



# Greening Ballarat

## A green-blue city action plan

March 2016

---

# Acknowledgements

This action plan has been prepared by the City of Ballarat with the assistance of E2Designlab and ASPECT Studios.

It was developed in conjunction with council partners including:

- Department of Environment, Land, Water and Planning
- Central Highlands Water
- Corangamite Catchment Management Authority
- Glenelg Hopkins Catchment Management Authority
- Workshop participants including local engineers, environmental groups, urban designers and landscape architects, as well as construction and maintenance managers.



# What is this action plan about?

---

This action plan sets out principles and ideas on how the urban area of Ballarat can better support urban greening and local water management outcomes. It introduces the concept of a green-blue city, and explores the benefits that a synergistic approach to greening and water management could bring to Ballarat. Using a series of case studies in the city, possible design interventions are explored that will deliver those benefits. A series of actions, including both possible physical projects and actions that will develop policy, practice and culture that will support better outcomes are proposed to be taken forward by Council and its partners. This action plan demonstrates how the objectives of the Ballarat Strategy to deliver increased canopy cover, improved liveability and exemplar water management can be put into practice.



---

# Contents

<b>1. Creating a Green-Blue City of Ballarat</b>	<b>05</b>
1.1 What is a Green-Blue City?	06
<b>2. Context</b>	<b>10</b>
2.1 Ballarat in Context	11
<b>3. Green-Blue Opportunities</b>	<b>15</b>
3.1 The Opportunities	16
3.2 The Benefits	17
3.3 Example Applications	20
<b>4. Green-Blue Possibilities: Six Case Studies in Ballarat</b>	<b>24</b>
4.1 Original Style Heritage Streetscape	27
4.2 Modern Style Heritage Streetscape	35
4.3 Carparks	43
4.4 Industrial Areas	51
4.5 Eureka Gardens Precinct	59
4.6 Victoria Park	66
4.7 Comparison	73
<b>5. Implementation</b>	<b>77</b>
5.1 Focus Areas for Action	78
5.2 Recommended Actions	81
5.3 Recommended Investments	86





# Creating a Green-Blue City of Ballarat

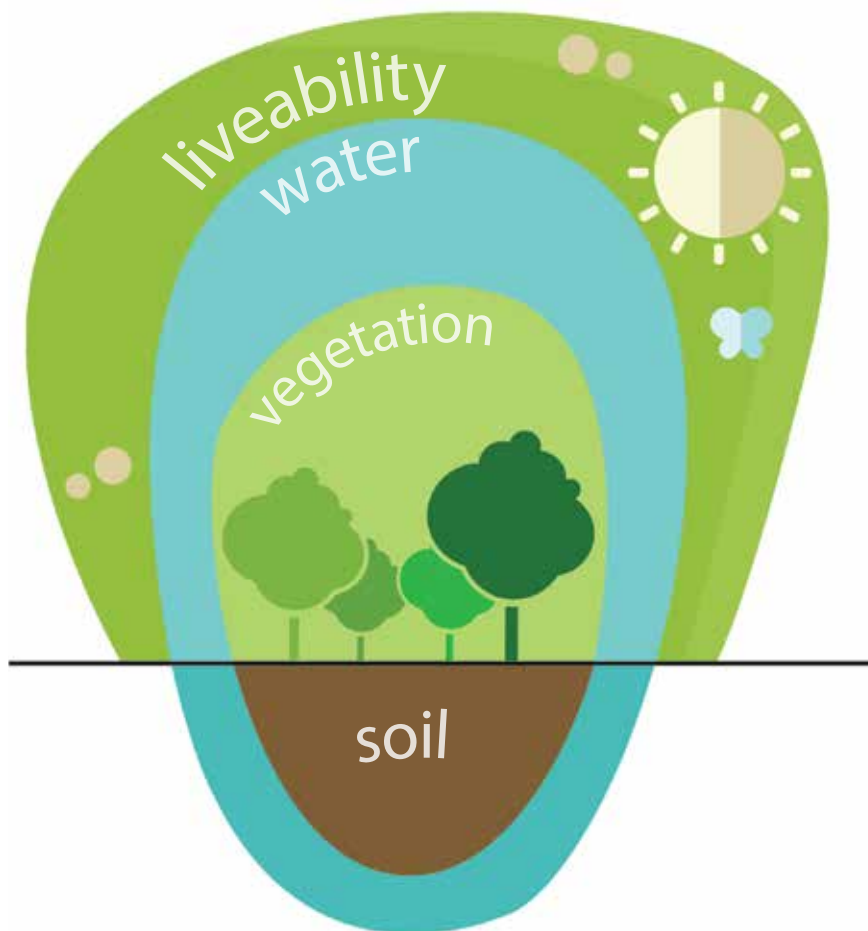
---

01

## 1.1. What is a green-blue city?

A green-blue city aims to recreate a naturally-oriented water cycle while contributing to the amenity of the city by facilitating urban greening and supporting healthy green infrastructure. Through integrated design a green-blue city can benefit from the synergies between local water management (blue infrastructure) and green space and urban trees (green infrastructure). This is achieved by combining and protecting the hydrological and ecological values of the urban landscape and recreating a more natural water cycle that restores soil moisture while reducing stormwater runoff. Designing and utilising the urban environment to manage local water resources and to create resilience to both flood and drought are key drivers in a green-blue city.

Water management and healthy landscapes are inextricably linked through natural processes. The urban environment is a complex one, but one where better integration and less separation of green and blue infrastructure will provide multiple benefits to the environment, communities and local economies.





## 1.1.1 Green supports blue

Trees and green areas intercept rainwater, promoting infiltration into the soil layer, uptake of water by vegetation and evaporation. Green infrastructure can also be designed to provide filtration and treatment of stormwater before it is released. Through the use of water sensitive urban design practices, soils and vegetation can be designed to trap sediment and remove nutrients, heavy metals and other pollutants in stormwater. By improving stormwater quality and reducing the volume of stormwater runoff, green infrastructure thereby contributes to the reduction of waterway pollution and surface water flooding.

**This action plan supports the delivery of outcomes outlined in the Stormwater Management Plan and the emerging Integrated Water Management Strategy for Ballarat.**



## 1.1.2 Blue supports green

The provision of water in the landscape is essential. Distribution of water to our soils through irrigation or natural infiltration will support establishment and ongoing health of trees, vegetation and recreation areas. But furthermore, ensuring that there is a healthy level of soil moisture is core to long term health of the landscape, preparing for droughts and variations in climates. Urbanisation and the sealing of surfaces results in significant decreases in the amount of water entering the soil layer, meaning that there is less reserve to support landscapes in drier times. With water, urban forest provides natural cooling through its evapo-transpiration processes, and a healthy tree canopy also provides essential shade in summer. For a garden city like Ballarat, a green environment is central to identity and character, providing a wonderful amenity that underpins economic vitality and liveability. Feedback from Ballarat's community in the Imagine Ballarat surveys confirmed that healthy and accessible green spaces are a key priority.

**This action plan supports the delivery of outcomes driven by the emerging Urban Forest Strategy for Ballarat.**





# Our Vision

---

A green-blue city of Ballarat has healthy trees, parks and gardens supported by sustainable water supplies and the city utilises natural assets to slow, treat and store stormwater runoff.



Context

---

02



## 2.1. Ballarat in Context

Ballarat is the third most populous urban area in Victoria, and is a growing and changing city. With a strong heritage, its central urban area is characterised by wide streets, often lined with mature street trees or with a central garden median. Both water and the city's green surrounds have historically been a defining element for the city. Located on the Yarrowee River, and a number of waterways passing through the urban area, waterway corridors are a defining feature of the city and key recreational routes. Local parks and gardens, ranging from the expanse of Victoria Park and the Ballarat Botanical Gardens to local pocket parks and ovals, provide residents with a range of green spaces to enjoy within the city. Lake Wendouree remains an iconic asset for the city, stretching 2km across, the constructed Lake is a haven for wildlife, a fishing spot, a rowing destination and a focus for recreation and visitors. When Lake Wendouree dried up during drought conditions from 2006-2011, it was estimated that Ballarat suffered an economic loss of \$55 million in tourism.

The Ballarat community is proud of its unique and beautiful city, its heritage buildings and streetscapes, Lake Wendouree, and its park and gardens. It is important to the community these elements which make Ballarat unique are not lost as the city grows.

**Today, Tomorrow, Together: the Ballarat Strategy sets out a vision for the future of Ballarat as a successful, proud, desirable, friendly and healthy place to live and work. The Strategy sets out two key platforms for change - one of which is creating a “City in a Landscape”, where the creation of climate resilient green-blue urban landscapes is central to the vision for change.**



Redan Creek Wetlands

## 2.1.1 Ballarat's Water

Water management has always been a major challenge in Ballarat. Historically, water supply has always been dependent on water available from swamps and creeks. Accordingly, settlement locations have often been selected to be near these water supplies, meaning that many developed areas of Ballarat are built on flood-prone areas. As the climate changes, extreme weather events are expected to change the frequency and intensity of rainfall events, meaning that flooding will continue to be a pressing issue for the city. Conversely, drought has had major implications for the city in the past, and drought conditions are likely to return in the future. The resilience of the city and its green assets requires forward planning for both drought and flood conditions.

Recent investment has substantially improved the resilience of Ballarat to drought and flooding. The *Harnessing Ballarat's Stormwater* Project has linked a number of stormwater sources across the city, provided treatment, and transferred the treated stormwater to top-up Lake Wendouree and to irrigate a number of parks and gardens across the city. Recycled water is also utilised within the scheme, ensuring that the Lake is maintained as a healthy and highly valued asset for the community. Examination of the water cycle in Ballarat has highlighted that rainwater and stormwater are major under-utilised water resources which could provide considerable opportunity for improving the self-sufficiency of the region in future. With support from DELWP, this action plan is one initiative developed as part of the Ballarat and region's Water Future (BWF) integrated water management strategy which seeks to harness local water resources more effectively. City of Ballarat's Stormwater Management Plan sets objectives to facilitate greater stormwater capture and reuse, while also delivering water sensitive urban design to improve water quality in local waterways. It highlights open spaces as excellent opportunities to integrate amenity and recreation provision with flood mitigation and stormwater treatment functions through the integration of multi-functional retarding basins and wetlands. Council's former Water Action Plan encouraged the use of rainwater and stormwater reuse in council activities as well as the reduction of potable water use through water efficiency. As parks, gardens and sporting grounds make up the majority of Council's potable water use, there is a direct opportunity to consider the design and operation of open spaces and water supplies together.

City of Ballarat is also continuing to invest in reducing the risk of flooding. A substantial body of work has been done to understand riverine flooding, and also to identify flooding hot spots where the capacity of the local drainage system is being exceeded. By creating more permeable green areas and by using natural assets to slow, absorb and store water, there will be opportunities to reduce surface water flooding issues downstream.

With respect to surface water management, Ballarat's centre has unique drainage arrangements which are core to its character. Bluestone surface drains often line the edges of the streets in place of underground drainage pipes. These bluestone drains are a key heritage feature, but are also an excellent asset for supporting green-blue outcomes. With gaps between the bluestone, the water has an opportunity to seep into the ground, aiding soil moisture and slowing down runoff to waterways. By keeping water on the surface, instead of hiding storm water in pipes below, there is also a further opportunity to more easily divert this water to adjacent landscapes.





Lake Wendouree



## 2.1.2 Ballarat's Landscapes

City of Ballarat's Open Space Strategy recognises the core role that parks, gardens and sporting grounds play in supporting the Ballarat community and providing great enjoyment for visitors to the City. The interrelationship with water is explicitly highlighted in the strategy, highlighting that drought poses a major risk to the quality and safety of open spaces. With more than 300 public open spaces managed by the Council, sporting grounds are prioritised for irrigation, with other key recreational spaces and streetscapes also provided with supporting irrigation. The provision of alternative water sources is a major opportunity to secure water resources to support the health of green spaces all year round and in times of drought.

The creation of a network of living corridors is a major opportunity for Ballarat, providing recreational and biological links connecting natural areas. Improvement of creeks and their adjoining open spaces provide an excellent opportunity to create living corridors and these can be improved through the incorporation of extended creek lines in new development areas and the retrofitting of corridors in existing urban areas.

The Ballarat Strategy also recognises the vital role that trees play in Ballarat, and has set a target to increase tree canopy cover on public land in Ballarat from 17% to 40% by 2040. The delivery of more trees and healthier trees with a larger canopy will require design improvements which allow tree roots more room to grow, and take advantage of local water sources to increase soil moisture. Trees play a vital role in controlling local climates and minimising health risks during heat waves, by providing shade and naturally cooling through evapotranspiration, helped all the more by the provision of water.

The Ballarat Strategy also aims to increase and improve open spaces and to enhance biodiversity. It recognises that there is a prime opportunity to manage stormwater as part of the renewed focus on green infrastructure. Accordingly, a focus on green-blue solutions is highly complementary and central to the future vision for Ballarat - as a 'city in a landscape'. The 'Greening through local water management' initiative has already been commenced in Ballarat CBD to begin investment in urban forest solutions supported by stormwater management.

# Green-Blue Opportunities

03

## 3.1. The Opportunities

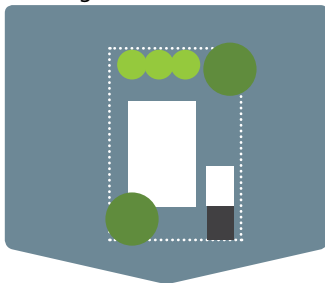
Ballarat already has some wonderful landscapes within its urban area. There is opportunity to do much more, and a greener Ballarat supported by a sustainable local water cycle is a city which will provide economic resilience and liveability for its communities in the long term. Comparatively, as an urban area, Ballarat is well placed to become an exemplar green-blue city. Ballarat has several characteristics which could give rise to a range of green-blue opportunities:

- A strong heritage which draws on street trees and gardens as a core part of Ballarat's character, and a council committed to increasing canopy cover,
- A network of creeks and rivers crossing all of the cities quadrants that provide recreation and habitat links,
- Localised risks of flooding which could be eased through greater integration of permeable surfaces and storage areas,
- Strong landscape assets ranging from Lake Wendouree and Victoria Park to local parks and play spaces,
- An increasing population and a need to provide a high quality of life for everyone,
- A widely-recognised water supply challenge and an innovative network of local water supplies delivered by local stakeholders, and
- Active community groups and environmental networks who can drive initiatives.

The opportunities are present at all scales and will require efforts from a range of stakeholders. At a local scale, residents and businesses can help to create a green-blue city from the ground-up, making changes on their own properties and working with groups in their local suburbs. The City of Ballarat will be able to drive and support opportunities in the streetscape and public realm, in open spaces and in waterway corridors. At a city scale, Council, Central Highlands Water and the local Catchment Management Authorities will work together to secure strategic initiatives and plan resources for the future.

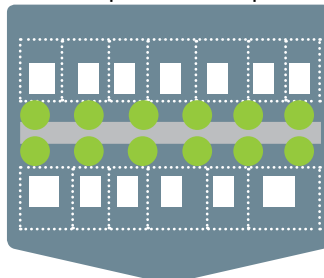
The green-blue opportunities in Ballarat are at three scales:

Buildings and surrounds



Residents, businesses and other property owners can enhance their buildings and landscape by integrating vegetation and capturing rain water for local reuse and infiltration.

Streets, squares and car parks



The council and its partners who design and manage the public realm can create multi-functional streetscapes and public spaces that integrated green-blue solutions to enhance amenity while also managing stormwater runoff.

Open spaces and networks



Bigger scales lead to even bigger opportunities for creation and enhancement of green infrastructure networks, recreational spaces and waterbodies.



## 3.2. The benefits



**STORMWATER  
TREATMENT**

### Stormwater Treatment

Urban areas generate nutrients, heavy metals and sediments which are washed into our drains and harm our waterways. Natural systems can be used to treat stormwater, utilising vegetation and soil to trap pollutants while allowing plants to absorb nutrients.



**ALTERNATIVE  
WATER SUPPLY**

### Alternative Water Supply

Green-blue solutions can aid both the creation and use of alternative water supplies. Irrigation of trees and green space is an excellent use for alternative water supplies as it provides water to soils in urban areas and can help to reduce potable water demands for open space irrigation. By securing alternative water supplies, Ballarat can increase its resilience during drought and prepare for the effects of climate change.



**RUNOFF  
DETENTION**

### Runoff Detention

Storage of water in soil layers or in natural basins can provide reduction of peak runoff flows to local drainage systems, potentially increasing level of service of drainage system or avoiding drainage upgrades where capacity is insufficient.



**RUNOFF  
REDUCTION**

### Runoff Reduction

Vegetated and permeable areas promote a re-balance of the natural water cycle which has been severely impacted by the development and sealing of ground surfaces in urban areas. Landscape areas can allow water to infiltrate into the ground, be taken up by plants or evaporate, reducing the stormwater runoff to local creeks. Ever stood under a tree when it's raining and stayed dry? That's because a tree crown intercepts significant amounts of rainfall, preventing stormwater runoff.



### BIODIVERSITY

## Biodiversity

Large trees in urban areas provide a wealth of benefits to biodiversity, by providing habitat for insects primarily and having cascading effects for the food chain. Urban trees in particular provide a highly valued resource amongst a hostile urban environment. According to the US Forest Service, a large tree with a trunk diameter 10 times larger than a small tree produces 60-70 times the ecological services<sup>1</sup>.



### QUALITY TREES AND VEGETATION

## Quality Trees and Vegetation

Landscapes will only be able to provide benefits when they are in good condition. Urban trees which are planted in a constrained environment without sufficient soil area or watering are expected to have a shorter lifespan. An American study found that urban trees with a small soil area commonly had a lifespan of only 13 years. Comparing this standard tree, with an expanded soil area which also incorporated passive watering from stormwater, the lifetime was estimated to be 50 years<sup>2</sup>.



### QUALITY RECREATION SPACES

## Quality Recreation Spaces

Irrigation water for sports grounds, gardens and landscapes is often the first to be restricted during a drought. The creation of new non-potable water supplies such as rainwater, stormwater or recycled water, is a way to ensure recreation spaces and landscapes can provide for the community year-round.



### INCREASED SOIL MOISTURE

## Increased Soil Moisture

Provision of good soil moisture around trees can reduce pavement and underground utility damage caused by root intrusion as trees seek out water, reducing hazards and maintenance costs. Ensuring that a significant volume of water is allowed to soak into the soil layers allows water to be 'banked' for vegetation to draw on in drier times.

1. McPherson, E. G. (1994~) Benefits and costs of tree planting and care in Chicago. pp. 115-34. General Technical Report No. NE-186. U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station, Radnor, PA.

2. The Kestral Design Group (undated) Investment vs. Returns for Healthy Urban Trees: Lifecycle Cost Analysis. Deeproot.



### AMENITY AND CHARACTER

## Amenity and Character

Trees and urban greening can increase property values. The effect is locally specific, with increases observed ranging from 1-15% but generally tree-lined streets and properties with access to good quality open spaces are more attractive to home buyers. Greener areas are also good for business. A study also found that people would pay 9 to 12 per cent more for goods sold in central business districts with high-quality tree canopy<sup>3</sup>.



### AIR QUALITY IMPROVEMENT

## Air Quality Improvement

Trees absorb air pollutants that have major health effects in cities. Larger trees and certain species have a greater effect, and can be very beneficial in highly trafficked and polluted areas.



### SHADE AND COOLING

## Shade and Cooling

Measurements in Melbourne found that non-irrigated grass was on average between 3.6°C and 5.2°C hotter than watered grass, while tree cover can regulate surface temperatures to 10 degrees lower than exposed concrete surfaces by providing shade<sup>4</sup>. Sufficient irrigation contributes to plants providing the maximum amount of shade and natural cooling possible, supporting the health of local communities during hot periods. Shady trees can increase the useful life of asphalt pavement by at least 30%, which can be of considerable value in the hot climate of Australia where asphalt degrades quickly<sup>5</sup>.



