PLANNING A GREEN-BLUE CITY

A how-to guide for planning urban greening and enhanced stormwater management in Victoria.

Planning a Green-Blue City

Department of Environment, Land, Water and Planning

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Produced with assistance from E2Designlab

E2DESIGNLAB

VICTORIA State Government | Environment, Land, Water and Planning

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PART I

Introduction

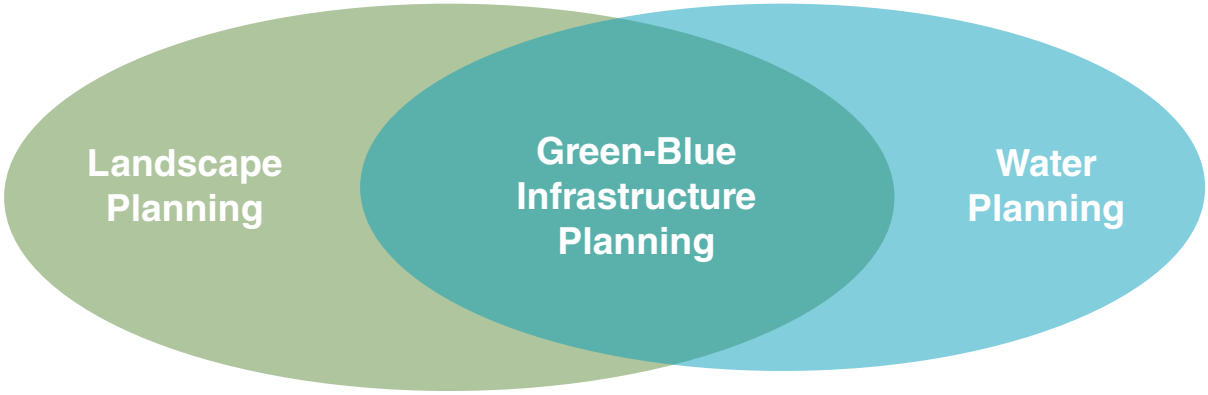
Royal Park Wetlands and Stormwater Harvesting Scheme

1.0 Why plan a green-blue city?

1.1 What is green-blue city?

A green-blue city is an urban area that is designed to successfully incorporate natural systems that provide the ecological and amenity value associated with urban greening, and also provide stormwater management. Often “green” assets (trees, parks, gardens) and “blue” assets (Water Senstive Urban Design (WSUD), drainage areas and flood storage) are planned separately. However, often the same asset can provide multiple services that benefit both “green” and “blue” objectives. By purposely planning for green-blue infrastructure that achieves multiple objectives, cities and towns can benefit from efficient infrastructure, greater collaboration and heightened benefits.

Within the context of this guide, a planning and creation of a green-blue city refers the planned inclusion of extensive green-blue infrastructure throughout the built up area of a city or town. The guide has been developed with cities and towns in Victoria, Australia in mind.



1.2 Addressing a challenging and evolving context

A drier climate

After more than a decade of severe water restrictions and periods of extreme heat in the Millennium Drought, many of the greener parts of urban landscapes in cities and towns across Victoria are under immense stress, and are already in a state of accelerated decline. With aging tree stock and highly utilised green space in many areas, Victoria's green assets are also highly vulnerable to the changing climate.

The south-eastern area of Australia is likely to experience serious impacts as a result of climate change, with significantly warmer and drier climates expected. Heat waves, fires, floods, and droughts are all likely to occur more frequently and with greater intensity. We are already experiencing a drier climate, with significant and persistent reductions in cool season rainfall over the last ten years (April to October - when traditionally Victoria received most of its rainfall).

The combination of a drier climate and increased evaporation means soil moisture is likely to continue to decline over much of Victoria. The impacts will further affect our sports fields, parks, gardens, green spaces, wetlands, lakes and tree-lined streets that contribute enormously to the identity and liveability of our cities and towns. Continued access to functional open space is essential to supporting active lifestyles and its compromise presents a real risk to health and well-being.

Simultaneously, we will continue to experience a range of pressures on urban water systems, and the increasing frequency of droughts will means that we will need to increase our use of local water sources to ensure urban landscapes can be supported.

Dried out football oval which has become dangerous to play on

Changing roles and responsibilities

Local government strives to enhance liveability in its communities and to maintain and improve recreational assets and urban landscapes to provide health and amenity benefits for everyone. In Victoria, local government is often also charged with responsibilities to manage stormwater runoff from our urban areas, and protecting the health of our waterways. Concurrently, water supplies are managed by water corporations, providing potable and recycled water supplies to developed areas.

Increasingly, there is a recognised need for water corporations, catchment management authorities and local government to work together more closely. The State Government policy, Water for Victoria, provides an Integrated Water Management framework that highlights greater roles for water corporations, catchment managers and local government to work in partnership to develop and implement local integrated water management solutions to support thriving urban landscapes, healthy urban waterways and improved flood resilience.

In this context, councils can examine options to deliver green-blue initiatives and assess the full range of benefits they can deliver. In many instances projects will be able to be delivered within existing project budgets for road improvements and development of new facilities. In other cases, integrated water management planning may identify where appropriate cost-sharing arrangements can be applied[1].

Water management planning needs to consider impacts on liveability and wellbeing of communities

1. Guidance on setting a framework for partnered funding based on distributed costs and benefits is available from DELWP

1.3 Capitalising on the opportunity for cities and towns

Our cities and towns are experiencing the interception of three key pressures:

- **Communities want greener neighbourhoods:** A growing appreciation of the need and desire for greener cities, with urban trees and green space strongly contributing to a sense of identity and the provision of liveability;
- **Cities and towns are facing real water challenges:** A recognition of ongoing urban water management challenges, brought to front of mind during the millennium drought, and furthermore through local flooding and water pollution events; and
- **Expectations for levels of service are increasing:** A continual evolution and growth of the urban environment and a heightened expectation of levels of service from the local community.

The response to these pressures could also be a major opportunity. Through pro-active planning and delivery of green-blue infrastructure, urban centres can exploit the synergies between local water management and urban greening while also creating attractive and successful cities and towns.

When planned and designed well, green-blue infrastructure often doesn't result in increased costs, in fact, the dual benefits created can result in maintenance reductions for council and increased lifetime of assets. For example, planning new street trees to allow for passive irrigation from stormwater runoff from the adjacent road is likely in increase the health of the tree, reduce pavement uplift due to roots seeking out moisture and provide treatment of stormwater. This can help councils to support multiple outcomes through a single investment while also reducing ongoing costs.

The delivery of green-blue infrastructure in cities and towns in Victoria is also a core strategy for climate resilience and improved liveability. Urban environments were often built many years ago, for a difference climate and a different community, and may no longer be fit for purpose for the future we desire.

Accordingly, supporting the greening of our urban centres through local water management is not simply a 'nice to have' ambition but a necessary strategy to preserve the character, liveability and economic viability of our cities and towns.

1.4 The green-blue infrastructure planning 'gap'

To date, local governments in Victoria have built a deep understanding of their own water management, open space and urban forest assets and the future needs of their cities and towns. Often, either explicitly through published strategies, or implicitly through officer knowledge and ongoing work, there is an established understanding of both the opportunities and constraints affecting delivery of green-blue infrastructure at a local level.

However, the opportunities are most commonly examined with regard to a single outcome, e.g. stormwater management, water security, flood management, tree health, recreation needs or biodiversity. The inherent multi-functionality of natural systems requires an equally integrated approach to identify, prioritize and deliver initiatives that will create greener and more successful cities. The planning of green-blue infrastructure aims to do just that; to explore synergistic opportunities for integrated greening and water management outcomes and to create a framework for collaboration between council departments and key industry and community groups to deliver a new blue-print for cities and towns.

Accordingly, a green-blue infrastructure action plan should be an integrative document that draws on documents and evidence already developed by Council, but should be embedded in the current council plan, strategic resource plan and budget to enable integrated delivery of initiatives.

2.0 About this guide

2.1 Purpose of this guide

This how-to guide has been developed by the Department of Environment, Land, Water & Planning (DELWP) to assist cities and towns in planning for increased presence and effectiveness of green-blue infrastructure in their urban areas. It is designed to assist councils and their partners in:

- Developing a robust and locally tailored evidence base for green-blue infrastructure opportunities
- Identifying green-blue infrastructure opportunities at all scales
- Reviewing opportunities for greatest benefit and value
- Allocating priority projects and key actions
- Identifying delivery pathways and funding mechanisms

The guide will assist councils in developing the core components of a green-blue infrastructure action plan that will inform and drive council-led initiatives.

2.2 Who should use this guide

This guide has been developed for the use of local government, in particular for the councils of cities and towns in Victoria. Within the council, involvement will be required from a range of stakeholders with varying skills and responsibilities, including:

- Planning
- Environment
- Landscape
- Engineering
- Roads and transport
- Operations
- Communications
- Economic development
- Asset management.

While the council will take a leading role in green-blue infrastructure planning, support and engagement from local partners will be crucial, including:

- Water utilities
- Catchment management authorities
- Community groups and representatives
- Developers
- Urban design and engineering consultants.

In some locations, Integrated Water Management planning processes will be available to allow key local partners to collaborate effectively and harness expertise to identify green-blue infrastructure opportunities and bring them to fruition.

2.3 How to use this guide

This guide provides a framework for the development of a locally tailored action plan for the planning and delivery of green-blue infrastructure. Part II includes the recommended steps for green-blue infrastructure planning, supplemented with tips and case studies that may aid the process. Part III includes a set of practice notes for typical contexts in which green-blue infrastructure can be delivered, providing planning and design principles and examples.

Part I - Introduction

Introduction to green-blue infrastructure and why it is important

Part II - How to Develop an Action Plan

Steps, tips and case studies for green-blue infrastructure planning

Part III - Practice Notes

Planning principles and examples for different typologies

Raingarden integrated into a public space with seating

3.0 Types and scales of green-blue infrastructure

3.1 Defining green-blue infrastructure

In the context of this document, the term ‘green-blue infrastructure’ refers to the use of vegetation, soils and natural processes in an urban context to simultaneously deliver landscape and water management benefits.

For Australian urban centres, there is a very direct and important link between greening and water management, though too often landscape and water planning are considered separately. Healthy trees and vegetation rely on provision of soil moisture to thrive and flourish, while vegetated areas play a key role in absorbing, treating and controlling the excess water in urban areas.

When planned and designed well, green-blue infrastructure can help to solve urban and climatic challenges through the provision of ecosystem services that enhance the well-being and prosperity of local communities.

3.2 Green-blue infrastructure elements

Green-blue infrastructure can be delivered at a range of scales, from building scale initiatives to precinct scale or regional features. Regardless of scale, these systems will all typically have the following characteristics in common:

- Vegetation, providing amenity and habitat;
- Soil, of adequate volume, nutrient content and drainage characteristics; and
- A link to rainwater, stormwater or recycled water supply, with a frequency and quantity sufficient to support vegetation and soil health.

In addition some systems may provide additional water management functions:

- Water treatment capacity, utilising natural process to filter local water supplies and reduce pollutants entering local waterways
- Water storage capacity, using volumes within soils or above ground space to provide detention of stormwater

The following table presents different types of green-blue infrastructure which can be used across the urban realm.

