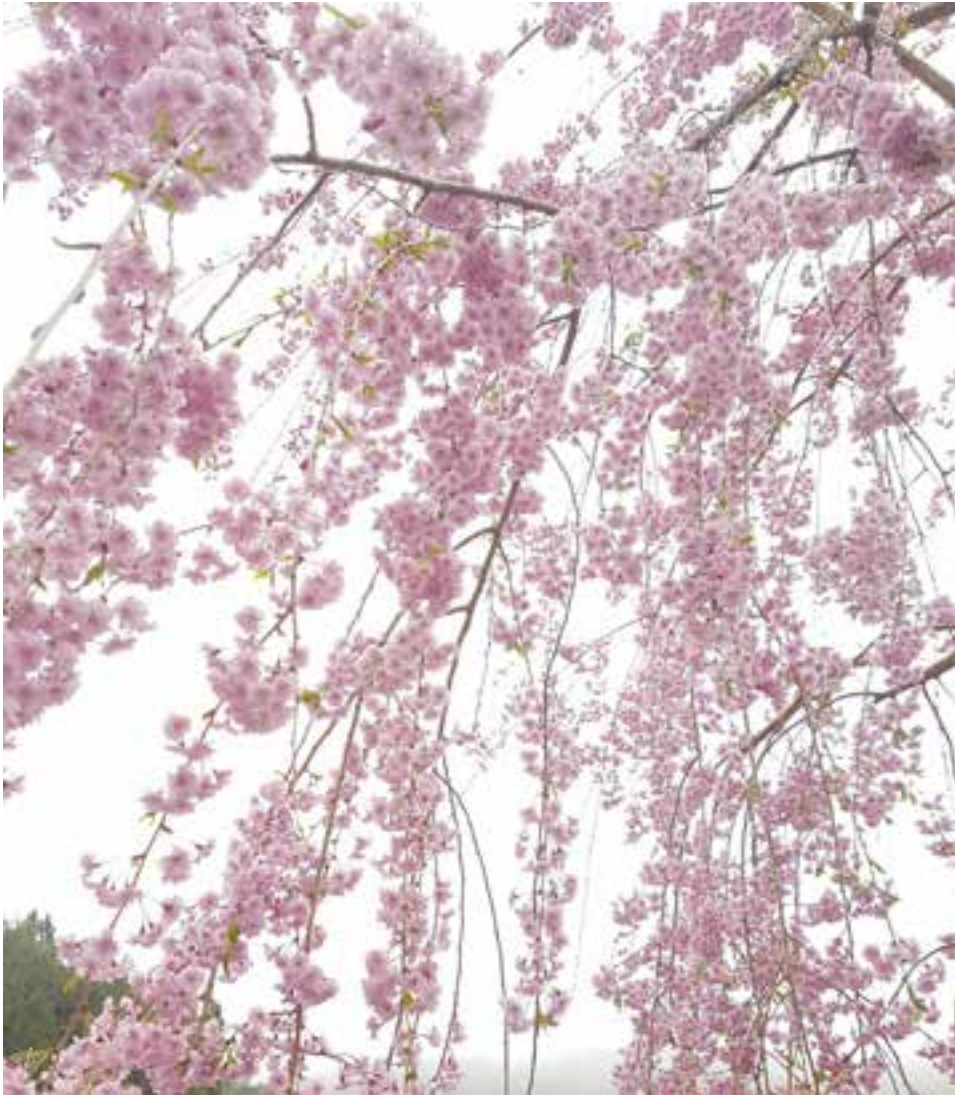
Melaleuca Formosa (Nt)



Melaleuca Irbyana (E)

National Identity

The cherry blossoms in Japan and the orange trees in Seville have become an attraction drawing the attention of tourists and locals alike.



Cherry Blossoms, Japan



Orange Tree, Seville, Spain

Connection to the Seasons

Trees help us connect to the cycles of nature.



A Sense of Place

Tree lined boulevards can turn a place from a thoroughfare into a destination.

"Adopt the pace of nature: her secret is patience."
- Ralph Waldo Emerson



Rothschild Boulevard in Tel Aviv, Israel



A view of Paris, France from the Arc de Triomphe on a sunny day



El Prado in Old Havana



Andrássy Boulevard in Budapest, Hungary

A Tourist Drawcard

Would La Rambla in Barcelona have the same appeal if it weren't for the river of plane trees providing a cool green shadeway?



La Rambla, Barcelona, Spain

A Place to Relax and Restore

TreeTunnel of Taiwan

"I have grown taller from walking with the trees..."
- Karle Wilson Baker



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Level 19, 160 Ann St,
Brisbane QLD 4000
Australia

PO Box 13204, George St. Bris-
bane QLD 4003
Australia

www.waterbydesign.com.au | www.hlw.org.au