### EDUCATION

## Education

Providing connections with natural systems and fostering productive landscapes within the urban environment can create greater environmental awareness and provide opportunities for communities to interact with nature, harvest food and create character.

3. Akbari, H. (2009) Cooling our communities. A guidebook on tree planting and light coloured surfacing. Berkeley, CA: Lawrence Berkeley National Laboratory.

4. Coutts A, Harris R 2013. Urban Heat Island Report: A multi-scale assessment of urban heating in Melbourne during an extreme heat event: policy approaches for adaptation, Victorian Centre for Climate Change Adaptation Research.

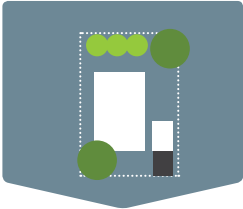
















5. Moore, G. M. Urban trees worth more than they cost. AILA.



### 3.3. Example applications

The following applications have been identified by local practitioners as possible options for Ballarat.


















#### 3.3.1 Buildings and surrounds

		Rainwater harvesting for garden irrigation	Private raingardens	Green roofs supported by harvested rainwater	Green walls supported by harvested rainwater
Buildings and surrounds 					
Stormwater treatment					
Alternative water supply					
Runoff retention					
Runoff reduction					
Biodiversity					
Quality trees and vegetation					
Quality recreation spaces					
Increased soil moisture					
Amenity and character					
Air quality improvement					
Shade and cooling					
Education					
Relative Cost		\$	\$\$	\$\$\$	\$\$\$
KEY		HIGH	MEDIUM	VARIABLE	N/A

### 3.3.2 Streets, Squares and Carparks

		Passive irrigation of trees and gardens	Raingardens	Raingarden tree pits	Tree-lined roadside swales	Permeable paving supporting trees
Streets, squares and carparks						
Stormwater treatment						
Alternative water supply						
Runoff retention						
Runoff reduction						
Biodiversity						
Quality trees and vegetation						
Quality recreation spaces						
Increased soil moisture						
Amenity and character						
Air quality improvement						
Shade and cooling						
Education						
Relative Cost		\$	\$\$	\$\$	\$\$	\$\$\$
KEY		HIGH	MEDIUM	VARIABLE	N/A	

### 3.3.3 Precinct open spaces and networks

		Ponds and lakes fed by storm water	Wetlands	Sunken sports fields retarding flood waters	Stormwater harvesting for open space irrigation
Open spaces and networks					
Stormwater treatment					
Alternative water supply					
Runoff retention					
Runoff reduction					
Biodiversity					
Quality trees and vegetation					
Quality recreation spaces					
Increased soil moisture					
Amenity and character					
Air quality improvement					
Shade and cooling					
Education					
Relative Cost		\$	\$\$	\$\$	\$\$\$
KEY		HIGH	MEDIUM	VARIABLE	N/A



		Green corridors and waterway riparian areas	Community gardens with rainwater harvesting	Daylighted Creeks	
Open spaces and networks 					
Stormwater treatment					
Alternative water supply					
Runoff retention					
Runoff reduction					
Biodiversity					
Quality trees and vegetation					
Quality recreation spaces					
Increased soil moisture					
Amenity and character					
Air quality improvement					
Shade and cooling					
Education					
Relative Cost		\$	\$\$	\$\$\$	
KEY		HIGH	MEDIUM	VARIABLE	N/A

# Green-Blue Possibilities: Six Case Studies in Ballarat

---

04

# Selected Sites

---

Six sites were selected across Ballarat's existing urban area as case studies. A possible green-blue initiative is proposed for each site, and the difference in costs and benefits is described. Covering a range of spatial scales, the case studies provide insight into the types of issues and opportunities present in Ballarat, but also explore the quantum of investment required and where the best value gains can be made. The benefits of each initiative have been estimated using metrics provided by the council and industry standard stormwater management modelling using MUSIC v.6. The solutions proposed are concept designs and require further investigation and trial before use.



1

### Original style heritage streetscape e.g. Lyons St

Explores opportunities to retrofit green-blue infrastructure into existing heritage streets with gravel shoulders and bluestone drains

2

### Modern style heritage streetscape e.g. Errard St

Explores opportunities to enhance outcomes when redeveloping heritage streets to include a kerb and channel arrangement

3

### New carpark e.g. Eastern Oval carpark

Explores opportunities in a new open air carpark

4

### Industrial areas e.g. Delacombe

Explores opportunities in industrial areas, focussing particularly on the public streetscapes

5

### Eureka Gardens Stockade Precinct

Explores local supply opportunities to meet local demand in this precinct which includes an outdoor pool, irrigated gardens and the Museum of Australian Democracy

6

### Victoria Park

Explores opportunities in the largest park in Ballarat, demonstrating the value of incorporating an assessment of green-blue opportunities during the masterplanning process

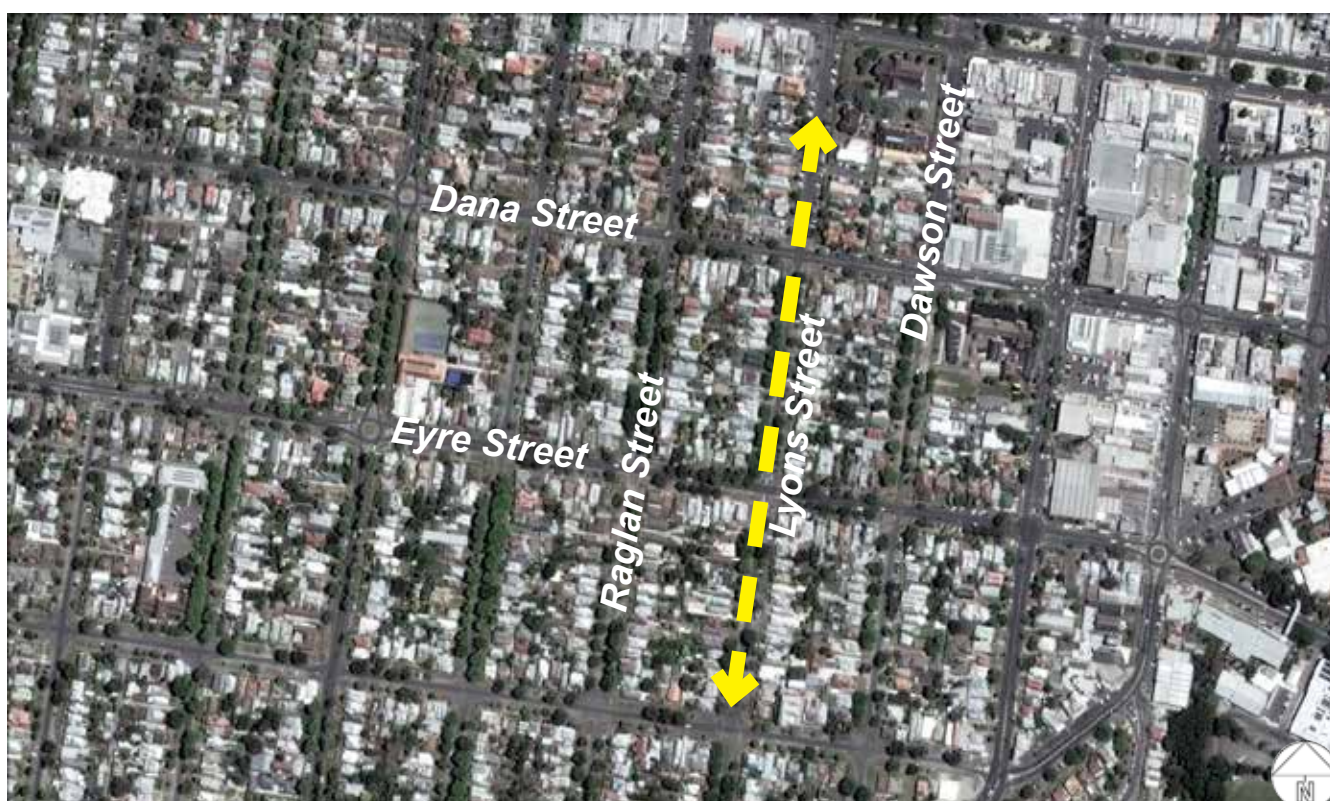
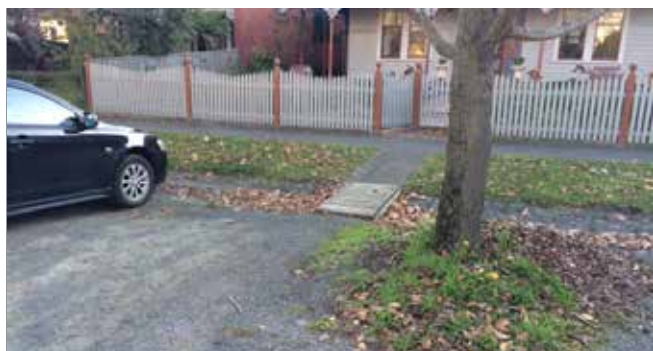




## 4.1. Original Style Heritage Streetscape

### 4.1.1 Context

A quintessential streetscape in Ballarat in heritage areas - characterised by the presence of gravelled shoulders either side of a paved central roadway. This case study examines the heritage areas surrounding the central business district where bluestone surface drains run between the gravel shoulder and a grassed verge and footpath. These 'original style' heritage streetscapes often benefit from large mature trees forming a lush green canopy over the street. Trees are planted within the gravel area, and are impacted by regular carparking.



Example street: Lyons Street



## 4.1.2 Key Challenges



Erosion of gravel in parking areas next to paved road due to wheel rutting on wet gravel, further deteriorated by pooling water. Council have a regular renewals program to address this issue.



Water quality impacts and maintenance burden due to leaf litter and gravel migrating into stormwater drains. This is a major water quality risk for Ballarat identified in the Stormwater Management Plan.



Informal parking in gravel areas leading to compacting of soil and damage of tree roots (which migrate under the gravel area), posing a threat to tree health. Car parking pressures on trees are particularly intense near the CBD and near key community infrastructure (e.g. hospitals).



Heaving of pavement and bluestone drains as tree roots seek growing space and water. Heaving has substantially increased since the drought began and is a continued threat in future climates. This is a health and safety risk that leads to ongoing repairs.

### 4.1.3 Green-blue Initiatives

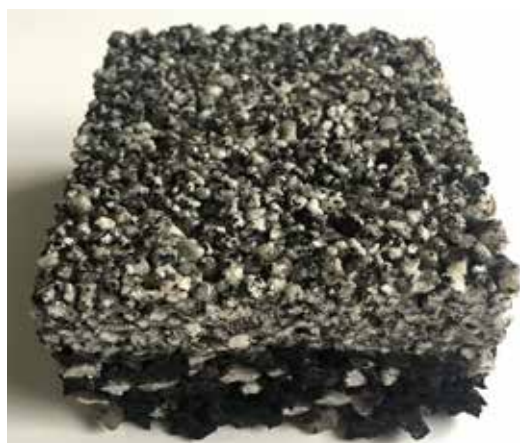
#### Proposal: Retrofit streetscape to:

1. Use a slotted raised edge at the transition point between the gravel area and the bluestone drain to prevent migration of gravel and leaves into the drain and to promote simple leaf clearing. In areas close to the CBD where parking pressure is high, the gravel surface could instead be repaved with a suitable hard wearing surface.
2. Introduce a 'runoff transition zone' (see options below) between the existing paved area and the gravel parking area to intercept runoff from the road surface. The 'runoff transition zone' will perform three functions:
  - Reducing the amount of water shed onto the gravel which causes rutting and potholes
  - Reducing sediment mobilisation from the gravel surface into stormwater runoff
  - Channelling runoff from the road surface laterally along the road to the tree zone to provide water to the root zone.
3. Support the health of the existing mature trees by:
  - Protecting the core tree root area from traffic using bollards.
  - Creating a defined tree zone, where the existing gravel is carefully loosened to increase permeability in the existing soil.
  - Utilising stormwater runoff from the road for tree irrigation by linking the permeable paving channel to a soakage hole (e.g. 100 litre volume) within the tree's outer root zone. The well will need to be constructed using hydroexcavation and under supervision of an arborist to minimise root damage. A sleeved insert is included in the well to capture sediment, and can be regularly removed and shaken out.

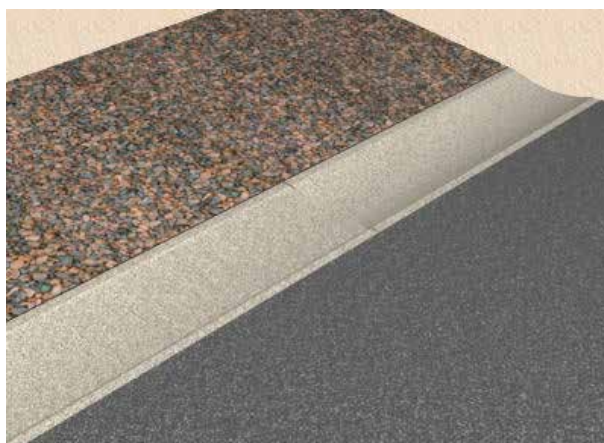
New trees in heritage streetscapes should be planted with sufficient soil area and passively irrigated, but also should be a tree species selected to have a broad canopy but a low height to avoid clashing with power lines.

#### Runoff transition zone options

A permeable surface could be used to capture runoff and channel it below surface (as shown in section). This could consist of 100mm depth of epoxy bound bluestone with no fines, providing a visually similar surface to asphalt top coat. Alternatively, a shallow spoon drain and grated inlet could be used.

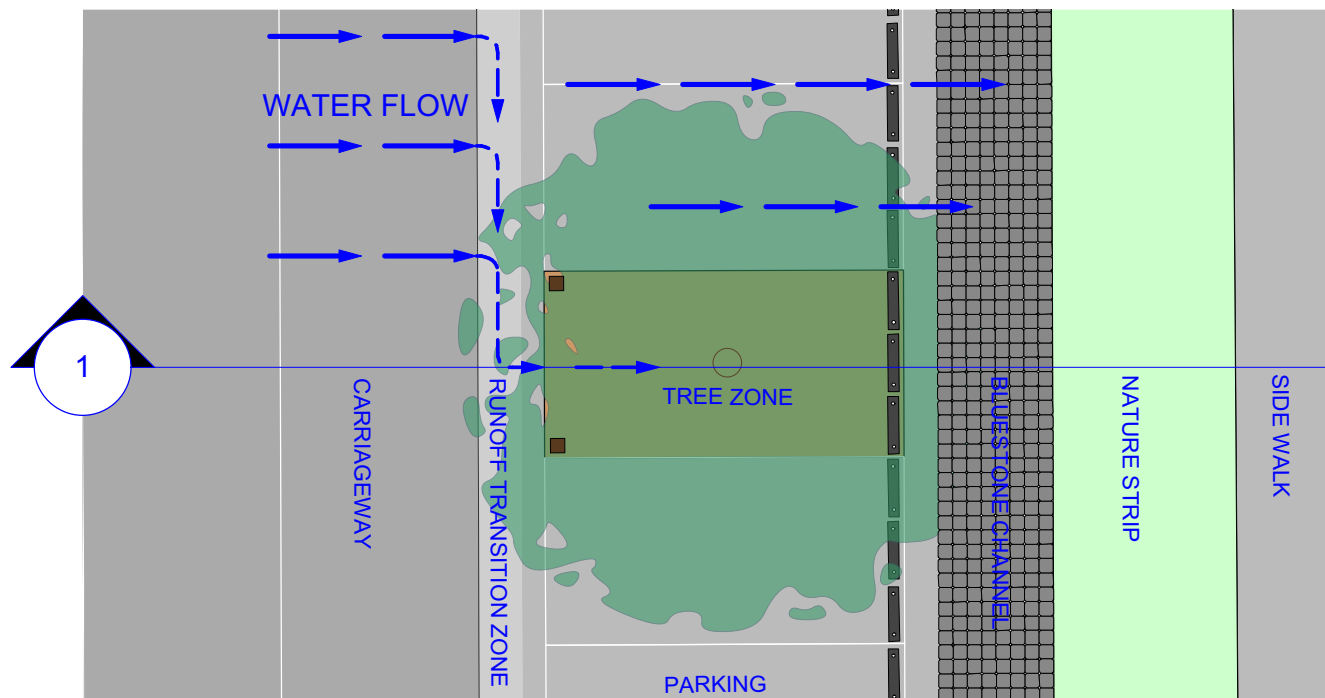


Bonded aggregate permeable pavement underlain by a perforated pipe in gravel

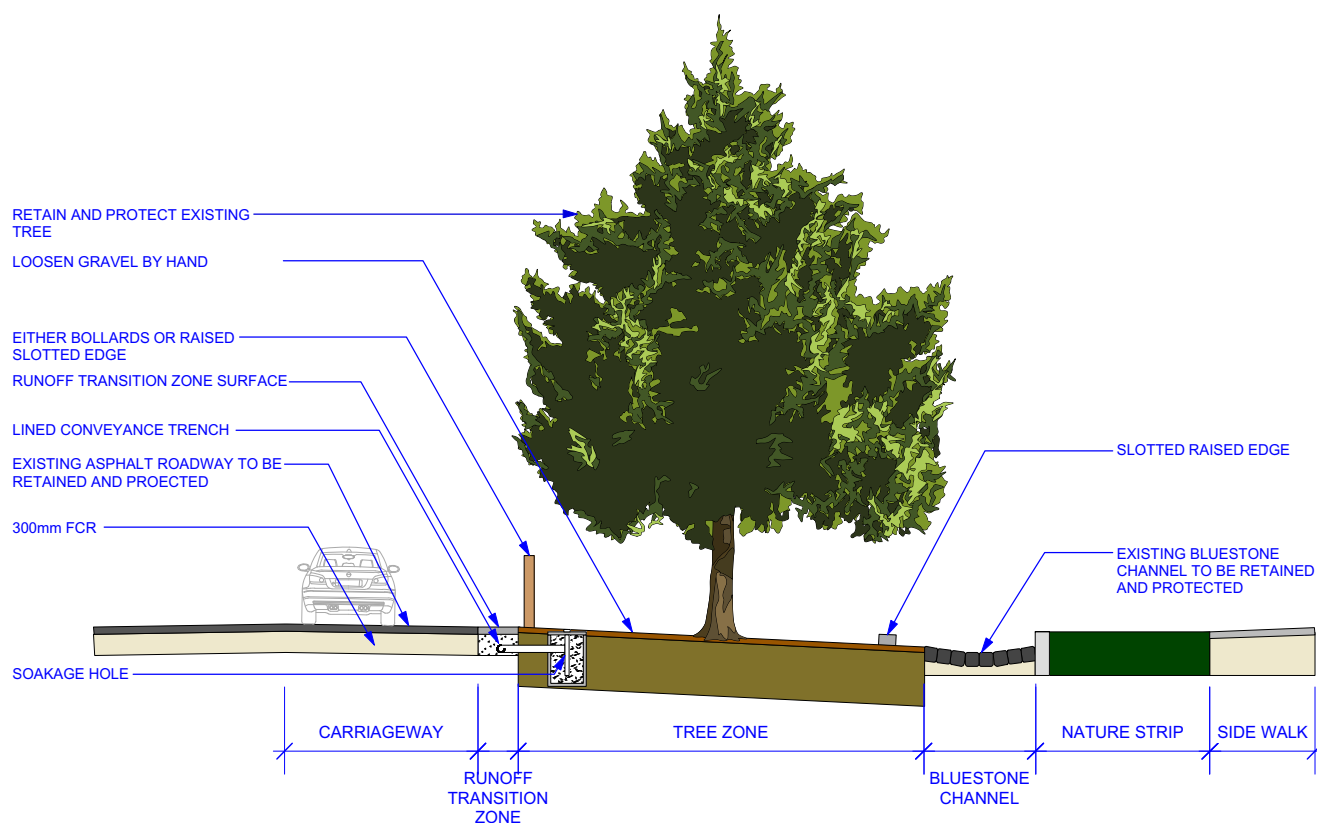


Surface spoon drain (with grated inlet to transfer to tree)