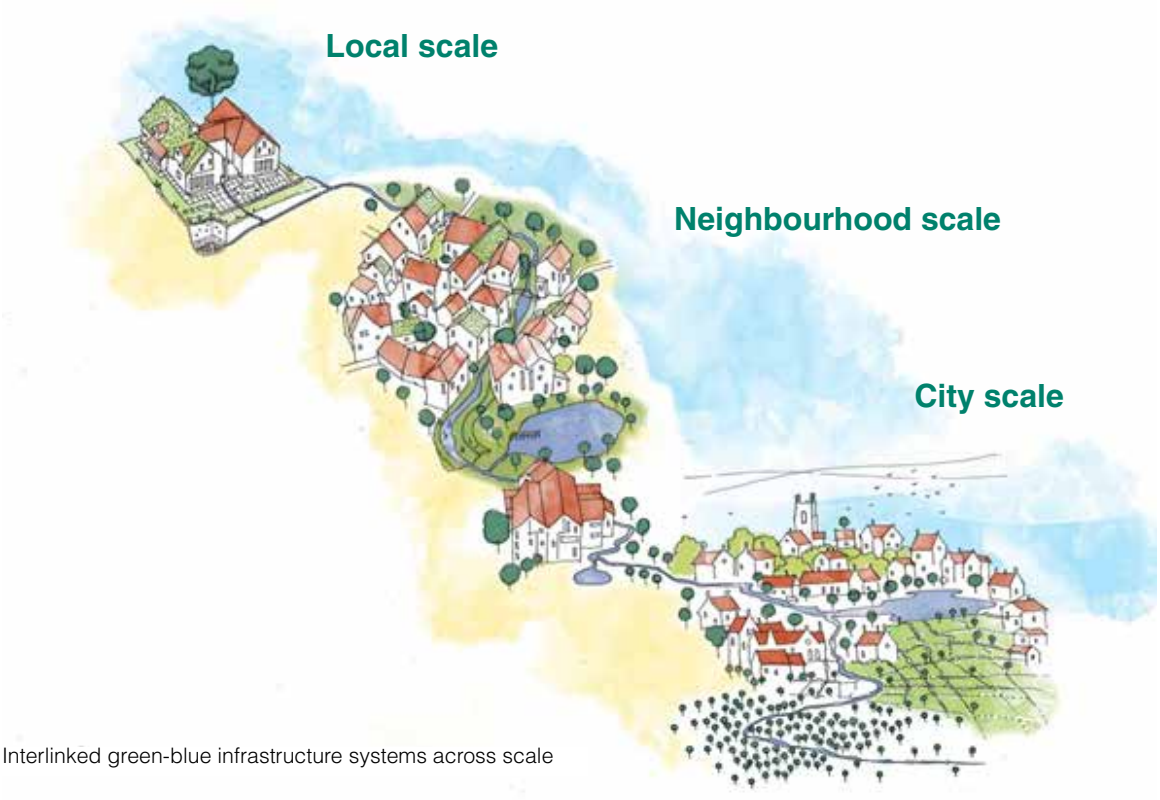
Table 1: Green-blue infrastructure elements and descriptions

Green-blue infrastructure element		Description
Green roofs		Green roofs are building roofs which have be partially or completely covered in vegetation which is planted into a growing medium sitting above a waterproof membrane. Harvested rainwater can be used for irrigation.
Green walls		Green walls are a vertical garden on the side of a building which comprises vegetation planted within a growing medium which is attached to the wall. Rainwater or greywater from the building can be used to support plant health.
Street trees		Trees planted in growing medium underneath sidewalks which can be designed to be passively irrigated from stormwater runoff from pavements and roads. These can also be designed to enhance stormwater pollutant removal with the inclusion of special filter media. Permeable paving can also be used to channel stormwater into underground soil areas to support trees.
Gardens		Gardens comprise vegetation planted into a growing media (soils). Stormwater can be directed into gardens to provide passive irrigation, or an active irrigation system can be provided, fed by alternative water sources.
Raingardens		Raingardens are garden beds which are designed to capture, detain and treat stormwater runoff as it filters through the underlying filter media before it is discharged at the base of the system either into the surrounding soils or into the local stormwater network.
Swales		Swales are shallow, vegetated open channels that convey and treat stormwater. The vegetation can vary from mown turf to sedges.
Parks		Parks are public open space areas which provide the local community with a range of recreational activities. These could be irrigated using an alternative water supply or designed to provide stormwater detention and infiltration.

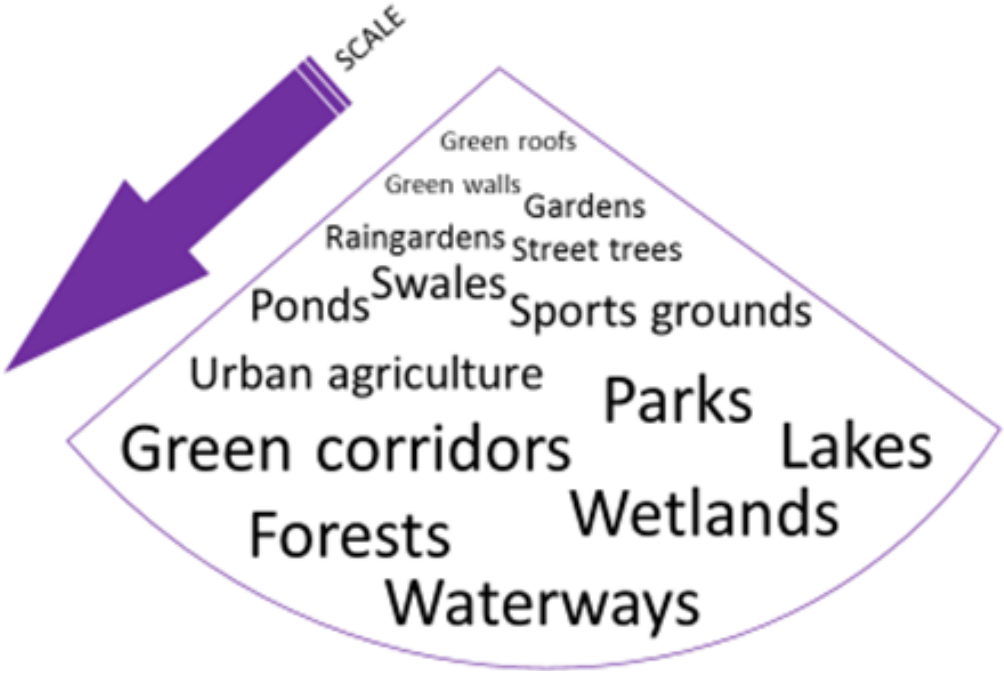
Green-blue infrastructure element		Description
Sports grounds		Sports grounds are large open space areas which support active recreational activities. These could be irrigated using an alternative water supply or designed to provide stormwater detention and infiltration.
Urban agriculture		Urban agriculture is the local production of food products. This can include community gardens which are open to the public, or commercially viable small-scale urban farms. Suitable alternative water sources can be harnessed for irrigation.
Green corridors		Green corridors are linear green spaces that can provide a range of connectivity services including natural habitat and recreational pathways. These areas are typically located along waterways or other easements.
Ponds and lakes		Ponds and lakes are open water bodies which are designed to permanently hold water. They can be fed by a stormwater supply or a recycled water supply. Vegetation can be included around the edge or in shallow sections.
Wetlands		Wetlands are heavily vegetated water bodies. These systems can either be natural features in the landscape or can be constructed to treat stormwater. They can appear as natural systems or integrated as hard edged features in urban areas.
Waterways		Waterways are channels that capture and convey flows from catchments. They include streams, creeks and rivers and can be natural or modified systems (e.g. rock edged or even concrete lined)
Forests		Forests are large areas of dense plantings of trees, shrubs and ground covers. They can be remnant, regrowth or newly created urban forests. Forests play an important part in the water cycle, creating pervious area to absorb stormwater.

3.3 Importance of scale in green-blue thinking

Successful green-blue infrastructure planning naturally requires an integration of different scales of planning and application. Accordingly, green-blue infrastructure planning will likely be for a whole urban area or catchment, but will need to consider possible interventions at all scales, and their cumulative impact.



Interlinked green-blue infrastructure systems across scale



Green-blue infrastructure elements applicability to scale

4.0 Objectives for green-blue infrastructure planning

A green urban landscape and a sustainable water cycle is central to the ongoing success of cities and towns. Green-blue infrastructure planning seeks to ensure cities are healthy, prosperous and resilient, with ten core objectives.

Healthy – making the best of our local environment

1. To support year-round passive and active recreation
2. To protect and enhance local waterways and aquatic environments
3. To support urban biodiversity

Prosperous – making changes to better our city

4. To improve the amenity of the urban environment
5. To create stronger connections between communities and nature
6. To improve the functionality of urban places
7. To drive increased tourism and visitation

Resilient – making sure we are ready for challenges

8. To make use of alternative water supplies locally to prepare for drought
9. To reduce the impacts of flooding
10. To provide pleasant and cooling environments during hot weather

The relative importance of these objectives will change depending on the local needs and challenges of your city. It is likely that many of these objectives and the broader values they represent are share by mulitple stakeholders. The achievement of these objectives necessitates cross-disciplinary working and draws on a comprehensive understanding of many aspects of urban design and natural ecosystems. The following sections provide additional detail on these objectives.

4.1 Healthy – making the best of our local environment




Core planning and design principles to create healthy cities and towns

1. To support year-round passive and active recreation

- Select appropriate species that will support recreation needs year-round and in future climates
- Secure local water supplies to provide irrigation for key sporting grounds
- Utilise passive irrigation techniques for urban landscapes
- Integrate green-blue infrastructure with key walking and cycling routes to provide shaded connections

2. To protect and enhance local waterways and aquatic environments

- Integrate Water Sensitive Urban Design measures to provide treatment of stormwater runoff using vegetation and soils
- Slow and reduce urban stormwater runoff by managing stormwater on the surface, and using vegetated surfaces to increase infiltration and evapo-transpiration
- Enhance waterway corridors through naturalisation of modified waterways and riparian planting
- Re-connect floodplains to the waterway and encourage subsurface flows through riparian zones

3. To support urban biodiversity

- Select locally appropriate species that provide diversity and complement local ecosystems
- Use a diverse range of species to build biodiversity and resilience
- Provide food and habitat for native fauna where appropriate
- Look to enhance remnant fragments and build connectivity between them for habitat linkages

4.2 Prosperous – making changes to better our city




Core planning and design principles to create prosperous cities and towns

4. To improve the amenity of the urban environment

- Support integration of healthy trees and vegetation, ensuring provision of sufficient growing space, and ongoing access to good soil, nutrients and water
- Locate green-blue infrastructure in key gateway areas to the city and core business areas and pedestrian routes
- Design with maintenance needs in mind to provide easy access and to ensure that long-term amenity benefits can be delivered within budget

5. To create stronger connections between communities and nature

- Provide opportunities for nature play and passive and active learning about natural processes
- Provide a variety of natural systems, such as gardens, trees and building integrated vegetation, within all residential and employment areas
- Involve local communities in the design and management of features

6. To improve the functionality of urban places

- Avoid clashes with other urban utilities and infrastructure through good design and proactive management
- Enhance the performance of the urban infrastructure such as pedestrian pathways, roads, parking areas, buildings and drainage systems by using natural areas to provide for shade, cooling, stormwater management and air filtration.

7. To drive increased tourism and visitation

- Showcase initiatives and plan in tandem with key attractions and city gateways
- Integrate views of green areas and water from public spaces

4.1 Resilient – making sure we are ready for challenges




Core planning and design principles to create resilient cities and towns

8. To make use of alternative water supplies locally to prepare for drought

- Utilise alternative water resources generated by urban areas, such as rainwater, stormwater or wastewater for irrigation purposes to support green areas and trees.
- Identify areas with demands for alternative water which can be co-located with potential storages which can also provide landscape benefits (e.g. wetlands, ponds).
- Use vegetated systems (such as wetlands or biofilters) to provide treatment of alternative water supplies for local use. Use alternative water from buildings to support green walls and green roofs.

9. To reduce the impacts of flooding

- Increase permeability of urban areas by increasing proportions of green space and unpaved areas to reduce stormwater runoff volumes.
- Direct stormwater runoff to vegetated areas and maximise soil volumes to create storage and to maximise infiltration and evapotranspiration, therefore minimising runoff and reducing pressure on drainage systems.
- Integrate 'sunken' areas and overland pathways within green spaces which can occasionally accommodate flood waters but can be used for alternative purposes otherwise.

10. To provide pleasant and cooling environments during hot weather

- Maximise tree canopy and vegetated cover in highly pedestrianised areas to provide shade
- Increase presence of vegetated ground cover, moist soil and open water to provide natural cooling in an urban environment
- Look for areas where prevailing winds can blow over urban water features or saturated soils and provide passive cooling.

PART II

How to develop an action plan

Capital city trail green corridor

Steps to scope and deliver an action plan

1. Set the scene

Context review
Identify your local drivers
Set a vision

2. Scope the possibilities

Map the data
Explore the options
Identify a selection of typologies
Test the selected typologies

3. Plan delivery

Prioritise green-blue infrastructure projects
Review delivery factors
Set actions
Monitor success

5.0 Set the Scene

1. Set the scene

Context review
Identify your local drivers
Set a vision

5.1 Context review

It is likely that your council will already have a number of strategies and policy documents in place that support or affect the delivery of green-blue infrastructure in some way. A good green-blue infrastructure action plan will reference the objectives and evidence base developed in these documents, and will focus on identifying synergies and focusing action. A review should be led by an appropriate council department, but to draw on information across a wide range of departments who can affect green-blue infrastructure directly or indirectly.

In particular, a green-blue infrastructure action plan can draw important background information and evidence base from strategies and studies related to 'greening' including open space strategies, tree management and landscape plans, and those related to 'water management' including stormwater management plans, flood studies and water use strategies. It may also draw on recent community visioning and consultation which has identified needs and ambitions for improved amenity, recreation or natural asset improvement.

The green-blue infrastructure action plan will also interact with other council policies and plans regarding urban design, infrastructure works and development planning, where consistency and integration are important. In some cases, updates may be required to other council documents to ensure green-blue infrastructure can be delivered effectively and in alignment with other council priorities.

The final green-blue infrastructure action plan will need to be linked to the council plan, the strategic resource plan and the council budget, so it is important to understand the timelines and content of these plans as well as the action plan is developed.