## 4.1.4 Plan View At Tree Zone

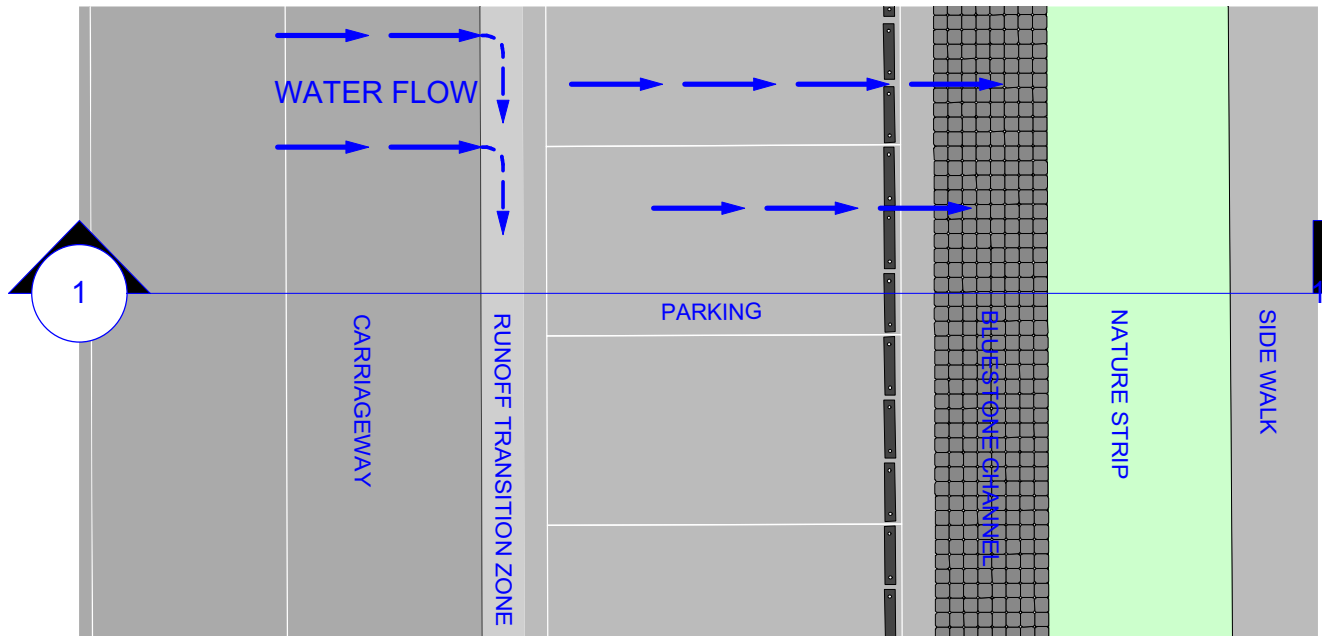


## 4.1.5 Section At Tree Zone

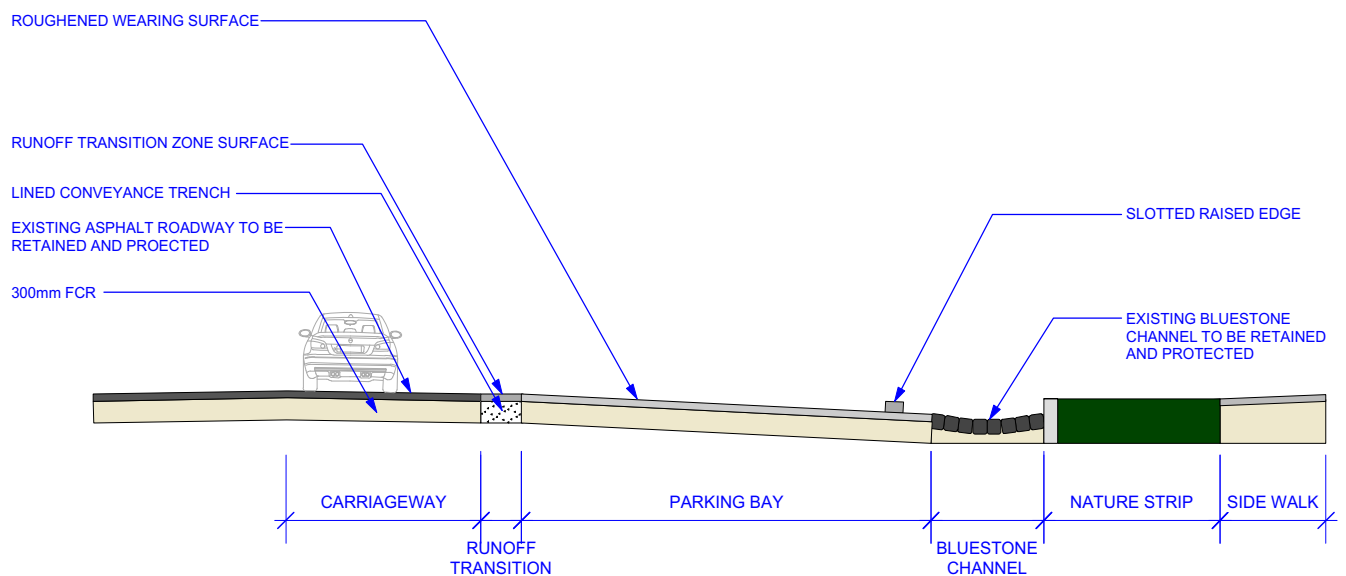




#### 4.1.6 Plan View At Parking Zone



#### 4.1.7 Section At Parking Zone



## 4.1.8 Financial Costs and Benefits

### Expected capital investment costs:

Green-Blue Initiative	Estimated cost/tree	Estimated cost/km of Street (trees both sides)
Creation of a tree zone with bollards and surface mulching	\$350	\$54,902
Passive irrigation system	\$500	\$78,431
Permeable paving strip	\$1,900	\$298,039
Raised leaf and gravel barrier	\$320	\$50,196
Total:	\$3,070	\$481,569

### Expected operational costs:

- No significant additional operating costs. Approximately every 6 months, the sleeve in the soakage hole could be lifted and shaken out to remove sediment and maintain good performance. This could amount to an estimated \$750 per year in labour costs for each km of street.

### Potential capital investment benefits:

- Avoided investment in additional paved area: One of the common investment programmes to upgrade original style heritage streets involves the widening of the road asphalt area by 1.5m each side and the re-profiling of gravel areas. This approach reduces wheel traffic on the gravel at speed and reduces the potholes and water pooling (but provides no benefit to the trees). The cost of this approach is approximately \$300,000 per km of road. The green-blue proposal will result in a widened paved area and may reduce or eliminate the need for this investment.

### Expected operational benefits:

- Simple leaf litter removal along the raised edge: The reduction of manual leaf removal from the bluestone drains will make leaf clearance during Autumn easier for Council.
- Reduction of gravel erosion: Gravel repairs in a typical heritage street which are conducted on an as needed basis can amount to \$2700 per km of street.
- Reduced tree root damage to bluestone drains: Tree roots can migrate into the drain area in search of water, causing damage that can cost \$300 per square metre to repair. Whilst this root ingress may still occur on occasion, the increased and more homogenous soil moisture within the tree root growing zone is anticipated to reduce this occurrence.

### 4.1.9 Green-blue benefits (per km)



#### STORMWATER TREATMENT

Passive irrigation of street trees will reduce nitrogen by 1.7kg/year (32%) and suspended solids by 198kg/year (53%). The reduction of gravel and leaf litter migration will significantly reduce pollution.



#### ALTERNATIVE WATER SUPPLY

Throughout the year, 490,000 litres of irrigation water will be provided to street trees.



#### RUNOFF DETENTION

The water held in the passive irrigation system and tree soil layers will help to slow runoff from roads and could improve the performance of local drainage systems.



#### RUNOFF REDUCTION

The channelling of runoff to the tree allows runoff to be absorbed into the soil but also to be diverted from the gravel area where it caused bogging and erosion issues.



#### BIODIVERSITY

Supporting the health of existing mature trees provides habitat for a range of insects and birds in the city.



#### QUALITY TREES AND VEGETATION

The growth and lifespan of the tree will be supported by irrigation and a protected tree zone. An increase of 650m<sup>2</sup> is expected in canopy cover.



#### QUALITY RECREATION SPACES



#### INCREASED SOIL MOISTURE

A 100 litre soakage hole is provided for each tree, keeping soil moist and supporting a healthy tree.



#### AMENITY AND CHARACTER

Protects the treasured mature trees and heritage streetscapes while reducing potholes.



#### AIR QUALITY IMPROVEMENT

Street trees in busy urban areas will help to cleanse pollutants from cars from the air



#### SHADE AND COOLING

The support of mature trees will ensure a healthy canopy provides shading to the road and footpath areas. An irrigated tree will provide further cooling.



#### EDUCATION

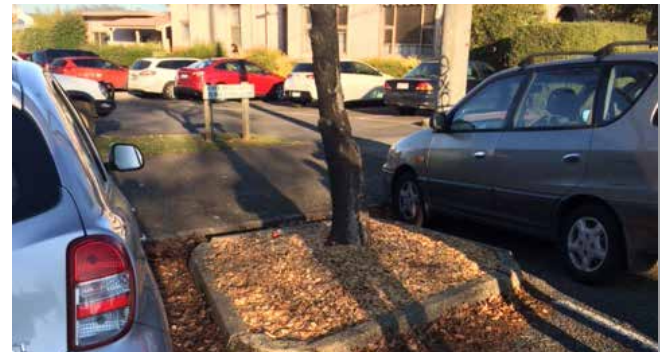




## 4.2. Modern Style Heritage Streetscape

### 4.2.1 Context

Some of the streets in the heritage area of Ballarat have evolved to become a more conventional and modern example of a streetscape - redeveloped to include kerb and channel drainage, full sealed surfaces and parking delineation. This type of street is also common in other Ballarat suburbs and in new developments. This typology is examined as a planned reconstruction opportunity, considering what changes could be made to the existing template for modern streetscapes in central Ballarat.



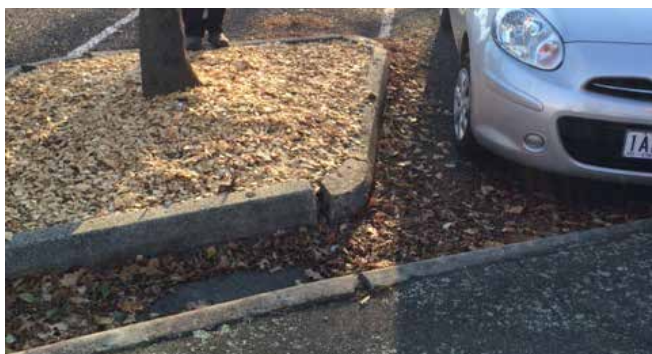
Example Street: Errard Street



## 4.2.2 Key Challenges



Clash of tree canopy with powerlines resulting in an unbalanced tree and a significant decrease in canopy cover per tree.



Difficulties in managing leaf litter as street sweepers cannot access gap between tree 'island' and kerb.



Limited soil volume restricting tree growth. The effect of limited soil volume is often noticeable on the same street, where trees of the same age are vastly different sizes due to soil volume allowed.



'Island' around tree prevents entry of water from the adjoining road, restricting passive irrigation and limiting soil moisture. This often leads to uplift of pavements and footpaths as trees search for water - creating safety hazards to pedestrians.



### 4.2.3 Green-blue Initiatives

#### Proposal: Construct streetscape to:

1. Relocate tree growing area to the edge of the parking zone (near the roadway), therefore addressing two issues:
  - Reducing the clash of tree canopy with powerlines
  - Creating a wide gap behind the tree growing area and the kerb that street sweepers can pass through.
2. Provide irrigation water to the trees soil area via a kerb inlet designed to capture runoff while minimising sediment inflow. Water is passed into a soakage hole or infiltration trench within the tree zone. A sleeve insert is included in the well to capture sediment, and can be regularly removed and shaken out.
3. Provide an extended soil volume under the paved surface between the tree and the kerb by using structural soil cells. This provides the additional soil volume required to support a healthy tree while also providing a drainage layer adjacent to the tree pit that will protect against water logging.

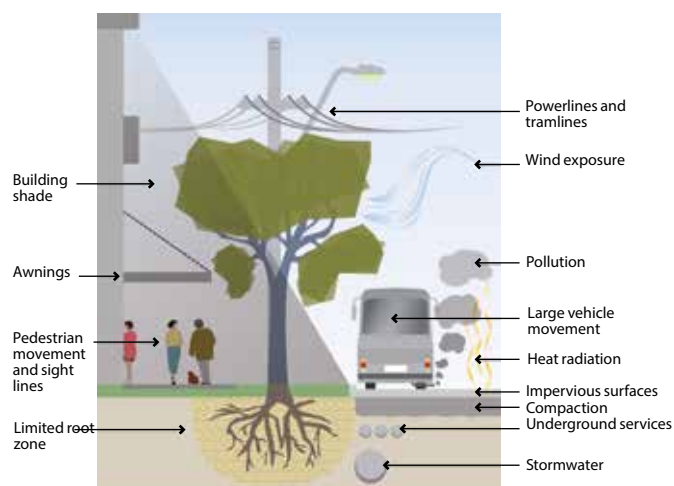


Example of a passive irrigation inlet to a tree pit in Northcote

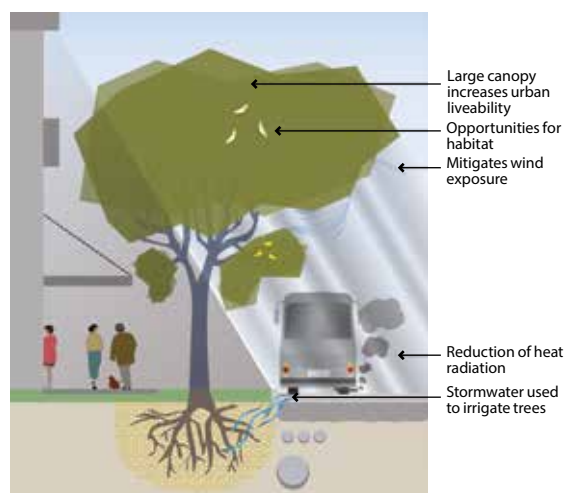
4. Protect the core tree root area from traffic using bollards, with a flush tree surface area open to air.

This streetscape design lends itself particularly to streets with 90 degrees or angled parking (not parallel parking). Each street renewal needs to be assessed on its own merits, considering site-specific constraints and opportunities.

Alternative designs could place the tree in a green verge between the road and the footpath and use a similar kerb inlet arrangement or passive irrigation to the surface of the tree pit similar to case study 4.

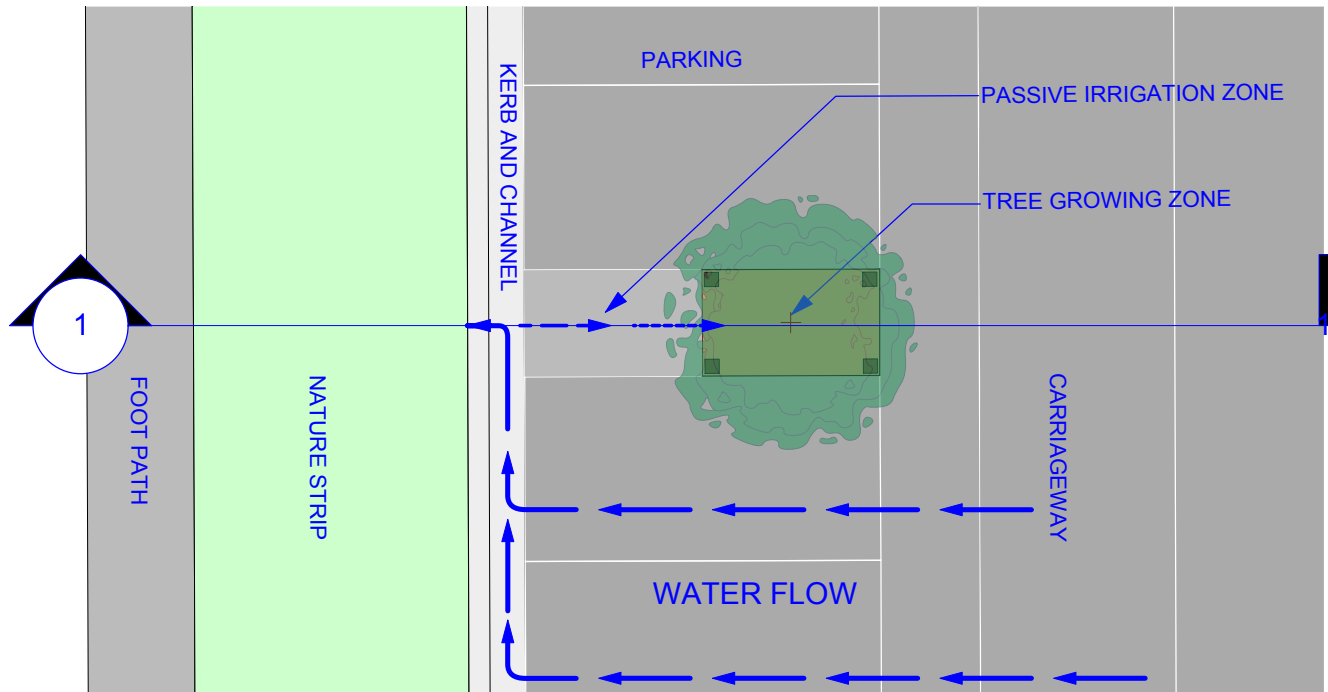


Common street tree challenges (source: urban forest diversity guidelines)

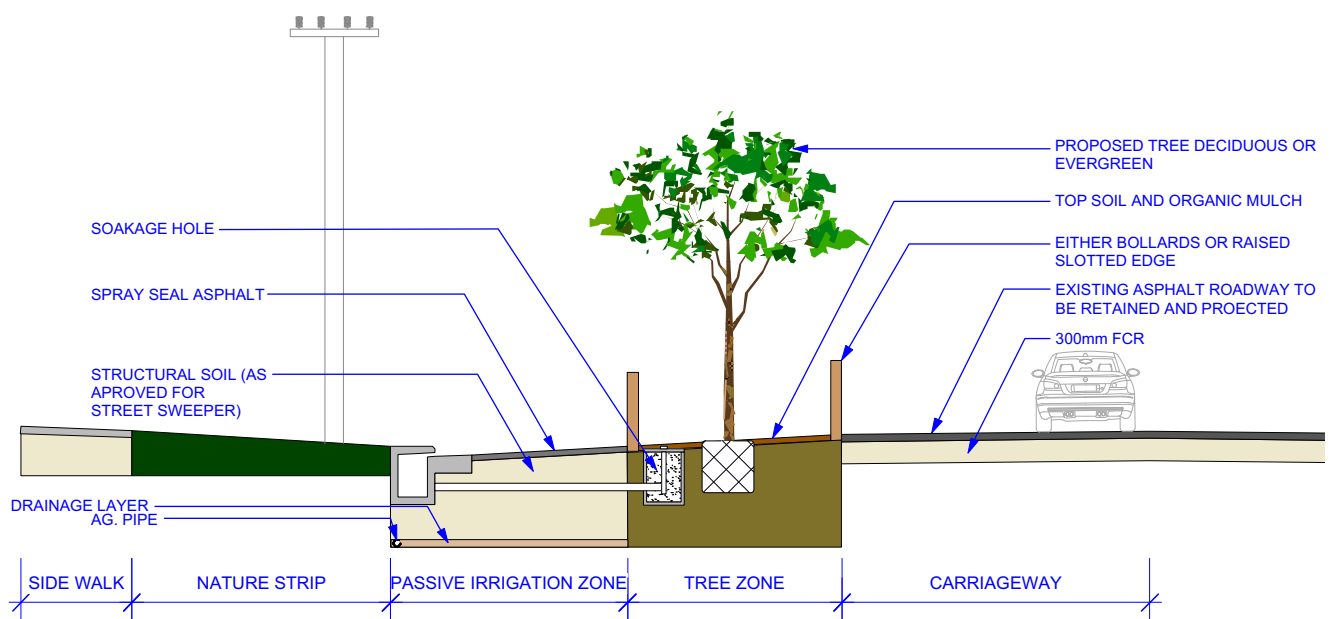


Green-blue solutions for street trees (source: urban forest diversity guidelines)

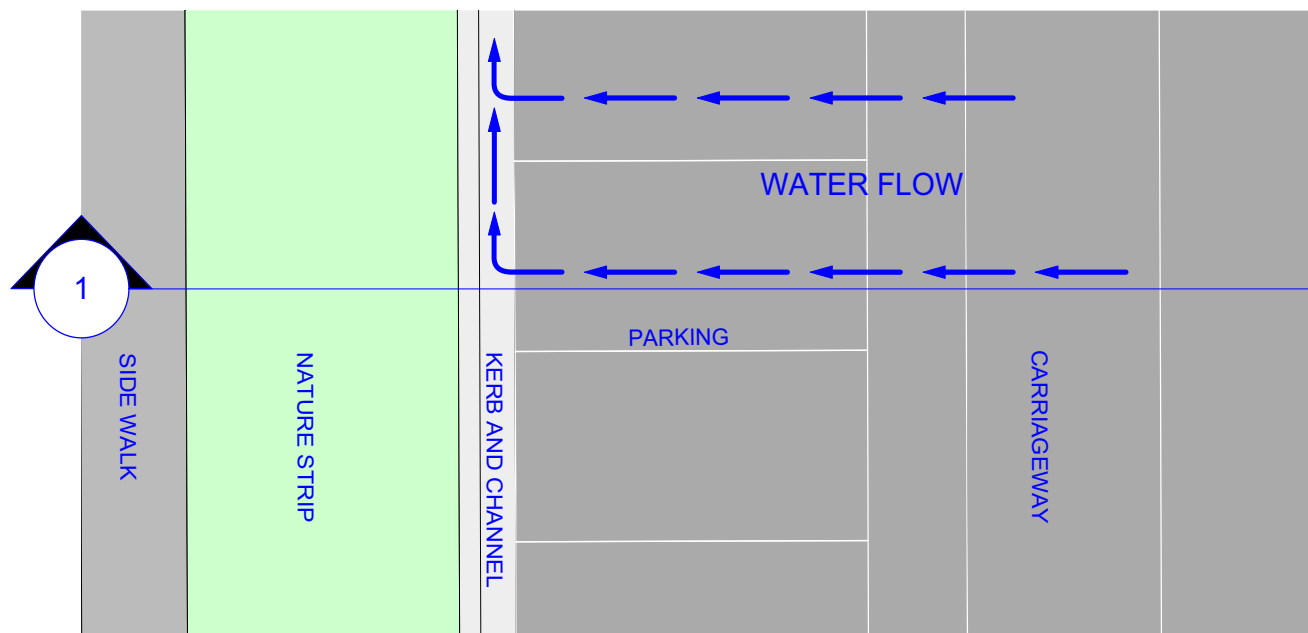
#### 4.2.4 Plan View at Tree Zone



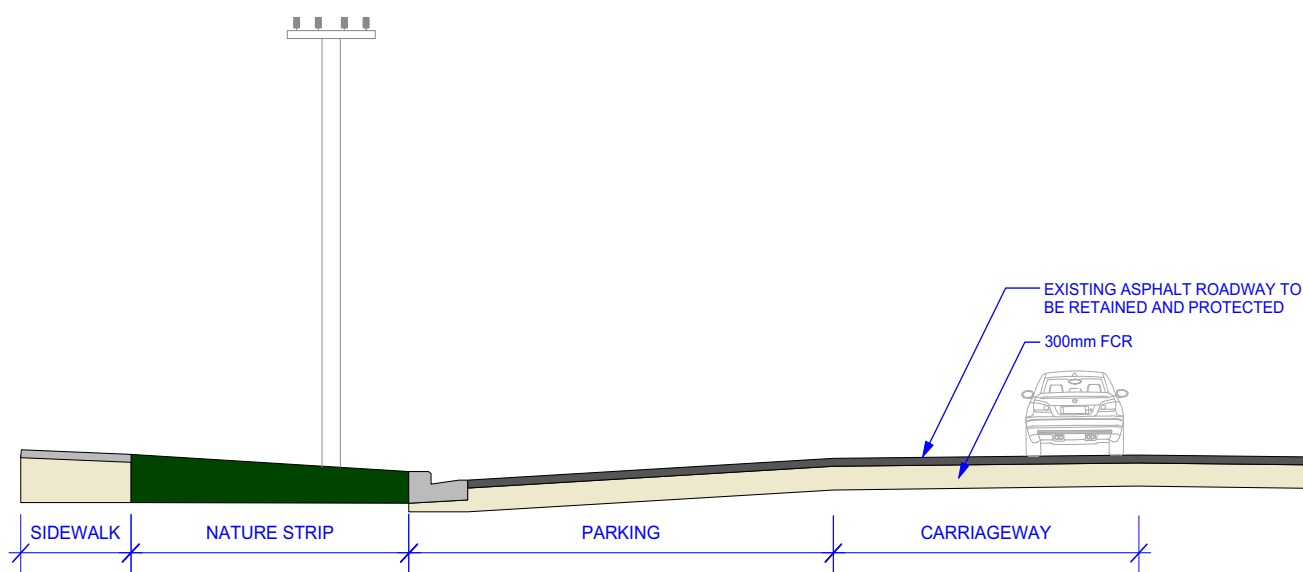
#### 4.2.5 Section At Tree Zone



#### 4.2.6 Plan View At Parking Zone



#### 4.2.7 Section At Parking Zone



## 4.2.8 Financial Costs and Benefits

### Expected capital investment costs:

Green-Blue Initiative	Estimated cost/tree	Estimated cost/km of Street (trees both sides)
Creation of a tree zone with bollards and surface mulching	Nil additional cost compared with business as usual	Nil
Creation of structural soil zone under paved area between tree zone and kerb	\$1,395	\$223,200
Passive irrigation system	\$800	\$128,000
<b>Total:</b>	<b>\$2,195</b>	<b>\$351,200</b>

### Expected operational costs:

- No significant additional operating costs: Approximately every 6 months, the sleeve in the soakage whole could be lifted and shaken out to maintain good performance. This could amount to an estimated \$750 per year in labour costs for each km of street.

### Potential capital investment benefits:

- Avoided cost of construction of additional car parks: The estimated cost of constructing new car parks on the fringe of the Ballarat CBD is \$20,600 per car park\*. If tree planting areas are slimmed by 0.25m each (due to the substantial additional soil volume provided under the pavement between the tree and the kerb), over a kilometre of street, an additional 16 car parks could be created. These car parks constitute a potential avoided capital cost of \$330,000 per km.

### Expected operational benefits:

- Street sweeper access: The prevention of manual leaf removal from the kerbs adjacent to the 'tree islands' could save Council an estimated \$700 in manual labour time per km of street every week during Autumn.
- Reduction of pruning due to clash with powerlines: The offset of trees from the kerb should significantly reduce the area of tree canopy which requires pruning or prevent the need for pruning. Currently, the pruning of 4,700 trees to avoid powerlines in Ballarat costs the council \$300,000/year. There may be some reductions in pruning costs due to reduced area of canopy in the powerline corridor.
- Reduced tree root damage to roads and footpaths: Tree roots can spread in search of water and nutrients when they are contained without sufficient access to soil and water. An estimated 90% of the footpath repair budget in City of Ballarat is dedicated to the repair of path uplift caused by tree roots which results in a trip hazard. This amounts to \$270,000/year across the city.

\*Based on cost of construction of new car parking in Ballarat CBD Parking Study, AECOM, 2011



### 4.2.9 Green-blue benefits (per km)



#### STORMWATER TREATMENT

Passive irrigation of street trees will reduce nitrogen by 4.2kg/year (81%) and suspended solids by 360kg/year (96%). The reduction of leaf litter migration will significantly reduce pollution.



#### ALTERNATIVE WATER SUPPLY

Throughout the year, 1,250,000 litres of irrigation water will be provided to street trees.



#### RUNOFF DETENTION

The water held in the passive irrigation system and tree soil layers will help to slow runoff from roads and could improve the performance of local drainage systems. Modelling estimates a 6% reduction in peak flow for a 1 in 1 year event.



#### RUNOFF REDUCTION

The channelling of road runoff to the tree allows runoff to be absorbed and reduced.



#### BIODIVERSITY

Healthy trees provide habitat for a range of insects and birds in the city.



#### QUALITY TREES AND VEGETATION

The growth and lifespan of the tree will be supported by irrigation and a large soil growing area. An increase of 1700m<sup>2</sup> is expected in canopy cover.



#### QUALITY RECREATION SPACES



#### INCREASED SOIL MOISTURE

A 100 litre soakage hole is provided for each tree, keeping soil moist and supporting a healthy tree.



#### AMENITY AND CHARACTER

Creates treasured healthy trees in popular pedestrian environments.



#### AIR QUALITY IMPROVEMENT

Street trees in busy urban areas will help to cleanse pollutants from cars from the air.



#### SHADE AND COOLING

The support of a healthy canopy provides shading to the road and footpath areas. An irrigated tree will provide further cooling.



#### EDUCATION



## 4.3. Carparks

### 4.3.1 Context

Ground level open-air carparks are a common feature in cities, and there are many precedents in Ballarat. Often vast expanses of paving with no greenery or dedicated footpath areas, car parks can be an unwelcoming environment for pedestrians.

This case study examines a proposed car park at the Eastern Oval, which includes 157 car parking spaces and a series of refuge islands separating car parks from roadways and pedestrian routes. A master plan was already proposed for the carpark, so the green-blue proposal provides simple amendments that could be applied to the master plan while retaining the layout and the number of car parks.

The broader design principles apply to all open-air council or privately developed (or redeveloped) car parks with appropriate policy mechanisms in place.



Case study site: Eastern Oval Carpark

### 4.3.2 Key Challenges



Lack of shading creates an unpleasant pedestrian environment and increases heat in parked cars. This is a risk to health and well-being.



Car parks are often poor amenity areas, providing no character or value to the city landscape.



Car parking pressure means that the integration of green areas should be multifunctional in nature to make efficient use of space.



High stormwater runoff impacts due to the large paved areas and highly trafficked surfaces, meaning polluted stormwater is directly entering the drainage system to be discharged to local waterways.



### 4.3.3 Green-blue Initiatives

#### Proposal: Amend existing master plan and construct car park to:

1. Distribute trees and planting areas across carpark using these to also delineate between circulation routes, pedestrian routes and car parking areas. Planting will increase the amenity of the carpark and provides shade to pedestrians and cars. Ensure all planted areas receive passive irrigation. The garden edges can be flush with the ground surface or provided with a kerb including a gap to allow water in.
2. Take into account the existing slope of the carpark area (lower on the east) to identify a proportion of planted areas that will incorporate bioretention areas that will intercept stormwater and provide treatment before it is released to the drainage system. A total area of at least 1% of the car park area should be allocated to a bioretention to provide best practice treatment.
3. Place bioretention areas adjacent to tree growing zones to allow trees to take advantage of the expanded soil area and access water draining through the bioretention area.

#### Design principles for new carparks:

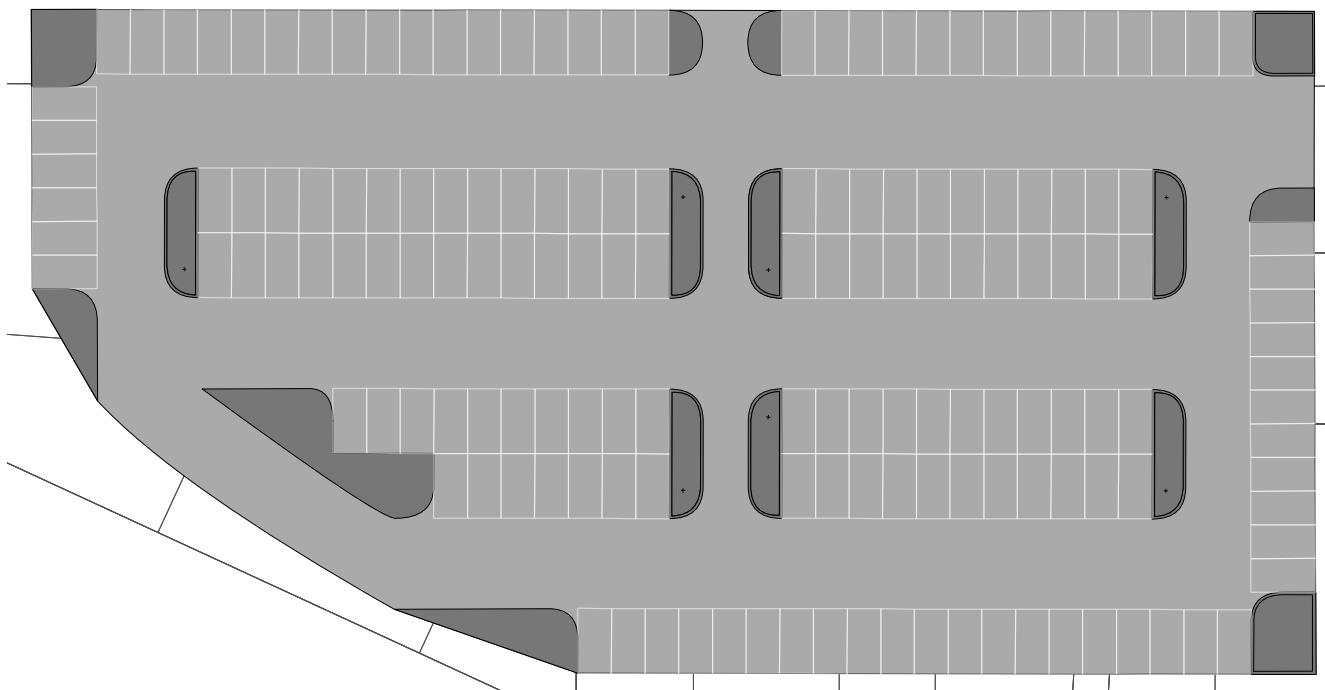
A range of arrangements of stormwater treatment and vegetation are possible in new carparks. Key green-blue design principles are:

- Integrate trees to maximise canopy coverage to provide shade for pedestrians and cars. East-west rows along northern side optimise shade.
- Utilise bioretention or swales for stormwater treatment. Treatment areas can be clustered to minimise need for extended underdrainage infrastructure.
- Where kerb protectors are needed, inlet points to a bioretention area can be defined for easier sediment cleaning and litter removal.

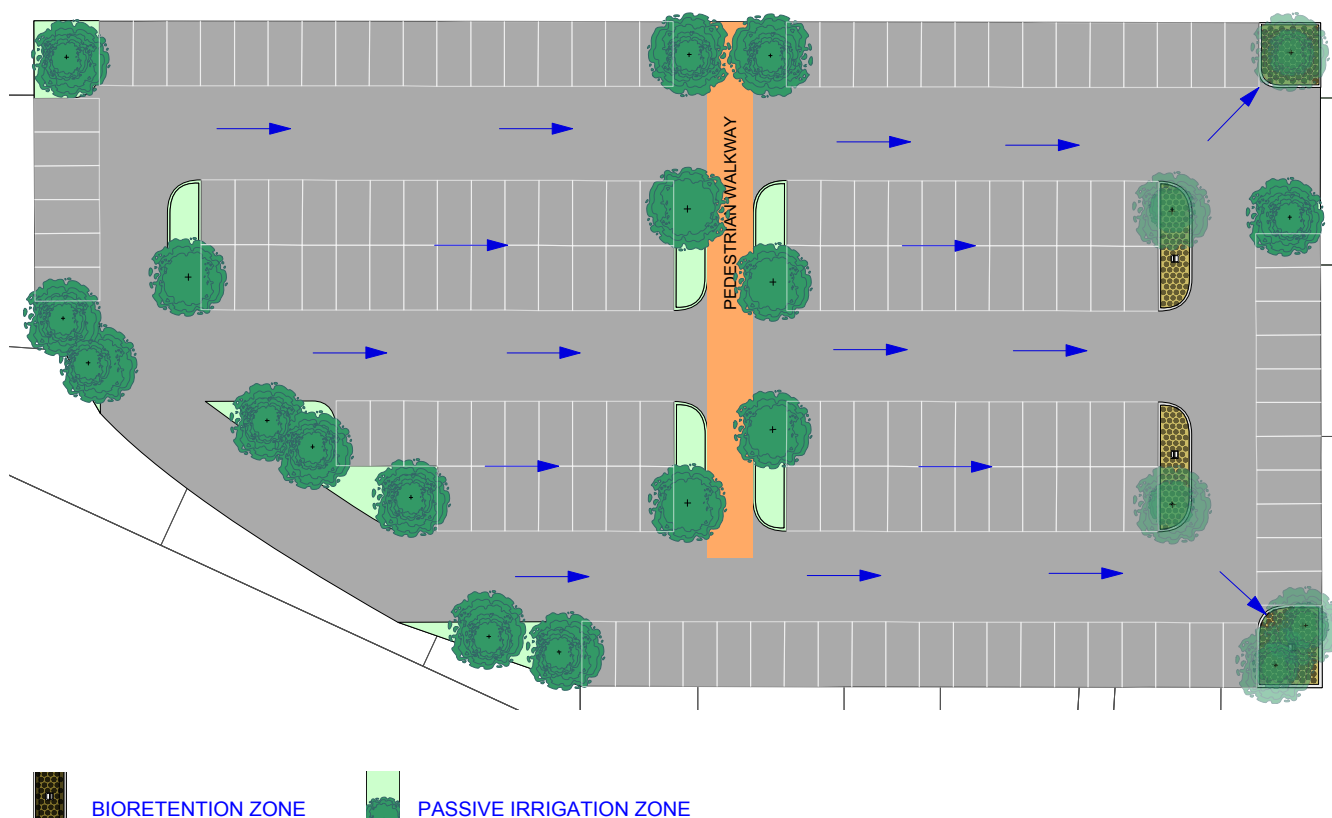


Precedent images

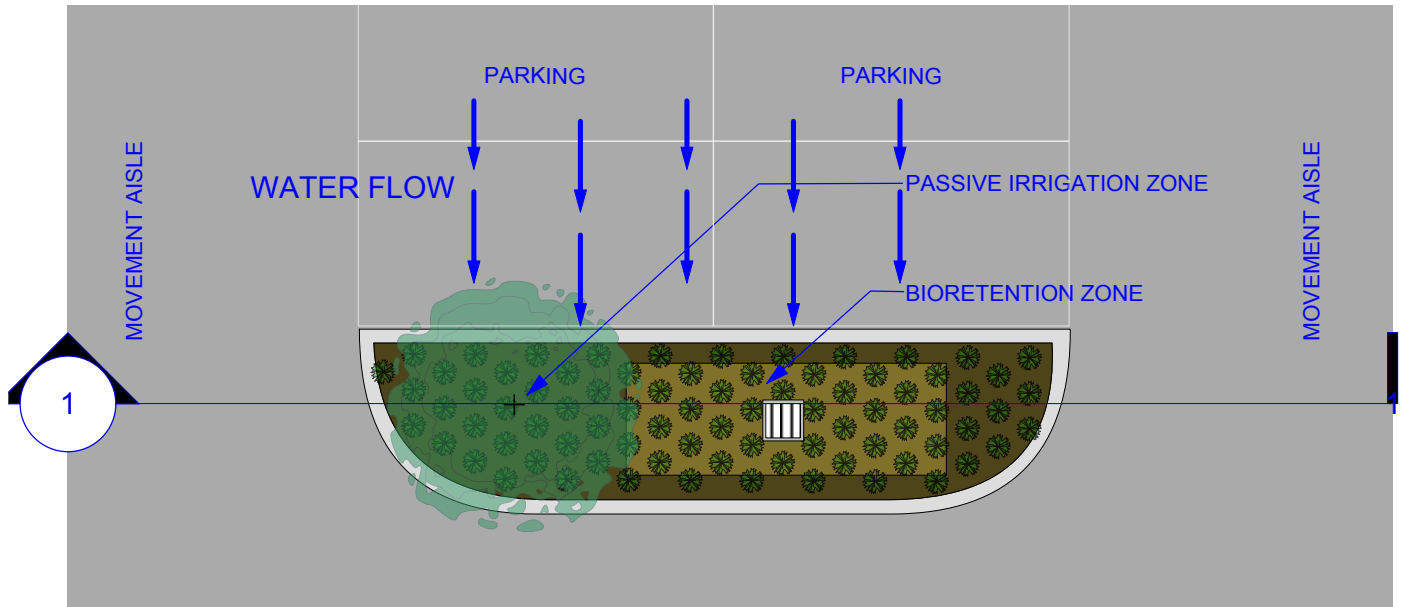
### 4.3.4 Existing Eastern Oval Master Plan