Core documents for evidence base and strategic context

City strategy or local plan

Community plans

Open space strategy

Urban forest strategy

Biodiversity strategy

Sustainable water use plan

Stormwater management plan

Integrated water management strategy

Flood studies

Environment strategy

Climate change adaptation strategy

Walking and cycling strategy

Public health and wellbeing plan

Heritage studies

Core documents for integrated and consistent delivery

Municipal Strategic Statement

Planning Scheme

Structure plans

Precinct masterplans

Infrastructure design manual

Urban design manual

Landscape design manual

Case study: City of Greater Bendigo Public Space Plan

Use of CrowdSpot to seek community feedback

City of Greater Bendigo utilised CrowdSpot to encourage residents to rate the open spaces in Bendigo. Members of the public can use the website can be used to place a pin on a space they use, rating it as a great, ok or poor space, and to also pin locations where they have an idea for improvements or new initiatives. The exercise provided the council with context on the performance of existing spaces and ideas for new investments.

5.2 Identify your local drivers

The review of existing documents and information will have helped to provide context around the opportunities and challenges in delivering green-blue infrastructure in your city or town. You may return to this evidence base later in the process to draw out specific data and spatial information. For now, it is important to identify the key drivers for green-blue infrastructure (selling points) to make sure green-blue infrastructure planning is well integrated with wider council objectives. Identifying the key needs and benefits from the local community's point of view is also helpful at this point to link the action plan with wider council aims and measurables.

Activity: Workshop

At this time, it may be helpful to hold a workshop with key stakeholders within and outside the council. Including a general introduction to green-blue infrastructure, the workshop could include discussion around these questions:

- What benefits do you think green-blue infrastructure could deliver here?
- Which stakeholders would benefit from green-blue infrastructure? How strong is their influence?
- Review the city plan or local plan, which objectives could be supported by green-blue infrastructure?
- What are the top 5 drivers from your point of view? (drivers can be recorded, discussed and voted on to establish some consensus)

The core drivers for green-blue infrastructure could mean that the types of green-blue infrastructure solutions change, or the scale or desired locations to which they are applied are given more focus. For example, drivers that focus on amenity and increasing local economic value may focus on initiatives that increase the support of trees, gardens, and water features in the gateway areas, pedestrian routes and renewal areas. Where core drivers are around reducing dependence on drinking water supplies and flood resilience, focus may turn to large-scale initiatives in parks and waterway corridors, where stormwater can be locally captured and harvested as an alternative supply for irrigation needs.

Consultation workshop

Case Study: City of Ballarat Green-Blue Infrastructure Action Plan

Sourcing key drivers from the City Strategy

City of Ballarat developed a City Strategy that reflected core needs and aspirations that arose in an in-depth community consultation process. The strategy outlines the long-term plan for a greener, more vibrant and connected Ballarat.

Two key platforms were identified to guide the future of the city; 'a 10-minute city' and 'a City in a Landscape'. The creation of the City in a Landscape platform for the City Strategy became a central driver for green-blue infrastructure planning in Ballarat. The platform directly reflected community feedback on what is important to the future of the city, which included:

- Highly valued green spaces for passive and active recreation,

- The importance of Lake Wendouree as an asset for tourism,

- The importance of heritage in the landscape, including trees in streetscapes and bluestone drainage channels, and

- The vulnerability of the city to impacts of drought, particularly effects on natural assets and liveability.

Activity: Objectives review

Review the objectives for green-blue infrastructure planning in Part I. Which objectives resonate most strongly with your council?

- To support year-round passive and active recreation
- To protect and enhance local waterways
- To support urban biodiversity
- To improve the amenity of the urban environment
- To create stronger connections between communities and nature
- To improve the functionality of urban places
- To make use of alternative water supplies locally
- To reduce the impacts of flooding
- To provide safe and pleasant environments during hot weather

5.3 Set a vision

At this stage, it is helpful to set a succinct and compelling vision or a set of clear outcomes for green-blue infrastructure planning in your city. This vision statement should capture the key drivers and can be developed with your stakeholder group.

Case Study: City of Ballarat Green-Blue Infrastructure Action Plan

Vision statement

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. Integrated design of the urban environment ensures that Ballarat's environment is protected and celebrated and its urban infrastructure is efficient and effective.

Chirnside park green spine. Image courtesy of ASPECT Studios

6.0 Scope the possibilities

2. Scope the possibilities

Map the data
Explore the options
Identify a selection of typologies
Test the selected typologies

6.1 Map the data

Now that we have an overview of the local context and the key drivers, we need to deepen our understanding of the 'where and what':

- Where green-blue infrastructure could deliver the greatest benefits?
- Where there are emerging opportunities for intervention?
- What types of urban environments provide the most opportunity?

Drawing on the initial information review and talking to other stakeholders, try to answer the following examining questions, gathering helpful data where possible. Key stakeholders to involve in the development of the evidence base and the wider action plan could include:

- Council (all relevant departments), usually the project leader,
- Local Water Authority,
- Local Catchment Management Authority,
- State government (Department for Environment, Land, Water and Planning),
- Community representatives and groups, particularly associated with waterway management, recreational facilities, greening and biodiversity,
- Local landscape architecture, engineering and ecology consultants, and
- Local developers.

Table 2: Useful data for an evidence base

Examining question	Helpful data
Open space	
Are there key open spaces in need of improvement?	• Open space needs assessment • Landscape capital works plans • Sporting ground and key landscape irrigation needs (current and future) (ML/year on a locational basis)
What types of new open spaces are needed where?	
Which sporting grounds, gardens and open spaces are currently irrigated? Which would benefit from irrigation in the future?	
Urban forest	
What is the current % canopy cover?	• Tree inventory (condition, age, species, location, life expectancy) • Canopy mapping • Tree planting budgets • Tree management costs (specifically cost that may be able to be improved through design, including canopy pruning for power lines, pavement uplift repair) • Pedestrian movement maps
Future drivers for increases in urban forest?	
What are the key challenges for existing urban forest?	
Where are the key pedestrian areas and routes that would benefit most from shade?	
Biodiversity	
What are the ecological challenges for the area?	• Biodiversity mapping (including vegetation, fauna and wetlands)
Where could ecological networks be enhanced, extended or connected?	
Waterway health	
What is the quality of existing waterways, in terms of: • Water quality • Ecological value • Amenity and recreation value	• Waterway corridor mapping (including riparian reserve, adjacent open space, amenity issues, pedestrian and cyclist access) • Waterway quality mapping • Waterway catchment boundaries • Ecological surveys • Urban stormwater volumes and pollutant load draining to each major waterways • Identification of major point pollution sources to waterways (industrial discharges, wastewater treatment plant discharges, septic tank areas)
What and where are the key sources of waterway pollution? These may include: • Urban stormwater catchments • Industrial discharges • Treated wastewater discharges • Septic tank releases	

Examining question	Helpful data
Water resources	
What assets are the top council water users for potable water?	• Major water users • Quantum of alternative water available in urban area (rainwater, stormwater, wastewater) • Map of existing alternative supply schemes
What alternative water sources are available?	
Flooding	
Which areas are at risk of flooding during major rainfall events?	• 1 in 100 ARI flood mapping • 1 in 2, 1 in 5 and 1 in 10 ARI flood mapping (including the minor drainage system)
Which areas are at risk of flooding more frequently due to exceedance of the minor drainage system?	
Health	
Where is the air quality poor?	• Air quality maps • Health indicators as spatial data (obesity, asthma, mental health) • Thermal image of the city • Heat wave vulnerability indicators as spatial data (populations of aged persons, people with a disability who require assistance and households where English is not the first language)
Which communities have health challenges which could benefit most from green space and recreation areas?	
Which areas and communities are most vulnerable to extreme heat?	
Land use	
Where are the key public spaces, retail areas, employment areas and recreation areas where outdoor amenity could be improved?	• Activity centres • Retail and employment centres • Car parks and plazas • Recreation areas and routes • Average house price data
Where could amenity improvements help improve a neighbourhood and property prices?	
Renewal and change	
Where will development occur in the city?	• Major development locations • Renewal areas • Capital works plans for landscape, road and public realm works
Where will changes be occurring in the urban area in the next 5-10 years?	

Document the outcomes of this process on a series of maps, summarising the data from each of these different layers. Use meetings with stakeholders to confirm the data used and to also address any knowledge gaps that may exist.

The different layers can then be combined into one or more summary maps which can be used to identify potential areas of opportunities.

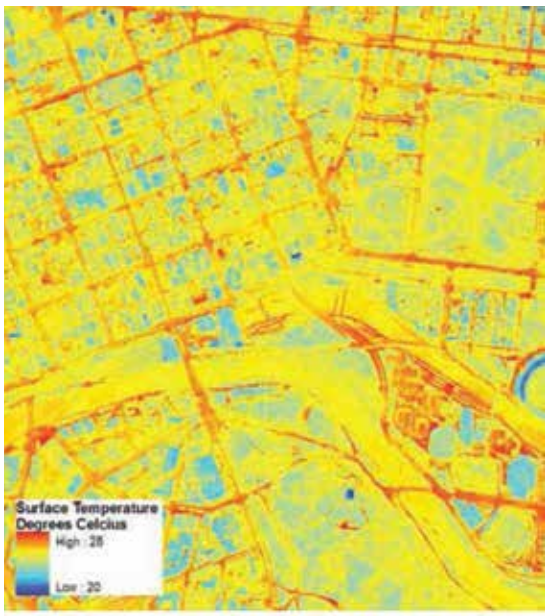
Activity: GIS analysis

If you are able to gather a lot of relevant spatial data, Geographic Information Systems (GIS) can be used to overlay and examine spatial locations where multiple benefits could be gained. A substantial amount of data is freely available for use. This analysis can be used to provide both an evidence base for action and to aid in prioritisation of investment.

Case Study - City of Melbourne Urban Forest Strategy

Data on health and location of existing trees

City of Melbourne completed a detailed tree audit to understand the location, age and condition of their urban forest. This was developed into a web-based and publically accessible data set. Several other spatial analyses contributed to the understanding of the need for urban forest and helped to prioritise investment. These included a heat map of the city and an analysis of the vulnerability of local populations to extreme heat.



Case Study - Brisbane City Council Norman Creek 2012-2031 Master Plan

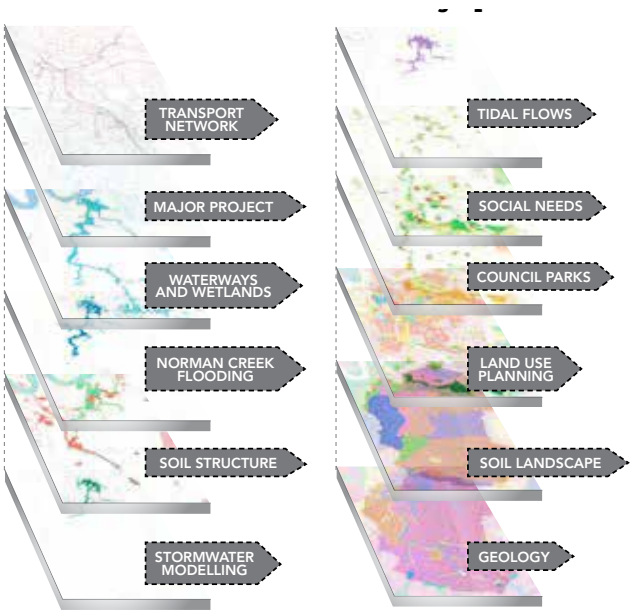
Context analysis

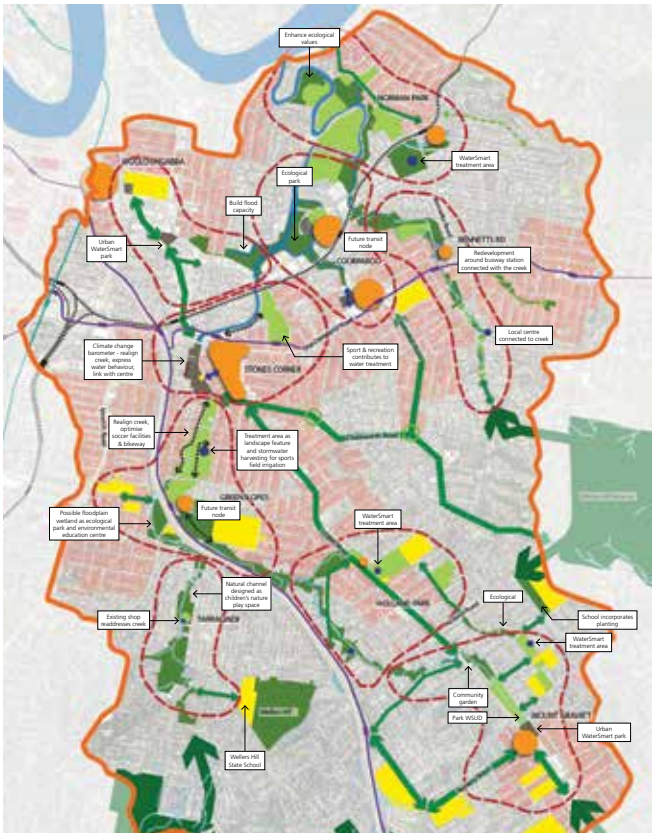
The Norman Creek 2012-2031 Master Plan identifies key initiatives aimed at rejuvenating the Norman Creek Catchment.