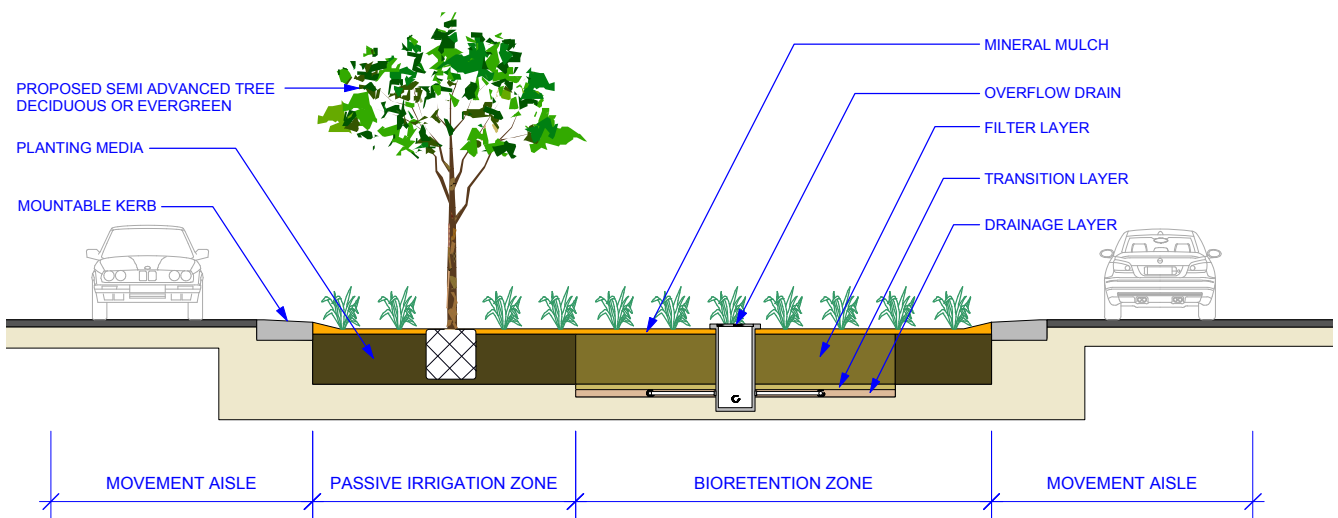
### 4.3.5 Proposed Green-Blue Eastern Oval Master Plan



### 4.3.6 Plan At Bioretention Zone



### 4.3.7 Section At Bioretention Zone





### 4.3.8 Financial Costs and Benefits

#### Expected capital investment costs:

Green-Blue Initiative	Estimated cost for car park	Estimated cost/ 1000m <sup>2</sup>
Planted areas and trees (incorporating 21 trees)	\$15,600	\$2,480
Bioretention areas	\$29,340	\$4,658
Total:	\$44,945	\$7,134

#### Expected operational costs:

- Management of trees in carpark areas: Basic pruning and tree care is estimated to amount to \$60/tree/year, amounting to \$1,260 for the case study car park/year.
- Management of bioretention areas: Maintenance of the bioretention areas will include care of vegetation, litter removal and periodic sediment removal from the top layer of media. This amounts to an estimated \$1470/year for the case study car park area.

#### Potential capital investment benefits:

- Multi-functionality: There may be some savings related to the incorporation of multiple uses in the same space. Space for vegetation and bioretention could be integrated with pedestrian pathways and traffic/directional medians to minimise cost and space implications.

#### Expected operational benefits:

- No significant operational savings expected: Car parks are low or zero maintenance environments under business as usual practice. Though, over the lifetime of the carpark tree shade may extend the lifespan of asphalt.



### 4.3.9 Green-blue benefits for the case study carpark



#### STORMWATER TREATMENT

Introduction of bioretention in the carpark will reduce nitrogen by 5kg/year (45%) and suspended solids by 627kg/year (80%), achieving best practice stormwater management.



#### ALTERNATIVE WATER SUPPLY

The trees will be provided with passive irrigation, with an estimated 246,750 litres of water provided to trees in the carpark each year.



#### RUNOFF DETENTION

The water held in the bioretention systems and tree soil layers will help to slow runoff from carparks and could improve the performance of local drainage systems.



#### RUNOFF REDUCTION

The channelling of runoff to the vegetated areas allows runoff to be absorbed and reduced.



#### BIODIVERSITY

Healthy trees provide habitat for a range of insects and birds in the city.



#### QUALITY TREES AND VEGETATION

The growth and lifespan of the tree will be supported by passive irrigation and a large soil growing area. An increase of 270m<sup>2</sup> is expected in canopy cover.



#### QUALITY RECREATION SPACES



#### INCREASED SOIL MOISTURE

The adjacent bioretention areas and passive irrigation inlets provide a frequent source of water to the tree growing areas.



#### AMENITY AND CHARACTER

Significantly improves the visual amenity of car park areas.



#### AIR QUALITY IMPROVEMENT

Trees in busy urban areas will help to cleanse pollutants from cars from the air.



#### SHADE AND COOLING

Provides an important source of shade for pedestrians and parked cars.



#### EDUCATION





## 4.4. Industrial Areas

### 4.4.1 Context

This case study focusses on industrial areas which accommodate a range of light industry and bulky goods retail premises. The area of focus is the Delacombe industrial area which is located to the west of the CBD. The focus is on the streetscape areas, as these are where Council has most control, working with its own assets and partnering with VicRoads. However, complementary initiatives could also be taken within the private lots. There are broadly two types of streets in the industrial case study area, a large thoroughfare (e.g. La Trobe Street), typically managed by VicRoads (with verge areas managed by Council), and smaller internal streets (e.g. Martin Street), which are managed by the council. The case study streets are typified by the presence of green verges often without a footpath and very little tree canopy cover relative to the rest of Ballarat. Air quality is a particular issue in the area, with dust from truck loads and on-site works migrating to road and becoming airborne with traffic movements.



## 4.4.2 Key challenges



Low air quality in the area due to dust and traffic movements affects the health of those working in the area and living downwind.



An area of Ballarat with very little vegetation or tree cover and poor amenity value.



High sediment loads, hydrocarbons and heavy metals washing into the stormwater system from industrial areas are a high risk to waterway health.



Lack of shade and a predominantly paved area intensifies the urban heat island effect and heightens health risks related to heat exposure.



### 4.4.3 Green-blue Initiatives

#### Proposal: Retrofit industrial area to:

1. Integrate trees into the street-side green verges, taking advantage of the soil area to provide increased tree canopy and the amenity, microclimate and air quality benefits trees provide. Semi-mature trees are recommended for effective establishment.
2. Provide passive irrigation and provide some treatment of stormwater by introducing runoff from the kerb into tree zones. The tree area will be sunk into the ground to allow water to enter from the kerb and to provide some storage of water which will gradually soak into the ground. Side slopes should be no steeper than 1 in 5 to allow mowing.
3. An agi pipe running along the kerb line can be put in place (or may already be in place with modern kerbs) to provide drainage and prevent water logging. If an agi pipe is not in place, tree species should be selected that can tolerate wet soils for long periods.

The proposal is a low cost, low maintenance solution using simple mechanisms to combine stormwater management and tree irrigation.

In new industrial areas, these street initiatives can be built into new designs, but on-lot initiatives can also be introduced through planning. These could include:

- Introduction of rainwater harvesting on site to take advantage of large industrial roofs to provide water for dust suppression, on-site landscapes and on-site non-potable uses (e.g. toilet flushing and wash down). The harvesting of rainwater will reduce stormwater runoff and benefit waterway health.
- Inclusion of bioretention and passively irrigated vegetation areas in carparks and front courtyards of commercial buildings, as per case study 4. By sloping towards the front of the property, vegetated frontages can benefit from watering while providing stormwater treatment. This will add amenity to worker and commercial areas, while providing greening and water management outcomes.

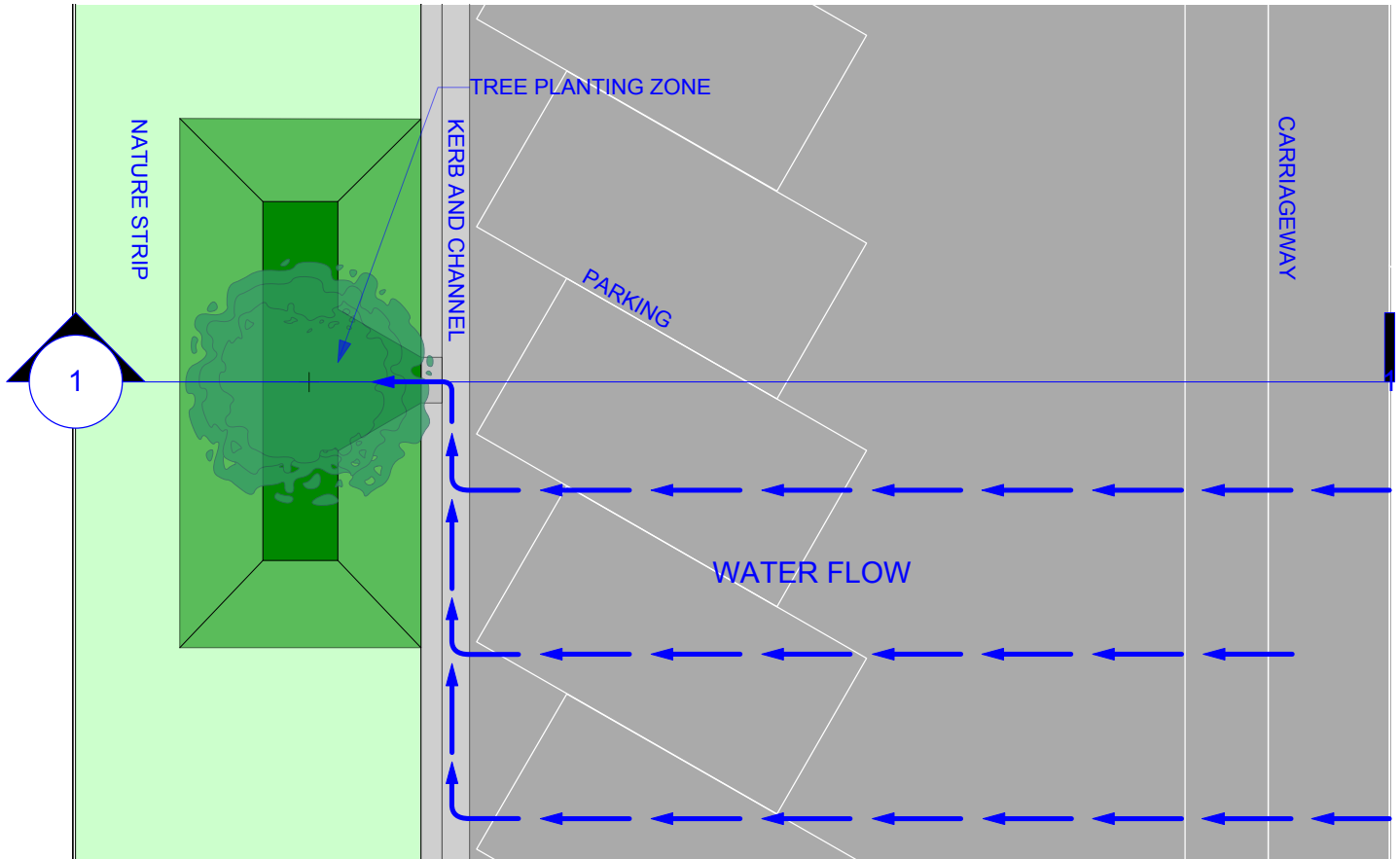
A possible alternative design could include the installation of linear infiltration trenches along the green strip linked to inlets from the kerb.



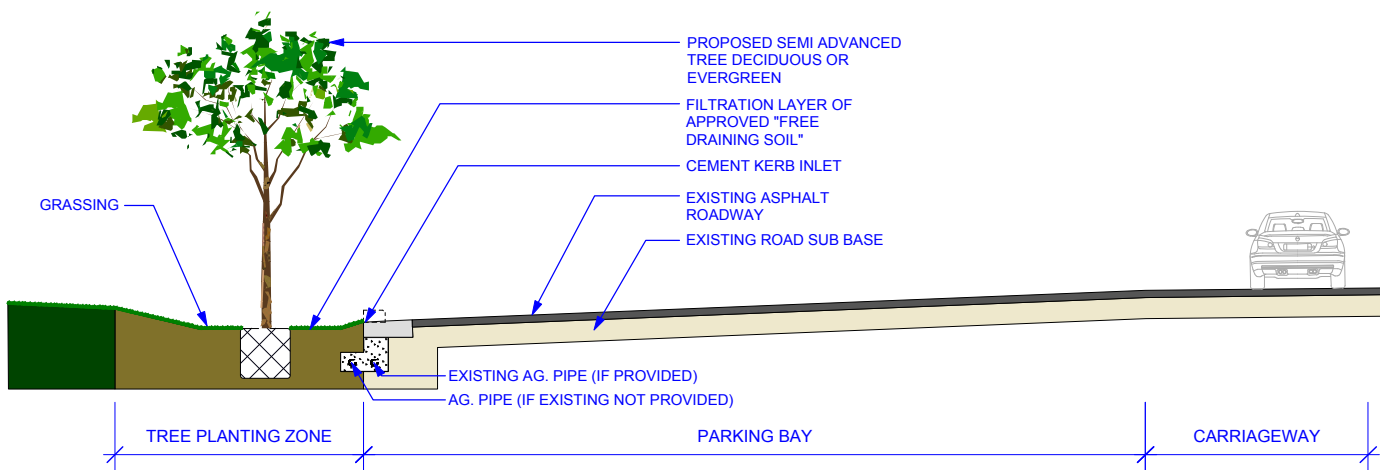
Precedent images



#### 4.4.4 Plan View At La Trobe St

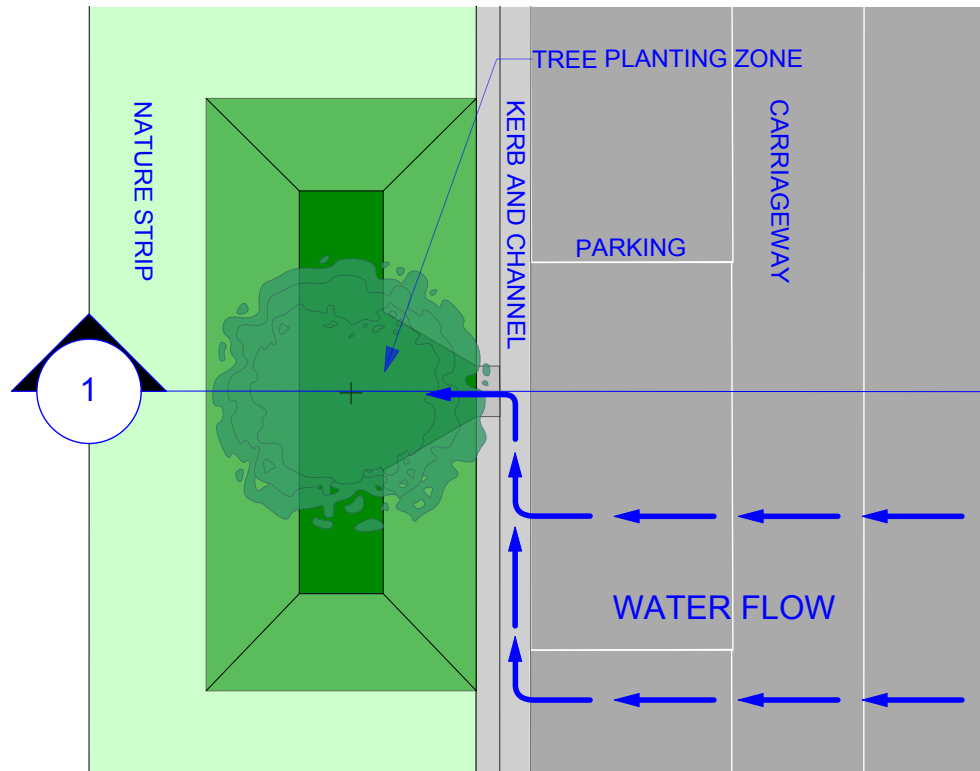


#### 4.4.5 Section At La Trobe St

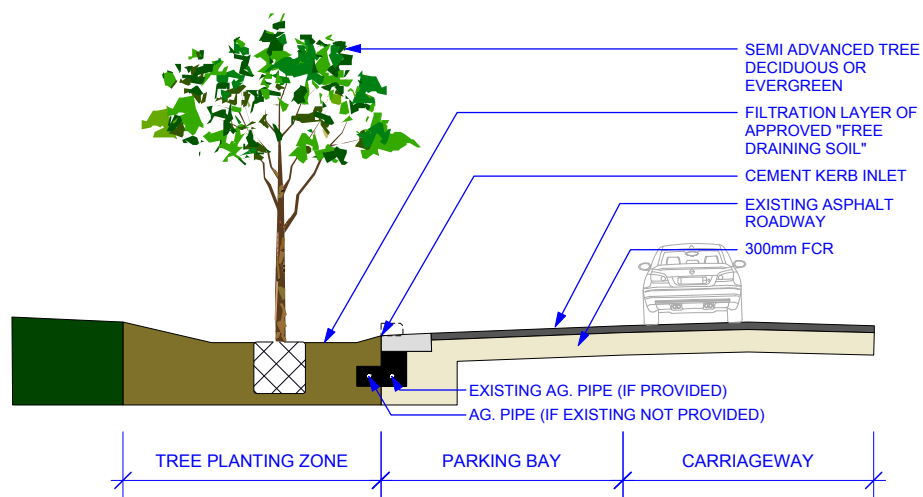




#### 4.4.6 Plan View At Martin St



#### 4.4.7 Section At Martin St



## 4.4.8 Financial Costs and Benefits

### Expected capital investment costs:

Green-Blue Initiative	Estimated cost/tree	Estimated cost/ km of street (trees both sides)
New semi-mature tree and soil	\$575	\$92,000
Creation of sunken area with kerb inlet	\$980	\$156,800
<b>Total:</b>	<b>\$1,555</b>	<b>\$248,800</b>

### Potential capital investment benefits:

- None identified

### Expected operational benefits:

- No significant operational savings expected: Industrial streetscapes are low or zero maintenance environments under business as usual practice.

### Expected operational costs:

- Management of trees: Basic pruning and tree care is estimated to amount to \$60/tree/year, amounting to \$9,600 per km of trees spaced at 12.5m on both sides.
- Management of passive irrigation system: Maintenance of the sunken passive irrigation areas will include mowing (required regardless), litter removal and periodic sediment removal from the top layer of soil (once every 5-10 years). This could amount to an estimated \$750 per year in labour costs for each km of street.



Visualisation of La Trobe Street with passive irrigation

#### 4.4.9 Green-blue benefits (per km) - La Trobe Street



##### STORMWATER TREATMENT

Introduction of passive irrigation in 1km of road will reduce total nitrogen by 11.3kg/year (36%) and total suspended solids by 1710kg/year (82%).



##### ALTERNATIVE WATER SUPPLY

Throughout the year, 1,880,000 litres of irrigation water will be provided to street trees in 1km of road.



##### RUNOFF DETENTION

The water held in the shallow storage and tree soil layers will help to slow runoff from the street and could improve the performance of local drainage systems. Modelling shows this measure can reduce peak flow rates in a 1 in 1 year event by 28%



##### RUNOFF REDUCTION

The channelling of runoff to the vegetated areas allows runoff to be absorbed and reduced.



##### BIODIVERSITY

Healthy trees provide habitat for a range of insects and birds in the city.



##### QUALITY TREES AND VEGETATION

The growth and lifespan of the tree will be supported by passive irrigation and a large soil growing area. An increase of 3150m<sup>2</sup> is expected in canopy cover.



##### QUALITY RECREATION SPACES



##### INCREASED SOIL MOISTURE

The passive irrigation inlets provide a frequent source of water to the tree growing areas.



##### AMENITY AND CHARACTER

Significantly improves the visual amenity of industrial areas.



##### AIR QUALITY IMPROVEMENT

Street trees in busy urban areas will help to cleanse pollutants from cars from the air. This is particularly important in industrial areas.



##### SHADE AND COOLING

Provides an important source of shade in a highly paved area.



##### EDUCATION

Tree planting in an area like Delacombe would be a prominent public activity, and could involve local business owners and the wider community.





## 4.5. Eureka Gardens Precinct

---

### 4.5.1 Context

This case study considers opportunities on a specific site, the Eureka Gardens Stockade Precinct which includes the Museum of Australian Democracy at Eureka (MADE museum), the Eureka Gardens and an open air swimming pool operated by the Council. The Eureka Gardens (recently supplemented with new landscaping), MADE and the outdoor pool are together the top water user in the Council's portfolio currently.

The case study analysis considered several opportunities with the aim of making better use of local water sources and supporting the local landscape.



## 4.5.2 Key Challenges



High water use in summer for the outdoor pool, particularly due to evaporation losses and water use for backwashing of the filters.



High water use in summer for irrigation of the gardens and landscape.



Existing pond fed by a small stormwater catchment, important for heritage character and amenity.



Large carpark and roof area has been recently created to complement the MADE museum development.



### 4.5.3 Green-blue Initiatives

This case study considered three opportunities to harness local water sources to meet local water demands from the pool and landscape. These included:

- Rainwater harvesting from the MADE museum roof to provide water for pool backwashing: Due to the large demand for pool backwashing water in summer, harvesting rainwater from the roof would only provide a small proportion of the water needs (approximately 7%). If down pipes from the museum roof can be easily accessed to direct water to a central storage, this option may be worthwhile, but was not selected as the highest potential option for the area.
- Reuse of backwash water for irrigation: It is possible to capture, treat and store pool backwash water for irrigation purposes. However, a treatment plant will need to be constructed to provide the level of treatment required to manage risks associated with human waste. For a single pool of this size, this option was not selected as the highest potential option for the area.
- Harvest stormwater for pool backwashing or irrigation: By accessing stormwater runoff from a large urban area, a significant volume of water could be harvested for treatment, storage and use in the precinct. The creation of an acceptable drawdown volume in the existing pond could provide space for storage of the water. This option was selected as the preferred proposal.



Options examined

**Proposal: Retrofit landscape to:**

1. Harvest stormwater from a considerable catchment, intercepting stormwater from Stawell Street South, and the land areas to the east (which drain to Stawell Street South), and the on-site carpark. It is assumed that stormwater can be transferred from pipes in Stawell Street South by gravity to the pond location (estimated 3m level change).
2. Utilise the existing pond, with an allocated additional 0.25m depth for storage of water which can be drawdown when necessary. This will require consideration of the edging of the pond to maintain amenity during high and low pond levels. The ability to drawdown and refill the pond using flows from a larger catchment will ensure that there is a good reliability of supply for either landscape irrigation or pool backwash.
3. Provide natural treatment of harvested stormwater. This could be done by constructing a bioretention area (~360m<sup>2</sup>) in the gardens for water to pass through before it is transferred to the pond. Alternatively, in keeping with the existing floating vegetation in the pond, a floating wetland (rafts of aquatic vegetation) could be installed, however the achievable coverage is unlikely to provide best practice water treatment. A bioretention area is preferable in terms of cost and assurance of water quality standards.



Grassed Swale



Floating Wetlands



## 4.5.4 Financial Costs and Benefits

### Expected capital investment costs:

Green-Blue Initiative	Estimated cost
Stormwater diversion and transfer	\$173,480
Stormwater treatment	\$136,800
Additional excavation and edge treatment of storage	\$22,625
Connection to park irrigation system or pool backwash system	\$5,000
Total:	\$337,905

### Expected operational costs:

- Management of bioretention area: Maintenance of the bioretention area, including plant care, litter removal and periodic sediment removal from the top layer of soil is estimated at \$6,840 year.

### Potential capital investment benefits:

- None identified

### Expected operational benefits:

- Purchase of water: The proposal will provide 4.4ML of water per year for either irrigation or pool backwashing. Accordingly there is a potential saving of purchasing potable water of \$8,000/year.
- Water security: In drought times, 'non-essential' water uses like irrigation and pool filling can be restricted. By investing in alternative supplies, there may be avoided shutdowns of public facilities and avoided costs of hand watering to keep key trees alive.

### 4.5.5 Green-blue benefits



#### STORMWATER TREATMENT

Introduction of bioretention and stormwater harvesting will reduce nitrogen by 36kg/year (42%) and suspended solids by 4,264kg/year (75%).



#### ALTERNATIVE WATER SUPPLY

Throughout the year, 4,400,000 litres of irrigation water or backwashing water.



#### RUNOFF DETENTION

The extraction of water from the drainage system and its storage and reuse could improve performance of the local system.



#### RUNOFF REDUCTION

Stormwater harvesting will significantly reduce runoff entering waterways.



#### BIODIVERSITY

Healthy trees and parkland provide habitat for a range of insects and birds in the city.



#### QUALITY TREES AND VEGETATION

Eureka gardens is provided with an alternative source of water which isn't subject to restrictions.



#### QUALITY RECREATION SPACES

The support of Eureka gardens ensures an important asset for the community and tourists is looking its best. The area provided with irrigation could be 10,000m<sup>2</sup>.



#### INCREASED SOIL MOISTURE

Provision of irrigation water to the gardens area will help to sustain the landscape year-round.



#### AMENITY AND CHARACTER

Ensures amenity of the precinct is protected.



#### AIR QUALITY IMPROVEMENT

Healthy landscapes will benefit air quality.



#### SHADE AND COOLING

Irrigated green areas and pools provide cooling and become a pleasant refuge on hotter days.



#### EDUCATION

There are opportunities for community education through on-site signage and collaboration with the museum and pool operators.



## 4.6. Victoria Park

### 4.6.1 Context

This case study considers possible green-blue initiatives that could be undertaken in Victoria Park, a key open space in Ballarat. The case study aligns with directions being considered and recommended with the Draft Victoria Park masterplan. The park is a large green space, providing a range of recreational areas and habitat, Victoria Park is a treasured resource for communities and is a key focus for the Council.

The case study focusses on the eastern area around the two existing ponds where improved sporting grounds may be established in the future. The northern pond already captures stormwater from a significant urban area to the north of the park, however, as a result it experiences occasional algal blooms. The second pond to the south receives overflow from the first pond and stormwater from the adjacent school via series of open drainage channels. There is an existing flooding issue due to convergence of these channels near the intersection of Plane Avenue and Poplar Avenue and a collapsed culvert under the road at this point.



Victoria Park



## 4.6.2 Key Challenges



Increasing demand for irrigation water is expected (up to 10ML/year) as improved ovals and sporting grounds are introduced to the park. Provision of water to existing trees is also a priority.



Maintenance of the amenity of existing ponds is a concern, as algal blooms have been known to occur on occasion due to the inflow of untreated stormwater.



The park experiences flooding of roadways and some green areas in significant rainfall events.



Existing drainage channels could be enhanced to provide better amenity and biodiversity value while also aiding stormwater treatment.

### 4.6.3 Green-blue Initiatives

#### Proposal: Retrofit landscape to:

1. Provide treatment of the harvested stormwater currently entering the park from the north, by constructing a wetland in and around the upstream area of the northern pond. This will protect against algal blooms and ensure stormwater is treated to best practice standards.
2. Contour and revegetate the existing drainage channel from the school to the second pond, providing a level of treatment of stormwater to ensure it is suitable for storage and subsequent irrigation. This will also improve amenity and allow the swale to become a landscape feature.
3. Excavate a storage pond area at the convergence point of the swales adjacent to Plane Avenue and upstream of the second ornamental pond. This will hold water from the northern and school catchment to provide an irrigation storage and a retarding area to alleviate the current flooding issue.
4. Utilise the second pond as both an amenity pond and an irrigation storage, allowing drawdown of up to 0.5m to supply water to adjacent sporting grounds and ovals. The existing bluestone edge of the pond will ensure that drawdown will have minimal impact.

More broadly in Victoria Park, several improvements could be made to support green-blue outcomes:

- Integrate contour swales across the park to gather and direct park drainage to harvesting points. These will also hold water and can aid adjacent trees through provision of soil moisture.
- Provide sunken sporting fields or retention areas to reduce downstream flooding during major rainfall events.
- Revegetate swales and drainage channels to provide greater amenity and stormwater treatment.



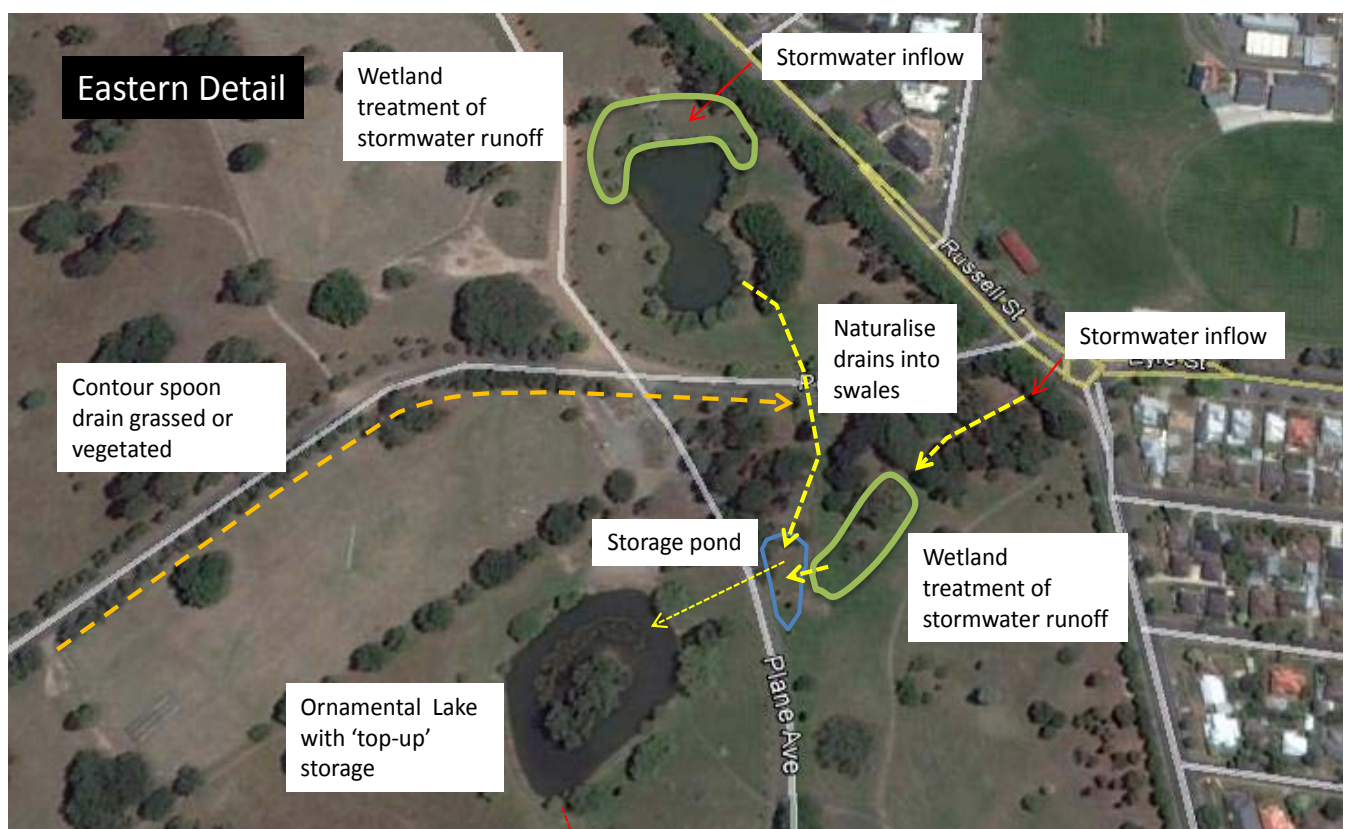
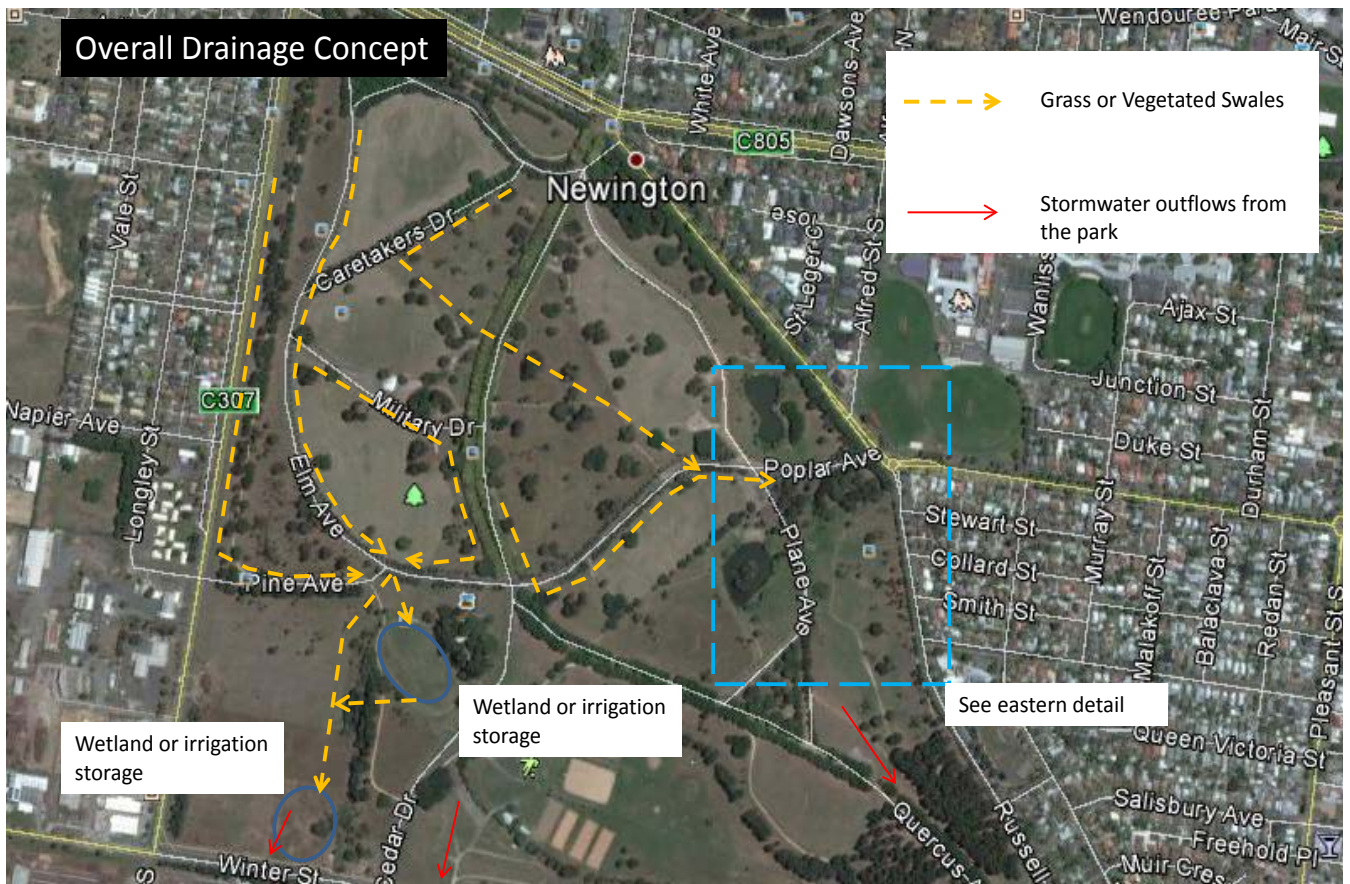
Grassed Swale



Grassed Swale



## 4.6.4 Proposals



## 4.6.5 Financial Costs and Benefits

### Expected capital investment costs:

Green-Blue Initiative	Estimated cost
Wetland (3,000m <sup>2</sup> ) partially utilising the existing pond	\$231,000
Swale vegetation and widening	\$7,500
Storage pond (3,500m <sup>2</sup> ) and outlet	\$226,550
<b>Total:</b>	<b>\$465,050</b>

### Expected operational costs:

- Management of wetland: Maintenance of the wetland is estimated at \$6,930/year including vegetation care and periodic sediment removal.
- Management of swale: Maintenance of the swale is estimated at \$2,348/year including mowing, vegetation care and periodic sediment removal.
- Management of the new storage pond: Maintenance of the storage pond is estimated at \$1,133/year.

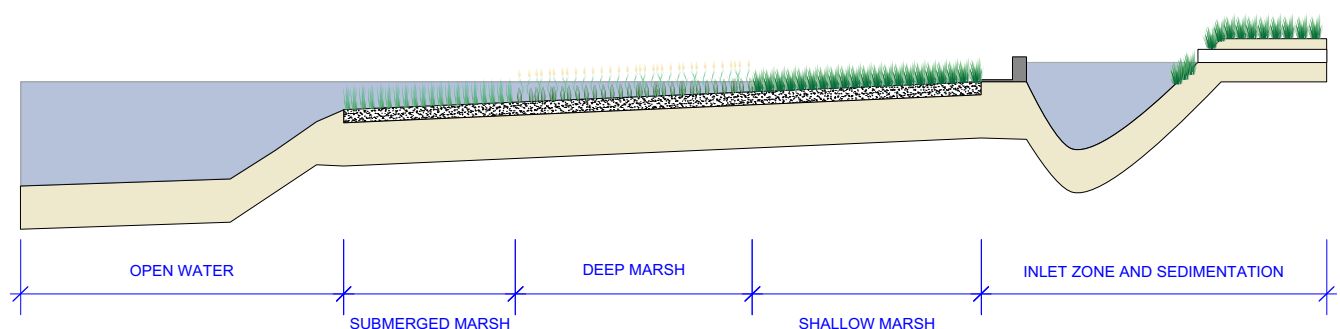
### Potential capital investment benefits:

- Avoided cost of retarding basin construction: A retarding basin has been proposed just to the south of the proposed storage pond with a similar volume. Accordingly, there is an equivalent avoided capital cost estimated at \$226,550.

### Expected operational benefits:

- Purchase of water: The proposal will provide 10ML of water per year for irrigation, which should provide good reliability of supply (87%) for two ovals (one premier and one standard). Accordingly there is a potential saving of purchasing potable water of \$18,000/year.
- Water security: In drought times, 'non-essential' water uses like irrigation and pool filling can be restricted. By investing in alternative supplies, there may be avoided shutdowns of public facilities and avoided costs of hand watering to keep key trees alive.

## 4.6.6 Section At Wetland





### 4.6.7 Green-blue benefits



#### STORMWATER TREATMENT

Introduction of the wetland, swale and stormwater harvesting will reduce nitrogen by 218kg/year (62%) and suspended solids by 27,450kg/year (96%).