The master planning process involved the assessment and layering of multiple spatial layers to build a holistic picture of the catchment.

This process revealed unique strategies that are suited to a number of different locations across the catchment including:

- greening the local banks
- urban stormwater harvesting
- water smart buildings
- artwork and other interactive community activities
- sub-tropical boulevards and neighbouring shadeways
- multiple use open spaces.





Constructed wetland within a housing development, South-East Melbourne

6.2 Explore the options and the benefits

The answers to the questions in the previous step may uncover specific green-blue infrastructure opportunities in themselves, or may provide evidence to underpin a business case for delivery. Present this information as part of a workshop to confirm and ground test the conclusions, and to provide a conversation starter for the stakeholder group to help to identify and locate opportunities.

Develop your own green-blue infrastructure ideas and locations and collate ideas from others. These can be very project specific or quite general in nature. Recording possible opportunities on a map will provide a useful reference on an ongoing basis.

Activity: Workshop

Engagement with stakeholders is useful at this point to test the outcomes of data analysis, but also to gather ideas for opportunities. Activities could include:

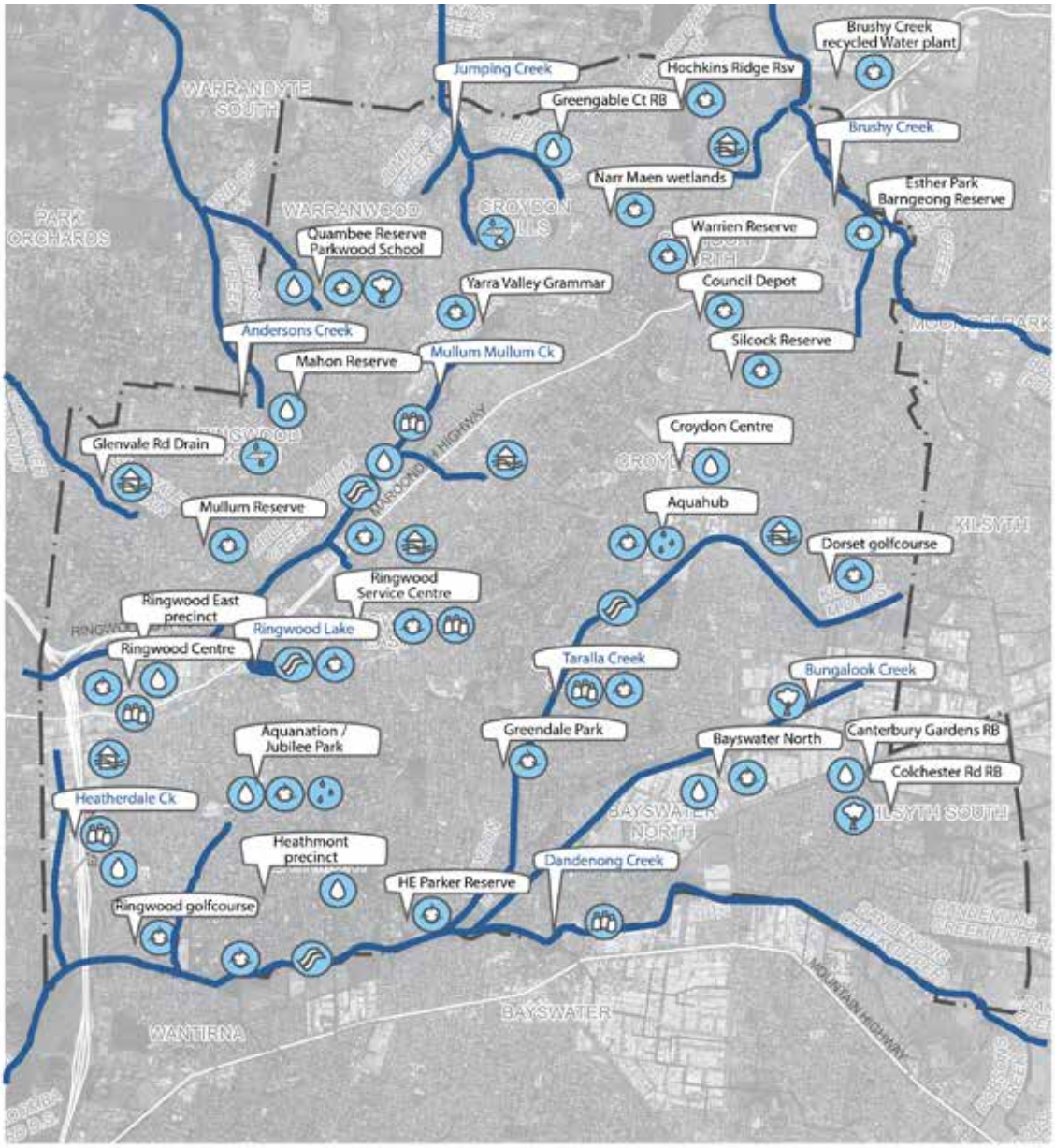
- Assign groups to consider each 'scale' in more detail (e.g. lot scale, public realm, precinct scale). Ask them to identify the key types of opportunities and rank these based on deliverability.
- Print aerial maps of your city. Ask groups to add pins where they can think of a green-blue infrastructure opportunity. Opportunities may arise due to planned future interventions (e.g. development or renewal) or due to particular locational attributes that would lead to good benefits being achieved.
- Fill in the table below and ask participants to prioritise opportunities which could deliver the most benefit.

Green-blue infrastructure opportunities	Key benefits	Possible locations
...	...	...

Case Study - Water Sensitive City of Maroondah Strategy

Opportunity mapping

Maroondah developed a water sensitive city strategy focused on stormwater management and greening outcomes. Opportunities identified during the analysis and in workshops were recorded and developed into an opportunity map for future reference.



6.3 Identify a selection of typologies

Having identified a range of opportunities, select 4-8 of 'typologies' in more detail.

A 'typology' is a classification of physical characteristics commonly found in urban places – a specific context for the delivery of green-blue infrastructure. Typologies are useful as they can provide a template for a green-blue infrastructure location which is valid in many locations.

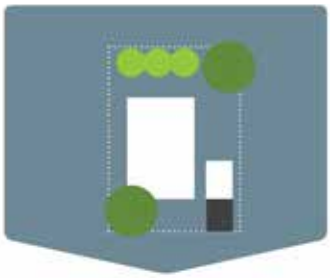
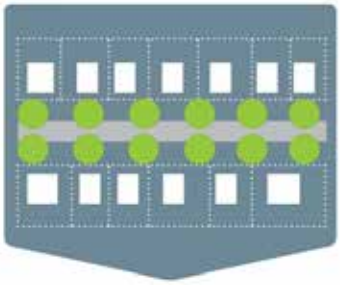
You may choose to include some priority opportunities with a location in mind, however, keep in mind that where analysis becomes too context specific, the results may not be transferable. It should also be specified whether the typologies selected are a retrofit or new build situation.

Refer to Part III for practice notes on the planning of green-blue infrastructure for typical typologies. These practice notes provide ideas and guidance in optimizing the benefits provided by green-blue infrastructure in these contexts.

The purpose of the typology specific analysis is to:

- Demonstrate how green-blue infrastructure solutions can be integrated into the local environment
- Explore delivery avenues (e.g. planned renewals, capital projects) and possible challenges
- Evaluate costs and potential benefits
- Provide insight into which green-blue infrastructure initiatives will deliver the most value
- Provide evidence for a tailored business case for green-blue infrastructure delivery in your city.

The typologies selected should cover a range of scales and land uses:

Allotment scale / private realm 	• Residential lots • Commercial lots • Industrial lots • Council buildings
Streets and local public realm 	• Streets (with specific characteristics according to adjoining use, width, drainage configurations, location of above and below-ground utility corridors, existing vegetation, verges, footpaths etc) • Public squares • Carparks • Pocket parks
Precinct and catchment scale 	• Parkland and open spaces • Waterway corridors • Green corridors • Forests • Community gardens • Ecological areas

The selected typologies can also consider a range of delivery mechanisms (e.g. policy requirements in new development, council led investments, community projects, co-funded projects between partner organisations).

Activity: Typology shortlist

Develop a typology shortlist to discuss with key stakeholders to agree a number to be taken forward for detailed analysis, for example:

Typology	Attributes	Expected benefits
CBD street	• *Retail frontages* • *Some existing trees* • *Kerb and channel drainage* • *Traffic calming desirable* • *Retrofit situation*	• *Shade* • *Stormwater treatment* • *Amenity* • *Improved functionality (traffic calming)*
New infill development	• *Renewed streets and public spaces* • *Development requirements for water management* • *Constrained by existing services and infrastructure*	• *Improved micro-climate in built-up area* • *Stormwater management* • *Alternative water sources* • *Amenity and 'selling points' for development*
…	…	…
…	…	…
…	…	…

6.4 Test the selected typologies

Develop a concept design for green-blue infrastructure for each typology. It is likely that there will be a range of green-blue infrastructure initiatives that would be appropriate to each typology. You may wish to conduct preliminary testing of several initiatives before developing concept design for evaluation.

To develop and evaluate the performance of a green-blue infrastructure concept for each typology, step through this process:

1. **Clarify typology characteristics:** It is important to fully understand and define the characteristics of the typology up-front. A reference location can be useful, or mock location could be developed which visually presents the typology. This could include an aerial diagram or a cross-section showing typical characteristics.

2. **Identify contextual influences for the typology:** It is useful to understand the current performance of the typology in urban design terms, for example:
    - how the area is used
    - what existing management and maintenance is required (and the costs)
    - existing issues or problems that could be improved
    - design preferences and existing guidelines (e.g. tree species, heritage character, materials, safety requirements)

3. **Identify key benefits to be delivered:** Review the local drivers for green-blue infrastructure in your city and identify possible benefits that could be delivered in this typology. You may wish to refer to the practice notes in Part III to identify initiatives that could deliver your priority objectives.

4. **Develop a green-blue infrastructure concept design:** This will most likely require input from a range of disciplines, including engineering, landscape, urban design and operations specialists.

   A concept design will include sufficient information to demonstrate that a concept can be delivered, and will include rough sizing in order to estimate the likely scale of costs and benefits. Design should be specific to local context and seek to maximise the desired benefits and address identified challenges. Part III of this guidance provides tips on how to maximise benefits through planning and design. Various general design guidance documents are available to inform best practice design, including:

   - Water sensitive urban design: Melbourne Water WSUD website (Melbourne Water, 2015)
   - Street trees: Street tree design guide (Landcom, 2008)
   - Open spaces: Open space design guide (Landcom, 2008)
   - Green roofs, walls and facades: Growing Green Guide (Department of Environment and Industry, Victoria, 2014)

Figure 1: Concept design evolution through sketching

5. **Develop an estimate of likely costs:** Estimate the capital and operating costs of the green-blue infrastructure proposals. Depending on the level of detail you would like to go to, you can either estimate the relative scale of investment required, or complete a bespoke costing that estimates the full investment over the lifetime, by totaling the net present value of capital and operating expenditures over a defined lifetime (e.g. 30 years).

6. **Identify any avoided costs:** There may be direct financial savings which will occur as a result of the green-blue infrastructure proposal due to improved functionality of the urban environment. These may be capital or operational savings and should also be estimated over a lifetime. These avoided costs could include:

   - Avoided repair costs of pavement, kerb or utility repairs due to tree root ingress which can be avoided if trees are provided with adequate access to soil and water. You may be able to determine existing maintenance costs for this from your council.
   - Avoided costs of stormwater drainage upgrades or retarding infrastructure required to reduce flood risk. This is likely to be area specific.
   - Avoided cost of water supply due to provision of an alternative water source. This can be based on the local demand and the price of water.
   - Avoided asphalt replacement. The presence of shady trees in 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 quite quickly. Specific data may be available on replacements from your council.

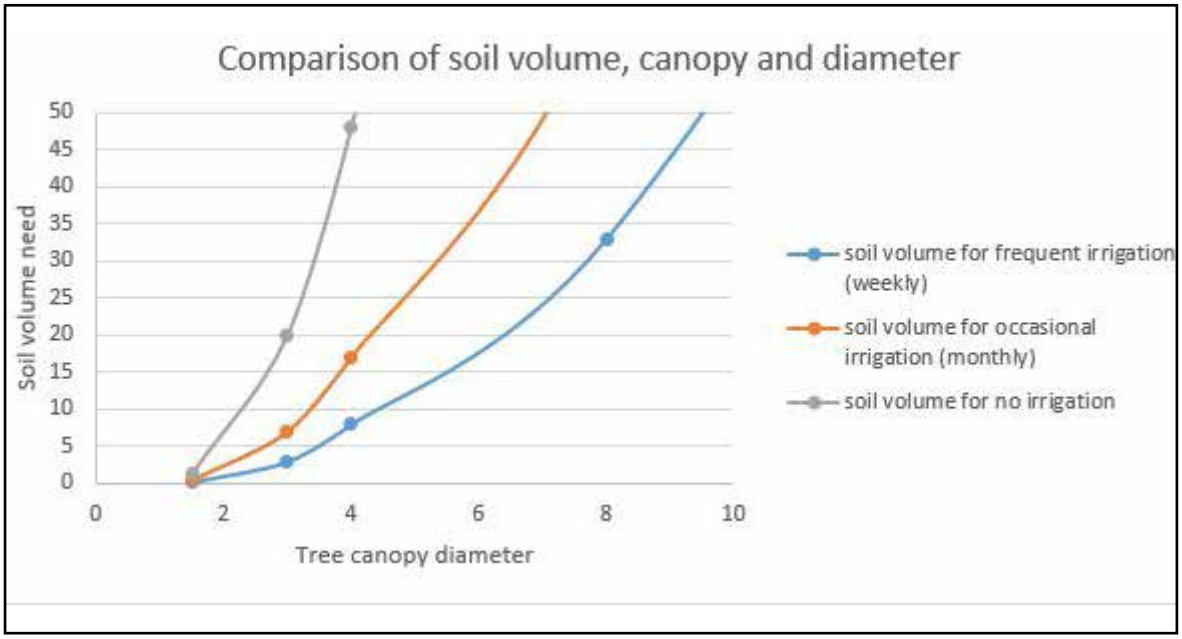
7. **Identify environmental and social benefits and quantify where possible:** Evaluate the performance of the green-blue infrastructure proposal against the objectives outlined in Part I to help you identify the additional benefits that the proposal offers. Write a description of each benefit, and where possible quantify these. In some cases a benefit may also be able to be 'monetised' whereby a dollar value is attributed to a benefit but does not represent an existing direct cost or revenue stream. For instance, a recent Latrobe University study commissioned by AFL Victoria concluded that for every $1 invested in a community football club, there is a $4.40 return in terms of increased social connectedness, wellbeing, mental health status, employment outcomes, personal development, physical health, civic pride and support of other community groups.

   A green infrastructure economic framework has been developed by Victoria University which identifies a range of benefits which can be quantified and developed into an economic business case.

The table below provides examples of benefits that can easily be quantified for most typologies and suggests methods to estimate values. The second table suggests reference studies where general commentary can be drawn from quantifications made in reference studies conducted elsewhere (but where direct data is unlikely to be obtainable for the typology).

Table 3: Indicators which can typically be estimated using industry tools and data

Benefit	Quantification measure
Stormwater treatment	Pollutant removal (TN, TSS, TP) can be modelled using MUSIC
Stormwater flow reduction	Flow removed due to infiltration, evaporation or reuse can be evaluated using MUSIC
Stormwater provided for irrigation	Reuse volumes and reliability can be evaluated using MUSIC
Soil moisture increase	Days per year above wilting point (tree specific) compared to business as usual
Canopy cover	Increase in expected canopy cover due to tree planting, increased soil volume or access to water (refer graph 1)
No of supported trees / area of open space irrigated	Total number of trees or area of open space provided with irrigation water from stormwater



Graph 1: Comparison of required soil volume to achieve ultimate tree canopy in different irrigation conditions (utilising data for Melbourne from Hitchmough, J. (1994) Urban Landscape Management, Inkata Press)

Table 4: Example reference studies for quantification of benefits

Benefit	Example reference studies for relatable quantifications
Increases in property prices due to green-blue assets	Very locally specific and can be influenced by a range of factors. Possible reference studies include: • Restoration of an urban drain to a vegetated stream achieved a 4.4 per cent increase in property prices for homes within 200 metres of the project site[1].
Increases in retail value due to improved tree canopy	Very locally specific and can be influenced by a range of factors. Possible reference studies include: • People would pay 9 to 12 per cent more for goods sold in central business districts with high-quality tree canopy[2].
Increased tree life time due to improved growing conditions	Average lifetime of an urban tree in your local area may be known from data. • US study has shown an urban tree can increase in lifetime from 13 years to 50 years when provided with required soil volume and health conditions[3].
Improved microclimate due to irrigation or shade	General effects on microclimate due to shading and evapotranspiration can be drawn from: • A study in Melbourne found that non-irrigated grass was on average between 3.6°C and 5.2°C hotter than watered grass[4].
Improved health due to access to nature	Large number of reference studies available from ASLA[5].
Improved air quality due to presence of trees	Estimates available for specific tree species are available from i-tree[6].
Increased biodiversity and ecological services due to size of trees	• 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[7].

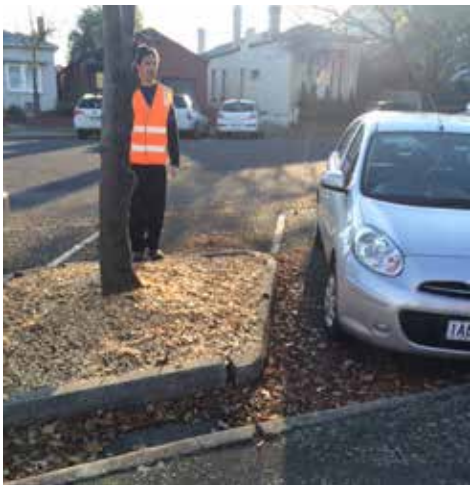
1. Fogerty, et. al (2015) The value of restoring urban drains to living streams. CRC for Water Sensitive Cities.
2. Wolf, K.L. (2005) Business District Streetscapes, Trees and Consumer Response. Journal of Forestry 103, 8:396-400.
3. Deeproot (2008) Investment vs. return for healthy urban trees.
4. Coutts, A. and R. Harris (2012) A multi-scale assessment of urban heating in Melbourne during an extreme heat event and policy approaches for adaptation. Monash University: Melbourne.
5. http://www.asla.org/healthbenefitsofnature.aspx
6. https://www.itreetools.org/
7. McPherson, E. G., Nowak, D. J., Rowntree, R. A., eds. 1994. Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project. Gen. Tech. Rep. NE-186. Radnor, PA: U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station: 201 p.

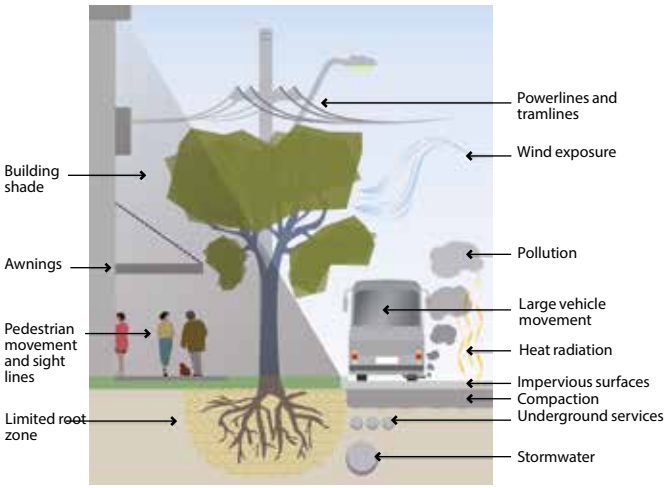
Lake Wendouree and surrounding walking paths, a central tourist attraction for Ballarat

Case Study: City of Ballarat Green-Blue Infrastructure Action Plan

Central city street renewal

Context: A standard street design for reconstructed streets in the central heritage area of Ballarat includes 'tree islands' within the parking area. There are some distinct disadvantages to the current design, including poor tree health due to confined soil volume and lack of access to water (council has observed pavement uplift as a result of tree roots searching for water), accumulation of leaf litter with no street sweeper access, and clash of the tree canopy with overhead powerlines due to tree placement.



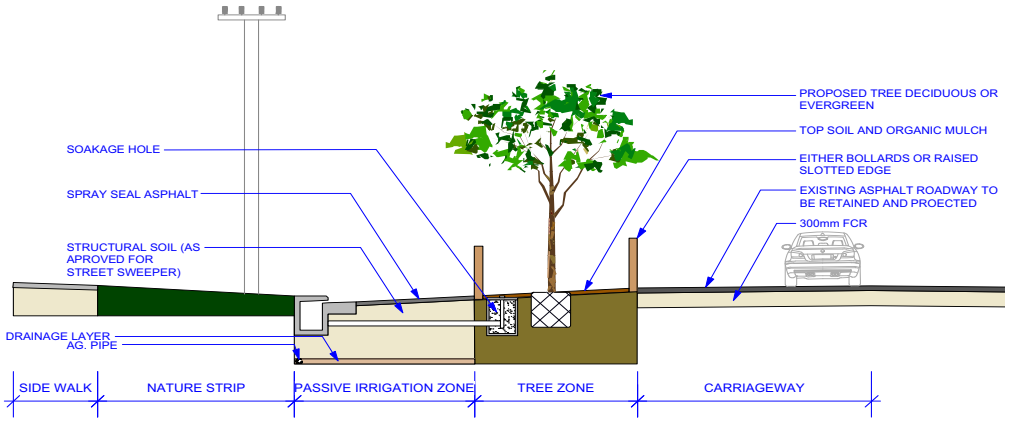


Green-blue proposal:

Relocate tree growing area to the edge of the parking zone (near the roadway), to reduce the clash of tree canopy with powerlines and create a gap behind the tree growing area and the kerb that street sweepers can pass through.

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.

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.



Case study continued....

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
Total:	$2,195	$351,200

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:

- The re-design of tree pits increased soil volume while minimising impact on parking. Due to the avoided cost of construction of additional car parks in Ballarat CBD the design constitutes a potential avoided capital cost of $330,000 per km.

Expected operational benefits:

- Creation of space for a street sweeper could save Council an estimated $700 in manual labour time per km of street every week during Autumn.

- The offset of trees from the kerb should significantly reduce the area of tree canopy which requires 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.

- 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 which will be reduced by the proposed design.

Broader community benefits:

- 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.

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

- 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.

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

Case Study: City of Ballarat Green-Blue Infrastructure Action Plan

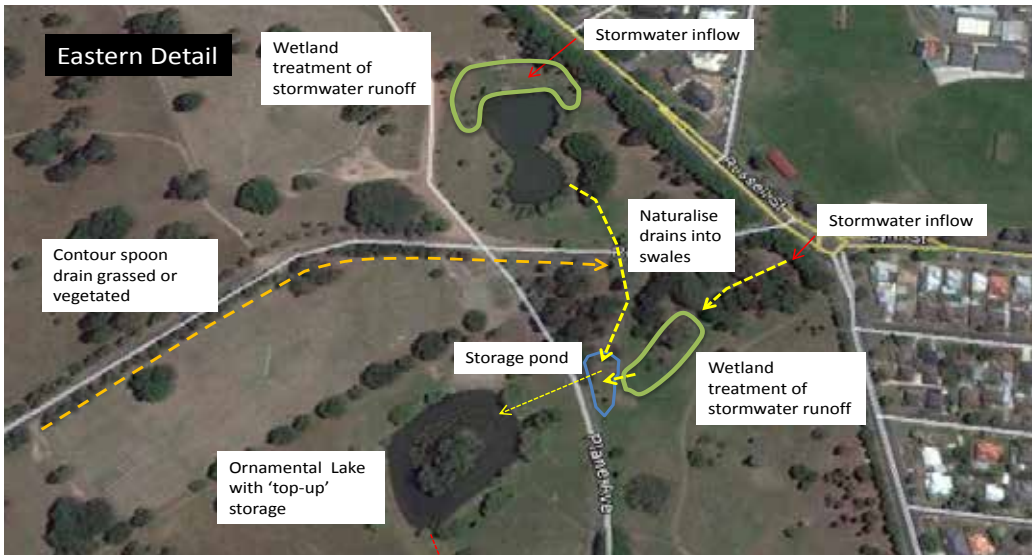
Open spaces, with a demonstration location of Victoria Park

Context: The case study focuses on improving and harvesting from the two existing ponds to support improved sporting grounds 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.

Green-blue proposal:

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.

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.



Case study continued....

Expected capital investment costs:

Green-Blue Initiative	Estimated cost
Wetland (3,000m2) partially utilising the existing pond	$231,000
Swale vegetation and widening	$7,500
Storage pond (3,500m2) and outlet	$226,550
Total:	$465,050

Expected operational costs:

- Maintenance of the wetland is estimated at $6,930/year. Maintenance of the swale is estimated at $2,348/year including mowing, vegetation care and periodic sediment removal.

- 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.

Broader community benefits:

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

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

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.

The support of Victoria Park through provision of an alternative water source ensures an important asset for the community and tourists is looking its best. The area provided with irrigation is 35,000m^2.

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

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

7.0 Plan Delivery

3. Plan delivery

Prioritise green-blue infrastructure projects
Review delivery factors
Set actions
Monitor success

7.1 Prioritise green-blue infrastructure projects

The testing phase will provide some insight into what level of value different green-blue infrastructure projects may offer. At this point it is important to refer back to the objectives and the vision that were identified in Part I. Check that these still hold true (as engagement and analysis throughout Part II may have shifted perspectives of the stakeholder group) and adjust these as necessary.