#### ALTERNATIVE WATER SUPPLY

Throughout the year, 10,000,000 litres of irrigation water will be available to enhance sporting grounds and parkland.



#### RUNOFF DETENTION

The provision of the storage pond will also act as a retarding basin when needed and mitigate flooding issues. Integration of stormwater harvesting with retention has been shown to significantly reduce frequent flooding in Ballarat.



#### RUNOFF REDUCTION

Stormwater harvesting will significantly reduce runoff entering waterways.



#### BIODIVERSITY

Healthy trees and parkland provide habitat for a range of insects and birds in the city.



#### QUALITY TREES AND VEGETATION

Victoria Park is provided with an alternative source of water which isn't subject to restrictions.



#### QUALITY RECREATION SPACES

The support of Victoria Park ensures an important asset for the community and tourists is looking its best. The area provided with irrigation is 35,000m<sup>2</sup>.



#### INCREASED SOIL MOISTURE

Provision of irrigation water to the gardens area will help to sustain the landscape year-round.



#### AMENITY AND CHARACTER

Ensures amenity of the park is protected and additional amenity is added through swales and water bodies.



#### AIR QUALITY IMPROVEMENT

Healthy landscapes will benefit air quality.



#### SHADE AND COOLING

Irrigated green areas provide cooling and become a pleasant refuge on hotter days.



#### EDUCATION

There are opportunities for community education through on-site signage.



## 4.7. Comparison

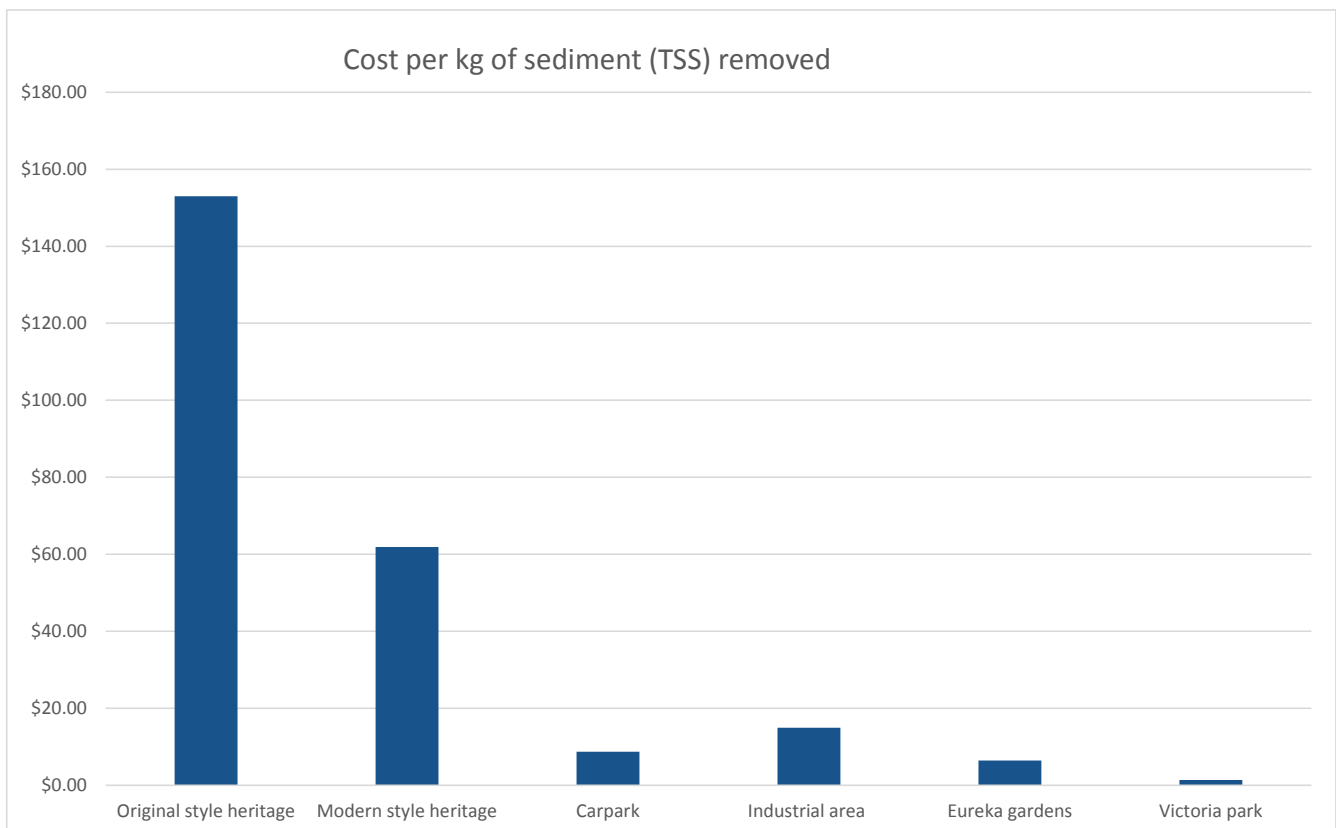
### 4.7.1 Comparing value through performance lenses

The case studies each demonstrated how a range of benefits could be delivered through the introduction of green-blue solutions. By examining their performance through a number of lenses, we can compare their relative value.



### 4.7.2 Performance Lens 1: Improved stormwater quality

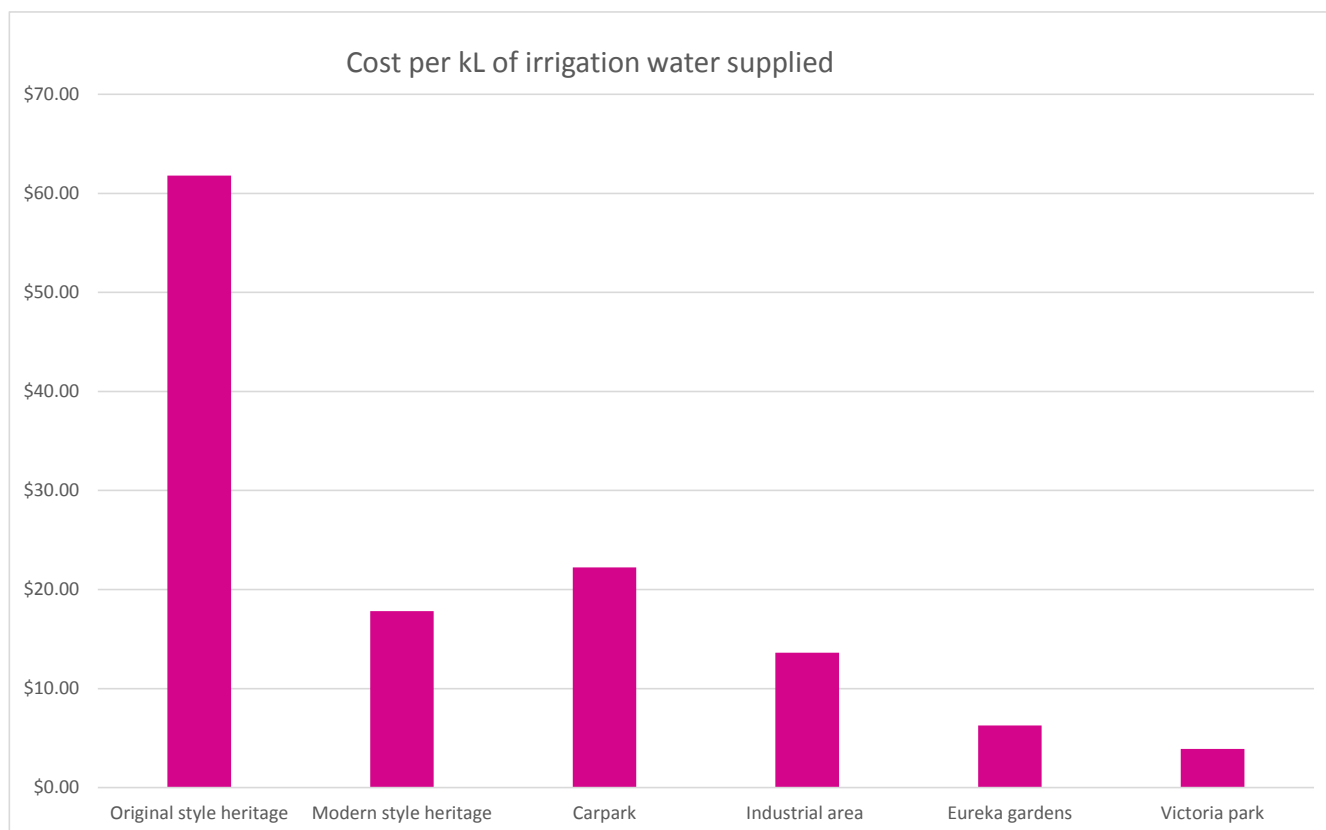
All of the proposed green-blue solutions act to improve stormwater quality by filtering or removing pollutants that would otherwise enter local waterways. The figure below shows the relative effectiveness of the solutions in removing sediment relative to the overall cost of the solution. Here we can see that the larger precinct scale stormwater harvesting schemes at Victoria Park and Eureka Gardens provided the best value in achieving stormwater quality outcomes. The low cost solutions in the large industrial roads and the carpark also show a good cost-benefit through this lens. In contrast, the passive irrigation measures in heritage streets represent relatively high cost options from solely a stormwater treatment point of view, though they do achieve many other benefits.





### 4.7.3 Performance Lens 2: Irrigation to support urban greening

All of the options support urban greening by providing an alternative water source (stormwater) for irrigation (either passive irrigation or supply to an active irrigation system). The stormwater harvesting schemes at Victoria Park and Eureka Gardens provide large amounts of irrigation water, and benefit from economies of scale. However, the modern style heritage streetscape and the industrial area streetscape also provide large amounts of water to the trees and soil (aiding the creation of a more natural water cycle) at a reasonable cost comparatively. The original style streetscape shows the highest cost through an irrigation lens as it is a retrofit solution that involves substantial works.

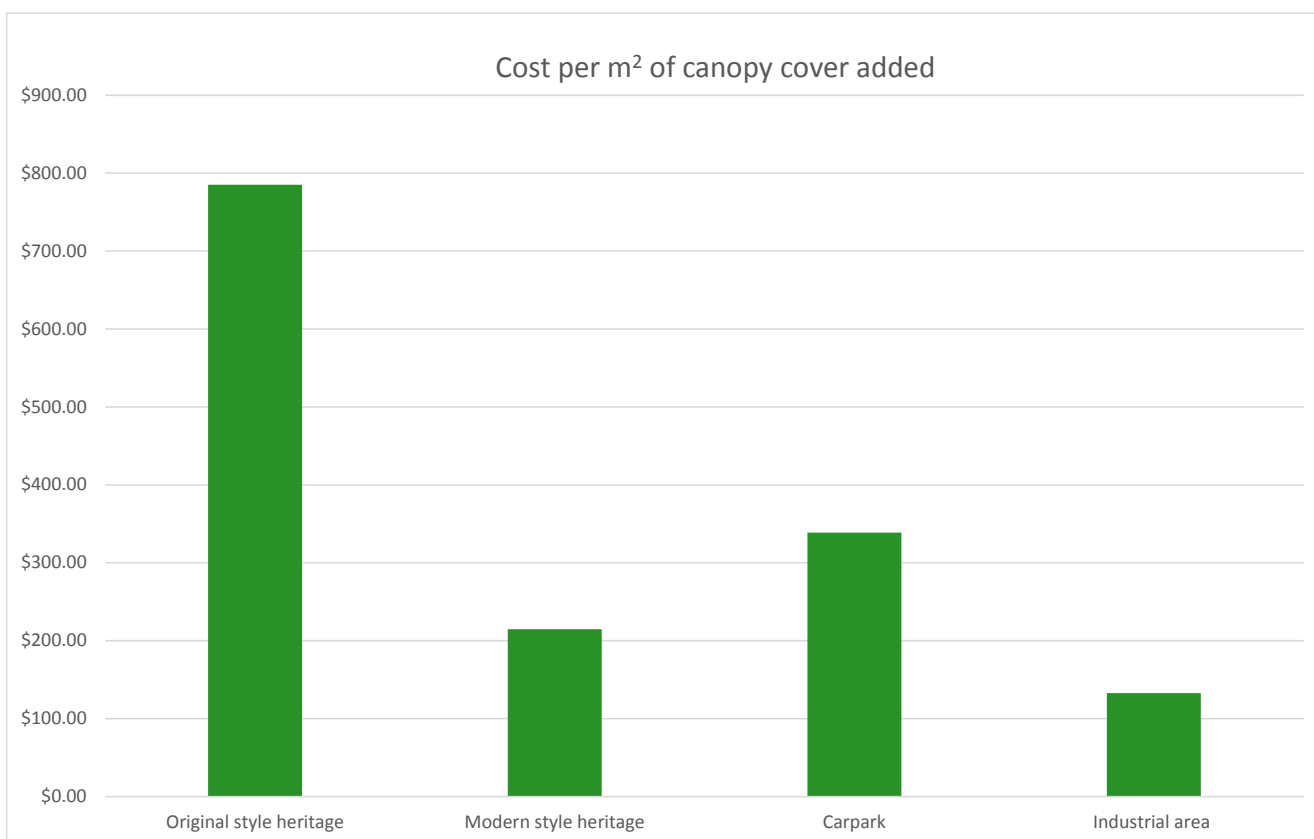
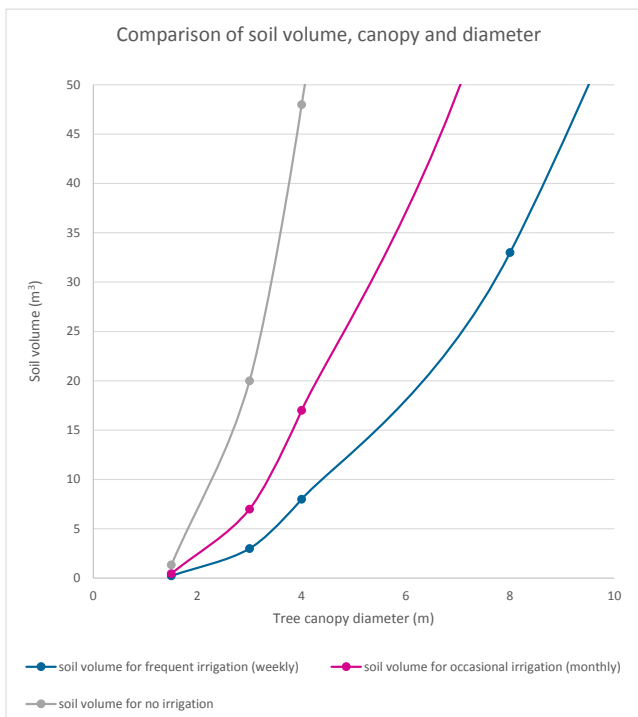






### 4.7.4 Performance Lens 3: Creation of urban canopy cover

The first four case studies directly increase canopy cover by supporting existing trees or introducing new trees. There is a direct relationship between tree canopy (and health), soil volume available to the tree, and access to water. The adjacent figure shows that relationship where soil is in a containerised environment\*. The standard soil volume provided to street trees in the modern streets in Ballarat corresponds to a predicted ultimate canopy diameter of only 1.5m. By contrast, the proposed green-blue solution for the modern heritage style streets corresponds to a predicted ultimate canopy diameter of 4m due to an increased soil volume and the provision of frequent irrigation (via passive irrigation from stormwater). The cost-benefit graph from an urban canopy lens, shows that the proposals for the modern style heritage street and the industrial area streets are the most cost-beneficial in delivering tree canopy increases for Ballarat.

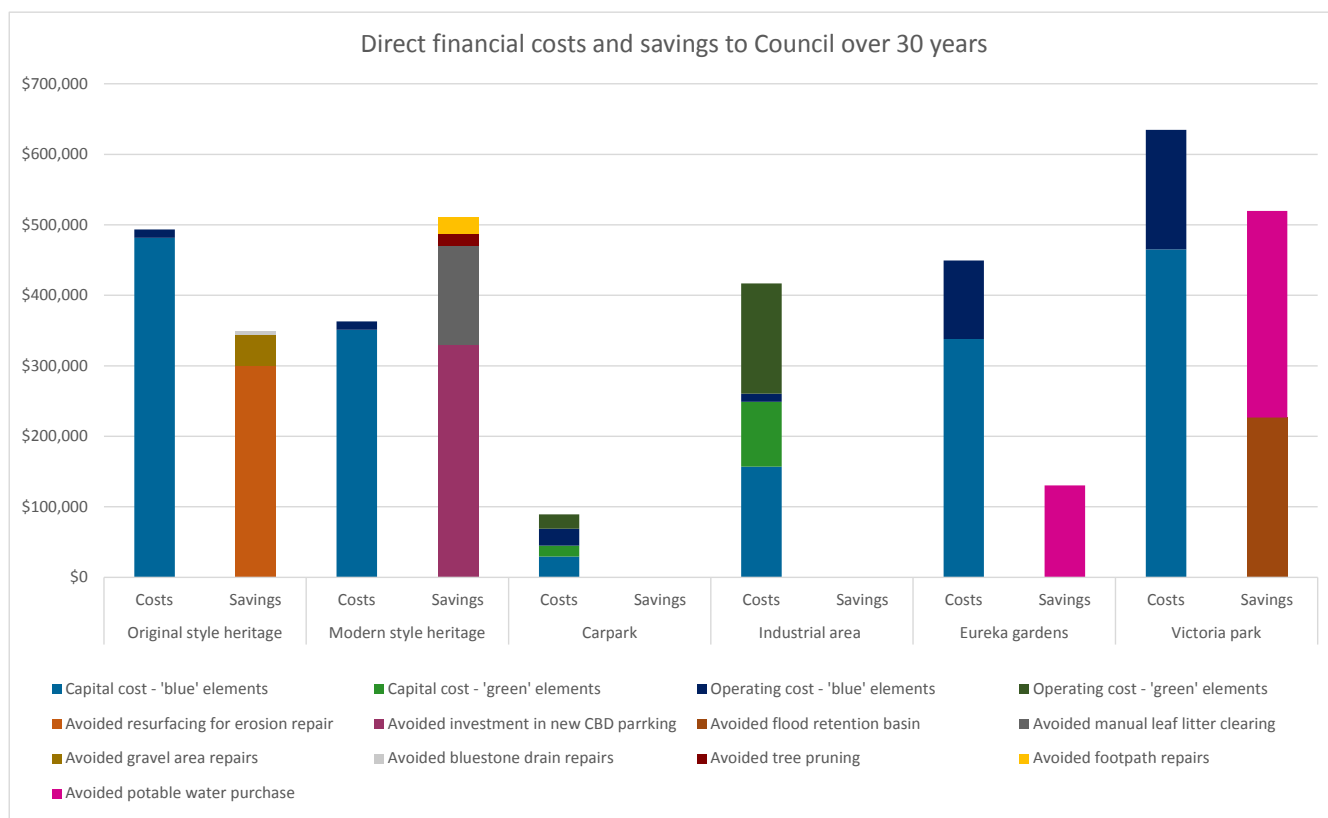


\* James Hitchmough (1994) 'Roof gardens and other landscapes involving finite volumes of artificial soils' published in Urban Landscape Management. Inkata Press, Sydney.

## 4.7.5 Performance Lens 4: Direct financial savings for Council

Some of the options also deliver direct financial benefits for Council – resulting in cost savings or reallocations of investment that improve the efficiency of Council services. The figure below compares the financial costs and savings of the options for Council over a 30 year lifetime\*. However, the graph does not recognise the broader environmental and community benefits delivered by the solutions which are not direct revenue streams to the council (e.g. amenity, biodiversity, pollution reduction, benefits to health and wellbeing).