Drawing on the typology performance, highlight certain types or locations where green-blue infrastructure projects would deliver a lot of value, and which can be the focus of delivery in the short-term. Prioritisation should consider:

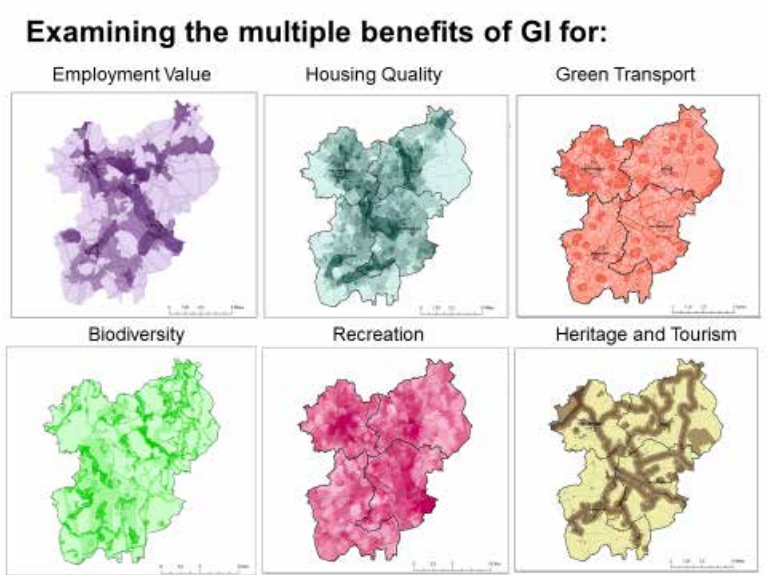
- Types of benefits, and their ability to contribute to the defined objectives.
- Scale of benefit achieved compared to cost (including avoided costs),
- Locations where the benefits are likely to have most impact (this can draw from GIS data gathered in the 'Map the data' stage.

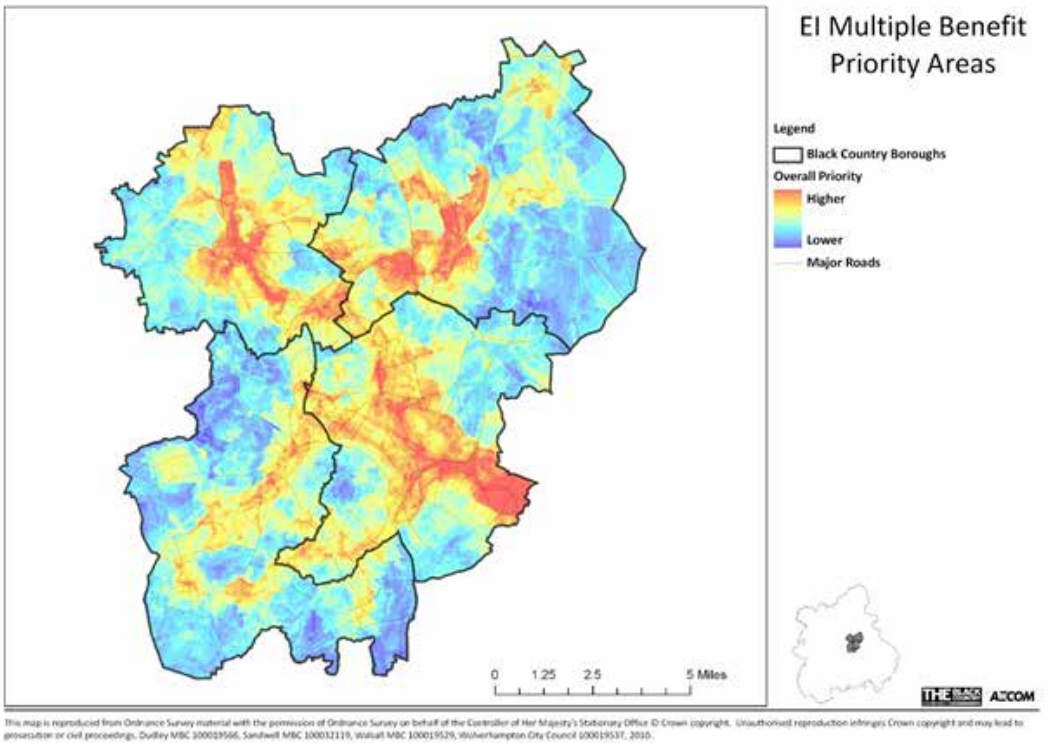
Prioritisation can be conducted with the stakeholder group or using a multi-criteria analysis. Utilising the opportunity map developed in Part II, there is an opportunity to update and re-prioritise projects in response to opportunistic events in the future (e.g. planned road renewals, new precinct plans).

Case Study - Black Country Green infrastructure Plan

Location prioritisation

Four local authorities in the UK joined forces to examine and prioritise green infrastructure investments across their region. An extensive GIS analysis was completed, using economic, social and environmental data to determine where the benefits of green infrastructure were most needed. As tourism was important to the area, a focus on delivery of green infrastructure was made around attractions and visitor routes, as well as in key retail centres and in areas where health could be improved. Scoring was added to data to determine overall priority areas.





7.2 Review delivery factors

Delivery of green-blue infrastructure is often dependent on people and processes. Often the green-blue infrastructure proposals themselves are relatively simple, but they could involve changes in standard practice or making sure that the opportunities are realised at the right time and in the right places. For example in plans for a new road, design of kerbs to provide passive irrigation of street trees and gardens can be achieved with a small additional cost, but would be much more costly to retrofit later.

In the previous tasks, you would have identified a range of possible 'structural' projects and potential locations. However, successfully getting those structural projects on the ground often relies on 'non-structural' factors being addressed to create supportive conditions such as an encouraging culture, collaborative processes, secured funding approval and good construction and maintenance knowledge for that project to become a reality.

In understanding what supportive conditions are already in place, and what delivery barriers are present (or perceived), it is useful to discuss the effectiveness of the council and its partners in five core areas:

1. Leadership: Funding commitments, leadership interest, ambition, presence of champions
2. Policy and Requirements: Planning, requirements for council projects
3. Communication processes: Internal design process, cross-departmental communication, community engagement
4. Knowledge: Training in green-blue infrastructure, existence of local guidelines and practice notes
5. Innovation and challenge: Ongoing updates of practice, pilot project budgets, review systems

Workshop

Present the results of the investigation so far and examine delivery pathways in more detail. Firstly it's important to understand existing drivers and barriers for green-blue infrastructure delivery. Discuss questions like:

- How well do we currently plan for green-blue infrastructure?
- How well do we currently deliver green-blue infrastructure?
- What is stopping us from delivering green-blue infrastructure at the moment?
- What are the top 5 delivery barriers from your point of view?

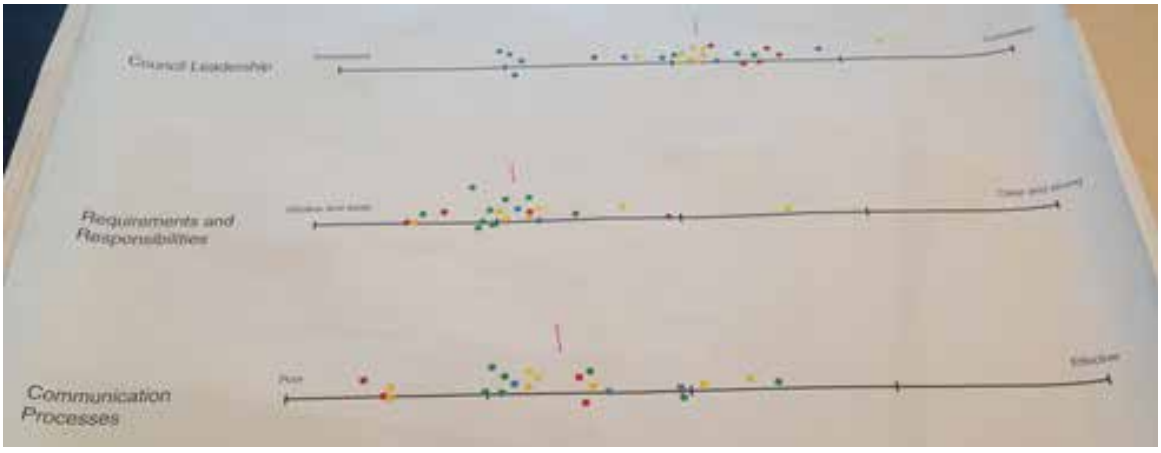
It may be useful to discuss some of the more specific typologies developed in Part II to draw out delivery drivers and barriers specific to those contexts.

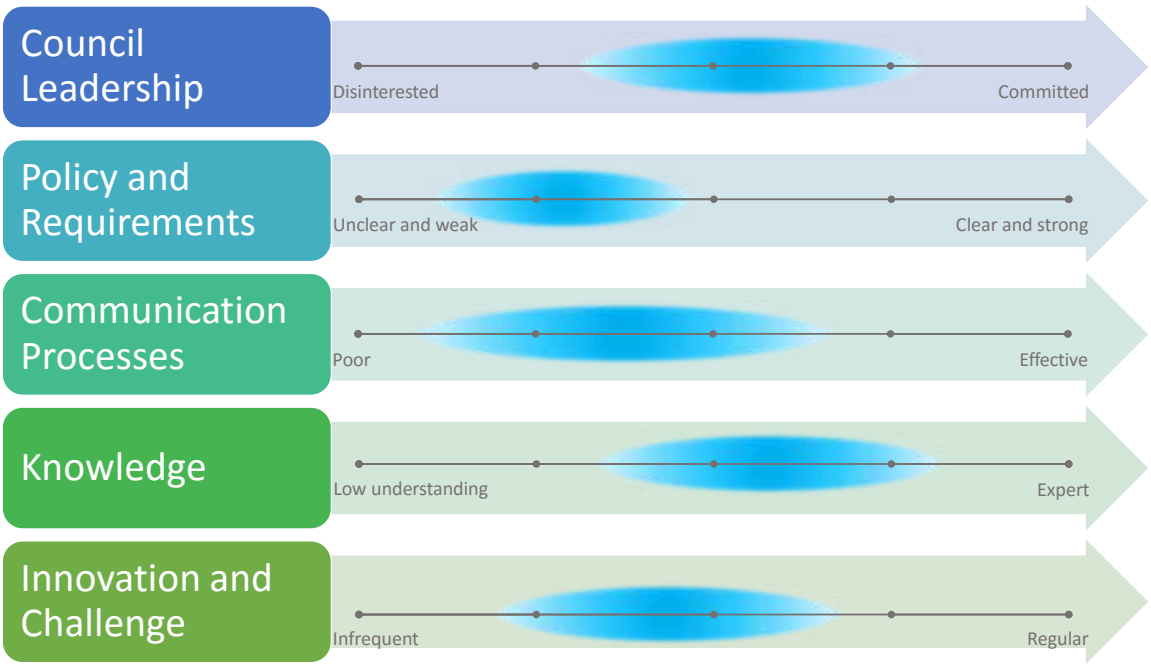
Case Study - City of Darebin Watershed Strategy

Identification of delivery barriers

As part of the developing of the City's Watershed Strategy, which aims to improve management of water and greening of the environment in Darebin, a range of stakeholders (internal and external to council) were brought together to examine delivery barriers.

Participants were asked to rate how well placed Darebin is to transition towards its vision for each key delivery factor based on a sliding scale of 'poor' to 'good'. The delivery factors that scored low then became the focus for actions in the action plan.





7.3 Set actions

Using the review of delivery factors, think about what actions could be taken to overcome barriers and to capitalise on opportunities to ensure green-blue infrastructure is delivered well. It will be useful to discuss and test possible actions with the stakeholder group.

Actions should be 'SMART':

- Specific – target a specific area for improvement.
- Measurable – quantify or at least suggest an indicator of progress.
- Assignable – specify who will do it (council department or partner).
- Realistic – state what results can realistically be achieved, given available resources.
- Time-related – specify when the result(s) can be achieved.

7.4 Monitor success

The action plan should also set out key criteria that can be monitored over time to measure the success of the action plan and to identify when further investment can be made. The action plan should include time-related actions which should be reviewed annually. Council may choose to also implement some outcome based indicators which measure delivery of green-blue infrastructure. These could include:

- Canopy cover
- ML of stormwater utilised for greening
- Stormwater pollutant removal / year (nitrogen and suspended solids are commonly used indicators)
- Proportion of open space fed by an alternative water source.

Case Study: City of Ballarat Green-Blue Infrastructure Action Plan

Development of actions

The culmination of the analysis undertaken by City of Ballarat was a series of actions. These actions are designed to support the delivery of the priority projects and to overcome the key delivery barriers identified.

Actions were rated on a scale of importance to allow council to invest resources and time accordingly.

Internal council communication and integration	
Install a new council position for a staff member to: - Champion green-blue solutions - Encourage collaboration and communication between departments - Review masterplans, development and capital works proposals annually prior to financial year budget planning processes by Council - Address the 'possible barriers to delivery' identified in section 5.1.3 - Provide technical advice (e.g. green-blue design options, maintenance requirements, capital and operating budget planning).	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	
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

PART III

Practice notes

Practice Note A: Waterways and Green Corridors

Description

Waterways and green corridors provide important linear links in urban environments which can provide connected environmental and recreational corridors. The green corridors are typically associated with waterway corridors and the associated flood prone land, but they can also be created due to heritage trails and other easement corridors.

Key contextual information

- Existing waterway/green network strategies and plans
- Key drivers related to waterways and green corridors (drawn from council objectives and community visioning)
- Existing pathway networks
- Adjoining land uses (current and future)
- Riparian corridor vegetation type and quality
- Current access to waterway for the community
- Water quality and targets for improvement
- Ecosystem health, habitat potential and key species
- Flood studies and mapped flood extents
- Hydrology (and expected future changes in flow)

Good practice tips for delivery

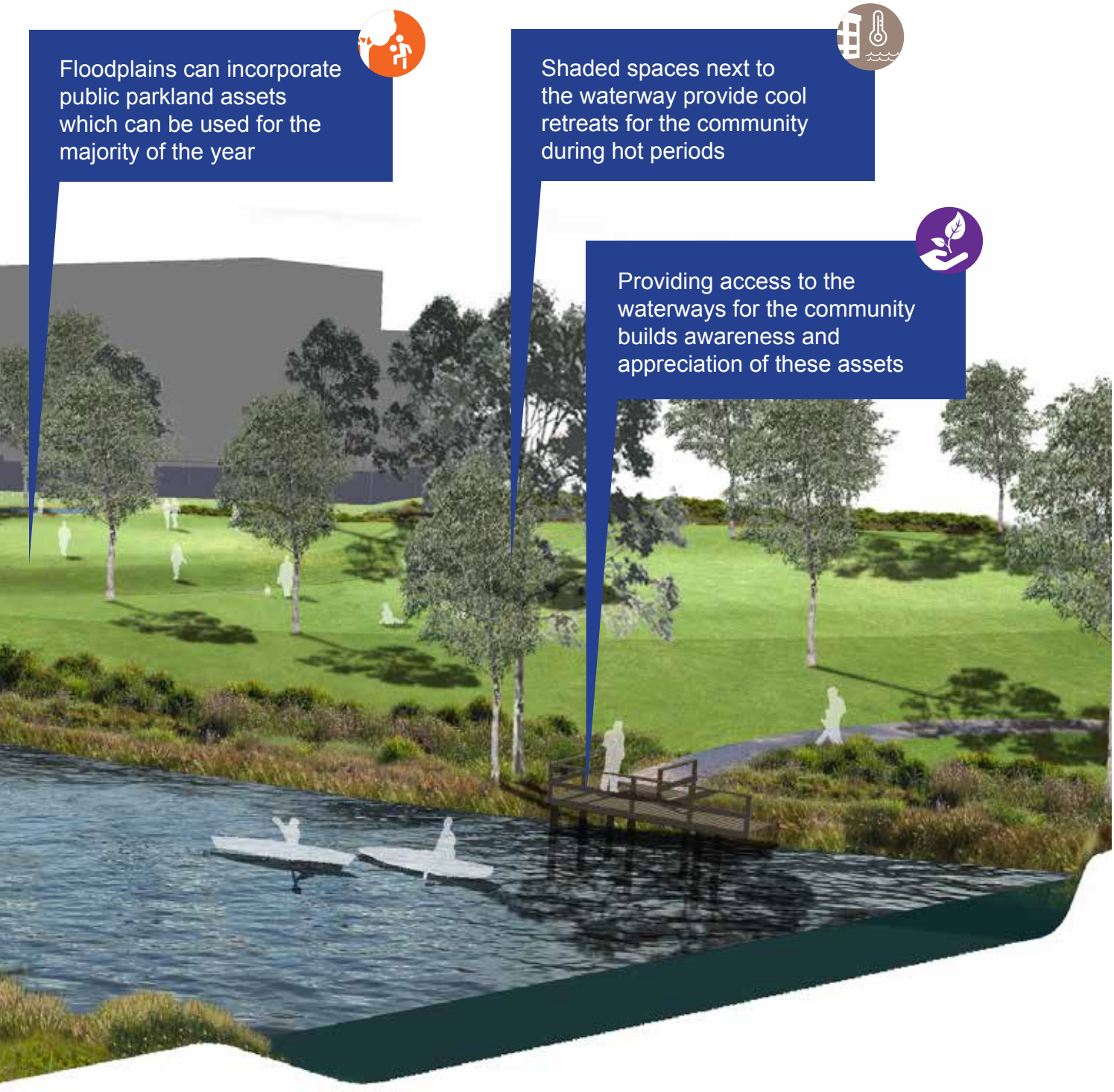
- Understand what other projects are happening in the area and coordinate the planning and delivering of works with these. This can provide synergistic opportunities and reduce overall costs.
- Work with local community groups, catchment management authorities and schools (e.g. information sessions, planting days, vegetation maintenance).
- Allocate appropriate budgets for ongoing monitoring and maintenance.
- Be prepared for adaptive management as natural systems are dynamic, and this is a normal part of delivering successful waterway and green corridor projects.
- Report back internally and to the community – celebrate successes and take on board learnings.

Possible green-blue initiatives

Initiative		Key objectives met	Tips on enhancing benefits
Vegetated riparian zones		*- Waterway protection* *- Urban biodiversity*	- Using native species - Ground covers to slow and treat flows - Disconnect stormwater pipes from waterway and promote infiltration and shallow subsurface flows - Trees used to enhance bank stability, provide shade and woody debris for in-stream habitats - Connected corridor with mixed structure to provide habitat
Green spaces in floodplain		*- Active and passive recreation* *- Urban biodiversity*	- Provision of multiple recreational activities which are relevant for the waterway use and adjacent land uses (e.g. cycle and pedestrian pathways, sporting fields, kayaking)
		- Urban amenity *- Community connections* *- Functional places* *-Tourism*	- Integrate with urban design strategy to create well designed places and shaded and safe community spaces - Provide access to the waterway to enhance community understanding of the asset
		- Flood management	- Floodplain designed to provide flood storage in flood events
Floodplain wetlands		*- Waterway protection* *- Urban biodiversity*	- Constructed regional stormwater treatment wetlands can improve water quality - Enhancement of natural floodplain wetlands can provide habitat and improve ecosystem health
		- Flood management *- Alternative water sources*	- Wetlands can be designed to provide flood storage (detention) and also used to maintain water quality for stormwater harvesting as part of an alternative water irrigation strategy

Objectives in action

Visualisation provided courtesy of Lat 27, E2Designlab and Logan City Council



Objectives:

Healthy
making the best of our local environment

Prosperous
making changes to better our city

Resilient
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Practice Note B: Residential Streets

Description

Trees and landscapes within local streets provide important habitat for native birds and provide shade and amenity for residents. Creating shaded streets that link public transport hubs, parks and key facilities also encourages walking and recreation.

Roads are also a major source of stormwater runoff and stormwater pollution. By integrating vegetation and soils into our streets we can provide natural filtration for stormwater and support vegetation health through passive irrigation.

Key contextual information

- Relevant strategies, local neighbourhood plans
- Road hierarchy
- Road grade
- Existing underground services, poles, pathways
- Driveway access
- Existing stormwater network
- Known locations of nuisance flooding / under-capacity drains
- Linkages with other green and blue spaces, parks and corridors
- Location and linkage with public transport nodes and local shops/services
- Community desires

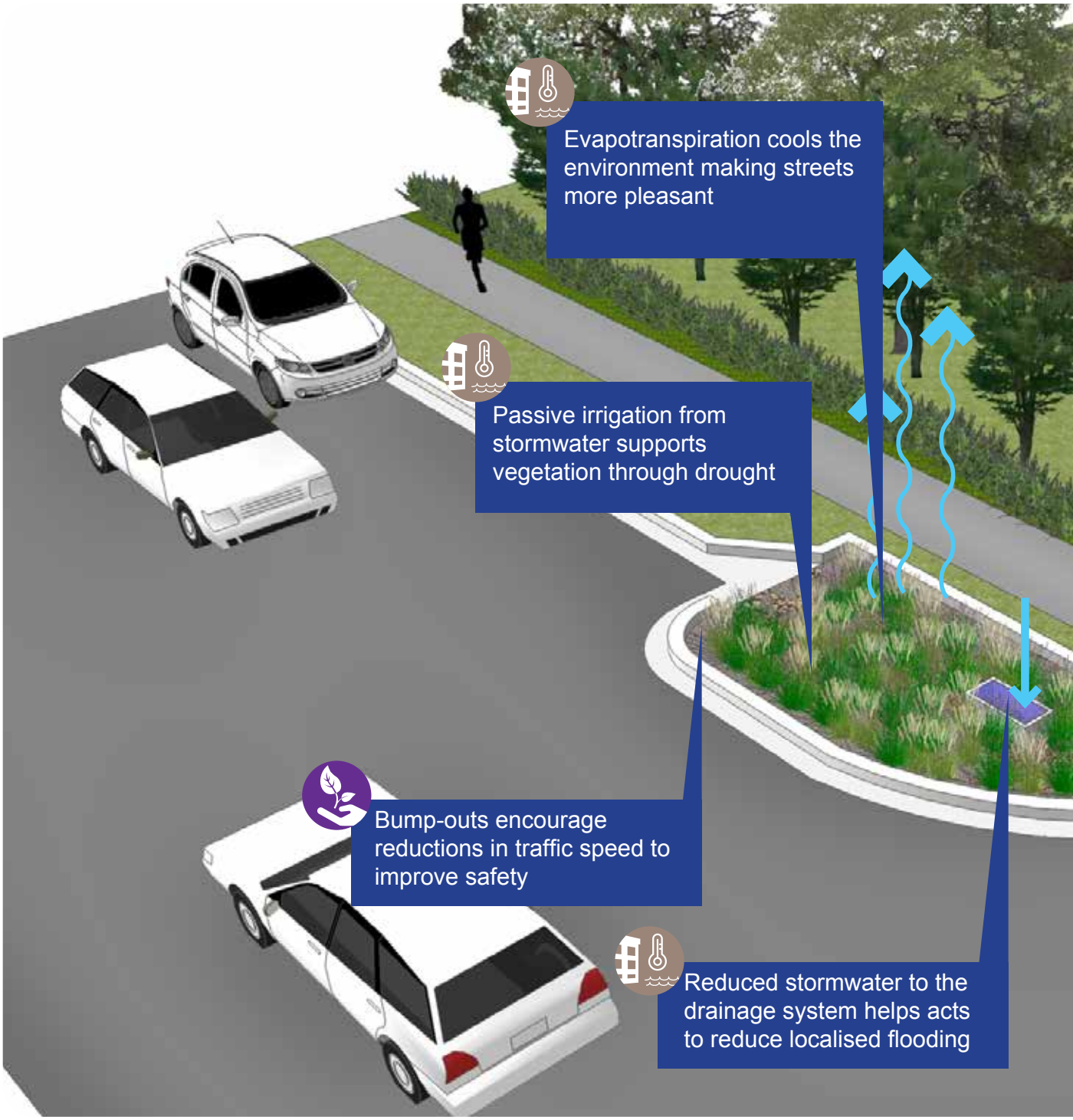
Good practice tips for delivery

- Understand what other projects are happening in the area and coordinate the planning and delivering of works with these. This can provide synergistic opportunities and reduce overall costs.
- Hold consultation sessions in the park to keep the local community engaged and informed.
- Erect signage during construction to inform the local community.
- Work with local community groups, catchment associations and schools (e.g. information sessions, planting days, vegetation maintenance).
- Allocate appropriate budgets for ongoing monitoring and maintenance.

Possible green-blue initiatives

Initiative		Key objectives met	Tips on enhancing benefits
Streetscape bioretention / water sensitive urban design		*- Waterway protection*	- Size and position WSUD in streetscapes to ensure best practice stormwater treatment can be achieved for the expected runoff catchment (typically 1-2% of drained impermeable area required). - Follow available design guidance.
		- Functional places *- Urban amenity* *- Community connections*	- Incorporate into traffic calming islands and bump outs - Provide additional verge width for integration of bioretention with pathways - Locate bioretention on street corners where more space is typically available - If retrofitting existing streets, determine plant template in collaboration with residents - Avoid driveway crossovers - Provide interpretive signage to communicate the role and benefit of the systems
		- Flood management	- Allow for water to temporarily pond (extended detention) to enhance treatment and reduce pressure on drains during a rain event
Passively watered street trees		*- Active and passive recreation* *- Urban biodiversity*	- Native species will enhance local ecology - Productive trees can be a local food source - Provide continuous trees for shading along key pedestrian routes to public transport, parks, waterways and services
		- Urban amenity *- Functional places*	- Provide passive irrigation to minimise pavement uplift and root intrusion - Use structural soil or soil cells to expand soil pits under parking and road areas (increasing soil volume)
		- Cooler environments	- Passive irrigation supports larger shade canopies and cools via evapotranspiration

Objectives in action



Visualisation provided courtesy of City of Port Phillip

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Practice Note C: Parks

Description

Parks provide important places for respite, passive and active recreation and green space for urban ecology and habitat. As such they provide most value when they are green, lush and contain shade. Stormwater harvesting can support green parks and provides benefit to downstream receiving environments. Constructed wetlands and bioretention systems are green-blue infrastructure elements that can be effectively integrated into parks to provide multiple benefits.