The capital and operating costs relating to the ‘green’ (urban vegetation) and ‘blue’ (stormwater management) aspects of the solution are broadly indicated in the graph. The green-blue proposals for the two heritage streetscapes are underpinned by a strong business case, as the design addresses existing problems within the streetscape, which the council needs to invest in regardless. Accordingly, the green-blue solutions can be delivered through adjustments to existing works. The Victoria Park proposal also provides direct savings by providing a major new water source.



\* Utilising costs and benefits as stated in case studies.

# Implementation

---

05

## 5.1. Focus areas for action

---

This action plan focusses on taking opportunities as well as overcoming delivery barriers. The follow sections summarise the best-value opportunities, and the primary delivery barriers for green-blue infrastructure in Ballarat. An action plan is then outlined with prioritised actions for the Council to take forward.

### 5.1.1 Best value opportunities in Ballarat

The relative cost-benefit of green-blue opportunities very much depends on the local context – in terms of both the design integration needs and the benefits which can be delivered. For example, water can be provided to street trees in a relatively low cost fashion during a new construction project or a road redevelopment by integrating plans into the design early. Retrofitting existing streets can be more of a challenge, but often a design solution can be found that can provide multiple benefits.

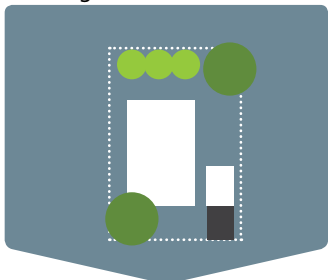
The case studies demonstrate some of the green-blue solutions which could be delivered in the Ballarat context. There are many more. However, from the case studies, we can deduce the following delivery principles for Ballarat:

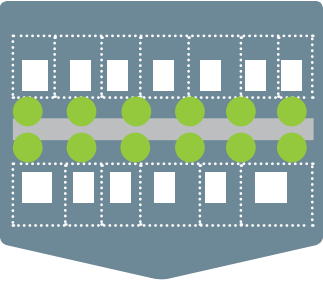
- **Seek multiple benefits:** Case studies show that integrated design solutions ‘stack-up’ when based on multiple objectives.
- **Ensure greening initiatives don’t forget water:** Trees can be integrated into the urban environment, but without sufficient access to soil and water, they will not thrive. The target of 40% canopy cover for Ballarat could be delivered in many ways, but the least cost-approach to tree planting won’t be the best value. Green-blue solutions should be used to integrate trees into the urban landscape and ensure they are provided with water but also utilised as a water management asset. The existing trees and green landscape should also not be forgotten - a lot can be gained by maximising the benefits of existing green assets through improved care.
- **Link with place-making:** The best-value initiatives will play a core role in the Ballarat Strategy, delivering community and economic value in strategic locations.
- **Re-think standard designs with green-blue in mind:** A lot of opportunities require re-consideration of standard practice, but are simple solutions. By re-thinking existing designs, a number of other issues can be addressed while introducing green-blue solutions.
- **Make renewal areas and new development work hard:** Growth areas and public realm improvements which are undergoing change are an opportunity to set new standards of expectation and to deliver cost-effective infrastructure.




## 5.1.2 Priority delivery locations

Green-blue solutions will always deliver benefits, though the location and context will affect the magnitude of the benefits and the availability of any cost advantages. Some specific locations have been suggested by stakeholders during the development of the action plan, however the feasibility of green-blue solutions at these locations has not been tested. These are recommended for further investigation. Opportunities that have been reviewed and recommended are included in the ‘Recommended Investments’ section.

Scale	Possible types of green-blue applications
<p>Buildings and surrounds</p> 	<ul style="list-style-type: none"> <li>• Rainwater harvesting for garden irrigation</li> <li>• Private raingardens</li> <li>• Green roofs supported by harvested rainwater</li> <li>• Green walls supported by harvested rainwater</li> </ul>
Priority Contexts	Suggested locations for further investigation
<ul style="list-style-type: none"> <li>• New developments</li> <li>• Extensions and redevelopments</li> <li>• Schools, kindergartens and educational facilities</li> <li>• Community buildings</li> <li>• Hospitals, healthcare and aged care facilities</li> <li>• Council offices</li> </ul>	<ul style="list-style-type: none"> <li>• Ballarat West Urban Growth Zone</li> <li>• Ballarat West Employment Zone</li> <li>• Civic Hall</li> <li>• Sebas Library</li> <li>• Ballarat Regional Library</li> <li>• CBD Laneways</li> </ul>

Scale	Possible types of green-blue applications
<p>Streets, squares and carparks</p> 	<ul style="list-style-type: none"> <li>• Passive irrigation of trees and gardens</li> <li>• Raingardens</li> <li>• Raingarden tree pits</li> <li>• Tree-lined roadside swales</li> <li>• Permeable paving supporting trees</li> </ul>
Priority Contexts	Suggested locations for further investigation
<ul style="list-style-type: none"> <li>• New streets</li> <li>• Carparks, particularly large, uncovered carparks with high utilisation and those serving members of the community most vulnerable to heat stress (e.g. schools and aged care)</li> <li>• Existing highly trafficked pedestrian routes</li> <li>• Existing arterial roads and city entrances</li> </ul>	<ul style="list-style-type: none"> <li>• Ballarat West Urban Growth Zone</li> <li>• Ballarat West Employment Zone</li> <li>• Big W CBD carpark</li> <li>• Eastwood carpark</li> <li>• Homemaker Centre carpark (private)</li> <li>• Wendouree Village carpark (private)</li> <li>• Wendouree Sports Precinct carparks</li> <li>• Railway Precinct</li> <li>• Hospital Precinct</li> <li>• Drummond St North</li> <li>• Howitt Street</li> <li>• Sturt Street</li> <li>• Eyre Street</li> <li>• Creswick Rd</li> <li>• Raglan Street</li> <li>• Errard Street</li> <li>• Talbot Street</li> <li>• Norman Street</li> <li>• Gillies Street</li> <li>• Mair Street</li> <li>• Albert Street</li> <li>• Burnbank Street</li> </ul>

Scale	Possible types of green-blue applications
<p>Open spaces and networks</p> 	<ul style="list-style-type: none"> <li>• Ponds and lakes fed by stormwater</li> <li>• Wetlands</li> <li>• Sunken sports fields retarding flood waters</li> <li>• Stormwater harvesting for open space irrigation</li> <li>• Green corridors and waterway riparian areas</li> <li>• Community gardens with rainwater harvesting</li> <li>• Daylighted creeks</li> </ul>
Priority Contexts	Suggested locations for further investigation
<ul style="list-style-type: none"> <li>• Major Activity Centres</li> <li>• Community gardens (that can be linked with rainwater harvesting from adjacent buildings)</li> <li>• Key open space assets with a large irrigation need where stormwater could be harvested or where other blue-green improvements could be made.</li> </ul>	<ul style="list-style-type: none"> <li>• Ballarat West Urban Growth Zone</li> <li>• Ballarat West Employment Zone</li> <li>• Victoria Park</li> <li>• Yuille Park Primary School</li> <li>• Black Hill Primary School with Binney Reserve</li> <li>• Midlands Reserve</li> <li>• Prince of Wales Recreation Reserve</li> <li>• Russell Square utilising Nerrina wetlands</li> <li>• Doug Dean Reserve utilising the existing retarding basin</li> <li>• Eastern Oval utilising the Warrenheip Catchment diversion</li> <li>• Regional Soccer Facility and Trotting Track utilising site retarding basin</li> <li>• Vickers Park and St Georges Reserve</li> <li>• Cherry Tree Community Centre and adjacent sports grounds</li> </ul>

### 5.1.3 Possible barriers to delivery

There are many opportunities to deliver green-blue infrastructure which will provide real value for Ballarat's communities. City of Ballarat and its partners play a leading role in the delivery of green-blue infrastructure, particularly in our public spaces – our streets, our parks and our community areas. Through policy and communication, the council can also encourage communities and developers to deliver green-blue solutions on private land.

So what's stopping us? The five key delivery barriers that have been identified are:

- **Commitment:** A change from the norm requires commitment at all levels of the organisation. This involves commitment from council leaders, creation of consistent council design manuals and strategies that support green-blue solutions and clear communication of support within the organisation.
- **Lack of integration with every-day practice:** This action plan has demonstrated that there are opportunities to deliver green-blue solutions at every scale, and that often the solutions require fairly simple modifications to design. The barrier to these solutions being integrated into design of roads, carparks, new buildings and open spaces is often a lack of communication and championing of these solutions at the right time in the design process.
- **Understanding and allocation of capital funding:** Cost is often cited as a barrier to delivery, but on further investigation it was found that the scale of additional cost is not often a barrier in itself, but that the business case needs to be made clear to decision makers, and that sufficient funding needs to be allocated accordingly so that the intent and commitment is clear.
- **Anticipated maintenance:** Green-blue solutions often require a maintenance programme that combines skills in vegetation care and water management. This combination in skills often requires training, but also often results in a cross-over between landscape and drainage budgets which can end up without a clear 'owner'. The maintenance needs of green-blue assets are not significantly higher than other assets, but maintenance funding and skills are needed.
- **Policy and enforcement:** City of Ballarat can use policy tools to drive the delivery of green-blue solutions, particularly in new developments. Currently, it is felt that more could be done to proactively encourage and/or enforce requirements for urban greening and water management.



## 5.2. Recommended actions

The action plan below aims to overcome the delivery barriers identified and to take the opportunities available to the Ballarat. The recommended actions for City of Ballarat fall under three themes:

1. Commit
2. Connect
3. Create

Actions have been classified as medium, high or very high priority based on the expected impact they will have on delivery.

### 5.2.1 Commit

Budgets	
Commit at least \$250,000 in council funding for pilot green-blue solutions in budget year 2015/2016.	Very high
Commit capital works budgets for green-blue solutions year-on-year for the next five years, totalling at least \$2 million over five years (see recommended capital works plan).	Very high
Conduct an audit of existing urban forest and open space assets to determine condition and tree health improvement needs.	High
Conduct an audit of existing WSUD assets to determine any rectification or additional maintenance needs.	Medium
Commit maintenance budgets sufficient to care for existing and new green-blue assets.	Very high
Policy and targets	
Commit to delivering at least 50% of new street trees with passive irrigation or access to an alternative water source for irrigation.	High
Conduct a Ballarat-wide water balance and assess additional stormwater harvesting and recycled water reuse opportunities to determine and commit to a ML/year target for alternative water use by 2040. This target will complement the existing potable water use reduction and tree canopy targets, while ensuring alternative water sources are harnessed to supporting greening.	Medium
Amend the Ballarat planning scheme to include an water sensitive urban design policy which extends application of best practice to: <ul style="list-style-type: none"> <li>• Construction of commercial, industrial and mixed use buildings;</li> <li>• Subdivision in a commercial zone (where a Clause 56 assessment has not been undertaken); and</li> <li>• Extensions to existing buildings which are 50 square metres in floor area or greater.</li> </ul>	Very high
Review and recommend adjustments to the Infrastructure Design Manual to provide consistency in encouragement and design of green-blue solutions in roads, car parking, drainage system and landscape design.	High
Update Landscape Design Manual to provide consistency in encouragement and design of green-blue solutions.	High
Update Council's water sensitive urban design guidelines to provide consistency in encouragement of green-blue solutions.	High
Develop an integrated water management strategy to set site-specific requirements for Ballarat West.	Very high

## 5.2.2 Connect

Internal council communication and integration	
<p>Install a new council position for a staff member to:</p> <ul style="list-style-type: none"> <li>• Champion green-blue solutions</li> <li>• Encourage collaboration and communication between departments</li> <li>• Review masterplans, development and capital works proposals annually prior to financial year budget planning processes by Council</li> <li>• Address the ‘possible barriers to delivery’ identified in section 5.1.3</li> <li>• Provide technical advice (e.g. green-blue design options, maintenance requirements, capital and operating budget planning).</li> </ul>	Very high
Appoint a green-blue Ballarat working group (with representatives from different departments) that will assist with the Action Plan implementation, evaluation and reporting. It will report annually to Council.	High
Require a cross-departmental meeting for major capital projects at concept design phase to ensure design opportunities are considered.	Medium
External communication and working with partners	
Advocate for reinstatement of state government funding to assist in bundling or undergrounding of powerlines in existing areas to reduce clashes with mature trees and liaise with Powercor to minimise impacts of pruning on tree health.	High
Work in partnership with Central Highlands Water and local Catchment Management Authorities to develop an integrated water management plan for Ballarat.	High
Work with local community groups to identify and implement green-blue solutions in Ballarat	High
Liaise with VicRoads to agree partnered approach to design of green-blue solutions in major roads in Ballarat	Medium
Communicate the dual benefits of greening and local water management to local communities, encouraging on-lot greening and use of harvested rainwater for garden use.	Medium

## 5.2.3 Create

Create new knowledge to aid delivery of green-blue solutions	
Complete stormwater harvesting opportunity mapping to identify priority investments in large scale green-blue solutions	High
Create a prospectus of future projects which can be used as a basis for seeking future funding	Very high
Regularly identify forthcoming road renewals that could deliver green-blue benefits and pilot revised designs (as per 2015 review in section 5.3.2)	Very high
Regularly identify forthcoming public realm and open space renewals that could deliver green-blue benefits and pilot revised designs (as per 2015 review in section 5.3.2)	Very high
Create specifications for integration of passive irrigation to tree pits to accompany the delivery of increased canopy cover as part of the urban forest strategy	High
<p>Utilise case studies within this document and additional work to develop practice notes for best practice design of new:</p> <ul style="list-style-type: none"> <li>• Car parks</li> <li>• Roundabouts</li> <li>• Residential roads</li> <li>• Major roads</li> <li>• Open spaces</li> </ul> <p>These practice notes can be linked to the Infrastructure Design Manual as approved alternative council designs.</p>	Very high
<p>Allocate priority areas for green-blue infrastructure delivery based on spatial data, including:</p> <ul style="list-style-type: none"> <li>• Social vulnerability to heat waves</li> <li>• Pedestrian and cycling routes</li> <li>• Ecological deficiency</li> <li>• Flood risk</li> <li>• Economic renewal</li> </ul>	Medium
Improve knowledge and skills of council staff	
Develop a training programme or utilise existing resources (e.g. Clearwater) for training of key staff across departments in WSUD and green infrastructure design and maintenance.	Medium
Develop Asset Management and Operational plans for green-blue assets, which identify the maintenance objectives for systems, maintenance tasks required, and key roles and skills required.	Medium

## 5.3. Recommended investments

---

A review of forthcoming council projects and suggested priority areas has been undertaken to recommend a portfolio of investments in the next five years. A cost estimate for green-blue solutions has been estimated for these projects and benefits have been evaluated to create a recommended capital works plan, whereby highest priority projects are allocated in the first three years.

### 5.3.1 Why invest?

This action has identified real benefits which can be delivered through the integration of planning and design of water management and urban greening initiatives. The primary reasons why it makes sense to invest in green-blue solutions in Ballarat are:

- **Resilience to climate change:** Climate change poses a serious threat to liveability and prosperity in Ballarat. The recent impacts of drought on Lake Wendouree and Ballarat's parks and gardens were keenly felt both economically and culturally. Green-blue solutions can provide alternative water sources, support cooler environments during heat waves and reduce flooding.
- **Solutions are practical and deliverable:** Green-blue solutions are often simple and do not require complicated or unproven technologies. The key to delivery is often in questioning the 'way we have always done things' and integrating design of urban spaces. In some instances, Council will re-coup significant savings in maintenance and operations over the lifetime of the investment as the new designs improve performance of public spaces.
- **City of Ballarat is committed to improving urban forest and green space:** The Ballarat Strategy places urban greening as one of its two priority pillars. Investment in new trees and improved open spaces is a priority in Ballarat and will support the prosperity of neighbourhoods and commercial areas. Integration of water management with these greening initiatives will require design thinking and some top-up investment, but the rewards are worth the investment - creating healthier, larger trees and attractive and year-round recreational spaces.

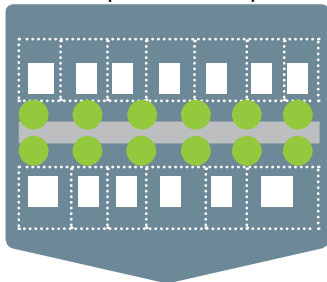



































### 5.3.2 Recommended capital works budget allocations

The following tables outline the recommended capital works budget allocations for projects at each of the three spatial scales. Based on the results of the case study analysis which show the greatest value for money was delivered by larger precinct scale projects, the most budget is allocated at this scale. A significant budget allocation has also been made for streets and car parks, particularly projects where tree cover can be supported through passive irrigation in key CBD locations and gateways to the City. At the allotment scale, allocations have been made to assist key public projects that will support community health and well-being through the creation of green-blue landscapes.

Some projects already have allocated capital budgets which could accommodate the delivery of green-blue solutions through appropriate design and specification. No capital allocation has been made for these projects (though it is noted what contribution which should be ringfenced). Others require some top-up to existing budgets for specialist design. Each type of project is colour coded as per the key on each table. Three measureable performance indicators are also included for comparison.

Scale		Recommendation total 5-year additional allocation						
<div>Buildings and surrounds</div> 		\$35,000						
		KEY:						
		New capital allocation required						
		Top-up may be required to existing allocation						
		Investment can likely be made through existing allocation						
Recommended annual capital works allocation (\$000)								
Project Type	Project	Year 1	Year 2	Year 3	Year 4	Year 5	Total	Performance
Rainwater harvesting for irrigation	Wendouree sports prec.	15					15	 30kgTSS  80kL  130m²
	Sebastapol Library		n/a				15	 100kgTSS  350kL  1500m²
	Central Library			n/a			20	 400kgTSS  160kL  100m²
Green wall supported by rainwater	Little Bridge St Toilet Block	20					20	 5kgTSS  15kL  15m²

Scale		Recommended total 5-year additional allocation						
<div>Streets, squares and carparks</div> <div></div>		\$750,000						
		KEY:						
		New capital allocation required						
		Top-up may be required to existing allocation						
		Investment can likely be made through existing allocation						
Recommended annual capital works allocation (\$000)								
Project Type	Project	Year 1	Year 2	Year 3	Year 4	Year 5	Total	Performance
Passive irrigation of trees and gardens	Creswick Rd (with Vic Roads)		120	120			240	 450kgTSS  1600kL  2500m²
	Howitt St (with Vic Roads)				120	120	240	 450kgTSS  1600kL  2500m²
	Armstrong St		30				30	 30kgTSS  80kL  130m²
	Dawson St				30		30	 30kgTSS  80kL  130m²
Raingarden tree-pits	Wendouree sport prec. carpark	n/a	n/a				70	 1000kgTSS  400kL  400m²
	Lucas Hub carpark		n/a	n/a			15	 200kgTSS  80kL  80m²
	Bonshaw Creek Hub carpark				n/a	n/a	15	 200kgTSS  80kL  80m²
	30 CBD Nibs	70	70	70			210	 4000kgTSS  1600kL  1050m²

Scale		Recommendation total 5-year additional allocation						
Open spaces and networks		\$1,130,000						
		KEY:						
		New capital allocation required						
		Top-up may be required to existing allocation						
		Investment can likely be made through existing allocation						
Recommended annual capital works allocation (\$000)								
Project Type	Project	Year 1	Year 2	Year 3	Year 4	Year 5	Total	Performance
Stormwater harvesting for open space irrigation	Victoria Park*	170	170	170			510	   27500kgTSS 10000kL 35440m²
	Projects identified in 2016 review				250	250	500	   tbc tbc tbc
Green corridor	Sutton St green-blue road corridor	120					120	   225kgTSS 800kL 1250m²

\*This capital allocation could be already partially funded by allocated funds for the retarding basin on-site.

The total allocation of capital budget recommended is just under \$2 million over the next five years. A suggested annual allocation has been made for each project, totalling approximately \$400,000 per year. City of Ballarat has already committed \$150,000 for 2016 capital works as part of the 'Greening Ballarat through Local Water Management' initiative, which has been match funded by DELWP. This funding could contribute towards projects identified in this budget.