Key contextual information

- Open space plans
- Key drivers related to waterways and green corridors (drawn from council objectives and community visioning)
- Park hierarchy and level of service
- Existing facilities, pathway networks, access
- Adjoining land uses current and future
- Catchment area and stormwater network
- Linkages with other green and blue spaces and corridors
- Needs assessment (sporting, kick and throw, play equipment, nature based play, toilets etc).

Good practice tips for delivery

- Understand what other projects are happening in the area and coordinate the planning and delivering of works with these. This can provide synergistic opportunities and reduce overall costs.
- Hold consultation sessions in the park to keep the local community engaged and informed.
- Erect signage during construction to inform the local community.
- Work with local community groups, catchment associations and schools (e.g. information sessions, planting days, vegetation maintenance).
- Allocate appropriate budgets for ongoing monitoring and maintenance.
- Report back to the community how much potable water was saved due to the stormwater harvesting implemented.

Possible green-blue initiatives

Initiative		Key objectives met	Tips on enhancing benefits
Stormwater harvesting		*- Alternative water sources*	- Look for shallow stormwater pipes to intercept flows or divert surface flows from local streets and car parks. - Where waterways or channels pass through parklands, excess flows may be diverted for capture, treatment and reuse - Treat stormwater in wetlands or bioretention systems for water quality management - Stormwater harvesting systems incorporating wetlands and lakes provide additional visual amenity and passive recreation opportunities - Passive irrigation using wicking beds can provide cost effective irrigation of turf kick and throw areas - Underground storage can be provided where space is constrained
Wetlands / Bioretention or swales for stormwater treatment		*- Waterway protection*	- Plant with a variety of native species suited to the various water depths
		- Urban amenity *- Community connections*	- Integrate within parkland by providing boardwalks and viewing platforms - Incorporate public art, poetry, nature play and interpretive signage
		- Flood management	- Wetlands integrated into parklands can provide flood storage (detention) - Direct overland flows to vegetated swales to slow and treat flows. This helps to eliminate boggy turf zones which are difficult to mow.
Enhance native vegetation		*- Urban biodiversity*	- Using native tree species to provide shade and habitat - Wetlands planted with native sedges provide habitat for aquatic and terrestrial fauna that wouldn't otherwise occur in the parklands.

Objectives in action

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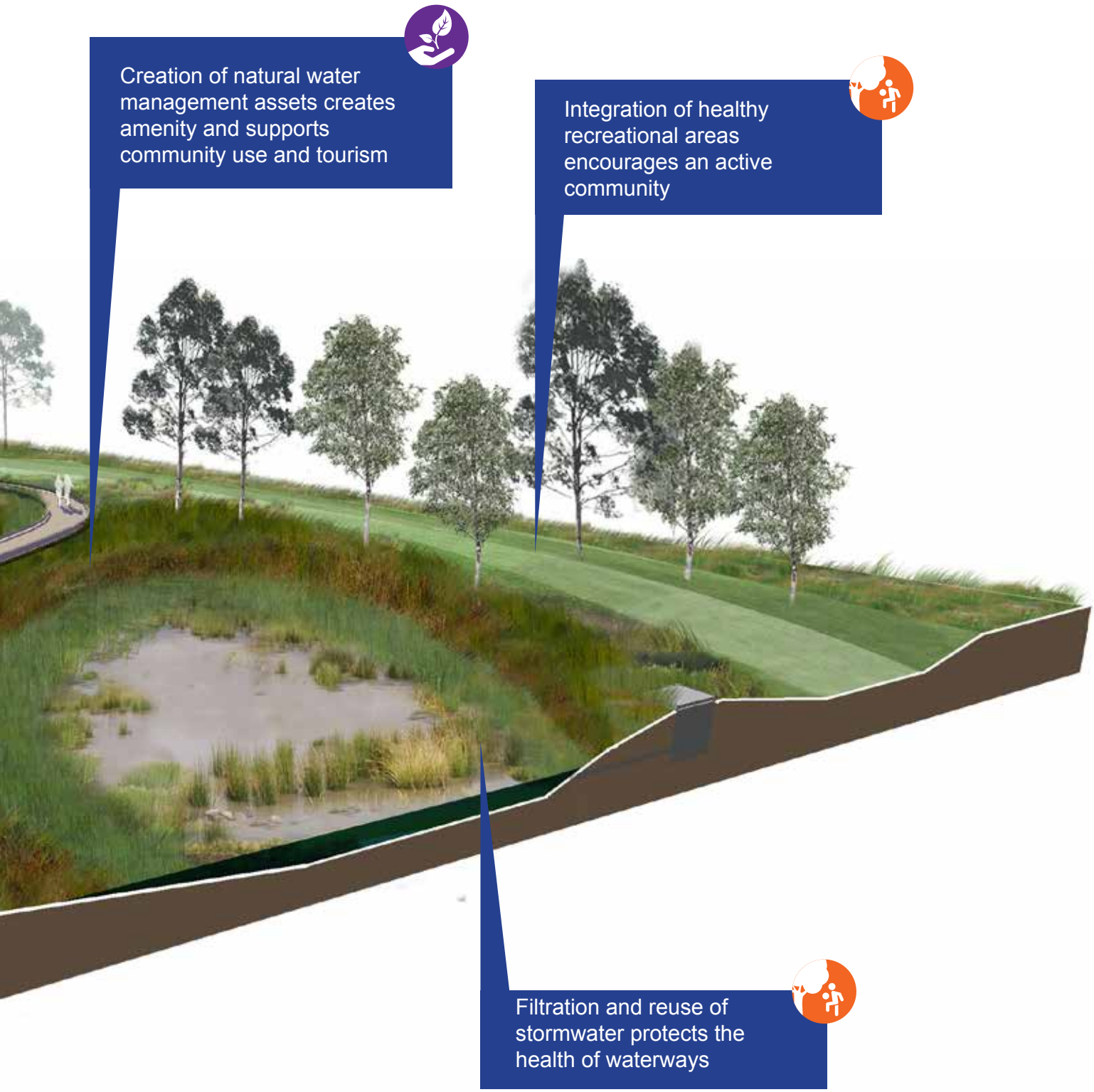

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Practice Note D: Retail centre

Description

Retain centres need to look attractive and cater for high pedestrian movement. The large area of hard impervious surfaces typically limit infiltration and create stormwater runoff. The stormwater generated can be used to create green shaded streets and roof water can help sustain green walls for high impact visual amenity and to help mitigate the urban heat effect.

Key contextual information

- Town centre and retail strategies, master plans
- Key drivers related to waterways and green corridors (drawn from council objectives and community visioning)
- Predicted visitation and requirements for pedestrian and vehicle movement
- Existing facilities, pathway networks, access, public transport nodes
- Adjoining land uses (current and future)
- Catchment area and stormwater network
- Existing underground and aboveground utilities

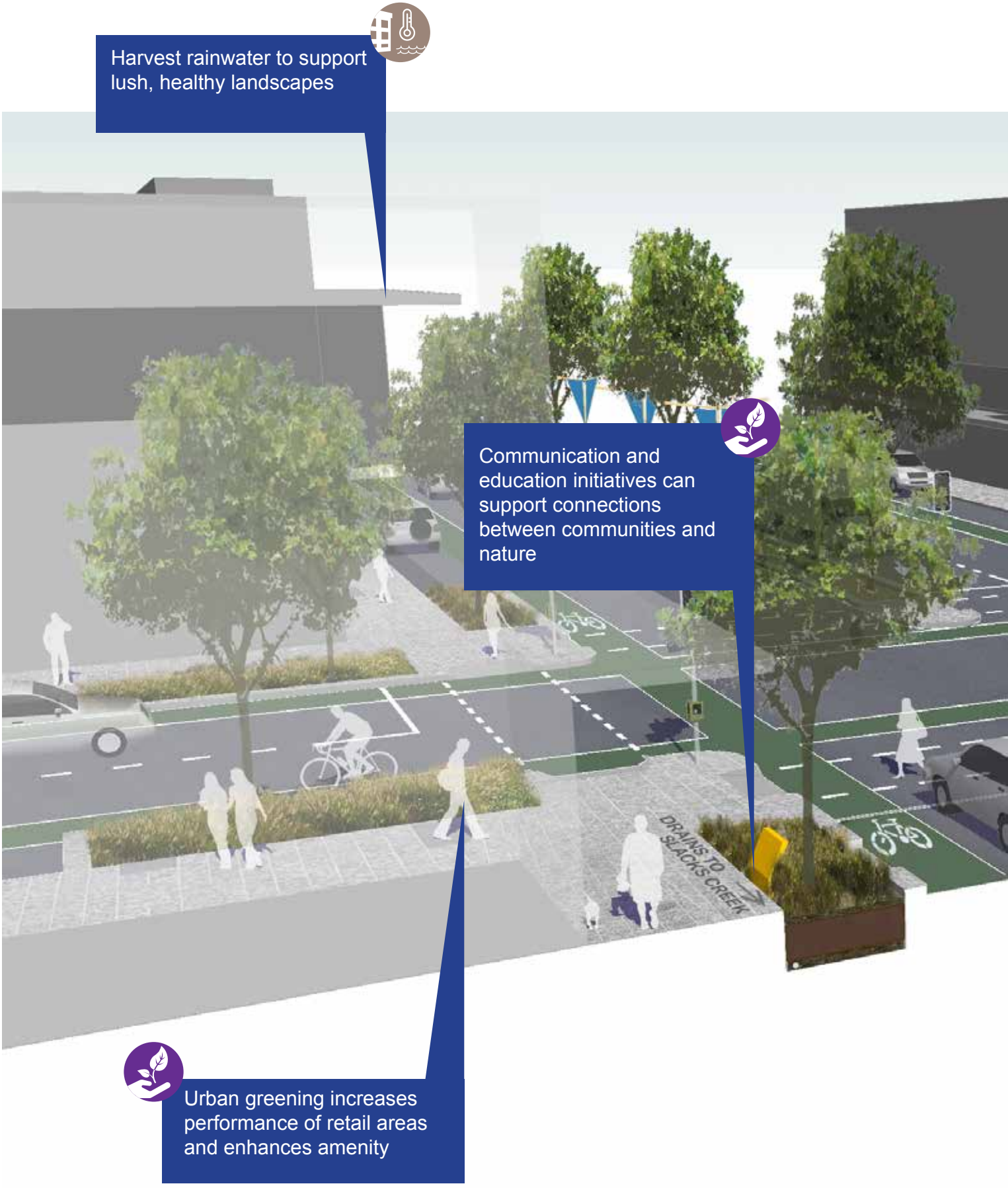
Good practice tips for delivery

- Ensure bioretention and passively watered landscapes are protected during the construction phase.
- Disconnect the bioretention systems with temporary continuous kerbing until construction is complete or delay construction until site is sealed.
- Fence off bioretenion systems during construction to avoid damage by construction vehicles.
- Allocate appropriate budgets for establishment and maintenance.

Possible green-blue initiatives

Initiative		Key objectives met	Tips on enhancing benefits
Bioretention raingardens in streets and carparks		- *Waterway protection*	- Size and position WSUD in streetscapes to ensure best practice stormwater treatment can be achieved for the expected runoff catchment (typically 1-2% of drained impermeable area required). - Follow available design guidance.
		- *Functional places* - *Urban amenity* - *Community connections*	- Locate to improve public safety and encourage road crossing at dedicated points - Central bioretention swales incorporating trees can provide a shaded boulevard aesthetic and improve shading of wide roads - Avoid deciduous trees - Include interpretive signage - integrate with seating
Passively watered street trees		- *Active and passive recreation*	- Provide continuous trees for shading along key pedestrian routes to public transport, parks, waterways and services
		- *Urban amenity* - *Functional places*	- Provide passive irrigation to minimise pavement uplift and root intrusion - Enable stormwater to flow into tree pits for passive watering - Porous pavement can be effective at filtering gross pollutants prior to stormwater entering tree pits located in car parks and plazas - Provide a sub-surface drain to prevent water-logging - Use structural soil or soil cells to expand soil pits under parking and road areas (increasing soil volume)
		- *Cooler environments*	- Passive irrigation supports larger shade canopies and cools via evapotranspiration
Green roofs and walls		- *Urban amenity*	- Green roofs and walls can provide greenery and relaxation spaces in busy retail areas
		- *Cooler environments*	- Consider orientation of the wall to maximise microclimate benefits
Harvest rainwater		- *Alternative water sources*	- To sustain high quality landscapes, incorporate a roofwater and/or stormwater harvesting scheme to provide an alternative water source for irrigation

Objectives in action



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Passive irrigation and good soil conditions will create healthy urban trees with large canopies


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